Price Transmission Behavior of Melons Market in China-Myanmar Border Trade

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Introduction

Border trade is the main channel for exports of fresh fruits from Myanmar to the China Market. Melons account for the highest export volume and values among other fresh fruits. According to the data from the Myanmar Ministry of Commence, approximately 70% of total production is exported, while domestic consumption accounts for only 30%. In 2016-17, 707 thousand MT of watermelon and 124 thousand MT of muskmelon were exported, valuing at 70.94 million and 23.36 million US dollars, respectively. From this total exported amount, over 90 percent are exported via border trade, mainly to China. Because of high export volume and potential to expand the market, melons are considered as one of the priority crops in export promotion strategy. Although it is the huge export market with high potential to expand the market, there are some weak points in operating the market. With limited information flow and the many steps in procurement process, the markets are not operated efficiently. The objective of this study is to analyze how is the price transmitted between the export market or border market and the destined market or import market.

Background of melons market in China-Myanmar border trade

The peak season for melon export is November through April which is the off season in China. After harvest, melons are transported directly to Muse-Yuili border trade area. The border trade market is operated by private companies and these companies serve as brokers in connecting with China buyers. Melons prices are mostly determined by China buyers. There are many factors that affect the price offered by China buyers to Myanmar brokers. For example, melon prices increase following unfavorable weather conditions in China, high demand during New Year festival, and less supply of melons from Myanmar due to conflicts in the region. After
negotiation for price, off-loading and repackaging are done and sometimes it takes two to three days to get enough melons to fill the transportation vehicles (trucks). These many steps in procurement process point out that transaction costs might have a significant impact on the price changes of imported melons. The brief structure of melons market can be expresses as below,

Two production seasons per years; monsoon and winter
Monsoon – few acres, for domestic consumption
Winter – for exports, large-scale production
Growing, harvesting and packaging done on farm
Transport to Muse border trade zone by car, nearly 12-15 hours drive.

Main areas for the export market
- The whole border trade market is operated by private business organization
- East North Gate Wholesale market is organized by more than 40 brokers. Nearly 80% of the border trade market is operated by these brokers.
- Brokers play as a negotiator between Myanmar farmers and China buyers. Brokers do the custom clearance and taxation processes for Myanmar farmers. Brokers receive 3-5% of sale value as their commission fee
- Price is considered based on size and quality of the fruits
- Price negotiation is done in MUSE border trade area and then fruits are changed to another truck load in Yuili border trade zone.
- During truck load change, some modifications to the price agreement might take place because of mixing large and small sized fruits, low quality fruits.
- From Yuili, melons are transported to various provinces of China
Information on daily price and traded volume at border market is very limited. Because of the sources that provide accurate market information are limited, the producers try to forecast the price of melon in border market based on the daily price posted on the companies’ Facebook pages. Even though producers try to adjust the date of harvesting based on the posted daily prices, because of the unavoidable delays up to a few days in harvesting and also the existing traffic along the main transportation channels frequently, farmers fail to have their production to the border market in time to capture the optimum price. Additionally with the perishable nature of melons, the price fluctuation becomes very high. Thus, for adjusting the date of harvest and considering the delays in transportation, speed of price transmitted from destination market to border market is an important indicator for producers’ profitability determination.

Factors such as lack of accurate market information, delay in transportation, and high transaction costs due to many steps in procurement process, cause uncertainties for producers not to get better price. The weak or inaccurate market information could have negative impacts on the market efficiency (Gotz et al.). In international trade, price changes of a commodity in one market are the reflection of price changes in the trading partner country. If the price difference is higher than transaction costs, then arbitrage opportunities occur and price difference is expected to be reduced to the level that the difference between export and import market prices is equal to the transaction costs. In the short term, the speed of price adjustment is an indicator of the extent of price transmission and it is expected to indicate the level of the integration. In the case of Myanmar melons industry, the way price is transmitted from China buyers to Myanmar producers and the behavior of price transmission between Muse border market and the import markets is still a question. With the purpose to provide a better understanding of the border trade market for melons, the price transmission behavior of the melons markets is estimated by using a
vector error correction model. Ward (1982) found that in analyzing pricing behavior of the fresh produce markets, the wholesale market is the most important level in the determination of the price changes as compared to the other levels such as retail and farm levels. Compared with the retail level, the wholesale level prices are more valid as the wholesale markets deliver to many important markets. Thus, in this study, the wholesale markets in Kunming, Yunnan Province is selected for price comparison with border market.

Data

Different cultivars of watermelons and muskmelons are exported from Myanmar to China via border trade. Among them two cultivars of watermelon: Taiwang and Seedless, and ‘Wu Khone’ muskmelon are selected for this study, as these cultivars are the most popular. Daily prices of three different cultivars of melons in Muse border market are collected from Company’s facebook page. The company’s facebook page updates the daily prices of melons and it is the main source of information for producers to estimate the price. Daily price data of Kunming market is also collected via wholesale company’s website.

Melons export season is from November to April and price data for three crop seasons; November 2015 – April 2016, November 2016 – April 2017 and November 2017 – April 2018, are collected. There are some missing values in data as there is no trade flow during Myanmar new year festival, Chinese new year festival, and sometimes due to conflicts in the region. As the number of missing values is small and the changes of price are not large, the missing values are estimated with the day before and after prices. Based on the highest and lowest daily price data, average price is calculated. The summary statistics of three cultivars of melons are shown in table 1, 2 and 3. A line graph is created with the daily price data to demonstrate the trend in the price changes. Because there are some missing values in lowest price and the percentage of same
price value is high in average daily price, only the highest daily price is used in estimating the price adjustment. The line graphs for average daily price of each cultivar are shown in Figure 4, 5, and 6. According to the graph, it can be generally concluded that the price changes between these two markets have some extent of relation and the price is more stable in Kumming market compared to the border market.

Method of Analysis

The main variables are two price series which represent the lowest, highest, and average daily prices in the border and Kumming markets. The time series properties of these two data sets are analyzed by using an Augmented Dickey Fuller Unit Root test. Both the original data and first difference of data are tested for stationarity. The stationarity means that the statistical properties of the time series are constant over time. During the second step, the data are tested for cointegration. Johansen’s cointegration test is used to determine the rank of cointegration between the price data. Vector error correction model (VECM) is used to estimate the adjustment parameter. When the time series data have cointegration of I(1), then the vector error correction model is used. It is a different form of variable autoregressive model and in the VECM model both variables are “error-correct” (Hill et al.). VECM is one of the most common methods for spatial price transmission analysis when only price data is available. All of these methods are analyzed by using SAS.

Results

Augmented Dickey Fuller Unit Root Test

The actual price value and the first difference values are tested for unit root tests at 5% significance level. The null hypothesis for the test is the time series is nonstationary (H₀ => ρ = 1
and $H_A \implies \rho < 0$). The results show that the extent of autocorrelation reduces slowly. According to the results, it is found that test with the level data fail to reject the null hypothesis of $p=1$ and it can be concluded that the series is nonstationary with unit root. The test with the differenced value reject the null hypothesis of nonstationary. Thus, the series are said to be I(1). The results of unit root tests are shown in Table (4).

**Cointegration Test**

Johansen's cointegration test is used in this analysis and this test is applicable for both nonstationary and stationary time series. This is the likelihood-ratio test and the null hypothesis is that there is no cointegration between two series of data. Both maximum eigenvalue and trace test are applied. The test statistic of trace and eigenvalue are compared with critical values to test the null hypothesis. For a time series with the number of variables $p$, the rank $r=p-1$. The null hypothesis for maximum eigenvalue test is that the rank of the matrix is zero ($r=0$) which means there is no cointegration. The alternative hypothesis is the number of cointegrating price vectors is less than or equal to one ($r > 0, r=1$). If the rank $r$ is zero then there is no cointegration between the two series. If the price series are cointegrated, then the proper model is selected to continue the analysis. The results for all three cultivars show that the $p$-value is smaller than alpha critical value, thus null hypothesis is rejected and the alternative hypothesis is accepted at 5% significance level. Thus, it can be concluded that there is cointegration between prices of border market and China market for all of these three cultivars.

**Vector Error Correction Model**

The vector error correction model (VECM) is used to estimate the price adjustment between these two markets. The basic of vector error correction model is estimated by two stage
least square procedure. With the cointegrated price data, the VECM model can be estimated as follows;

\[
\Delta P_t = \rho \gamma P_{t-1} + \alpha + \sum_{m=1}^{M} \beta_m \Delta P_{t-m} + \varepsilon_t \tag{1}
\]

In the above model, the price changes in two different locations (\(\Delta P_t\)) are explained by the prices in previous period which is represented as the number of lags (\(M\)). Price in current period (\(P_t\)) = (\(P_{1,t}\), \(P_{2,t}\)) where \(t\) is the time period. \(P_{1,t}\) and \(P_{2,t}\) are prices in border market and Kumming market. \(\gamma\) is the cointegration vector and \(\gamma P_{t-1}\) measures the price in border market minus price in Kumming market and it is also called the error correction term. The lagged short-term reaction to previous changes in price in expressed with \((\Delta P_{t-m})\) for 'm' number of lag. The speed of price adjustment between these two markets is estimated with the value of \(\rho\) in this analysis. The symbol 'alpha' represents the constant value or intercept (Hu and Brorsen). In VECM model, the error term (\(\varepsilon_t\)) is assumed to have \(E(\text{error}) = 0\) and covariance matrix = 

\[
\begin{pmatrix}
\delta_1^2 & 0 \\
0 & \delta_2^2
\end{pmatrix} \in (R^+)^{2+2}.\]

With this structure, the VECM model can be written as follow,

\[
\begin{bmatrix}
[\Delta P_{1,t}] \\
[\Delta P_{2,t}]
\end{bmatrix} =
\begin{bmatrix}
\rho^1 \\
\rho_2
\end{bmatrix}
\begin{bmatrix}
[P_{1,t-1}] \\
[-P_{2,t-1}]
\end{bmatrix} +
\begin{bmatrix}
[\alpha^1] \\
[\alpha^2]
\end{bmatrix} +
\sum_{m=1}^{M}
\begin{bmatrix}
[\beta_{m}^{11}] \\
[\beta_{m}^{21}] \\
[\beta_{m}^{12}] \\
[\beta_{m}^{22}]
\end{bmatrix}
[\begin{bmatrix}
[\Delta P_{1,t-m}] \\
[\Delta P_{2,t-m}]
\end{bmatrix}] +
[\begin{bmatrix}
[\varepsilon_t^1] \\
[\varepsilon_t^2]
\end{bmatrix}]
\]

The highest daily price data for two markets are run using PROC VARMAX in SAS to get the above VECM model. In the SAS command, the model is run as a continuous linear function. The results of the VECM model for each cultivar are shown in Table 4. According to the result, the estimated cointegration vector for Taiwang cultivar is \([1, - (0.93)]\) and it can be interpreted as the long run relationship between these two market is \(PMM_t = 0.93\text{PCC}_t\). This result proves the prior assumption of melon price in China would be higher than border market.
The melons are transported from the border market to Kumming and thus, the price in Kumming is expected to be higher than the border market price. For border market price, the parameter estimates show negative value and it means price in Kumming is higher than the border market price. Only one lag is significant in the result and it can be concluded that the price adjustment between the two markets is only one day.

For seedless cultivar, the long run relationship of the two markets can be estimated as $\text{PMM}_t = 1.03\text{PCC}_t$. According to the results, the price in the border market is higher than the Kumming market. Actually, it is opposite of the actual condition. There are some possible causes for this result. The first one is that the number of observation for seedless cultivar that used to run VECM is lower than other two cultivars as there are missing values during the early and end of the season in both markets which are not easy to apply missing data imputation techniques. The lower number of observation might have cause a problem in the analysis. The second one is the amount of seedless cultivar that are produced in Yunnan and neighbor provinces like Hunnan. During the offseason, some southern provinces still have favorable weather condition for melons production and seedless cultivar is one of the most popular cultivar in China. In this case, the local production might have impact on the price of imported melon.

For Wu Khone cultivar, the long run relationship of the two markets can be estimated as $\text{PMM}_t = 14.042 \text{PCC}_t$ and that means price in Kumming market is higher than the border market. It is also found that the price adjustment is significant for only one lag and it can be concluded that the price adjustment between these two markets is fast. There are some points that need to find out the reason such as the price changes from border market to Kumming market is not significant. There might have some problems in running the model.
Conclusion

According to the results, it can be concluded that these three different cultivars show the certain extent of price relation and the price adjustment is fast which is only one lag or a day. With this initial analysis, the further research on price transmission behavior will be continue. Although the price difference between two markets is noticeable with the graph, some of the estimates from the test results are not significant. There might have some possible reasons that this analysis is done only with the price data and the number of data for some cultivars is low. Here, only ADF and cointegration tests are done. VECM is run with the assumption of linear form. Thus, it is required to check the causality and linearity tests. In analyzing price transmission, transaction costs have high impact in price adjustment. As the data collection for transaction cost is still ongoing, only the price data are used. By considering both price data and transaction costs, parity bound model will be used in the further analysis step.
References


Ministry of Commerce (MOC), Myanmar. 2016. Oversea and border trade export data of fruit and vegetables. Nay Pyi Taw, Myanmar

Table 1 – Summary Statistics of Taiwang cultivar

<table>
<thead>
<tr>
<th></th>
<th>S1- Border market</th>
<th>S2- Border market</th>
<th>S3- Border market</th>
<th>S1-Kumming</th>
<th>S2- Kumming</th>
<th>S3- Kumming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>2</td>
<td>1.9</td>
<td>3.1</td>
<td>2.0</td>
<td>3.2</td>
<td>3.8</td>
</tr>
<tr>
<td>High</td>
<td>2.3</td>
<td>2.3</td>
<td>3.4</td>
<td>2.4</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Avg</td>
<td>1.8</td>
<td>2.3</td>
<td>3.2</td>
<td>2.4</td>
<td>3.9</td>
<td>3.6</td>
</tr>
<tr>
<td>L</td>
<td>1.30</td>
<td>1.80</td>
<td>0.80</td>
<td>0.00</td>
<td>0.80</td>
<td>0.65</td>
</tr>
<tr>
<td>H</td>
<td>4.50</td>
<td>6.00</td>
<td>5.25</td>
<td>3.8</td>
<td>5.0</td>
<td>4.90</td>
</tr>
<tr>
<td>Std dev</td>
<td>0.897</td>
<td>1.157</td>
<td>0.998</td>
<td>0.873</td>
<td>1.064</td>
<td>0.928</td>
</tr>
<tr>
<td>Percentage of same price in each series</td>
<td>10%</td>
<td>7%</td>
<td>4%</td>
<td>24%</td>
<td>10%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Table 2 – Summary Statistics of Seedless Cultivar

<table>
<thead>
<tr>
<th></th>
<th>S1- Border market</th>
<th>S2- Border market</th>
<th>S3- Border market</th>
<th>S1- Kumming</th>
<th>S2- Kumming</th>
<th>S3- Kumming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>2</td>
<td>2.3</td>
<td>1.85</td>
<td>3.0</td>
<td>3.3</td>
<td>3.1</td>
</tr>
<tr>
<td>High</td>
<td>2.3</td>
<td>2.3</td>
<td>3.4</td>
<td>3.4</td>
<td>4.0</td>
<td>3.9</td>
</tr>
<tr>
<td>Avg</td>
<td>1.9</td>
<td>2.3</td>
<td>3.2</td>
<td>2.4</td>
<td>3.9</td>
<td>3.6</td>
</tr>
<tr>
<td>L</td>
<td>1.30</td>
<td>1.80</td>
<td>1.60</td>
<td>1.00</td>
<td>1.50</td>
<td>1.25</td>
</tr>
<tr>
<td>H</td>
<td>4.50</td>
<td>6.00</td>
<td>5.25</td>
<td>4.5</td>
<td>5.2</td>
<td>5.0</td>
</tr>
<tr>
<td>Std dev</td>
<td>0.917</td>
<td>1.189</td>
<td>1.02</td>
<td>0.936</td>
<td>1.076</td>
<td>0.949</td>
</tr>
<tr>
<td>Percentage of same price in each series</td>
<td>10%</td>
<td>7%</td>
<td>4%</td>
<td>24%</td>
<td>10%</td>
<td>8%</td>
</tr>
</tbody>
</table>

Table 3 – Summary Statistics of Wu Khone Cultivar

<table>
<thead>
<tr>
<th></th>
<th>S1- Border market</th>
<th>S2- Border market</th>
<th>S3- Border market</th>
<th>S1- Kumming</th>
<th>S2- Kumming</th>
<th>S3- Kumming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>3.5</td>
<td>5</td>
<td>4.25</td>
<td>3.5</td>
<td>5</td>
<td>3.75</td>
</tr>
<tr>
<td>High</td>
<td>3</td>
<td>5</td>
<td>3.75</td>
<td>2.5</td>
<td>3</td>
<td>2.4</td>
</tr>
<tr>
<td>Avg</td>
<td>2.5</td>
<td>3</td>
<td>3.2</td>
<td>2.4</td>
<td>3</td>
<td>2.4</td>
</tr>
<tr>
<td>L</td>
<td>1.20</td>
<td>3.00</td>
<td>2.35</td>
<td>0.8</td>
<td>1.9</td>
<td>1.45</td>
</tr>
<tr>
<td>H</td>
<td>4.50</td>
<td>7.50</td>
<td>5.75</td>
<td>4.5</td>
<td>5.2</td>
<td>5</td>
</tr>
<tr>
<td>Std dev</td>
<td>0.691</td>
<td>1.04</td>
<td>0.809</td>
<td>0.727</td>
<td>0.693</td>
<td>0.724</td>
</tr>
<tr>
<td>Percentage of same price in each series</td>
<td>10%</td>
<td>7%</td>
<td>4%</td>
<td>24%</td>
<td>10%</td>
<td>8%</td>
</tr>
</tbody>
</table>
Table 4 – Augmented Dickey-Fuller Unit-Root Tests Using Actual and Differenced Values

<table>
<thead>
<tr>
<th></th>
<th>Taiwang</th>
<th>D_Taiwang</th>
<th>Seedless</th>
<th>D_Seedless</th>
<th>Wu Khone</th>
<th>D_Wu Khone</th>
</tr>
</thead>
</table>

Table 5 – Johansen’s Cointegration Test

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Eigenvalue</th>
<th>Trace Value</th>
<th>Significance Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taiwang</td>
<td>0.0134</td>
<td>5.4876</td>
<td>**</td>
</tr>
<tr>
<td>Seedless</td>
<td>0.0225</td>
<td>9.6022</td>
<td>**</td>
</tr>
<tr>
<td>Wu Khone</td>
<td>0.0135</td>
<td>6.2871</td>
<td>**</td>
</tr>
</tbody>
</table>

** means it is significant at 5% level.

Table 6 – Vector Error Correction Model for Taiwang cultivar

<table>
<thead>
<tr>
<th></th>
<th>Taiwang Cultivar</th>
<th>Seedless Cultivar</th>
<th>Wu Khone Cultivar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
<td>Estimate</td>
<td>Std. Error</td>
<td>Sig</td>
</tr>
<tr>
<td>Border Market</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-0.04445</td>
<td>0.02453</td>
<td>-0.06131</td>
</tr>
<tr>
<td>ΔPMM_{t-1}</td>
<td>-0.04806</td>
<td>0.02233</td>
<td>**</td>
</tr>
<tr>
<td>ΔPCC_{t-1}</td>
<td>-0.04486</td>
<td>0.02085</td>
<td>**</td>
</tr>
<tr>
<td>ΔPMM_{t-2}</td>
<td>-0.00972</td>
<td>0.05159</td>
<td></td>
</tr>
<tr>
<td>ΔPCC_{t-2}</td>
<td>-0.03344</td>
<td>0.04133</td>
<td></td>
</tr>
</tbody>
</table>

Kumming Market

<table>
<thead>
<tr>
<th></th>
<th>Taiwang Cultivar</th>
<th>Seedless Cultivar</th>
<th>Wu Khone Cultivar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>0.13931</td>
<td>0.02378</td>
<td>0.3313</td>
</tr>
<tr>
<td>(\Delta \text{PMM}_{t-1})</td>
<td>0.15143</td>
<td>0.02584</td>
<td>***</td>
</tr>
<tr>
<td>(\Delta \text{PCC}_{t-1})</td>
<td>-0.14136</td>
<td>0.02413</td>
<td>***</td>
</tr>
<tr>
<td>(\Delta \text{PMM}_{t-2})</td>
<td>-0.03746</td>
<td>0.05971</td>
<td>-0.01475</td>
</tr>
<tr>
<td>(\Delta \text{PCC}_{t-2})</td>
<td>-0.11298</td>
<td>0.04783</td>
<td>*</td>
</tr>
</tbody>
</table>

‘*’, ‘**’, ‘***’ mean 1%, 5% and 10% significance levels respectively.

**Figure 1** - Comparison of average price for Taiwang cultivar (Year One)

**Figure 2** - Comparison of average price (Seedless cultivar, Year One)
Figure 2 – Comparison of average price for Seedless cultivar (Year One)

Figure 3 – Comparison of average price for Wu Khone cultivar (Year One)

Figure 4 – Comparison of average price for Taiwang cultivar (Year Two)

Figure 5 – Comparison of average price for Seedless cultivar (Year Two)
Figure 6 – Comparison of average price for Wu Khone cultivar (Year Two)

Figure 7 – Comparison of average price for Taiwang cultivar (Year Three)
Figure 8 – Comparison of average price for Seedless cultivar (Year Three)

Figure 9 – Comparison of average price for Wu Khone cultivar (Year Three)