Factors Affecting Thailand’s Major Agricultural Exports Using Panel Cointegration Method

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Abstract

The main purpose of this research is to study how certain variables affect the value of exports for Thailand’s agricultural products. Specifically, the research analyzes the long-term relationship between the dependent variables; which are i) the importers’ Gross Domestic Product (GDP), ii) free on board price (FOB), iii) domestic product prices (DP), iv) exchange rate (EXC), and v) quantity of product (PRO); and the independent variables which are the values of the exports derived from the four main agricultural products that are exported to five main importing countries. For this research, the four main agricultural products consist of i) rubber, ii) rice, iii) cassava products, and iv) frozen prawns. The data used in this research is annual panel data from 2001 – 2010.

The methods used in this research are; firstly, five standard methods of unit root tests. Secondly, a Panel Cointegration test based on the Pedroni Residual Cointegration test which is employed in examining variables in the model. Finally, the Ordinary Least Squares (Snyder & Nicholson, 2008), Dynamic Ordinary Least Squares (DOLS) and Fully Modified Ordinary Least Square (FMOLS) methods are used to estimate the long-term relationship between Thailand’s major agricultural export models. In the long-run, the results indicate that factors affecting Thailand’s major agricultural export values are i) the importer’s GDP, ii) FOB price, iii) EXC, iv) DP, and v) PRO. Most of the results in this research are consistent with economic theories and can be applied to policy making.

Key word: Thailand; Agricultural; Export; Panel Unit Root Test; Panel Cointegration Test; long-run relationship
Introduction

All countries need to rely on each other. Due to the fact that no one country can survive only on its own local output, imported goods are needed from foreign countries with lower costs of production and higher production capabilities to maintain and improve the standard of living of the people in the country (Mingnakhin, 2005). Accordingly, agricultural reformation has occurred, and the progress in agricultural science and technology has been used to increase the production of agricultural produce (Pityavivit, 2007; Tubpan, 2008). This has also raised the quantity produced in the same amount of time. Therefore, many countries, including Thailand, which have relied on agricultural reformation have adopted it as one of the principal and main policies. The models of crop cultivation and husbandry have also been determined using the pattern based on Economies of Scale (Institution for the Promotion and Development of Learning Innovation, 2010; Pintarak, 2010).

From January 2011 to October 2011 Thailand had a trade surplus of 57,235.3 million baht. The total value of imports was 5,854,538.4 million baht. On the other hand, the total value of exports was 5,911,773.7 million baht, which had increased by around 15.1 per cent from the same period in the previous year. Considering the export values of Thailand by type of goods, agricultural goods constituted the second largest export, equivalent to 692,378.6 million baht (Department of International Trade Promotion, 2011). From the above-mentioned, it can clearly be seen that the export of Thai agricultural produce plays an important role in the Thai economy. The export of agricultural produce makes up around 12.8 % of the total export value of Thailand (Laorujisawad, 2009). Moreover, the agricultural sector is the main source of Thai employment; accounting for about 43.3 % of the total labor force in Thailand (Bank of Thailand, 2010).

According to the existing literature, there are various factors affecting the amount of exports. Many scholars identify different variables based on their empirical studies. Regarding agricultural products, it can be summarized that i) domestic price of the exported product, ii) exchange rate, iii) FOB price, iv) importer’s GDP and v) the amount of production are crucial factors for an exporting country. Furthermore, by collecting relating research papers, it has been found that only a few researchers have been concerned with studying factors affecting the export of Thailand’s major agricultural products using the Panel Cointegration method.
Research Methodology

This study consists of four different methods in analyzing the long run equilibrium relationship between factors affecting the export values and export amounts of Thai’s agricultural produce.

The Conceptual Framework

From the literature review of factors affecting Thailand’s export value, the function of export value can be represented as follows (Abolagba, Onyekwere, & Agbonkpolor, 2010; Cavenaile, 2010).

\[ Y_{it} = f(GDP_{it}, EXC_{it}, FOB_{it}, DP_{it}, PRO_{it}) \]  \hspace{1cm} (1)

This is the function obtained by analyzing the panel data contained in the relationship of factors in the Panel Cointegration model. Therefore, the panel model of factors affecting export values can be expressed as follows;

\[ \ln Y_{it} = \alpha_i + \beta_1 \ln GDP_{it} + \beta_2 \ln EXC_{it} + \beta_3 \ln FOB_{it} + \beta_4 \ln DP_{it} + \beta_5 \ln PRO_{it} \]  \hspace{1cm} (2)

Where;  
- \( i \) = Cross-section data (the trade partners: China, Japan, United States, Malaysia, and South Korea)
- \( T \) = Time series data (t = 1, 2, 3, …, 10)
- \( Y \) = Thailand’s export values to trade partners
- \( GDP \) = Gross Domestic Product of Thailand’s trade partners
- \( EXC \) = Exchange rate between Thailand and trade partners
- \( FOB \) = Prices of Thailand’s exported products
- \( DP \) = Domestic products price of Thailand
- \( PRO \) = Thailand domestic production quantity
- \( \alpha, \beta \) = Parameters; \((\beta_1, \beta_5 > 0 \text{ and } \beta_2, \beta_3, \beta_4 < 0)\)

Unit Root Test

The panel unit root test is the method used in testing the panel data which will be used in this study. The methods used in this study are LLC Test, Hadri Test, IPS Test, and Fisher-Type Tests using ADF and PP Tests.

<table>
<thead>
<tr>
<th>Common Panel Unit Root Test Method</th>
<th>( H_0 )</th>
<th>( H_1 )</th>
<th>Statistic value</th>
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<tbody>
<tr>
<td>LLC (2002)</td>
<td>With unit root</td>
<td>No unit root</td>
<td>( t^* )-Statistic</td>
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<td>Breitung (2001)</td>
<td>With unit root</td>
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<td>Hadri (2000)</td>
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<table>
<thead>
<tr>
<th>Individual Unit Root Test Method</th>
<th>( H_0 )</th>
<th>( H_1 )</th>
<th>Statistic value</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPS (2003)</td>
<td>With unit root</td>
<td>Some variables have no unit root</td>
<td>( W )-Statistic</td>
</tr>
<tr>
<td>Fisher-Type (1999)</td>
<td>With unit root</td>
<td>Some variables have no unit root</td>
<td>Fisher Chi-Square</td>
</tr>
</tbody>
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Panel Cointegration Test

The Pedroni method employed to examine the long-run relationship between factors affecting Thailand’s major agricultural exports and Thailand’s major agricultural exports value is the test based on the Engle-Grange Cointegration Test (Pedroni, 2001, 2004). The equation is as follows;

\[ y_{it} = \alpha_i + \delta t + \beta_i X_{it,i} + \beta_{2i} X_{2it,j} + \ldots + \beta_{Mi} X_{Mit,j} + e_{it} \]  

Where \( i = 1, 2, \ldots, N \) are cross-section data  
\( t = 1, 2, \ldots, T \) are time-series data  
\( m = 1, 2, \ldots, M \) are regression variables

Assume that \( y_{it} \) and \( X_{Mi,t} \) have an order of integration =1 or I (1) for individual units of \( i \). In addition, the coefficient \( \beta_{1i}, \beta_{2i}, \ldots, \beta_{Mi} \) will be different for individuals of the cross-section term. And the individual effect in cross-section is \( \alpha_i \). In addition, the differentiation in individual cross-section term and trend effects are \( \delta_{it} \).

The residual \( (e_{it}) \) obtained from a regression equation will be I (1) with the exception of null hypothesis or no cointegration and can be examined by the following equation.

\[ e_{it} = \rho_i e_{it-1} + \sum_{j=1}^{K} \varphi_{ij} \Delta e_{it-j} + v_{it} \]  

- \( H_0: \rho_i = 1 \)  
- \( H_1: \rho_i < 1 \) or \( \rho_i < 1 \) Cointegration

Standardized Statistic that has Asymptotically Normally Distribution

\[ \frac{N_{N,T} - \mu \sqrt{N}}{\sqrt{V}} \to N(0,1) \]  

Where \( \mu \) and \( V \) are Monte Carlo Generated Adjustment Terms

If panel statistics reject a null hypothesis, this indicates that all variables of the Panel Cointegration model have cointegration. On the other hand, if group panel statistics reject a null hypothesis, this indicates that at least one variable in the Panel Cointegration model has cointegration.

**Estimating Panel Cointegration model**

**The Ordinary Least Square: OLS** (Baitagi, 2006; Baltagi, 2005)

Basic equation

\[ Y_{it} = \alpha_i + \beta_i X_{it,i} + e_{it} \]  

\( \beta_i \) can be estimated by Ordinary Least Squares, as follows

\[ \hat{\beta}_{i,OLS} = \left[ \sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it,i} - X_i)^2 \right]^{-1} \sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it,i} - X_i)(Y_{it} - Y_i) \]  

where  
\( i \) = Cross-section data, where \( N \) is the number of cross-section data  
\( t \) = Time series data, where \( T \) is the number of time series data  
\( \hat{\beta}_{i,OLS} \) = Standard Panel OLS Estimator  
\( X_{it,i} \) = Exogenous variable  
\( \bar{X}_i \) = Means of \( X_i \)  
\( Y_{it} \) = Endogenous variable
$Y_i = \alpha_i + \beta_i X_i + \sum_{j=K}^N \gamma_{ik} \Delta X_{ij-k} + \epsilon_{it}$ \hspace{1cm} (8)

where,

$i$ = Cross-section data, where $N$ is the number of cross-section data

$t$ = Time series data, where $T$ is the number of time series data

$\hat{\beta}_{i, DOLS}$ = Dynamics OLS Estimator

$Z_{it} = 2(K+1) \times 1$

$\hat{Z}_{it} = (X_{it} - X_{it}^*)$

$X_{it}^*$ = Means of $X_{it}$

$\Delta X_{ij-k}$ = Differentiation of $X$

The Dynamic Ordinary Least Square: DOLS

Due to the fact that serial correlation and non-exogeneity problems were found, Pedroni (2001) created the estimation method that can solve these problems by estimating Between-Dimension, Group-Means Panel DOLS was improved from (7) as follows:

$\hat{Y}_{it} = \hat{\beta}_{i, DOLS} X_{it} + \epsilon_{it}$ \hspace{1cm} (9)

$\hat{\beta}_{i, DOLS}$ = Fully Modified OLS Estimator

$Y_{it} = \alpha_i + \beta X_{it} + \epsilon_{it}$ \hspace{1cm} (6)

$\beta$ of FMOLS Estimators is:

$\hat{\beta}_{FMOLS} = \left[ \sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it} - X_{it}^*) (X_{it} - X_{it}^*)' \right]^{-1} \times \left[ \sum_{i=1}^{N} \sum_{t=1}^{T} (X_{it} - X_{it}^*) Y_{it}^* - T \Delta Y_{it}^* \right]$ \hspace{1cm} (7)

Where;

$i$ = Cross-section data and $N$ is number of cross-section data

$t$ = Time series data and $T$ is number of time series data

$\hat{\beta}_{FMOLS}$ = Fully Modified OLS Estimator

$X_{it}$ = Exogenous variables

$X_{it}^*$ = Means of $X_{it}$

$Y_{it}$ = Endogenous variables

$Y_{it}^*$ = Means of $Y_{it}$

$Y_{it}^* = (Y_{it} - Y_{it}^*) - \left[ \left( \hat{\Omega}_{21} / \hat{\Omega}_{22} \right) \Delta X_{it} \right]$
Results

The empirical result of the panel unit root test

The five standard panel Unit Root Tests namely; LLC Test, Breitung Test, IPS Test, Fisher-Type Test (Fisher-ADF Test and Fisher-PP Test) and Hadri Test were applied to examine the six economic variables, which are i) agricultural export value, ii) the importers’ Gross Domestic Product (GDP), iii) free on board price (FOB), iv) domestic product prices (DP), v) exchange rate (EXC), and vi) the quantity of product produced (PRO). The result of the panel unit root tests indicates that the statistical value of all economic variables accept the null hypothesis of unit root (non-stationary) and reject the null hypothesis of no unit root (stationary) for, The Hadri Test. According to the results, the six economic variables are non-stationary data. So, all the variables should be taken the first differencing. The results show that all economic variables reject the null hypothesis of unit root except The Hadri Test with opposite null hypothesis. In other words, all variables in this result satisfy the sufficient condition for Panel Cointegration test.

The empirical result of Panel Cointegration

The result of Pedroni Panel Cointegration test of Thailand’s major agricultural export value model based on no intercept and trend indicate that the most of variable’s statistic value of Panel-Statistic are significant at rejection of null hypothesis (no cointegration) at the 0.01 and 0.05 level of significance. They imply that all variables in this model have the long-run relationships with each other or have cointegration. Moreover, the statistic value of Group - Statistics are significant at rejection of null hypothesis (no cointegration) at the 0.01 level of significance. The results indicates that at least one variable in Thailand’s major agricultural export value model have long-run relationships.

The empirical result of estimating Panel Cointegration model

The results of the long-run relationship for Thailand’s major agricultural export value model based on OLS-estimator (ln Y it is the dependent variable) are reported that; firstly, the domestic price variable of this model implies that increases 1% in domestic price lead to 5.03%, 1.10% and 1% increase in export value of rice, cassava and prawn respectively with expected sign. Secondly, the coefficient of exchange rate suggests that a1% appreciates in exchange rate causes export value of rice and cassava decrease 5.67% and 1.41% respectively as expected sign. Moreover, free on board price shows negative sign as expected. It indicates that 1% rises in free on board price will decrease export value of rice in 4.72% and frozen prawns as very low percent. Furthermore, importer’s GDP implied that 1% increase in
importer’s GDP lead 0.46% increase in rubber’s export value as expected sign. The coefficient of cassava is unexpected. Finally, the coefficient of agricultural production suggests that 1% increases in agricultural production cause 26.11% and 1.30% increase in export value of rice and cassava as expected sign. The coefficient of frozen prawns is unexpected.

The results of the long-run relationship for Thailand’s major agricultural export value model based on DOLS-estimator (\(\ln Y_t\) is the dependent variable) are reported that; firstly, the domestic price variable of this model implies that 1% increase in domestic price lead to 4.31% and 1% increase in export value of rice and frozen prawns respectively as expected sign. But the domestic price of rubber and cassava are unexpected. Secondly, the coefficient of exchange rate suggests that a1% appreciates in exchange rate causes export value of rice and cassava decrease 8.91% and 2.50% respectively as expected sign. Moreover, free on board price indicates that 1% rise in free on board price will decrease export value of rice in 5.35% and frozen prawns as very low percent as expected sign. Furthermore, importer’s GDP implied that 1% increase in importer’s GDP lead 0.26% and 1.27% increase in export value of rice and cassava as expected sign, except existing result of frozen prawns. Finally, the agricultural production suggest that 1% increase in agricultural production cause export value of rice and cassava increase 33.05% and 1.15% respectively as expected sign. The unexpected results are rubber and frozen prawns.

The panel group FMOLS-estimation (five-country group) results are reported which most of the result carry out correct expectation sign. The result of rubber’s export value model implied that 1% increase in rubber’s production cause 1.2% increase in rubber’s export value as expected sign. Secondly, the coefficient of domestic price, rice’s production and free on board price in rice’s export value model, suggesting that 1% increase in those variables will increase 5.87%, 28.06% and decrease 5.17% respectively. Furthermore, the coefficient of exchange rate and cassava productions in cassava’s export value model carry correct expected sign, show that when exchange rate and cassava productions increase 1% led to decrease 0.95% and increase 1.57% respectively. Finally, the existing result in prawn’s export value model suggested that only coefficient of domestic price are significant but in unexpected sign.

The individual country FMOLS model estimation result reported that; the result of rubber’s export value model implied that the coefficients in all case of domestic price are significant but in unexpected sign. Similarly, the coefficient of exchange rate indicates that
the appreciation of exchange rate cause reduce in export value of rubbers as expected, except China, USA and Malaysia. Furthermore, the statistic values of FOB price are significant but in unexpected sign. Moreover, the coefficient of importer’s GDP suggests that the increase in importer’s GDP will increase the export value of rubbers as expected only on Malaysia. Finally, the coefficient of rubber production indicates that the increase in rubber production will increase the export value of rubbers as expected.

In addition, the result of rice’s export value model implied that the coefficients in all case of domestic price are significant and suggests that the increase domestic price will increase the export value of rice as expected. Similarly, the coefficient of exchange rate indicates that the appreciation of exchange rate cause reduce in export value of rice as expected sign, except China. Furthermore, the statistic values of FOB price implied that the increase in FOB price will reduce in export value of rice as expected, except USA. Moreover, the coefficient of importer’s GDP indicates that the increase in importer’s GDP will increase the export value of rice as expected, except Malaysia and South Korea, Finally, the coefficient of rice production indicates that the increase in rice production will increase the export value of rice.

However, the result of cassava’s export value model implied that the coefficient in \ domestic price suggests that the increase domestic price will increase the export value of cassava as expected, except China. Similarly, the coefficient of exchange rate carry negative sign as expected, it indicates that the appreciation of exchange rate cause reduce in export value of cassava. Furthermore, the coefficients in all case of FOB price are significant but in unexpected sign. Moreover, the coefficient of importer’s GDP indicates that the increase in importer’s GDP will increase the export value of cassava as expected, except Japan and South Korea, Finally, the coefficient of cassava production indicates that the increase in cassava production will increase the export value of cassava.

Moreover, the result of prawn’s export value model implied that the coefficients in all case of domestic price are significant but in unexpected sign. Similarly, the coefficient of exchange rate indicates that the appreciation of exchange rate cause reduce in export value of prawn as expected, except China and Japan. Furthermore the statistic values of FOB price implied that the increase in FOB price will reduce in export value of prawn as expected, except USA. Moreover, the coefficient of importer’s GDP indicates that the increase in importer’s GDP will increase the export value of prawn as expected, except Japan, Malaysia
and South Korea. Finally, the coefficient of prawn production indicates that the increase in prawn production will increase the export value of prawn, except USA.

Discussions

From the empirical results of this research can conclude that the factors affecting Thailand’s major agricultural export are as follows; first, the unexpected result in negative relationship of rubber’s domestic price and export value, implied that the decrease in domestic price because decline in domestic industries that involve the use of rubber. Therefore, export rubber trends to increase and export value also increase, which is correspond with Cui (2010). Moreover, unexpected result of FOB implied that, although FOB price increases, trade partner of Thailand still continue consume those products from Thailand. Thai rubber and cassava have competitiveness and high volume of production as the reason. These results are corresponding with the previous studied of The Agricultural Futures Trading (Sunasuan, Sombudwichathor, & Thanapongpipat, 2011) and Business Analysis Department, EXIM Bank (2009). Furthermore, unexpected result of importer’s GDP might be cause by adequate quality requirement in importer countries. When importers have higher GDP, they will turn to import higher quality product from other countries. Finally, the unexpected result might cause of the decreasing rate of production are lower than the increasing rate of FOB price. Therefore the exports value still increase while the productions decrease.

Recommendations

According to the results of long-run relationship, suggest important role of the cooperation between government and private sector. With the target creating the efficiency of production and the competitiveness of Thai agricultural produced by support and provide new knowledge to famers. Moreover, the government has to be an intermediary in negotiating with trade partners. To increases bargaining power in conflict and benefit issue. To encourage foreign demand, concerned department should promote the agricultural product by arranging agricultural road show. Due to the empirical result of exchange rate, government should intervene the exchange rate for suitable level. Moreover, agricultural exporters need alternative plan for handed with the depreciation of US dollar such as seeking for new markets to reduce the portion of income in term of US dollar.
References


