Examination of the international market power for Iranian pistachios

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Abstract:

Abstract Iran accounts for more than 50 percent of the world pistachios market and thus has a leading role in price formation of pistachios. The objective of this study is to determine the price transmission pattern between domestic and world markets of pistachio and to investigate the link between market power and asymmetric adjustment. An innovative specification of asymmetric autoregressive model of Pricing to Market (PTM) employed to study the export-domestic price relationship by incorporating the exchange rate in increasing and decreasing components of the PTM model. Results indicate that PTM analysis-based specification is preferable to a simple model that does not cover the exchange rate effect. Also, the empirical findings suggest that export prices are more responding to the exchange rate increases than decrease in the exchange rates. The asymmetric transmission effect of the exchange rate also indicates a possible source of market power exerted by Iranian exporters

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Keywords: **Asymmetric transmission, Pistachio, Market power, Pricing to Market, Iran**

1. Introduction

Iran is the largest and the main exporter of pistachios in the world, accounting for a market share of higher than 50 percent during most of 1961-2010. During this period pistachios global trade volume as well as its export price increased. The Iranian export value amounts to more than 1 billion USD (FAO, 2010). Therefore, one may be interested in knowing the relationship of export and domestic price and the potential of exerting market power. There are numerous studies in Iran that tried to cover different features of pistachios export. Most of them investigate the factors influencing pistachios export quantity like Mahmoodzade and Zibai (2004). Despite the importance of price formation in world and domestic market and how it also transmits from one market to another, scarce attention has been paid to it. The asymmetric price transmission is the process which implies that transmission differs according to whether prices are increasing or decreasing (Von Cramon-Taubadel& Meyer, 2000). Peltzman (2000) emphasized some unusual notes on economic theories by studying the price transmission of 282 products and product categories, including 120 agricultural and food products. He found the price transmission an asymmetric process in most cases. He strongly concluded that the standard economic theory of markets is wrong, because it does not predict or explain the prevalence of asymmetric price adjustment (Peltzman 2000). An example of spatial asymmetric price transmission (APT) was reported by Abdulai (2000) among local maize markets in Ghana. Aguiar and Santana (2002) also argue that farm prices are expected to show asymmetric price transmission. Recently, Ahn and Lee (2013) also found the existence of asymmetric price transmission between factory and wholesale prices of fiberboard in Korea. However, there are cases of symmetric price transmission like what is reported by Bakucs and Ferto (2006) between farm gate and retail markets of Hungarian pork market.

On the other hand, authors like Gauthier & Zapata (2001) and Von Cramon-Taubadel & Meyer (2000) recommend a cautionary conclusion since there may be some methodological problems associated with empirical tests developed for asymmetry. They point out that standard tests such as the one applied by Peltzman may lead to excessive rejection of the null hypothesis of symmetry under common conditions. In addition, as Meyer and Von Cramon-Taubadel (2004) point out more attention is needed about the data applied to test, in particular, some issues such as data frequency are important. There is poor literature on the importance of data frequency. In the case of data frequency Von Cramon-Taubadel & Loy (1996) point out the need for data with a frequency that exceeds that of the adjustment process. Two issues may arise from the asymmetric price transmission. First, as Peltzman (2000) points out, APT may point to gaps in economic theory and some doubt will be cast on the body of the economic theories that are considered as instruments for decision making. Second, as Meyer and Von Cramon-Taubadel (2004) suggest, APT could have important welfare and hence policy implications. Briefly, APT implies that when an asymmetric price transmission exists a group involved in a commodity market does not benefit from a price reduction (buyers) or increase (sellers) as would be advantageous under the symmetric price transmission.

Much emphasis is placed on the role of market power in APT occurrence and noncompetitive structure. In the case of known agricultural commodities, an example of competitive market which farmers have little bargaining power on, it is expected that margin-squeezing events which increase origin prices (or decreases destination prices) transmit faster and/or more completely than the corresponding margin-stretching price changes (Meyer and Von Cramon-Taubadel, 2004). This case of the APT is referred to as positive APT. On the other hand, Ward (1982) suggested that market power may lead to negative APT because oligopolists may be reluctant to be exposed to the risk of losing market share as can occur by increasing destination prices. Bailey & Brorsen (1989) also in the case of firms facing a kinked demand curve argue that if a firm believes that no competitor will match a price increase, but all will match a price cut, negative asymmetry will result. Most studies find the positive APT more common than negative APT while Bailey & Brorsen (1989) for the US beef market argue that a negative APT was due to packers attempt to decrease cost by increasing the operating scale and, therefore, reduction in marketing margin. In contrast, Peltzman (2000) argues that it is easier for a firm to reduce origins in the case of a destination reduction than it is to recruit more origins to increase destination, so a positive APT is expected. Hence it is not clear a priori whether market power will lead to positive or negative asymmetry (Bailey & Brorsen 1989). Many authors, especially for agricultural commodities have suggested market power as a common source of APT (Mc Corriston et al., 1998; Azzam and Schroeter, 1995; Chen and Lent, 1992; Bunte and Peerlings, 2003; Carman and Sexton, 2005) but few attempts have been made to investigate the link between market power and APT.

As was revealed above, market power may be a potential source of APT. Market power is defined as the ability to profitably alter prices away from competitive levels (Stoft, 2002). Market power exists when one group of marketing agents has a higher bargaining power than the other (Weerahewa, 2003). However, Peltzman (2000) found conflicting impacts of market power indices on APT. His results revealed that asymmetry increases as the number of enterprises falls, while it tends to decrease as concentration increases.

Almost all the studies cover price transmission between domestic markets or local markets while transmission between domestic and export market has not received adequate attention in asymmetric context. However, there is significant literature for export markets in which price transmission is considered based on pass-through effect of exchange rate or exchange rate pass-through (EPT) effect which is used to explore imperfect condition known as "pricing to market" (PTM). Based on PTM hypothesis developed by Krugman et al., (1987), in an imperfect market, a large trader may adjust the exchange rate proportionally with price movements. Exporters try to absorb at least part of the exchange rate changes into their profit margins in order to keep the export price relatively stable (Yang, 1998). This issue can be the case of interest for the Iranian pistachio market as it accounts for a significant share of global exports.

The common implication derived from PTM is to examine the possibility of market power. For example, Yumkella et al. (1994) using PTM model found evidence of imperfect exchange rate pass-through effect in the US and Thai rice export market and suggested the possibility of exerting market power. Using a similar analytical framework Griffith and Mullen (2001) examined PTM in the Australian rice export market. They rejected the hypothesis of competitive prices. Unlike the mentioned studies in which exporters market power has been considered, Rakotoarisoa and Shapouri, (2001) investigated the market structure of vanilla beans imported by the USA from five producers of vanilla beans in developing countries. They found some evidence that the US importers of vanilla beans have the market power to apply price discrimination and to adjust import prices in reaction to exchange rate movement vis-à-vis exporters.

2. Methodology

In line with the proposed objective of the current study, two approaches are used to address the possible market power in the Iranian pistachio export market. First, price transmission examination, which tests symmetry in transmission of price from Iranian domestic market as origin to export market as destination. Price transmission behavior is examined since asymmetric transmission is considered as common source of market power (Scherer and Ross, 1990). Another approach is pricing to market which has been widely used to examine market power in export market. Asymmetric price transmission examination includes three sections. First, in the next section the theoretical literature of price transmission is addressed. In this section asymmetric price transmission is considered in general using simple model of Ward

(1982). Then asymmetric price transmission is examined in section 3.2 while cointegration analysis is also considered. In this setting it is also first assumed that cointegrated series have an error correction representation in which destination market price corrects any positive or negative deviation from the long-run equilibrium the same. Then the model is extended by allowing destination market price to respond differently to deviations from the long-run equilibrium. In addition, some innovative specifications like asymmetric autoregressive model are considered. Finally, in section 3.3 as last step of asymmetric price transmission examination, a testing procedure is introduced.

3.1 Price transmission

The standard empirical models assume that prices are transmitted symmetrically from the origin to destination market. While, Peltzman (2000) finds asymmetric price transmission to be the rule rather than the exception. Given that the price of pistachio in origin market, i.e. Iran, is the main input cost in destination market price of pistachio and in terms of specifications developed by Ward (1982) which are the extended specifications of Houck (1977), the relationship between origin and destination markets is as follows:

$$P_t^w = \beta_0 + \sum_{j=1}^{K}(\beta_j^+ \sum_{j=1}^{T} D_t^+ \Delta P_{t-j+1}^d) + \sum_{j=1}^{L}(\beta_j^- \sum_{t=1}^{T} D_t^- \Delta P_{t-j+1}^d) + \varepsilon_t \tag{1}$$

$$\Delta P_t^w = \beta_0 + \sum_{j=1}^{K}(\beta_j^+ D_t^+ \Delta P_{t-j+1}^d) + \sum_{j=1}^{L}(\beta_j^- D_t^- \Delta P_{t-j+1}^d) + \gamma_t \tag{2}$$

where Δ is the first difference operator, P_t^d and P_t^w are price in origin and destination markets, respectively. α , β_j^+ and β_j^- are coefficients, β_j^+ for the increasing origin price phases and β_j^- for the decreasing origin price phases, t is the current time period, D_t^+ and D_t^- are dummy variables with: $D_t^+ = 1$ if $P_t^d \geq P_{t-1}^d$ and $D_t^+ = 0$ otherwise; $D_t^- = 1$ if $P_t^d \prec P_{t-1}^d$ and $D_t^+ = 0$ otherwise and ΔP_t^w is defined as $P_t^w - P_{t-1}^w$ (Meyer and Von Cramon-Taubadel, 2004). By means of the dummy variables, the origin price is split into one variable that includes only increasing origin prices and another that includes only decreasing origin prices. As a result, two origin price adjustment coefficients are estimated; these are β^+ for the increasing origin price phases and β^- for the decreasing origin price phases. Symmetric price transmission is rejected if β^+ and β^- are significantly different from one another, which can be evaluated using an F-test. In other words, in such setting, the asymmetries or rigidities in price transmission persists when the coefficients on the slope dummies are significantly different from zero (Wlazlowski et al, 2009). In fact, in this specification focus is on the slope differences.

Boyd and Brorsen (1988) are the first to use lags to differentiate between the magnitude and the speed of transmission. Based on comparisons of individual β – coefficients in Equations (1) and (2) - the speed of price transmission in specific periods is analyzed, and based on the sums of these coefficients its magnitude is analyzed as well. Other specifications are like those of Ward.

3.2 Asymmetric price transmission

After cointegration analysis, considerable challenges were created. In the context of price transmission for P_t^d and P_t^w as nonstationary series, based on the cointegration analysis and using ECM model asymmetric adjustment terms are entered into equations (1) and (2), providing a more appropriate specification for testing APT.

Based on this approach and in terms of our variables, Eq. (3) is estimated. If tests prove that Eq. (3) is not a spurious regression, then P_t^d (domestic price) and P_t^w (export price) are referred to as being cointegrated and Eq. (3) can be considered an estimate of the long-term equilibrium relationship between them.

Engle and Granger (1987) approach has been widely used to test dynamic long-run equilibrium relationship between two variables. In the case of the export (P_t^w) and domestic (P_t^d) market prices and considering that P_t^d and P_t^w are stationary in the first difference, this approach is as follows:

$$P_t^w = \alpha_0 + \alpha_1 P_t^d + \mu_t \tag{3}$$

where μ_t is a random error term with constant variance that can be contemporaneously correlated. Long-run market integration test within this framework verifies whether any stable long-run relationship exists between the two price series. That implies μ_t, the errors, are stationary (Dwyer and Wallace, 1992). The Engle–Granger approach involves using μ_t from Eq. (3) to estimate ρ in the following relationship:

$$\Delta\mu_t = \rho\mu_{t-1} + \varepsilon_t \tag{4}$$

where ε_t is a white noise process. If the residuals are stationary with mean zero, the null hypothesis of no cointegration will be rejected. In the second step, an ECM that relates changes in p_t^w to changes in p_t^d as well as the error correction term (ECT) - the lagged residuals from the estimation of Eq. (3) - is estimated. Considering the ECT measures deviations from the long run equilibrium between P_t^d and P_t^w, including it in the ECM allows P_t^w not only to respond to changes in P_t^d but also to 'correct' any possible deviations from its long run equilibrium that may be left over from previous periods (Meyer and Von Cramon-Taubadel, 2004). The model of error correction is the standard procedure for studying dynamic price adjustment. Given the existence of a cointegrating vector in the Eq. (3) as well as the asymmetric price transmission from export market to domestic market, the error correction representation is as follows:

$$\Delta P_t^w = \beta_0 + \sum_{j=1}^{k}(\beta_j^+ D^+ \Delta P_{t-j+1}^d) + \sum_{j=1}^{k}(\beta_j^- D_t^- \Delta P_{t-j+1}^d) + \phi ECT_{t-1} + \gamma_t \tag{5}$$

where ECT is the one-period lagged residual from Eq. (3). The short-run asymmetry is captured by breaking price changes into $D^{+}\Delta P^{d}_{t-j+1}$ if their respective difference is above zero and $D^{-}\Delta P^{d}_{t-j+1}$ otherwise.

Splitting the ECT into positive and negative components, i.e. positive and negative deviations from the long-term equilibrium – ECT^{+} and ECT^{-} – make it possible to test for asymmetry in adjustment process. The ECM, including lagged changes in P^{d}_{t} will be as follows:

$$\Delta P^{w}_{t} = \beta_0 + \sum_{j=1}^{k}(\beta^{+}_{j} D^{+}\Delta P^{d}_{t-j+1}) + \sum_{j=1}^{k}(\beta^{-}_{j} D^{-}_{t}\Delta P^{d}_{t-j+1}) + \phi^{+} ECT^{+}_{t-1} + \phi^{-} ECT^{-}_{t-1} + \gamma_t \quad (6)$$

ECT^{+}_{t-1} (ECT^{-}_{t-1}) is the one-period lagged residual from Eq. (3) when export price is above (below) the long run equilibrium, measuring long run disequilibrium between the export and domestic market prices. However, it should be noted that splitting ECT into positive and negative components stems from the fact that price adjustment process is asymmetric. Symmetry of adjustment process can be formally tested, as introduced in the next section.

Cointegration and the ECM are based on the idea of a long run equilibrium; which prevents P^{d}_{t} and P^{w}_{t} from drifting apart. Hence, in the framework of equation such as (6) it is only possible to consider asymmetry with respect to the speed of price transmission, not the magnitude. APT with respect to magnitude means that there is a permanent difference between positive and negative episodes of transmission; this will, in the long run, ratchet the prices in question apart, with the result being that they cannot be cointegrated (Meyer and Von Cramon-Taubadel, 2004).

As the last step, the traditional tools used to test for asymmetries in price transmission and described in Eq. (6) were augmented to account for autoregressive effects captured by Eq. (7). In such setting the following model was estimated:

$$\Delta P^{w}_{t} = \beta_0 + \sum_{j=1}^{k}\theta_i \Delta P^{w}_{t-j} + \sum_{j=1}^{k}(\beta^{+}_{j} D^{+}\Delta P^{d}_{t-j+1}) + \sum_{j=1}^{k}(\beta^{-}_{j} D^{-}_{t}\Delta P^{d}_{t-j+1}) + \phi^{+} ECT^{+}_{t-1} + \phi^{-} ECT^{-}_{t-1} + \gamma_t \quad (7)$$

Ahn and Lee (2013) extend the asymmetry to lagged own variables segmented to positive and negative components as follows:

$$\Delta P^{w}_{t} = \beta_0 + \sum_{j=1}^{k}(\theta^{+}_{j} D^{+}\Delta P^{w}_{t-j}) + \sum_{j=1}^{k}(\theta^{-}_{j} D^{-}_{t}\Delta P^{w}_{t-j}) + \sum_{j=1}^{k}(\beta^{+}_{j} D^{+}\Delta P^{d}_{t-j+1}) + \sum_{j=1}^{k}(\beta^{-}_{j} D^{-}_{t}\Delta P^{d}_{t-j+1}) + \phi^{+} ECT^{+}_{t-1} + \phi^{-} ECT^{-}_{t-1} + \gamma_t \quad (8)$$

Given that Eq. (8) is the most extended and augmented model of the study, on the one hand, the short-run asymmetry is captured by breaking domestic price changes into positive and negative components. On the other hand, the asymmetry in the adjustment speed at which relative prices return to their long-run equilibrium is introduced by splitting one-period lagged residuals into positive and negative components. A short asymmetry pattern occurs when the short-run coefficients β^{+}_{j} and β^{-}_{j} are different from each other. By comparing the aggregation of these coefficients, asymmetry in magnitude known as "amount asymmetry" is also tested (Bettendorf et al., 2009; Von Cramon-Taubadel, 1998).

3.3 Asymmetric adjustment test

The implicit assumption of the Engle–Granger test is that the system exhibits symmetric adjustment (Enders and Granger, 1998). This assumption is problematic if prices are sticky in the downward direction, but not in the upward direction (Abdulai, 2000). Enders and Granger (1998) introduced asymmetric adjustment by allowing the deviations from the long-run equilibrium in Eq. (3) to behave as a Threshold Autoregressive (TAR) process:

$$\Delta\mu_t = I_t\rho_1\mu_{t-1} + (1-I_t)\rho_2\mu_{t-1} + \varepsilon_t \qquad (9)$$

where, I_t is the Heaviside indicator function so that:

$$I_t = \begin{cases} 1 & \text{if } \mu_{t-1} \geq 0 \\ 0 & \text{if } \mu_{t-1} \prec 0 \end{cases} \qquad (10)$$

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 μ_{t-1} is below its long-run equilibrium.

Engle–Granger approach, which is based on the hypothesis of symmetric adjustment, means that $\rho_1 = \rho_2$, so the Engle–Granger approach will be a special case of (9) and (10). Enders and Granger (1998) show that Eq. (9) can be augmented with lagged changes in the μ_{t-1} sequence such that it becomes a p-th order process as follows:

$$\Delta\mu_t = I_t\rho_1\mu_{t-1} + (1-I_t)\rho_2\mu_{t-1} + \sum_{i=1}^{p-1}\pi_i\Delta\mu_{t-1} + \varepsilon_t \qquad (11)$$

Appropriate lag length is also determined by diagnostic checks of the residuals and conventional model selection criteria.

Null hypothesis is $\rho_1 = \rho_2 = 0$. If cointegration relationship of Eq. (9) is approved then the null hypothesis of symmetric adjustment $\rho_1 = \rho_2$ can be tested using a standard F-distribution (Enders and Granger, 1998). If the null hypothesis of symmetric adjustment is rejected, then residual series should be split into positive (ECT^+) and negative (ECT^-) components. The test statistics for the null hypothesis using the TAR specification of (9) and (10) are called Φ_μ and the appropriate critical values for Φ_μ are tabulated in Enders and Granger (1998) and Enders and Siklos (1998).

Instead of estimating Eq. (9) with the Heaviside indicator of Eq. (10) in which decay is dependent on the level of μ_{t-1}, it may be allowed to decay depending on the changes in μ_{t-1} as follows (Abdulai, 2000):

$$I_t = \begin{cases} 1 & \text{if } \Delta\mu_{t-1} \geq 0 \\ 0 & \text{if } \Delta\mu_{t-1} \prec 0 \end{cases} \qquad (12)$$

Eq. (12) is particularly useful when adjustment is asymmetric to the degree that the series exhibits more "momentum" in one direction than the other (Enders and Granger, 1998).

The cointegration analysis based on Equations (9) and (12) is termed momentum-threshold autoregression (M-TAR) approach. The test statistics for the null hypothesis using the TAR specification of (9) and (10) and the M-TAR specification of (9) and (12) are called Φ_μ and Φ_μ^*, respectively.

Finally, given the existence of a cointegrating vector in the form of Eq. (3) as well as asymmetric adjustment process, the error correction representation for our augmented model (8) can be written as:

$$\Delta P_t^w = \beta_0 + \sum_{j=1}^{k}(\theta_j^+ D^+ \Delta P_{t-j}^w) + \sum_{j=1}^{k}(\theta_j^- D_t^- \Delta P_{t-j}^w) + \sum_{j=1}^{k}(\beta_j^+ D^+ \Delta P_{t-j+1}^d) + \sum_{j=1}^{k}(\beta_j^- D_t^- \Delta P_{t-j+1}^d) + I_t \phi^+ ECT_{t-1}^+ + (1-I_t)\phi^- ECT_{t-1}^- + \gamma_t \quad (13)$$

where ϕ^+ and ϕ^- are the adjustment coefficients for positive and negative deviations, respectively.

3.4 Pricing to market

To test the occurrence and effectiveness of PTM and the presence of market power, the completeness of exchange rate pass-through (EPT) must be checked (Rakotoarisoa and Shapouri, 2001). Complete EPT may indicate a perfectly competitive market structure but incomplete EPT is also possible in an imperfect market.

To implement the test, it is assumed that a representative Iranian pistachio exporting firm produces for imperfectly competitive overseas markets and costs are independent of destination as the product exported is identical across markets. We assume that profit of the firm is given by

$$\Pi(p^w) = \sum_{i=1}^{n} p^w x(p^{w*}) - C[(x(p^{w*})w)] \quad (14)$$

Where C (.) is cost function, which depends on firm's total production and input prices (w), and $x(p^{w*})$ is demand faced by the firm in export market. Also, p^w is the export price in units of the exporter's currency, i.e. $p^w = p^{w*}e$ where e is the exchange rate[1], defined as units of the exporter's currency per unit of the export market currency. We drop time argument for simplicity. The first-order condition of firm's profit maximizing problem generates the following equation:

$$p^w = MC(\varepsilon / \varepsilon - 1) \quad (15)$$

where MC is the marginal cost and $\varepsilon = \varepsilon(p^{w*})$ denotes the elasticity of the demand in the export market. The equation given by (15) implies that the exporter optimal price to export market depends on the common marginal cost and the markup of price over marginal cost (Gil-Pareja, 2003). The mark up, in turn, depends on exchange rate. Since information on marginal cost is difficult to obtain for the study period and regarding the dominant role of domestic price

[1] Exchange rate is USD as we use the aggregated export date in which export unit values are in USD.

of pistachio in exported pistachio price, it is assumed that marginal cost is equal to the domestic price of pistachio (p^d) [2]. Considering the explanations presented for Eq. (15) the test of pricing-to-market will be carried out by the following model:

$$P_t^w = \lambda_0 + \lambda_1 e_t + \lambda_2 P_t^d + u_t \qquad (16)$$

where P_t^w is the export price in the Iranian currency, e the exchange rate (domestic currency per unit of foreign currency, i.e. the US dollar), P_t^d is the Iranian domestic market price, λ_1 shows the exchange rate effect, λ_0 is constant, and u is the error term. Subscript t indicates the time. All values are in the Iranian currency (Rials). If changes in bilateral exchange rate are fully reflected in bilateral export prices, there should be no exchange rate, i.e. $\lambda_1 = 0$. This reveals a perfectly competitive market.

Given the impact of exchange rate changes on the pricing behavior of the Iranian exporters in the pistachio export market, we now extend Eq. (13) by incorporating exchange rate as follows:

$$\Delta P_t^w = \beta_0 + \sum_{j=1}^{k}(\theta_j^+ D^+ \Delta P_{j-1}^w) + \sum_{j=1}^{k}(\theta_j^- D_t^- \Delta P_{j-1}^w) + \sum_{j=1}^{k}(\beta_j^+ D^+ \Delta P_{t-j+1}^d) + \sum_{j=1}^{k}(\beta_j^- D_t^- \Delta P_{t-j+1}^d) + \lambda \Delta e_t + I_t \phi^+ ECT_{t-1}^+ + (1-I_t)\phi^- ECT_{t-1}^- + \gamma_t \qquad (17)$$

Finally, we extend Eq. (17) as follows to capture the possible asymmetry in behavior of export price with respect to exchange rate variable.

$$\Delta P_t^w = \beta_0 + \sum_{j=1}^{k}(\theta_j^+ D^+ \Delta P_{t-j}^w) + \sum_{j=1}^{k}(\theta_j^- D_t^- \Delta P_{t-j}^w) + \sum_{j=1}^{k}(\beta_j^+ D^+ \Delta P_{t-j+1}^d) + \sum_{i=1}^{k}(\beta_j^- D_t^- \Delta P_{t-j+1}^d) + \sum_{j=1}^{k}(\lambda_j^+ D^+ \Delta e_{t-j+1}) + \sum_{j=1}^{k}(\lambda_j^- D^- \Delta e_{t-j+1}) + I_t \phi^+ ECT_{t-1}^+ + (1-I_t)\phi^- ECT_{t-1}^- + \gamma_t \qquad (18)$$

In fact, Eq. (18) considers PTM analysis in the context of asymmetric transmission since it let all variables of Eq. (16) - the standard model to test PTM- to be split into positive and negative components. In addition, it captures asymmetry in adjustment of long run disequilibrium between the export and domestic market prices as it applies one-period lagged residual from Eq. (16) in positive and negative components.

Data and stationarity tests

The data used in this analysis are based on yearly observations of domestic wholesale prices and export prices obtained from the Food and Agriculture Organization (FAO) database. Export prices are converted to the Iranian local currency (Rials) using free market exchange rate. Exchange rate series was also obtained from the Iranian Central Bank statistics year

[2] This assumption is similar to Durevall, (2007) who used importing price of coffee as marginal cost in production of roasted coffee in Sweden. He points out that marginal cost information is difficult to obtain as well as imported green coffee beans has a dominant role in coffee roasting. Therefore, assumed that marginal cost is equal to the import cost of beans.

books. The data cover the period of 1966-2010. The price series stationarity is tested using the augmented Dickey Fuller (ADF) test. The results are not presented here for brevity. Unit root test results support the presence of one-unit root, indicating nonstationarity in each price and exchange rate series.

3. Results

Price transmission from the Iranian domestic market to export market is investigated using Eqs. (3) and (16). Eq. (3) is the original equation to investigate price transmission in the context of APT, while Eq. (16) is the standard model to test exchange rate pass-through effect. Having obtained evidence of non-stationarity, first we proceed with the long run estimation results to investigate the relationship between domestic and export price. Then cointegration test results are presented in Table 3.

Long run and cointegration estimations

As presented in Table 2, based on both equations (3) and (16), the null hypothesis of no long run relationship between two markets is rejected. Constant absolute margin between two markets is not significant statistically, indicating variable margin. Long run coefficients for equations. (3) and (16) are 1.283 and 1.087 respectively, and highly significant. If the coefficients are not statistically different from 1 then price transmission will be complete (Bakucs and Ferto, 2006). The Wald test showed that the long run coefficient in Eq. (16) specification is not statistically different from 1, indicating a complete transmission process in long run. It should be noted that formal hypothesis testing about the value of the cointegrating parameters cannot be carried out with the cointegration results because verification of nonstationarity of price series implies that the estimated standard errors are not consistent, although the estimates of the parameters are consistent (Abdulai, 2000). However, long-run integration in this context implies prices in the domestic and export market move together (Dercon, 1995). Therefore, in the next step cointegration techniques are applied to examine the cointegration between export and domestic prices.

Table 2
Long run estimation results

	α_0	α_1	λ_0	λ_1	λ_2	AIC	Q(2)[c]
Eq. (3)	1015700 (799922)[b]	1.283***[a] (0.045)	-	-		33.52	3.84(0.15)
Eq. (16)	-	-	752925 (660532)	1.087*** (0.079)	-25.939 (403.11)	32.92	2.22(0.33)

[a]The levels of statistical significance are denoted with ** for the 5% and *** for the 1%.

[b]Numbers in parentheses are standard errors.

[c]$Q(p)$ is the significance level of the Ljung–Box statistic in which the first p of the residual autocorrelations are jointly equal to zero.

As indicated in Table 2, the values of constants are not significant in either specification. This indicates that the export and domestic markets are not linked by a constant absolute margin. The estimated values of domestic price coefficients are greater than 1 and statistically significant, indicating a higher price in export market compared to the domestic. However, incorporating exchange rate effect that allows the price difference between the two markets to be corrected results in lower price differences, indicating that in the long run a fraction of higher prices in the export market is lost.

Table 3 presents the test results of three cointegration approaches including the Engle–Granger, TAR and M-TAR models, applied to test cointegration between domestic and export prices. The corresponding t-statistics from the Engle–Granger test for the null hypothesis of $\rho = 0$ are -4.05 and -5.33 for Eq. (3) and (16), respectively. The critical values for the two and three variable cases are -4.12 and -4.59 respectively at the 1% significance level and the corresponding values at the 5% significance level are -3.46 and -3.92 (Enders, 2003). Therefore, given that the 5% significance level[3] is accepted, the null hypothesis of no cointegration between the domestic and export can be rejected for both Equations.[4] The Ljung–Box Q-statistics reported in Table 3 for Engle–Granger cointegration test indicate that the residuals are not significantly correlated.

Based on the results of Table 3 for Engle–Granger approach, it is shown that there is a long run relationship between domestic and export markets prices, so an error correction model is available. In spite of the clear results about the relation between the markets, a basic hypothesis of the Engle-Granger approach is the symmetric adjustment of short run deviation from their long run trend. Enders and Granger (1998) cast doubt on this hypothesis; therefore they presented the TAR process to test the residual stationary and also long run relationship. The TAR model is estimated next in the form of Eqs. (9) and (10). In the Enders and Granger approach null hypothesis is $\rho_1 = \rho_2 = 0$. The critical value for the test of null hypothesis at 1% is 8.64 (Enders, 2003). Therefore, regarding the results of Table 3, the null hypothesis can be rejected for both equations (3) and (16), indicating a long run relationship between domestic and export market.

Given that the price series are cointegrated, the null hypothesis of symmetric adjustment (i.e., $\rho_1 = \rho_2$) can be tested using a standard F-distribution (Enders and Granger, 1998). The sample value of 7.41 for Eq. (3) is above the critical value at the 1% significance level. The null hypothesis of symmetric adjustments can therefore be rejected at the 1% level. The corresponding value for Eq. (16) is also 0.09 indicating symmetric adjustment.

Table 3
Results of cointegration analysis for export and domestic prices

[3] For estimated coefficients also we have accepted 5% significant level.

[4] For equation (16) the null hypothesis of no cointegration between domestic and export market prices can be rejected in 1% significant level as well.

		ρ [d]	ρ_1 [e]	ρ_2 [f]	Φ_μ [g]	$\rho_1 = \rho_2$ [h]	$Q(2)$ [c]
Eq. (3)	Engle–Granger cointegration	-0.651***[a] (0.161) [b]	-	-	-	-	0.369(0.83)
	Threshold cointegration (TAR)	-	-1.162*** (0.221)	-0.352 (0.224)	60.04	7.41***	0.63(0.73)
	Momentum threshold cointegration (M-TAR)	-	-0.807*** (0.195)	-0.169 (0.447)	23.87	4.39**	4.04(0.13)
Eq. (14)	Engle–Granger cointegration	-0.797*** (0.150)	-	-	-	-	3.84(0.147)
	Threshold cointegration (TAR)	-	-0.847*** (0.125)	-0.754*** (0.208)	13.93	0.09	1.162(0.56)
	Momentum threshold cointegration (M-TAR)	-	-0.832*** (0.208)	-0.759*** (0.226)	13.60	0.06	1.05(0.59)

[a]The levels of statistical significance are denoted with ** for the 5% and *** for the 1%.
[b] Numbers in parentheses are standard errors.
[c] $Q(p)$ is the significance level of the Ljung–Box statistic in which the first p of the residual autocorrelations are jointly equal to zero.
[d]Coefficients and standard errors for the null hypothesis $\rho = 0$. Critical MacKinnon (1991) values are applied to test null hypothesis.
[e] Coefficients and standard errors for the null hypothesis $\rho_1 = 0$.
[f] Coefficients and standard errors for the null hypothesis $\rho_2 = 0$.
[g]Sample values of Φ_μ and Φ_μ^*
[h]Sample F-statistic for the null hypothesis in which the adjustment coefficients are equal.

The M-TAR model is also estimated using Eqs. (9) and (12) and the results are presented in Table 3. The sample values of the Φ_μ^* statistic are 23.87 and 13.60 for Eq. (3) and (16), respectively, which are both above the critical value of 8.59 at the 1% level of significance (Enders, 2003), indicating that the null hypothesis of $\rho_1 = \rho_2 = 0$ can be rejected in both cases. However, the results of symmetric adjustment ($\rho_1 = \rho_2$) for Eq. (3) and (16) are not the same. Based on sample values of F, Eq. (3) shows an asymmetric price adjustment, while like TAR model, Eq. (16) indicates a symmetric adjustment process. In equation (3) like the TAR model, M-TAR model shows that positive deviation from the long-run equilibrium relationship is eliminated more rapidly than negative one. However, Eq. (16) indicates that both the negative and positive deviations from long-run equilibrium are eliminated in the same way.

Error correction estimations

Table 4 reports the estimation results of the error correction model for Eq. (3). Four models are presented for Eq. (3). In Model 1 none of export market prices and error correction terms are split into increasing and decreasing components. In Model 2 error correction terms are split into increasing and decreasing terms, while in line with Ahn and Lee (2013) the same is done for export market price lags in Model 4. Model 3 includes both variables segmented into increasing and decreasing series. Although four error correction models are developed for equation (3), there is some criteria to distinguish among them[5].

In terms of the number of statistically significant coefficients and diagnostic checks of the residuals (such as the Ljung–Box tests and model selection criteria like Adjusted R^2), Models 3

[5] Despite asymmetry adjustment test results that suggest splitting error correction term (ECT) to positive and negative components, however, in order to gain additional insight into the results two specifications are also presented while ECT is applied in its initial values (Model 1 & 4)

and 4 in which export price is split into increasing and decreasing components are preferred to Models 1 and 2, indicating the importance of dividing export price into positive and negative series. In Model 4 two out of four and for Model 3 three out of four coefficients of export price variable are significant. Additionally, in Model 3, error correction term, consistent with cointegration analysis results of Table 3, is split into positive and negative series. Therefore, it may be preferable to Model 4[6]. In addition to model selection criteria like Adjusted R^2 and Ljung–Box test results, and unlike other Models, coefficient of error term is also insignificant in Model 4. Therefore, the model that fully incorporates asymmetric features, i.e. asymmetric response with respect to all variables including own export price lags, domestic price as well as error correction terms (Model 3) is preferred over other models. For all estimations, a dummy variable is added to capture an unusual movement of the export price for the period 1999-2010.

Estimation results on Model 3 show that a rise or fall in domestic prices induces a decrease in export prices. This finding may appear inconsistent with our perception as it shows a reduction in export prices regardless of the changing direction in domestic market. However, domestic price may affect export price via lagged own variables of export market price, since contrary to the domestic market prices, previous export prices induce an increase in the current export prices. Both the decrease and increase in previous export prices are expected to increase current export prices. In other words, the negative impact of domestic market prices is dampened by lagged own export prices, however, their combined effects are expected to increase export prices as the coefficient of decreasing term for lagged price (θ_1^-) is as high as 2.2. Therefore, domestic price transmission to export price should be investigated via lagged own variable of export price as well. However, it is worth noting that if we accept the specification of Model 3 for Eq. (3) then effects of lagged own variable may be attributed to domestic prices while based on Eq. (16) and PTM theory, exchange rate changes are also important in export price changes. This issue has been examined in detail in the following section. In general, second order lagged variables are statistically insignificant, or the magnitude of their estimated effects is relatively small, indicating that the lagged effects in price transmission tend to be fully realized within a short time period, which may last at most two periods. While most of the first order lagged variables are significant with relatively higher estimated coefficients.

Another important finding of Model 3 is the statistical significance of the error correction terms. This indicates that export market prices respond to both negative and positive discrepancies in the long-run price relationship between the export and domestic markets. Error correction coefficients, ϕ^+ and ϕ^-, are significant at 95% confidence level. However, they are in opposite directions. While positive deviation of the previous export price from its long run equilibrium is expected to decrease the current short-run export market price, negative deviation will increase the current short-run export market price. In other words, any deviation from long-run equilibrium tends to return to long run path. Further, the F-test result shows that

[6] In the interest of brevity only Model 3 is explained in detail.

these error-correction effects are asymmetric (Table 5), and this asymmetry is positive as indicated by $|\phi^{+}| \succ |\phi^{-}|$, implying that positive deviation tends to return to long run path more rapidly than negative deviation. The point estimates imply that export prices adjust to eliminate the whole of a unit positive deviation from the equilibrium relationship created by changes in domestic price in one period, while the corresponding time period for the negative changes is more than one. The same directional results are obtained for Model 4 where error correction term is not split into positive and negative components. This ensures our results on the negative effect of domestic price on export price and dampening effects caused by own lagged prices.

Table 5 also presents null hypothesis tests carried out for symmetry in price transmission from domestic market to export market. It contains current and cumulative domestic market price as well as error correction effects. As Table 5 shows, the null hypothesis that the effect of the current domestic market price is symmetrically transmitted to the current export price is rejected at the 99% confidence level for Models 3 and 4. In addition, the hypothesis that the cumulative effect of domestic prices is symmetric ($\sum_{i=0}^{2}\beta_j^{+} = \sum_{i=0}^{2}\beta_j^{-}$) is also rejected. Based on both the current and cumulative effects, export price responds with a larger amount to a domestic market price decrease than to an increase. The symmetry can be strongly rejected for cumulative lagged own price effects of Model 3. However, as discussed above, these asymmetric effects may appear in other variables like exchange rate. This issue has been addressed in more detail in the following part.

Table 4
Results of error correction models for Eq. (3) ($P_t^w = \alpha_0 + \alpha_1 P_t^d + \mu_t$)

Coefficient	Regressor	Model 1		Model 2		Model 3		Model 4	
	Constant	1602544**[a]	(592138)[b]	2301201***	(670320)	1338285***	(435481)	545796	(467868)
θ_1	ΔP_{t-1}^{w}	-0.044	(0.209)	-0.066	(0.200)				
θ_2	ΔP_{t-2}^{w}	-0.807***	(0.266)	-0.369	(0.340)				
θ_1^{+}	$D^{+}\Delta P_{t-1}^{w}$					0.977***	(0.191)	0.963***	(0.232)
θ_1^{-}	$D^{-}\Delta P_{t-1}^{w}$					-2.186***	(0.311)	-2.067***	(0.376)
θ_2^{+}	$D^{+}\Delta P_{t-2}^{w}$					0.721**	(0.330)	0.134	(0.357)
θ_2^{-}	$D^{-}\Delta P_{t-2}^{w}$					-1.577	(1.046)	-1.955	(1.265)
β_0^{+}	$D^{+}\Delta P^{d}$	-1.193***	(0.177)	-1.158****	(0.171)	-0.657***	(0.136)	-0.724***	(0.164)
β_0^{-}	$D^{-}\Delta P^{d}$	2.797***	(0.626)	2.019***	(0.719)	2.519***	(0.439)	3.414***	(0.454)
β_1^{+}	$D^{+}\Delta P_{t-1}^{d}$	0.718***	(0.228)	0.504**	(0.244)	-0.307	(0.186)	-0.011	(0.206)
β_1^{-}	$D^{-}\Delta P_{t-1}^{d}$	2.178***	(0.671)	2.260***	(0.643)	2.306***	(0.526)	2.169***	(0.637)
β_2^{+}	$D^{+}\Delta P_{t-2}^{d}$	0.307	(0.193)	-0.036	(0.255)	-0.598**	(0.186)	-0.171	(0.182)
β_2^{-}	$D^{-}\Delta P_{t-2}^{d}$	-0.942	(0.627)	-0.626	(0.621)	-0.049	(0.391)	-0.464	(0.457)
ϕ	ECT_{t-1}	0.523**	(0.217)					-0.342	(0.230)
ϕ^{+}	ECT_{t-1}^{+}			-0.153	(0.404)	-1.198***	(0.290)		
ϕ^{-}	ECT_{t-1}^{-}			1.483***	(0.534)	0.762**	(0.340)		
	Dummy	11406526***	(3315277)	15529651***	(3611857)	11994651***	2420467	7278138***	(2546945)
	Adjusted R^2	0.712		0.736		0.904		0.857	
	Q(2)[c]	3.66	(0.16)	0.73	(0.69)	1.91	(0.38)	5.78	(0.06)

F-statistics	11.13***	11.39***	31.26***	22.00***

[a] The levels of statistical significance are denoted with ** for the 5% and *** for the 1%.
[b] Numbers in parentheses are standard errors.
[c] $Q(p)$ is the significance level of the Ljung–Box statistic in which the first p of the residual autocorrelations are jointly equal to zero.

Table 5
F-test results of asymmetry of models for Eq. (3) ($P_t^w = \alpha_0 + \alpha_1 P_t^d + \mu_t$)

Null hypothesis	Model 1	Model 2	Model 3	Model 4
$\sum_{j=1}^{2} \theta_j^+ = \sum_{j=1}^{2} \theta_j^-$	-	-	15.86***	9.49***
$\beta_0^+ = \beta_0^-$	31.46***	15.86***	44.46***	69.87***
$\sum_{j=0}^{2} \beta_j^+ = \sum_{j=0}^{2} \beta_j^-$	7.11**	8.27***	38.03***	23.45***
$\phi^+ = \phi^-$	-	3.82	15.24***	-

Table 6 reports the estimation results of the error correction models for Eq. (16). Based on the possible importance of splitting exchange rate and lagged own export price effects to positive and negative components four models are presented for Eq. (16). However, in line with the findings of cointegration with the TAR and M-TAR adjustments in this study that implies it is correct to estimate a symmetric error correction model, error correction term is not split into positive and negative components.

Comparing the results of Models 6 and 8 clearly reveals that incorporating exchange rate in positive and negative segments into specification results in insignificant coefficients of lagged own export price variables. Whereas domestic price coefficients are affected slightly, leading to the conclusion that lagged own export price, captures exchange rate effects.

An important finding is the statistical insignificance of the error correction term in Model 7, indicating that export market prices do not appear to respond to disequilibria in domestic and export market prices relationships.

The F-test results of Table 7 provide strong evidence of asymmetry in transmission of current and cumulative exchange rate effects as well as current domestic price effects in Model 7. However, contrary to Model 3 of Eq. 3 (Table 5), cumulative effects of domestic price are symmetric. In this regard, one interesting result is that cumulative effects of domestic price in Models 5 and 6 in which exchange rate is not segmented into positive and negative components are asymmetric. This may imply that splitting exchange rate into positive and negative components allows domestic price effect to also be addressed in further detail.

Like the results of Table 4, in Model 7, any change in domestic prices is also expected to induce a reduction in export price and is likely to hold for both current and cumulative effect of domestic prices. However, in terms of the absolute value of the coefficients, there is a significant difference. While the point estimate of β_0^+ and β_0^- shows coefficients higher than

1.4, the corresponding values for cumulative effects are less than 0.9[7]. This fact indicates that price transmission tends to be realized within a short time period.

One special feature of our study is the inclusion of the exchange rate effect whose contribution to explore market power is twofold. First, it allows having implications for market power based on PTM analysis. Second, asymmetric response of export price to exchange rate changes which is exchange rate pass-through effect examination in asymmetric transmission context, is expected to give additional insight into market power.

Based on PTM analysis, significant coefficients for exchange rate presented in Tables 6 indicate that the Iranian exporters react to the exchange rate increment by price adjustment. In other words, any exchange rate appreciation is faced with the Iranian exporters price adjustment (increase), showing a type of market power. These results suggest that in the case of exchange rate fluctuations, local currency stability is considered by the Iranian exporters. In other words, the exporters are able to impose price adjustment as exchange rate fluctuations occur. Positive exchange rate effects indicate that the export price moves together with exchange rate, both current and lagged, meaning a rise (fall) in exchange rate induces an increase (reduction) in export price. This finding is consistent with our expectation. However, as F-test results (Table 7) for the Model 7 show, both the current and cumulative effects of exchange rate are transmitted to export prices asymmetrically, anticipating the higher effect of exchange rate increase compared to decrease in exchange rate. Again combined with the findings on exchange rate effects, the significance of negative lagged own export price effects means that the lagged own prices work as a dampening factor even though negative exchange rate effects may dominate. As is also illustrated in Fig. 5, this effect of previous own export prices leads to higher response of export price to positive exchange rate effect as compared to that of negative one. This asymmetric transmission effect of exchange rate also indicates a possible source of market power exerted by Iranian exporters.

Table 6
Results of error correction models for Eq. (16) ($P_t^w = \lambda_1 + \lambda_2 e_t + \lambda_3 P_t^d + u_t$)

Coefficient	Regressor	Model 5		Model 6		Model 7		Model 8	
	Constant	750614***[a]	(259985)[b]	539733**	(218652)	274531	(278531)	-13378.8	(221221.5)
θ_1	ΔP_{t-1}^w	0.240	(0.133)			-0.404	(0.258)		
θ_2	ΔP_{t-2}^w	-1.670***	(0.293)			-1.021**	(0.368)		
θ_1^+	$D^+\Delta P_{t-1}^w$			0.484***	(0.123)			-0.196	(0.196)
θ_1^-	$D^-\Delta P_{t-1}^w$			-0.796***	(0.286)			-1.738***	(0.358)
θ_2^+	$D^+\Delta P_{t-2}^w$			-1.089***	(0.290)			-0.110	(0.346)
θ_2^-	$D^-\Delta P_{t-2}^w$			-1.040	(0.745)			0.351	(3.716)
β_0^+	$D^+\Delta P_t^d$	-1.640***	(0.103)	-1.386***	(0.108)	-1.402***	(0.127)	-1.047***	(0.124)
β_0^-	$D^-\Delta P_t^d$	3.323***	(0.255)	3.297***	(0.217)	1.573**	(0.690)	1.208**	(0.520)
β_1^+	$D^+\Delta P_{t-1}^d$	1.044***	(0.141)	0.607***	(0.163)	0.541**	(0.220)	-0.062	(0.216)
β_1^-	$D^-\Delta P_{t-1}^d$	2.080***	(0.302)	1.801***	(0.368)	-1.979	(1.267)	-1.688	(0.942)
β_2^+	$D^+\Delta P_{t-2}^d$	-0.098	(0.167)	-0.161	(0.136)	0.320	(0.207)	0.295	(0.153)

[7] Only statistically significant coefficients are taken into consideration.

β_2^-	$D^-\Delta P^d_{t-2}$	-0.735**	(0.291)	-0.689**	(0.258)	-1.225***	(0.319)	-1.189***	(0.236)
λ	Δe_t	3747.3***	(457.8)	3340.2***	(397.17)				
λ_1	Δe_{t-1}	-3345.9**	(1212.6)	-1554.17	(1072.69)				
λ_2	Δe_{t-2}	3917.6***	(1118.9)	2798.04**	(991.95)				
λ_0^+	$D^+\Delta e_t$					3568.03***	(497.73	3812.26***	(371.93)
λ_0^-	$D^-\Delta e_t$					27997.6***	(7381.75)	23842.9***	(5537.5
λ_1^+	$D^+\Delta e_{t-1}$					999.37	(1644.27)	2090.32	(1256.80)
λ_1^-	$D^-\Delta e_{t-1}$					3227.56	(3839.53)	10631.97***	(3424.74)
λ_2^+	$D^+\Delta e_{t-2}$					2634.70**	(1115.64)	1364.02	(837.98)
λ_2^-	$D^-\Delta e_{t-2}$					22563.57***	(5587.94)	14298.92	(12246.16)
ϕ	ECT_{t-1}	1.217***	(0.180)	0.651***	(0.205)	0.371	(0.331)	-0.378	(0.302)
	Dummy	18413330***	(2085879)	14340862***	(1978526)	15317885***	(2144467)	9754657***	(2018794)
	Adjusted R^2	0.958		0.973		0.969		0.983	
	Q(2)[c]	0.98	(0.61)	1.62	(0.44)	0.74	(0.69)	0.29	(0.87)
	F-statistics	73.62***		98.84***		81.12***		132.90***	

[a] The levels of statistical significance are denoted with ** for the 5% and *** for the 1%.
[b] Numbers in parentheses are standard errors.
[c] $Q(p)$ is the significance level of the Ljung–Box statistic in which the first p of the residual autocorrelations are jointly equal to zero.

Table 7
F-test results of asymmetry models for Eq. (16) ($P_t^w = \lambda_1 + \lambda_2 e_t + \lambda_3 P_t^d + u_t$)

Coefficient	Model 5	Model 6	Model 7	Model 8
$\sum_{j=1}^{2}\theta_j^+ = \sum_{j=1}^{2}\theta_j^-$	-	1.83	-	0.08
$\beta_0^+ = \beta_0^-$	228.60***	287.28***	14.05***	13.47***
$\sum_{j=0}^{2}\beta_j^+ = \sum_{j=0}^{2}\beta_j^-$	48.84***	48.32***	0.244	0.27
$\lambda_0^+ = \lambda_0^-$	-	-	11.05***	13.16***
$\sum_{j=0}^{2}\lambda_j^+ = \sum_{j=0}^{2}\lambda_j^-$	-	-	10.07***	6.18***

Following Ahn and Lee (2013) and to examine the influences of domestic price and exchange rate asymmetries as well as adjustment effects of previous export prices on the exporters' price, component price diversions (CPDs) between export and domestic markets has been simulated based on our estimation results of Model 7 in Table 6[8]. In Fig. 4 three types of CPDs are calculated including domestic price, exchange rate and total effect. Due to high difference in (nominal) value of variables during the study period, CPD simulations are plotted in two sub-periods including 1968-1990 and 1991-2010.[9] Then, regarding asymmetric effect of exchange

[8] As already mentioned, specifications of Eq. (16) presented in Table 6 which include exchange rate effect are preferred to those for Eq. (3) presented in Table 4. Throughout the specifications of Eq. (16), i.e. models 5 to 8, Model 7 is chosen.
[9] The predicted export price is calculated as $\hat{P}_t^w = \hat{P}_{t-1}^w + \Delta\hat{P}_t^w$ for t = 1, ..., n, with the predetermined export price at the initial period (t = 0).

rate on export price explored in Table 7, export price response to positive and negative changes in exchange rate is plotted in Fig. 5.

As indicated in Fig. 4, domestic price effect is negative for the examined period while CPDs for exchange rate and total effect is negative only for some periods. During 1968-85 while both domestic and exchange rate effects are negative, total effect is positive, indicating the positive effect of lagged own export prices. In other words, domestic price and exchange rate, in addition to their direct effect, affect export price indirectly via lagged own export price such that their total effect is positive for 1968-1985. As Fig. 4 illustrates, export–domestic price margin tends to increase during the mentioned period. Similar increasing margin for actual margins is also observed in Fig. 3. Correlation between predicted and actual export-domestic price margin is 71.5%. The corresponding correlation for the examined period, except for the 1990s amounts to 84%. On the other hand, in line with decreasing actual export price in Fig. 2, total effect shows negative values for the 1990s. Over this period exchange rate effects are positive, however, lagged own export price negative effects outweighed the positive effects of exchange rate. This may implicitly indicate additional sources affecting export price and an issue worthy of further research.

Figure 5 shows that export price response to positive changes in exchange rate is higher than that of negative changes. This fact stems from exchange rate asymmetric effect on export price presented in Table 6. However, as previously mentioned, a part of this effect is realized by lagged own export price. For positive component, current effect is lower than cumulative one, whereas current negative effect exceeds cumulative negative effect. In other words, part of the reduction in export price caused from decreased exchange rate in the current period is adjusted during subsequent periods. The difference between current and cumulative effects for positive component is less compared to negative component. This may also indicate relatively higher sensitivity of export price to decrease in exchange rate. Increase in exchange rate appears to be transmitted with larger effect to export market than the reduction. These results are consistent with our previous discussion in which based on exchange rate effects and PTM theory the possible market power was suggested.

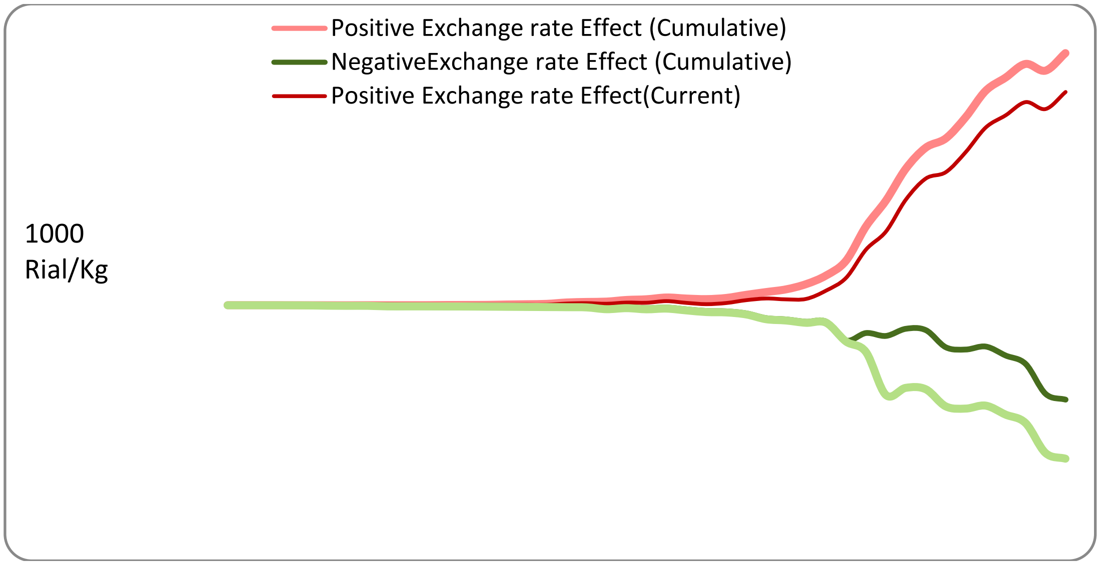

Fig 5. Asymmetric response of export prices to exchange rate

4. Conclusion

Spatial price transmission between export and domestic market is an issue that has not received adequate attention. Contrary to the fact that asymmetric price transmission is a commonly cited source of market power (Scherer and Ross, 1990), implications developed for market power based on price transmission are not strongly conclusive and firm. The current empirical works in the context of export and domestic market relationship which address market power have been based on pricing behavior called "pricing to market" (PTM). In this context export prices response to exchange rate changes is also examined while symmetric adjustment is assumed for both rising and falling exchange rates. Based on PTM analysis in which export price response to exchange rate changes is examined, one may derive implications about market power. The objective of this study was to contribute to literature to have implications for market power. Our contribution was twofold, first we applied asymmetry transmission framework for export-domestic prices relation. Second, we applied the PTM analysis framework in the context of asymmetry transmission. In other words, both market structure examining measures, i.e., PTM and APT are applied together.

Two types of models were applied. The first one included domestic market price as well as export prices lagged own values. Then the model was extended to include exchange rate. Four specifications were estimated for each type. There are some significant differences between the two types of models. One specification was chosen throughout each type to discuss in detail. Given the preferred specifications of each type (Model 3 and 7), while the first category of specifications strongly supports the asymmetric price responses hypothesis for both current and cumulative domestic price effects, in exchange rate included specification, symmetric responses for cumulative domestic price effects cannot be rejected. The preferred specification of first type also tends to attribute a significant and asymmetric role for lagged own values of export price, indicating that in response to a change in lagged own export price, the current export price increases in greater magnitude when the lagged own export price falls than when it rises. Whereas in exchange rate included specification, export price responds to its lagged own values symmetrically. This indicates implicitly that asymmetric response of export price to its lagged own values in first type specifications may be assigned to exchange rate which appears in the second type of specifications. In general, based on econometric aspects, the second type of specifications are preferable to the first one, indicating the significant role of exchange rate in investigating structure of price transmission from domestic market to export market. Based on the model selection criteria we focused on specification that uses lagged values of export price in their initial values while exchange rate and domestic prices are necessary for use in positive and negative series separately (Model 7). Based on this specification, it is worth noting that exchange rate asymmetric effect on export price is more significant than domestic market price. Therefore, the first type of specifications suffers from dropping an important source of asymmetric price response, i.e., exchange rate.

If changes in bilateral exchange rates are fully reflected in bilateral export prices, there should be no exchange rate effect and exchange rate coefficient should be equal to zero (Griffith and Mullen, 2001). As the results reveal, the hypothesis of insignificant effect of exchange rate can be strongly rejected, indicating existence of an imperfect competitive market. In addition, as the results of the component price diversions and asymmetry test results for exchange rate show, export price will increase in greater magnitude when the exchange rate rises than when it falls. This shows an incomplete pass-through effect of exchange rate which may be considered as a sign for an imperfect competitive condition. Indeed, this implication indicates that exporters can exert extent of market power in export market. While in the current literature market power is suggested as a possible source of asymmetric price adjustment, our exchange rate effect analysis provides stronger implications of asymmetric adjustment as evidences for market power. Additionally, based on component analysis in which export price responds to exchange rate increase effect with higher magnitude compared to exchange rate decrease, if we consider domestic price as marginal cost for exporters like Durevall, (2007) who used importing price of coffee as marginal cost in production of roasted coffee in Sweden, then we may suggest that increase in exchange rate results in higher price-marginal cost margin. This also can be considered as a criterion for market power.

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