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Big Events and the Structural Changes of Foreign Trade in Guangdong Province of China

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Authors' contributions

This work was carried out in collaboration between authors QC and YM. Author QC designed the study and wrote the first draft of the manuscript. Author YM managed the literature searches, conducts the research to the big events from 2000 to 2013. Both of the two authors read and approved the final manuscript.

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ABSTRACT

Foreign trade in Guangdong province of China plays an important role in the country and even the whole world. There are two kinds of big events which may impact Guangdong's imports and exports, one is universal events such as the outbreak of financial crisis in 2008, the other is regional events such as the launch of CEPA in 2004. Big events may have great impact on foreign trade in Guangdong province. By applying the method advanced by Lumsdaine and Papell, the relationship between big events and Guangdong's foreign trade is investigated. It shows that the big events, including the launch of CEPA in 2004, the RMB exchange rate formation mechanism reform in 2005, the outbreak of financial crisis in 2008, have impacted significantly on the imports of Guangdong. It also indicates that the growth rate of exports is slow down due to the financial crisis and European debt crisis.

Keywords: Big events; foreign trade; structural changes.

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1. INTRODUCTION

According to the annual data of 2013 from World Trade Organization, China, US, Germany are the world's top three exporters, accounting for 11.74%, 8.39% and 7.72% of world total exports respectively. US, China, Germany are the top three importers, accounting for 12.33%, 10.32% and 6.29% of world total imports respectively. Inside China, the top three regions in foreign trade amounts are Guangdong province, Jiangsu province, Shanghai municipality (China Statistical Yearbook, 2014). From January to July in 2013, Guangdong province's imports and exports accounted for 24.6% and 29.6% respectively across the country. Therefore, Guangdong's foreign trade has a vital role in China and even the whole world. In order to evaluate the effects of foreign trade policies applying in Guangdong, It's very important to study the structural changes of the time series of imports and exports in this province.

There were many big events happened from 1978 to 2000, for example, the third Plenary Session of the 11th CPC Central Committee in 1978, which was the prologue of China's reform and opening up and a great turning point in China's history; the establishment of the Shenzhen Special Economic Zone in 1980, which made Shenzhen as the window of China's market-oriented reforms; Deng Xiaoping's southern tour speech in 1992, which contributed to the establishment of China's socialist market economy. These big events had made significant impacts on imports and exports of Guangdong, and had been widely recognized by academia and the public.

Since 2000, there have been a lot of big events taking place in China or Guangdong Province. For example, China joined WTO in December 2001, the outbreak of Severe Acute Respiratory Syndromes (SARS) in Guangdong in November 2002, which damaged people's health and social stability. The Closer Economic Partnership Arrangement (CEPA) formally implemented in January 2004, the reform of RMB exchange rate regime in July 2005, the financial crisis started in September 2008. Whether these events occurred in the 21st century have resulted in the structural changes of the time series of trade in Guangdong? Studies on structural changes have achieved fruitful results since the 1990s [1]. This paper analyzes the impact of big events on the imports and exports in Guangdong, explores the distribution changes of foreign trade growth in the province since the year of 2000, and provides policy recommendations for Guangdong's foreign trade.

The main contributions of this paper are: (1) Expanding Lumsdaine and Papell breakpoint test model(LP model) by adding model BB, BA and BC in order to get more breakpoints that the original mode failed to find [2]; (2) Dedicating to the study of structural changes for the Guangdong's imports and exports, and draws a significantly different conclusion comparing to that of the whole nation's import and export trade; (3) Finding out that the formal implementation of CEPA in 2004 had only continued to affect Guangdong's imports and exports; (4) Finding out the reform of RMB exchange rate regime in 2005 did not lead to structural changes of export series, and the impact only appeared in import sequence; (5) Discovering the exacerbation of European debt crisis in 2011 made the exports growth rate to slow down, and the financial crisis in 2008 had impact on both of imports and exports.

The basic framework of our study is as follows: The second part of this study reviews the relevant literature and points out the main problems existing in the papers; the third part expands the LP model and makes it more completed; the fourth part gets the critical value for breakpoints test with Monte Carlo simulation experiments; the fifth part tests structural changes of the Guangdong's imports and exports since 2000, analyzes the relationship between the major events and the structural changes of foreign trade in Guangdong province; the sixth part draws conclusions.

2. LITERATURE REVIEW

There are a lot of literature at home and abroad focusing on the impact of big events on a country's imports and exports. Big events varies in all kinds of forms including trade liberalization reform, implementation of export food safety standards, reform of foreign exchange management system, natural disaster, terrorist attack, etc.

In recent years, the foreign representative literatures studying in this area are [3-6] and so on. [3] established the imports, exports and trade balance model to study the impact of trade liberalization events on Mexico's imports and exports. It was found that the Mexican trade liberalization reform in 1986 had a significant

impact on imports and exports, but the North American Free Trade Agreement which was entered into force in January 1994 did not have a positive impact on exports. [7] believed that the EU and the US were independent of each other on commodity exports. Therefore, the US's exports would not increase if the EU's export subsidies reduce significantly. [8] used vector autoregression model (VAR) to analyze Philippines's exports, and got a conclusion that the financial crisis happened in 2008caused a significant negative impact on Philippines's exports. [10] used the test method proposed by [9] to study the international impact of the imports and exports of pork, which was led by a big event that Japan stopped imports of pork from Taiwan in March 1997. The results showed that the US pork market share in Japan rose, while Canada, Denmark declined in Japan's market share after the implementation of Japan's pork embargo against Taiwan. [11] used the Global Trade Analysis Project (GTAP) to analyze the negative impact of 911 terrorist attacks on world trade. There is similar study in [12].

Many scholars are concerned about China's foreign trade because the amount of China's foreign trade ranks the highest in the world. [4] explored the impact of China's accession to WTO in December 2001on agricultural trade, and found that there were significant changes on China's agricultural trade such as trade amounts, product categories, business partners after the accession to WTO. [5] used the panel data of leaves, vegetables and other seven categories of export products from 1992 to 2008, and applied the co-integration method to study the impact of implementation of food safety standards on Chinese food exports. The study found there was a positive impact on food exports after the use of food safety standards. [6] used the data of exports to analyzed the impact of exchange rate adjustment on China's exports. The results showed that the RMB exchange rate adjustment (appreciation) did not lead to the decline in exports. Instead, [13]'s found that the RMB appreciation had a sustained negative effect on China's exports of clothing, footwear and furniture. The research of [14]'s reached the similar conclusion with that of [13]. [15] analyzed the impact of the import restrictions introduced by United States and the European Union on China's exports. The study found that there was not enough evidence to suggest that big events of restrictions on Chinese products imports that occurred during the sample had forced a large number of Chinese products to flow into the third parties outside of the European and American markets.

Domestically, the recent representative literatures are [16], [17], etc. [16] used the data decomposition method proposed by Beveridge and Nelson [18] to decompose random impulse that led by the undetermined events such as Wenchuan earthquake in 2008. [19] constructed revealed competitiveness index, compared before and after China's accession to WTO manufacturing competitiveness changes, found the overall competitiveness of China's manufacturing industry trends appeared drift after the WTO entry. [17] used the method proposed by [2] and the annual imports and exports data from 1981 to 2006 to study the impact of the reform of the exchange rate system in 1994 and other big events on China's foreign trade, it was found that the merger of the exchange rate regime and other major events only generated structural changes to China's exports.

Although the existing literatures are helpful for our study, there are still deficiencies in these domestic and international studies. (1) The conclusions might be unreliable because the study such as [3,8] didn't test dependent and independent variables for structural changes, but used "co-integration" technology directly or derived regression method to analyze [20,21]; (2) There are massive literature studying big events in China or other countries (regions), however, there are lack of academic literature that studying the impact of specialized events, especially regional characteristics distinct events, on import and export trade in Guangdong province; (3) Some literature only analyze one structural change point, for example, [19] only analyzed the impact of the WTO entry on the manufacturing competitiveness of China, but there were other big events such as the unification of exchange rates in 1994, the Asian financial crisis in 1997, the reform of the RMB exchange rate formation mechanism in 2005 in the sample period (1990-2009), and the WTO entry in 2001 was just one of the reasons leading to the structural changes of China's manufacturing industry competitiveness.

3. MODELS FOR TEXTING STRUCTUAL CHANGES

We want to solve the following questions: (1) Whether big events such as the implementation of CEPA, the formation mechanism reform of

RMB exchange rate, the financial crisis caused structural changes of time series of foreign trade in Guangdong? (2) Where did the structural changes occur? (3) What was the direction of the changes? (4) How much was the magnitude of the structure changes? Therefore, we must detect the structural changes of time series of Guangdong's imports and exports. The establishment and improvement of "history test" or "sequential test" methods have created conditions for testing the breakpoints of time series. [2] can solve the problem of the unknown breakpoints in advance, so we can apply the LP model test structural changes of time sequences of Guangdong's foreign trade.

The null hypothesis of Lumsdaine and Papell endogenous breakpoint test is that the sequence $\{y_t\}$ is a unit root process of no structural change [2]. The data generating process (DGP) of $\{y_t\}$ can be made by the formula below:

$$y_t = \mu + y_{t-1} + \varepsilon_t \tag{1}$$

The alternative hypothesis is a segmented trend stationary process in which structural changes happened, that is:

$$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{2}$$

In this equation, $DU1$、$DU2$ are intercept dummy variables, showing the occurrence of mean shifts at moment $TB1$ and $TB2$, that is $DU1_t = 1$, $DT1_t = t - TB1$ when $t > TB1$; $DU2_t = 1$, $DT2_t = t - TB2$ when $t > TB2$; k is the lag order, which role is to eliminate the influence of possible stochastic disturbances that are not independent and identically distributed [22].

Thus, [2] set AA, CC, CA models for endogenous breakpoint test, and used the models to test the structural changes of the time series of US macroeconomic data. The models AA, CC, CA are as follows:

Model AA: $$\Delta y_t = \mu + \beta t + \theta DU1_t + \omega DU2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{3}$$

Model CC: $$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{4}$$

Model CA: $$\Delta y_t = \mu + \beta t + \theta DU1_t + \gamma DT1_t + \omega DU2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{5}$$

It can be seen above that model AA corresponds to the case of breakpoints are intercept drift; model CC corresponds to the case of breakpoints are co-drift situation; model CA corresponds to the case of breakpoints are intercept drift and trend term co-drift.

The LP model has been widely used, such as the empirical research in [23-25], etc. However, The LP model is incomplete because there is no description for the situation that there are more than two breakpoints in one time sequence [17]. Structural changes in the form of statistical models are diverse. The five models [26] established for structural change tests are more than those of [2]. According to permutations and combinations theory, another six other possible scenarios BA, AB, BB, AC, BC, CB should be added on the base of the LP original model, so there are 9 models in total plus the original model AA, AC, CC. Because the alternative hypothesis didn't make provision for the order of the breakpoints, model AB, AC, CB, is equivalent with BA, CA, BC respectively. Therefore, based on the original model AA, AC, CA, the model BA (trend term drift and intercept drift of breakpoints), BB (trend term drift), BC (trend drift of breakpoints and intercept, trend co drift breakpoints) are added in the paper, and they are collectively referred to LP expand model.

Model BB: $$\Delta y_t = \mu + \beta t + \gamma DT1_t + \psi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t \tag{6}$$

Model BC: $\Delta y_t = \mu + \beta t + \gamma DT1_t + \omega DU2_t + \psi DT2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$ (7)

Model BA: $\Delta y_t = \mu + \beta t + \gamma DT1_t + \omega DU2_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-i} + \varepsilon_t$ (8)

The breakpoints location $\lambda = [\lambda_1, \lambda_2]$, and the value range Λ is $(0,1)\times(0,1)$ closed subset. DGP changes into first-order differential form. Thus the null hypothesis changes into $\alpha = 0$, alternative hypothesis is $\alpha < 0$ .According to LP original model 3-5 and expand model 6-8, we can get $\hat{\alpha}$ sets and their corresponding *t* values after doing LS regression for every pair $\lambda = [\lambda_1, \lambda_2]$ .The λ corresponding to the smallest value of *t* is the most likely structural change breakpoint of Guangdong's foreign trade series, expressed by $\hat{\boldsymbol{\lambda}}^{i}_{\inf} = (\hat{\lambda}^{i}_{1\inf}, \hat{\lambda}^{i}_{2\inf})$, $t[\hat{\boldsymbol{\lambda}}^{i}_{\inf}] = \inf_{\lambda\in\Lambda} t_{\hat{\alpha}^i}(\boldsymbol{\lambda})$ .Among them, i represents LP original model (3-5) or expand model (6-8). Supposing $k^{i}_{\inf,\beta}$ is unilateral gradual threshold limit distribution at $\inf_{\lambda\in\Lambda} t_{\hat{\alpha}^i}(\boldsymbol{\lambda})$ significant level, the unit root null hypothesis would be rejected if $t[\hat{\boldsymbol{\lambda}}^{i}_{\inf}] < k^{i}_{\inf,\beta}$. That is to say, the alternative hypothesis that the series is piecewise stationary process would be accepted if $t[\hat{\boldsymbol{\lambda}}^{i}_{\inf}] < k^{i}_{\inf,\beta}$.

The basic idea of structural changes can be extended to the stationary test of time series. Using the above LP original model and its expand model, this paper intends to comprehensively test whether there are structural changes in time series of Guangdong's imports and exports, and then analyzes the impact of big events on them.

4. SIMULATION EXPERIMENT

The models in this paper are based on the method proposed by [2], however, we should not use its one-tailed test value when it comes to the breakpoint test critical value problem. There were only 500 replications when [2] used Monte Carlo simulation method to estimate the test values, and a small number of independent replications make the calculated results obviously instable.

The fewer number of replications in simulation experiment can lead to poor results, which can be verified by different $\inf_{\lambda\in\Lambda} t_{\hat{\alpha}^i}(\boldsymbol{\lambda})$ fitted density functions generated by different cycles. The $\inf_{\lambda\in\Lambda} t_{\hat{\alpha}^i}(\boldsymbol{\lambda})$ distribution can be produced by the following method: the unit root sequence sets $\{\tilde{y}^{j}_{t}\}_{j=1}^{J}$ of samples are generated randomly; then we get the discrete distributions of $\inf_{\lambda\in\Lambda} t_{\hat{\alpha}^i}(\boldsymbol{\lambda})$ and one-tailed test value of the corresponding significance level after putting $\{\tilde{y}_t\}$ into the LP original models 3-5 and expand models 6-8 to do least squares regression. $\{\tilde{y}^{j}_{t}\}_{j=1}^{J}$ can be generated by Monte Carlo simulation by taking the initial value $y_1=0$, $\Delta y_t=\varepsilon_t$. k value in LP original model and expand model is decided by the significance of $\hat{c}^{i}_{k}$, and it can be set with 1.6 according to the study of [23].

With the obvious advantage of much quicker computing speed of workstation in the background than ordinary computer, wedid a large number of independent experiments of Monte Carlo simulation. Using $\Delta y_t=\varepsilon_t$ as DGP, we got breakpoint test critical values at1%-99% significance level (Table 1).

5. EMPIRICAL FINDINGS

5.1 Data Sources and Processing

The monthly data of Guangdong's imports and exports from January 2000 to July 2013 are from Guangdong Statistical Information Network. Through a simple equation that total foreign trade amount equals imports plus exports, as well as cross-checking the data obtained from varieties of other channels, we found that there were something wrong on the "Month of total imports" ($ 1.005 billion) announced on September 12, 2002 and the "total exports this month" ($ 1.26 billion) announced on December 12, 2012in the Guangdong Statistical Information Network, they should be amended to $ 10.205 billion and $ 10.533 billion respectively.

Table 1. ADF test critical value through 9,000 replications

Significance level	AA	BA（AB）	BB	CA（CA）	BC（CB）	CC
1%	-6.684741	-6.935116	-6.702854	-7.060718	-7.010186	-7.284685
2.5%	-6.401556	-6.661261	-6.379424	-6.757344	-6.661235	-6.979095
5%	-6.136519	-6.406245	-6.113022	-6.506600	-6.416339	-6.760306
7.5%	-5.988341	-6.255559	-5.943999	-6.346180	-6.252550	-6.600484
10%	-5.872439	-6.127780	-5.817367	-6.227331	-6.140472	-6.475317
12.5%	-5.762155	-6.049693	-5.691504	-6.127023	-6.035740	-6.384094
15%	-5.678198	-5.953939	-5.604378	-6.044045	-5.959372	-6.307656
17.5%	-5.604265	-5.884925	-5.530709	-5.968472	-5.886718	-6.232572
20%	-5.534438	-5.819877	-5.459948	-5.903194	-5.825317	-6.168400
22.5%	-5.477442	-5.758122	-5.392437	-5.835002	-5.769662	-6.110115
25%	-5.426073	-5.691524	-5.330668	-5.779153	-5.716175	-6.053934
27.5%	-5.373379	-5.638472	-5.269040	-5.723656	-5.659269	-6.002366
30%	-5.326019	-5.586099	-5.208173	-5.674122	-5.610686	-5.958839
32.5%	-5.274070	-5.545075	-5.150047	-5.627731	-5.563607	-5.911406
35%	-5.231481	-5.495633	-5.102292	-5.576397	-5.512067	-5.870703
37.5%	-5.184801	-5.453340	-5.052075	-5.535701	-5.471562	-5.825460
40%	-5.141897	-5.409080	-5.006006	-5.486551	-5.426284	-5.778427
42.5%	-5.097798	-5.358687	-4.959492	-5.446163	-5.381726	-5.731747
45%	-5.055574	-5.312654	-4.918520	-5.405016	-5.340577	-5.688919
47.5%	-5.015143	-5.267035	-4.874895	-5.364265	-5.294724	-5.647868
50%	-4.973549	-5.222929	-4.826350	-5.319921	-5.253448	-5.603787

The data of imports and exports showed seasonal fluctuation characteristics during the sample period. In general, foreign trade is in phased "trough" in February each year and "peak" most appeared in December. Therefore, seasonal adjustment is needed to show the potential loop trend variable in time series of imports and exports, and reflects truly objective laws of economic time series.

Overall, the seasonal fluctuation of Guangdong's imports and exports time series was proportional significantly to the original series. Therefore, the multiplicative model rather than additive model should be used when doing seasonal adjustments. Phases, the fluctuation was small in early stage, and increasing in middle and late samples. Thus, this paper used Census X12 method to do seasonal adjustments for Guangdong's foreign trade series. Because the natural logarithm doesn't change the nature of the original data, we take the natural logarithm for import and export amounts after seasonally adjustments. The import and export series here in after are the natural logarithm series after the seasonal adjustments.

5.2 Stationary Test

Stationary test must be carried out in the usual sensebefore using the complete LP model (including the original model and expand model) to test breakpoints. It would be meaningless to test breakpoints if the original series of Guangdong's foreign trade is stationary because it is sure in advance there are no break points. ADF stationary test results show that both imports and exports series are $I(1)$ processes.

5.3 Breakpoint Test

The traditional unit root tests did not consider the structural changes of time series, therefore, we can't judge Guangdong's foreign trade is a unit root process or section stationary process according to the ADF stationary test results, we need to do breakpoint test on the time series of imports and exports.

Basing on the results of 9000 computing replications with Monte Carlo calculations, we set $k_{\max} = 12$ and $\lambda 1, \lambda 2 \in [0.1,\ 0.9]$, use LP original model and expand model to do the breakpoint test on Guangdong's imports and exports, and get the results rejecting the null hypothesis above 90% confidence level (Table 2).

For the time series of Guangdong's exports, the original model doesn't reject the unit root null hypothesis at 90% confidence level (Table 3). If relying solely on the original model test results, then we will draw the wrong conclusion that Guangdong's export trade is sticky to the impact

of big events, and structural changes of time series does not appear. The expanding model BA rejects the unit root hypothesis at 90% confidence level, the breakpoints of export series are 2008M11 and 2011M02 (Table 4). Breakpoint 2008M11 is corresponding to the negative coefficient of the intercept dummy variable (-0.197266), indicating that the outbreak of the financial crisis in September 2008 makes time series of Guangdong's exports drift downward. The breakpoint of 2011M02 is corresponding to the negative coefficient of the trend dummy variable (-0.004894), indicating that the exacerbation of European debt crisis at the beginning of 2011 makes Guangdong's export growth rate decline.

For imports series, the original model AA, CC, CA and the expand models BC, BA find out a breakpoint at 2008M11. The original model also get a breakpoint at 2004M02, while the expand model find out breakpoints in the summer of 2005 (2005M06, 2005M07). Specifically, model AA tests a breakpoint at 95% confidence level, and breakpoint 2004M02 is corresponding to the positive coefficient of intercept dummy variable (0.131919), which indicates that the formal implementation of CEPA at the beginning of 2004 has played long-term positive effects to the rapid growth of Guangdong's resumed imports. CEPA includes "Mainland and Hong Kong Closer Economic Partnership Arrangement" signed by the central government of China and the Hong Kong SAR Government. "Mainland and Macao Closer Economic Partnership Arrangement" signed by the central government of China and the Macao SAR Government. The breakpoint 2008M11 is corresponding to the negative coefficient (-0.253237) of intercept dummy variables, which indicates that the outbreak of the financial crisis in September 2008 made Guangdong's imports decline. Model CC, CA also explain the formal implementation of CEPA had prompted the growth of Guangdong's imports (the coefficients of intercept dummy variables are 0.093563 and 0.097659), but the import growth trend declined slightly in the subsequent deterioration of the bird flu (coefficients-of-trend dummy variables are -0.004257 and -0.004496). CC model gets a breakpoint at 97.5% confidence level, the intercept dummy variable and trend dummy that 2008M11 is corresponding to variables are negative coefficient (-0.273479 and -0.000503), which indicate that the financial crisis made Guangdong's import series drift downward and the growth rate slightly slower. Model CA testing out a breakpoint at 99% confidence level also shows that the breakout of financial crisis in September 2008 has caused Guangdong's imports decline (the intercept dummy variable is negative coefficient -0.270811). The expand model BC, BA testes out breakpoint 2008M11 at 97.5% confidence level, which is a further evidence that of the 2008 financial crisis had a significant negative impact on imports. The intercept dummy variable coefficient is -0.247067, which reveals the big event financial crisis caused Guangdong's import trade decline. The trend dummy variable coefficient is small (0.000170), and isn't significant (the estimated t statistic is 0.157720), so the economic explanatory power is not strong. It shall be mentioned that the expand model BC, BA find out breakpoints at 97.5% level in June, July 2015 which the original model AA, CC, CA failed to get. The result that the coefficient of trend dummy variable is positive (0.00552) at the breakpoint 2005M07 reveals exchange rate formation mechanism reform in July 2005 has promoted the growth of Guangdong's imports and exports to some extent. The value of RMB against US dollar rose 2.01 percent on July 21, 2005, and rose 2.04 percent at the end of that month. The exchange rate formation mechanism reform made RMB appreciate rapidly, so that it accelerated the growth rate of Guangdong's imports and exports.

Table 2. The stationary test results of foreign trade in Guangdong

Series	Test type	t_α	Critical value at 1%,5% and 10% level			Lag intervals (SIC)
			1%	5%	10%	
Imports (level)	(c,t,0)	-2.673681	-4.016064	-3.437977	-3.143241	1
Exports (level)	(c,t,0)	-1.298223	-4.016433	-3.438154	-3.143345	2
Imports (first difference)	(c,0,1)	-21.53610	-3.471192	-2.879380	-2.576361	0
Exports (first difference)	(c,0,1)	-13.29799	-3.471454	-2.879494	-2.576422	1

Table 3. The breakpoint test results of LP original model

Series	Model	alpha	t_alpha	Breakpoint	theta	t_theta	gama	t_gama
Exports	AA	-0.430448	-5.620746	2011M07	-0.077769	-3.430490		
				2008M11	-0.176398	-5.079766		
	CC	-0.559262	-6.001065	2008M11	-0.196483	-5.065728	-0.003009	-3.576566
				2002M01	0.068423	2.113075	0.007913	2.946558
	CA	-0.479709	-6.197682	2010M11	0.040022	1.444276	-0.005653	-4.017844
	(AC)			2008M11	-0.203380	-5.701336		
Imports	AA	-0.888962	***-6.242364***[c]	2008M11	-0.253237	-5.142239		
				2004M02	0.131919	3.918977		
	CC	-1.065861	***-7.138126***[b]	2008M11	-0.273479	-5.676358	-0.000503	-0.526823
				2004M02	0.093563	2.672444	-0.004257	-2.990129
	CA	-1.048984	***-7.212045***[a]	2004M02	0.097659	2.868607	-0.004496	-3.340539
	(AC)			2008M11	-0.270811	-5.667593		

Note: The letters of a, b, c represent 1%, 2.5%, 5%significance level respectively. The numbers in parentheses are t values of alpha

Table 4.The breakpoint test results of LP expand model

Series	Model	alpha	t_alpha	Breakpoint	theta	t_theta	gama	t_gama
Exports	BB	-0.425593	-5.362302	2009M01			0.020371	4.220073
				2008M06			-0.022727	-4.584923
	BC	-0.465853	-5.945283	2011M04			-0.006884	-3.113810
	(CB)			2008M11	-0.211456	-5.511339	0.001119	0.899913
	BA	-0.478341	***-6.172481***[e]	2011M02			-0.004894	-4.248230
	(AB)			2008M11	-0.197266	-5.609399		
Imports	BB	-0.675281	-4.808621	2009M01			0.019594	4.316242
				2008M02			-0.022274	-4.536430
	BA	-1.001992	***-6.949592***[b]	2005M06			0.005434	-4.852679
	(AB)			2008M11	-0.249031	-5.263074		
	BC	-1.000643	***-6.848794***[b]	2005M07			0.005520	-3.999149
	(CB)			2008M11	-0.247067	-5.167009	0.000170	0.157720

Note: The letters of b, e represent 2.5%, 10% significance level respectively. The numbers in parentheses are t values of alpha

6. CONCLUSION

Foreign trade in Guangdong Province has an important role in China and even in the whole world. Big events such as the outbreak of financial crisis in September 2008 had a significant impact on it. In consideration of the lack of researches on Guangdong's import and export trade by existing literature, as well as the deficiencies on model specification, critical value simulation and others in the existing researches, this paper studied the impact of big events on the structural changes of Guangdong's imports and exports.

In this paper, we expand the LP model by adding model BB, BA, BC, which makes the empirical test of structural changes more comprehensive than that of [2]. If we only use the original model to test the breakpoints, then we would draw a wrong conclusion that the time series of Guangdong's exports doesn't reject the unit root null hypothesis over 90% confidence level since 2000. [2] and many followers such as [23-25] have omitted other ways of breakpoint combinations. Therefore, the hypothesis that there are structural changes can't be rejected if the LP original model does not test out the structural changes. The test results of LP expand model and BC model proved this point, we can't reject over 90% confidence level that the 2008 financial crisis and worsen of European debt crisis in 2011 didn't have structural impact on Guangdong's exports.

We find out that time series of Guangdong's imports and exports are piecewise smooth processes since 2000 and the time when the breakpoint occurred is corresponding to big events. The implementation of CEPA in 2004 has promoted the growth of Guangdong's exports effectively; the reform of RMB exchange rate formation mechanism in 2005 has promoted the growth of imports to some extent; the outbreak of

financial crisis in 2008 had impacted significantly on the growth rate of both imports and exports; the exacerbation of European debt crisis in 2011has caused the growth rate of export trade slow down significantly. These show that a small number of big events make structural changes of time series of imports and exports in Guangdong province, leading the series to adjust their growth path. Piecewise smooth also means the distribution of imports or exports are same within the plateau, that is to say, the probability distribution function is identical. Therefore, big events that occurred during the period (except big events such as the outbreak of financial crisis that brought structural changes) only had short-term impacts on foreign trade of Guangdong province. In the aspect of structural changes of imports, [17] draw a conclusion that there is no structural breakpoint in imports, which is opposite to our study that the import series is also a piecewise stationary process. There are two possible reasons: (1) The sample data of [17] are from 1981 to 2006, while this article's data are from 2000 to 2013, there are significant changes in the imports growth law of Guangdong or China in recent years; (2) The former researched China's foreign trade, while the latter study on foreign trade in Guangdong Province, which has some different characteristics from the whole nation.

The conclusions of this paper have some political significance for Guangdong's foreign trade. Among the big events that bought structural changes, some of them have seriously impact the foreign trade growth of China, such as the outbreak of the financial crisis in 2008. Some of them have obvious regional characteristics, such as officially implementation of CEPA in 2004. That is to say, there are two classes of big events which may impact Guangdong's foreign trade. Therefore, in the formulation of policies of Guangdong's foreign trade, we should consider the universal factors of national wild, but also adapt the local foreign trade policies that focus on the regional characteristics of Guangdong. Promoting the development of foreign trade in Guangdong province can't copy China's model completely. Substantial empirical literatures found the role of RMB appreciation in limiting exports. However, most of these studies are based on national data. Based on the import and export data in Guangdong province, we find that the reform of RMB exchange rate formation mechanism in 2005 (RMB appreciation) did not bring structural changes to export series, and the impact appears only in import series. This shows that the reform of RMB exchange rate formation mechanism in July 2005 was offset by the China's strong economic growth and favorable international market conditions during the same period, therefore there were not significantly decline in exports after the appreciation of RMB in 2005. The outbreak of financial crisis in 2008 and worsen of European debt crisis in 2011 have bought structural changes to the export series of Guangdong, which also illustrates the importance of the international market for exports of this province. There are relatively limited countermeasures of the foreign trade sector faced with big events such as the financial crisis in 2008. However, Guangdong's foreign trade sector can take difference measures to the impacts such as the exacerbation of European debt crisis, pay more attention to the emerging markets of Association of Southeast Asian Nations (ASEAN), South Asia, Middle East, South America, and so on.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Csörgö M, Horváth L. Limit theorems in change-point analysis. John Wiley & Sons, New York; 1997.
2. Lumsdaine L, Papell D. Multiple trend breaks and the unit-root hypothesis. The Review of Economics and Statistics, 1997;79(2):212-218.
3. Penélope P. The effect of trade liberalization on exports, imports, the balance of trade and growth: The case of Mexico. Journal of Post Keynesian Economics. 2005;27(4):595-619.
4. Veeck G. China's exports and imports of agricultural products under the WTO. Eurasian Geography and Economics, 2008;49(5):569-585.
5. Mangelsdorf A, Portugal A, Wilson J. Food standards and exports: Evidence for China. World Trade Review. 2012; 11(3):507-526.
6. Yamashita N, Jayasuriya S. The export

response to exchange rates and product fragmentation: The case of Chinese manufactured exports. Journal of the Asia Pacific Economy. 2013;18(2):318-332.
7. Muhammad A, Kilmer R. The impact of EU export subsidy reductions on U.S. dairy exports, Agribusiness. 2008;24(4):557-574.
8. Cudia P. The effect of global financial crises on the Philippines' export. Journal of International Business Research. 2012;11(2):13-29.
9. Qu Z, Perron P. Estimating and testing structural changes in multivariate regressions. Econometrica. 2007;75(2):459-502.
10. Felt H, Gervais P, Larue B. Market power and import bans: The case of Japanese pork imports. Agribusiness. 2011;27(1):47-61.
11. Walkenhorst P, Dihel N. Trade impacts of the terrorist attacks of 11 September 2001: A quantitative assessment, Paper presented at the Workshop on The Economic Consequences of Global Terrorism, Berlin; 2002.
12. Walkenhorst P, Dihel N. Trade impacts of increased border security concerns. International Trade Journal. 2006;20(1):1-31.
13. Thorbecke W, Zhang H. The effect of exchange rate changes on China's labour intensive manufacturing exports. Pacific Economic Review. 2009;14(3):398-409.
14. Thorbecke W, Smith G. How would an appreciation of the Renminbi and other east asian currencies affect China's exports?. 2010;18(1):95-108.
15. Bown P, Crowley M. China's export growth and the China safeguard: Threats to the world trading system?, Canadian Journal of Economics. 2010;43(4):1353-1388.
16. Zilian L. A study on the shock effect of uncertain events in international trade. The Theory and Practice of Finance and Economics. 2010;31(6):77-82.
17. Zhenquan W, Yanbin T, Shouyang W. On structural change in China's import and export. Systems Engineering – Theory & Practice. 2009;29(2):10-17.
18. Beveridge S, Nelson R. A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the business cycle. Journal of Monetary Economics. 1981;7(2):151-174.
19. Limin C. Whether the WTO has become a turning point?. Statistical Research. 2011;28(5):33-40.
20. Qishui C, Zhenquan Wang. Impact of money supply structural changes on prices, Economic Science. 2013;193(1):10-21.
21. Qishui C. The impact of money supply on the price: Evidence from China. Research in World Economy. 2014;5(1):75-87.
22. Zivot E, Andrews D. Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis. Journal of Business and Economic Statistics. 1992;10(3):251-270.
23. Ben-David D, Lumsdaine R, Papell D. Unit roots, postwar slowdowns and long-run growth: Evidence from two structural breaks. Empirical Economics. 2003;28(2):303-319.
24. Papell H, Prodan R. Restricted structural change and the unit root hypothesis. Economic Inquiry. 2007;45(4):834-853.
25. Kruse R. A new unit root test against ESTAR based on a class of modified statistics. Stat Papers, Springer-Verlag; 2009.
26. Gutierrez L. Simple tests for co-integration in panels with structural breaks. Applied Economics Letters. 2010;17(2):197-200.

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