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India's Horticultural Sector - A Port-Level Analysis of Onion Export Pricing.

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Abstract

Extending the traditional model of agricultural pricing behaviour and market structure with the constructed commodity specific export weighted exchange rates, this paper analyses the exchange rate induced market power, asymmetric effects of exchange rate, country specific discrimination as well as the impact of government's minimum export price policy on the export prices of Indian onion exporters using port-level data. Onion price escalation has been seen to cause tears not only in the kitchen but tumble governments. Although this study observes a competitive market structure in majority of the destination market, however, the pricing-to-market behaviour was prevalent in three destination markets where the exporters were following local currency stabilization. Furthermore, minimum export price policy variable showed that even when the minimum export price requirement was in place, exporters were able to adjust their price downward and sell in those markets.

JEL Classifications: E31, F10, F13, F41, L11, Q17

Keywords: Keywords: Pricing to market, market power, exchange rates, India, trade policy, port data.

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1. Introduction

The focus of the paper is to examine the pricing behavior of Indian onion exporters in the world market for onions because of the importance of onion as an essential commodity in a consumer's food basket. In many countries, like India, onion is a major commodity and the surge in prices can even "bring down governments". Bellemare (2015) has shown that food prices cause social unrest where food price volatility brings about negative outcomes that range from the defeat of political leaders and their party to the worst case of riots and looting. In recent years, India is showing an export potential in a range of high value agricultural commodities. The high value commodity concentration of agricultural trade is occurring in a context where we experience a global shift in consumption preferences towards high value products such as fruits, vegetables, fish, dairy products and other processed food products (Varma and Issar, 2016). The structural transformation has greater implications for agricultural supply chains, small farmer participation and public and private investment (Gulati et al., 2007). Therefore, the shift in consumption preferences is creating enormous opportunities for developing country exporters like India (Varma and Issar, 2016).

Onion is among the high value agricultural commodities that show tremendous potential for export. Onion is an important vegetable crop grown and consumed widely across the world. India is the second largest producer of onion in the world after China. India is the third largest exporter of fresh onion. Exports of onion from India are permitted by the Government only after meeting the domestic requirements and as a result the onion exports fluctuations are quite often (Singh, 2013). Initially the exports were permitted to State Trading Enterprises (STEs) and National Agricultural Cooperative Marketing Federation of India Limited (NAFED) and currently STEs issues Non Objection Certificate (NOCs) to associate exporters (Singh, 2013). However, the government policies have an important bearing on the volume of exports of onion. Due to the strategic significance of onion, the Government often intervenes in the market to regulate the domestic prices.

Recently Onion exports have rose substantially after the removal of Minimum Export Price (MEP) by the Central Government on 24 December 2015. The MEP was introduced in onion export in 2010 as a policy measure to control the rise in price of onion in domestic markets. Removal of MEP in 2015 has made Indian onion very competitive in the exports market beating traditional rivals like Pakistan and Egypt and even China.

There have not been many attempts to analyse the pricing behavior of Indian agricultural exporters in the world market. This is also due to the fact that India was often treated as a "small country" within the theoretical notions of international trade (Varma and Issar, 2016). Nonetheless, an analysis of pricing behavior assumes greater significance in a context where India is showing good potential in the exports of some of the high value commodities. The major objective of the present study is to analyse the pricing behavior of onion exporters' in the world market. We use port level export data instead of using the aggregate exports data. The micro data on exports would allow us to eliminate implausible observations which might result in misleading findings and interpretations (Friebel et al., 2015). Therefore relying on highly aggregated data might ignore differences that are better captured using micro level data. Since the firm level data was not available, in order to overcome this limitation, the present study makes use of port-level export data.

There are four specific objectives for the study. The first objective is to see whether Indian onion exporters are able to price discriminate across various markets. The second objective is to analyse the nature of price discrimination, whether it is market specific or exchange rate influenced, or both. The third objective is to analyse the asymmetric effects of exchange rate changes on export prices. Finally, we examine the effect of Minimum Export Price policy on pricing behavior of onion exporters.

Section 2 provides a brief discussion on the trends in onion exports from India. Section 3 discusses the conceptual background and provides a brief review of relevant literature. In section 4, the modelling approach is presented, followed by a description of the data and the markets. Section 5 discusses the empirical results. The final section presents the concluding observations.

1. Conceptual Background and Relevant Empirical Studies

The new trade theory models based on the assumptions of scale economies and product heterogeneity upholds the view that that the real-world trade is characterised by imperfect competition and oligopolistic market structures. The oligopolistic market structure is viewed as a source of price discrimination in international trade. In an imperfect competition setting, price is greater than marginal revenue and marginal cost. The underlying reason lies in the firm's residual demand ,that is, a firm's optimal mark-up over marginal costs depends upon the functional form of its perceived residual demand (Friebel et al., 2015). In a perfectly competitive market a firm's residual demand is perfectly elastic (zero or no mark-up). As a result, the case for price discrimination is negligible (Pall et al., 2013). If the market structure is imperfectly competitive, then the firm would be facing a downward sloping residual demand curve causing a variable optimal mark-up across markets. As mentioned by Carew and Florkowski (2003), the firm's ability to price discriminate in the destination markets depends on the destination specific elasticity of demand and on its relationship with common marginal cost. Lavoie and Liu (2007) claim that changes in exchange rates affect the pricing behavior of an exporter in an imperfectly competitive market because the changes in exchange rates results in large gap between the price that is set by the seller and the price paid by the consumer.

The concept of pricing to market (PTM), introduced by Krugman (1987), explains the non-competitive pricing behavior of firms. PTM behavior implies exchange-rate induced price discrimination. A change in the exchange rate drives a wedge between the import price in the importer's currency and export price, denoted in the exporter's currency. Mallick and Marques (2012) define exchange rate pass through as the responsiveness (elasticity) of export prices to exchange rate induced changes. As per PTM, if a firm a possess market power in the export markets it will either maintain or even increase export prices when currency depreciation takes place relative to importer's currency. This phenomenon is known as incomplete exchange rate pass through (ERPT) where it prevents prices from equating to marginal cost. The export prices can have destination specific mark-up of price over marginal cost. In a general equilibrium framework, PTM refers to the local currency pricing whereby prices are pre-set in the buyers currency (Byrne et al., 2013) and this has become popular in open economy macroeconomic models.

The response of export prices to exchange rate appreciation and depreciation may not be symmetric and it can be asymmetric due to several reasons (Knetter, 1992). Price discrimination during the currency depreciation can be due to marketing bottlenecks or supply restrictions while price discrimination during currency appreciation can be due to the increase in market share by exporters. The former is known as ‘bottlenecks model’ while the latter is known as ‘market share model’.

Knetter (1989), in the first empirical estimation of PTM, used a fixed effect model to examine the price discrimination by U.S. and German exporters to see the responsiveness of commodity’s export price to destination specific exchange rate induced changes. The study concluded the presence of PTM behavior by both German and US exporters. There have been a couple of attempts of PTM behavior in the context of agricultural and food products as well. Pick and Park (1991) analysed the competitive market structure of U.S.A agricultural exports of selected products of wheat, cotton, corn and soybeans. The study revealed the market power of exporters in these products’ international market. They extended their analysis by comparing their PTM results between nominal and real exchange rate system. Furthermore, Yumkella et al. (1994) studied the US and Thailand rice exporters for PTM behavior and found evidence of imperfect pricing behavior, either through price discrimination across destination markets or through imperfect exchange rate pass-through. Carew (2000) studied the pricing behavior of wheat, pulses and tobacco exported by US and Canada to various destination markets provided evidence for market imperfection and price discrimination especially in the case of wheat. Miljkovic, Brester and Marsh (2003), showed that the effects of exchange rate changes on US beef, pork and poultry export prices through market specific exchange rates effect.

Using monthly price data, Lavoie (2005) analysed Canadian wheat exports where the study observed that the Canadian Wheat Board (CWB) practiced price discrimination across international markets. Quarterly price data was used by Jin and Miljkovic (2008) for U.S. wheat exports and found that in 9 out 22 destination markets exchange rate fluctuations was primarily influencing export pricing strategy of the exporters. Pall et al. (2013) analysed the pricing behavior of Russian wheat in 25 destination markets using quarterly data for 2002 to 2010. and found that the exporters were able to price discriminate in relatively a few destination markets. The authors made use of both the nominal and real exchange rates in their analysis. Moreover, Miljkovic and Zhuang (2011) study for Japan employed commodity-specific exchange rates. This exchange rate model analysis was different from the earlier studies where exchange rates were aggregate trade-weighted exchange rates provided by the Central Bank authorities or sources. Goldberg (2004) and Pollard and Coughlin (2006) highlight that exchange rate pass-through results were sensitive to the exchange rate index employed in the analysis. The study by Varma and Issar (2016) for India's high value agri food exporters provided evidence of imperfect competition either through price discrimination or through incomplete exchange rate pass-through. The results also indicated that the exchange-rate pass-through is sensitive to the kind of exchange rate index utilised. The study found that commodity specific exchange rate index better predicted the pricing to market behavior in most cases. Another study by Issar and Varma (2016) for India's rice exporters also found empirical support for price discrimination behavior by exporters. Varma and Issar (2016) have compared their PTM results between nominal, real and commodity specific exchange rates in their analysis. Similar to these studies, the authors also employ nominal, real and commodity specific exchange rates in our analysis to reflect on the sensitivity of the PTM results.

2. Theoretical and Econometric Specification

Krugman's (1987) PTM model was econometrically developed by Knetter (1989) to determine the presence of price discrimination in international trade and provides a testable econometric model for our analysis. Initial testing model for alternative market structures and PTM behavior is as follows:

$$lnp_{ijkt} = \lambda_i + \theta_t + \delta_j + \alpha_k + \beta_i(lne_{it}) + \gamma MEP_{it} + u_{ijkt} \; ; \quad where\ i = 1, \ldots. N; j = 1, \ldots J; \quad k = 1, \ldots K; t = 1, \ldots T \quad (1)$$

Where $\boldsymbol{p_{ijkt}}$ is the (log) onion export price (fob price) measured in Indian rupees, by port $\boldsymbol{j}$ located in Indian state $\boldsymbol{k}$ to the importing nation $\boldsymbol{i}$ in time period $\boldsymbol{t}$. $\mathbf{e_{it}}$ refers to the (log) bilateral nominal, real and commodity specific exchange rate put in units of the domestic currency of country $\boldsymbol{i}$ per Indian rupee.

The parameters of the above model are :

- $\boldsymbol{\lambda_i}$, are the country (destination markets) fixed effects
- $\boldsymbol{\theta_t}$, are the time fixed effects
- $\boldsymbol{\delta_j}$ **,** are the Indian port fixed effects
- $\boldsymbol{\alpha_k}$ **,** are the Indian state fixed effects

Since we follow a log-log functional form, $\boldsymbol{\beta_i}$ is to be understood as the elasticity. The $ln(e_{it})$ is the log of destination-specific exchange rate expressed as the units of the domestic (importer's) currency per unit of Indian rupees. $\boldsymbol{\gamma}$ is the parameter that represents the coefficient of the dummy variables MEP_{it} and captures the impact of Minimum Export Price Policy (MEP) of the government on the pricing behavior**.**

The underlying market structure for India's onion can be inferred from the beta coefficient, $\boldsymbol{\beta_i}$**.** $\boldsymbol{\beta_i = 0}$, implies either a perfectly competitive market or an imperfect market with a common mark-up[1]. In such a scenario, the prices of imports change in proportion the changes in the bilateral exchange rates. Apart from the ambiguity associated with the market structure when $\boldsymbol{\beta_i = 0}$, a beta coefficient where $\boldsymbol{\beta_i \neq 0}$**,** unambiguously indicates an imperfectly competitive market structure. Here, the curve of the residual demand schedule influences the direction in which the export price changes, i.e, either a positive or negative sign of $\boldsymbol{\beta_i}$ coefficient. The positive

[1] These two cases are econometrically indistinguishable.

sign of $\boldsymbol{\beta_i}$ indicates the amplification of exchange rates while a negative $\boldsymbol{\beta i}$ indicates local currency stabilization of prices (Varma and Issar, 2016).

A shock in the exchange rates can affect the export prices through changes in marginal costs and elasticity of demand. However, only the changes in elasticity of demand are known as PTM (Friebel et al., 2015). Therefore the time affects (θt) controls for all variables that changes over time but remains to be as the same for all the importing countries. This means PTM does not consider the marginal costs that might vary across destination markets.

The port effects ($\boldsymbol{\delta_j}$) captures all factors which differ across the ports and similarly the Indian state ($\boldsymbol{\alpha_k}$) captures the differences across the States where the ports are located. The term λ_i refers to the time-invariant destination specific effects. The destination specific effects may also capture the heterogeneity in preferences among the destination markets if the product is not homogenous (Friebel et al., 2015). Finally, u_{it} is the regression error term distributed normally. u_{it} also accounts for unobservable factors and any measurement error in the dependent variable.

The equation (1) tests three hypotheses. First, H_0: $\beta_i = 0$, $\lambda_i = 0$. Second, H_A: $\beta_i=0$, H_A: $\lambda_i \neq 0$. Third, H_A: $\beta_i \neq 0$, H_A: $\lambda_i \neq 0$. The first scenario tells us the failure to reject the null hypothesis (H_0: $\beta_i = 0$, $\lambda_i = 0$) will prove competitive pricing in the international market where export prices are hardly influenced by exchange rate changes ($\beta_i = 0$) and country effects ($\lambda_i = 0$) (Carew, 2000). The failure to accept the null hypothesis indicates the presence of imperfect competition and price discrimination. The second scenario indicates constant elasticity of demand with respect to the export price. Therefore, a statistically significant λ_i indicates the fact that the exporting country is a price maker in the market. In such a model, mark-up over marginal cost is constant but may vary over time and across destination markets. Similarly, export prices are hardly affected by exchange rate fluctuations ($\beta_i = 0$). The significance of the parameter λ_i estimated with respect to the country effects does not necessarily show imperfect competition as the country effect also captures quality differences (Knetter, 1989; Falk and Falk, 2000; Pall et al., 2013).

The third scenario indicates price discrimination with varying elasticity of demand. The elasticity of demand may vary along with exchange rate fluctuations. This is pricing to market behavior because the optimal mark up over marginal cost will not only vary across destination markets but also is changed due to exchange rate changes and, therefore, $\beta_i \neq 0$ and $\lambda_i \neq 0$. The estimated statistically significant parameter of β_i associated with exchange rate effects can be positive or negative (Knetter, 1993). 'Incomplete pass-through' would occur if $\beta_i < 0$ and it is said to be more than complete if $\beta_i > 0$.

A negative β_i implies that the exporting firms are practicing 'local currency price stabilization'. On the contrary, a positive β_i implies the amplification of exchange rate effects. When both the estimated coefficients are significantly different from zero ($\beta_i \neq 0$ and $\lambda_i \neq 0$), this indicates the possibility for an exporting firm to amplify the effect of destination specific exchange rate changes through destination specific changes in the mark-up (Pall et al., 2013).

To bring in the asymmetric response of export prices to exchange rate appreciation and depreciation, equation (1) is re-specified in the following manner An interaction of the dummy variable with the exchange rate capture the differential impact of appreciation and depreciation (Knetter, 1992; Vergil, 2011).

$$E_{t=} (\beta_1 + \beta\alpha_2 D_t) E_t$$
$$= \beta_1 E_t + \beta_2 D_t \times E_t$$

An indicator value of 1 is associated with periods of appreciation (a fall in E_t) and 0 for periods of depreciation; $D_t = 1$ if $\Delta E_t >$

0 (i.e. the appreciation of the Indian Rupee) ; $D_t = 0$ if $\Delta E_t < 0$ (i.e. depreciation of the Indian Rupee).

Accordingly, equation (1) can be specified as follows:

$$ln\,p_{ijkt} = \lambda_i + \theta_t + \delta_j + \alpha_k + \beta_1(ln\,e_{1t}) + \beta_2(ln\,e_{2t}) + \gamma MEP_{it} + u_{it} \quad (2)$$

$$ln\,p_{ijkt} = \lambda_i + \theta_t + \delta_j + \alpha_k + \beta_1(ln\,e_{1t}) + \beta_2(ln\,e_{2t} \times D_t) + \gamma MEP_{it} + u_{it} \quad (3)$$

As highlighted by Byrne et al. (2010), if asymmetry variable indicator coefficient is statistically significant and positive, the effect of appreciation of exporter's currency (Indian rupee) on export prices is greater than in depreciation. Similarly, a significant and negative coefficient implies that the effect of depreciation of exchange rates on export prices is greater than appreciation.

3. Data, Markets Selection and Descriptive Statistics

To test for the non-competitive pricing behavior and price discrimination by Indian exporters of fresh onion, equation (3) was estimated using monthly data for the time period from January 2007 to February 2016 (a period of 98 months). Varma and Issar (2016), using aggregated data on high valued commodities traded in the international markets, find evidence of amplification and local currency price stabilization in majority of the countries analysed. Nonetheless, as mentioned earlier, the disaggregated data would allow us to eliminate implausible observations which might result in misleading findings and interpretations. Therefore, instead of aggregate exports data we use a port-level dataset that gives us the quantity (kgs) and value (rupees) of onion exports from major sea ports of India. Port-level data helps in the inclusion of port and state fixed effects that should provide more robust estimates of the PTM behavior. Additionally, a relatively disaggregated port-level data in contrast to a disaggregated firm-level dataset - as in Friebel et al (2015) – would give a relatively more accurate detection of pricing-to-market behavior among exporters. The top 20 major sea-ports selected for onion exports are given in Table 1.

Table 1: List of sea-ports and their states.

Port Name	State
BHITHAMORE ICD	West Bengal
CALICUT(KOZHICODE) SEA	Kerala
CHENNAI SEA	Tamil Nadu
COCHIN SEA	Kerala
GHAJADANGA SEA PORT	West Bengal
ICD JANORI	Maharashtra
KANDLA SEA	Gujarat
MUMBAI SEA	Maharashtra
MUNDRA SEA	Gujarat
NHAVA SHEVA SEA	Maharashtra
PIPAVAB(VICYOR) SEA	Gujarat
TUTICORIN SEA	Tamil Nadu
ICD CFS Nashik	Maharashtra
ICD SABARMATI	Gujarat
IFFCO KISAN SEZ NELLORE	Andhra Pradesh
KATTUPALLI PORT/ TIRUVALLUR SEA	Tamil Nadu
KOLKATA SEA	West Bengal
OKHA SEA	Gujarat
PORBANDAR Sea	Gujarat
SIPCT ELE HW HITE SEZ ORAGADAM	Tamil Nadu

Source: APEDA

The port-level dataset as provided by Agricultural and Processed Food Products Export Development Authority (APEDA) contains all the data from all ports to each importing country for the period under the study. The data has been cleaned to incorporate only those observations where the quantity exported was more than 1000 Kgs (1 tonne) so that our estimation is not biased by observations of small quantities.

The top 10 countries selected for the study together account for approximately 92% of total exports of onion exports from India (as of 2015). Table 2 gives the quantity and value of exports of onion to the top 10 destination markets analysed for this study as of 2015.

Table 2: Top 10 destination markets and their share in Indian exports of onion (2014-15)

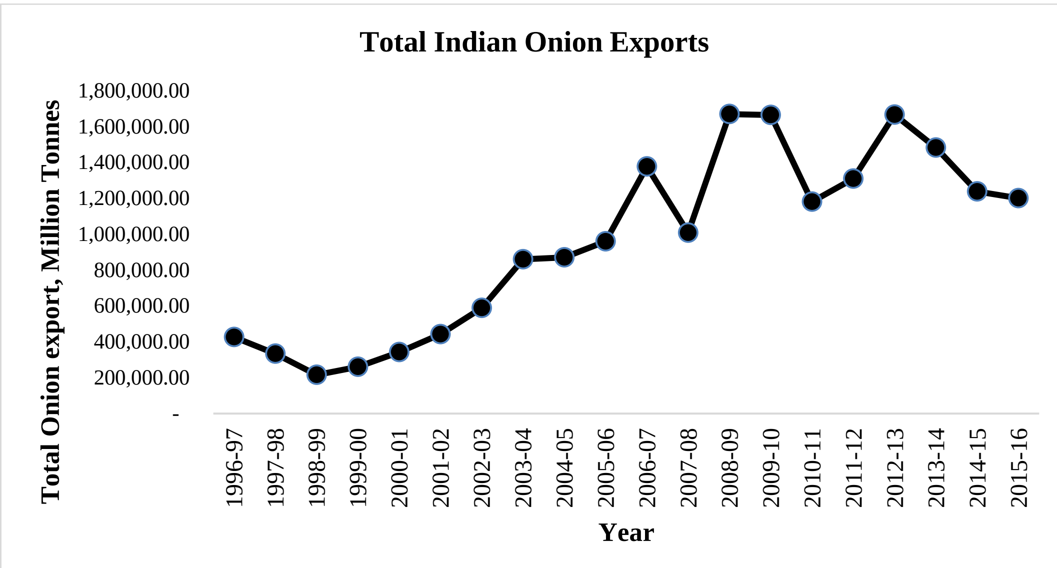
Destination Markets	Quantity (in Kgs)	Value (in 1000 USD)
Bangladesh	552,703,996	143,651.26
Malaysia	285,721,172	83,078.63
Sri Lanka	198,732,023	57,779.32
UAE	181,816,575	52,238.49
Nepal	83,188,078	25,259.85
Indonesia	71,940,072	13,092.43
Singapore	37,198,767	12,023.5
Qatar	35,137,275	11,436.31
Kuwait	35,672,309	11,103.00
Oman	24,291,816	7,146.74
Total Export of Top 10	1,506,402,083	416,809.53
Rest of the world	126,570,325	43,480.50
Total Export of Onion	1,632,972,408	460,290.03
% Share of Top 10 Countries	**92.25%**	**90.55%**

Source: Author's calculation using DGCIS and APEDA data.

The unit value of export is taken as a proxy for export price. The details about the major horticultural products exported and destination markets is obtained from APEDA database which has obtained its data from the Directorate General of Commerce and Intelligence and Statistics, Government of India (DGCIS).

The top destination markets are identified on the basis of share in total exports as well as the percentage annual growth in share. Bangladesh, Indonesia, Kuwait, Malaysia, Nepal, Oman, Qatar, Singapore, Sri Lanka and the UAE are selected for fresh onion. We apply Knetter's panel model to a port-level dataset collected from APEDA. Figure 1 below shows the trend in the Indian export of onion to the world market for the period of 1996 to 2015. We observe that in concordance with India's increase in production of onion, exports of onion have risen tremendously since 1996.

Figure 1: Total Indian onion exports (1996-2015)



Source: Authors' calculation based on DGCIS data.

Table 3 below shows India's standing position in the world trade of onion. India is a leading exporter of onion after Netherlands as of 2014-15. However, over the years we do see a rise in competition for India as an exporter as it's share in global exports seems to be declining. This observation is what the authors find in the PTM analysis in section 5. Though Netherlands percentage share seems to remain stable, we do see other countries like China whose percentage share seems to be rising.

Table 3: Top 10 exporters of onion in the world market.

	2012		2013		2014	
Exporting Country	Quantity (in Million Tonnes)	% share in World Onion Export	Quantity (in Million Tonnes)	% share in World Onion Export	Quantity (in Million Tonnes)	% share in World Onion Export
Netherlands	931726.64	16.33	1039011.75	16.08	1059648.8	16.14
India	**1123682.24**	**19.70**	**983963.13**	**15.22**	**898060.61**	**13.68**
China	452491.13	7.93	584462.21	9.04	588536.57	8.96
Spain	280595.16	4.92	350824.41	5.43	387156.55	5.90
Egypt	291923.12	5.12	315293.01	4.88	362649.69	5.52
Mexico	318406.25	5.58	345143.72	5.34	361692.99	5.51
USA	247501.85	4.34	268299.17	4.15	278419.1	4.24
Peru	190512.86	3.34	236892.32	3.67	271116.76	4.13
Pakistan	45986.94	0.81	131745.6	2.04	185243.59	2.82
New Zealand	169057.87	2.96	175613.16	2.72	181225.95	2.76

Source: Authors' calculation based on DGCIS and APEDA data.

Nominal exchange rates and the consumer price index (CPI) to compute real exchange rates for the importing countries were obtained from the OANDA and the World Bank database[2]. In order to calculate the real exchange rate for the importing countries, the nominal exchange rates were multiplied with the consumer price index (CPI) of India and divided it by CPI of the respective countries (Knetter (1989); Pick and Park (1991); Pall et al. (2013)). The period of analysis for this study has been from January 2007 to February 2016, a period of 98 months.

Finally, in addition to the analysis using nominal and real exchange rates, we construct the commodity-specific (export) trade-weighted exchange rate, as developed by Goldberg (2004) and a variant applied by Miljkovic and Zhuang (2011). The commodity-specific (export) trade-weighted exchange rate uses the real exchange rates computed initially and the weights of each importer in the following formula:

$$XER_t^p = \sum_i w_t^{pi}.RER_t^i, \;\; where\; w_t^{pi} = \frac{X_t^{pi}}{\sum_i X_t^{pi}} \qquad (8)$$

where XER_t^p is the export weighted (real) exchange rate for commodity p (onion) at time period t; w_t^{pi} is the export weight assigned to the importing destination markets i ; and RER_t^i is the real exchange rate between India and destination market i.

[2]OANDA is a website from where we obtained the exchange rates. And even though OANDA appears in uppercase, it is not an acronym.

4. Results and Discussion

Table 4 shows the results of the Fisher-type unit root test on export price and the exchange rates. It is important to note that all statistical inferences are based on the assumption that the variables in the model are stationary, i.e. no unit root process. To support this assumption, we conduct the Fisher unit root test using both augmented Dickey-Fuller test as well as Philips-Peron unit root test. The result of the tests in Table 4 shows that the null hypothesis that all panels contain a unit root is clearly rejected for both export price as well as the exchange rates.

Table 4: Fisher unit root test on export price and exchange rates (2007-2016)

	Modified inverse Chi-squared			
Test Specification	Export Price	Nominal Exchange Rate	Real Exchange Rate	Commodity Exchange Rate
ADF Unit Root Test				
1 lag	64.6956***	8.0403***	17.3101***	93.9431***
1 lag with trend	58.0707***	7.1794***	13.1361***	90.6617***
Philips-Peron Unit Root Test				
1 lag	123.8743***	6.1504***	28.1583***	56.2117***
1 lag with trend	121.9258***	5.8881***	21.5469***	50.4369***

Notes: *** denotes statistical significance at 1%. ADF is the Augmented Dickey-Fuller test of the Fisher-type unit root tests. The null hypothesis in ADF and Philips-Peron unit root tests is that all panels contain unit roots.

To choose the appropriate estimation for our panel structure, we conduct the Hausman specification test. The test result supports our choice of using the fixed-effects estimation procedure. Hence, the panel model as given in equation 3 is estimated using the within-group estimator with clustered robust standard-errors. To test the joint significance of the country and exchange rate effects, F-test was conducted. The null hypotheses that all country-effects are equal (H_0: $\lambda_1 = \lambda_2 = \ldots = \lambda_N = 0$) and the null that all exchange rates are equal (H_0: $\beta_1 = \beta_2 = \ldots = \beta_N = 0$) is rejected for the nominal and commodity specific exchange rate model (see Table 5).

This suggests that in nominal and commodity-specific exchange rate model there exits the evidence of pricing-to-market and country-specific effects.

Table 5: F-test to test the joint hypothesis of variables.

Null Hypothesis	Nominal Exchange Rate Model	Real Exchange Rate Model	Commodity Exchange Rate Model
H_0: $\beta_1 = \beta_2 = \ldots = \beta_N = 0$ (joint exchange-rate effect)	4.75***	1.11	2.89***
H_0: $\lambda_1 = \lambda_2 = \ldots = \lambda_N = 0$ (joint country effects)	5.43***	1.35	6.49***

Note: *** indicate statistical significance at 1%.

Table 6-8 show the results of the estimation of equation 3 for the three exchange rate models. First, we discuss the results of the exchange rate and country specific effects as observed in Table 6-8. Then we discuss the impact of asymmetry in exchange rates and the impact of minimum export price imposed by the government to curb exports of Onion.

4.1 Exchange rate and country effects.

In Table 6, we present the results of the estimation of equation 3 for commodity-specific exchange rate model. According to test-statistics presented in Tables 6-8 - the adjusted R-squared, the Akaike's information criteria (AIC) and the Bayesian information criteria (BIC) - we see that the commodity exchange rate model better predicts the PTM model relative to the other two exchange rate model, i.e. nominal and real exchange rate. Therefore, we begin our discussion on commodity exchange rate model.

Based on Knetter's model that allows for price discrimination between different market structure, the coefficient for exchange rate effects, i.e. $\beta = 0$ could not be rejected for 7 out of the 10 destination markets. In other words, exchange rate pass-through was complete in all the seven importing countries. Therefore, exchange rate changes did not allow an onion exporter with the flexibility to adjust the export prices rather the exchange rate changes were fully reflected in export prices. Among the 10 destination markets we find incomplete exchange rate pass through in three markets- Bangladesh, Oman and Qatar.

The negative coefficient of β for these three countries indicates that the exchange rate changes resulted in local currency price-stabilization, i.e. the tendency of exporters to adjust downward the mark-ups of prices over the cost when there is a depreciation of the importer's currency relative to the Indian currency. This situation mostly occurs when the exporters face a residual demand that is inelastic, which is an indication of a competitive behavior in these destinations with other major exporters of onion (for example, China).

The majority of destinations where we fail to reject the null hypothesis for exchange rate effects, does indicate that in majority of the destination onion exporters face a competitive market structure where price discrimination is not observed as exporters face tough competition in these markets due to the presence of other competitors such as China.

Additionally, we failed to reject the null hypothesis of country specific effects in all the importing countries. This implies that exporters do price discriminate across markets and the prices that the exporters fix in these markets remain to be homogenous.

Table 6: Estimation results for commodity-specific exchange rate model

	Commodity-specific Exchange Rate Model			
	Exchange Rate Effect β	**Country-specific Effects Λ**	**Asymmetry of Exchange Rate**	**Min. Export Price Effect**
Bangladesh	**-0.142***		**0.270***	0.059
	(0.074)		**(0.159)**	(0.069)
Indonesia	-0.063	0.005	-0.101	-0.106
	(0.063)	(0.215)	(0.166)	(0.078)
Kuwait	0.024	-0.138	0.079	-0.022
	(0.063)	(0.215)	(0.134)	(0.051)
Malaysia	-0.071	-0.129	0.128	0.058
	(0.062)	(0.203)	(0.149)	(0.055)
Nepal	-0.168	0.164	0.279	0.054
	(0.109)	(0.172)	(0.236)	(0.071)
Oman	**-0.128****	-0.017	0.063	**0.092****
	(0.050)	(0.200)	(0.131)	**(0.038)**
Qatar	**-0.136*****	-0.039	0.089	**0.102*****
	(0.051)	(0.201)	(0.134)	**(0.034)**
Singapore	-0.023	-0.04	-0.033	0.042
	(0.050)	(0.204)	(0.137)	(0.042)
Sri Lanka	0.000	-0.275	0.033	0.012
	(0.047)	(0.196)	(0.130)	(0.040)
United Arab Emirates	0.000	-0.127	0.039	0.000
	(0.000)	(0.210)	(0.143)	(0.000)
Constant	3.557***			
	(0.248)			
Time fixed Effects			Y	
Port Fixed Effects			Y	
State Fixed Effects			Y	
Observations		1,795		
Months		98		
Sea Ports		20		
Log-Likelihood		-1019.35		
R^2 adjusted		0.168		
R^2 within		0.195		
R^2 between		0.054		
R^2 overall		0.114		
F-statistic		28.224		
p-value		0.000		
AIC		2150.69		
BIC		2457.657		

Note: ***, **, * denote statistical significance at 1%, 5% and 10% , respectively. Values in parentheses are the standard errors. Y denotes "yes" for the presence of those effects. AIC is the Akaike's Information Criteria and BIC is the Schwarze's Bayesian Information Criteria.

For nominal and real exchange rate model in Tables 7 and 8, we observe the same story as the commodity-specific exchange rate model in Table 6 i.e. onion Indian exporters practicing local currency stabilization in those markets where the exchange rate pass-through was partial. The coefficient for exchange rate pass-through came out to be statistically significant and negative in Kuwait and Nepal as per the nominal exchange rate model (see Table 7) and only in Nepal as per the real exchange rate model (see Table 8). The negative β coefficient implies when there is a depreciation of importer's currency in relation to Indian rupee, the export prices tend to be adjusted downward. This signals that the residual demand faced by Indian exporters is elastic, which is an indicator of competitive behavior in international markets. Moreover, the real and nominal exchange rate also clearly indicates that in majority of destination markets for onion exports, the exporters face a relatively perfect competitive market structure where a wedge between export and import prices is hardly observed. However, in Table 7 and 8, we do find the significance of country-specific effects in nominal and real exchange rate model. The country-specific effects, i.e., λ, in Table 7 is significant for Kuwait and Nepal and in Table 8 it is significant for Nepal. The significance of country specific effects shows that the Indian exporters of onion face constant mark-up and constant elasticity of demand that varies across destination markets. It is interesting to note that the negative and statistical significance of the exchange rate effects combined with the significance of the country-specific effects signals that the demand schedule for Indian onion exporters is more concave than a constant elasticity of demand ($\beta i < 0$ and $\lambda i \neq 0$).

Table 7: Estimation results for nominal exchange-rate model

	Nominal Exchange Rate Model			
	Exchange Rate Effect β	**Country Effects Λ**	**Asymmetry of Exchange Rate**	**Min. Export Price Effect**
Bangladesh	0.478		0.100	0.240
	(0.811)		(0.084)	(0.858)
Indonesia	0.105	-0.612	0.174	-0.03
	(0.517)	(2.734)	(0.123)	(0.083)
Kuwait	**-0.705****	**-3.621***	0.098	-0.010
	(0.348)	**(1.980)**	(0.061)	(0.073)
Malaysia	0.51	1.439	-0.047	-0.083
	(0.383)	(1.225)	(0.058)	(0.136)
Nepal	**-42.499*****	**19.982*****	0.175	0.073
	(14.596)	**(6.812)**	(0.161)	(0.901)
Oman	-0.022	-0.053	-0.040	-0.039
	(0.281)	(1.546)	(0.053)	(0.075)
Qatar	-0.026	-0.048	-0.024	-0.082
	(0.352)	(1.094)	(0.068)	(0.137)
Singapore	-0.200	-0.611	-0.02	-0.039
	(0.236)	(1.055)	(0.043)	(0.099)
Sri Lanka	-0.317	0.199	0.000	0.154
	(0.521)	(0.416)	(0.044)	(0.454)
United Arab Emirates	-0.382	-0.942	0.036	-0.021
	(0.358)	(1.075)	(0.086)	(0.142)
Constant	3.365***			
	(0.395)			
Time fixed Effects			Y	
Port Fixed Effects			Y	
State Fixed Effects			Y	
Observations		1,795		
Months		98		
Sea Ports		20		
Log-Likelihood		-1024.19		
R^2 adjusted		0.163		
R^2 within		0.190		
R^2 between		0.354		
R^2 overall		0.178		
F-statistic		26.338		
p-value		0.000		
AIC		2164.376		
BIC		2482.306		

Note: ***, **, * denote statistical significance at 1%, 5% and 10% , respectively. Values in parentheses are the standard errors. Y denotes “yes” for the presence of those effects. AIC is the Akaike’s Information Criteria and BIC is the Schwarze’s Bayesian Information Criteria.

Table 8: Estimation results for real exchange rate model

	Real Exchange Rate Model			
	Exchange Rate Effect β	**Country Effects Λ**	**Asymmetry of Exchange Rate**	**Min. Export Price Effect**
Bangladesh	-0.111		-0.028	0.868
	(0.700)		(0.095)	(1.162)
Indonesia	0.465	-2.731	0.16	0.012
	(0.972)	(5.188)	(0.104)	(0.086)
Kuwait	0.387	1.841	0.073	-0.07
	(0.518)	(2.729)	(0.061)	(0.084)
Malaysia	-0.019	-0.244	0.000	-0.155
	(0.292)	(0.768)	(0.084)	(0.167)
Nepal	**-8.528****	**3.398****	0.183	1.024
	(4.217)	**(1.671)**	(0.152)	(1.111)
Oman	-0.487	-2.529	-0.037	-0.089
	(0.324)	(1.684)	(0.062)	(0.090)
Qatar	-0.248	-0.855	0.005	-0.183
	(0.329)	(0.938)	(0.079)	(0.166)
Singapore	-0.154	-0.701	0.022	-0.115
	(0.363)	(1.350)	(0.050)	(0.119)
Sri Lanka	-0.345	0.015	-0.032	0.429
	(0.311)	(0.358)	(0.049)	(0.492)
United Arab Emirates	-0.151	-0.629	0.152	-0.166
	(0.163)	(0.488)	(0.095)	(0.168)
Constant	3.446***			
	(0.391)			
Time fixed Effects			Y	
Port Fixed Effects			Y	
State Fixed Effects			Y	
Observations		1,795		
Months		98		
Sea Ports		20		
Log-Likelihood		-1027.51		
R^2 adjusted		0.160		
R^2 within		0.187		
R^2 between		0.267		
R^2 overall		0.189		
F-statistic		25.178		
p-value		0.000		
AIC		2171.01		
BIC		2488.94		

Note: ***, **, * denote statistical significance at 1%, 5% and 10% , respectively. Values in parentheses are the standard errors. Y denotes “yes” for the presence of those effects. AIC is the Akaike’s Information Criteria and BIC is the Schwarze’s Bayesian Information Criteria.

4.2 Asymmetric Effects and Minimum Export Price.

Table 6-8 also shows the effects that asymmetry in exchange rate as well as the imposition of domestic minimum export price policy has on the export price. Owing to a competitive market structure in majority of destination for Indian onion exports, we do not find significance in the asymmetry of exchange rate apart from Bangladesh in Table 6 for commodity specific exchange rate. This implies that whether a depreciation or appreciation in Indian rupee, the effect is negligible as the market structure is such that Indian exporters are not able to take advantage of the change in Indian currency in these destination markets. For Bangladesh in Table 6, the asymmetry coefficient is positive and significant implying that the effect of appreciation of Indian rupee is more on the export price than depreciation of Indian rupee.

Now we turn to the domestic trade policy of imposing minimum export price (MEP) to regulate the outflow of exports. Over the period of the authors' study, January 2007- February 2016, Government of India has variably imposed the MEP depending on the domestic climate of onion production and price. Table 6, shows the effect of imposing of minimum export price in India to regulate the trade flow of onion export. We observe that for countries Oman and Qatar, where we observe a PTM behavior, we see that imposing MEP policy raises the export price beyond the MEP suggesting a positive influence on the market power of Indian exporters of onion. The results show that India's trade policy tool has had a positive and statistically significant effect in countries like Oman and Qatar (Table 6) signalling that export restriction in the form of minimum export price by the government did not influence the exporters pricing behavior in these countries where PTM was observed.

5. Conclusion.

India's international position in the trade of onion has shown that the exports from India has been rising since 1996 and at present stands second in the list of international competitors of onion exports into the world market. However, since 2010, the Government of India has restricted exports of onion by imposing the minimum export price policy to regulate the export owing to the rise in domestic price of onion. The present study made an attempt to analyse the market power, asymmetric effects of exchange rates as well as the effects of minimum export price policy on the export pricing of India's top horticultural product, fresh onion. Applying the pricing to market model on port-level-data from 20 major sea ports of India for monthly data from 2007-2016, we observed a competitive market structure in majority of the destination markets. However, the pricing-to-market behavior was prevalent in three destination markets- Bangladesh, Oman and Qatar. In these markets, the exporters were following local currency price stabilization-i.e., reducing the price whenever the Indian currency appreciates against the importer's currency. The dummy variable for minimum export price was positive and statistically significant in those markets where the pricing to market behavior was observed indicating that even when the minimum export price requirement was in place, exporters were able to adjust their price downward and sell in those markets.

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