Trade Factors Affecting Apple Exports from China to Thailand

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Abstract

Export supply and import demand factors are used to examine the apple exports from China to Thailand. Error Correction Model (ECM) and Cochrane-Orcutt regression are applied to examine the apple trade from 1976 to 2007. China apples export supply to Thailand is only influenced by domestic production cost. An increase in China apples production cost leads to a decrease of export quantity to Thailand. The result is consistent with the Thailand import demand function, where import quantity is negatively related to the China apple export price. The real exchange rate also plays an important role in the apples trade between China and Thailand. Thai baht appreciation would cause Thai import less apples from China.

Key words: apples, export supply, import demand, error correction model

JEL classification: F14, Q13, Q17

Introduction and Background

Since the economic reform initiated in 1979, Chinese farmers have more freedom in planting decisions. Many farmers have chosen fruits and vegetables production since they are more profitable than grain production. Apples are one such cash crop, bringing an average net profit $690 per acre versus an average of $148 per acre from grain production in 2004 (Huang and Gale, 2006).

China's apple production has increased dramatically during the last 30 years. Its production quantity rose from 1.7 million tonnes in 1976 to 27.9 million tonnes in 2007. China has exceeded the U.S. as the world's largest apple grower since early the 1990s and became the largest apple exporter in 2003, one year after becoming a WTO member. According to Heckscher-Ohlin theory, international trade is determined by difference in factor endowments. Countries will export goods that make intensive use of locally abundant factors. Compared to grain production, apple production is a labor intensive industry, and China's abundant rural labor leads to increasing apple production. Abundant labor also gives China a comparative advantage in apple production due to the low labor cost.

China mainly exports apples to the Asian area and Russian, and the Southeast Asia is a big market for China. In 2005, Southeast Asian countries[1] imported around 34% of China's total export apples. Before the Asian financial crisis, the United States is the major apple exporter to Southeast Asia. In 1999, China surpassed United States as the leading supplier of apples to Southeast Asia, and its share in volume grew to nearly 70% in 2004. The U.S. share of the Southeast Asian apple market fell from 50% in 1997 to 13% in 2004 (Huang and Gale, ERS, 2006). China has become a major competitor for Southeast Asia markets.

(***Figure 1 is here***)

[1] Southeast Asian countries include Indonesia, Malaysia, the Philippines, Singapore, and Thailand.

(***Table 1 is here***)

Thailand imports about 7% of China total export in recent years, and more than 80% of import apples in Thailand are from China. Figure 2 shows that the apple export from China to Thailand suddenly increased in 1999, and the increase rate was significantly high in the past 10 years. In 2007, the apple export to Thailand reached to 74,436 tonnes, increased 3 times compared to 18,348 tons in 1999.

(***Figure 2 is here***)

This paper aims to analyze (1) what economic factors affect China's apple export supply to Thailand; (2) what economic factors affect Thailand import demand for China's apples.

Literature Review

Export quantity and price are taken as endogenous variable in a simultaneous equation approach. Goldstein and Khan (1976) develop a simultaneous model to investigate the relationship between export quantity and price. The model incorporates adjustment mechanism which introduces lagged dependent variable into the model. The export of commodities is

$$\log X_t = a_0 + a_1 \log(PX/PXW)_t + a_2 \log YW_t + a_3 \log X_{t-1} \quad (1)$$

where

X = volume of export

PX = price of exports

PXW = weighted average of the export prices of trading partners

YW = weighted average of real incomes of trading partners

The price of commodities is

$$\log PX_t = \beta_0 + \beta_1 \log X_t + \beta_2 \log P_t + \beta_3 \log Y^*_t + \beta_4 \log PX_{t-1} \quad (2)$$

where

PX = price of exports

X = volume of exports

P = domestic price index

*Y** = an index of domestic capacity

The export quantity is hypothesized to be negative to be a negative function of the relative export price *PX/PXW* between the export country the country's trading partner, to be positive to the import country's real income YW, and to be positive to the lagged dependent variable X_{t-1}. The export price is hypothesized to be positive to the export quantity X and domestic price P, negative to the domestic production capacity Y*, and positive to the lagged dependent variable PX_{t-1}.

Tayebi and Ghanbari (2008) studied the impact of Iran's WTO accession on the Saffron export market by applying simultaneous model developed by Goldstein and Khan. In the Iran's saffron export supply function, real exchange rate and three dummy variables – WTO membership, economic adjustment, and exchange rate unification are in the model. They used the Spanish export price index as a proxy for Iran's trading partner export price, since Spain is the major trading partner that imports about 80% of Iran's saffron. They found that WTO membership significantly increased Iran's saffron exports, while two other dummies are not statistically significant.

Bahamani-Oskooee (1998) studied the long-run equilibrium relation between volume of imports and its determinants and the relation between the volume of exports and its determinants. The import and export demand models are as follows[2]:

$$\log M_t = a_0 + a_1\log(PM/PD)_t + a_2\log NEX_t + a_3\log Y_t \quad (3)$$

[2] Tested countries include Greece, Korea, Pakistan, the Philippines, Singapore and South Africa, the choice of countries is dictated by the availability of quarterly data.

$$\log X_t = a_0 + a_1 \log(PX/PXW)_t + a_2 \log NEX_t + a_3 \log Y_W \quad (4)$$

where

M = volume of imports

PM = import prices

PD = domestic price index

NEX = nominal effective exchange reate

Y = domestic income

X = volume of exports

PX = export price

PXW = world export price level

YW = world income

Prices are taken as exogenous variables, the conclusion of the study is that currency depreciation could improve the trade balance of LDCs in the sample.

Andın et al. (2004) used both single equation and vector auto regression framework to estimate the export supply and import demand for the Turkish economy. The results show that exports are determined by the unit labor costs, export prices and the national income, and imports are affected by the real exchange rate and national income.

Fuller et al. (1992) examined Canadian and Japan import demand factors for U.S. dry onions. In the model, U.S. dry onions export price was taken as an exogenous variable. Per capital dry onions demand was hypothesized to be a function of lagged dependent variable, U.S. export price, exchange rate, import country's income, and substitute commodity prices.

Empirical Model

In order to analyze (1) what economic factors affect China's apple export supply to Thailand, and (2) what economic factors affect Thailand import demand for China's apples. We developed export supply and import demand models respectively.

(1) Export supply model – export price and quantity as endogenous variables

We first will use simultaneous models to examine what determines China's export quantity to Thailand. We cannot use Goldstein and Khan's model to examine apple trade between China and Thailand. According to Goldstein and Khan's model, we need to find YW, the trading partner's export price. But Thailand is an apple net import country, the apple export is null since the humid and hot weather is not suitable for apple production in Thailand.

The demand for China apples is developed as

$D = a_0 + a_1 P + a_2 Y + a_3 E \quad (1)$

where

D = quantity of excess demand of apples in Thailand, tonne

P = apples export price, yuan/tonne

Y = Thailand real per capital GDP, baht

E = real exchange rate, baht/yuan

An increase in the yuan price of apples P lowers the quantity of China exports demanded by Thailand. Higher import country income Y leads to higher demand for export from China if apples are normal good. Depreciation of Thailand currency baht relative to China currency yuan (increase in E) lowers apple demand since the price of Chinese apples becomes higher for the Thai consumer.

The quantity of China apples export to Thailand is written as

$X = b_0 + b_1P + b_2Q + b_3C$ (2)

where

X = quantity of apples exports supplied by China, tonne

P = apples export price, yuan/tonne

Q = quantity of apple production in China , tonne

C = cost of apple production in China, yuan/tonne

An increase in apple production leads to more exports to Thailand, if the increased production quantity surpasses the domestic consumption quantity. China's increasing export market advantage lies in its low production cost. (Huang and Gale, ERS, 2006). Apple production is a labor intensive industry, China's abundant rural labor supple leads to low wages and labor costs, which makes producers get more profits, leading to more production. Here we use producer price as a proxy for production cost, since low cost are reflected in low wholesale price.

The supply of apple from the rest of the world is a function of price only

$S = c_0 + c_1P$ (3)

where

S = quantity of apples exports supplied by other countries, tonne

P = apples export price, yuan/tonne

From equation (1), (2), and (3), we can get reduced form equation,

$P^e = \alpha_0 + \alpha_1Y + \alpha_2E + \alpha_3C + \alpha_4Q$ (4)

Substitute (4) into (2), and China apples export is a function of the exogenous variables,

$X^e = \beta_0 + \beta_1Y + \beta_2E + \beta_3C + \beta_4Q$ (5)

We transfer the variables into log form to estimate the elasticities directly.

$$lnX^e = \beta_0 + \beta_1 lnY + \beta_2 lnE + \beta_3 lnC + \beta_4 lnQ \quad (6)$$

Thus, we will use equation (6) to estimate exogenous variables Y, E, C, Q's effects on China apples export.

(2) Import demand model — export price as an exogenous variable

The humid and hot weather is not suitable for apple production in Thailand, its major import countries are China and U.S. After the Asian financial crisis, the apple import volume from China has surpassed the U.S. In 2005, about 83% of total apples in Thailand were imported from China, and only about 12% were imported from the U.S. There are two important reasons that China's apples are attractive to Thailand. First, China enjoys geographic advantage near to the Southeast Asia. Second, the labor intensive industry makes China's apples cheaper than the U.S.'s apples. The principle price-determining forces are associated the domestic apple market in China, so it is reasonable to view the import country, Thailand, as a price-taker.

Besides China apples export price, substitutes prices are considered in the model. Since U.S. is a major competitor for Thailand apple market with China, we use U.S. apple export price to examine the U.S. apples substitute effect on China apples export. Thailand also imports large volume of pears from China, so we also examine the effect of substitute commodity pear's price on Thailand demand for Chinese apples. D is dummy variable for Asian financial crisis. $DlnE_t$ and $DlnY_t$ are interaction terms that attempt to examine Asian financial crisis's impact on Thailand exchange rate and real per capital income.

We develop the Thailand import demand for China apples as:

$$lnX_t = \alpha_0 + \alpha_1 lnPxc_t + \alpha_2 lnE_t + \alpha_3 lnY_t + \alpha_4 \ln Pxa_t + \alpha_5 \ln Pxp_t + \alpha_6 lnX_{t-1} + \alpha_7 D + \alpha_8 DlnE_t + \alpha_9 DlnY_t \quad (7)$$

where

X = quantity of import apples from China, tons

Pxc = China apples export price, yuan/ton

E = real exchange rate, yuan/baht

Y = Thailand real per capita GDP, baht

Pxa = U.S. apple export price, yuan/ton

Pxp = China pear export price, yuan/ton

D = dummy variable, Asian financial crisis, 1976-1996=0, 1997-2007=1

The effect of own-price on import demand is hypothesized to be negative and the sign on the exchange rate variable is expected to be negative since baht depreciation (increase in E) makes imported Chinese apple relative expensive, the import volume would decrease as a result. The influence of income and price of substitutes on import demand is hypothesized to be positive. The sign on the lagged endogenous variable is expected to be positive.

Stationarity Analysis

For the China export model, Table 2 reports stationarity analysis for the natural logs of dependent and independent variables. Variables are transformed into natural logs to estimate demand elasticities directly. An autoregressive AR test examines whether the variable is I(0) stationary. The first order AR(1) model is $y_t=a_0+a_1y_{t-1}+\varepsilon_t$. If a_1 <1, the variable y_t approaches its dynamic equilibrium. The test for a stationarity is whether

$|a_1+2\sigma|<1$ where σ is the standard error of a_1 implying a 95% chance that $a_1<1$. All of the variables lnX, lnY, lnE, lnQ and lnC are not stationary in levels since $|a_1+2\sigma|>1$.

Difference stationarity is estimated through Dickey-Fuller DF test with no constant, adding a constant, time trend, and adding lags of the dependent variable through the augmented Dickey-Fuller ADF test until difference stationary cannot be reject. All of the variables are difference stationary. There is no evidence for autocorrelation through Durbin-Watson DW test and for heterskedasticity through ARCH(1) tests, so the residue is white noise and can be used in the OLS regression.

(*** Table 2 is here***)

For the Thailand demand model, Table 5 reports that all the variables are difference stationary, although China export price, lnPxc is also stationary in level.

(*** Table 5 is here***)

Regression Model Results

Since all the variables are difference stationary, we first use difference model

$$\Delta lnX_t = a_0 + a_1\Delta lnY_t + a_2\Delta lnE_t + a_3\Delta lnQ_t + a_4\Delta lnC_t + u_t \quad (8)$$

to capture the dynamic adjustment process.

Table 3 reports the spurious regression in levels. The regression passed the Engle-Granger EG test reported in the last column, suggesting the variables are cointegrated. So we can use error correction model ECM to estimate the relationship between dependent variable and independent variables. The ECM includes the spurious model in the difference model by introducing the spurious residual.

(***Table 3 is here***)

$$\Delta lnX_t = a_0 + a_1\Delta lnY_t + a_2\Delta lnE_t + a_3\Delta lnQ_t + a_4\Delta lnC_t + b_y\varepsilon_{t-1} \quad (9)$$

Table 4 reports the difference model results and ECM model results respectively. We cannot find statistically significant relations in the difference models. In ECM model, an increase in China apples cost leads to Thailand decreasing their imports from China. Every 1% increase in the production cost would generate 9.27% decrease in China exports to Thailand. If we take dummy variable and interaction terms into account, the export quantity can decrease to 9.65%.

(***Table 4 is here***)

Table 6 reports the spurious regression in levels. The regression passed the Engle-Granger EG test reported in the last column, suggesting the variables are cointegrated. So we can use error correction model ECM to estimate the relationship between dependent variable and independent variables.

(***Table 6 is here***)

For the Thailand import demand model, we also use ECM model to estimate what factors determines Thailand import demand for China apples. In Table 7, we can see that every 1% increase in the real exchange rate (deprecation in baht) would generate 30.63% decrease in demand for China apples. According to our expectation, every 1% increase in China apple export price leads to 14.93% decrease demand for China apples. If we take dummy variable and interaction terms into account, it shows the same results although the magnitudes are slight different. The dummy variable has no significant effect on China's export.

(*** Table 7 is here***)

Table 8 shows the Cochrane-Orcutt estimation, which is a procedure to adjust for serial correlation in the error term. The result is a little different than ECM model. Thai per capital income is positively related to the apple import quantity, which indicates that apple is normal good for Thai consumers. Every 1% increase in income lead to apple import increasing by 21% from China. The China apple export price is still negatively related to the import quantity from Thailand. But the magnitude is smaller than ECM estimation. Every 1% increase in production cost leads to 7.3% decrease export to Thailand.

Both the U.S. apple export price and China pear export price are not significant in the import demand function.

(*** Table 8 is here***)

Conclusion

Since China economy reform, apple production has dramatically increased. China has become the largest apple producer and exporter. Asian area is a critical market for China, especially the southeastern Asia, where apples production is limited due to the hot and humid weather and where people with relative high per capital income would be paying more for imported fruits compared to other Asian areas. In this study, we employ two country trade models to study what factors determine China apples export supply to Thailand and what factors determine Thailand apples import demand from China.

China apples export supply to Thailand is only influenced by domestic production cost. An increase in Chinese apple production cost leads to a decrease of export quantity to Thailand. The result is consistent with the Thailand import demand function, where import quantity is negatively related to the China apple export price. The increase in production cost will cause export price increase, so Thailand import less apples from China as a result. The real exchange rate also plays an important role in the apples trade between China and Thailand. Thai baht appreciation would cause Thai import less apples from China.

Appendix

Dataset: 1976-2007

China export quantity/Thailand import quanity: UNcomtrade

China apple production: FAOSTAT-Agriculture

China apple domestic production price: FAOSTAT-Agriculture

China apple export price: FAOSTAT-Agriculture

China pear export price: FAOSTAT-Agriculture

U.S. apple export price: FAOSTAT-Agriculture

Real exchange rate: ERS/USDA

Thailand per capital GDP: World Bank

Tables

Table 1. Major Apple Import Countries from China, 2005

Country	Quantity	Percent
Russian Federation	124734	15.13
Indonesia	87770	10.65
Philippines	60938	7.39
Kazakhstan	60697	7.37
Thailand	58783	7.13
Malaysia	47963	5.82
Kyrgyzstan	36717	4.46
China, Hong Kong	26754	3.25
Singapore	26081	3.17
Southeast Asia[1]	281535	34.16

[1]Southeast Asia includes Indonesia, Malaysia, Philippines, Singapore and Thailand.

Table 2. Stationarity Table

	AR(1)	DF	DFc	DFt	ADF	ADF(2)
lnX F DW ARCH(1)	0.90<1	-1.87 3.53 2.29 0.88				
lnY F DW ARCH(1)	1.01>1	6.06	-1.24 1.53 0.98*	-0.95 1.00 0.95*	-1.94 5.05 1.95 7.14*	-1.59 3.36 1.95 7.25*
lnE F DW ARCH(1)	1.03>1	-1.22 1.48 1.75 3.83				
lnQ F DW ARCH(1)	1.04>1	3.19	-0.69 0.47 2.66*	-1.86 1.78 2.39 4.91		
lnC F DW ARCH(1)	1.09>1	1.93	-0.17 0.03 2.17 0.29			
Critical values τ_{DF} φ DW 1.52, 2.48		-1.95	-2.93 6.73	-3.50 5.13	-3.50 5.13	-3.50 5.13

Table 3. Spurious Regression

constant	lnY	lnE	lnQ	lnC		EG_t -3.18
-158.90** (-2.12)	15.14 (1.21)	4.17 (0.78)	1.91 (0.45)	-4.26 (-1.04)	ajuR^2 0.487 DW 2.03 ARCH 1.01	-5.91* DW 2.19 ARCH 0.86

Table 4. ECM Model

Intercept	ΔlnY	ΔlnE	ΔlnQ	ΔlnC	D	DΔlnY	DΔlnE	Res_{-1}	
0.65 (0.59)	-1.69 (-0.09)	-8.25 (-1.24)	1.39 (0.28)	-9.27** (-2.39)				-1.07*** (-5.96)	$adjR^2$ 0.536 DW2.33 ARCH 1.63
-0.71 (-0.27)	13.21 (0.34)	-10.27 (-1.16)	2.45 (0.44)	-9.65** (-2.30)	1.89 (0.60)	-12.69 (-0.21)	0.62 (0.03)	-1.11*** (-5.61)	$adjR^2$ 0.485 DW2.41 ARCH 2.25

Table 5. Stationarity Table

	AR(1)	DF	DFc	DFt	ADF	ADF(2)
lnX	0.90<1	-1.87				
F		3.53				
DW		2.29				
ARCH(1)		0.88				
lnY	1.01>1	6.06	-1.24	-0.95	-1.94	-1.59
F			1.53	1.00	5.05	3.36
DW			0.98*	0.95*	1.95	1.95
ARCH(1)					7.14*	7.25*
lnE	1.03>1	-1.22				
F		1.48				
DW		1.75				
ARCH(1)		3.83				
lnPxa	1.01>1	2.58	-1.87			
F			3.50			
DW			2.05			
ARCH(1)			3.49			
lnPxc	0.98<1	1.85	-2.35			
F			5.50			
DW			2.18			
ARCH(1)			2.56			
lnPxp	0.96<1	1.63	-2.72	-1.86		
F			7.40*	3.62		
DW				1.57		
ARCH(1)				1.48		
Critical values						
τ_{DF}		-1.95	-2.93	-3.50	-3.50	-3.50
φ			6.73	5.13	5.13	5.13
DW 1.52, 2.48						

Table 6. Spurious Regression

constant	lnY	lnE	lnPxa	lnPxc	lnPxp		EG_t -3.18
-15.29 (-0.30)	10.16* (2.01)	-12.53 (-1.41)	8.29 (1.17)	-10.29 (-1.18)	-6.95 (-1.05)	ajuR^2 0.557 DW 2.22 ARCH 1.26	-6.14* DW 2.13 ARCH 0.75

Table 7. ECM Model

Intercept	ΔlnY	ΔlnE	ΔlnPxa	ΔlnPxc	ΔlnPxp	D	DΔlnY	DΔlnE	Res_{-1}	
1.92 (1.42)	-24.37 (-1.08)	-30.63*** (-2.95)	-2.35 (-0.24)	-14.93* (-1.90)	-3.86 (-0.48)				-1.14*** (-5.81)	adjR^2 0.532 DW2.26 ARCH 0.05
0.27 (0.10)	0.84 (0.02)	-37.57*** (-2.91)	-4.48 (-0.43)	-16.53* (-1.98)	-1.85 (-0.21)	1.67 (0.49)	-27.26 (-0.42)	13.26 (0.56)	-1.19*** (-5.57)	adjR^2 0.490 DW2.31 ARCH 0.28

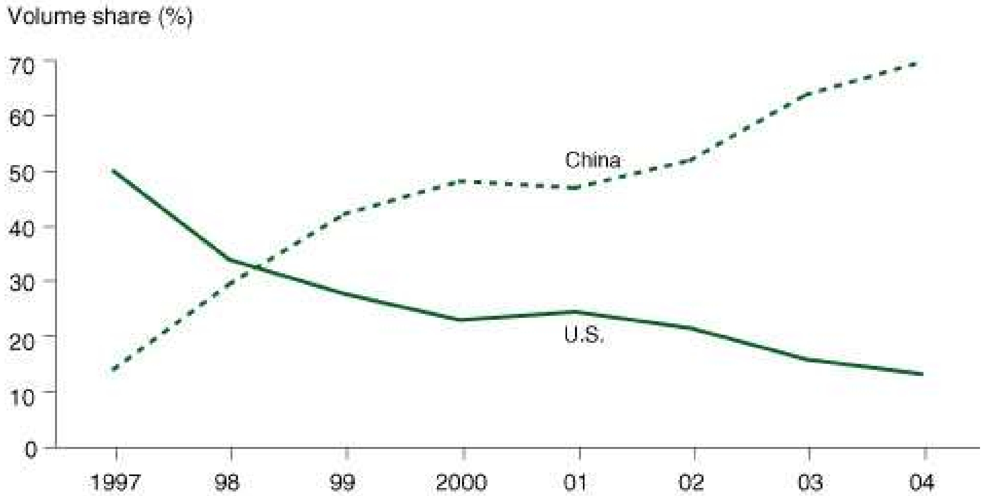
Table 8. Cochrane-Orcutt Estimate Thailand Import Demand for China Apples

Variable	Coefficients	
	Model 1	Model 2
Intercept	-231.74*** (-2.90)	-188.23 (-1.71)
lnY	21.53* (1.82)	24.41 (1.56)
lnE	5.75 (1.10)	-0.60 (-0.07)
lnPxa	1.85 (0.46)	-0.51 (-0.11)
lnPxc	-7.30* (-1.84)	-7.27* (-1.73)
lnPxp	0.42 (0.18)	-2.76 (-0.40)
D		100.40 (0.27)
DlnY		-9.86 (-0.29)
DlnE		8.77 (0.41)
Adj. R^2	0.597	0.563
D-W	2.29	2.37
LB	0.72	1.14
F	9.90	5.85

Figures

Figure 1.

China surpassed the U.S. in Southeast Asian import market for apples*



*Southeast Asia includes Indonesia, Malaysia, the Philippines, Singapore, and Thailand.
Source: USDA, Economic Research Service calculations based on data from USDA, Foreign Agricultural Service, Global Agricultural Trade System.

Figure 2. China apples export quantity to Thailand

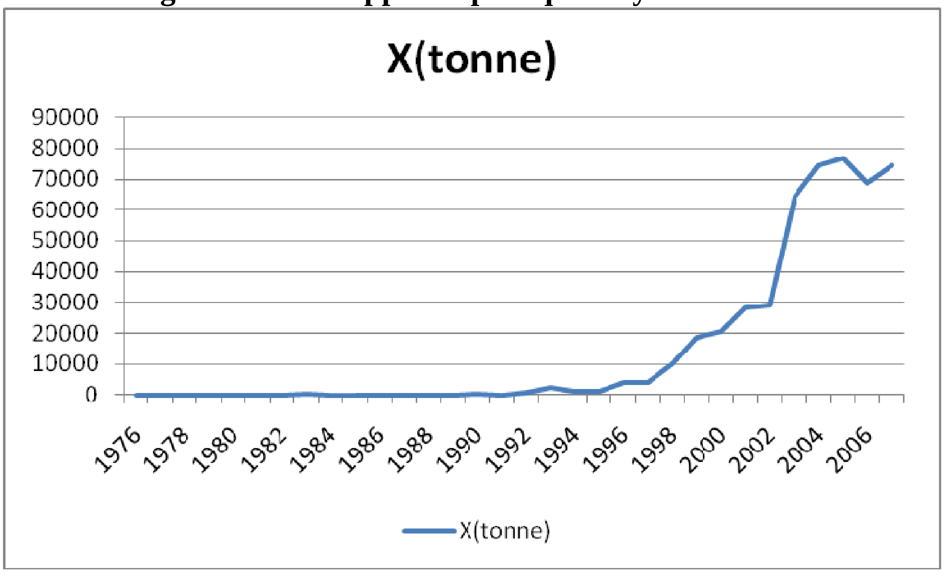
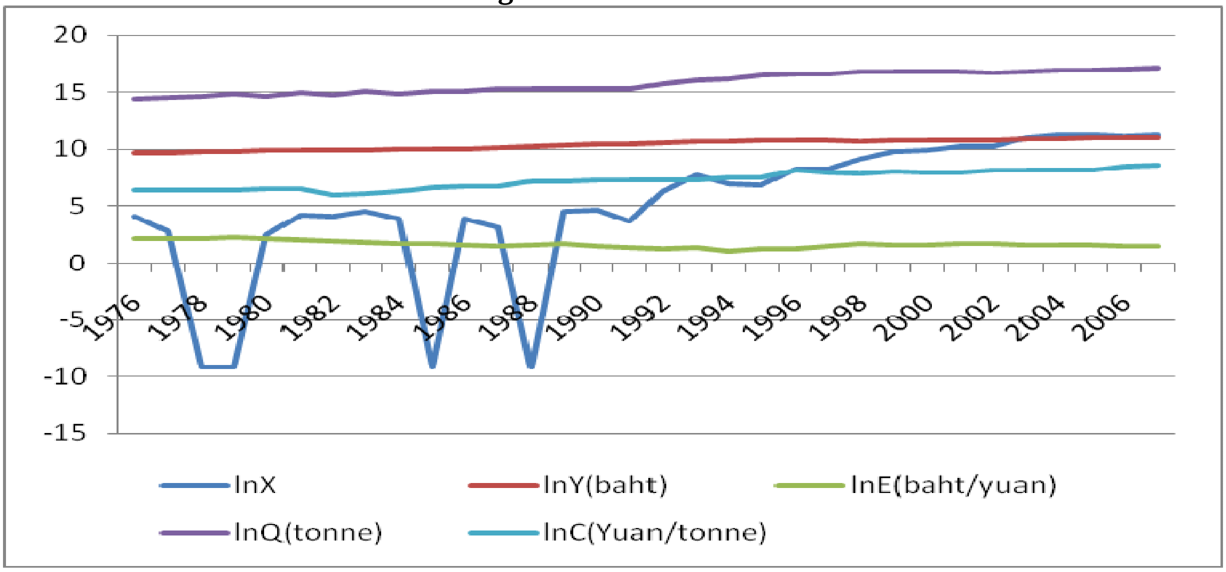


Figure 3. Data Series



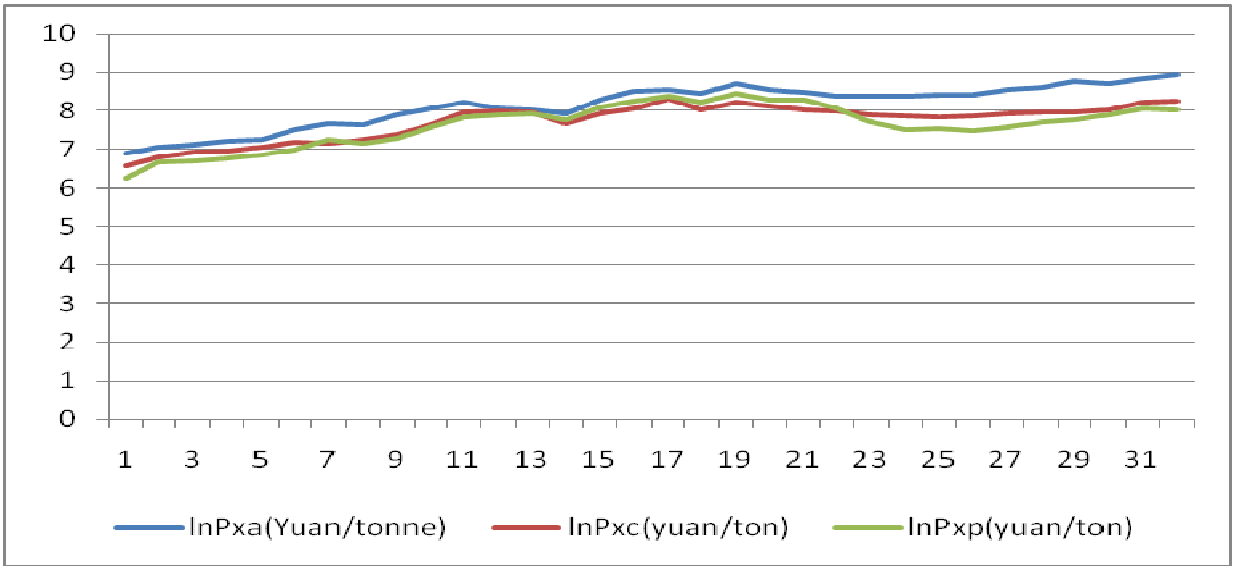
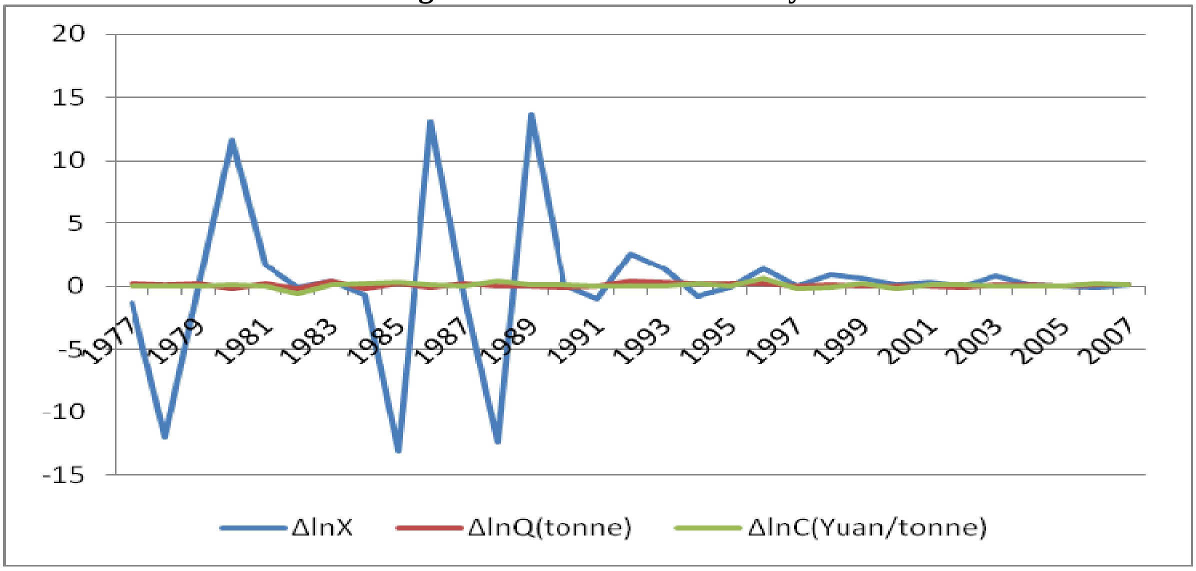


Figure 4. Difference Stationary



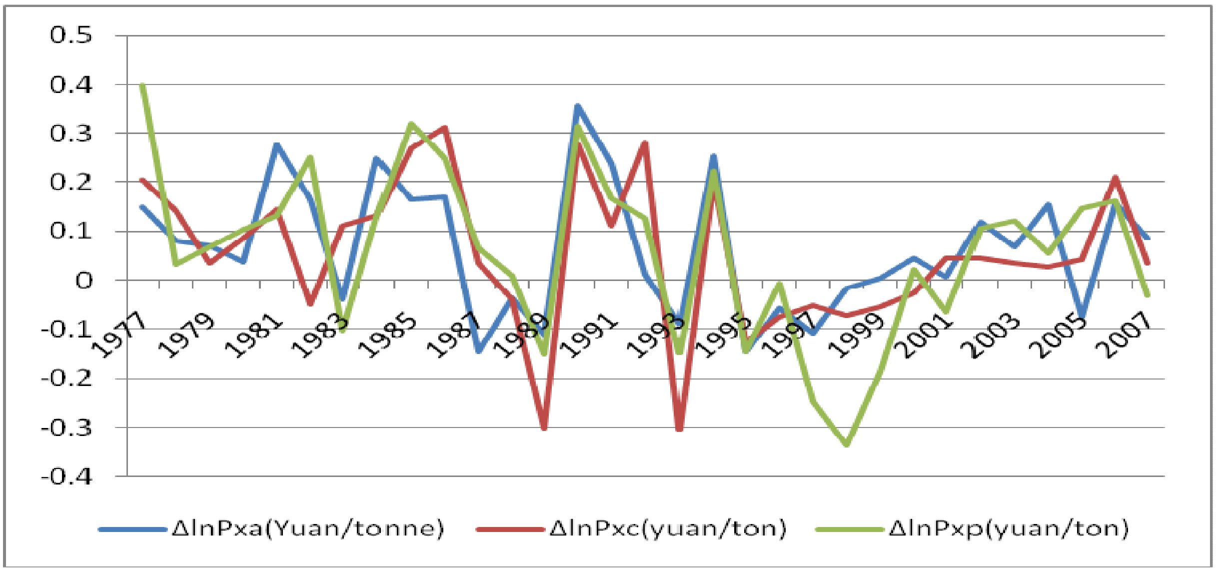
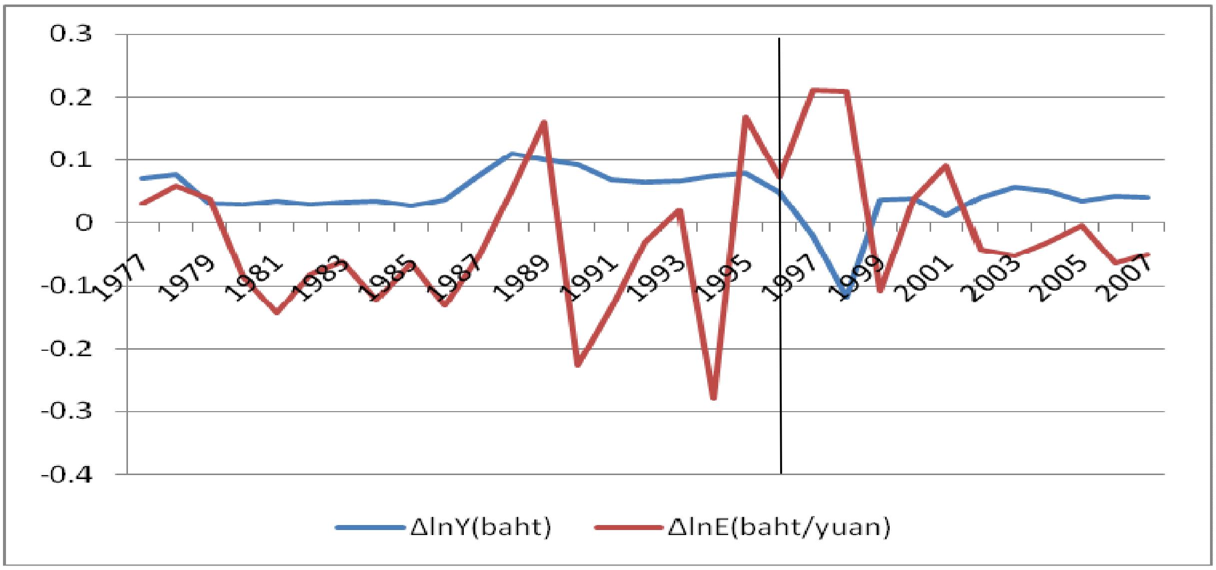


Figure 5. Difference Stationary with 1997 Structural Break



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