ADDIS ABABA UNIVERSITY SCHOOL OF GRATUATE STUDIES

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF ECONOMICS

COMPATIBILITY OF ETHIOPIAN AGRICULTURAL COMMODITIES PRICE WITH THEIR RESPECTIVE INTERNATIONAL PRICE

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June 2019

Addis Ababa, Ethiopia

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Compatibility of Ethiopian Agricultural Commodities Price with their Respective International Price

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University in Partial Fulfilment of the Requirements for the Degree of Masters of Science in Economics (Economic Policy Analysis)

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June, 2019

Addis Ababa, Ethiopia

Approval

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This is to certify that the thesis prepared by Bereket Meseret, entitled*: Compatibility of Ethiopian Agricultural Commodities Price with Their Respective International Price,* and submitted in partial fulfilment of the requirements for the degree of Master of Science in Economics (Economic Policy Analysis) complies with the regulations of the university and meets the accepted standards with respect to originality and quality.

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Declaration

I hereby declare that this Msc. thesis entitled **''Compatibility of Ethiopian Agricultural Commodities Price with Their Respective International Price**'' was carried out by me for the masters of science in economics under guidance and supervision of Dr. Alemayehu Geda, Addis Ababa University, College of Business and Economics, Department of economics.

The interpretation put forth are based on my reading and understanding of the original texts and they are not published anywhere in the form of books, articles and reports. The other books, articles and websites, which I have made use of are acknowledged at the respective place in the text.

For the present thesis, which I am submitting to the university, no degree or diploma or distinction has been conferred on me before, either in this or in any other university.

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Acknowledgement

First of all, I would like to thank the Almighty God and his Mother Saint Marry for all things happen in my life.

I owe my greatest appreciation to my advisor Dr Alemayehu Geda for his invaluable support and communication through the preparation of this study, starting from promoting my study area on inception level to crafting the research with all necessary support.

I would like to thank major coffee, sesame & pea beans exporters and respective staffs working in the National Bank of Ethiopia and Ministry of Trade for being part of the primary data source and providing me constructive ideas.

Finally, I would like to thank my organization (ECX) and my families for their direct & indirect support helped me to complete this thesis.

Abstract

This study investigates the compatibility of the domestic and international price of major primary agriculture products namely Coffee, Sesame & Pea beans. Cointegration Analysis is employed using monthly data over the period of 2012 to 2018 on top of analysing primary data through interview and focused group discussion. The empirical finding shows that selected agricultural products does not have a long-run relationship with their respective international price (FOB Price) and in most cases, the domestic price is distorted compared to the international price. According to primary data analysis the price incompatibility is aggravated through countries existing macroeconomic instability and prevalence of critical trade balance deficit. This leads to import business operators' become engage in export for the sake of securing foreign currency to their import and then export business become a scapegoat for import business. The analysis also tells that the price incompatibility does have a multidimensional effect on promoting imported inflation & worsen society's welfare in addition to affecting macro-economic variables like manipulating interest rate & exchange rate. Overall, the empirical analysis both in secondary & primary sources indicates that there is the absence of price compatibility on primary agricultural export business and, unless necessary policy intervention is implemented, the macroeconomic instability will exacerbate due to such irregularity.

Key Words: Cointegration, Market Integration, Price Transmission**,** Commodity Market

JEL: *C22, E31, M10, M20, Q13, Q17*

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List of Acronyms

ADF	Augmented Dickey-Fuller
BoP	Balance of Payment
CIF	Cost Insurance Freight
ECM	Error Correction Methods
ECX	Ethiopia Commodity Exchange
ERCA	Ethiopian Revenue and Customs Authority
FAO	Food and Agriculture Organization
FOB	Freight on Board
GTP	Growth & Transformation Plan
ICE 'C'	New York Coffee Future Price Quotes
ICO	International Coffee organization
LOP	Law of One Price
MT	Metric Ton
NBE	National Bank of Ethiopia
PP	Phillips Perron
SSA	Sub Sahara Africa
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USD	United States Dollar

CHAPTER ONE

INTRODUCTION

1.1. Background of the Study

The developing countries economy is hindering with commodity dependence economic structure. About two-thirds of developing countries gain the majority of their export earnings from exports of primary commodities such as agricultural commodities & foods, fuels and minerals (UNDP, 2011). On the other side, such exports are usually coupled with imports of highly valued goods from the developed economies.

Commodity dependence of either form jeopardizes developing countries through terms of trade imbalance, fiscal and monetary policy stresses, and impact on domestic consumers and producers - as their economies are susceptible to the global commodity price shocks and volatility. It also leads the countries to record low levels of development and high poverty rates, thereby exacerbating the livelihood condition of their poor households. Overall, it may cause potentially harmful impacts and affect all dimensions of sustainable development (UNCTAD and FAO, 2017).

According to UNCTAD (2017), Ethiopia's commodity exports share out of its total merchandise value was 92% during the year 2014/15. This makes the country among the most commodity export-dependent countries in the world. UNCTAD labels a country as ''strongly commodity export dependent'' when a country's commodity exports value is more than 80% of its total merchandise exports value. Thus, the sustainability of the recently-on-fast-growing economy of Ethiopia also hinges on confronting this particular challenge and risk of commodity dependence, among others.

Ethiopia is no exception to the challenge and risk of export commodity dependence that is being witnessed in the developing economies. The country's domestic export markets, particularly of the primary agricultural commodities are potentially exposed to international shocks and price volatility.

Developing countries, especially those whose principal means of foreign exchange earnings come from the exports of primary commodities; unstable commodity prices create macro-economic instabilities and complicate macroeconomic management. Erratic price movements generate inconsistency on export earnings, cause instability in foreign exchange reserves and are strongly associated with growth volatility. The more commodities-dependent economy with a higher share of primary goods export becomes more likely vulnerable to commodity price shocks (UNDP, 2011).

Similar to developing countries, Ethiopia's export depends on agricultural commodities. The lion share of export in Ethiopia has depended on a primary agricultural commodity like coffee, oilseed, pulses, flower and etc. Ethiopia's total exports of goods have been dropped at an average rate of 2% between 2014 and 2018. Ethiopia's export sector is still small; evidenced by the lower export to GDP ratio and the declining share of exports in import financing coverage. One of the reasons for lower export earning is due to dependency on few agricultural commodities like coffee, oilseeds and pulses; where the three commodities account on average 51% of the total export earnings between 2014 and 2018. Out of the total exports of the country, coffee was the dominant export commodity followed by oilseed and pulse having 26%, 16% and 8% average shares respectively during last five years (ERCA, 2018).

On the other hand, over the last decade, the country has embarked on a series of policy initiatives to transform its economy. The policy priorities are mainly directed towards agricultural sector growth, promotion of manufacturing sector and export diversification (MoFED, 2010). The current, second phase of the national development plan, also known as *'the Growth and Transformation Plan II'*, for instance, underscores on the necessity of making a shift in the export sector through addressing the supply side factors of limited productive capacity, limited diversification of the economy and industrial development.

Having this, the study is to analyse and provide valuable findings on the price compatibility of Ethiopia's most valuable export commodities namely coffee, sesame seed and pea beans with their respective international price[1].

[1] FOB price of those commodities while they sell to the rest of the world

1.2. Statement of the problem

Along with the declining trajectory of export earning against the target in the countries agricultural products earning, lack of competitiveness by the price & quality on the international market is a major reason. Where Ethiopia is a small open economy and hence expected to bear international market offer for its agricultural products', obtaining rational domestic price discovery is very basic. The domestic price shall be symmetric with the international market, unless export competitiveness' of the country become challenged. And this challenge goes to influencing trade balance of the country and will have a cross-cutting effect on macro-economic instability and welfare of the society.

Based on the supply chain of these products, agricultural products price discovery process in the value chain starts from the primary market; a place where farmers/producers and suppliers come together and transact with farm get price adjacent to farmers. Then supply to ECX and trade takes place between supplier and exporters in the exchanges platform with pre-defined trading procedures. The trading process will be expected to rely on demand and supply forces by considering international reference price subject to each commodity. Although the secondary market in ECX is expected to follow the international market price discovery, on different stakeholder's engagement with value chain actors and through different informal discussion with them, they claimed that there is price inconsistency between prices discovered on ECX platform & its respective international price. This becomes paradox to the export earning of the country and other related macroeconomic parameters.

In many circumstances, plenty of reasons are mentioned as causes for this paradox, some of these includes; prevalence of import substitution/import subsidy by exporters, prevalence of exporters' foreign currency retentions' sell to importers, commercial banks loan facility rationale, prevalence of excess finance to exporters, and lack of effective government policy to the export sectors are potential reasons.

Prevalence of import subsidy by the exporters means that although the exporters do export business, their intrinsic motivation is not getting profit by export rather they have originally affiliated import specialized companies, which salivates to get foreign currency for their import as foreign currency availability is a major problem in the country. Thus due to this constraint,

many exporters buy the products with inflated price domestically then sell it to the international market with a lower price for the sake of getting foreign currency to finance their import. Where companies having foreign currency access (retention policy gives privilege to access of foreign currency as a result of their export), they will utilize it for their import and they compensate their loss exercised from export by import through increasing imported goods selling price on the final consumers. This does have a cross-cutting effect on the welfare of the society and trade balance of the country. It is also reflected with an act of repetitive quality deterioration of export goods in the international market & occurrence of frequent sell contract default from Ethiopian exporter's side. It hurts countries reputation on the international market and also deflates the premium value of Ethiopian organic products in the international market.

Exporters' foreign currency retention sell is also the same with import subsidy except for the process. In this scenario exporters are not direct importers rather they sell their foreign currency retention to importers with under table agreement which compensates their loss exercised from exporting certain products by a lower price. Still, they have purchased these export products from ECX platform with the higher price. This also affects macroeconomic stability with imported inflation and the overall effect is the same on welfare and trade balance of the nation as mentioned above.

According to the existing financial policy of the government of Ethiopia, the export sector is the major priority area to get preferential treatment including access for a loan with least interest rate and without major precondition. Except for having an export licence and moderate export performance in the existing fiscal/previous budget year, they become eligible for loan access with least interest rate. Due to this privilege, many market actors engaged in the sector just to get access for the loan whether export sector becomes profitable & can be competitive in the market or not. This unrestricted & simple access for the excess loan also has an adverse effect on the export competitiveness on top of switching the export loan to other much profitable sectors. As a result, the prevalence of excess finance to export sector also does have an impact on macroeconomic instability.

Commercial banks loan facility and governments policy gaps are also other reason for the paradox. In many cases regardless of assessing proper utilization of export loan for its predefined

objectives pertinent institutions just focus on borrower's potential to the repayment of the loan. This creates fallacy on the export loan facility; even though the borrower can repay the loan it might not utilize for the targeted purpose. Potentially the exporters couldn't utilize the loan only for its pre-determined purposes rather they shift it to other sectors which return is much higher than export. Still, the government policy urges commercial banks to easily avail credit facility to export sectors with a minimal interest rate with the aim of promoting export earnings with the mission of improving trade deficit. This privilege seemingly aggravates exporters to engage with irrational price competition in export business by having a back of interest rate advantage compared with fairy competing business operators out of export sector (those borrowing with higher interest rate than them). In addition, those companies report an income statement with loss through export business and the countries revenue authority entertain this report also. This also another tricky on tax evasion through unhealthy trading practice and communicates the wrong slogan[2] in the sector.

Thus, the research focus on these issues and how the domestic and international price is correlated and its impact on the countries BoP by addressing the following research questions;

- How the domestic and related international prices do correlate in terms of magnitude and pattern? (price discovered in ECX platform and their FOB price)
- What are the real causes of price paradox if any?
- What will be the policy direction to be pursued as a way out of this paradox and ensuring macroeconomic stability & welfare?

1.3. Objective

The general objective of this research is to verify the major reason for the domestic & international price difference of main agricultural export products and come up with a possible policy recommendation.

[2] They advocate that export business is not profitable and they work for the sake of shouldering countries burden & frustrating rational new comers to the sector.

The specific objective includes;

- To check the compatibility of domestic price with its respective international price and find out the deviation;
- To describe major causes for the price difference;
- To explain its impact on potential foreign exchange earning of the country that is lost, macroeconomic stability and welfare of the society
- To recommend a possible way out for the paradox

1.4. Significance of the study

Where the scarcity of foreign currency becomes survival issues of the country's macro economy, researching about export competitiveness related to price correlation of domestic and international price becomes significant on the following approaches;

- The country is incapable to meet the export target year to year and our export products competitiveness in the international market become deteriorates. Thus researching on price correlation will have importance to come up with the recommendation to better competitiveness';
- Macroeconomic instability is an issue in the countries existing situation and many consumable goods & services are imported. so researching on addressing price issue will have a positive adverse effect to have normalized import-export business, then to have better macroeconomic stability like minimizing inflationary signals on imported goods;
- Researching on price paradox is also relevant to have a healthy value chain which favours respective value chain actors as per their value addition effort. Since the value chain is highly suffered due to irrational speculation & pricing matrix.

1.5. Scope and limitation of the study

1.5.1. Scope of the study

The study specifically focuses on price compatibility analysis of major exportable agricultural products traded in the secondary market (ECX) with a mandated approach by the law. This includes coffee, sesame & white pea beans accounted for half of export earnings to the country.

The research is conducted through both primary and secondary data sources. Primary information is collected from market actors & stakeholders stationed in Addis Ababa only. While secondary data is based on ECX data for domestic price and respective FOB price generated from the National Bank of Ethiopia (NBE) and/or Ethiopian Revenue & Customs Authority (ERCA).

1.5.2. Limitation of the study

The first limitation of the study is focusing only prices discover on the secondary market (ECX) and its respective international market. It lacks the primary market price to see the price transmission process with a compressive way due to the unavailability of the data.

The second limitation of the study is a lack of integrity among government stakeholders. This becomes a challenge for articulating the possible policy recommendations on the subject matter. Similarly, frequent amendment & lack of assessments of policy's, proclamations & procedures was also a challenge for this study on reviewing the effectiveness of each instrument to come up with policy recommendation.

Resource scarcity is another limitation to expand the study across all value chain actors stationed in a different part of the country & out of Ethiopia[3].

1.6. Organization of the study

The study is structured in five chapters. The second chapter next to this introductory part is a review of literature, which is sub-sectioned into theoretical and empirical works. Then follow with the data and methodology chapter. Under this chapter, data and methods of analysis are explained and the applicable econometric model specifications are outlined. Chapter four discusses the study's findings, where both primary data finding and pertinent econometric test results are analysed & presented. Finally, chapter five concludes the study by pointing out relevant policy implications.

[3] It refers international trading houses & buyers of Ethiopian products around the world.

CHAPTER TWO

LITERATURE REVIEW

2.1. Theoretical Literature

2.1.1. Theories about attributes of price compatibility

I. PRICE TRANSMISSION

The concept of price transmission can be thought of as being based on three notions, or components (Prakash, 1999; Balcombe and Morisson, 2002). These are:

- Co-movement and completeness of adjustment which implies that changes in prices in one market are fully transmitted to the other at all points of time;
- Dynamics and speed of adjustment which implies the process by, and the rate at which, changes in prices in one market are filtered to the other market or levels; and,
- Asymmetry of response which implies that upward and downward movements in the price in one market are symmetrically or asymmetrically transmitted to the other.

Both the extent of completeness and the speed of the adjustment can be asymmetric. Within this context, complete price transmission between two spatially separated markets is defined as a situation where changes in one price are completely and instantaneously transmitted to the other price, as postulated by the Law of One Price presented by the relation below;

$$P_{1t} = P_{2t} + C$$

An efficient marketing system is essential to keep the pace of economic growth. In an efficient marketing system, producers are able to get remunerative prices to their products and consumers to get the product at affordable prices (Kanakaraj, 2010).

The extent of marketing efficiency depends on the nature of the market structure, market conduct and market performance. Seller and buyer concentration, the firms' size and entry conditions are the main elements of market structure, impacting the nature of competition and pricing within the market (M. Antonova, 2013 p.6). Market conduct indicates the behaviour of market agents with regard to price determination, sales promotion tactics and the regulatory activities of the

government. Price formation has a direct link with these actions. If market agents determine prices on the basis of some collusive tactics, it will lead to an imperfect price transmission within the given market or in-between the markets, and therefore to the inefficient marketing system as a whole. On the other hand, if the price is determined in the way of a perfectly competitive market, it resembles an effective marketing system (M. Antonova, 2013 p.6).

The economic result of market structure and of market conduct represents market performance (Kanakaraj, 2010 p. 53). Market performance resembles price level, profit margin, level of investment, reinvestment of profit etc. In an economy, if the price fixed by the firm is just equal to average cost (the condition in perfect competition), the market is said to be performing well or efficient. In other words, through the level of prices and the level of profit margin, one can determine the degree of market efficiency (M. Antonova, 2013 p.6).

There are two criteria to measure marketing efficiency. One is market integration and the other is price spread. For examining the efficiency of a marketing system, one must inevitably look at the degree to which village primary, secondary and terminal markets are related to each other, which require addressing the concept of integrated markets (Lele, 1971). Whenever the actions of agents of one market affect the actions of agents of other markets, it is said to be a situation of the integrated market (Kanakaraj, 2010, p. 3). Markets are known to be interlinked when the transaction in one influences the terms of exchange in other markets. Petzel and Monke (1979-80) defined integrated markets as markets in which prices of differentiated products do not behave independently. Ravallion (1986) observes that equilibrium will have the property that, if a trade takes place at all between any two regions, the price in the importing region equals price in the exporting region plus the unit transport cost incurred by moving between the two. Goodwin and Schroeder (1991), caution that markets that are not integrated may convey inaccurate price information that might distort the producer's marketing decision and contribute to inefficient product movement. Thus, the degree of market integration determines the efficiency of a certain market (M. Antonova, 2013).

Another criterion to measure market efficiency is a price spread. The price spread is defined as the difference between the price received by the producer and the price paid by the consumers for a commodity at a point of time (Kanakaraj, 2010, p. 59). Price spread might be similarly

defined as the difference between the retail price of the product and its value in production. This difference includes charges for assembling, processing, storing, transporting, wholesaling and retailing. Lesser the difference more efficient is the market system. Lower price spread allows producers and consumers to gain from affordable price and reasonable profit, thus contributing to higher market efficiency (M. Antonova, 2013). Economic literature (Gardner, 1975; Schroeter and Azzam, 1991; etc.) sometimes operate with the term marketing margin, which in principle reflects a similar subject as the price spread. The "marketing margin" as computed by USAID is equal to the difference between the average price paid by consumers for a finished product with an agricultural raw material base and payment received by farmers for equivalent quantities of the raw material product (Beckman and Buzzell, 1955).

Farm-retail price spread and marketing margin are static measures of the relationship between prices, while the price transmission concept offers to measure comparative static or dynamic price relationships. Price transmission is a statistical relationship between prices, which might be either horizontal (spacial) between certain markets or regions, or vertical, such as from farm to retail price (Gardner, 1975; Schroeter and Azzam, 1991).

Different studies have estimated the degree of price transmission between price changes occurring at the farm gate and the appropriate change in price at the retail level. Searching for the theoretical determinants of price transmission, below I have briefly discussed and factors of different kinds of elasticity are that impact price transmission (Gardner, 1975; Schroeter and Azzam, 1991).

- **Factors determining farm retail price transmission**

The focus on measuring the degree of price transmission is based on the concern that there are some characteristics of the commodity market, which lead to the less-than-full pass-through of prices. For example, McCorriston et al. (1989; 2001) estimate the impact of different types of elasticity's on the relationship between farm and retail prices. These study reports that if the share of an agricultural input increases, price transmission increases; if the elasticity of demand for an output increases, price transmission decreases (in a case of perfect competition); if the elasticity of substitution between inputs increases, price transmission increases; the impact of the elasticity of supply for marketing inputs on price transmission is ambiguous depending on the

degree of market power (McCorriston et al., 1989). In McCorriston et al. (2001) such parameters as the share of agriculture, the elasticity of output demand, the elasticity of substitution between inputs and input & supply elasticity were investigated for their impact on price transmission elasticity (Gardner 1975).

- **The imperfect market structure as a determinant of price transmission**

Much research has been done investigating factors impacting the farm-retail price ratio; however, McCorriston et al. (1989) is one of the first, who started to model the market structure having an impact on price transmission. In the study (1989), they show that market power will reduce the degree of price transmission between the farm and retail stages. Thus, if downstream markets are imperfectly competitive price transmission is less than complete. This result was long expected in the agricultural economics literature, as all previous investigations were done under the assumption of perfect competition. Thus, McCorriston et al. (1989) drew particular attention to the market structure as one of the determinants of price transmission and boosted the number of studies modelling imperfect competition scenarios in food markets. McCorristo's (1989) proxy variable for imperfect competition arises from the profit maximization condition and implies a ratio of a marginal increase in the industry-produced quantity and a marginal increase in the quantity produced by a single firm.

- **Domestic and international price transmission**

Domestic prices are linked to world market prices primarily through trade. If the commodity is imported, the domestic price P_t^D equals the international price P_t^G plus the transaction costs $\tau_t^{I,E}$ for import I and export E. Depending on the trade balance (a positive T_t denotes exports, a negative T_t imports), we can therefore distinguish the three cases (Samuelson, 1952):

$$P_t^D = P_t^G + \tau_t^I \qquad \text{if } T_t < 0 \qquad (1a)$$

$$P_t^D = P_t^G - \tau_t^E \qquad \text{if } T_t > 0 \qquad (1b)$$

$$P_t^D = D(Q_t^D , Y_t^D) \qquad \text{if } T_t = 0 \qquad (1c)$$

Where $D(Q_t^D , Y_t^D)$ is the inverse of the domestic demand function which depends on demand Q_t^D and income Y_t^D. Equations (1a) - (1c) imply that the domestic price is independent of the global price if and only if it is not profitable to export nor to import the commodity(Samuelson, 1952), i.e. if

$$P_t^G - \tau_t^E < D(Q_t^D , Y_t^D) < P_t^G + \tau_t^I \qquad (2)$$

Spatial arbitrage through trade links to domestic and global prices immediately. There exists, however, also another form of arbitrage through storage which links current prices to expected (future) prices. Assuming rational expectations, current prices are a function of expected futures prices (Wright, 2011).

$$P_t = \beta E_t[P_{t+1}] \qquad \text{if } I_t > 0 \qquad (3a)$$

$$P_t > \beta E_t[P_{t+1}] \qquad \text{if } I_t = 0 \qquad (3b)$$

Where pt is the price of the commodity at time t; $\beta=(1-\delta)/(1+r)$ contains the interest rate r and rate of deterioration δ; $E_t[\cdot]$ refers to the expectation at time t; and I_t denotes the inventory of grains. When there are no inventories (I_t=0), current and future prices are not directly linked through intertemporal arbitrage (Wright, 2011).

Consider now the case of a country which has a zero or negative trade balance (that may change over time) but which is never in an exporting state. Combining Equations (1a) and (3a) for the domestic and global markets and assuming positive storage on both, for exactly s consecutive periods without trade, we obtain:

$$P_t^D=\gamma^s P_t^G+[\beta^D]^s E[\tau_{t+s}] \qquad \text{if} \quad I_{t+j}^{D,G} >0,\ T_{t+j} = 0 \text{ for } 0<j<s \qquad (4)$$

Where $\gamma:=\beta D / \beta G = (1-\delta^D)(1+r^G) / (1-\delta^G)(1+r^D)$. Equation (4) indicates that domestic prices depend on global prices even when there is *no trade* in a sequence of s periods. If trade is expect in the future periods (which brings domestic and global prices back to equilibrium) current domestic prices are adjusted according to intertemporal arbitrage (Wright, B. D. (2011).

II. TRANSFER PRICING

Transfer pricing refers to the pricing of goods and services bought and sold by operating units or divisions of a single company. In other words, transfer pricing concerns intra-corporate exchanges- transactions between buyers and sellers that have the same corporate parent. For example, Toyota subsidiaries sell to and buy from each other. This happens when the company expands and profit centres are shaped in the corporate financial picture. There are three alternative approaches to transfer pricing: (1) cost-based pricing, (2) market-based transfer pricing, and (3) negotiated prices[4].

Some companies using a ***cost-based*** approach may arrive at transfer prices that reflect variable and fixed manufacturing costs only. Alternatively, transfer prices may be based on full costs, including overhead costs from marketing, research & development, and other functional areas. The way costs are defined may have an impact on tariffs and duties sales to affiliates and subsidiaries by global companies. Cost-plus pricing is also based on costs but a different approach. In this approach, profit must be shown for any product or service at every stage of movement through the corporate system. It may be set at a certain percentage of fixed costs such as 15 per cent of the cost. It is unrelated to competitive and demand conditions but many exporters use it. (Zaribaf, M. 2008)

Another approach to transfer pricing is ***market- based*** approach. A market–based transfer price is derived from the price required to be competitive in the international market. The volume level also plays a major role in pricing. To use market- based transfer prices to inter in a small market, third country sourcing may be required. This enables a company to establish its name or franchise in the market without committing to major capital investment.

A third alternative is to allow the organization affiliates to negotiate transfer prices among themselves. In some instances, the final transfer price may reflect costs and market prices, but this is not a requirement.

The companies also may use three policies on worldwide pricing: *extension ethnocentric, adaptation/polycentric and invention/ geocentric.* In the first policy, the price of an item is the

[4] *Pricing Challenges in global marketing: A model for Export Pricing, Mehedi Zaribaf, 2017*

same around the world and the importer absorbs freight and import duties. In this policy, no information on competitive or market condition is required and does not respond to every market either it maximize the company profits in each national or global market. Its only advantage is to simply enter a market if it suits their price which the exporter has no information about it.

In the second policy, the exporter tries to match the price with any individual local market. This policy permits subsidiary or affiliate manager to establish any price they feel is most desirable in their circumstances. This policy may cause product arbitrage, because of different prices in a different location and enterprising business managers may use it and foster a grey market for the company's product. It may also weaken the corporate strategies of the central company because all local market managers have the freedom to set the price for their markets. Different prices for different places may have another disadvantage, because it may send a signal to the rest of the world that is contrary to company interests. A price move anywhere in the world is known instantly all over the world.

The third and the best policy to international pricing is termed invention/ geocentric. Using this approach a company neither fixes a single price nor remains apart from subsidiary price decisions, but instead strikes intermediate positions. There are unique market factors, like local costs, income levels, competition, and local marketing strategies that should be recognized in arriving at pricing decisions. Local costs plus a return on invested capital and personnel fix the price floor for the long term. This approach lends itself to global competitive strategy. A global competitor will take in to account global markets and global competitors in establishing prices. Prices will support global strategic objectives rather than the objectives of maximizing performance in a single country.

There are four main theoretical concepts for a transfer price[5] are;

- The *external market* or *arms-length* transfer price,
- The *efficient* transfer price,
- The *profit-maximizing* transfer price, and

[5] *Export and import pricing index manual- theory and practice, International Monetary Fund- World Bank 2009*

- The *economic* transfer price that is suitable for collection by a statistical agency (W. Erwin Diewert).

The first concept for a transfer price is feasible if there is a well-defined *external market price* for the traded commodity and units can be bought or sold at a common price (let us call it *w*). Then the transfer price for the commodity is just this price *w*. This is the *arm's length transfer price*.

The second concept for a transfer price arises if there is no external market for the commodity that is traded between two production units (or establishments) of a multinational that are located in different countries (William F. Alterman). The *efficient transfer price* is generated by solving a joint profit maximization problem involving the two establishments, and it is a Lagrange multiplier, or shadow price, that corresponds to the constraint that says the output of the producing establishment must equal the input of the purchasing establishment. If there are no tax distortions, then this transfer price can also be generated by setting up two profit maximization problems for the two establishments involving the traded commodity being sold by one unit at the price *w*, say, and being purchased by the other production unit at the price *w*. This artificial price is then varied so that the supply of the one establishment equals the demand of the other establishment and the resulting transfer price is called the *optimal decentralized transfer price*[6]. If there are no tax distortions and the establishments take all other input and output prices as fixed, this transfer price will also be a socially efficient one.

The *profit-maximizing transfer price* is the third main concept for a transfer price. With no taxes on trade and no taxation of business income in the two jurisdictions, the profit-maximizing transfer price[7] is the same as the efficient transfer price. But with tax distortions in either of the two jurisdictions, then the profit-maximizing transfer price will generally be different from the

[6] *This concept of a transfer price was also called an arm's-length transfer price by Hirshleifer (1956); see also Diewert (1985, p. 61). Under the no-tax-distortions assumption and a no increasing returns to scale assumption for each establishment, this second concept for a transfer price is equal to Diewert's (1985, pp. 49–66) efficient, arm's length, and decentralized transfer price concepts. Note that the external market transfer price is also efficient and, in fact, multinational profits will always be greater (or at least not less than) in the situation where an external market for the product exists than in the situation where no such market exists.*

[7] *The profit maximizing transfer price is indeterminate under these conditions; it could be any positive price because it cancels out of the objective function of the multinational's global profit maximization problem.*

efficient transfer price. In fact, with tax distortions and no constraints on the behaviour of the multinational, the profit-maximizing transfer price will usually be zero or an arbitrarily large number. However, usually, the tax authorities will not allow such extreme transfer prices and either it will impose a transfer price or the multinational will choose a strategic transfer price that the tax authorities will accept (Eden, L. (2001).

The *economic transfer price* that is suitable, in theory, for collection by a statistical agency will in all cases be a marginal cost (for the exporting establishment) or marginal revenue (for the importing establishment). In the case of no tax distortions, the economic transfer price will coincide with the external market transfer price or the efficient transfer price (W. Erwin Diewert).

III. PARITY PRICING

Parity means equal or equivalent. Parity pricing is making the price of a particular commodity *equal* or *equivalent* to a reference price for the same commodity in another location (Import/Export Parity Price Analysis, USAID, 2009).

Another way to look at parity pricing is that it is a way of accounting for differences in prices of a particular commodity in two different locations. In this sense, parity pricing helps us explain why the price of a commodity in one market is different than the price of the same commodity in another market. By attributing the difference in prices to costs like transport, taxes and so forth, we can then say the prices are equivalent or at par. In accounting terms, the prices balance (not equal) after considering all relevant adjustments. (Import/Export Parity Price Analysis, USAID, 2009).

❖ Calculation of Parity Pricing

Calculating a parity price involves taking the price of a commodity at a border post or port of entry and adjusting it for the transport, marketing and transaction costs that are incurred when bringing the commodity to the geographic location under consideration. Policy effects such as taxes, subsidies and tariffs on the commodity are also included in these adjustments, and if we are interested in expressing the parity price in local currency terms, a currency conversion must be made using the appropriate foreign exchange rate. The end result is a unit price referred to as

the parity price, which reflects the cash or financial value of the commodity in the location under consideration.

Examining parity pricing will have the below-listed attributes (Shideler, J. H. 1953);

- Parity prices measure the incentives or disincentives for agricultural production, given competition from international trade and/or cross border flows,
- Parity prices measure the incentives or disincentives for moving commodities from one location to another, specifically across borders,
- Parity prices can help detect unfair commodity pricing,
- Parity prices can be analysed over time to assess the dynamics of food security in a given location.

Two types of parity prices

i. ***Import parity price (IPP)*** **–** the value of a unit of product bought from a foreign country, valued at a geographic location of interest in the importing country.
ii. ***Export parity price (XPP)*** **–** the value of a product sold at a specific location in a foreign country, but valued from a specific location in the exporting country (William A. Ward).

Import and export parity prices are used to assess the incentives to trade as well as the incentives to produce where local producers are in competition with producers and suppliers from outside the country or across the border. Parity price analysis is an important tool for food security and early warning analysts in that it can be used to determine the incentives to produce food and the potential for profitable importation of food and agricultural inputs through primary ports of entry or across internal regional borders. Parity prices are used to compare the prices of a commodity in two different locations when the two locations are in different countries (William A. Ward).

Below three issues are attributes to analyse parity pricing on import-export pricing.

i. ***Price transmission rate*** – is based on the assumption that price information in different locations is transmitted efficiently to all market participants spread over different locations. In other words, traders in one place receive price information from other places quickly – almost immediately (i.e. the *price transmission rate* is high). When this

condition holds, calculating parity prices by taking prevailing prices at different locations in the same period of time is acceptable. This means that even though the commodity passes through the different locations at different times, the price of the commodity at different time periods is disregarded and price information at the same time period but in different locations is used instead. Typically it takes time for a commodity to move from one place (or stage within the market or value chain) to another. Thus, the commodity will be physically located at the port of exit at one time and will arrive at the port of entry in the importing country at a later time. It will then arrive in a city for consumption at an even later time. Therefore, in principle, calculations of parity prices based on prevailing prices and costs observed at a one-time point are somewhat unrealistic and inaccurate. If it were possible, one ought to trace back the movement of the commodity over time and through different stages in the supply chain and use corresponding prices for the different line items in the parity price calculation. However, this can be tedious and very difficult, especially if data are hard to come by. This is why most calculations simply assume a high rate of price transmission (Import/Export Parity Price Analysis, USAID, 2009). Therefore, it is standard to assume a high price transmission rate unless:

- ✓ Prices and exchange rates fluctuate a lot within a very short period of time
- ✓ The country under consideration has very high levels of inflation
- ✓ The price information is not easily communicated from one location to another.

The reality on the ground can be very different – delays can be substantial (e.g., clearing customs can take several days, bad roads and severe weather conditions such as floods and storm can cause delays). Because of this, the price transmission rate should always be assessed by the analyst to determine the validity of his/her parity price calculations. To gain a sense of how high or low the rate of price transmission is, one can compare the changes in prices in one location to those in other locations and determine whether they are generally increasing or decreasing at the same times and if the changes between time periods are very high or not. For example, the border price of wheat in a country for the last 120 days can be graphed with the price of wheat in a market centre. It can then be observed if the price changes more or less coincide with when the border price changes and how drastic these changes were over a short space of time). This is a relatively crude but rapid assessment method. There are other more complex techniques that can be used

to analyse price transmission rates in detail but these take more time and data to execute (Import/Export Parity Price Analysis, USAID, 2009).

ii. ***Traded versus non-traded goods*** - Traded goods are defined as those products that can be exported or imported (e.g., KCL fertilizer and agricultural commodities), while non-traded goods are those that cannot (e.g., domestic transport services). Non-traded goods cannot be traded either because of their nature (e.g., if they cannot be transported into or out of a country such grain milling services) or due to restraining production and marketing costs or due to restrictive trade policies and regulations (Import/Export Parity Price Analysis, USAID, 2009).

In the context of food security analysis, it only makes sense to calculate import and export parity prices for traded goods because non-traded goods can only be made available in a country through local production (Import/Export Parity Price Analysis, USAID, 2009).

Of course, some goods are officially non-traded only because of restrictive trade policies but through so-called "black markets" these goods might still be traded. In such cases, it may still make sense to calculate IPP and XPP. In addition, parity price calculations can be made for non-traded goods that are found in different locations within a country. This may be done to compare prices in different areas in a country and thus ascertain incentives or disincentives to move the non-traded good from one part of the country to another, even though the good is not moved across country borders. However, these party prices are not what is typically referred to as IPP or XPP, but rather relevant to general spatial price analysis, which is important in food security analysis and can be tied in with Import and Export Parity Price Analysis (Import/Export Parity Price Analysis, USAID, 2009).

iii. ***Law of one price*** - in calculating parity prices, it is assumed that prices of the same commodity in different locations are only different because of transport, marketing and transaction costs. This is sometimes referred to as the *law of one price* (LOOP). It is assumed that no individual or firm can persistently earn excessive profits just by buying a product in one market and selling it in another because other individuals will see the opportunity and do the same, thereby increasing the quantity sold in the lucrative market and in turn lowering prices (Fackler and Goodwin 2002).

The law of one price is based on the assumption that domestic country markets are competitive and well-integrated with world markets and people can freely enter the market. However, it is possible, and often the case in the real world, that domestic country markets are not competitive (e.g., a monopoly controlling a grain market). Thus while the assumption underlies our calculations we ought to assess the different components of our calculated parity prices, and see what proportion of the price might be attributed to excessive profiteering (Rapsomanikis, *et al*. 2006).

2.1.2. Approaches to Analyse Market Integrity (Price Compatibility)

A number of approaches have been used to analyse price transmission, either linear or non-linear approaches. Linear approaches include the correlation coefficient and regression models, Granger causality, Ravallion model and the co-integration and error correction mechanism approach. However, there are other approaches that recognize the non-linear nature of price transmission; these include the threshold model and the parity bound models. In the following paragraphs, these approaches are discussed in detail.

Earlier studies on price transmission used simple correlation coefficient and regression approaches of contemporaneous prices. The correlation coefficient indicates the degree of relationship between two variables (Abdulai, 2007). The correlation coefficient ranges between 0 and 1 where 0 means no relationship, and 1 means perfect correlation. Such that a high correlation coefficient is evidence of co-movement and was interpreted as a sign of an efficient market. Abdulai (2007) notes that the advantage of this method is that it is easy to calculate and understand because the coefficient of determination R^2 indicates a share of variation in one variable explained by other variables, but it has a serious disadvantage of only considering the relationship between prices at same time hence does not take into account lags.

The limit of this approach is that it is founded on strong hypothesis of the permanence of commercial flows between the markets; the fixity of the costs of transfer and the fact that on a market, the prices are supposed to be given in an exogenous way (Nkendah and Nzouessin, 2006). Another limitation recognized with this approach is that the coefficient can be high and even equal to 1 whereas no trade exists between the two markets. This can be the case if the

prices in the two markets are affected by the same factors namely the inflation and seasonal movements (Nkendah and Nzouessin, 2006).

According to Nkendah and Nzouessin (2006), the approach based on the estimate of a model of regression is founded on the hypothesis: of linearity between the prices of the various markets. The method of regression comprises a static regression approach. Static regression analyses are used to find the equation that best fits the data (Nkendah and Nzouessin, 2006). One of the cited advantages is that the approach gives information to calculate transmission elasticity that can take into account effects of inflation, and seasonality however on the negative side the methods is believed to give misleading results if data are non-stationary (Nkendah and Nzouessin, 2006).

In the regression framework, Granger (1969) proposed causality approach, which improves greatly on the simple bivariate correlation and regression tests. Granger (1969) causality test provides evidence of whether price transmission is occurring between two markets, and in which direction. The price in market A is said to granger-causes the price in market B if both the current and the lagged values of price in market A improve the forecasting of price in market B. The Granger causality concept refers to the notion of causality in terms of lead and lag relationships: significant coefficients of the lagged prices imply that shocks to prices in one market induce significant responses in another after some lags (Granger, 1969).

Granger causality tests have some advantage over correlation coefficients as they allow for lagged or leading effects in price inter-relationships. However, the inferences from Granger causality tests do not reveal the nature of the relationship and results can still be spurious since they did not take into account seasonality and other implications of non-stationarity (Kilima, 2006). Hence the development of the Ravillion's model. In general, Ravallion's model was an improvement compared to the bivariate correlation/regression and Granger causality as it made provisions for other variables that affect prices (Rapsomanikis, *et al*. 2003).

Ravallion's (1986) model specifies a framework of numerous rural markets linked to a central market, and the test for market integration determines whether the price of a commodity in a given producer market is influenced by its price in a central market. The model indicates that the price in the central market is influenced by contemporary and lagged prices in all other markets and its own lags, while the price in any of the other rural markets is influenced by the

contemporary and lagged values of the price in the central market and its own lagged values, only (Fackler and Goodwin, 2002).

Rapsomanikis, *et al*. (2003) note that various hypotheses can be tested using this model, which includes, the market segmentation, central market, short-run and long-run market integration hypotheses. This model became the standard tool as it provided a more comprehensive assessment of markets inter-relationships and resolved many of the shortfalls of the previous approaches. It also gave rise to a series of extension, for instance, Timmer in 1987 extended the usefulness of Ravallion's approach through an index of market connection (IMC) that gives an easily comprehensible measure of short-run market integration between two markets.

However, the interpretation of the IMC is still ambiguous; because a larger value of IMC, for example, might indicate that markets are not integrated or that markets are integrated but transport costs exhibit a higher degree of persistence. In the same way, a low IMC suggests that markets are not isolated but it is unclear how connected the markets are (Kilima, 2006). Another major shortfall of the Ravallion approach stems from its underlying assumption of radial markets system in which market prices are exogenous is deemed abstract. Again ignoring the impact of trade amongst local markets seems a very strict assumption (Fackler and Goodwin, 2002).

While these various approaches and their extensions reflected some improvements in analyzing price transmission, namely, the elasticity of transmission, the direction of influence, dynamic adjustment structure, and multi-market considerations; they did not address the problem of spurious regression associated with non-stationary series as raised by Granger and Newbold (1974). This led Engel and Granger in 1987 to develop the technique of co-integration of time series data. Co-integration between the price series implies that although two prices may behave in a different way in the short run, they converge toward a common behaviour, in the long run, a process called long-run equilibrium (Conforti, 2004). Unlike the Ravillion's model, cointegration establishes long-run equilibrium between series without requiring the series to be stationary and does not require any assumptions, or any restrictions on the market structure like the radial market structure (Granger and Lee, 1989).

Engel and Granger (1987) defined a long-run equilibrium relationship between the price in a given market P_t^1 and the price in another market P_t^2 in the equation below:

$$P_t^1 = \alpha_0 + \alpha_1 P_t^2 + \mu_t \quad \ldots\ldots. (5)$$

The above representation is estimated using Ordinary Least Squares (OLS) and the residuals from (5) are used to test for cointegration in the following representation:

$$\Delta \mu_t = \rho \mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots (6)$$

Such that the null of $\rho=0$ is tested against an alternative of $\rho \neq 0$. If the null is rejected, then the two price series are co-integrated and thus a long-run relationship exists between the two markets, and hence price transmission can occur between the two markets.

If a long-run relationship exists, the characteristics of the dynamic relationship between the prices can be described by an Error Correction Model (ECM) (Barrett and Li, 2002; Rapsomanikis *et al.*, 2003), the short-run adjustment parameter of this type of model can be interpreted as a measure of the speed of price transmission, while the long run multiplier can be interpreted as a measure of the degree of price transmission of one price to the other (Rapsomanikis *et al.*, 2003). The advantage of ECM over an ordinary OLS model is that it accounts for dynamic relationships that may exist between a dependent variable and explanatory ones, which may span several periods(Rapsomanikis *et al.*, 2003).

According to Rapsomanikis *et al.*, (2003) two commonly employed approaches to co-integration analysis are Engel and Granger (1987) used for bivariate analyses and the Johansen (1994) variance autoregressive (VAR) approach used in multivariate analyses. The first step in employing any of the two approaches is testing for unit roots in the price series individually under a null hypothesis of unit roots using the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) or other tests. Phillips and Perron (1988) developed a generalization of the Dickey-Fuller procedure that allows for fairly mild assumptions concerning the distribution of the errors. Hence the PP test, unlike the ADF test, allows the disturbances to be weakly dependent and heterogeneously distributed. (Enders, 2004).

Abunyuwah (2007) notes that the ECM representations have brought considerable insight into long-run market relationships/price dynamics with a great policy interest in commodity markets. However, Barrett and Li (2002) criticized cointegration and ECM methods. Because first, they do not incorporate trade flow and transfer data into market integration concept. Second, Cointegration and error correction modelling techniques also assume linear relationships between market prices,

therefore, these methods tend to violate consistent market integration condition of discontinuities in trade, implied by spatial arbitrage conditions (Barrett and Li, 2002).

The realization that price relationships may be nonlinear due to transactions costs motivated the introduction of a class of models called switching regime models (SRM) namely Threshold Autoregressive (TAR) models and Parity Bound Models (PBM) (Meyer, 2003). TAR models and PBM integrate price and transactions cost series and are quite widely applied to agricultural price series (Rapsomanikis *et al.*, 2003). In Africa, these models have been applied to test for spatial arbitrage in grain markets in Mozambique, Ethiopia, Tanzania and Madagascar (Abdulai, 2007).

Threshold models were introduced by Enders and Silko's in 1999 to explicitly recognize the influences of transactions costs faced by traders on spatial market integration and account for them without necessarily using actual transactions costs data (Conforti, 2004). The idea is that inter-market price differentials must exceed thresholds bands arising from transactions costs, before provoking existing market equilibrium and causing price adjustment to ensure market integration. Meyer (2003) argues that spatial markets, transportation costs limit the transmission of price shocks below a critical level because potential gains from trade cannot offset these costs and hence a perfect price adjustment will not take place.

Takayama and Judge (1971) predict partial equilibrium theory where short-run price adjustments due to arbitrage will take place only if the difference between international and domestic prices exceeds a threshold that is determined by transport and transaction costs. If the difference between prices is less than this threshold, there is no incentive for traders to engage in arbitrage, and prices can move independently of one another (Barrett and Li, 2002). The specification of the threshold models starts with the estimation of the Engel-Granger relationship below:

$$P_t^1 = \alpha_0 + \alpha_1 P_t^2 + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where; μ_t is a random error term with a constant variance that can be contemporaneously correlated. Therefore, Engel and Granger (1997) introduced asymmetric adjustments by letting the deviations from the long-run equilibrium in equation (6) behave as a Threshold Autoregressive (TAR) process:

$$\Delta\mu_t = I_t\rho_1\mu_{t-1} + (1 - I_t)\rho_2\mu_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

Where It is the Heaviside indicator function so that:

$$I_t = \begin{cases} 1 \; if \; \mu t - 1 \; \geq 0 \\ 0 \; if \; \mu t - 1 < 0 \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

Assuming the system is convergent, $\mu_{t-1} = 0$ can be considered as the long-run equilibrium value of the sequence. If μ_{t-1} is above its long-run equilibrium value, the adjustment is $\rho_1\mu_{t-1}$, while the adjustment is $\rho_2\mu_{t-1}$ if below its long-run equilibrium. The adjustment is symmetric if $\rho_1 = \rho_2$. Instead of estimating equation (8) with the Heaviside indicator equation (9) depending on the level of μ_{t-1}, the decay could also be allowed to depend on the previous period's change in μ_{t-1}. The Heaviside indicator could then be specified according to the following rule:

$$I_t = \begin{cases} 1 \; if \; \Delta\mu t - 1 \; \geq 0 \\ 0 \; if \Delta\mu t - 1 < 0 \end{cases} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10)$$

According to Engel and Granger (1987), replacing (8) by (9) is particularly useful when adjustment is asymmetric to the degree that the series exhibits more "momentum" in one direction than the other. Models estimated using Equations (7), (8), and (9) are termed momentum threshold autoregression (M-TAR) models. If $|\rho_1| > |\rho_2|$, the M-TAR model exhibits little decay for negative $\Delta\mu_{t-1}$ but substantial decay for positive $\Delta\mu_{t-1}$. Thus, decreases tend to persist but increases tend to revert quickly toward the attractor. The Heaviside indicator of (9) can be used in a dynamic model augmented by lagged changes in μ_t.

The test statistic for the null hypothesis using the TAR specification of (6) and (7) and the M-TAR specification of (8) and (9) are called Φ_μ and Φ_μ^*, respectively. Three main factors determine the distributions of Φ_μ and Φ_μ^*. These are the number of lags in the augmented equation (8), the number of variables and the type of deterministic elements included in the cointegrating relationship. The appropriate critical values for Φ_μ and Φ_μ^* Enders and Granger (1998) and Enders and Siklos (1999).

Finally, the analysis of symmetry will proceed by estimating the market integration relation in equation 6 and then tested for asymmetric adjustment using specifications 7, 8 and 9. In other words, both the TAR and the M-TAR specifications will be estimated. As in other studies (Alderman, 1993; Alexander and Wyeth, 1994), constant costs are assumed between markets. Any other assumption about costs would make the analysis dependent both on assumptions about the variation of costs with

quantities transacted and on the variation of transaction costs across agents (Dwyer and Wallace, 1992).

Baulch in 1997 introduced the PBM to price transmission and market integration analysis, while Barrett and Li (2002) made a significant extension to it. The PBM explicitly consider transaction costs and trade flow data, in addition to price series, in analyzing market integration. PBM has the advantage of allowing for a variety of inter-market price relationships within the range of perfect market integration and complete market segmentation unlike dynamic approaches, which rigorously accept price transmission or reject a null hypothesis at a given significance level (Kilima, 2006).

TAR and PBM methods have their drawbacks too, Barret (2005) notes that they rely heavily on inherently arbitrary distributional assumptions in estimation and typically ignore the time series properties of the data, not permitting analysis of the dynamics of inter-temporal adjustment to short-run deviations from long-run equilibrium and potentially important distinctions between short-run and long-run integration. Moreover, these sophisticated techniques are inherently difficult to model and are data intensive and require specific computer skills or software (Kilima, 2006).

Other important models in price transmission analysis are the impulse response models. These measure the spread of a price shock and provide additional information regarding the dynamic time-path of price adjustments (Kilima, 2006). Goodwin and Piggot (2001) note that the most important aspect of the impulse response analysis is the possibility of checking whether the price series converge quickly after an isolate, an exogenous shock to one of them. Because impulse response analysis has been interpreted as both dynamic disequilibrium adjustments and equilibrium adjustments they cause ambiguity in interpreting their results (Fackler and Goodwin, 2002).

Today, the majority of the price transmission studies use the econometric techniques of time series especially of cointegration analysis and ECM. Rapsomanikis *et al.,* (2003) and Kilima (2006) argue that they provide good results concerning the transmission of the prices if a methodological framework of the suitable test is used and correctly interpreted the results.

2.1.3. Theories about the cause of inflation

If the finding of the research assures that there is price incompatibility, it's also aiming to identify the cause & effects of the incompatibility. So it is hypothesised that price incompatibility does have a dual effect on inflation. In one way excess finance and absence of

entry barriers to the sector make everybody become exporter within stagnant supply volume, which leads demand to become very elastic and domestic price is booming irrespective to the international market. On the other way, exporters become importer and working to compensate their export loss and cost of import by maintaining their profit margin. This leads to the existence of imported inflation on imported items.

Thus to have a theoretical foundation on this hypothesis, below theories about causes of inflation are discussed.

A. Cost-Push Theory

Cost-push inflation is caused by wage increases enforced by unions and profit increases by employers. The type of inflation has not been a new phenomenon and was found even during the medieval period. But it was reviewed in the 1950s and again in the 1970s as the principal cause of inflation. It also came to be known as ―New Inflation‖ (Jalil Totonchi, 2011). The basic cause of Cost-Push inflation is the rise in money wages more rapidly than the productivity of labour. (Thomas M. Humphrey, 2018)

The labour unions press employers to grant wage increases considerably, thereby raising the cost of production of commodities. Employers, in turn, raise the prices of their products. Higher wages enable workers to buy as much as before, in spite of higher prices. On the other hand, the increase in prices induces unions to demand still higher wages. In this way, the wage-cost spiral countries, thereby, leading to cost-push or wage-push inflation. Cost-push inflation may be further aggravated by an upward adjustment of wages to compensate for the rise in the cost of living. A few sectors of the economy may be affected by an increase in money wages and prices of their products may be rising. In many cases, their products are used as inputs for the production of commodities in other sectors. As a result, the cost of production of other sectors will rise and thereby push up the prices of their products. Thus wage-push inflation in a few sectors of the economy may soon lead to an inflationary rise in prices in the entire economy (Jalil Totonchi, 2011).

Further, an increase in the price of imported raw materials may lead to cost-push inflation. Another cause of Cost-Push inflation is profit-push inflation. Oligopolist and monopolist firms

raise the price of their products to offset the rise in labour and cost of production to earn higher profits. There being imperfect competition in the case of such firms, they are able to administered price of their products. Profit-push inflation is, therefore called administered-price inflation or price-push inflation. This occurs when firms increase prices to maintain or protect profit margins after experiencing a rise in their costs of production. The main causes are - Growth in Unit Labour Costs, Rising input costs, Increases in indirect taxes, and Higher import prices (Imported inflation) (Jalil Totonchi, 2011).

B. Demand Pull Theory

John Maynard Keynes (1883-1946) and his followers emphasized the increase in aggregate demand as the source of demand-pull inflation. The aggregate demand comprises consumption, investment and government expenditure (J. M. Keynes, 1936). When the value of aggregate demand exceeds the value of aggregate supply at the full employment level, the inflationary gap arises. The larger the gap between aggregate demand and aggregate supply, the more rapid is the inflation (Jalil Totonchi, 2011). Keynesian (Keynes and his followers) do not deny this fact that even before reaching full employment production factors and various appearing constraint can cause an increase in public price.

This inflation constraint that appears quickly during prosperity is originally resulting from the non-proportioned section, branches and or various economic resources that are accounted from natural properties of discipline based on the market. Therefore, in one period of prosperity, it is completely natural. According to demand-pull inflation theory of Keynes, a policy that causes a decrease in each component of total demand is effective in the reduction of pressure demand and inflation. One of the reductions in government expenditure is a tax increase and to control the volume of money alone or together, can be effective in reducing effective demand and inflation control. In difficult conditions, e.g. hyperinflation during the war that control of the volume of money or decrease in general expenditure may not be a practical increase in tax can get along with direct action for control on demand. Demand-pull inflation is often monetary in origin - because the authorities allow the money supply to grow faster than the ability of the economy to supply goods and services. The phrase that is often used is that there is "too much money chasing too few goods" (Jalil Totonchi, 2011).

2.2. Empirical Literature

Several studies have focused on price transmission in sub-Saharan Africa. These studies have analysed price transmission in a number of selected food and cash crop markets and found that price transmission in African markets is characterized by more incomplete transmission or African domestic markets well poorly linked to international ones. They emphasize that across Africa very high increase in prices were seen but they did not correlate with international prices. Further, they say it is likely that higher prices observed in Africa responded more to local factors and perhaps to inflation imported through rising oil prices.

Baffes and Gardner (2003) examined the transmission of world commodity prices to domestic markets under policy reforms in eight countries: Chile, Ghana, Madagascar, Indonesia, Egypt, Mexico, Argentina and Columbia. The study used error correction mechanism to analyse price transmission in 10 commodities: namely maize, wheat, cocoa, rice, sugar, palm oil, sorghum, soybeans and coffee hence a total of 31 country/commodity pairs for the period from 1970 to 1997. The study found that of the eight countries examined, only Mexico, Chile, and Argentina prices had a significant pass-through of world price movements.

For the remaining five countries Ghana, Madagascar, Indonesia, Egypt, and Colombia the transmission was either low or non-existent, and the variability of world prices is not reflected in domestic price movements in any important way. The study concludes that the political desire to insulate domestic markets from world commodity markets is remarkably persistent even in the most liberalized countries. The present study is different in that it does not introduce structural breaks as the above study did to account for trade policies hence the current focus more on the effect of world price transmission into domestic prices solely.

Conforti (2004) analysed price transmission in selected markets in sixteen countries - Argentina, Brazil, Chile, Costa Rica, Egypt, Ethiopia, Ghana, India, Indonesia, Mexico, Pakistan, Senegal, Thailand, Turkey, Uganda, and Uruguay - primarily for basic food commodities. The analysis was done using an ECM on a price database collected from various sources. Results show that African countries normally have a lower degree of price transmission compared to that of other countries in Asia and Latina America. Secondly, the analysis showed that vertical transmission is generally higher than the spatial transmission of changes in the world reference prices.

The study, however, revealed mixed results suggesting that it is difficult to draw definite generalizations on price transmission when analysing many different commodities within different countries. The study was also constrained by many missing data especially in African countries hence the study results did not allow for a rigid conclusion.

Kilima (2006) analysed the extent to which world market price changes are transmitted through border prices into local producer prices for four Tanzanian markets namely sugar, cotton, wheat and rice commodities for the period between 1994 and 2005. The study used co-integration and causality techniques to test for price linkages. For the analysed commodity prices (sugar, cotton, wheat, and rice), the co-integration results indicate that the prices in Tanzania were not well integrated with commodity prices in the world market. However, Granger-causality tests revealed the existence of a unidirectional- causal relationship, whereby commodity prices in the world market Granger-caused prices in Tanzania.

The two methodologies taken together imply that commodity prices in the world market and local markets in Tanzania drifted apart, but some shocks from the world market passed through to Tanzania but not the reverse. The present study uses VECM instead of co-integration hence test not only if markets are integrated but also the magnitude of price transmission and the speed of adjustment. In addition, the current study does not test Granger causality because it assumes only world prices influence domestic prices as Rwanda is a small country, therefore, does not have an influence on world prices.

Kaspersen and Føyn (2010) investigated price transmission for agricultural commodities in Uganda. The prices of Robusta coffee and sorghum were examined using an empirical vector autoregressive(VAR) model for the period from June 2000 to September 2006 for sorghum while for coffee the period analysed was January 1986 to April 2006. The study found that sorghum price is not integrated with world markets, However, for the cash crop, Robusta coffee, especially, in the period of 1990s with high coffee prices on the world market, coffee prices in Uganda were strongly connected to world prices.

The study concluded that price transmission from world markets has only been evident in the case of rising prices of an exported commodity, but otherwise, agricultural commodity markets in Uganda are poorly linked to world markets. The current study is similar to this in the manner

that it seeks also to establish whether there is price transmission of world prices into Rwanda's markets but it differs from this study as it uses a different method, VECM instead of VAR. Second, it analyses the price transmission of a highly traded food commodity, rice compared to sorghum thus minimizing the effect the non-tradability.

Minot (2010) studied the transmission of world food price changes to African markets African countries: Ethiopia, Ghana, Kenya, Malawi, Mozambique, South Africa, Tanzania, Uganda and Zambia. The study used a vector error-correction model approach. The data consisted of 62 domestic price series for maize, rice, and wheat for a period of five years. Only 13 of the 62 price series show a long-run relationship in which the domestic price is influenced by the international price of the same commodity. Indeed, of these 13 domestic prices that show a long-run relationship with international prices, only six have a long-term elasticity of transmission that is statistically significant.

The study found also that the degree of price transmission differs across commodities, for example for the case of maize only 10% of tested domestic prices were significantly related to world maize prices while almost 50% of the domestic rice prices were related to world rice prices. The study argued that it is not astonishing for such differences because most SSA countries are close to self-sufficient in maize, but rely heavily on imported rice to meet local demand. The current study uses similar methodological approaches. However, it focuses on a single country and commodity hence the present study is more specific to the case of Rwanda.

Amikuzino (2012) reviewed the contribution of agricultural economics to rice transmission analysis and market policy in SSA. The study used a Metadatabase obtained from 45 price transmission studies published between 1978 and 2011. The study used meta-regression analysis to provide an overall assessment of the potential impact of selected, study-specific attributes on estimated price transmission coefficients and in identifying asymmetric price transmission. Results indicated large dispersion of estimated price transmission coefficients between 2.5% and 94.2%.

The study established that in general, the extent of price transmission in SSA is comparatively low and asymmetric price transmission differs consistently across the attributes in SSA. This

study uses the different methodology of VECM instead of Meta-regression analysis and does not attempt to measure asymmetry of price transmission.

Chilanga (2014) conducted an analysis of the efficiency and integration of Zambian sugar markets. Analyses involved vertical and spatial price transmission between the world and Zambian sugar prices and testing for price transmission asymmetry using an ECM from 1996 to 2010 period. Findings show low integration between the world and Zambian sugar price. Results also showed that the adjustment process is asymmetric between the world and Zambian sugar prices hence suggesting low market efficiency. However, vertical price transmission analysis revealed that Zambian sugar markets are relatively more integrated and efficient.

These results suggest that there are distortions in the sugar market, which may include transaction costs, high concentration in the market structure as well as inappropriate policies such as high taxation, high-interest rates and import bans. The current study does not analyse market efficiency hence does not conduct price transmission asymmetry and analysis of vertical price transmission of producer, wholesale and retail prices relations. Instead, both studies are similar in the manner that both studies use ECM approach to establish a quantitative relationship between world markets and domestic markets.

Acharya, *et al.* (2012) studied world rice and wheat price transmission to the Indian domestic markets for the period from 1996 to 2011. Tests were done using Johansen methodology of estimating a VECM. Results showed that domestic prices during the crisis period did increase but the increase was considerably lower than the increase in global prices. In addition, the results suggest that the transmission from international prices to farm-gate prices is asymmetric, which shows that farm-gate prices respond differently in rising and falling phases of international prices.

Because price transmission is influenced by the marketing and price policies, the paper also reviewed domestic policies related to marketing of rice and wheat in India. The study established that government interventions in rice and wheat markets were major factors that impacted the price transmission of global prices to Indian markets. The present study though it quantifies transmission of international prices into Rwanda's rice markets does not review price policies in

Rwanda and their influence on the transmission process. However, both studies use similar econometric approach, the VECM.

Greb *et al*. (2016) conducted a study on the extent and speed of transmission of international cereal(rice, maize and wheat) price changes to the domestic retail and wholesale level in developing and emerging countries with a focus on African countries. The study employed the extensive FAO GIEWS[8] price data set from 1995 to 2011 using a VECM approach. The study found that the share of co-integrated commodity markets is higher in African countries compared with the other countries in the sample (49% compared to 35%). In addition in most case domestic prices adjusted to deviations from the long-run price relationship, but international did not.

The study further analysed how much the variation in the samples of price transmission estimates can be explained by country or product specific factors (economic, political, geographical, as well as infrastructure and trade variables using Meta-regression analysis. The analysis found that an increased ratio of net imports is associated with slower price transmission leading to the conclusion of increased intervention on politically more sensitive markets. The current study uses similar methodological approaches but does not conduct regression analysis. In addition, it focuses on a single country and commodity contrary to the study under review hence the present study provides more specificity to the case of Rwanda.

The foregoing analysis seems to indicate that the most widely used empirical model to study price transmission is the Vector Error Correction Model (VECM). The VECM which is an extension of co-integration techniques has an intuitive appeal for the study of price transmission since it allows separating short and long-run market dynamics (Conforti, 2004). The distinction between short run and long run price transmission is important and the speed by which prices adjust to their long-run relationship is essential in understanding the extent to which markets are integrated (Conforti, 2004).

[8] FAO Global Information and Early Warning System

CHAPTER THREE

METHODOLOGY OF THE STUDY

This chapter begins by giving an overview of Ethiopian agricultural export so as to define the methodology of analysing primary and secondary data collected to address the research question. After discussing the overview, the second part of this chapter discusses the source of data & type followed by the methodological rationale to analyse primary and secondary data with descriptive way and using econometric model.

3.1. Overview of the Ethiopian Agricultural Commodities Export

The export practice of agricultural product of Ethiopia is predominantly originated by primary agricultural products without significant value addition across all value chain actors. The value chain is composed of framers/growers to exporters by having aggregators, suppliers, processers/service providers in between these two operators.

Framers are mostly small-scale growers of those export products which couldn't fit for direct export due to minimum economic of scale and they supply the products to aggregators through farm gate price set by aggregators with informal way Farmers just sell their products to those aggregators and the aggregators collect the commodities in such manner through the door to door searching without organized packaging & transportation modality. In many cases, the aggregators would be agents of supplier offering the price based on suppliers price matrix. After the aggregators collect the commodities from different producing areas, they just supply to suppliers at the primary transaction centre established[9] around producing areas within the approximately 40-50km radius.

Although ministry of trade, coffee & tea development & marketing authority directives/proclamation[10] respectively states that primary transaction centres & processing stations are a place where only producers of non-coffee agricultural products & coffee producers come to the market as sellers and suppliers become buyers on those centres, in realities farmers failed to act as a seller in those transaction places. This is because farmers supply quantity is the

[9] The transaction centers are established by an appropriate regional organ as per Regulation Number 178/2010

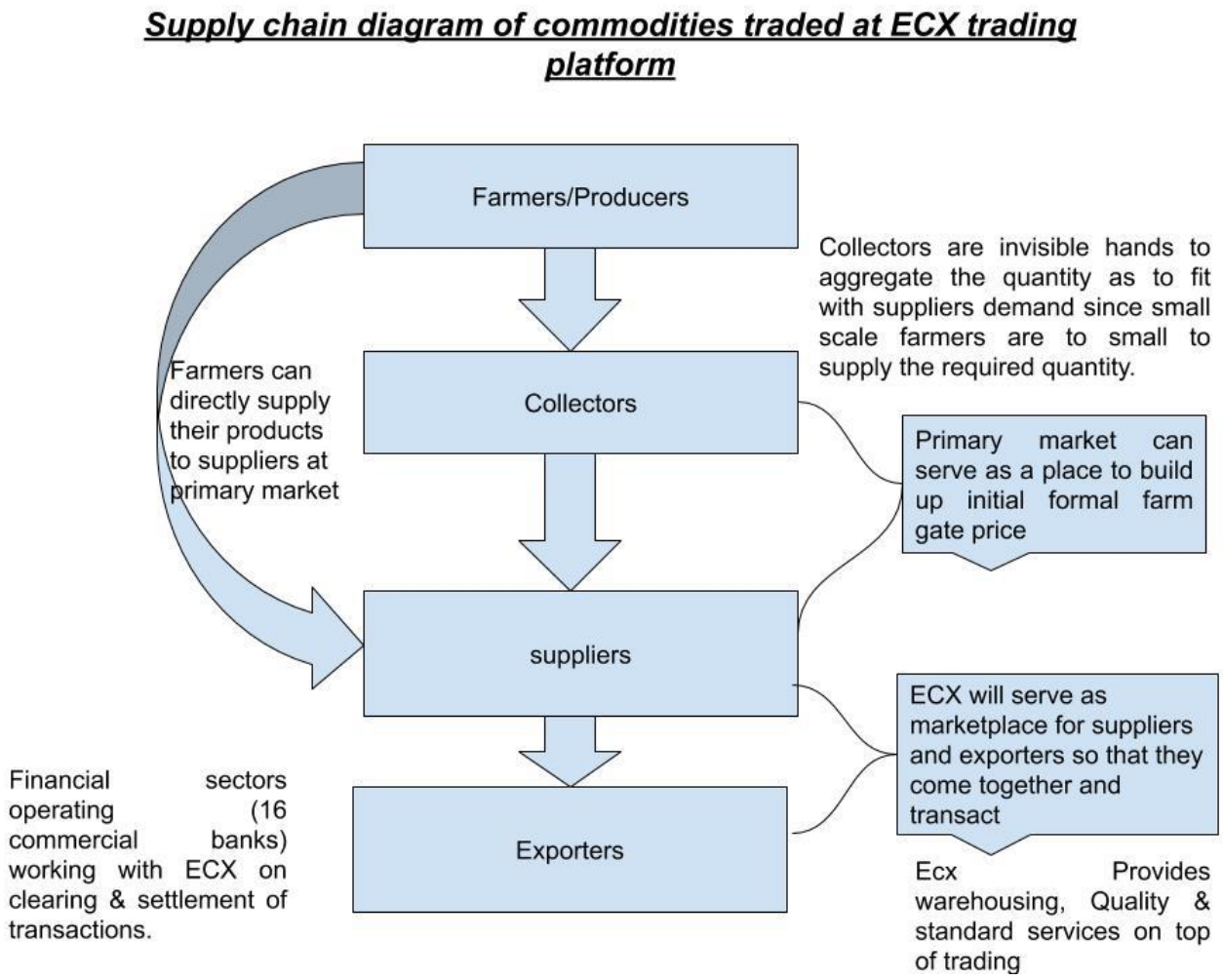
[10] ***Regulation Number 178/2010:*** Sesame & White Pea Beans Transaction, Council of Ministers Regulation
Proclamation 1051/2017: Coffee Marketing & quality Control Proclamation, House of Peoples Representative

very small quantity and hence entails high transaction cost for them. As a result, aggregators/collectors enter in the system to aggregate individual farmers product and then supply to those centres' and act as a seller in the transaction centre while suppliers become buyers.

On this transaction centres, suppliers buy the products from collectors and supply to ECX trading platform. ECX platform serves as a secondary market next to the primary transaction centre where suppliers & exporters come together and transact electronically with predefined standard compliance[11]. In this process, exporters buy products for exporting through two approaches, either they come to ECX to comply with initially signed sell contracts or they will buy to have stock for future sell through speculation. In both cases, exporters are expected to purchase commodities from the ECX platform by considering the international price of the respective commodities to maintain their business sustainability. According to the practice, exporters export their purchase from ECX after processing in line with their buyer's demand modality within two months, although different exceptions on shipments period & international market modality constrain this process.

[11] ECX rule states that any of market actors looking to transact on its platform should have a membership right and this right is applicable only for exporters, suppliers and local wholesaler's (in coffee case)

Figure 3.1 Supply Chain of Commodities traded in ECX Platform



Author Compilation based on work procedure of the respective stakeholders

Legal framework and stakeholder's role in facilitating export sector

National Bank of Ethiopia (NBE)

National bank of Ethiopia is a major stakeholder on managing export & import business of the country by drafting different directives and controlling commercial banks which give banking service to their respective exporter clients. NBE focuses on foreign currency administration which is at the very core point of the import-export business. NBE promotes exporters to improve export earnings by providing different incentives. Of those incentives, retention

directive[12] is the one which gives access to utilize foreign currency's generated by exporters for import business on the following the provision on article 5 of the directive. This article offers the retention right as;

Exporters of goods and services, as well as recipients of inward remittances, shall have the right to retain their foreign exchange earnings in retention accounts A & B as follows;

a) **Account A:** thirty per cent (30%) of the account balances for the indefinite period of time
b) **Account B: -** Seventy per cent (70%) of the account balances for up to 28 days. After the 28days, any balances shall automatically be converted in the next working day into local currency by the customer's bank using the prevailing buying exchange rate.

Thus, National bank of Ethiopia develops different procedures & work process to encourage exporter's performance in foreign currency earning of the country. Of those incentives, the aforementioned retention policy is the major one that aims to attract exporters to the export industry by giving them the privilege of utilizing 30% of their export earn in foreign currency to their own import business/foreign currency need.

In addition to a retention policy, commercial banks' loan facility to export business is another incentive available to exporters that offers export loan with a minimal interest rate (9 – 11%) and without collateral through export guarantee loan[13]. Banks lend with 18% interest rate for import business. This shows that business operators engaged in export sectors have much better incentive and hence are encouraged through the provision loan facilities on top of other incentive's provided to the sector.

Ethiopia Commodity Exchange (ECX)

ECX is a market place where buyer and seller come together and transact. In doing so buyers will be exporters or wholesalers to domestic market and sellers are suppliers of exportable commodities or exporters who sell by-products of their export which will be consumable by

[12] Directive No. FXD / 48/2017 Directive for Amendment of Retention & Utilization of Export Earning
[13] It is a kind of loan provided to exporters to promote export just by taking signed export sales contracts as guarantee with no need of collateral through minimal interest rate (nearly by half of non-export sectors lending rate)

domestic consumers. As per the Proclamation No. 550/2007[14], the exchange is established in 2008 to provide the following operations from arrival to delivery of commodities processed in the exchange;

- **Development & approval of contracts: -** the exchange drafts commodities contract parameter and gets approval from regulatory bodies. This contracts will be guidelines on way forward of the trading process.
- **Warehousing & Quality Compliance: -** the exchange provides warehousing service for commodities traded in the platform after grading of the commodities according to quality parameter & approved contracts.
- **Trading: -** the exchange avails both outcry & electronic trading platform which serve as a playground for traders to conduct their trade with defined trading rules & regulations. The trade is conducted through the price-time priority algorithm[15] within a defined price range of up & low by referring previous day closing price. Any attempt beyond the price range defined is disqualified and the price discovery will be expected through demand and supply rational within a price range and by taking consideration of the international price of respective commodities i.e. ICE 'C'[16], Public ledger Reference price for Sesame.
- **Clearing & settlement: -** after the trade takes place the exchange does clearing & settlement for the transaction executed with T+1[17] settlement modality without any default aligned with 14corresspondet commercial banks.

Based on the above operational activities of the exchange, the exporters are expected to come up with active trade license and engage on the trading process on the buyer side and buy the contracts which will be exported after processing according with their respective buyers' buy order around the world.

[14]A Proclamation to provide for the establishment of Ethiopia Commodity Exchange; Proclamation No. 550/2007, House of Peoples Representative
[15] Initial better price submitted to the system have absolute advantage to execute as soon as any counterpart is available to transact.
[16] ICE New York Future Coffee Price, Commodity Futures Price Quotes
[17] Clearing & Settlement conducts on next day after the transaction executed

Ministry of Trade

Whereas export sector does have cross-cutting stakeholders, ministry of trade is the major one which is responsible to facilitate & control export business of the countries on different hierarchical structure from the head office to woreda level trade offices;

- **Trade Licensing: -** regarding with licensing of value chain actors, except farmers all value chain actors are expected to have an active licence for their business operation and this license is issued through the ministries office[18]. For exporters, they are expected to get the license from head office and other actors like suppliers & aggregators get their licence from regional/zone/woreda trade offices.
- **Formulation of a system to create a conducive environment to export sectors: -** the ministry is responsible to establish a trading system which increases efficiency & competitiveness of export sectors in the international market and also conducts promotional activities aligned with the pertinent organization to have better destination market for countries export.
- **Controlling of under-invoicing & contract default on export products: -** where the country's export product needs representative price equivalent with its value, the ministry has a role to control abnormalities on export pricing aligned with NBE. On the other hand, exporters should comply their contract with their buyers and strict control will be made on default incidents to maintain countries reputation on international market & also to get foreign currency as soon as fast.

3.2. Data and Data Source

This study uses both primary and secondary data obtained from market actors and stakeholders' institutions in the export sector. Primary data are collected from both market actors and selected experts from stakeholder companies. Thus Top ten exporters of coffee, sesame & pea beans (around 60% of export is performed by these companies) have addressed in primary data collection. In addition experts in the Ministry of Trade and Industry, National Bank of Ethiopia & Ethiopia commodity Exchange is also considered in primary data collection. The primary data

[18] Proclamation 686/2010:- Commercial Registration & Business Licensing Proclamation, House of Peoples Representative

is collected through focused group discussion and individual interview so as to dwell on addressing the aforementioned research questions.

Secondary data are predominantly generated from Ethiopian commodity exchange, National Bank of Ethiopia, Ministry of Trade & Industry and New York Stock Exchange coffee price-New York ICE 'c'. Ethiopian Commodity Exchange (ECX) price tells the domestic price of coffee, sesame, and pea beans discovered in the exchanges platform for the last seven years (from 2012 to 2018). This data mainly shows what the domestic price of respective commodities was. This is done by taking into account the upper-value chain of price transmission i.e. inclusive of the farm gate price (price offered through collectors/aggregators), primary market price & operating costs in the exchange process till the product secure the market. On the other hand, National Bank of Ethiopia and Ministry of Trade & Industry data shows the respective value of each commodity while it is exporting up on the contract modality (either through FOB Djibouti or CIF). NBE data mainly focused on price register in the bank permit while Ministry of Trade & Industry data is obtained from the Revenue and Customs Authority when the export product is clear out from the countries border. New York Stock exchange coffee price is a reference price of coffee across a period of time where every country coffee is traded in the international market by referring it on a regular base. This means that the data collected from this exchange is utilized in this research in examining the price compatibility by evaluating the direction of the transmission.

All the secondary data collected from the above-mentioned organizations become analysed on monthly bases having 84 observation of each series of price on every commodity category namely coffee, sesame & pea beans.

3.3. Methods of Data Analysis

3.3.1. Descriptive Methodology

One of the methodologies of this research is descriptive analysis by using primary data from the industry. The primary data includes interview and focus group discussion with value chain actors on the selected issues which is not reflected through analysing secondary data sources. The basic need for utilization of primary data is where the thematic area of the research is highly

susceptible and dynamic to existing situation of the country, the issues will not fully reflect on secondary data only rather it needs further encoding of economic agents rationale.

Through the primary data collection method, top ten exporters of coffee, sesame & pea beans will be included in the interview and focused group discussion. These top ten exporters have an average of 60% export share from the industry which shows addressing them become representative of the industry.

Having the findings collected through the interview and selected group discussion, it is analysed through narration with supportive tables, charts or graphs.

3.3.2. Econometric Methodology

On this part general overview of econometric models applicable to analyse market integration & price compatibility is discussed. Firstly some theoretical concepts to measure market integration are presented. After this empirical analysis using those techniques are done and finally, it presents the summary of the technique chosen to conduct this research.

Theoretical Framework

Static Price Correlation Methods

Analysing market integration started with the use of static price correlations to test for spatial market integration in agricultural markets. This approach involves the estimation of bivariate correlation and regression coefficients of a homogeneous good are distinct markets (Hossain and Verbeke, 2010). The intuition behind this approach is that there is a co-movement of prices between integrated markets. Thus high/low correlation coefficient is interpreted as market integration/segmentation. The regression coefficient measure follows the "Law of One Price" (LOP) which is based on the formulation;

$$P_{1t} = \beta_o + \beta_1 P_{2t} + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

The ε_t is the error term and β_o and $\beta_1$are parameters to be estimated. The strong version of the LOP states that prices of a given good on spatially separated markets are equal and move perfectly together in time and the necessary condition is to test $\beta_o = 0$ and $\beta_1 = 1$. A weak version

of the LOP was also defined since the strong version rarely occurs in reality and hence the necessary restriction for equation (3.1) is to test $\beta_o \neq 0$ and $\beta_1 = 1$ (Hossain and Verbeke, 2010).

Cointegration Models

One characteristic of price series used for testing market integration with the use of the conventional measures is that the series are often non-stationary and hence tests are invalid.

As a result of this problem, Engle and Granger (1987) and Engle and Yoo (1987) introduced the concept of Cointegration and defines it as the existence of long-run relationship among different series. The absence of cointegration between two market price series indicates market segmentation whiles the otherwise is an indication of market interdependence. The analysis of cointegration involves determining the order of integration using the appropriate unit root test, constructing the cointegration regression if price series are integrated of the same order and finally testing for stationarity of the residuals from the cointegration regression. The absence of a stochastic trend in the residuals indicates the existence of a long-run relationship between the two series (Negassa et al., 2003). The Engle and Granger approach do not allow testing for all possible cointegrating vectors in a multivariate system which led to the development of the Johansen (1988) cointegration approach. The Johansen method uses maximum likelihood to test for cointegrating relationships among several economic series. In evaluating the short-run dynamics, Engle and Granger (1987) suggest the use of error correction models if there is the existence of cointegration relation between variables under consideration. The error correction representation sheds more light on the adjustment process in both short-run and long-run responsiveness to price changes which generally reflects arbitrage and market efficiency (Abunyuwah, 2007). The use of cointegration and error correction models help to explore further notions such as completeness, speed and asymmetry of price relationships as well as the direction of causality between two markets.

Today, the majority of the price transmission studies use the econometric techniques of time series especially of cointegration analysis and error correction model. Rapsomanikis *et al.*, (2003) and Kilima (2006) argue that they provide good results concerning the transmission of the prices if a methodological framework of a suitable test is used and correctly interpreted the results.

Empirical Framework

The research is conducted through testing of the variables stationary level through Augmented Dickey-Fuller test (ADF), GLS Dickey-Fuller & Phillips-Perron (PP). After getting the unit root test result the research continues to test cointegration between the international and domestic price of coffee, sesame & pea beans by using Johansen Cointegration method.

The model for conducting this research is specified as;

$$P_{et} = \beta_0 + \beta_1 P_{dt} + \varepsilon_t$$

Where;

$\mathbf{P_{et}}$ –export price of given commodities registered on National Bank of Ethiopia for respective commodity contracts i.e. coffee selling price to the rest of the world in terms of USD cents/lb, sesame & pea beans selling price to the rest of the world in terms of USD/MT (considered as international price of respective commodities)

$\mathbf{P_{dt}}$ – the price of domestic market discovered on Ethiopian Commodity Exchange Trading platform on the mentioned commodity class. This price is exporters' buying price from suppliers located on different parts of the country.

$\boldsymbol{\beta_0}$ – an arbitrary constant that accounts for the price differential, i.e., transportation costs and quality differences…

$\boldsymbol{\beta_1}$ – is the cointegrating parameter of the model (the slope)

$\boldsymbol{\varepsilon_t}$ – the error term estimating the marketing margin to check the stationary and long-run movement of the two variables (export and domestic price)

Based on the above model, the following unit root test techniques and Johansen Cointegrating techniques are used for this research.

a. Stationarity test

There are several ways to test the stationarity of the series: some of these are Augmented DickeyFuller (ADF), Phillips-Perron (PP), Kwiatkowski, Phillips, Schmidt, and Shin (KPSS), GLS detrended Dickey-Fuller, Elliott, and Ng and Perron (NP) unit root tests. In this study ADF, PP and GLS(extended ADF) test will be conducted. Because these tests had higher power compared to other tests especially the modified Dickey-Fuller. The other tests are important when there is a structural break in data series.

Augmented Dickey-Fuller Tests

The stationarity of a time series can be tested directly by the ADF test. In the empirical literature, the Augmented Dickey-Fuller (ADF) most frequently adopted as the procedure of testing unit root. The Augmented Dickey-Fuller (ADF) test is starting with to estimate the following Autoregressive order P (AR (P)) model (Wooldridge, 2016).

$$\Delta y_t = \alpha + \beta t + \delta_1 y_{t-1} + \delta_2 \Delta y_{t-1} + \delta_3 \Delta y_{t-2} + \cdots + \delta_p \Delta y_{t-p-1} + \varepsilon_t,$$
$$\varepsilon_t \sim IID(0, \quad \delta^2)$$

Rewrite the above equation in to

Where; α is a constant, β is the coefficient of time trend and ε_t is the error term. Imposing the constraints $\alpha = 0$ and $\beta = 0$ corresponds to modeling random walk and using the constraint $\beta = 0$ corresponds to modeling a random walk with a drift. ε_t Should be satisfy three things: Uncorrelated error terms, the assumptions of normality and constant error variance.

$$\Delta y_t = \alpha + \beta t + \delta_1 y_{t-1} + \sum_{j=1}^{p} \delta_{j+1} \Delta y_{t-j-1} + \varepsilon_t, \qquad \varepsilon_t \sim IID(0, \quad \delta^2)$$

In the above equation, the test for unit root using ADF is when the null hypothesis is that there exists a unit root in the time series (non-stationary time series), which is,H_0: $\delta_1 = 0$ against the alternative hypothesis that the time series is stationary (no unit root) which is, H_1: $\delta_1 < 0$. In the ADF test, if the calculated statistic (t-statistic) is less in absolute terms than the MacKinnon (1996) values (t-critical), the null hypothesis is accepted. It means there is a unit root (not

stationary) in the series. The opposite is true when the calculated statistic (t-statistic) is greater than the MacKinnon critical value.

Modified Dickey-Fuller

The test proposed by Elliott, Rothenberg, and Stock (1996). Elliott, Rothenberg, and Stock and studies have shown that this test has significantly greater power than the augmented Dickey-Fuller test. the DF-GLS test for the series of models that include 1 to *k* lags of the first-differenced and detrended variable. As discussed in, the augmented Dickey-Fuller test involves fitting a regression of the form

$$\Delta y_t = \alpha + \beta t + \delta_1 y_{t-1} + \delta_2 \Delta y_{t-1} + \delta_3 \Delta y_{t-2} + \cdots + \delta_p \Delta y_{t-p-1} + \varepsilon_t,$$
$$\varepsilon_t \sim IID(0, \quad \delta^2)$$

And then testing the null hypothesis of the unit root (non-stationary) $H_0: \delta_1 = 0$ against the alternative hypothesis of stationary $H_1: \delta_1 < 0$. The DG-GLS test is performed analogously but on GLS-detrended data. The null hypothesis of the test is that y_t is a random walk, possibly with drift. There are two possible alternative hypotheses: y_t is stationary about a linear time trend or y_t is stationary with a possibly nonzero mean but with no linear time trend.

Phillips–Perron stationarity test

The test proposed by Phillips–Perron (1988). The null hypothesis is that the variable contains a unit root ($H_0: \delta = 0$), and the alternative is that the variable was generated by a stationary process ($H_0: \delta < 0$). Phillips–Perron uses the regression fitted by Dickey–Fuller and write in the following form.

$$y_t = \alpha + \beta t + \delta y_{t-1} + \varepsilon_t, \qquad \varepsilon_t \sim IID(0, \quad \delta^2)$$

The Phillips–Perron involve this fitting model, and the results are used to calculate the test statistics. Phillips and Perron (1988) proposed two alternative statistics. Phillips and Perron's test statistics can be viewed as Dickey-Fuller statistics that have been made robust to serial correlation by using the Newey–West(1987) heteroskedasticity and autocorrelation-consistent

covariance matrix estimator. The critical values for the Phillips–Perron test are the same as those for the augmented Dickey-Fuller test.

b. Cointegration Test

Most econometric literature provides different methodological procedures to empirically examine the long-run relationship between two or more time-series variables. The most commonly used methods include the two-step residual based procedure for testing the null hypothesis of no cointegration which is attributed to Engle and Granger (1987) and the full information maximum likelihood-based approach of Johansen (1988) approach, all this methods of cointegration required that the variables should be integrated of the same order i.e., order one I(1) (Pesaran et al., 1999). As a result, these methods of Co-integration test cannot apply when there is a mixture of I(0) and I(1) variables in our model. Thus in this study, the Johansen cointegration test is used.

Johansen cointegration test

Johansen cointegration test is one of the most widely used tests in the literature. And the test is based on the number of the cointegrated equation; the first is Johansen's "trace" statistic method. The second is his "maximum eigenvalue" statistic method. All these methods are based on Johansen's maximum likelihood (ML) estimator of the parameters of cointegrating equations as written below.

$$\Delta y_t = \alpha \boldsymbol{\beta}' y_{t-1} + \delta_1 y_{t-1} + \sum_{t=1}^{p-1} \Gamma_i \, \Delta y_{t-i} + \varepsilon_t$$

where y is a $(K \times 1)$ vector of I(1) variables, α and $\boldsymbol{\beta}$ are $(K \times r)$ parameter matrices with rank $r < K$, $\Gamma_1, \ldots \ldots \ldots \Gamma_{p-1}$ are $(K \times K)$ matrices of parameters, and ε_t is a $K \times 1)$ vector of normally distributed errors.

In order to determine the number of cointegrating vectors, the Johansen method provides two different likelihood ratio tests, the trace test and the maximum eigenvalue test. The null hypothesis for the trace test is that the number of cointegration vectors is $r = r^* < k$, and the

alternative that $r = k$. Testing proceeds sequentially for $r^* = 1, 2$, etc. and the first non-rejection of the null is taken as an estimate of r Soren et al. (1991).

CHAPTER FOUR

RESULTS AND DISCUSSION

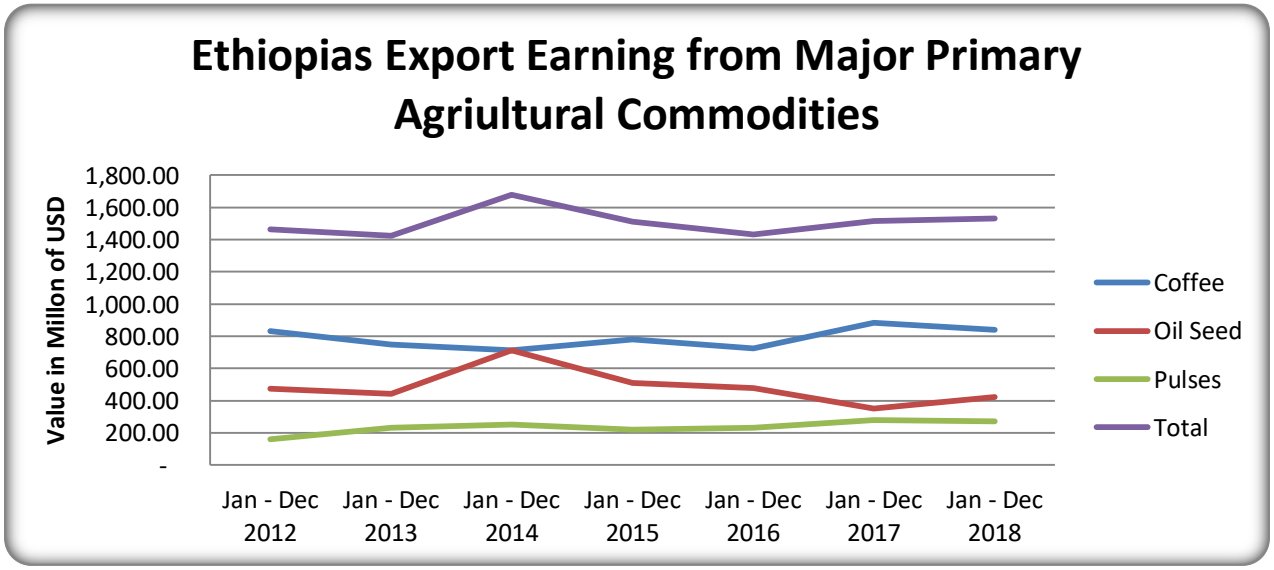
4.1. Part One: Primary Data Analysis

The findings of the primary data's on interviews and focused group discussion with respondents are analysed as follows;

Analysis related with export performance

Except for a few exporters in coffee & pea beans export business, the exporters responded that their export performance is decreasing during the last five year both in terms of volume and value. Whereas the leading exporters in coffee & pea beans stated that their export performance has increased. Regarding profit earning, almost all exporters responded that they suffered a loss in export business and declare loss to the tax authority. The graph compiled through secondary data demonstrated below, supports exporters' reflection on Ethiopia's export performance has not increases during the last seven years; as planned to increase on 1st and 2nd growth & transformation plan of the country (GTP 1 & 2).

Figure 4.1:- Selected major agricultural commodities: export performance during the last 7 years.



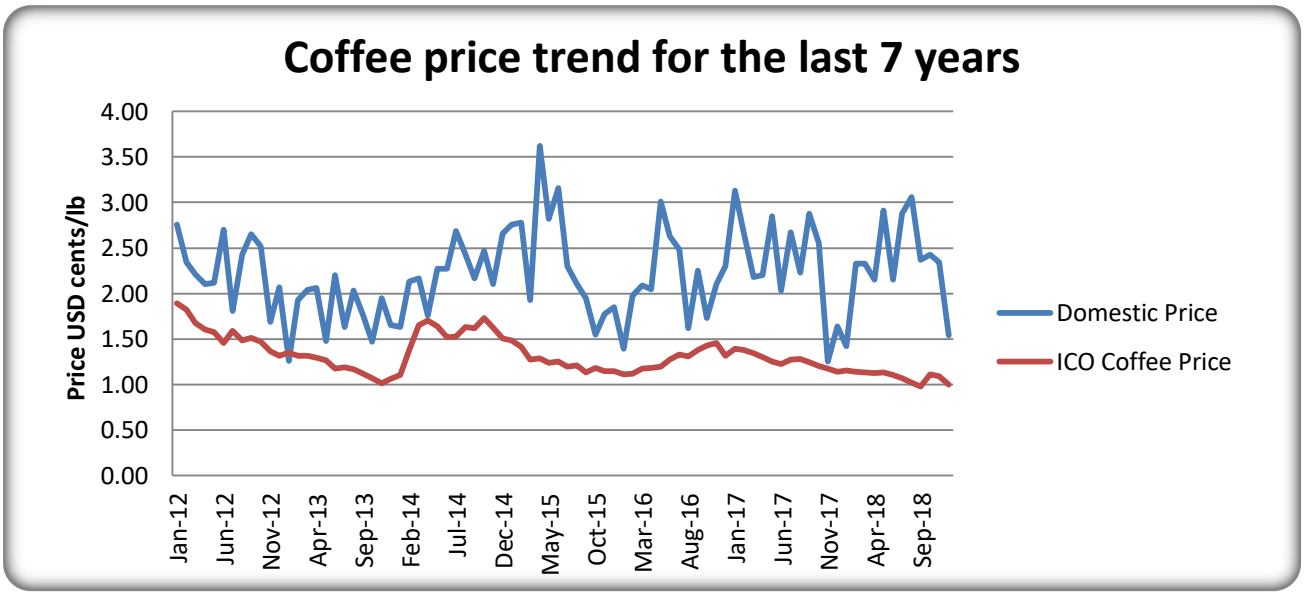
Compilation developed based on the Ministry of Trade and Industry Data

Unlike many exporters, champion exporters in pea beans and coffee export responded that they are profitable in the last five years. They mentioned that they have been working on managing their transaction cost to overcome agricultural products price deterioration on the international market.

Analysis related with price transmission

All exporters agreed that the price transmission starting from farmers to international buyers has been distorted. The price in the upper supply chain, on the farmer's level, is not transmitted to the secondary market on economic rationale. This distortion continues to FOB price of a given product and the price incompatibility is clearly observed on the major export product of the country. In many circumstance prices discovered on the primary market[19] is depressing secondary market against international market price for those agricultural products. This is reflected through ECX price didn't follow international reference price, rather it is beyond international price as depicted on the below graph in the coffee market.

Figure 4.2:- International and domestic coffee price trend



Compilation developed based on ECX and ICO (International Coffee Organization) price data from 2012 to 2018

Exporters perceive that the price discovery at the secondary level depends on the demand and supply of a given commodity in the market. But this demand and supply might not be realistic due to the following factors:

- Even though there is much tradable quantity and available cash balance in both sides, this might not be active order within the actual trading session. This means that even if the demand and supply indicators (Cash & Commodity Balance) are seemingly available in the market, this doesn't mean that it is active for trade on that moment rather they can Hord & speculate on it for other trading day till 60 days from seller side and for indefinite period

[19] Market established nearby farmers, farmers & suppliers are market actors on this market as seller and buyer respectively.

from the buyers side[20]. Therefore, the price discovery doesn't rely on aggregate supply available in Exchange's warehouse and aggregate demand reflected through buyer's cash balance in pay-in account. The market depends on active sell & buy order which is notified after the trading process is started in a specific trading session[21].

- According to the exporters, prevalence of artificial demand or supply with the motive of increasing or decreasing market price through pace making approach is another potential threat for demand and supply driven price discovery.

The exporters opined that, the discovery of market clearing price when new sessions, start does not depend on real market forces rather it will be hijacked through brokers and collectors when trading starts on the primary market level. The lagging effect of primary market distortion continues to ECX and usually, the opening price for the certain contract does not depend on real demand and supply force instead, it relies on other external forces. This opening price will have cross-cutting effect throughout the season by serving as a reference price in all circumstances.

With regard to the implementation of price limit on the free movement of price discovery, exporters responded that it is important to protect the price from sudden price shock. But the price limit implemented right now has a limitation on compatibility with an international price. The price limit/range implemented in secondary market shall map out with international market of New York coffee Price 'C'. When the price range is calculated by referring to international price, price discovery in the domestic market will automatically follow the international market and price transmission process become dynamic.

Many exporters responded that price discovery in the domestic market is not compatible with the international market; instead, in many circumstances especially on sesame trade, the domestic price doesn't align with international price.

Exporter's perception on the compatibility of domestic price with its international respective price is a bit distorted. Majority of the respondents reflected that their awareness was/is wrong. For instance; some of the exporters responded that, as soon as the net effect of the business (either in export, import or manufacturing business) is positive, they don't worry about the price compatibility and profitability of the export business, rather they try to reconcile export loss with their import earning.

[20] Although deposit period for commodity is vary across commodities, maximum deposit period for supplier is 60days and for buyer's they can deposit their money on exchanges controlled pay-in account for indefinite period of time since they are comfortable on the interest rate.

[21] Trading session is allotted time for traders to enter to the trading venue and bargain on their respective sell-buy order then trade executes. It is usually 15 – 25' for certain commodity classification like Washed Sidamo Coffee session, Whitish Hummera Gondar Sesame Session.

Regarding loan utilization & foreign exchange earnings, exporters raised the following issues on the usage of those services;

- Majority of the export guarantee loan is utilized for export operation, but in exceptional circumstances, exporters may use this loan to another business other than exporting. Especially under circumstances where lender banks supervision is poor, such an act is very common.
- For the sake of having better transaction turnover which is criteria of banks to replenish the loan in the coming period, exporters use the existing loan for purchasing the product regardless of its pricing & profitability. They just focus on securing the coming loan and getting grace period for their repayment or renewing of their loan by paying the interest only.
- Almost all exporters focus only on their export business; the majority of exporters utilize their foreign exchange earning to their own import business or transfer it to other importers with under table agreement[22].

- Although the national bank retention direction directs that the foreign exchange earned through exports shall be utilized only for improving export business facilities, almost in all circumstance, exporters utilize their respective retained foreign currency for commercial import purpose against the directive.

According to exporter's responses, almost all exporters, have an import business or they sell their retention amount of foreign currency[23] to importer companies through 'under table agreements' facilitated by banks. The import business is directly owned by the same company or sister/affiliated company who have preferential right to get priority on getting hard currency for their import. The pricing mechanism for import business is considering the cost elements for the importing item and also cost incurred to secure the foreign currency; Narrated as;

- Where the countries trade deficit is very serious and companies wait an extended time to secure hard currency for import, banks advise the importers to engage in export and they could facilitate their foreign currency need if they generate foreign currency in export. Based on this rationale, almost every importing company engage in export business, regardless of export profitability rather they just salivate the hard currency for their import business. In doing so, the export pricing become much distorted, companies calculate their export los; which will be compensated through inflated price in the imported item. This does have a cross-cutting effect on the undervaluation of the export business and also importing inflation from the rest of the world in the result of affecting society's welfare. In

[22] An illegal agreement orchestrated by commercial banks through issuing the retention amount of certain exporters foreign currency to another importer who is looking to get it for import.
[23] When exporters illegally sell their dollar to import companies nearly they sell it by 10-15br higher than banks exchange rate.

general, lately, export & import business is wrongly interrelated. Import business is operating at the expenses of export business & society's welfare.

Subject to the future plan of export business, except very few exporters who are interested to engage in value addition & processing of primary agricultural products to excel their export earnings in the coming five years, majority of the exporters reflect that they are feed up with the export business conspiracy. And they are planning to withdraw from export business or fully engaged in import specialization, and deal with export business only, for the sake of getting hard currency. Unlike others, one exporter responded that have a plan to be an export business consultant & establish an institute[24] in the coming five years.

Generally, both on individual interviews and focused group discussion with the respondents indicated the following major issues;

- Primary agricultural products competitiveness is paralyzed because of the absence of proper price transmission in the supply chain and wrong price transferring. Affiliated companies working as buyer and seller in domestic market, irrationally inflate or deflate the price against demand and supply forces through wrong price transferring approach. This wrong price transferring approach is also implemented on international level; between Ethiopian traders and foreigners' joint companies[25] established in Ethiopia and abroad also.
- The domestic agricultural products price regime is usually upward sticky against the dynamics to the international market. As a result of this perception, both market actors (sellers & buyers) are complaining against the sector claiming that the market is very uncertain and it is not governed by international situations.
- Incentive packages to do the export business in Ethiopian are miss-utilized. Especially, loan facilities and retention allocation are the major areas of problems related to promoting export. In many circumstance exporters don't utilize these incentives to promote export business, instead they utilize it for any other business which offers better return: like financing construction sector through export-oriented credit facility (export guarantee loan) and utilizing retention scheme for import business.
- Usually Ethiopian agricultural products get the premium price in the international market compared with other competitive countries. But due to distorted domestic pricing in the supply chain, the country couldn't fully exploit this opportunity. Still, in the international

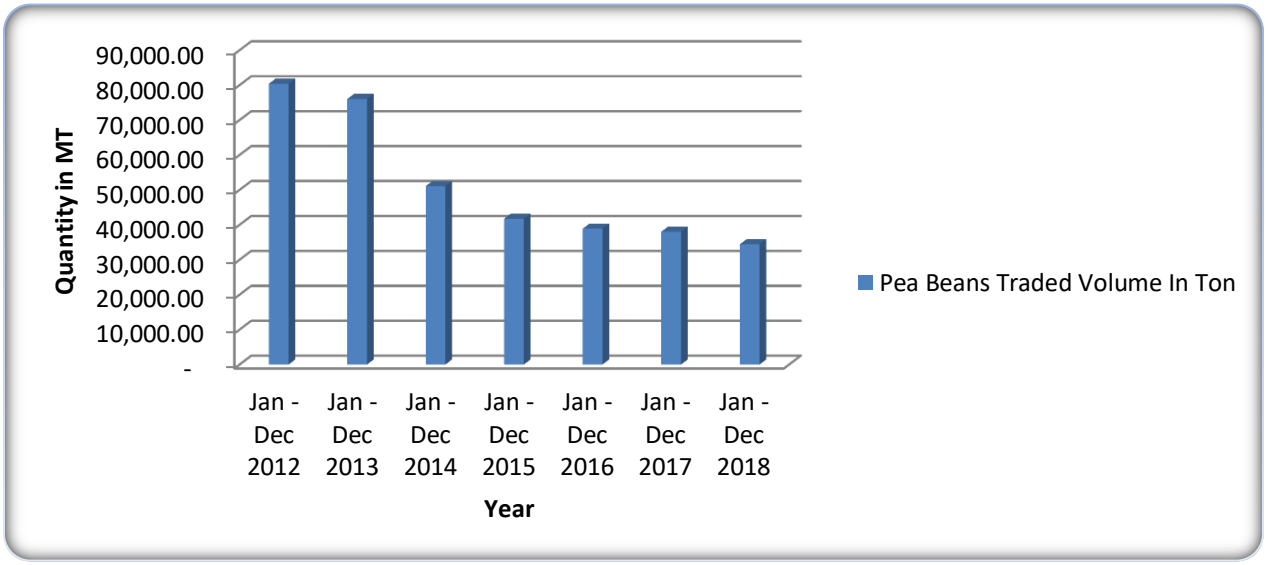
[24] This exporter strongly argued that the export business is operated through non-professional to the sector and anybody can do the business without knowledge and expertise as soon as he/she gets the finance. This damages the sector and he is willing to address this gap through establishing organized private institute working on these areas with reasonable payment.

[25] Some Ethiopian export companies affiliate with foreign companies and they establish import export business relation and chase the domestic market subject to their vested interest. Suppose a sesame export company creates affiliation with Chinese row material/electronic company, they cartel the domestic sesame price by increasing so as to replenish by import of those materials from there. In some circumstances foreign affiliated companies by themselves set domestic price as per their need also.

market, Ethiopia's primary agricultural products get a better price than other competitive countries.

- Prevalence of illegal acts in the value chain became another reason for unhealthy pricing. Significant contraband trade is observed in coffee & pea beans trade. This can be supported by the significant reduction of ECX trade volume in selected coffee delivery sites[26] and pea beans trade year to year as depicted on below charts. Not only volume reduction, but also the price offered for contraband trade is very attractive than ECX price; and traders make their own cost-benefit analysis and usually prefers the illegal trading front. At this time, the legal market is scares and the price is booming against the international market. This makes the price become incompatible to the international market.

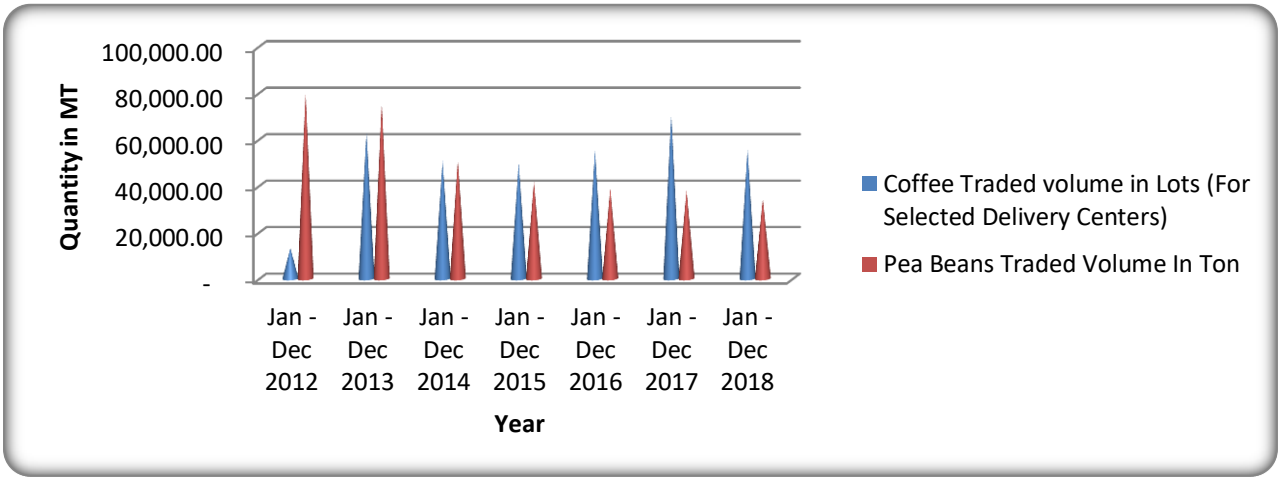
Figure 4.3:- Pea beans supplied volume in the last 7 years



Compilation developed as per ECX trade data

[26] Bedelle, Bonga, Gimbi & Jimma Delivery Centers which are surrounding areas for potentially more vulnerable to contraband trade

Figure 4.4:- selected coffee types and pea bean trade volume in the last 7 years



Compilation developed as per ECX trade data

- Subject to financial sectors engagement in the export sector, both the subjects of the interview and discussion has agreed that ‘‘unless the bank’s supervisory operations is tighter and manage the excess loan facilities injected to the industry in addition to managing distorted retentions scheme, the sector will suffer more and more due to financial sabotage’’.

Analysis related with the role of government & private sectors on managing price distortion (issues raised through government officials)

The government officials responded that the supply chain does have its own limitation like the presence of brokers before commodities reach to ECX and different abnormal activities conducted by suppliers & exporters to manipulate domestic price discovery in ECX. Due to these abnormalities, the price transmission process in primary agricultural products is not ideal as stated in the above theory. In some cases, price discovered on farm level also goes beyond international market price. This shows that the price transmission theory for that contract has failed to comply.

The government has introduced different incentive packages to promote export such as: availing export grantee credit facility without collateral[27] and with a minimal interest rate, retention scheme for promoting their business, prioritize service delivery for exporters before any other business sector, duty-free schemes for export-related facilities. According to respective government organization directives & rules, every organization is responsible to follow up the utilization of those incentives for their intended purpose through surprise check-up based on information, regular supervision on operating banks and also regular monitoring activities to be

[27] The loan is issues through guaranting export sell contract which is not reliable as asset collateral and not easily manageable.

conducted as per the annual plan of each organization. Especially on financial sector regular site visit on exporter's office & processing site is conducted to check whether they utilize the incentive for its intended purpose or not, and also follow up with predefined checklist and report to regulatory bodies. Another monitoring tool by the regulatory organization is document review based on the annual business plan of each company. Each company is expected to draft and submit its annual business plan in terms of planned performance & expected support from the government in every year before the season starts; the regulatory bodies follow up the company's performance and also their incentive utilization for achieving their plan at the beginning of the season.

The effectiveness of incentives to promote export business in recent years is inconsistent. Many market actors joined to export business and acquire the incentives, not for promote the export business, rather to use it for import business. Due to this and other domestic and international factors, the overall export performance of the country couldn't excel as planned, instead, it is deteriorating in terms of value and volume from year to year.

There are many irregularities on the supply chain of agricultural commodities from farm to central market. These irregularities are reflected on the overvaluation of products on the supply chain regardless of the international market & their final destination. According to the officials, the main reason for such inconsistency is categorized into three clusters;

a) Government related

The main problem for the prevalence of irregularities in supply chain & pricing matrix is the lack of integration on government structure from bottom to the upstream line. The bottom government structure is working to push price at upper-value chain, regardless of considering countries existing situation and international market response. Although this segment is expected to facilitate and control outliers in order to the market shall discover its price upon real demand and supply, they just focus on attaining expensive price at farm gate level even if it is factious and result of illegal brokers act. On the contrary, the policymakers and regulators on the central market level are expected to maintain the market health by intervening through the micro foundation to macro initiatives; they fail to do so and the market become fragile to transmitting its price to the rest of the world (to get better foreign currency earnings from the export).

b) Private sector related issues

Many exporters are not competent to the international market, and also, they just enter to unnecessary competition among themselves and it leads the pricing paradox to become a saviour in the supply chain. Given that rational competition is expected in the sector to become profitable, the majority of exporters compete irrationally; by their intrinsic motivation of subsidizing their import business through export incentives. Now a days even if they try to compensate for their failure in export through import, this became not feasible to many of the

operators, due to the eradication of the distortion[28]. As a result of this wrong movement, many rational exporters are cornered and stopped their operations until the market is stable.

c) International Market related issues

International market price decrease and competing countries higher production volume and demand contributes to the irregularities. Especially, on world coffee price, frequent ups and downs were affecting pricing across supply chain leads to hoarding & speculation, but mostly, this disfavours the price transferring process because the domestic market lacks organized marketing infrastructure & dynamism compatible to the international market.

In general, the government officials reflected that before three/four years, import-export business relation is normal and operated through rational way; without the survival of one at the expense of others. But in recent time, as a result of critical hard currency problem for import and another business process on a macro level, export sector become a scape goat for the survival of import business in a wrong way and now things become worst and this leads both import and export business to sever loss.

Analysis related with welfare & macroeconomic imbalance

According on primary data analysis, all the respondents clearly mentioned that prevalence of price asymmetry is backed through substituting export loss through import business & manipulating incentive packages to the export sector. In doing so, once the economic agents buy with high price and sell it with minimum price and exercise loss which is planned to compensate through import, the price of imported item become inflated with irrational way. These imported products are basic goods used by end user consumer and the products price is increased through imported inflation. This affects society welfare on micro level by affecting their consumption bundle without proper economic rationale to manipulate the price on such magnitude. This welfare effect also extends to the farmers through irrational price volatility in the market. Where farmers are not such competent compared with exporters, price movement without economic rationale manipulates farmer's speculation on price management by expecting better price they spend much expenses for production but they didn't get the price as they expect in the reality.

Related with macroeconomic imbalance, this price asymmetry does have adverse effect on interest rate, inflation rate, unemployment and trade deficit as well. Given that interest rate labelled for export business is minimal compared with import business and economic agents manipulate the loan granted for export business to the import business, it affects effectiveness of

[28] Almost all importers became exporter for the sake of hard currency and they try to do export business without any knowledge just only salivating through incentive, this leads the sector much lees competitive and regular exporters become cornered.

interest rate for predetermined objective rather it become pretended rate for the export business and also create double standard with legal importers doing the business under normal circumstance. The price asymmetry also has an effect on promoting unemployment, once the export sector is manipulated and rational market actors withdraw from the market and those market actors who manipulate the business will sustain in the sector, employment opportunity will reduce significantly and it do have significant implication on increasing unemployment. (Note that this sector holds millions of working labour along the value chain starting from upper to lower value chain). In addition to adverse effects on interest rate & unemployment rate it also has effect on promoting trade deficit. Since the exporters do the business for the sake of getting hard currency to their import, they might ignorant to the valuation of their export but the price of their import product is properly valued from exporting countries, this aggravates trade deficit. Because Ethiopian exporters undervalue their export product but import products with their fair value, which makes the imbalance more and more worsen.

4.2. Part Two: Econometric Analysis

4.2.1. Discussion and presentation of the result

The result on the compatibility of the domestic and international price of major agricultural export products are presented in this section. The empirical analysis uses monthly price data of both domestic and respective international market price for the major export item (namely coffee, sesame and pea beans) for the last 7 years (2012 to 2018) having 84 individual observation on each commodities price category. There are four parts in this section. The second part reports descriptive statistics of variables whereas the third part discusses the outcome of diagnostic tests applied for this research. Finally, the fourth part is about result and discussions of the finding with its respective summary.

4.2.2. Descriptive Analysis

The descriptive statistics considered the mean, median standard deviation, skewness, kurtosis, maximum and minimum values of the dependent and independent variables. The statistics are on three types of the commodities, having two price categories for each commodity. The mean represents the average value of the variables whilst standard deviation indicates how variables are distributed around their mean values.

Table 4.1 the descriptive statistics of the variables.

	Coffee Domestic price	Coffee International Price	Sesame Domestic price	Sesame International Price	Pea Beans Domestic price	Pea Beans International Price
Mean	1.266706	2.214405	1401.644	1530.207	559.9629	732.2720
Median	1.202334	2.175000	1313.746	1440.255	518.1338	685.0000
Maximum	2.006370	3.620000	2240.566	2467.150	1028.567	1260.000
Minimum	0.915904	1.250000	806.9176	978.4400	44.94278	310.0000
Std. Dev.	0.210140	0.478382	380.8399	404.7823	183.5742	174.8832
Skewness	1.349304	0.243977	0.410187	0.690289	0.419869	0.818736
Kurtosis	5.182473	2.865832	2.020659	2.335673	4.178966	3.865732
Jarque-Bera	42.15987	0.896349	5.712430	8.215642	7.332917	12.00781
Probability	0.000000	0.638793	0.057486	0.016444	0.025567	0.002469
Sum	106.4033	186.0100	117738.1	128537.4	47036.89	61510.85
Sum Sq. Dev.	3.665195	18.99447	12038241	13599442	2797057.	2538483.
Observations	84	84	84	84	84	84

Source: Author's computation on NBE & ECX data.

According to summary, statistics of table 4.1, on average, coffee was domestically traded at 1.26 US dollar per pound during the last seven year whereas it was sold to the rest of the world at 2.21 US dollar per pound. In the same period, sesame was domestically traded on 1401.64 US dollar per metric ton while it was sold to the international market at 1530.20 US dollars per metric ton. Pea beans were domestically traded at 559.96 and sold by 732.27 US dollar per ton to the international market on average during the reviewing period.

As per the summary, statistics of standard deviation result, during the last 7 years, the international price of coffee and sesame were more volatile than its respective domestic price. It is depicted through a higher standard deviation of each commodities international price than their respective domestic price movement. But in pea beans trade domestic price volatility was higher than the international one.

Based on summary statistics of skewness result, international coffee price is more inclined to symmetric distribution compared with others but still, all the prices have positive skewness. on kurtosis result domestic coffee price, both international and domestic pea beans price has recorded a value beyond 3 which shows that this price distribution is peaked (leptokurtic) relative to the normal but the remaining; coffee international price and sesame's domestic & international price's kurtosis value is less than three and its distribution is flat (platykurtic) relative to the normal.

4.2.3. Result and Discussion

Unit Root Test Result

To examine the unit root test the Augmented Dicky Fuller test (ADF), Phillips-Perron Unit root test (PP test) and the modified Dickey-Fuller test (DF-GLS) is applied.

As depicted on below table, in all three tests coffee domestic price and the international price is non-stationary at level except the coffee domestic price was stationary through PP test on the deterministic equation of intercept plus trend @ 1% significant level. Still, on average coffee domestic prices test result is non-stationary i.e. out of 6 test result, 5 of it shows it is non-stationary. As shown in the result (See Appendix A) both t_{cal} and P_{val} of the aforementioned test results show its non-stationary and leads to next level testing.

On the same manner, sesame domestic and international price's test results in all test cases shows that it is non-stationary at the level and accepting the null hypothesis (Ho has a unit root/non stationarity). Thus testing will continue to 1^{st} difference.

Pea bean domestic price is non-stationary in both ADF & PP test while it has a stationary result on one of DF-GLS test @5% significance level through a constant deterministic equation. But in the same test through constant plus trend deterministic equation it also becomes non-stationary

as shows on below table result and constant plus trend deterministic equation is inclusive of the constant deterministic equation too. Pea beans international price result is non-stationary on average having non-stationary result in all ADF tests and either of the remaining two tests. Upon this result, testing will continue to 1st difference.

Table 4.2:- Unit Root Test result at level

Variable	ADF Test		PP Test		DF-GLS Test	
	None	Intercept & Trend	None	Intercept & Trend	Intercept	Intercept & Trend
CDP	(-1.380577)	(-2.687094)	(-1.559827)	(-4.231786)*	(-1.070922)	(-2.517138)
CIP	(-0.855763)	(-2.569048)	(-1.063150)	(-6.542427)	(-1.607663)	(-2.551071)
SDP	0.004030	(-1.848139)	(0.089587)	(-1.802618)	(-1.364148)	(-1.587716)
SIP	0.046531	(-1.610189)	0.049966	(-1.663495)	(-1.095220)	(-1.241176)
PDP	(-0.492402)	(-2.080835)	(-0.547474)	(-2.686682)	(-2.032944)**	(-2.072247)
PIP	(-0.551192)	(-2.262126)	(-0.615971)	(-3.332281)**	(-2.104168)**	(-2.185816)

*Note: Where CDP, CIP, SDP, SIP, PDP & PIP stands for coffee domestic, coffee International, sesame domestic, sesame international, pea beans domestic and pea beans international price respectively. ***, **&* Significance level at 1%, 5% and 10%. PP stands Phillips-Perron Unit Root Test and DF-GLS stands for Dickey-Fuller GLS unit root test (Modifies Dickey-Fuller Test) and ADF is Augmented Dickey-Fuller Test*

Table 4.3:-Unit Root Test Result at 1st difference

Variable	ADF test			PP test			DF-GLS test	
	None	Intercept & Trend	Prob.	None	Intercept & Trend	Prob.	None	Intercept & Trend
CDP	(-11.831)***	(-11.937)***	0.0000	(-12.039)***	(-2.2575)***	0.0000	(-11.939)***	(-12.057)***
CIP	(-15.299)***	(-15.109)***	0.0000	(-19.239)***	(-18.915)***	0.0000	(-3.2415)***	(-13.665)***
SDP	(-10.159)***	(-10.067)***	0.0000	(-10.170)***	(-10.080)***	0.0000	(-10.131)***	(-10.115)***
SIP	(-8.9161)***	(-8.8205)***	0.0000	(-8.9162)***	(-8.8208)***	0.0000	(-8.9024)***	(-8.6610)***
PDP	(-12.802)***	(-12.646)***	0.0000	(-12.8-2)***	(-12.646)***	0.0000	(-12.766)***	(-12.725)***
PIP	(-14.438)***	(-14.286)***	0.0000	(-14.543)***	(-14.403)***	0.0000	(-14.293)***	(-14.347)***

*Note: Where CDP, CIP, SDP, SIP, PDP & PIP stands for coffee domestic, coffee International, sesame domestic, sesame international, pea beans domestic and pea beans international price respectively. ***, **&* Significance level at 1%, 5% and 10%. PP stands Phillips-Perron Unit Root Test, DF-GLS stands for Dickey-Fuller GLS unit root test (Modifies Dickey-Fuller Test) and ADF is Augmented Dickey-Fuller Test.*

Based on the above result of unit root test at the 1st difference, in all test scenario, both t_{cal} and probability values show that all variables have a significant level at 1%, 5% & 10% and integrated at order one. Thus it leads to accepting the alternative hypothesis and continues to conduct the cointegration test.

Cointegration Test Result

Having all the variables are non-stationary at level and stationary on their 1st difference, cointegration test is conducted to know whether the respective variables have long run relation or not. To check this relationship, Johansen cointegration test is deployed.

Table 4.4:- Tests for Cointegration between international & domestic coffee price

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	None	0.137972	14.43592	15.49471
At most 1	At most 1	0.029315	2.410001	3.841466
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	None	0.137972	12.02591	14.26460
At most 1	At most 1	0.029315	2.410001	3.841466

**** Both trace and maximum Eigen-value test indicates no cointegration equation at 0.05 levels.***

Based on the cointegration test of international and domestic coffee price, the above table shows that there is no cointegration among these two variables. This result implies that the two prices doesn't have a long-run relationship and fails to the conformity of market integration.

Table 4.5:- Tests for Cointegration between international & domestic sesame price

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.109024	12.45400	15.49471	0.1364
At most 1	0.037590	3.103492	3.841466	0.0781
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.109024	9.350504	14.26460	0.2581
At most 1	0.037590	3.103492	3.841466	0.0781

**** Both trace and maximum Eigen-value test indicates no cointegration equation at 0.05 levels.***

Table 4.5 shows the cointegration test result both in trace and maximum Eigen value sesame price. Likewise, coffee price Ethiopian sesame international and domestic prices are not

cointegrated at 0.05% as depicted on the above table. This result is assuring that sesame international and domestic prices aren't compatible and there is no long-run relationship among them.

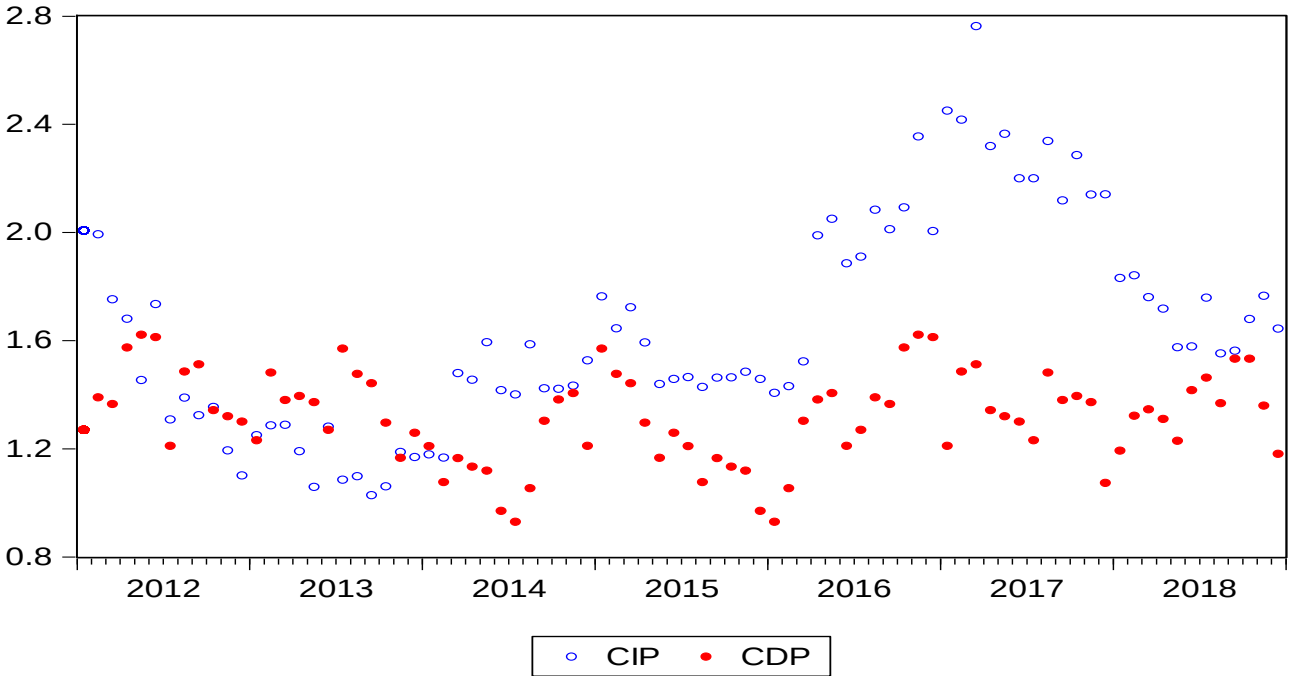
Moving to pea beans international and domestic prices cointegration, the result is still the same with coffee and sesame prices. The trace & maximum Eigen-value test result shows there is no cointegration between Ethiopian Pea Beans international and their respective domestic price as shows on below table. The two prices didn't move together in the long run and there is an absence of price compatibility between domestic buying and internationally selling price.

Table 4.6:-Tests for Cointegration between international & domestic Pea Beans price

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.191781	21.97766	25.87211	0.1416
At most 1	0.056734	4.730978	12.51798	0.6353
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.191781	17.24669	19.38704	0.0996
At most 1	0.056734	4.730978	12.51798	0.6353

**** Both trace and maximum Eigen-value test indicates no cointegration equation at 0.05 levels.***

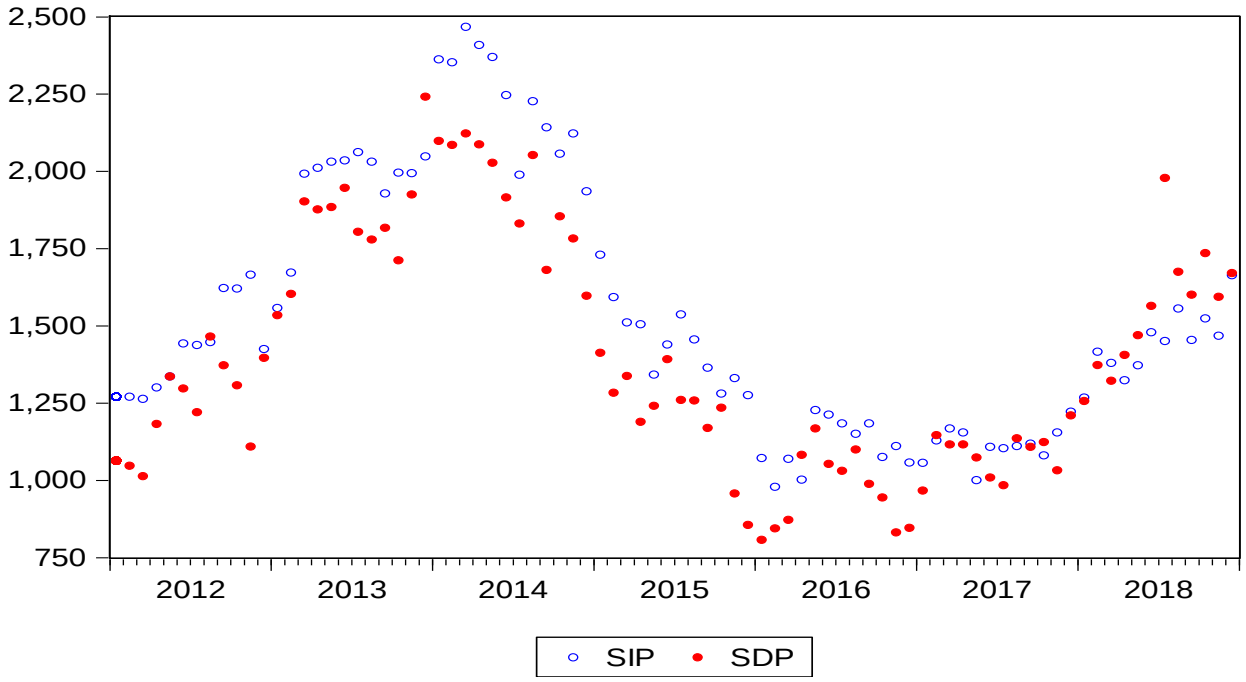
Figure 4.5:- Ethiopian Coffee Domestic and International price movement



The above graph shows the international and domestic coffee price during the last 7 years reviewing period in terms of US dollar per pound, it illustrates that there is asymmetry of price movement between domestic purchasing price and its selling price to the rest of the world. As shown in the above graph some selling price becomes outlier to the trend and also to its domestic price. In other circumstance, domestic average price becomes higher than its selling price (international price). Confirms that there was no proper price transmission from the upper supply chain to downstream rather at face value market actors were operating coffee export with a significant margin of loss.

Based on the above graph and primary data analysis, the price compatibility through price transmission theory doesn't prevail in coffee export rather there might be another way out for sustaining in this business after they bear such kinds of losses like compensating export loss by import business, managing the retention for their loss as a back-up or through distorting incentive packages granted to export.

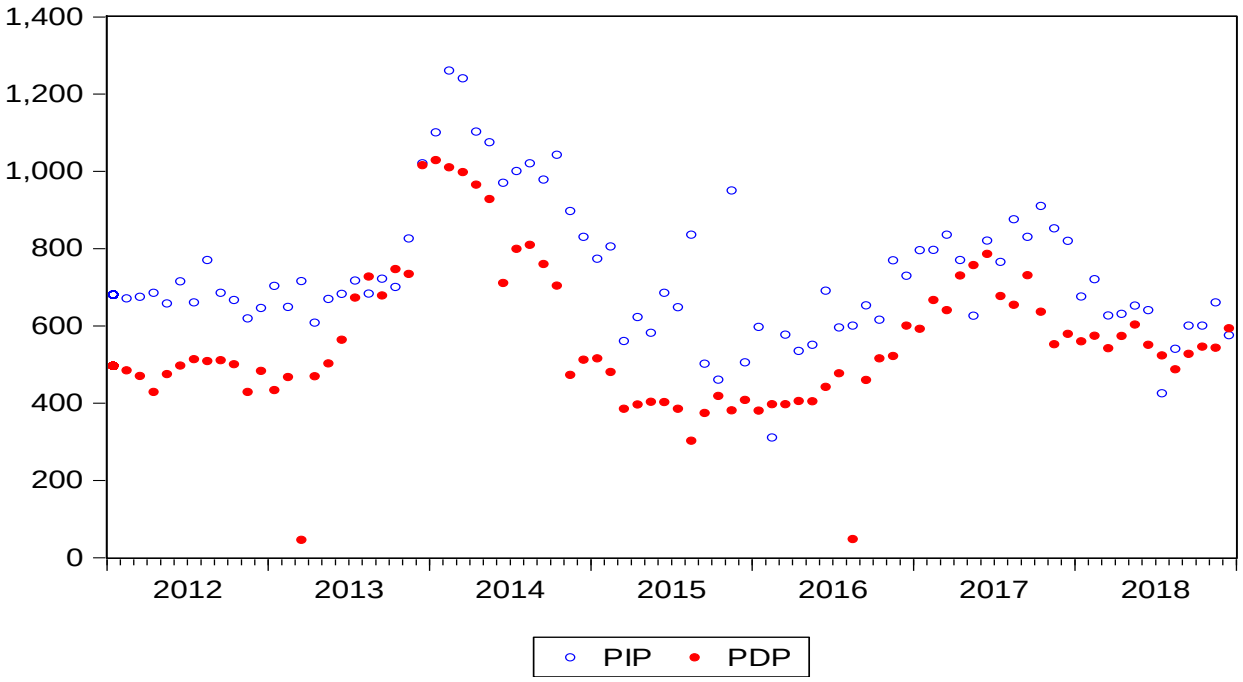
Figure 4.6:- Ethiopian Sesame Domestic and International Price Movement



The above graph shows sesame price movement for the last seven years in USD per metric ton. The price trend shows both the international and domestic price was booming during 2014 then decreases in 2015 and recently starts recovering. Within the price movement in many situations, the domestic price was overriding the international price (domestic buying price is greater than its selling price to the rest of the world). This clearly shows that there was no market integration on the supply chain which leads to failure against proper price transmission in the process.

Especially in 2018, almost throughout the year, sesame exporters bought sesame with expensive price than they sold the same commodity. This endorses that the sector was operating through loss and couldn't maintain price transmission rationality by building price on the respective level; instead, there was either overvaluation of commodities price domestically or undervaluation of it on the international market.

Figure 4.7:- Ethiopian Pea Beans Domestic and International price movement



Although pea beans price trend also shows that there was no well-managed price transmission process, it is moderate as compared to sesame trading trend. The above graph shows its price (in USD) per ton and both prices were tightly oscillating among each other. Some outlier price to the up or to lower were discovered during last seven years.

To sum up, both the primary and secondary data findings discussed so far in this chapter reveals that:

- In all types of commodities included in this study, the price transmission process couldn't persist.
- Price compatibility among domestic and international price for coffee, sesame and pea beans doesn't work rather it shows the non-compatibility and processing with a high margin of loss through the absence of pattern within the two prices.
- The finding shows that there is no long-run relationship between the two respective prices of each commodities and shows that they are seemingly distinct.

CHAPTER FIVE

CONCLUSION AND POLICY RECOMMENDATIONS

5.1. CONCLUSION

In general, the export earning of the country is not increasing as planned, and macroeconomic imbalances related to the trade deficit is getting serious from time to time. As per the study prevalence of asymmetric price transmission and non-compatibility among domestic & international price become one of the major cause for the decline of export earnings. Based on the study it is summarized that all types of commodities incorporated in this study suffers from price asymmetry.

Due to this asymmetry, Ethiopia's competitiveness becomes highly compromised in the world market, especially, on major primary agricultural commodities. On the other hand, competing countries are now working to take Ethiopia's position in world coffee & sesame market, by offering fair price as compared to Ethiopian price. It is because Ethiopian agricultural products price is distorted and not integrated with international price, and this inflates the selling price of commodities whilst other countries offer lower price to the rest of the world.

The price asymmetry is reflected through pattern and magnitude. In terms of magnitude Sesame price asymmetry is the worst of all, followed by coffee and pea beans, respectively. Especially, in 2018 sesame trade is totally against normal price transmission. In terms of pattern, almost all the pricing trend of commodities are inclined to non-compatibility with the world market.

The major reasons for such price paradox in the country, is highly associated with the prevalence of critical trade deficit, internal economic shocks in the country and institutional failure to manage the export sector. The country's critical trade deficit leads business operators to abuse the export sector for the subsistence of their import business. This is done by distorting the incentive packages granted to export for the import business (loan facilities, retention management, tax & other duties exemptions etc). Internal economic shocks generated from political instability, low production, high unemployment rate and high inflation rate manipulate economic agent's orientation to maximize their benefit in the shortest way; this also penalizes the export business. Once the internal shock is eradicated and every business operator is uncertain to

do the business and feel that macroeconomic problems are expanded (including speculation of devaluation and different government interventions to the economy) and they try to do any business which has better return regardless of societies welfare and business sustainability. This feature is reflected on import-export business by business operators, to secure hard currency for the import business they penalize export business and also society's welfare. Institutional failure is another major reason for the prevalence of such price paradox to the country's export sector. This is because the designated institutions were responsible to supervise the prudence of the sector and take corrective actions against loopholes. But on the ground, there is a gap to manage this conspiracy before it materialization of its undesirable effects.

The findings also revealed that, the effects of non-compatibility of price do have a cross-cutting effect on macro and micro variables of the country's economy. To start with macro economy, the distortion does have an adverse effect on manipulating exchange rate[29] and the (shadow and real) interest rates become very scattered. In addition, once the business operators in export business abuse the incentives granted for export and utilize it for import business, policy ineffectiveness will happen on macroeconomic level. Suppose we take interest rate which is lower for export and higher for import and other business, when exporters get a loan on minimal interest rate and they do other business but others do the business with its original privilege, the playground will be unfair and the policy becomes ineffective. With regard to microeconomic issues, society's welfare is critically compromised due to this distortion. Since exporters engage on their business by aiming to get profit from import, they will increase the retail price on the consumers to compensate for their extended cost through the import and also loss exercised through export. It is an act of importing inflation from other countries.

Finally, the study revealed that the absence of price compatibility on major agricultural commodities is/ would still be a challenge for country's economic sustainability; because this problems crates significant trade deficit which would have a direct / indirect impact on society's welfare.

[29] Where import business operators buy hard currency with significantly higher exchange rate than banks shadow rate or exporters by themselves operate export business through bank rate by taking account of black market exchange rate. This leads the bank rate become unrepresentative and it became shadow rate. It couldn't reflect the reality on the ground.

5.2. POLICY RECOMMENDATION

Considering the descriptive analysis & empirical reviews, the researcher identified the following points as areas for improvement to harmonize price compatibility and securing market integrity;

- The government of Ethiopia would benefit from reviewing its policy implementation and effectiveness on promoting export business. For instance, the NBE retention policy could be implemented based on a market actor's performance in terms of value and volume. Commercial banks interest rate management on loan facility for import and export business could be reviewed for betterment of the sector. Tax regime on export business and trade registration & licensing may also benefit from revision in favour of promoting export or protecting the export sector from the import sector's externality.

- Lack of strong institutional arrangement on managing the implementation of policy instrument and evaluation of policy effectiveness is a major reason for the prevalence of price incompatibility. To overcome this problem, the government of Ethiopia needs to establish a strong institutional arrangement on policy formulation, implementation & evaluation related to the export sector. If a strong institutional arrangement is in place with empowered expertise & respective decision-making power, it would be easy to follow up and correct any deliberate acts for price distortion. And also better institutional arrangement does have a positive impact on minimizing the illegal marketing & under table trading practices of foreign currency exchange.

- Many newly joining exporters are engaged in the sector for the sake of financing their affiliated import business, which is one of the reasons for price incompatibility. Thus the government of Ethiopia may benefit from controlling excess financing of the export sector and introduce tight entry barriers to screen potential exporters whose have endurance & long term plan in the sector from exporters who are in the bossiness for the sole goal of manipulating transactions and benefit from it.

- With a goal to enhance a positive contribution to attain price compatibility in the export sector, the country may also benefit from promoting import substitution strategy which could reduce high import demand or reliance.

- The government of Ethiopia needs to introduce effective and better economic and political policies and implementation strategies to overcome the significant trade deficit. These policies could improve export earnings and other external sources like remittance, aid and long-term loan. If the severity of trade deficit is minimized, then actual exporters and importers can specialize with their original business and export price incompatibility due to importation puzzle may be eliminated or its undesirable effect could be controlled.

5.3. Issues for further study

The study is attempted to illustrate the incompatibility of domestic (secondary market) and respective FOB price for coffee, sesame & Pea Beans. It captured price transmission process in two vertical markets for selected three commodities traded in ECX trading platform on mandated trade modality. However, in reality, price starts its build up from the primary market to the international market and also policy instruments affect this, considering on each supply chain. Thus, future studies could be conducted to tackle or understand price compatibility of Ethiopian exportable products, and it is important to consider price transmission from the primary market to the international market not limited with these commodities.

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APPENDIXES

APPENDIX A: Primary Data Collection Instruments

Interview Questions for Exporters

1. How do you evaluate your export performance in the last five years? In terms of volume you export and value of export earning & profit?
2. How do you evaluate the price transmission process of the primary agricultural export products? Products you are exporting starting from the upper supply chain to downstream?
3. How do you understand price discovery at the secondary market (ECX)? In terms of
    - Discovery of market clearing price (opening price) when the new season starts
    - Roll of having a price limit on the free movement of the price discovery
    - Its relation with an international reference price
4. List down major challenges on pricing with their remedial?
5. How do you perceive the compatibility of domestic price with its respective export and international price?
6. How did you use your loan and FX earning?
7. Do you have an import business? What is the pricing mechanism and how it is related to your export business?
8. What is your plan for your export business in the next five years?

Interview Questions for Government Officials

1. How do you evaluate supply chain and price transmission of primary agricultural products in the Ethiopian context? Any abnormality against the theory?
2. Could you tell us incentive package on primary products exporting with its implementation? (subject to your respective stake)
3. How do you follow & monitor the use of incentive to the intended objective?
4. How do you assess the effectiveness of export incentive with their return on increasing export earning of the country? And also asses overall export performance in terms of volume and value?
5. Have you observed any irregularities on primary export products pricing? If so what are those irregularities & their root cause?
6. Do you have any observation on the overvaluation of products in the domestic market and undervaluation on exporting? if so, how is frequent and its impact on trade deficit?
7. Overall observation on policy instruments on promoting export and protecting it from any abnormalities?
8. Discuss the relation b/n import & export business

Leading Questions for Focused Group Discussion with market actors & stakeholders

1. Discuss major problems on primary agricultural export products competitiveness'
2. Discuss on price regime of agricultural export commodities both in domestically and international approach
3. Discuss an incentive package and its effectiveness? Related to;
    - Foreign currency utilization (the retention)
    - Export credit facility (the financing)
    - Transfer pricing on import export business
    - Parity pricing of Ethiopian products with competitive countries product
4. Discuss the prevalence of potentially illegal acts in the sector
    - From financial industries perspective: - under-invoicing, money laundering through affiliated company's trade,
    - From contraband and illegal domestic trade
5. Way forward to avoid bottleneck problems related to the pricing

APPENDIX B: Unit Root Test Result at Level

❖ ADF Test Result

Null Hypothesis: CDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 10 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.833029	0.1906
Test critical values:	1% level	-4.088713	
	5% level	-3.472558	
	10% level	-3.163450	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CDP)
Method: Least Squares
Date: 06/01/19 Time: 14:35
Sample (adjusted): 2012M12 2018M12
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CDP(-1)	-0.405785	0.143234	-2.833029	0.0063
D(CDP(-1))	0.019233	0.147526	0.130371	0.8967
D(CDP(-2))	-0.047088	0.144853	-0.325075	0.7463
D(CDP(-3))	0.079655	0.140024	0.568869	0.5716
D(CDP(-4))	0.056654	0.139879	0.405021	0.6869
D(CDP(-5))	0.293600	0.126904	2.313565	0.0241
D(CDP(-6))	0.131617	0.132528	0.993124	0.3246
D(CDP(-7))	0.189189	0.127031	1.489312	0.1416
D(CDP(-8))	0.145270	0.122364	1.187196	0.2398
D(CDP(-9))	0.134649	0.116231	1.158457	0.2513
D(CDP(-10))	-0.038288	0.109072	-0.351037	0.7268
C	0.557951	0.198586	2.809616	0.0067
@TREND("2012M01")	-0.001183	0.000738	-1.602165	0.1144

R-squared	0.276383	Mean dependent var	-0.001176
Adjusted R-squared	0.131659	S.D. dependent var	0.119882
S.E. of regression	0.111712	Akaike info criterion	-1.385732
Sum squared resid	0.748777	Schwarz criterion	-0.977842
Log likelihood	63.57920	Hannan-Quinn criter.	-1.223180
F-statistic	1.909729	Durbin-Watson stat	1.994381
Prob(F-statistic)	0.051052		

Null Hypothesis: CDP has a unit root
Exogenous: None
Lag Length: 10 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.437498	0.5216
Test critical values:	1% level	-2.597025	
	5% level	-1.945324	
	10% level	-1.613876	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CDP)
Method: Least Squares
Date: 06/01/19 Time: 14:38
Sample (adjusted): 2012M12 2018M12
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CDP(-1)	-0.004936	0.011283	-0.437498	0.6633
D(CDP(-1))	-0.234186	0.121982	-1.919838	0.0595
D(CDP(-2))	-0.273593	0.125938	-2.172442	0.0337
D(CDP(-3))	-0.106388	0.129202	-0.823425	0.4134
D(CDP(-4))	-0.124457	0.129964	-0.957626	0.3420
D(CDP(-5))	0.153953	0.122142	1.260439	0.2122
D(CDP(-6))	-0.049811	0.121124	-0.411239	0.6823
D(CDP(-7))	0.023450	0.117509	0.199557	0.8425
D(CDP(-8))	-0.002037	0.115147	-0.017695	0.9859
D(CDP(-9))	0.010835	0.111706	0.096998	0.9230
D(CDP(-10))	-0.137508	0.107354	-1.280882	0.2050

R-squared	0.180720	Mean dependent var	-0.001176
Adjusted R-squared	0.048578	S.D. dependent var	0.119882
S.E. of regression	0.116934	Akaike info criterion	-1.316363
Sum squared resid	0.847766	Schwarz criterion	-0.971225
Log likelihood	59.04724	Hannan-Quinn criter.	-1.178819
Durbin-Watson stat	2.061860		

Null Hypothesis: CIP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 10 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.569048	0.2954
Test critical values:	1% level	-4.088713	
	5% level	-3.472558	
	10% level	-3.163450	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CIP)
Method: Least Squares
Date: 06/01/19 Time: 14:46

Sample (adjusted): 2012M12 2018M12
Included observations: 73 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CIP(-1)	-0.739585	0.287883	-2.569048	0.0127
D(CIP(-1))	-0.004476	0.268361	-0.016677	0.9867
D(CIP(-2))	0.292462	0.249947	1.170099	0.2466
D(CIP(-3))	0.227108	0.241768	0.939366	0.3513
D(CIP(-4))	0.109241	0.228572	0.477930	0.6344
D(CIP(-5))	0.109538	0.210241	0.521012	0.6043
D(CIP(-6))	0.103880	0.197812	0.525143	0.6014
D(CIP(-7))	-0.009889	0.185207	-0.053396	0.9576
D(CIP(-8))	0.082821	0.169552	0.488469	0.6270
D(CIP(-9))	-0.036397	0.158470	-0.229677	0.8191
D(CIP(-10))	-0.050423	0.127935	-0.394133	0.6949
C	1.457288	0.585542	2.488784	0.0156
@TREND("2012M01")	0.003592	0.002945	1.219623	0.2274

R-squared	0.409504	Mean dependent var	-0.002055
Adjusted R-squared	0.291404	S.D. dependent var	0.555123
S.E. of regression	0.467292	Akaike info criterion	1.476324
Sum squared resid	13.10169	Schwarz criterion	1.884214
Log likelihood	-40.88581	Hannan-Quinn criter.	1.638875
F-statistic	3.467452	Durbin-Watson stat	1.950750
Prob(F-statistic)	0.000655		

Null Hypothesis: CIP has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.855763	0.3423
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CIP)
Method: Least Squares
Date: 06/01/19 Time: 14:47
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CIP(-1)	-0.020135	0.023528	-0.855763	0.3947
D(CIP(-1))	-0.486259	0.098490	-4.937166	0.0000

R-squared	0.247449	Mean dependent var	-0.009756
Adjusted R-squared	0.238042	S.D. dependent var	0.549709
S.E. of regression	0.479842	Akaike info criterion	1.393369
Sum squared resid	18.41988	Schwarz criterion	1.452069
Log likelihood	-55.12812	Hannan-Quinn criter.	1.416936
Durbin-Watson stat	2.060610		

Null Hypothesis: SDP has a unit root

Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.848139	0.6722
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDP)
Method: Least Squares
Date: 06/01/19 Time: 16:04
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDP(-1)	-0.078470	0.042459	-1.848139	0.0683
C	135.1916	74.55493	1.813315	0.0735
@TREND("2012M01")	-0.431864	0.672882	-0.641813	0.5228

R-squared	0.041055	Mean dependent var	7.319458
Adjusted R-squared	0.017081	S.D. dependent var	141.4474
S.E. of regression	140.2341	Akaike info criterion	12.75998
Sum squared resid	1573248.	Schwarz criterion	12.84741
Log likelihood	-526.5391	Hannan-Quinn criter.	12.79510
F-statistic	1.712508	Durbin-Watson stat	2.165305
Prob(F-statistic)	0.186960		

Null Hypothesis: SDP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.004030	0.6811
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDP)
Method: Least Squares
Date: 06/01/19 Time: 16:06
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDP(-1)	4.32E-05	0.010729	0.004030	0.9968

R-squared	-0.002710	Mean dependent var	7.319458

Adjusted R-squared	-0.002710	S.D. dependent var	141.4474
S.E. of regression	141.6389	Akaike info criterion	12.75641
Sum squared resid	1645050.	Schwarz criterion	12.78556
Log likelihood	-528.3912	Hannan-Quinn criter.	12.76812
Durbin-Watson stat	2.240189		

Null Hypothesis: SIP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.610189	0.7807
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SIP)
Method: Least Squares
Date: 06/01/19 Time: 16:12
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SIP(-1)	-0.055139	0.034244	-1.610189	0.1113
C	112.7876	68.66629	1.642547	0.1044
@TREND("2012M01")	-0.565804	0.578173	-0.978608	0.3307

R-squared	0.031969	Mean dependent var	4.738916
Adjusted R-squared	0.007768	S.D. dependent var	110.6226
S.E. of regression	110.1921	Akaike info criterion	12.27780
Sum squared resid	971384.2	Schwarz criterion	12.36523
Log likelihood	-506.5288	Hannan-Quinn criter.	12.31293
F-statistic	1.320977	Durbin-Watson stat	1.942897
Prob(F-statistic)	0.272632		

Null Hypothesis: SIP has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.046531	0.6949
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SIP)
Method: Least Squares
Date: 06/01/19 Time: 16:13
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SIP(-1)	0.000358	0.007686	0.046531	0.9630

R-squared	-0.001831	Mean dependent var	4.738916
Adjusted R-squared	-0.001831	S.D. dependent var	110.6226
S.E. of regression	110.7238	Akaike info criterion	12.26393
Sum squared resid	1005301.	Schwarz criterion	12.29307
Log likelihood	-507.9531	Hannan-Quinn criter.	12.27564
Durbin-Watson stat	1.981994		

Null Hypothesis: PDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.080835	0.5484
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PDP)
Method: Least Squares
Date: 06/01/19 Time: 16:16
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PDP(-1)	-0.139411	0.066997	-2.080835	0.0407
D(PDP(-1))	-0.270517	0.109011	-2.481550	0.0152
C	83.01368	44.91598	1.848199	0.0684
@TREND("2012M01")	-0.080390	0.497261	-0.161665	0.8720

R-squared	0.161866	Mean dependent var	1.326092
Adjusted R-squared	0.129630	S.D. dependent var	114.2166
S.E. of regression	106.5568	Akaike info criterion	12.22278
Sum squared resid	885639.1	Schwarz criterion	12.34018
Log likelihood	-497.1341	Hannan-Quinn criter.	12.26992
F-statistic	5.021296	Durbin-Watson stat	2.014090
Prob(F-statistic)	0.003103		

Null Hypothesis: PDP has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

	t-Statistic	Prob.*

Augmented Dickey-Fuller test statistic		-0.492402	0.4999
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PDP)
Method: Least Squares
Date: 06/01/19 Time: 16:18
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PDP(-1)	-0.010001	0.020311	-0.492402	0.6238
D(PDP(-1))	-0.334420	0.105668	-3.164823	0.0022

R-squared	0.117655	Mean dependent var	1.326092
Adjusted R-squared	0.106625	S.D. dependent var	114.2166
S.E. of regression	107.9558	Akaike info criterion	12.22541
Sum squared resid	932356.6	Schwarz criterion	12.28411
Log likelihood	-499.2418	Hannan-Quinn criter.	12.24898
Durbin-Watson stat	2.047207		

Null Hypothesis: PIP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.262126	0.4493
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PIP)
Method: Least Squares
Date: 06/01/19 Time: 16:22
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIP(-1)	-0.174779	0.077263	-2.262126	0.0265
D(PIP(-1))	-0.357523	0.105727	-3.381582	0.0011
C	147.6179	66.19088	2.230184	0.0286
@TREND("2012M01")	-0.480729	0.533021	-0.901895	0.3699

R-squared	0.246916	Mean dependent var	-1.158537
Adjusted R-squared	0.217951	S.D. dependent var	126.7912
S.E. of regression	112.1259	Akaike info criterion	12.32467
Sum squared resid	980632.4	Schwarz criterion	12.44207

Log likelihood	-501.3115	Hannan-Quinn criter.	12.37181
F-statistic	8.524710	Durbin-Watson stat	1.974103
Prob(F-statistic)	0.000058		

Null Hypothesis: PIP has a unit root
Exogenous: None
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.551192	0.4754
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PIP)
Method: Least Squares
Date: 06/01/19 Time: 16:22
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIP(-1)	-0.009236	0.016757	-0.551192	0.5830
D(PIP(-1))	-0.438569	0.100716	-4.354518	0.0000

R-squared	0.198233	Mean dependent var	-1.158537
Adjusted R-squared	0.188211	S.D. dependent var	126.7912
S.E. of regression	114.2380	Akaike info criterion	12.33853
Sum squared resid	1044026.	Schwarz criterion	12.39723
Log likelihood	-503.8798	Hannan-Quinn criter.	12.36210
Durbin-Watson stat	2.017189		

- ❖ PP Test Result

Null Hypothesis: CDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.231786	0.0063
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.013855
HAC corrected variance (Bartlett kernel)	0.010678

Phillips-Perron Test Equation

Dependent Variable: D(CDP)
Method: Least Squares
Date: 06/01/19 Time: 14:40
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CDP(-1)	-0.312955	0.071414	-4.382235	0.0000
C	0.419283	0.106416	3.940047	0.0002
@TREND("2012M01")	-0.000788	0.000624	-1.262576	0.2104

R-squared	0.200551	Mean dependent var	-0.010842
Adjusted R-squared	0.180565	S.D. dependent var	0.132447
S.E. of regression	0.119894	Akaike info criterion	-1.368939
Sum squared resid	1.149969	Schwarz criterion	-1.281511
Log likelihood	59.81097	Hannan-Quinn criter.	-1.333815
F-statistic	10.03446	Durbin-Watson stat	2.315037
Prob(F-statistic)	0.000129		

Null Hypothesis: CDP has a unit root
Exogenous: None
Bandwidth: 12 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.559827	0.1111
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.017052
HAC corrected variance (Bartlett kernel)	0.009840

Phillips-Perron Test Equation
Dependent Variable: D(CDP)
Method: Least Squares
Date: 06/01/19 Time: 14:41
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CDP(-1)	-0.015483	0.011215	-1.380577	0.1712

R-squared	0.016088	Mean dependent var	-0.010842
Adjusted R-squared	0.016088	S.D. dependent var	0.132447
S.E. of regression	0.131377	Akaike info criterion	-1.209518
Sum squared resid	1.415311	Schwarz criterion	-1.180375
Log likelihood	51.19499	Hannan-Quinn criter.	-1.197810
Durbin-Watson stat	2.552493		

Null Hypothesis: CIP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.542427	0.0000
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.196237
HAC corrected variance (Bartlett kernel)	0.219203

Phillips-Perron Test Equation
Dependent Variable: D(CIP)
Method: Least Squares
Date: 06/01/19 Time: 14:48
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CIP(-1)	-0.683575	0.106711	-6.405850	0.0000
C	1.402895	0.242146	5.793594	0.0000
@TREND("2012M01")	0.002421	0.002105	1.150140	0.2535

R-squared	0.339050	Mean dependent var	-0.014699
Adjusted R-squared	0.322526	S.D. dependent var	0.548200
S.E. of regression	0.451216	Akaike info criterion	1.281736
Sum squared resid	16.28770	Schwarz criterion	1.369164
Log likelihood	-50.19204	Hannan-Quinn criter.	1.316859
F-statistic	20.51896	Durbin-Watson stat	2.113527
Prob(F-statistic)	0.000000		

Null Hypothesis: CIP has a unit root
Exogenous: None
Bandwidth: 9 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.063150	0.2579
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.290831
HAC corrected variance (Bartlett kernel)	0.102321

Phillips-Perron Test Equation
Dependent Variable: D(CIP)
Method: Least Squares
Date: 06/01/19 Time: 14:48
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CIP(-1)	-0.034895	0.026210	-1.331372	0.1868

R-squared	0.020447	Mean dependent var	-0.014699
Adjusted R-squared	0.020447	S.D. dependent var	0.548200
S.E. of regression	0.542566	Akaike info criterion	1.626962
Sum squared resid	24.13900	Schwarz criterion	1.656104
Log likelihood	-66.51891	Hannan-Quinn criter.	1.638670
Durbin-Watson stat	2.892775		

Null Hypothesis: SDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.802618	0.6947
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	18954.80
HAC corrected variance (Bartlett kernel)	17896.95

Phillips-Perron Test Equation
Dependent Variable: D(SDP)
Method: Least Squares
Date: 06/01/19 Time: 16:07
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDP(-1)	-0.078470	0.042459	-1.848139	0.0683
C	135.1916	74.55493	1.813315	0.0735
@TREND("2012M01")	-0.431864	0.672882	-0.641813	0.5228

R-squared	0.041055	Mean dependent var	7.319458
Adjusted R-squared	0.017081	S.D. dependent var	141.4474
S.E. of regression	140.2341	Akaike info criterion	12.75998
Sum squared resid	1573248.	Schwarz criterion	12.84741
Log likelihood	-526.5391	Hannan-Quinn criter.	12.79510
F-statistic	1.712508	Durbin-Watson stat	2.165305
Prob(F-statistic)	0.186960		

Null Hypothesis: SDP has a unit root
Exogenous: None
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.089587	0.7085
Test critical values:	1% level	-2.593121	

	5% level	-1.944762
	10% level	-1.614204

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	19819.88
HAC corrected variance (Bartlett kernel)	16355.74

Phillips-Perron Test Equation
Dependent Variable: D(SDP)
Method: Least Squares
Date: 06/01/19 Time: 16:08
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SDP(-1)	4.32E-05	0.010729	0.004030	0.9968

R-squared	-0.002710	Mean dependent var	7.319458
Adjusted R-squared	-0.002710	S.D. dependent var	141.4474
S.E. of regression	141.6389	Akaike info criterion	12.75641
Sum squared resid	1645050.	Schwarz criterion	12.78556
Log likelihood	-528.3912	Hannan-Quinn criter.	12.76812
Durbin-Watson stat	2.240189		

Null Hypothesis: SIP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.663495	0.7586
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11703.42
HAC corrected variance (Bartlett kernel)	12775.97

Phillips-Perron Test Equation
Dependent Variable: D(SIP)
Method: Least Squares
Date: 06/01/19 Time: 16:14
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SIP(-1)	-0.055139	0.034244	-1.610189	0.1113
C	112.7876	68.66629	1.642547	0.1044
@TREND("2012M01")	-0.565804	0.578173	-0.978608	0.3307

R-squared	0.031969	Mean dependent var	4.738916

Adjusted R-squared	0.007768	S.D. dependent var	110.6226
S.E. of regression	110.1921	Akaike info criterion	12.27780
Sum squared resid	971384.2	Schwarz criterion	12.36523
Log likelihood	-506.5288	Hannan-Quinn criter.	12.31293
F-statistic	1.320977	Durbin-Watson stat	1.942897
Prob(F-statistic)	0.272632		

Null Hypothesis: SIP has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		0.049966	0.6960
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	12112.06
HAC corrected variance (Bartlett kernel)	11990.47

Phillips-Perron Test Equation
Dependent Variable: D(SIP)
Method: Least Squares
Date: 06/01/19 Time: 16:14
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SIP(-1)	0.000358	0.007686	0.046531	0.9630

R-squared	-0.001831	Mean dependent var	4.738916
Adjusted R-squared	-0.001831	S.D. dependent var	110.6226
S.E. of regression	110.7238	Akaike info criterion	12.26393
Sum squared resid	1005301.	Schwarz criterion	12.29307
Log likelihood	-507.9531	Hannan-Quinn criter.	12.27564
Durbin-Watson stat	1.981994		

Null Hypothesis: PDP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.686682	0.2448
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11521.86
HAC corrected variance (Bartlett kernel)	9573.615

Phillips-Perron Test Equation
Dependent Variable: D(PDP)
Method: Least Squares
Date: 06/01/19 Time: 16:19
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PDP(-1)	-0.189604	0.065391	-2.899525	0.0048
C	109.1166	44.08599	2.475086	0.0154
@TREND("2012M01")	-0.044114	0.500945	-0.088062	0.9300

R-squared	0.095127	Mean dependent var	1.168256
Adjusted R-squared	0.072505	S.D. dependent var	113.5271
S.E. of regression	109.3340	Akaike info criterion	12.26217
Sum squared resid	956314.6	Schwarz criterion	12.34960
Log likelihood	-505.8800	Hannan-Quinn criter.	12.29729
F-statistic	4.205089	Durbin-Watson stat	2.436214
Prob(F-statistic)	0.018345		

Null Hypothesis: PDP has a unit root
Exogenous: None
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.547474	0.4770
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	12639.78
HAC corrected variance (Bartlett kernel)	7290.027

Phillips-Perron Test Equation
Dependent Variable: D(PDP)
Method: Least Squares
Date: 06/01/19 Time: 16:19
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PDP(-1)	-0.016526	0.021083	-0.783849	0.4354

R-squared	0.007331	Mean dependent var	1.168256
Adjusted R-squared	0.007331	S.D. dependent var	113.5271
S.E. of regression	113.1102	Akaike info criterion	12.30658
Sum squared resid	1049102.	Schwarz criterion	12.33572
Log likelihood	-509.7230	Hannan-Quinn criter.	12.31829
Durbin-Watson stat	2.650965		

Null Hypothesis: PIP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.332281	0.0682
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	13572.43
HAC corrected variance (Bartlett kernel)	11752.81

Phillips-Perron Test Equation
Dependent Variable: D(PIP)
Method: Least Squares
Date: 06/01/19 Time: 16:23
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIP(-1)	-0.267341	0.076032	-3.516179	0.0007
C	217.0929	65.40927	3.318994	0.0014
@TREND("2012M01")	-0.525840	0.552248	-0.952180	0.3439

R-squared	0.134938	Mean dependent var	-1.265060
Adjusted R-squared	0.113312	S.D. dependent var	126.0194
S.E. of regression	118.6651	Akaike info criterion	12.42596
Sum squared resid	1126512.	Schwarz criterion	12.51339
Log likelihood	-512.6774	Hannan-Quinn criter.	12.46109
F-statistic	6.239486	Durbin-Watson stat	2.519565
Prob(F-statistic)	0.003033		

Null Hypothesis: PIP has a unit root
Exogenous: None
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.615971	0.4476
Test critical values:	1% level	-2.593121	
	5% level	-1.944762	
	10% level	-1.614204	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	15560.04
HAC corrected variance (Bartlett kernel)	6797.424

Phillips-Perron Test Equation

Dependent Variable: D(PIP)
Method: Least Squares
Date: 06/01/19 Time: 16:24
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
PIP(-1)	-0.015176	0.018257	-0.831229	0.4083

R-squared	0.008255	Mean dependent var	-1.265060
Adjusted R-squared	0.008255	S.D. dependent var	126.0194
S.E. of regression	125.4982	Akaike info criterion	12.51443
Sum squared resid	1291484.	Schwarz criterion	12.54358
Log likelihood	-518.3491	Hannan-Quinn criter.	12.52614
Durbin-Watson stat	2.856180		

❖ DF-GLS

Null Hypothesis: CDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.070922
Test critical values:	1% level	-2.593121
	5% level	-1.944762
	10% level	-1.614204

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 14:43
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.033030	0.030843	-1.070922	0.2873

R-squared	0.007105	Mean dependent var	-0.010842
Adjusted R-squared	0.007105	S.D. dependent var	0.132447
S.E. of regression	0.131975	Akaike info criterion	-1.200429
Sum squared resid	1.428233	Schwarz criterion	-1.171287
Log likelihood	50.81782	Hannan-Quinn criter.	-1.188721
Durbin-Watson stat	2.485185		

Null Hypothesis: CDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.517138
Test critical values:	1% level	-3.644600
	5% level	-3.084400
	10% level	-2.791000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 14:43
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.140414	0.055783	-2.517138	0.0138

R-squared	0.071674	Mean dependent var	-0.000982
Adjusted R-squared	0.071674	S.D. dependent var	0.132447
S.E. of regression	0.127612	Akaike info criterion	-1.267672
Sum squared resid	1.335352	Schwarz criterion	-1.238529
Log likelihood	53.60838	Hannan-Quinn criter.	-1.255964
Durbin-Watson stat	2.383079		

Null Hypothesis: CIP has a unit root
Exogenous: Constant
Lag Length: 8 (Fixed)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.607663
Test critical values:	1% level	-2.596160
	5% level	-1.945199
	10% level	-1.613948

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 14:51
Sample (adjusted): 2012M10 2018M12
Included observations: 75 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.233786	0.145420	-1.607663	0.1127
D(GLSRESID(-1))	-0.408667	0.171582	-2.381752	0.0201
D(GLSRESID(-2))	-0.067053	0.172591	-0.388510	0.6989
D(GLSRESID(-3))	-0.096299	0.167284	-0.575662	0.5668
D(GLSRESID(-4))	-0.136021	0.163910	-0.829853	0.4096

D(GLSRESID(-5))	-0.126742	0.159006	-0.797085	0.4283
D(GLSRESID(-6))	-0.088130	0.153496	-0.574154	0.5678
D(GLSRESID(-7))	-0.145859	0.148639	-0.981299	0.3300
D(GLSRESID(-8))	0.018817	0.126363	0.148915	0.8821

R-squared	0.332769	Mean dependent var	-0.014800
Adjusted R-squared	0.251892	S.D. dependent var	0.556015
S.E. of regression	0.480915	Akaike info criterion	1.485914
Sum squared resid	15.26443	Schwarz criterion	1.764013
Log likelihood	-46.72177	Hannan-Quinn criter.	1.596956
Durbin-Watson stat	1.959120		

Null Hypothesis: CIP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 5 (Fixed)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.551071
Test critical values:	1% level	-3.663600
	5% level	-3.100400
	10% level	-2.806000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 14:53
Sample (adjusted): 2012M07 2018M12
Included observations: 78 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.378128	0.148223	-2.551071	0.0129
D(GLSRESID(-1))	-0.304187	0.160815	-1.891532	0.0626
D(GLSRESID(-2))	0.030708	0.158776	0.193401	0.8472
D(GLSRESID(-3))	0.028262	0.152429	0.185412	0.8534
D(GLSRESID(-4))	-0.008708	0.148461	-0.058655	0.9534
D(GLSRESID(-5))	-0.038069	0.121304	-0.313833	0.7546

R-squared	0.343167	Mean dependent var	-0.008853
Adjusted R-squared	0.297553	S.D. dependent var	0.559468
S.E. of regression	0.468902	Akaike info criterion	1.396957
Sum squared resid	15.83057	Schwarz criterion	1.578242
Log likelihood	-48.48132	Hannan-Quinn criter.	1.469529
Durbin-Watson stat	1.906968		

Null Hypothesis: SDP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.364148
Test critical values:	1% level	-2.593121
	5% level	-1.944762
	10% level	-1.614204

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:09
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.049862	0.036552	-1.364148	0.1763

R-squared	0.019540	Mean dependent var	7.319458
Adjusted R-squared	0.019540	S.D. dependent var	141.4474
S.E. of regression	140.0586	Akaike info criterion	12.73397
Sum squared resid	1608546.	Schwarz criterion	12.76312
Log likelihood	-527.4599	Hannan-Quinn criter.	12.74568
Durbin-Watson stat	2.179406		

Null Hypothesis: SDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.587716
Test critical values:	1% level	-3.644600
	5% level	-3.084400
	10% level	-2.791000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:09
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.060383	0.038031	-1.587716	0.1162

R-squared	0.028531	Mean dependent var	5.135396
Adjusted R-squared	0.028531	S.D. dependent var	141.4474
S.E. of regression	139.4150	Akaike info criterion	12.72476
Sum squared resid	1593796.	Schwarz criterion	12.75390
Log likelihood	-527.0776	Hannan-Quinn criter.	12.73647
Durbin-Watson stat	2.176462		

Null Hypothesis: SIP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.095220
Test critical values:	1% level	-2.593121
	5% level	-1.944762
	10% level	-1.614204

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:15
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.030794	0.028117	-1.095220	0.2766

R-squared	0.012586	Mean dependent var	4.738916
Adjusted R-squared	0.012586	S.D. dependent var	110.6226
S.E. of regression	109.9242	Akaike info criterion	12.24943
Sum squared resid	990833.5	Schwarz criterion	12.27858
Log likelihood	-507.3515	Hannan-Quinn criter.	12.26114
Durbin-Watson stat	1.950447		

Null Hypothesis: SIP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-1.241176
Test critical values:	1% level	-3.644600
	5% level	-3.084400
	10% level	-2.791000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:15
Sample (adjusted): 2012M02 2018M12
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.037077	0.029872	-1.241176	0.2181

R-squared	0.016108	Mean dependent var	5.359696
Adjusted R-squared	0.016108	S.D. dependent var	110.6226
S.E. of regression	109.7280	Akaike info criterion	12.24586

Sum squared resid	987299.7	Schwarz criterion	12.27500
Log likelihood	-507.2033	Hannan-Quinn criter.	12.25757
Durbin-Watson stat	1.945425		

Null Hypothesis: PDP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.032944
Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:21
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.132057	0.064959	-2.032944	0.0454
D(GLSRESID(-1))	-0.273651	0.107683	-2.541254	0.0130

R-squared	0.158455	Mean dependent var	1.326092
Adjusted R-squared	0.147936	S.D. dependent var	114.2166
S.E. of regression	105.4303	Akaike info criterion	12.17806
Sum squared resid	889243.3	Schwarz criterion	12.23676
Log likelihood	-497.3006	Hannan-Quinn criter.	12.20163
Durbin-Watson stat	2.014507		

Null Hypothesis: PDP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.072247
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:21
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

GLSRESID(-1)	-0.136186	0.065719	-2.072247	0.0415
D(GLSRESID(-1))	-0.271583	0.107709	-2.521456	0.0137

R-squared	0.160213	Mean dependent var	0.613682
Adjusted R-squared	0.149715	S.D. dependent var	114.2166
S.E. of regression	105.3201	Akaike info criterion	12.17597
Sum squared resid	887386.4	Schwarz criterion	12.23467
Log likelihood	-497.2149	Hannan-Quinn criter.	12.19954
Durbin-Watson stat	2.014461		

Null Hypothesis: PIP has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.104168
Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:24
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.153873	0.073128	-2.104168	0.0385
D(GLSRESID(-1))	-0.366098	0.104514	-3.502868	0.0008

R-squared	0.237394	Mean dependent var	-1.158537
Adjusted R-squared	0.227861	S.D. dependent var	126.7912
S.E. of regression	111.4132	Akaike info criterion	12.28846
Sum squared resid	993032.0	Schwarz criterion	12.34716
Log likelihood	-501.8267	Hannan-Quinn criter.	12.31202
Durbin-Watson stat	1.973402		

Null Hypothesis: PIP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-2.185816
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/01/19 Time: 16:25
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.163899	0.074983	-2.185816	0.0318
D(GLSRESID(-1))	-0.361285	0.104620	-3.453323	0.0009

R-squared	0.240626	Mean dependent var	-0.615588
Adjusted R-squared	0.231134	S.D. dependent var	126.7912
S.E. of regression	111.1768	Akaike info criterion	12.28421
Sum squared resid	988823.1	Schwarz criterion	12.34291
Log likelihood	-501.6526	Hannan-Quinn criter.	12.30778
Durbin-Watson stat	1.971668		

APPENDIX C: Unit Root Test Result at 1st Difference

❖ ADF

Null Hypothesis: D(CDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.93734	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:29
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CDP(-1))	-1.286570	0.107777	-11.93734	0.0000
C	-0.042599	0.029425	-1.447721	0.1517
@TREND("2012M01")	0.000674	0.000603	1.116933	0.2674

R-squared	0.643342	Mean dependent var	0.000277
Adjusted R-squared	0.634313	S.D. dependent var	0.212830
S.E. of regression	0.128703	Akaike info criterion	-1.226722
Sum squared resid	1.308589	Schwarz criterion	-1.138671
Log likelihood	53.29560	Hannan-Quinn criter.	-1.191371
F-statistic	71.25031	Durbin-Watson stat	2.023822
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CDP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-11.83133	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:29
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(CDP(-1))	-1.266858	0.107077	-11.83133	0.0000

R-squared	0.633451	Mean dependent var	0.000277
Adjusted R-squared	0.633451	S.D. dependent var	0.212830
S.E. of regression	0.128854	Akaike info criterion	-1.248148
Sum squared resid	1.344879	Schwarz criterion	-1.218798
Log likelihood	52.17406	Hannan-Quinn criter.	-1.236364
Durbin-Watson stat	2.004668		

Null Hypothesis: D(CIP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.10950	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:09
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CIP(-1))	-1.495428	0.098973	-15.10950	0.0000
C	-0.004186	0.110093	-0.038020	0.9698
@TREND("2012M01")	-0.000191	0.002263	-0.084300	0.9330

R-squared	0.743109	Mean dependent var	-0.004634
Adjusted R-squared	0.736605	S.D. dependent var	0.944801
S.E. of regression	0.484891	Akaike info criterion	1.426115
Sum squared resid	18.57443	Schwarz criterion	1.514165
Log likelihood	-55.47070	Hannan-Quinn criter.	1.461466
F-statistic	114.2615	Durbin-Watson stat	2.066305
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CIP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-15.29959	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:10
Sample (adjusted): 2012M03 2018M12

Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CIP(-1))	-1.495429	0.097743	-15.29959	0.0000

R-squared	0.742914	Mean dependent var	-0.004634
Adjusted R-squared	0.742914	S.D. dependent var	0.944801
S.E. of regression	0.479049	Akaike info criterion	1.378091
Sum squared resid	18.58850	Schwarz criterion	1.407441
Log likelihood	-55.50173	Hannan-Quinn criter.	1.389875
Durbin-Watson stat	2.064750		

Null Hypothesis: D(SDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.06799	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:12
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SDP(-1))	-1.125447	0.111785	-10.06799	0.0000
C	12.73744	32.46799	0.392308	0.6959
@TREND("2012M01")	-0.101676	0.667018	-0.152433	0.8792

R-squared	0.562007	Mean dependent var	1.133017
Adjusted R-squared	0.550919	S.D. dependent var	213.2916
S.E. of regression	142.9342	Akaike info criterion	12.79854
Sum squared resid	1613984.	Schwarz criterion	12.88660
Log likelihood	-521.7403	Hannan-Quinn criter.	12.83390
F-statistic	50.68419	Durbin-Watson stat	2.007625
Prob(F-statistic)	0.000000		

Null Hypothesis: D(SDP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.15995	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(SDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:13
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SDP(-1))	-1.122359	0.110469	-10.15995	0.0000

R-squared	0.560307	Mean dependent var	1.133017
Adjusted R-squared	0.560307	S.D. dependent var	213.2916
S.E. of regression	141.4323	Akaike info criterion	12.75364
Sum squared resid	1620252.	Schwarz criterion	12.78299
Log likelihood	-521.8992	Hannan-Quinn criter.	12.76542
Durbin-Watson stat	2.005751		

Null Hypothesis: D(SIP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.820594	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:15
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SIP(-1))	-1.012849	0.114828	-8.820594	0.0000
C	10.11785	25.62426	0.394854	0.6940
@TREND("2012M01")	-0.124405	0.526647	-0.236220	0.8139

R-squared	0.496513	Mean dependent var	2.395610
Adjusted R-squared	0.483766	S.D. dependent var	156.7939
S.E. of regression	112.6555	Akaike info criterion	12.32245
Sum squared resid	1002610.	Schwarz criterion	12.41050
Log likelihood	-502.2203	Hannan-Quinn criter.	12.35780
F-statistic	38.95279	Durbin-Watson stat	1.958898
Prob(F-statistic)	0.000000		

Null Hypothesis: D(SIP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.916103	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(SIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:16
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SIP(-1))	-1.010155	0.113296	-8.916103	0.0000

R-squared	0.495198	Mean dependent var	2.395610
Adjusted R-squared	0.495198	S.D. dependent var	156.7939
S.E. of regression	111.4012	Akaike info criterion	12.27627
Sum squared resid	1005228.	Schwarz criterion	12.30562
Log likelihood	-502.3272	Hannan-Quinn criter.	12.28806
Durbin-Watson stat	1.959492		

Null Hypothesis: D(PDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.64698	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:20
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PDP(-1))	-1.339921	0.105948	-12.64698	0.0000
C	4.259826	24.69193	0.172519	0.8635
@TREND("2012M01")	-0.064479	0.507573	-0.127033	0.8992

R-squared	0.669387	Mean dependent var	0.757147
Adjusted R-squared	0.661017	S.D. dependent var	186.8347
S.E. of regression	108.7793	Akaike info criterion	12.25242
Sum squared resid	934802.1	Schwarz criterion	12.34047
Log likelihood	-499.3492	Hannan-Quinn criter.	12.28777
F-statistic	79.97515	Durbin-Watson stat	2.051679
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PDP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-12.80251	0.0000

Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:20
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PDP(-1))	-1.339650	0.104640	-12.80251	0.0000

R-squared	0.669253	Mean dependent var	0.757147
Adjusted R-squared	0.669253	S.D. dependent var	186.8347
S.E. of regression	107.4498	Akaike info criterion	12.20404
Sum squared resid	935182.3	Schwarz criterion	12.23340
Log likelihood	-499.3658	Hannan-Quinn criter.	12.21583
Durbin-Watson stat	2.051333		

Null Hypothesis: D(PIP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.28653	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:22
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PIP(-1))	-1.444143	0.101084	-14.28653	0.0000
C	9.398531	26.10746	0.359994	0.7198
@TREND("2012M01")	-0.250950	0.536715	-0.467568	0.6414

R-squared	0.720975	Mean dependent var	-0.914634
Adjusted R-squared	0.713911	S.D. dependent var	215.0243
S.E. of regression	115.0106	Akaike info criterion	12.36382
Sum squared resid	1044967.	Schwarz criterion	12.45188
Log likelihood	-503.9168	Hannan-Quinn criter.	12.39918
F-statistic	102.0645	Durbin-Watson stat	2.022954
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PIP) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-14.43831	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:23
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PIP(-1))	-1.443092	0.099949	-14.43831	0.0000

R-squared	0.720168	Mean dependent var	-0.914634
Adjusted R-squared	0.720168	S.D. dependent var	215.0243
S.E. of regression	113.7460	Akaike info criterion	12.31793
Sum squared resid	1047990.	Schwarz criterion	12.34728
Log likelihood	-504.0353	Hannan-Quinn criter.	12.32972
Durbin-Watson stat	2.019170		

- **PP**

Null Hypothesis: D(CDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.25753	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.015958
HAC corrected variance (Bartlett kernel)	0.013468

Phillips-Perron Test Equation
Dependent Variable: D(CDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:30
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CDP(-1))	-1.286570	0.107777	-11.93734	0.0000
C	-0.042599	0.029425	-1.447721	0.1517
@TREND("2012M01")	0.000674	0.000603	1.116933	0.2674

R-squared	0.643342	Mean dependent var	0.000277
Adjusted R-squared	0.634313	S.D. dependent var	0.212830
S.E. of regression	0.128703	Akaike info criterion	-1.226722
Sum squared resid	1.308589	Schwarz criterion	-1.138671
Log likelihood	53.29560	Hannan-Quinn criter.	-1.191371
F-statistic	71.25031	Durbin-Watson stat	2.023822
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CDP) has a unit root
Exogenous: None
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.03901	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.016401
HAC corrected variance (Bartlett kernel)	0.014547

Phillips-Perron Test Equation
Dependent Variable: D(CDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:30
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CDP(-1))	-1.266858	0.107077	-11.83133	0.0000

R-squared	0.633451	Mean dependent var	0.000277
Adjusted R-squared	0.633451	S.D. dependent var	0.212830
S.E. of regression	0.128854	Akaike info criterion	-1.248148
Sum squared resid	1.344879	Schwarz criterion	-1.218798
Log likelihood	52.17406	Hannan-Quinn criter.	-1.236364
Durbin-Watson stat	2.004668		

Null Hypothesis: D(CIP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-18.91526	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.226517
HAC corrected variance (Bartlett kernel)	0.107178

Phillips-Perron Test Equation
Dependent Variable: D(CIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:10
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CIP(-1))	-1.495428	0.098973	-15.10950	0.0000
C	-0.004186	0.110093	-0.038020	0.9698
@TREND("2012M01")	-0.000191	0.002263	-0.084300	0.9330

R-squared	0.743109	Mean dependent var	-0.004634
Adjusted R-squared	0.736605	S.D. dependent var	0.944801
S.E. of regression	0.484891	Akaike info criterion	1.426115
Sum squared resid	18.57443	Schwarz criterion	1.514165
Log likelihood	-55.47070	Hannan-Quinn criter.	1.461466
F-statistic	114.2615	Durbin-Watson stat	2.066305
Prob(F-statistic)	0.000000		

Null Hypothesis: D(CIP) has a unit root
Exogenous: None
Bandwidth: 7 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-19.23900	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.226689
HAC corrected variance (Bartlett kernel)	0.106522

Phillips-Perron Test Equation
Dependent Variable: D(CIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:11
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CIP(-1))	-1.495429	0.097743	-15.29959	0.0000

R-squared	0.742914	Mean dependent var	-0.004634
Adjusted R-squared	0.742914	S.D. dependent var	0.944801
S.E. of regression	0.479049	Akaike info criterion	1.378091
Sum squared resid	18.58850	Schwarz criterion	1.407441
Log likelihood	-55.50173	Hannan-Quinn criter.	1.389875
Durbin-Watson stat	2.064750		

Null Hypothesis: D(SDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.08035	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	19682.73
HAC corrected variance (Bartlett kernel)	19255.39

Phillips-Perron Test Equation
Dependent Variable: D(SDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:13
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SDP(-1))	-1.125447	0.111785	-10.06799	0.0000
C	12.73744	32.46799	0.392308	0.6959
@TREND("2012M01")	-0.101676	0.667018	-0.152433	0.8792

R-squared	0.562007	Mean dependent var	1.133017
Adjusted R-squared	0.550919	S.D. dependent var	213.2916
S.E. of regression	142.9342	Akaike info criterion	12.79854
Sum squared resid	1613984.	Schwarz criterion	12.88660
Log likelihood	-521.7403	Hannan-Quinn criter.	12.83390
F-statistic	50.68419	Durbin-Watson stat	2.007625
Prob(F-statistic)	0.000000		

Null Hypothesis: D(SDP) has a unit root
Exogenous: None
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-10.17090	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	19759.17
HAC corrected variance (Bartlett kernel)	19402.60

Phillips-Perron Test Equation
Dependent Variable: D(SDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:13
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SDP(-1))	-1.122359	0.110469	-10.15995	0.0000

R-squared	0.560307	Mean dependent var	1.133017
Adjusted R-squared	0.560307	S.D. dependent var	213.2916
S.E. of regression	141.4323	Akaike info criterion	12.75364
Sum squared resid	1620252.	Schwarz criterion	12.78299
Log likelihood	-521.8992	Hannan-Quinn criter.	12.76542
Durbin-Watson stat	2.005751		

Null Hypothesis: D(SIP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.820874	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	12226.96
HAC corrected variance (Bartlett kernel)	12243.08

Phillips-Perron Test Equation
Dependent Variable: D(SIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:17
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SIP(-1))	-1.012849	0.114828	-8.820594	0.0000
C	10.11785	25.62426	0.394854	0.6940
@TREND("2012M01")	-0.124405	0.526647	-0.236220	0.8139

R-squared	0.496513	Mean dependent var	2.395610
Adjusted R-squared	0.483766	S.D. dependent var	156.7939
S.E. of regression	112.6555	Akaike info criterion	12.32245
Sum squared resid	1002610.	Schwarz criterion	12.41050
Log likelihood	-502.2203	Hannan-Quinn criter.	12.35780
F-statistic	38.95279	Durbin-Watson stat	1.958898
Prob(F-statistic)	0.000000		

Null Hypothesis: D(SIP) has a unit root
Exogenous: None
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.916295	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	12258.88
HAC corrected variance (Bartlett kernel)	12273.56

Phillips-Perron Test Equation
Dependent Variable: D(SIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:18
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(SIP(-1))	-1.010155	0.113296	-8.916103	0.0000

R-squared	0.495198	Mean dependent var	2.395610
Adjusted R-squared	0.495198	S.D. dependent var	156.7939
S.E. of regression	111.4012	Akaike info criterion	12.27627
Sum squared resid	1005228.	Schwarz criterion	12.30562
Log likelihood	-502.3272	Hannan-Quinn criter.	12.28806
Durbin-Watson stat	1.959492		

Null Hypothesis: D(PDP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.64698	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11400.03
HAC corrected variance (Bartlett kernel)	11400.03

Phillips-Perron Test Equation
Dependent Variable: D(PDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:21
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PDP(-1))	-1.339921	0.105948	-12.64698	0.0000
C	4.259826	24.69193	0.172519	0.8635
@TREND("2012M01")	-0.064479	0.507573	-0.127033	0.8992

R-squared	0.669387	Mean dependent var	0.757147
Adjusted R-squared	0.661017	S.D. dependent var	186.8347
S.E. of regression	108.7793	Akaike info criterion	12.25242
Sum squared resid	934802.1	Schwarz criterion	12.34047
Log likelihood	-499.3492	Hannan-Quinn criter.	12.28777
F-statistic	79.97515	Durbin-Watson stat	2.051679

Prob(F-statistic) 0.000000

Null Hypothesis: D(PDP) has a unit root
Exogenous: None
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.80251	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11404.66
HAC corrected variance (Bartlett kernel)	11404.66

Phillips-Perron Test Equation
Dependent Variable: D(PDP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:21
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PDP(-1))	-1.339650	0.104640	-12.80251	0.0000

R-squared	0.669253	Mean dependent var	0.757147
Adjusted R-squared	0.669253	S.D. dependent var	186.8347
S.E. of regression	107.4498	Akaike info criterion	12.20404
Sum squared resid	935182.3	Schwarz criterion	12.23340
Log likelihood	-499.3658	Hannan-Quinn criter.	12.21583
Durbin-Watson stat	2.051333		

Null Hypothesis: D(PIP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-14.40365	0.0000
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	12743.50
HAC corrected variance (Bartlett kernel)	12277.23

Phillips-Perron Test Equation
Dependent Variable: D(PIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:23
Sample (adjusted): 2012M03 2018M12

Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PIP(-1))	-1.444143	0.101084	-14.28653	0.0000
C	9.398531	26.10746	0.359994	0.7198
@TREND("2012M01")	-0.250950	0.536715	-0.467568	0.6414

R-squared	0.720975	Mean dependent var	-0.914634
Adjusted R-squared	0.713911	S.D. dependent var	215.0243
S.E. of regression	115.0106	Akaike info criterion	12.36382
Sum squared resid	1044967.	Schwarz criterion	12.45188
Log likelihood	-503.9168	Hannan-Quinn criter.	12.39918
F-statistic	102.0645	Durbin-Watson stat	2.022954
Prob(F-statistic)	0.000000		

Null Hypothesis: D(PIP) has a unit root
Exogenous: None
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-14.54395	0.0000
Test critical values:	1% level	-2.593468	
	5% level	-1.944811	
	10% level	-1.614175	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	12780.37
HAC corrected variance (Bartlett kernel)	12366.08

Phillips-Perron Test Equation
Dependent Variable: D(PIP,2)
Method: Least Squares
Date: 06/02/19 Time: 11:24
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PIP(-1))	-1.443092	0.099949	-14.43831	0.0000

R-squared	0.720168	Mean dependent var	-0.914634
Adjusted R-squared	0.720168	S.D. dependent var	215.0243
S.E. of regression	113.7460	Akaike info criterion	12.31793
Sum squared resid	1047990.	Schwarz criterion	12.34728
Log likelihood	-504.0353	Hannan-Quinn criter.	12.32972
Durbin-Watson stat	2.019170		

❖ DF-GLS

Null Hypothesis: D(CDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

	t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic	-11.93964

Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:31
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.275488	0.106828	-11.93964	0.0000

R-squared	0.637672	Mean dependent var	0.000277
Adjusted R-squared	0.637672	S.D. dependent var	0.212830
S.E. of regression	0.128110	Akaike info criterion	-1.259731
Sum squared resid	1.329391	Schwarz criterion	-1.230381
Log likelihood	52.64898	Hannan-Quinn criter.	-1.247948
Durbin-Watson stat	2.012146		

Null Hypothesis: D(CDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-12.05782
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:31
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.284409	0.106521	-12.05782	0.0000

R-squared	0.642212	Mean dependent var	-5.05E-05
Adjusted R-squared	0.642212	S.D. dependent var	0.212830
S.E. of regression	0.127305	Akaike info criterion	-1.272339
Sum squared resid	1.312735	Schwarz criterion	-1.242989
Log likelihood	53.16592	Hannan-Quinn criter.	-1.260556
Durbin-Watson stat	2.021354		

Null Hypothesis: D(CIP) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=11)

	t-Statistic

Elliott-Rothenberg-Stock DF-GLS test statistic		-3.241518
Test critical values:	1% level	-2.594189
	5% level	-1.944915
	10% level	-1.614114

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:11
Sample (adjusted): 2012M05 2018M12
Included observations: 80 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.591993	0.182628	-3.241518	0.0018
D(GLSRESID(-1))	-0.616462	0.162484	-3.793988	0.0003
D(GLSRESID(-2))	-0.259341	0.111047	-2.335420	0.0221

R-squared	0.655812	Mean dependent var	-0.008625
Adjusted R-squared	0.646872	S.D. dependent var	0.956099
S.E. of regression	0.568158	Akaike info criterion	1.743945
Sum squared resid	24.85588	Schwarz criterion	1.833271
Log likelihood	-66.75779	Hannan-Quinn criter.	1.779758
Durbin-Watson stat	2.097167		

Null Hypothesis: D(CIP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-13.66556
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:12
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.404698	0.102791	-13.66556	0.0000

R-squared	0.697462	Mean dependent var	-0.006490
Adjusted R-squared	0.697462	S.D. dependent var	0.944801
S.E. of regression	0.519674	Akaike info criterion	1.540889
Sum squared resid	21.87492	Schwarz criterion	1.570239
Log likelihood	-62.17643	Hannan-Quinn criter.	1.552672
Durbin-Watson stat	1.917499		

Null Hypothesis: D(SDP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-10.13129
Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:14
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.119729	0.110522	-10.13129	0.0000

R-squared	0.558914	Mean dependent var	1.133017
Adjusted R-squared	0.558914	S.D. dependent var	213.2916
S.E. of regression	141.6561	Akaike info criterion	12.75680
Sum squared resid	1625383.	Schwarz criterion	12.78615
Log likelihood	-522.0289	Hannan-Quinn criter.	12.76859
Durbin-Watson stat	2.004467		

Null Hypothesis: D(SDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-10.11526
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:14
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.117108	0.110438	-10.11526	0.0000

R-squared	0.558141	Mean dependent var	0.726981
Adjusted R-squared	0.558141	S.D. dependent var	213.2916
S.E. of regression	141.7802	Akaike info criterion	12.75855
Sum squared resid	1628233.	Schwarz criterion	12.78790
Log likelihood	-522.1007	Hannan-Quinn criter.	12.77034
Durbin-Watson stat	2.005965		

Null Hypothesis: D(SIP) has a unit root
Exogenous: Constant

Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-8.902486
Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:18
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.006332	0.113039	-8.902486	0.0000

R-squared	0.494434	Mean dependent var	2.395610
Adjusted R-squared	0.494434	S.D. dependent var	156.7939
S.E. of regression	111.4855	Akaike info criterion	12.27779
Sum squared resid	1006750.	Schwarz criterion	12.30714
Log likelihood	-502.3892	Hannan-Quinn criter.	12.28957
Durbin-Watson stat	1.964720		

Null Hypothesis: D(SIP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-8.661056
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:18
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-0.973741	0.112428	-8.661056	0.0000

R-squared	0.480742	Mean dependent var	1.855003
Adjusted R-squared	0.480742	S.D. dependent var	156.7939
S.E. of regression	112.9850	Akaike info criterion	12.30451
Sum squared resid	1034015.	Schwarz criterion	12.33386
Log likelihood	-503.4848	Hannan-Quinn criter.	12.31629
Durbin-Watson stat	1.982911		

Null Hypothesis: D(PDP) has a unit root

Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-12.76614
Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:21
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.337357	0.104758	-12.76614	0.0000

R-squared	0.667992	Mean dependent var	0.757147
Adjusted R-squared	0.667992	S.D. dependent var	186.8347
S.E. of regression	107.6544	Akaike info criterion	12.20785
Sum squared resid	938746.5	Schwarz criterion	12.23720
Log likelihood	-499.5218	Hannan-Quinn criter.	12.21963
Durbin-Watson stat	2.047754		

Null Hypothesis: D(PDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-12.72589
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:22
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.333850	0.104814	-12.72589	0.0000

R-squared	0.666593	Mean dependent var	0.498736
Adjusted R-squared	0.666593	S.D. dependent var	186.8347
S.E. of regression	107.8810	Akaike info criterion	12.21205
Sum squared resid	942702.5	Schwarz criterion	12.24140
Log likelihood	-499.6942	Hannan-Quinn criter.	12.22384
Durbin-Watson stat	2.045597		

Null Hypothesis: D(PIP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-14.29375
Test critical values:	1% level	-2.593468
	5% level	-1.944811
	10% level	-1.614175

*MacKinnon (1996)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:24
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.434330	0.100347	-14.29375	0.0000

R-squared	0.716094	Mean dependent var	-0.914634
Adjusted R-squared	0.716094	S.D. dependent var	215.0243
S.E. of regression	114.5709	Akaike info criterion	12.33239
Sum squared resid	1063246.	Schwarz criterion	12.36174
Log likelihood	-504.6278	Hannan-Quinn criter.	12.34417
Durbin-Watson stat	2.007161		

Null Hypothesis: D(PIP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic
Elliott-Rothenberg-Stock DF-GLS test statistic		-14.34787
Test critical values:	1% level	-3.648400
	5% level	-3.087600
	10% level	-2.794000

*Elliott-Rothenberg-Stock (1996, Table 1)

DF-GLS Test Equation on GLS Detrended Residuals
Dependent Variable: D(GLSRESID)
Method: Least Squares
Date: 06/02/19 Time: 11:25
Sample (adjusted): 2012M03 2018M12
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GLSRESID(-1)	-1.436903	0.100148	-14.34787	0.0000

R-squared	0.717631	Mean dependent var	-0.680567
Adjusted R-squared	0.717631	S.D. dependent var	215.0243
S.E. of regression	114.2605	Akaike info criterion	12.32696
Sum squared resid	1057493.	Schwarz criterion	12.35631
Log likelihood	-504.4053	Hannan-Quinn criter.	12.33874
Durbin-Watson stat	2.012988		

APPENDIX D: Coffee Price Cointegration Test

Coffee Price

Date: 05/19/19 Time: 22:22
Sample (adjusted): 2012M04 2018M12
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: CIP CDP
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.137972	14.43592	15.49471	0.0717
At most 1	0.029315	2.410001	3.841466	0.1206

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.137972	12.02591	14.26460	0.1097
At most 1	0.029315	2.410001	3.841466	0.1206

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

CIP	CDP
-0.625036	7.456788
2.659793	-0.261662

Unrestricted Adjustment Coefficients (alpha):

D(CIP)	-0.016216	-0.024969
D(CDP)	-0.051963	0.001171

1 Cointegrating Equation(s): Log likelihood 90.23317

Normalized cointegrating coefficients (standard error in parentheses)

CIP	CDP
1.000000	-11.93017
	(3.32439)

Adjustment coefficients (standard error in parentheses)

D(CIP)	0.010136
	(0.01092)
D(CDP)	0.032479
	(0.00939)

Sesame Price

Date: 05/17/19 Time: 19:36
Sample (adjusted): 2012M04 2018M12
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend
Series: SIP SDP
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.109024	12.45400	15.49471	0.1364
At most 1	0.037590	3.103492	3.841466	0.0781

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.109024	9.350504	14.26460	0.2581
At most 1	0.037590	3.103492	3.841466	0.0781

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

SIP	SDP
-0.007840	0.009129
0.003027	-0.000585

Unrestricted Adjustment Coefficients (alpha):

D(SIP)	23.25518	-10.14649
D(SDP)	-15.12800	-25.29103

1 Cointegrating Equation(s): Log likelihood -983.1478

Normalized cointegrating coefficients (standard error in parentheses)

SIP	SDP
1.000000	-1.164494
	(0.11546)

Adjustment coefficients (standard error in parentheses)

D(SIP)	-0.182310
	(0.07659)
D(SDP)	0.118596
	(0.12440)

Pea Beans Price

Date: 06/01/19 Time: 07:26
Sample (adjusted): 2012M04 2018M12
Included observations: 81 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: PIP PDP
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.191781	21.97766	25.87211	0.1416
At most 1	0.056734	4.730978	12.51798	0.6353

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.191781	17.24669	19.38704	0.0996
At most 1	0.056734	4.730978	12.51798	0.6353

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

PIP	PDP	@TREND(12M02)
0.012595	-0.010403	0.021194
-0.001294	-0.004842	-0.004640

Unrestricted Adjustment Coefficients (alpha):

D(PIP)	-46.11854	2.988947
D(PDP)	-3.073121	25.08383

1 Cointegrating Equation(s): Log likelihood -975.0191

Normalized cointegrating coefficients (standard error in parentheses)

PIP	PDP	@TREND(12M02)
1.000000	-0.825999	1.682758
	(0.11079)	(0.80629)

Adjustment coefficients (standard error in parentheses)

D(PIP)	-0.580858
	(0.13889)
D(PDP)	-0.038706
	(0.15343)