# An Empirical Comparison of Coffee Price Transmission in Vietnam and Colombia

**Xile Li, Graduate Student**
University of Kentucky, Department of Agricultural Economics
406 Charles E. Barnhart Bldg, Lexington, KY 40546-0276
E-mail: xilesmile@uky.edu

**Sayed Saghaian, Associate Professor**
University of Kentucky, Department of Agricultural Economics
314 Charles E. Barnhart Bldg, Lexington, KY 40546-0276
ssaghaian@uky.edu

Selected p*aper prepared for presentation at the Agricultural & Applied Economics Association's 2013 AAEA & CAES Joint Annual Meeting, Washington, DC, August 4-6, 2013*

**Abstract**

This study applies an Error Correction Model to identify the market integration and price transmission between the grower price and the world price in Colombia and Vietnam, with an emphasis on the price long-run relationship and short-run adjustment across coffee varieties. The results show that both Vietnam and Colombia coffee market are well integrated with world market in the long run. Moreover, high quality coffee from Colombia is integrated in a higher degree than low quality from Vietnam. In the short run, price is asymmetrically transmitted in different direction for both countries, which implies that policy makers should consider quality issue when they implement any intervention.

**Keywords**: price transmission, coffee, error correction

## Introduction

The world coffee market experienced high prices occurring during 1994 because of a drought in Brazil (Daviron and Ponte 2005). The "coffee crisis" started in 1999, when the international coffee price declined and many farmers sold their coffee at a price that did not cover production costs (Daviron and Ponte 2005). At the same time, the emergence of specialty coffees, fair-trade, and sustainable coffees gave rise to a "coffee boom" in coffee-consuming countries "coffee boom". The largest share of the total value-added was created within the coffee-value chain in importing countries (Daviron and Ponte 2005). Moreover, the institutional framework of the global-value chain for coffee has switched from a public-controlled (International Coffee Agreement between producing countries and consuming countries) system in which producers had a substantial say towards a consumer-dominated market (Daviron and Ponte 2005). Consequently, the coexistence of a "coffee crisis" and a "coffee boom" results in the "coffee paradox" in the global coffee-value chain (Daviron and Ponte 2005).

Three factors explain the divergent dynamics in the coffee industry. First, there is a constant oversupply in the global coffee market due to advancements in technology and the expansion of coffee plantations (Lennart 2009). Second, the coffee market can be characterized as an oligopsony: a few large companies such as Starbucks, Kraft, Proctor & Gamble, and Nestlé dominate the demand side (Lennart 2009). Third, price changes are asymmetrically transmitted. For instance, the decreases in the world coffee price are transmitted less rapidly than increases to the retail price in Belgium (Dellile 2008). The reason is not the material quality "content" that roasters and retailers are selling, but mainly symbolic and in-person service quality attributes (Lennart, 2009). Colombian Milds (Colombian is a kind of Arabica Tree) is washed Arabica beans originating in Colombia, Kenya and Tanzania which have the most expensive price among

all green coffee (International Coffee Organization). In contrast, Robusta from Vietnam is low quality with a lower price than the Colombian Milds in the international markets (Daviron and Ponte, 2005).

Few studies have paid attention to the differences in price transmission within a commodity such as coffee with the two quality differentiated commercial varieties, Arabica and Robusta. Both producer and world prices are significantly different for the two coffee varieties because quality of coffee matters in consumers' perspective and tastes and their willingness to pay for higher quality. The theoretical foundation of this idea is from Lancaster (2002), who pointed out that consumer demand for goods is a derived demand arising from the fact that goods have certain specific characteristics. This paper adds to the literature on price transmission by analyzing and comparing price transmission for the two varieties of coffee beans.

The objective of this study is to investigate the price link between the world price and the producer price for two coffee varieties, focusing on both the long-run relationship and short-run adjustment. The long-run relationship between the world price and grower price is of significant importance due to the fact that Colombia and Vietnam are the two major suppliers for Colombian Milds and Robusta, respectively. We conclude that the short-run price transmission is asymmetric for both varieties from the perspective of their adjustments toward the equilibriums.

The following section provides a background of the coffee market and literature review. The third section outlines the econometric specification, where an error correction model is applied for price analysis. Empirical results are discussed in the fourth section. The final section concludes the paper.

**Background of Coffee Market and Literature Review**

In this study, Colombian Milds and Robusta represent high and low quality coffee beans, respectively. Arabica and Robusta are two major commercial varieties of the coffee plant with the difference that Arabica is grown at a higher elevation that have, lots of moisture, rich soil, more direct sun; it is a much harder and higher quality bean (International Coffee Organization). Colombia Milds, Robusta, Brazilian Naturals, and Other Milds are the four groups categorized by regions from the International Coffee Organization (Daviron and Ponte 2005). Colombia and Vietnam are the two major suppliers of Colombian Milds and Robusta, respectively. The major exporters of each type of coffee are listed in Table 1.

Vietnam has experienced a dramatic increase in coffee production since the 1990s (World Bank, 2004). Over 90% of its coffee production belongs to the Robusta variety which represents approximately 20% of the total world coffee production (D'haeze, *et al.*, 2005). World coffee prices declined partly due to the oversupply of Robusta from Vietnam (Daviron and Ponte 2005). Empirical results show that there is a negative linear relationship between Vietnam's coffee export volumes and world trade price (ICARD and Oxfam 2002). The oversupply of Vietnam Robusta is the main reason for the coffee crisis (International Coffee Organization). Therefore, Vietnam is a good representative for exploring the relationship between the producer and world price of Robusta, which is part of the research question in this study.

By contrast, Colombia is famous for its high quality coffee. Colombian Milds is the highest quality "washed" Arabica coffee beans since it has a richer taste and stronger aroma than other varieties (Maria, *et.al.*, 2009). The National Federation of Colombia Coffee Growers (FNC) plays a vital role in supporting coffee farmers by stabilizing the coffee industry. Moreover, coffee farmers have access to the federation center to find out the current price for their coffee beans, which reduce incomplete information between local and international markets (Lennart,

2009). In the last two decades, The FNC marketing strategy for Colombian coffee primarily relied on trademark protection and geographical indication protection to increase market share and better protect their reputation (Lennart, 2009). The FNC helps the growers benefit from the high quality raw material they produce. Colombia is a successful coffee producing country, differentiating its own coffee variety from other countries. This partly explains the coffee boom in the coffee industry because of strong demand for high quality coffee. Therefore, Colombia is a reasonable choice for analyzing the price transmission between growers and the world market of high quality coffee.

As for the price transmission, vertical and horizontal price linkages are the two branches in the area of price transmission. Horizontal price linkages are typically concerned with spatial price relationships which is not the focus of this paper. This paper aims to study vertical links along the supply chain between the producer price and the world coffee price, which can be treated as the wholesale price. Vavra and Goodwin (2005) stated that the literature analyzing vertical price transmission has concentrated on evaluating the links between farm, wholesale, and retail prices. Aguiar and Santana (2002) found that price transmission results from previous studies cannot be applied to other products or for other periods. They showed that price increases are more rapid and fully transmitted compared to price decreases by analyzing the price transmission mechanism for coffee beans in Brazil. They also concluded that neither product storability (e.g. perishable fruits or storable beans) nor market concentration was required for an intense transmission process. Bettendorf and Verboven (2000) found weak transmission of coffee bean prices to retail prices in Netherlands because coffee bean prices were a relatively small share of total product cost. Delille (2008) concluded that the reduction of world coffee price is transmitted less rapidly than its increase to retail price in Belgium. A report from the U.K.

found little evidence of systematic asymmetric transmission in the EU food chains between the evolution of farm and retail prices during 1990s for about 90 products (London Economics 2004). In this study, the asymmetric transmission will mainly focus on how the world and grower price of Arabica and Robusta perform and investigate their long-run equilibrium.

**Data Description**

Both producer price and world price are monthly data from January 1990 through December 2011, obtained from the International Coffee Organization (ICO). Missing data of Vietnam grower price from June 2005 to January 2006 are substituted with the world price minus the average difference between the world price and grower price of Vietnam Robusta of the period February 2005 through May 2006. Grower price is the farm-gate price reported to ICO by the national coffee authorities and constitutes all grades purchased from the growers (ICO). The world price is calculated by the International Coffee Organization which provides an overall benchmark for the price of green coffee of all major origins and varieties received for row beans. It is considered to be the best available measure of coffee transactions on a global basis (ICO). However, it is not considered to be the retail price received by consumers in coffee importing countries. The advantage of using the world price instead of retail price is to capture the price link of the green coffee before it goes to the retail market. A description of the variables with units of US dollars per pound is shown in Table 2. It is clearly that the mean of world price for Colombian Milds is much higher than that of Robusta which clearly indicates the high quality of Colombian Milds.

**Empirical Methodology**

The first step is to develop a model for testing the price transmission between the world price and grower price in the coffee market. To analyze time series data we test the stationarity which requires that the time series values for the mean, the standard deviation, and

the covariance be invariant over time (Enders 2004). Otherwise, the Ordinary Least Squares (OLS) regression is no longer efficient, the standard errors are understated, and the OLS estimates are biased and inconsistent (Enders 2004). The Augmented Dicker Fuller (ADF) test is applied to test for stationarity with the null hypothesis that the time series is stationary. The results are presented in Table 3. The second column of Table 3 summarizes the ADF test results for individual variables, while the third column shows the results for the first difference of each variable. Except for the Vietnam grower price, the other three series are not stationary. But each is stationary after the first-differencing. The Vietnam grower price is also differenced in order to keep consistency in the data.

Based on the stationarity test, co-integration may exist since all of the series are integrated processes of order 1. Both the Engle-Granger method and Johansen test are methods for testing cointegration. We use the Johansen's test which is based on maximum likelihood estimation and is more powerful than the Engle-Granger criterion (Enders 2004). The Johansen cointegration test is designed to determine the cointegrating rank, or the number of cointegrating relations (Verbeek 2008). The null hypothesis is that the two series are not co-integrated. We start by testing the null hypothesis of r =0. If it is rejected, the test for r=1 is performed. When a test is not rejected, the testing stops and that value of r from the last test is the estimated number of cointegrating relations (Enders 2004). Table 4 presents the results of cointegration tests of world price and grower price for both Colombian Milds and Vietnam Robusta. If r=1, it means there exists a long-run relationship between the two prices.

The results of the Johansen test conclude that an Error Correction Model is appropriate for capturing both the long-run and short-run relationship between the prices. The function of an error-correction model is to describe how the two variables behave in the short-run consistent

with a long-run cointegrating relationship (Verbeek 2008). It is a dynamic model in which the change of the variables in any period is related to the previous gap from long-run equilibrium. Intuitively, if two variables are integrated and have a long-run relationship, there must be some force that pulls the equilibrium error back towards zero. In order to find the long-run relationship and short-run adjustment coefficient, each variable has an error correction model which will be identified after the pre-tests (Enders 2004).

Generally, an ECM takes the form (Enders 2004):

$$\Delta p_{i,t} = \alpha_1 + \alpha_i\left(p_{i,t-1} - \beta p_{j,t-1}\right) + \beta_2(L)\Delta p_{j,t-1} + \beta_3(L)\Delta p_{i,t-1} + \varepsilon_t \qquad (1)$$

$$\Delta p_{j,t} = \alpha_1' + \alpha_j\left(p_{i,t-1} - \beta p_{j,t-1}\right) + \beta_2(L)'\Delta p_{j,t-1} + \beta_3(L)'\Delta p_{i,t-1} + \varepsilon_t' \qquad (2)$$

$\Delta p_{i,t}$ and $\Delta p_{j,t-1}$ represent the first difference of price i and j, respectively. The term in the first set of parenthesis is called the error correction term in equation (1). The levels of $p_{i,t}$ and $p_{j,t}$ are cointegrated. The terms $\beta_2(L)$ ($\beta_2(L)'$) and $\beta_3(L)$ ($\beta_3(L)'$) are lag polynomials, $\varepsilon_t$ ($\varepsilon_t'$) is white-noise disturbances. Our particular interests are $\beta$ which is the coefficient of long-run equilibrium and the speed of adjustment coefficients $\alpha_i$ which has important implications for the dynamics of the system. We determine the number of lags by observing the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC). Similarly, we are interested in the speed of adjustment coefficients $\alpha_j$ in equation (2).

If $\beta$ is statistically significant based on the time series, then a long-run relationship exists between $p_{i,t}$ and $p_{j,t}$. We can further investigate how the two prices respond to its long-run equilibrium, which is associated with the price transmission.

Specifically, the variables of interest in this study are: world price of Colombian Milds (wpc), grower price of Colombian Milds (gpc), world price of Vietnam Robusta (wpv), and grower price of Vietnam Robusta (gpv). The first set of parenthesis in each equation is the error

correction term, where $\beta_{11}$ and $\beta_{21}$ are the coefficients of the long-run relationship between the world price and grower price for the Colombian Milds and Vietnam Robusta. The short-run parameters $\alpha_{11}$ $(\alpha_{11}')$ and $\alpha_{21}(\alpha_{21}')$ mean how each dependent variable in each equation respond to the change of long-run equilibrium.

$$\Delta wpc_t = \alpha_{10} + \alpha_{11}(wpc_{t-1} - \beta_{11} gpc_{t-1}) + \beta_{12}(L)\Delta wpc_{t-1} + \beta_{13}(L)\Delta gpc_{t-1} + \varepsilon_{1t} \quad (3)$$

$$\Delta gpc_t = \alpha_{10}' + \alpha_{11}'(wpc_{t-1} - \beta_{11} gpc_{t-1}) + \beta_{12}(L)'\Delta wpc_{t-1} + \beta_{13}(L)'\Delta gpc_{t-1} + \varepsilon_{1t}' \quad (4)$$

$$\Delta wpv_t = \alpha_{20} + \alpha_{21}(wpv_{t-1} - \beta_{21} gpv_{t-1}) + \beta_{22}(L)\Delta wpv_{t-1} + \beta_{23}(L)\Delta gpv_{t-1} + \varepsilon_{2t} \quad (5)$$

$$\Delta gpv_t = \alpha_{20} + \alpha_{21}'(wpv_{t-1} - \beta_{21} gpv_{t-1}) + \beta_{22}(L)'\Delta wpv_{t-1} + \beta_{23}(L)'\Delta gpv_{t-1} + \varepsilon_{2t}' \quad (6)$$

**Results**

Table 5 presents a summary of the empirical estimations of the β's (long-run equilibrium relations) and α's (speed of adjustment parameters) for the world price and grower price of Colombian Milds and Robusta. As all variables are logarithmic, we interpret coefficients in terms of elasticity. Due to the fact that Colombia and Vietnam are the two major suppliers for Colombian Milds and Robusta, results show that a 1% increase in the grower's price leads to 0.933% ($\beta_{11}$) and 0.88% ($\beta_{21}$) increase of the world price for Colombian Milds and Robusta, respectively. Therefore, a long-run equilibrium exsits between the world price and grower price in both Colombian Milds and Robusta although the $\beta_{11}$and $\beta_{21}$ are slightly different.

The reactions of the world price and grower price of both varieties to their lagged disequilibrium terms are captured by the short-run adjustment coefficient$\alpha_{11}$, $\alpha_{11}'$, $\alpha_{21}$ and $\alpha_{21}'$. The speed of adjustment toward the equilibrium is determined by the magnitude of α. For Colombian Milds, only the world price responds to the error correction term and no statistical evidence indicates that the grower price of Colombian Milds react when the system move out of the long-run equilibrium. Moreover, $\alpha_{11}$ equals $-0.111$ which means that roughly 11% of the

disequilibrium error is corrected in one time period. This implies that the world price of Colombian Milds is less stable than the grower price of Colombian Milds when there is shock in the system, which supports the role of FNC plays for helping the producers to increase market share and better protect their reputation (Lennart 2009). In other words, the world price and the grower price respond the disequilibrium asymmetrically for Colombian Milds.

On the contrary, the empirical results indicate the grower price of Vietnam Robusta is less stable than the world price when there is a shock in the system, since $\alpha_{21}$ is no different from zero. This implies that the world price of Robusta does not correct the disequilibrium error but the grower price responds the disequilibrium error term as showed in equation (6). The coefficient $\alpha'_{21}$ equals to $0.439$ means about 43% of the disequilibrium error is corrected in one time period. Similarly, the world price and grower price respond to the disequilibrium asymmetrically in terms of the adjustment toward it.

**Conclusion**

This study applies an Error Correction Model to identify the market integration and price transmission between the grower price and the world price in Colombia and Vietnam, with an emphasis on the price long-run relationship and short-run adjustment across coffee varieties. The results show that both Vietnam and Colombia coffee market are well integrated with world market in the long run. Moreover, high quality coffee from Colombia is integrated in a higher degree than low quality from Vietnam. In the short run, price is asymmetrically transmitted in different direction for both countries, which implies that policy makers should consider quality issue when they implement any intervention.

As discussed in the introduction, the market power owned by roasters is an important reason for explaining asymmetric price transmission since most value is generated during the

process of branding, advertising and distribution (World Bank 2004). However, it does not account for the results in this paper since this study is focusing on the green coffee which is the naked bean form before roasting, branding and distribution. In other words, we pay attention to the price link before the value added by the roasters or large coffee companies (Krivonos 2004).

The world price and grower price of Colombian Milds respond asymmetrically to their disequilibrium in the system, which indicates that the world price of Colombian Milds is less stable than the grower price of Colombian Milds. The conclusion supports the idea of the market power gained by Colombia coffee growers through the National Federation of Colombia Coffee Growers. On the contrary, the conclusion for Vietnam Robusta is that the grower price of Vietnam Robusta is less stable than its world price when there is a shock in the system. Vietnam growers have much less to say about the low price of the Robusta coffee partly because 1) lack of market power 2) the low quality of Robusta coffee 3) the glut of coffee. The constant oversupply of global coffee results in lower price facing producers. But this is not true for each variety. The demand for high quality coffee is much stronger than low quality coffee, and this makes the shortage of high quality coffee an important issue (Lennart 2009). Both the non-traditional supplier such as Vietnam and traditional producer like Brazil, have created a glut of coffee. The coffee crisis essentially is a low-quality coffee crisis since the expansion of coffee supply, for the most part, is not the result of market forces (Daviron and Ponte 2005).

In conclusion, the coffee crisis is not severe in Colombia as much as it in Vietnam in terms of the grower price since the mechanism of the improving coffee industry in Colombia is more successful than it is in Vietnam, which is partly due to its high quality coffee and effective management. The policy implication for Vietnam government is to improve its quality and avoid over-producing, since the Robusta oversupply is not only driving its own prices down, it is also

dragging down the price of other high-quality coffee. An obvious reason is coffee “blending”, which means the roasters may mix Robusta with Arabica to minimum its cost. The policy implication for Colombia Milds is more on maintaining on its reputation than on quality improvement.

There is much room for improvement for this paper. It does not account for the retail price of coffee and structural change which may highly influence the price transmission from 1990 to 2012. We have little information about the empirical evidence of the substitution effect among different varieties. Therefore, more research is needed to uncover the issues in coffee producing countries.

**References**


Aguiar Danilo, R. D., and J.A. Santana. Asymmetry in Farm to Retail Price Transmission: Evidence from Brazil. *Journal of Agribusiness*, 18(Jan.2002): 37-48.

Andres G., "Coffee and Landscape Change in the Colombia Countryside 1970-2002." A Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy, University of Florida. 2004.

Bettendorf, L. and F. Verboven. "Incomplete Transmission of Coffee Bean Prices in the Netherlands*", European Review of Agricultural Economics*, 27(2000), 1-16.

Daviron, B. and S. Ponte. *The Coffee Paradox: Global Markets, Commodity Trade and Elusive Promise of Development*, Zed Books, London & New York. 2005.

D. D'haeze, J. Deckers, D. Raes, T.A. Phong, and H.V. Loi. "Environmental and Socio-economic Impacts of Institutional Reforms on the Agricultural Sector of Vietnam Land Suitability Assessment for Robusta coffee in the Dak Gan region." *Agriculture, Ecosystems and Environment* 105(2005): 59–76.

Delille. N. "Relations between Coffee World Market Price and Retail Price in Belgium." Unpublished. Gembloux Agricultural University, Economics and Rural Development Unit, Belgium. 2008

Enders, W. *Applied Econometric Time Series*. 2nd. Hoboken. NJ: John Wiley & Sons. 2004.

ICARD and Oxfam. "The Impact of the Global Coffee Trade on Dak Lak Province, Vietnam: Analysis and Policy Recommendations." Information Centre for Agricultural and Rural Development (ICARD),Oxfam Great Britain and Oxfam Hong Kong. September. 2002

International Coffee Organization, *http://www.ico.org/trade_e.asp?section=About_Coffee*.

Lancaster. K *The American Economic Review*, Vol. 56, No. 1/2 (Mar. 1, 1966), pp. 14-23.

Krivonons, E. *The Impact of Coffee Market Reforms on Producer Prices and Price Transmission.* Policy Research Working Paper Series 3358, The World Bank, July 2004.

Lennart Schüβler . Protecting 'Single-Origin Coffee' within the Global Coffee Market: The Role of Geographical Indications and Trademark. *The Estey Centre Journal of International Law and Trade Policy*, Volume 10 Number 1 (2009), pp 149-185.

London Economics, *"Investigation of the Determinants of Farm-Retail Price Spreads,"* Final Report to DEFRA, U.K. 2004.

Maria-Alejandra Gonzalez-Perez, Adriana Roldán-Pérez, and Pham Thu Huong Dao Ngoc

Tien Coffee, "Cooperation and Competition: a comparative study between Colombia and Vietnam." Paper prepared for UNCTAD. UNCTAD Virtual Institute. 2009.

Cardenas .M and Z. Partow, "Oil, Coffee and the Dynamic Commons Problems in Colombia," Research Department Publications 3033, Inter-American Development Bank, Research Department, 1998.

Scholnick, B.. "Asymmetric Adjustment of Commercial Bank Interest Rates", Evidence from Malaysia and Singapore", *Journal of International Money and Finance,* 15(1996):485-496.

Vavra,P. and B.K.Goodwin. "Analysis of Price Transmission Along the Food Chain", OECD food, *Agricultural and Fisheries Working Papers*, No.3, OECD Publishing. 2005.

Verbeek, M. *A Guide to Modern Econometrics*. 3rd ed. Chichester, England: John Wily & Sons. 2008.

Von Cramon- Taubadel, S."Estimating Asymmetric Price Transmission with the Error Correction Representation: An application to the German pork market". *European Review of Agricultural Economics*. (1998): 25:1-18.

World Bank. Agriculture and Rural Development Department Report No. 29358 The Socialist Republic of Vietnam Coffee Sector. June.2004

**Table1. Coffee Exports by Major Countries**

| Colombian Milds | Robustas | Other Milds | Brazilian Naturals |
|---|---|---|---|
| Colombia | Vietnam | Guatemala | Brazil |
| Kenya | Indonesia | Mexico | Ethiopia |
| Tanzania | Uganda | Honduras | |
| | Other | Other | |

**Source: International Coffee Organization**

**Table2. Descriptive Statistics of Coffee Prices in the Empirical Model**

| | Colombian Milds | | Robusta | |
|---|---|---|---|---|
| | **World Price*** | **Grower Price*** | **World Price*** | **Grower Price*** |
| Observations | 264 | 264 | 264 | 264 |
| Mean | 127.75 | 94.85 | 68.05 | 52.85 |
| SD | 58.32 | 46.25 | 30.70 | 26.44 |
| Maximum | 318.5 | 268.52 | 182.78 | 126.94 |
| Minimum | 56.18 | 44.57 | 22.81 | 4.41 |

**Data Source: International Coffee Organization**

***Note: Unit for all prices is US cents/lb.**

**Table3. Augmented Dickey-Fuller (ADF) Test Results**

| Variables | Test Results for Variables in Levels | Test Results for Variables after First-Differencing |
|---|---|---|
| Colombia 1990:01-2011:12 | | |
| World Price | -1.171 | -14.748 *** |
| Grower Price | -0.639 | -14.290*** |
| Vietnam 1990:01-2011:12 | | |
| World price | -1.120 | -11.999 *** |
| Grower Price | -3.175** | -22.863*** |

Note: All results are absolute value and compared to MacKinnon (1991) critical value.
*** 1% significance level. ** 5 % significance level. *10% significance level

**Table4. Johansen's Test for Cointegration between the World Price and Grower Price**

| Null Hypothesis | Trace Statistic | 5% Critical Value | Eigenvalue |
|---|---|---|---|
| Colombian Milds | | | |
| r=0 | 21.587 | 15.41 | . |
| r=1* | 0.822 | 3.76 | 0.076 |
| Vietnam Robusta | | | |
| r=0 | 50.179 | 15.41 | . |
| r=1* | 2.793 | 3.76 | 0.165 |

**Note: r is the cointegrating rank**

**Table5: Parameter Estimates for the Long-run Equilibrium Relationship ($\beta$) and Short-run Adjustment ($\alpha_{ij}$)**

| Dependent Variable | Short-run Adjustment | Long-run Equilibrium |
|---|---|---|
| World price of Colombian Milds | $\alpha_{11}$: -0.111** | |
| Grower price of Colombian Milds | $\alpha_{11}'$: 0.067 | $\beta_{11}$: 0.933** |
| World price of Vietnam Robusta | $\alpha_{21}$: 0.056 | |
| Grower price of Vietnam Robusta | $\alpha_{21}'$ : 0.439** | $\beta_{21}$: 0.88** |

Note: *** 1% significance level. ** 5 % significance level. *10% significance level