MFA Fibers & Cotton Imported to the U.S. from China and Hong Kong – A Structural Change Analysis

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Abstract

Using the Endogenous Break Augmented Dickey Fuller ADF test of Zivot and Andrews (1992), our study sheds light on current research on MFA fibers mainly in cottons exported from Mainland China and Hong Kong to the U.S. We determine the order of integration of time series variables to avoid spurious regression, as pointed out by Granger and Newbold (1974). The variables are found as in different orders of integration and hence researchers should take caution when estimating export demand functions. We further investigate whether MFA cotton price and quantity demanded will converge to its arithmetic mean (equilibrium) in desirable period. We find mixed evidences. Finally, we trace the date on which the structural break of the series would take place in response to shock, like MFA quota abolishment. The break date in year 2000 was detected, and it took about 1.6-6.5 months for the repercussion of the shock to diminish to half of its initial impulse.

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I. Introduction

The aim of this research is to investigate the time series behavior of the MFA apparel and non-apparel fibers, mainly in cottons, imported to the U.S. from HK and Mainland China Monthly data from Jan, 1989 to Sept, 2005 were collected at the Office of Textiles and Apparel of the U.S. Department of Commerce. We apply Endogenous ADF unit root test advocated by Zivot and Andrews (1992) to address two questions. First, are the series under investigation stationary and would it converge to its mean over time? Second, once there is a economic shock like that of trade liberalization, when will the structural change take place and how long does it take to diminish to its half of initial shock immediately after the disturbance? Answers for the above two fundamental research questions are important to international textile and clothing buyers and sellers as well as the trade policy makers.

The discussions of the paper are organized as follows. Section 2 provides econometrics methodology for addressing the above two puzzles. The main findings and analyses are presented in Section 3. Section 4 concludes the results and the implications.

2. **Econometrics methodology**

2.1 Augmenting Dicky-Fuller(ADF) test

Stationarity of a time series can be tested statistically by Augmented Dicky Fuller (ADF) unit root test pioneered by Dickey and Fuller (1979). It shows that, under the null hypothesis of a unit root, ADF statistics do not follow the conventional Student's t-distribution, and they further derive the asymptotic results and simulate critical values for various test and sample sizes.

Consider a series at time t,

$$\Delta q_t = \alpha_0 + bq_{t-1} + \sum_{i=1}^{k} \sigma_i \Delta q_{t-i} + \varepsilon_t \quad (1),$$

where $\Delta q_{,t}$ is the series of interest in first difference. $\sum_{i=1}^{k} \sigma_i \Delta q_{t-i}$ is the augmenting term and ε_t is the Independent and Identically Distributed (IID) error term, i.e. $\varepsilon_t \sim iid(0, \sigma^2)$. Equation (1) is estimated by Ordinary Least Square (OLS) for a series under concerned. The unit root null hypothesis is to be rejected when the ADF-statistic is found to be significant for the null: b =0 against the alterative b <0.

Unit root tests are widely applied to empirical studies of international trade and finance especially the Purchasing Power Parity (PPP). It is assumed that arbitrage and market forces will force price in two locations of the same product to converge provided that no trade costs and trade barriers get in the way and there is evidence for price convergence if the relative price is found to be mean-reverting or stationary. Parsley and Wei (1996) estimates the rate of price convergence within the United States, using a panel of 51 prices from 48 cities. They find that the estimated speed of price convergence is substantially faster in the U.S. than that typically found in cross-country data.

If the unit root null hypothesis is rejected, it implies that the Data Generating Process (DGP) will converge to its mean value in the long run. Whenever there is a shock against the series the effect is only temporary and will eventually converge to its mean. As Granger and Newbold (1974) points out we must know whether a time series is stationary or non-stationary in order to avoid spurious regression. In this studies, we collect and analyze the unit prices and quantities for the MFA apparel and non-apparel fibers in general, and cottons in particular, imported to the U.S. from HK and Mainland China. The monthly data from Jan, 1989 to Sept, 2005 are seasonally adjusted using the X-12 routine (with multiplicative factors on the levels) which can be available in Eviews5.0. The unit price (US$/m^2) and quantity (m^2) are plotted in Appendix 1. Two preliminary observations are found. First, the unit prices of all items in Hong Kong are generally higher than that in Mainland China. Second, before Year 2000 the import quantity was roughly the same for Hong Kong and Mainland China, however, Mainland China increased its exports of all items tremendously after year 2000 and the gap is widening afterwards.

2.2 Endogenous Break ADF test

It is well known that structural breaks in the deterministic components of stochastic process tend to inflict on conventional unit root tests biasing towards the unit root null hypothesis. One potential problem with the conventional ADF unit root test is its neglect of possible structural breaks within the data generating process (DGP). Therefore, we apply the recent test method of Zivot and Andrews (1992) which checks for unit roots when the precise date of the structural break cannot be known in advance.

Perron (1989) proposes a so-called crash model for the broken trend, which involves a one-time shock to the level of deterministic trend without change in slope of the trend function. Says, T_B is the date of a hypothesized break in the series of q_t (log unit price and log quantity). Hence, the model becomes:

$$q_t = \alpha_0 + \theta DU_t + \beta t + dD(TB)_t + \rho q_{t-1} + \sum_{i=1}^{k} c_i \Delta q_{t-i} + \varepsilon_t \qquad (2),$$

where α_0, θ, β, d, ρ, and c_i' are estimated parameters and k is the number of augmenting terms aimed to whiten the residual term. DU_t, $\equiv 1$ if t> T_B, 0 otherwise. $D(TB)_t \equiv 1$ if t= T_B+1, 0 otherwise. Hence, including DU_t, an intercept dummy variable, in the model permits a one time shift in the trend function for q_t in period T_B. On the other hand, including $D(TB)_t$, in the model permits an unusual one time jump in an assumed unit root process for q_t in period T_B +1. However, Perron imposed the break date, T_B, on the series exogenously. To improve the model further, Zivot and Andrews (1992) (hereafter Z & A), suggests to determine the break date (T_B) endogenously by running the Perron's model as appropriate T-2 times, once for each $T_B \in \{2,...,T-1\}$. Then T_B is estimated to be the date with the smallest t-statistics for the null hypothesis $\rho = 1$. Denoting this t-statistics as $t_{\rho=1}$, and $t_{\rho=1} = t_{\rho=1}(T_B)$ for $T_B \in \{2,...,T-1\}$, Z & A estimate the break date ,T_B as:

$$\hat{T}_b \equiv \arg\min_{T_b \in (2,\dots,T-1)} t_{\rho=1}(T_b) \qquad (3),$$

whereby we tabulate critical values for the resulting unit root test statistics.

In addition, Z & A suggests two modifications to Perron's method. First, it assumes a simpler null hypothesis than Perron's, in which there is no presumed one-time shock to the unit root series. Thus Z & A's version of Perron's regressions for equation (2) becomes:

$$q_t = \alpha_0 + \theta DU_t + \beta t + \rho q_{t-1} + \sum_{i=1}^{k} c_i \Delta q_{t-i} + \varepsilon_t \qquad (4)$$

Eq(4) results in the regression that we are concerned in our study. Since the dummy variable, D(TB), is eliminated, it implies that an unusual one time jump in the unit root process in the period T_B +1 is not allowed. The lag length of k is selected with a general to specific strategy. We start with initial 12 lags and then sequentially eliminate the longest lag included in the model until its number of lag in the reduced model has a t-statistic exceeding 1.6 in absolute value. Appendix 2 shows the estimated break point t-statistics, $\hat{t}_{\rho=1}(T_{\mathrm{B}})$ at various sample date which provides us useful information on the degree of stationarity/non-stationarity when different possible break dates are taken into account.

3. Empirical results

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Insert Table 1, 2 about here

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Table 1 presents the result for the time series regression of Eq(4) on the seasonally adjusted data of apparel and non-apparel items in logarithm. In the Hong Kong case, we find that unit prices are I(1) while quantities demanded are I(0) except that of non-apparel cottons, which have non-stationary unit price and quantity demanded. The results are not surprising; the quantity transacted is relatively stable and converging to its mean in the long run due to the imposition of quota restraint, albeit, with the only exception of non-apparel cottons import. However, the price series is non-stationary and likely diverge from its mean because prices can be fluctuated freely in accordance with changes in costs of raw materials, labor and capital.

In the case of Mainland China, we find that unit price series for apparel items is I(1) while non-apparel items is I(0). Mainland China has long history of mixed economy in which market and planned price mechanisms co-exist. It may be one of the reasons why the prices of non-apparel items converge to its mean over time. We also find that demand series for all items are I(0) except non-apparel fibers. We may argue that the effect of MFA quota restraint on non-apparel fibers is not prominent when compared with other items in Mainland China, likely because of the inefficiency of use, or transfer, of non-apparel fiber quota.

More, Table 1 presents the break dates for various apparel and non-apparel items in the two export sources. In the Hong Kong case, several break dates are found for different items. However, in the case of Mainland China, the break dates are consistently found at Year 2000. Figures 5-8 in appendix 2 shows the estimated break point t-statistics, $\hat{t}_{\rho=1}(T_{\mathrm{B}})$ for various items at different sample date.

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Insert Figure 5-8 about here

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In this study, we refer to a term, half-life as month value, of which the repercussion of economy shock would take to diminish to its half of initial impulse on the price/quantity series. The results on half-life observation are listed in Table 2. On average, for the unit price and quantity demanded for apparel items, the values are 4.2 months and 1.8 months respectively in Hong Kong, while 5 months and 4.8 months are in Mainland China. Concerning the non-apparel items, on average, the half-life values for the unit price and quantity demanded are 5.9 months and 2.1 months respectively in Hong Kong and, by comparison, 3.6 months and 3.1 months are in Mainland China.

As said, the half-life† is interpreted as time for disturbance to alleviate to its half of magnitude after such an economic shock as trade policy changes. Some observations are worth mentioning: first, once an economic shock occurs in Mainland China's observations, it takes relatively longer time to diminish that shock and to return to its equilibrium for the export quantity of all items. Second, the half-life of unit price is roughly the same for all the items imported either from Hong Kong or Mainland China. Lastly, the time needed for unit price is longer than that of quantity demanded for shock to disappear. It may be due to the fact that prices are more sticky while the quantities demanded are controlled by a visible hand of trade administration.

We may imprudently assert that it requires longer time to eliminate economic shock in Mainland China because of two reasons. First, China is a transforming economy shunning from central planned economy with inert price mechanism while Hong Kong has long been devoted to free economy policy. As such we expect the time for price series in Mainland China should take more time to respond to international trade disturbance and to adjust to its equilibrium. Second, firms involved in the textiles businesses in Mainland China are more than that in Hong Kong. These firms are at large scale-oriented, emphasizing on longer production lead time for lower per unit factor cost inputs. Hence it expects that time needed for transaction processes in raw materials sourcing and subcontracting in Mainland China is longer than that in Hong Kong. However, we find no valid evidences for the above assertion. Finally, as Zandt (1997) argues in its survey, from the bounded rationality perspectives, we expect resources allocation quite inefficient when a large number of agent processes are generated and share information in various stages of transactions, wherein errors and lags are inevitably accumulated. We do not test directly the above hypothesis. Interestingly, our empirical results suggest that even there are many administrative processes in Mainland China the time needed for disturbance to disappear is reasonably short. Although the results not shown here we find that the half-life for series of Mainland China is nearly three times longer than that of Hong Kong if conventional ADF was estimated without taking structural break into account.

† The formula for calculation of Half Life (H-L) is equal to LN(0.5)/LN(1+p)

4. Conclusions

The paper provides answers to three important questions on the behavior of the aggregate MFA fibers, especially in cottons, imported to the U.S from HK and Mainland China. We believe that it is helpful for international buyers, sellers, and policy makers understand the behavior of unit price and quantity demanded longitudinally. Endogenous ADF unit root test advocated by Zivot and Andrews (1992) have been implemented. The period of analysis goes from January 1989 to September 2005. Monthly data that have been seasonally adjusted are applied to the regression study.

Generally we find that unit price is I(1) and quantity demanded is I(0) in the Hong Kong case. Moreover, we find that apparel items are I(1) and non-apparel items are I(0) generally in the case of Mainland China. Therefore, researchers should take caution when estimating export demand functions. Further researches are suggested in future. First, a panel unit root test which are taken into account the contemporaneous cross-correlation among panel members is encouraged to conduct so that more evidences for or against unit root null hypothesis can be found. Second, the break dates for different apparel and non-apparel fibers are detected within Year 2000. However, we suggest that a multiple break dates regression will be more realistic and allows more implicative findings to sink in. It's worth investigating further if unit price, quantity demanded and GDP per capita in the U.S. are co-move, forming a co-integration relationship in the long run if variables are found to be I(1) using the above mentioned modifications.

Lastly, we find that the half-life for various series is ranging from 1.6-6.5 months. The half-life in Mainland China is roughly the same as that found in Hong Kong when break dates are taken into account. However, it is interesting to investigate what factors behinds such observations. We believed that more useful information can be extracted from a panel study forming a multi-countries, multi factors, and multi-category model.

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Table 1. ADF Statistics: endogenous break date

Hong Kong Time Series	**Time Break**	**Min.t-stat.**	**1% C.V.**	**5% C.V**	**10% C.V.**	**Conclusion 5% sig. level**	**k**
Apparel Fibers							
LN(\$U.S./m^2)	March-2003	-3.59	-5.34	-4.8	-4.58	I(1)	1
LN(m^2)	Dec-2002	-4.97	-5.34	-4.8	-4.58	I(0)	3
Non-apparel Fibers							
LN(\$U.S./m^2)	Nov-1993	-3.39	-5.34	-4.8	-4.58	I(1)	2
LN(m^2)	March-1998	-4.65	-5.34	-4.8	-4.58	I(0)	2
Apparel Cottons							
LN(\$U.S./m^2)	March-2003	-2.76	-5.34	-4.8	-4.58	I(1)	2
LN(m^2)	June-2002	-5.15	-5.34	-4.8	-4.58	I(0)	3
Non-apparel Cottons							
LN(\$U.S./m^2)	Jan-2002	-3.48	-5.34	-4.8	-4.58	I(1)	2
LN(m^2)	June-1997	-4.38	-5.34	-4.8	-4.58	I(1)	2
Mainland China Time Series	**Time Break**	**Min.t-stat.**	**1% C.V.**	**5% C.V**	**10% C.V.**	**Conclusion 5% sig. level**	**k**
Apparel Fibers							
LN(\$U.S./m^2)	Jan-2002	-4.05	-5.34	-4.8	-4.58	I(1)	1
LN(m^2)	Nov-2002	-3.18	-5.34	-4.8	-4.58	I(1)	3
Non-apparel Fibers							
LN(\$U.S./m^2)	Jan-2002	-5.35	-5.34	-4.8	-4.58	I(0)	1

LN(m^2)	Jan-2002	-4.79	-5.34	-4.8	-4.58	I(0)	0
Apparel Cottons							
LN(\$U.S./m^2)	Jan-2002	-4.52	-5.34	-4.8	-4.58	I(1)	3
LN(m^2)	March-2002	-3.7	-5.34	-4.8	-4.58	I(1)	1
Non-apparel Cottons							
LN(\$U.S./m^2)	Jan-2002	-5.68	-5.34	-4.8	-4.58	I(0)	3
LN(m^2)	April-2002	-4.62	-5.34	-4.8	-4.58	I(1)	3

Table 2. Half Life

HK Time Series	**AR(1) Coeff.**	**Half Life**	**China Time Series**	**AR(1) Coeff.**	**Half Life**
Apparel fibers			**Apparel fibers**		
\$U.S./m^2	-0.148	4.3	\$U.S./ m^2	-0.1011	6.5
m^2	-0.294	2.0	m^2	-0.117	5.6
Non-apparel fibers			**Non-apparel fibers**		
\$U.S./m^2	-0.109	6.0	\$U.S./ m^2	-0.131	4.9
m^2	-0.283	2.1	m^2	-0.162	3.9
Apparel Cottons			**Apparel Cottons**		
\$U.S./m^2	-0.156	4.1	\$U.S./ m^2	-0.176	3.6
m^2	-0.355	1.6	m^2	-0.158	4.0
Non-apparel Cottons			**Non-apparel Cottons**		
\$U.S./m^2	-0.113	5.8	\$U.S./ m^2	-0.262	2.3
m^2	-0.285	2.1	m^2	-0.267	2.2

Appendix 1 –Original data

Figure 1- Apparel Fibers (Jan/1989 - Sept/2005)

Figure 1.a-Apparel fibers quantity

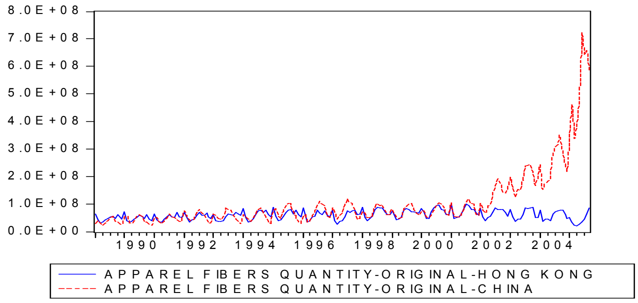


Figure 1.b-Apparel fibers price

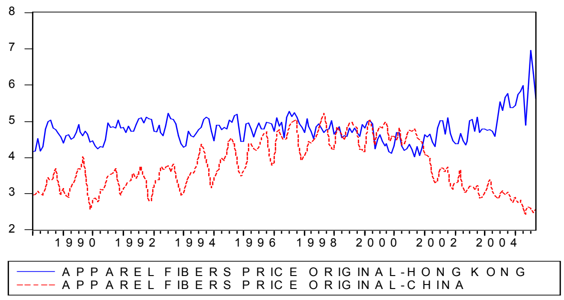


Figure 2- Non-Apparel Fibers (Jan/1989 - Sept/2005)

Figure 2.a-Non-apparel fibers quantity

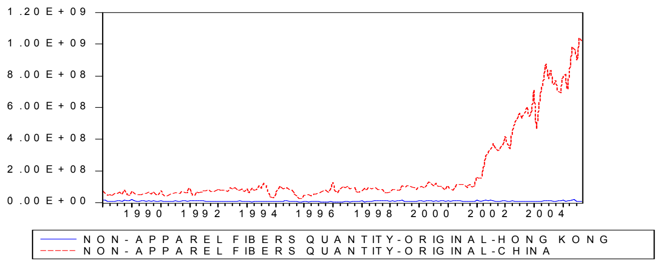


Figure 2.b-Non-apparel fibers price

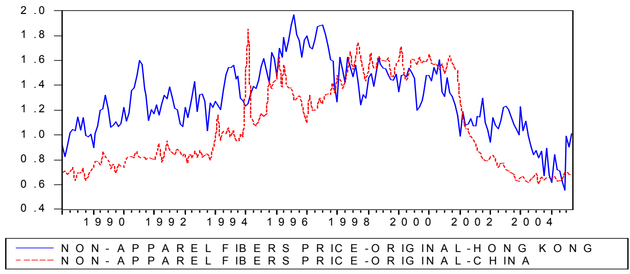


Figure 3- Apparel Cottons (Jan/1989 - Sept/2005)

Figure 3.a-Apparel cottons quantity

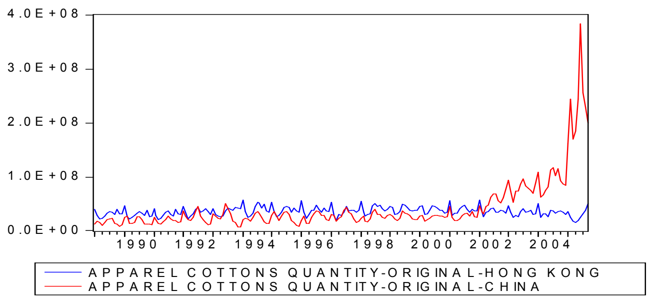


Figure 3.b-Apparel cottons price

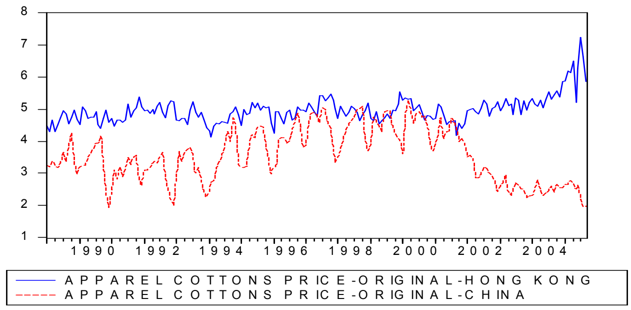


Figure 4- Non-Apparel Cottons (Jan/1989 -Sept/2005)

Figure 4.a-Non-apparel cottons quantity

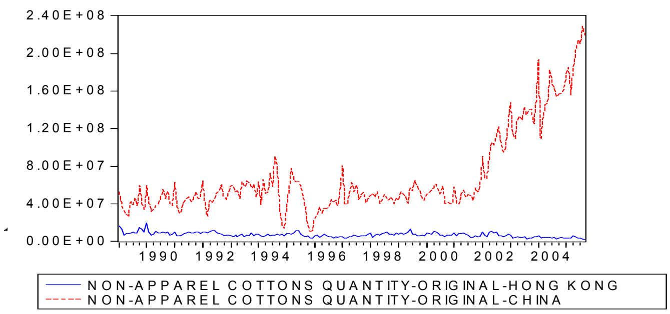
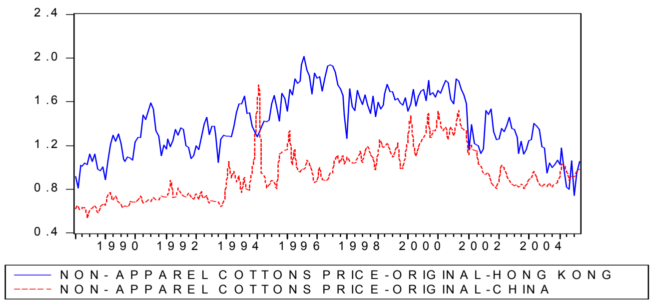


Figure 4.b-Non-apparel cottons price



Appendix 2 – Zivot-Andrews Statistics

Figure 5- Apparel Fibers (Jan/1989 - Sept/2005)

Figure 5.a-Zivot-Andrews test statistics for HK's Apparel fibers Quantity

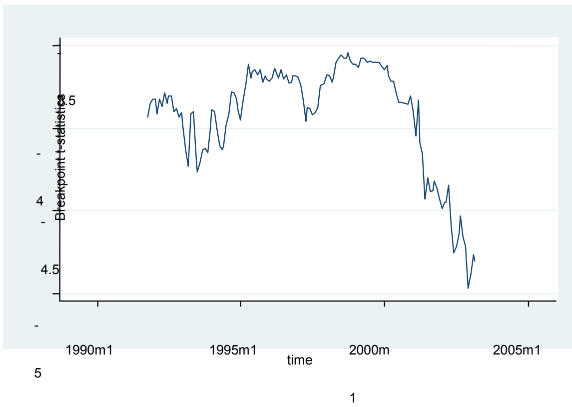


Figure 5.b-Zivot-Andrews test statistics for HK's Apparel fibers Price

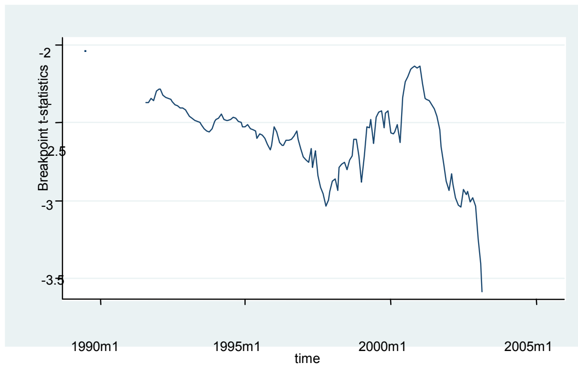


Figure 5.c-Zivot-Andrews test statistics for China's Apparel fibers Quantity

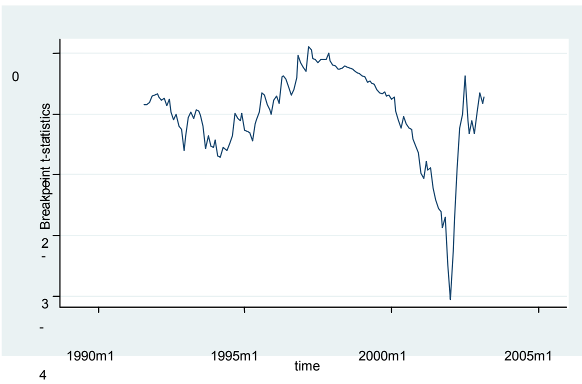


Figure 5.d-Zivot-Andrews test statistics for China's Apparel fibers Price

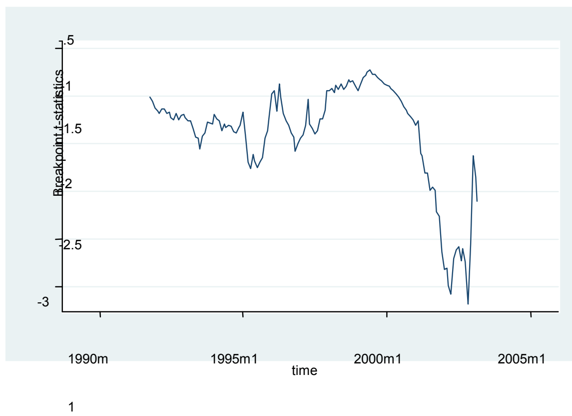


Figure 6- Non-Apparel Fibers (Jan/1989 - Sept/2005)

Figure 6.a-Zivot-Andrews test statistics for HK's Non-apparel fibers Quantity

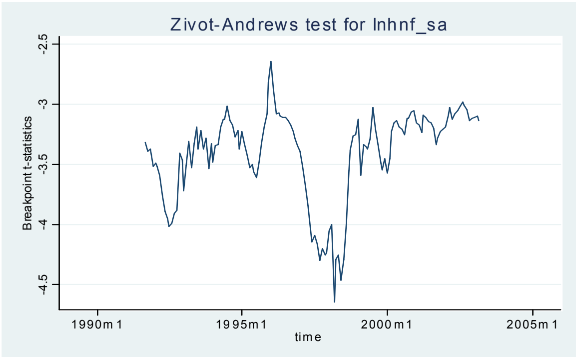


Figure 6.b-Zivot-Andrews test statistics for HK's Non-apparel fibers Price

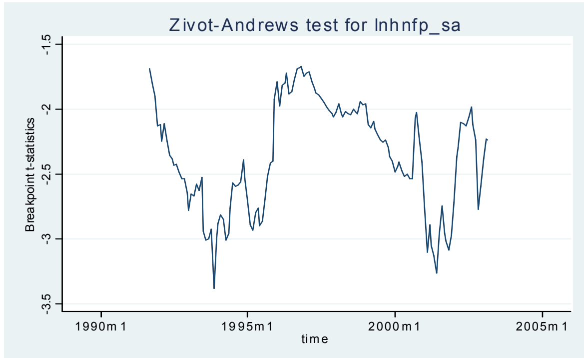


Figure 6.c-Zivot-Andrews test statistics for China's Non-apparel fibers Quantity

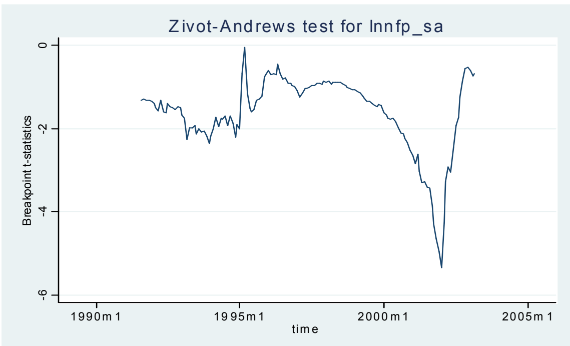


Figure 6.d-Zivot-Andrews test statistics for China's Non-apparel fibers Price

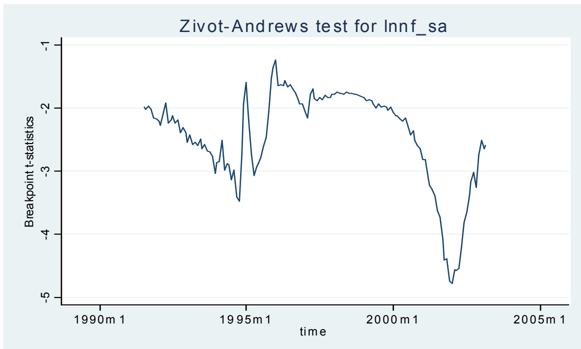


Figure 7- Apparel Cottons (Jan/1989 - Sept/2005)

Figure 7.a-Zivot-Andrews test statistics for HK's Apparel cottons Quantity

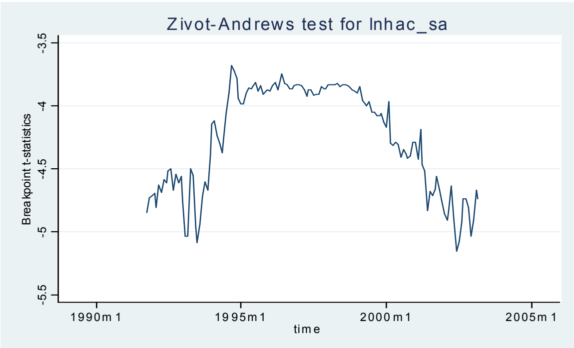


Figure 7.b-Zivot-Andrews test statistics for HK's Apparel cottons Price

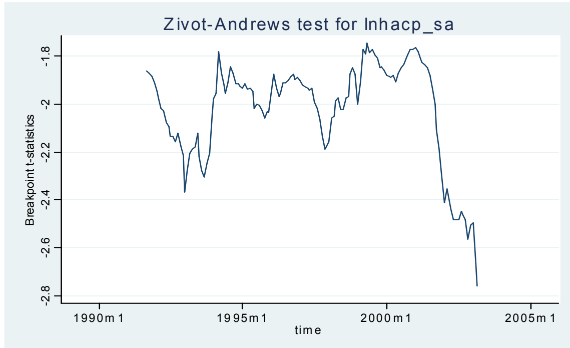


Figure 7.c-Zivot-Andrews test statistics for China's Apparel cottons Quantity

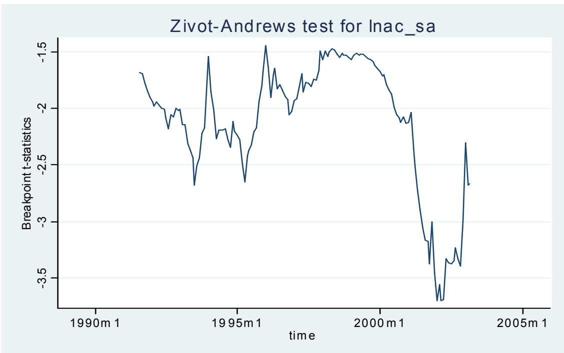


Figure 7.d-Zivot-Andrews test statistics for China's Apparel cottons Price

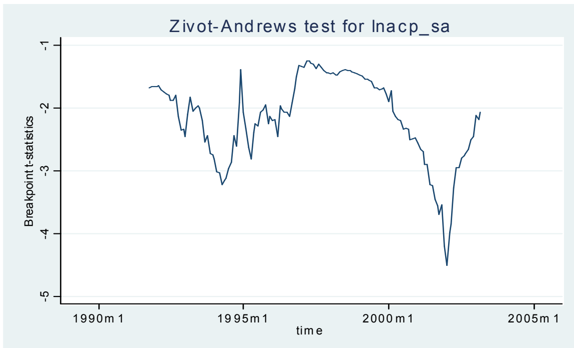


Figure 8- Non-Apparel Cottons (Jan/1989 -Sept/2005)

Figure 8.a-Zivot-Andrews test statistics for HK's Non-apparel cottons Quantity

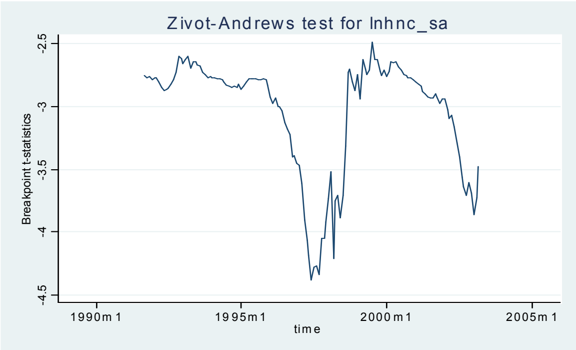


Figure 8.b-Zivot-Andrews test statistics for HK's Non-apparel cottons Price

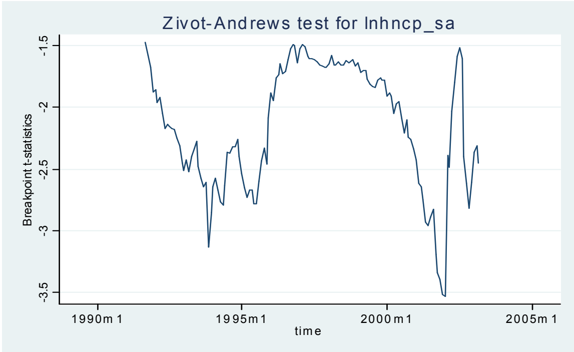


Figure 8.c-Zivot-Andrews test statistics for China's Non-apparel cottons Quantity

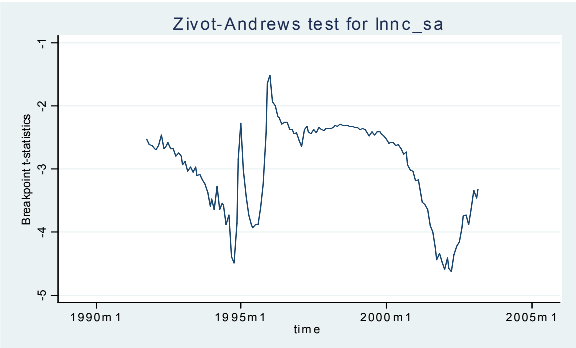


Figure 8.d-Zivot-Andrews test statistics for China's Non-apparel cottons Price