Testing vertical price transmission for Vietnam's Robusta coffee

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Vietnam has undergone market reforms over the last three decades; and as a consequence, the coffee sector has become increasingly market-driven. The success of the government's liberalisation policies in terms of market efficiency is investigated by examining the transmission of both positive and negative price changes for Robusta coffee between export and farmgate prices. We used a threshold vector error correction model and high-frequency daily data. The primary result here is that of a symmetric price transmission between export and farm-level prices. This result holds when tested with weekly price data, derived from the daily data. Farmgate prices respond faster to decreases than increases in export prices when the long-run deviation exceeds a certain threshold. These price changes are transmitted within several days. This research also confirms the importance of transaction costs, and other price frictions mostly ignored in prior analyses for coffee.

Key words: asymmetric price transmission, nonlinear adjustment, Robusta coffee, Vietnam.

1. Introduction

Coffee is the most important cash crop in Vietnam. In 2015, Vietnam exported US$2.7 billion worth of coffee, equivalent to about 16 per cent of export revenue from all agricultural commodities (MARD 2016). Currently, Vietnam is the world's second largest exporter of coffee and the single largest exporter of the Robusta variety.

Over the last three decades, Vietnam has transitioned from a planned to a market economy. In late 2006, it became the 150th member of the World Trade Organisation (WTO). Since accession to the world body, however, Vietnam has been designated the status of 'nonmarket economy', a status that will remain until at least 2019 (US–Vietnam Trade Council 2006). This designation has important implications in that other WTO members may find it easier to bring antidumping cases against Vietnam. In the context of this research, a question arises as to whether Vietnam can be considered a market-driven economy as reflected by its major sectors, including the coffee sector, when this designation expires in 2019. The answer to this question also implies the success of the policy reforms in terms of market efficiency for Vietnam's coffee sector. This insight can be observed by the study of price

transmission between global and farmgate prices for Vietnam's Robusta coffee, as the absence of asymmetric price transmission will provide credible evidence for market integration and efficiency (Meyer 2004).

The transition of Vietnam's coffee sector to become a global player is outlined in the remainder of the introduction, and the rest of the paper is organised as follows. Relevant literature is discussed in section two. Section three describes the price data and the estimation method. In section four, the results of the price transmission analysis are reported and interpreted. The final section concludes the paper.

1.1 Market reform policies over time

Coffee was first planted in Vietnam as early as 1857, but until 1970, only a few thousand hectares of land was dedicated to coffee cultivation. After Vietnam entered the Soviet-led Council for Mutual Economic Assistance (COMECON) in 1978, its coffee trade was limited to communist countries in the bloc. The area under coffee cultivation grew modestly to 30,000 hectares. Coffee and other agricultural exports were traded for industrial products with COMECON members on a barter basis. Hence prices in this period were not meaningful. Domestic producers were paid artificially low prices by the state (World Bank 2005).

Until the late 1980s, global coffee prices were kept stable at a relatively high level under an explicit system of quota arrangements between coffee-producing and coffee-consuming countries, in the form of the International Coffee Agreement (ICA). Vietnam was left out of these global trading arrangements because of its membership with COMECON. Immediately after the demise of ICA's export quota system in 1989, global coffee prices collapsed. In force since 2011, the current ICA agreement, involving 48 members including Vietnam, formalised its role as a facilitator of the global coffee trade through increased transparency and promotion of a sustainable coffee economy, particularly to benefit small-scale farmers in coffee-producing countries.

On the domestic front, the Vietnamese administration introduced major market reforms under the banner of '*Doi Moi*' in 1986, allowing for private sector operations in agriculture. Farmers were offered incentives to switch to cash crops such as coffee for export, while controls on basic foodstuff prices were retained. When COMECON was dissolved in 1991, Vietnam's coffee sector had to explore new export markets. The government supported coffee growers with a variety of measures and subsidies. One such measure was a Price Stabilisation Fund to which coffee exporters contributed a levy when global prices were high. However, this fee has not been collected since 1998.

The coffee sector then witnessed another wave of policy reforms from 2000. Firstly, the government encouraged participation of private businesses into the sector at a time when state-owned enterprises (SOEs) were dominant, but

operating inefficiently. Secondly, both an export bonus scheme and favourable credit were offered to domestic coffee exporters, while the export ban was lifted for foreign-owned companies. Thirdly, SOEs were restructured so that they were no longer solely government-owned. This restructuring was aimed at improving efficiency and creating a more level playing field for market participants. Finally, coffee growers were granted financial incentives to increase their production (AgroInfo 2012).

1.2 Effect of market reform policies on coffee prices

Baffes and Onal (2012) highlighted the state of Vietnam's coffee sector in terms of price margins at the domestic-world level, linking it to adverse policies pursued in the past. For example, between 1991 and 2003, coffee exporters in Vietnam earned, on the average, 80 per cent of the world coffee price, when their Ugandan counterparts (significant Robusta producers) received 86 per cent. The most widely used indicator, the Nominal Rate of Assistance (NRA), has been highly negative, meaning the measure of government assistance was, in effect, a heavy tax burden on Vietnam's coffee farmers. The NRA fell from its worst level (−70 per cent) in 1987 to about −10 per cent in 2003, but still quite negative. More relevant to this research, export prices did not transmit in favour of Vietnam's coffee growers. During the same period (1991–2003), coffee growers in Vietnam, on average, received only 62 per cent of the export price (and falling as low as 31 per cent in 2003) while their Ugandan counterparts received 70 per cent of the export price.

Since 2001, Vietnamese coffee farmers received among the highest share of the free on board (FOB) price in comparison with other coffee-producing countries. At times, the farmers' price can be higher than the spot FOB price. On average, Vietnamese farm gate prices settled at 96 per cent of the unit value of green (unroasted) coffee exports (World Bank 2005). This is significantly higher than in the pre-reform period in 1980s and 1990s. The World Bank (2005) report credits lower barriers to entry for trading and speculation as well as lower costs through vertical integration, for achieving the high share of the FOB price received by farmers. Other than access to cash and storage space, traders currently face no notable barriers. Private traders have moved up the marketing chain, applying greater efficiencies learned from global operations. By integrating parts of the marketing chain, they are saving on margins and transaction costs.

1.3 Effect of market reform on the coffee industry

Domestic market reforms, together with integration with global markets, brought positive results for the coffee industry. Coffee acreage, production and export earnings all experienced significant increase. In the 30 years since 'Doi Moi', Vietnam's coffee production has increased 100-fold, from 18,400 tonnes to 1.76 million tonnes. At 2.4 tonnes per hectare, Robusta yields in

Vietnam are the highest in the world, while their regional counterparts in Thailand, Indonesia and Laos average a meagre 0.8 tonnes, 0.5 tonnes and 0.4 tonnes per hectare, respectively. Some 95 per cent of this production is exported each year (Gro Intelligence 2016).

2. Literature review

Price transmission denotes the way in which a price change at one level is passed on to the price at another level in the marketing chain (Goodwin 2006). Asymmetric price transmission (APT) is defined as differences in response to magnitude, speed and direction of output prices to an increase or decrease in input prices (Meyer and von Cramon-Taubadel 2004). The literature has often classified APT as 'APT in magnitude' and 'APT in speed'. The former refers to the extent of price transmission among different market levels, while the latter denotes the pace of price transmission (Fousekis *et al.* 2016).

The study of price transmission in the food chain has been of special interest in agricultural economics. The magnitude and/or speed of the transmission of shocks among different chain-wide levels allow one to better understand the overall operation of the market, which has potential welfare and policy implications. While there is an extensive literature on price transmission for a variety of agricultural products, our interest is in studies that have investigated the incidence of APT for coffee prices (González 2007; Fafchamps and Hill 2008; Li and Saghaian 2013; Mofya-Mukuka and Abdulai 2013; Worako *et al.* 2013). These studies has been on the transmission between export prices and farmgate prices. While mixed results of APT were found for Arabica coffee (Mofya-Mukuka and Abdulai 2013; Worako *et al.* 2013), APT was more prevalent for Robusta coffee – a lower quality, less expensive coffee (González 2007; Fafchamps and Hill 2008). Other studies identified APT between international prices of coffee beans and retail prices of roasted coffee (Aguiar and Santana 2002; Gomez and Koerner 2009; Bonnet and Villas-Boas 2016).

Previous studies have also investigated the impacts of liberalisation policies, including the termination of the ICA quota arrangements and market reforms in coffee-growing nations in Africa and South America (Mofya-Mukuka and Abdulai 2013; Musumba and Gupta 2013; Worako *et al.* 2013). Empirical evidence suggests that price transmission between export and farm levels tends to improve with liberalisation policies but remains asymmetric. The impacts were more noticeable and significant in the group of countries where market liberalisation was of the highest degree (González 2007).

Meyer and von Cramon-Taubadel (2004) argue that empirical studies on APT should work with data of greater frequency than the frequency of the adjustment process, although there is a trade-off between data frequency and useful estimation. However, we found only two studies involving agricultural

products that used daily data to study price linkages; Goodwin and Piggott's research (2001) involving soybean and corn; and Ihle and Rubin (2013) studying price transmission for fruit and vegetable prices.

Our study uses daily data to evaluate price transmission for Vietnam's Robusta coffee between export and farmgate prices from mid-2011 to the end of 2015. This research makes several useful contributions. Firstly, the daily price data are of higher frequency than those used in all of previous APT investigations involving coffee and indeed most other agricultural products. In addition, our study also examines APT for weekly price data that are aggregated from the daily price data so as to see the effect of data frequency on price transmission for Vietnam's Robusta coffee. Secondly, our analysis partitions price changes into positive changes and negative changes so that any difference in price transmission for rising prices, as distinct from falling prices, can be observed. Lastly, we use the threshold vector error correction model (TVECM) which provides better specification as it takes into account the unobserved transaction and adjustment costs (Meyer 2004), reducing bias in the price transmission analysis (Goodwin and Piggott 2001). The three-regime TVECM is employed due to its greater flexibility to describe price adjustments than the two-regime variant (Hahn *et al.* 2016).

3. Method

3.1 Data description

The data used in this research are daily export and farmgate prices for Robusta coffee from 1 June 2011 to 31 December 2015, obtained from the Ministry of Agriculture and Rural Development (MARD) in Vietnam. Export prices (EP_t) are denominated in US dollars (USD) per tonne and quoted on FOB basis in Ho Chi Minh City, the commercial hub for Vietnam exports. Farmgate prices (FP_t) are expressed in Vietnam dongs (VND) per tonne and were collected in Dak Lak, the largest coffee-producing province in the country. Farmgate prices are then converted into USD using average daily exchange rates from Bloomberg (2016). The two price series are transformed into natural logarithms, which is the usual practice to alleviate the fluctuation of price series. Of 1197 observations, around 90 export prices and 220 farmgate prices were missing, most occurring during New Year and Lunar New Year holiday periods. These missing prices were replaced by the average of the two adjacent observed values. Where the gap was larger, the missing value was forecast from the AR(2) model (Wooldridge 2009).

As shown in Figure 1, fluctuations in export and farmgate prices almost mirrored each other as they followed an overall downward trend over the period.

Export prices were generally higher than farmgate prices, except in the early period. Both price series decreased sharply from over 2,500 USD/

Figure 1 Daily coffee export and farmgate prices from 6/2011 to 12/2015.

tonne to below 2,000 USD/tonne in the second half of 2011, then steadily recovered, but by the end of 2012, they decreased again to their previous low. They rose gradually over the next few months, but plunged to around 1,500 USD/tonne in November 2013. Early 2014 saw a rise in the two price series; however, both were on the decline for the remainder of the period.

3.2 Statistical analysis

Of two main approaches to APT investigations (Meyer and von Cramon-Taubadel 2004), the cointegration-based approach is dominant in the literature (Hahn *et al.* 2016). This cointegration-based approach adequately handles the problem of nonstationary data which could cause spurious regressions. This study uses the TVECM which is consistent with the cointegration approach that has the tendency to return to long-run equilibrium after a shock.

Prior to estimation of the TVECM, it is important to test for integration and cointegration of the price data. The Kwiatkowski–Phillips–Schmidt–Shin (KPSS) (Kwiatkowski *et al.* 1992) is a common test for stationarity. The Johansen (1988) test is then applied to ascertain whether two I(1) price series are cointegrated.

After confirming cointegration of export (EP_t) and farmgate prices (FP_t), the model was estimated. For the TVECM estimation, a simultaneous equation system with a lag length of one is considered appropriate. In this

TVECM, two thresholds are specified to divide the error correction process into three regimes. The system of the three-regime TVECMs has the following form:

$$
\Delta EP_t = \begin{cases}
\alpha_{1y} + \beta_{11y}^{+}\Delta FP_t^{+} + \beta_{11y}^{-}\Delta FP_t^{-} + \beta_{12y}^{+}\Delta FP_{t-1}^{+} + \beta_{12y}^{-}\Delta FP_{t-1}^{-} + \\
\delta_{1y}ECT_{t-1} + \gamma_{1y}\Delta EP_{t-1} + \omega_{ty} \ if \ ECT_{t-1} < \theta_1 \\
\alpha_{2y} + \beta_{21y}^{+}\Delta FP_t^{+} + \beta_{21y}^{-}\Delta FP_t^{-} + \beta_{22y}^{+}\Delta FP_{t-1}^{+} + \beta_{22y}^{-}\Delta FP_{t-1}^{-} \\
+ \delta_{2y}ECT_{t-1} + \gamma_{2y}\Delta EP_{t-1} + \omega_{ty} \ if \ \theta_1 \leq ECT_{t-1} \leq \theta_2 \\
\alpha_{3y} + \beta_{31y}^{+}\Delta FP_t^{+} + \beta_{31y}^{-}\Delta FP_t^{-} + \beta_{32y}^{+}\Delta FP_{t-1}^{+} + \beta_{32y}^{-}\Delta FP_{t-1}^{-} \\
+ \delta_{3y}ECT_{t-1} + \gamma_{3y}\Delta EP_{t-1} + \omega_{ty} \ if \ ECT_{t-1} > \theta_2
\end{cases}
$$

$$
\Delta FP_t = \begin{cases}
\alpha_{1x} + \beta_{11x}^{+}\Delta EP_t^{+} + \beta_{11x}^{-}\Delta EP_t^{-} + \beta_{12x}^{+}\Delta EP_{t-1}^{+} + \beta_{12x}^{-}\Delta EP_{t-1}^{-} \\
+ \delta_{1x}ECT_{t-1} + \gamma_{1x}\Delta FP_{t-1} + \omega_{tx} \ if \ ECT_{t-1} < \theta_1 \\
\alpha_{2x} + \beta_{21x}^{+}\Delta EP_t^{+} + \beta_{21x}^{-}\Delta EP_t^{-} + \beta_{22x}^{+}\Delta EP_{t-1}^{+} + \beta_{22x}^{-}\Delta EP_{t-1}^{-} \\
+ \delta_{2x}ECT_{t-1} + \gamma_{2x}\Delta FP_{t-1} + \omega_{tx} \ if \ \theta_1 \leq ECT_{t-1} \leq \theta_2 \\
\alpha_{3x} + \beta_{31x}^{+}\Delta EP_t^{+} + \beta_{31x}^{-}\Delta EP_t^{-} + \beta_{32x}^{+}\Delta EP_{t-1}^{+} + \beta_{32x}^{-}\Delta EP_{t-1}^{-} \\
+ \delta_{3x}ECT_{t-1} + \gamma_{3x}\Delta FP_{t-1} + \omega_{tx} \ if \ ECT_{t-1} > \theta_2
\end{cases}
$$

$$(1)$$

where $t = 1, 2, \ldots, T$; θ_1 and θ_2 are lower and upper thresholds.

EP_t and FP_t are export and farmgate prices;
ECT_{t-1} is the lagged residual (a.k.a. error correction terms) from:
$FP_t = \beta_0 + \beta_1 EP_t + e_t$;
$\Delta EP_t = EP_t - EP_{t-1}$;
$\Delta EP_t^{+} = \Delta EP_t$. if $\Delta EP_t > 0$; otherwise $\Delta EP_t^{+} = 0$;
$\Delta EP_t^{-} = \Delta EP_t$ if $\Delta EP_t < 0$; otherwise $\Delta EP_t^{-} = 0$;
$\Delta FP_t = FP_t - FP_{t-1}$;
$\Delta FP_t^{+} = \Delta FP_t$ if $\Delta FP_t > 0$; otherwise $\Delta FP_t^{+} = 0$; and
$\Delta FP_t^{-} = \Delta FP_t$ if $\Delta FP_t < 0$; otherwise $\Delta FP_t^{-} = 0$.

The procedure for the TVECM introduced by Balke and Fomby (1997) has four sequential steps, beginning with Tsay's (1989) test in the cointegration framework to examine whether the threshold effect is present. Following the confirmation of the nonlinear effect by Tsay's test, the lower and upper thresholds (θ_1 and θ_2) are estimated using the two-dimensional grid search based on the minimum sum of squared residual criterion (Goodwin and Piggott 2001). The two thresholds need to ensure a sufficient number of observations per regime, specifically about 10 per cent (120 observations) of the data (Hansen 1999). In the next step, the modified approach of Hansen (1997) is applied to test the significance of differences in coefficient estimates across the three regimes. The sup-F test statistic in Hansen's (1997) approach is calculated as:

$$F_{13} = T\frac{S_1 - S_3}{S_3} \tag{2}$$

where S_1 and S_3 denote the sum of the squared residuals of the VECM and three-regime TVECM, respectively.

The sup-F test statistic has a nonstandard distribution, so the simulation method is used to identify appropriate critical values (Hansen 1997). If the three-regime TVECM is significant, the two thresholds in this model will be used to recompute the system of TVECMs. As the error terms in this system are not independent, the Seemingly Unrelated Regression (SUR) (Zellner 1962) was employed in preference to the OLS method.

Finally, the test for equal coefficients of (ΔFP_t^+, ΔFP_t^-), (ΔFP_{t-1}^+, ΔFP_{t-1}^-), (ΔEP_t^+, ΔEP_t^-) and (ΔEP_{t-1}^+, ΔEP_{t-1}^-) is applied to check for APT in the short-run. This is because the TVECM assumes different speeds of adjustment towards the long-run equilibrium in each regime.

4. Results and discussion

Prior to applying the TVECM to determine the existence of any APT, the data are tested for integration and cointegration. The results of these tests are then presented.

4.1 Integration and cointegration tests

The KPSS test statistics for export and farmgate prices are 5.39 and 6.49 (at 1 per cent significance), respectively. Both are higher than the critical value of 0.463, offering sufficient evidence to reject the null hypothesis of stationarity for export and farmgate prices. On the contrary, the KPSS results for first differences in export and farmgate prices are lower than the critical value (0.077 and 0.071, respectively). The KPSS test indicates that there is evidence to confirm nonstationarity of both price series and that the first differences are both stationary. This means that FP_t and EP_t are integrated of order one, I(1).

The Johansen test confirms the cointegration between export and farmgate prices as shown in Table 1.

With regard to the trace test with $r = 0$, the test statistic (approximately 126.5) is significant, providing evidence to reject the null hypothesis of noncointegration. This is not the case for the trace test with $r = 1$; therefore, the null hypothesis of one cointegrating vector is accepted. For the max test with $r = 0$, the test statistic 117.55 is significantly greater than the critical value of 15.67; thus, the null hypothesis of zero cointegrating vectors is rejected in favour of the alternative hypothesis of one cointegrating vector. The max test with $r = 1$ is not significant, verifying the null hypothesis of one cointegrating vector.

Table 1   Results of cointegration tests

Johansen tests	Critical values	Test statistics
Trace test: $r = 0$	19.96	126.48***
Max test: $r = 0$	15.67	117.55***
Trace test: $r = 1$	9.24	8.93
Max test: $r = 1$	9.24	8.93

Note: ***$P < 0.01$. Critical values are at the 5 per cent significance level.

4.2 Asymmetries in the TVECMs

After meeting the necessary condition that export and farmgate prices are integrated of order one and that they are cointegrated, we proceed to detect any asymmetry in the price transmission process. TVECM postulates that the transmission of prices between markets is regime-dependent. TVECM allows for nonlinear adjustment of deviations from the long-run equilibrium that VECM does not. To justify the use of TVECM over VECM, we applied Tsay's (1989) test for threshold effects. For both the ascending and descending orders of arranged autoregression of ECTs, the Tsay test statistics (3.24** and 4.17**, respectively) are significant. This confirms the nonlinearity in the adjustment process of export and farmgate prices and superiority of TVECM over VECM.

The estimations from Hansen's (1997) approach to TVECMs are excluded from this paper for brevity. The Breusch-Pagan test demonstrates that the error terms are homoscedastic, making the use of the sup-F test statistic appropriate. The P-values for the sup-F test statistic are computed from the asymptotic distribution of 1000 simulations. While the TVECM for farmgate prices is insignificant, the TVECM for export prices is significant. This will suffice to demonstrate the nonlinear adjustment in the transmission process between export and farmgate prices. The thresholds (-0.023 and 0.024, respectively) in the TVECM for export prices will be used to recompute the system expressed by equation (1). The number of observations in regimes I, II and III is 238, 742 and 215 respectively.

The adjusted R^2 are 12.9 per cent and 3.2 per cent in the two TVECM equations (see Table S1), indicating the very low explanatory power of the system to model changes in export and farmgate prices. The Durbin–Watson test confirms that there is no first-order autocorrelation in the error terms of the system of TVECMs. Another point to note is that two coefficient estimates are greater than unity. This means that a one per cent increase in FP_t instantaneously leads to a 1.28 per cent increase in EP_t when ECT_{t-1} is greater than the upper threshold, θ_2 (in regime III). In addition, a one per cent increase in EP_t contemporaneously results in 2.03 per cent increase in FP_t when ECT_{t-1} lies in regime I (i.e. is less than the lower threshold, θ_1). This is unexpected as we would have expected a more gradual adjustment. Furthermore, the speed of adjustment towards the long-run equilibrium for

FP_t in regime I is higher than that in the regime III (10.1 per cent and 4.6 per cent per day, respectively). This means that coffee growers are better off when there are shocks to export prices. However, such an advantageous condition only lasts a short period of time.

As the system of TVECMs assumes that each regime differs in the speed of adjustment towards the long-run equilibrium, APT is tested only in the short-run. The results of APT are reported in Table 2.

Of the 12 possible short-run asymmetries, three are statistically significant; however, two of these must be disregarded (as the coefficients are greater than one), leaving only one short-run asymmetry in the price transmission process (ΔEP_t^+ and ΔEP_t^- in regime III). For this one positive short-run APT, rising export prices are transmitted more slowly to farmgate prices than falling export prices (coefficients of 0.33 and 0.64, respectively). This exposes the slightly disadvantaged position of growers in relation to exporters, in the coffee supply chain. As the variation in export price changes is reflected in farmgate prices within several days, it is evident that the APT is minimal for Vietnam's Robusta coffee when the threshold effects are taken into account.

Overall, this analysis confirms that prices are close to being symmetrically transmitted in both the short-run and the long-run between farm and export levels for Vietnam's Robusta coffee. The use of high-frequency data in this study better reflects the nature of price transmission between grower and export prices. Another explanation may lie with model specifications. In an earlier study on Vietnam's Robusta coffee, Li and Saghaian (2013) found little evidence of APT. Their results are not directly comparable as the authors used lower-frequency monthly price data for an earlier period from 1990 to 2011. In this study, the TVECM takes into account unobserved transaction costs and other price frictions, providing a better model specification than the linear VECM used by Li and Saghaian (2013).

Furthermore, our findings differ from the conclusions of previous studies involving other Robusta-producing countries such as Madagascar, Cameroon, Angola, Central African Republic and Uganda (González 2007; Fafchamps and Hill 2008). In these investigations, APT was present between grower and world prices, and neither was the APT eliminated as a result of market reforms that showed resilience even after market reforms. The use of

Table 2 Tests of short-run asymmetries in the system of TVECMs

Null hypothesis of equal coefficients	Regime I	Regime II	Regime III
Export price equation – test statistics			
(ΔFP_t^+, ΔFP_t^-)	0	0.001	21.366***
(ΔFP_{t-1}^+, ΔFP_{t-1}^-)	0.0782	0.0286	2.6694
Farmgate price equation – test statistics			
(ΔEP_t^+, ΔEP_t^-)	14.322***	0.1237	5.9596**
(ΔEP_{t-1}^+, ΔEP_{t-1}^-)	0.0085	1.2094	1.0723

Note: ***$P < 0.01$. **$P < 0.05$. Critical values at the 5 and 1 per cent significance level are 3.84 and 6.63 respectively.

monthly data may explain this difference. A further reason may result from the characteristic difference of Vietnam's coffee sector is Vietnamese exporters lacked the market power to maintain a price gap. The concentration of the eight largest export firms in Vietnam's coffee sector remained under 50 per cent in 2014 (Vu 2015). Meanwhile, the proportion of top ten exporters was around 87 per cent in Uganda in 2000/01 and 70 per cent in Cameroon in the 1990s (González 2007). Five exporters in Angola accounted for 90 per cent of total exports in 1998 while the coffee exports in Madagascar were controlled by less than ten firms.

To further examine the issue of data frequency, we also aggregated the daily coffee prices into weekly prices and re-evaluated price transmission between export and farm levels on a weekly basis. For the weekly price data, no short-run asymmetries are found in the TVECMs. Hence, data frequency (daily and weekly data) does not significantly affect the result of symmetric price transmission for Vietnam's Robusta coffee.

5. Conclusion

The objective of this research was to analyse the transmission between export and farmgate prices for Vietnam's Robusta coffee using daily price data between mid-2011 and the end of 2015. It improved on earlier work (Li and Saghaian 2013) using higher frequency data and by specifically testing the speed of price transmission in the presence of price increases and price decreases between levels. ΔFP^+ was used to denote a positive change (or increase) in the farm price, for example, and ΔFP^- was used to denote a fall in farm price. The advantage of this partitioning meant that it enabled us to test the different speeds of transmission when the prices at the different levels rose or fell. The research presented here also recognised nonlinearity in the price transmission process and utilised TVECMs to allow for this.

Our results confirm that the price transmission between farm and export levels is largely symmetric, regardless of rising or falling prices at the other level. Therefore, for example, a one per cent increase in export prices will be transmitted to farmgate prices at the same speed as a one per cent decrease in export prices. The study confirms the significance of threshold effects, in part caused by unobservable transaction and adjustment costs in the transmission process. There was only one positive short-run APT, revealing that rising export prices are transmitted more slowly to farmgate prices than are falling export prices; however, the difference in export price changes is transmitted to farmgate prices within several days.

Previous studies on Robusta coffee-producing countries yielded APT between global coffee prices and farmgate prices (González 2007; Fafchamps and Hill 2008). In contrast, for Vietnam's Robusta coffee, our research finds the absence of APT. Furthermore, no APT is observed for weekly price data, which was derived from the daily price data. Therefore, the result of symmetric price transmission in this study does not vary with data frequency.

Our finding of symmetry of price transmission from export prices to farmgate prices and vice versa provides evidence in support of Vietnam's ongoing efforts to integrate markets. The integration into the world market demonstrates the efficiency of Vietnam's coffee sector and implicitly validates the policy reforms. At the same time, the 2019 date approaches towards Vietnam's accession from its current 'nonmarket' status to that of a market economy in WTO. Our research lends support to the view that Vietnam will be well-positioned to meet this challenge.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1 TVECM estimation results, export and farmgate price equations.

Data S1 Daily export and farmgate prices of coffee from June 2011 to December 2015.