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Trend Changes in Stock Prices of Petrochemical Firms in the A-Share Market, China

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Abstract: The paper proposes that the PetroChina listing event has significantly impacted the change in stock price trend of petrochemical firms. The study selected three firms for cases. The paper tested for the break date using both the Perron IO Model C and Zivot-Andrews Model C. Also, the study conducted a unit root test applying regular ADF and PP techniques. Data were monthly stock price series. Tests suggest that only one out of three petrochemical firm stock price series contains a break date, which occurred around 2007 and was very close to the PetroChina listing date (November 2007). The study concludes that the PetroChina listing has produced a significant shock to the stock prices on the trend function. A high degree of similarity with the PetroChina in one firm's size and main businesses can account for the occurrence of a breakpoint on the firm's stock price trend. Break-date tests for more petrochemical stock price series are needed to justify the proposition.

Keywords: A-share market; Break date; Cointegration; petrochemical firm; Stock price.

1. Introduction

Historical events may impact the trend of a macroeconomic change over time. The 1973 oil price shock caused a shift in the trend function of U.S. GNP (Perron, 1989;1997). Considering the structural break in a time-series variable, a prior study finds that oil prices impact the stock prices of alternative energy companies (Bondia *et al.*, 2016). Taking structural breaks into account, oil shocks affect energy stocks directly (Broadstock *et al.*, 2014).

It has been suggested that the Chinese A-share Market experienced a change at the beginning of 2007; the main reason (shock) was the PetroChina Company Limited listing event occurred in November 2007 (Zou *et al.*, 2016). The Shanghai Composite Index and the Shenzhen Component Index both contained a structural break in early 2007. Also, Sichuan Road and Bridge stock prices included a shift in a time that is close to the beginning of 2007 (November 2008). Following the previous research, we argue that the PetroChina listing event must have imposed pronounced impacts on the price trend of other petrochemical stocks. This paper aims to test for a structural shift in share prices of three petrochemical firms listed in the A-share Market in China.

About ten petrochemical firm stocks trade on the A-Share Market. This study selects three representative petrochemical firm stocks for cases (Table-1). Table-2 compares the structure of their main businesses and income.

Table-1. Basic Data of Listed Petrochemical Enterprises in China's A-Share Market

Firm name	Stock code	Stock Exchange	Registration	Listing date	Outstanding shares (100 million, 31 Dec 2014)	Market capitalization (RMB100 million, 31 Dec 2014)
PetroChina Company Limited	601857	Shanghai	InterContinental Building, 16 Ande Road, Dongcheng District, Beijing	05-Nov-07	161.92	1750 (RMB10.81/share)
China Petroleum and Chemical Corporation	600028	Shanghai	22 Chaoyangmen North Street, Chaoyang District, Beijing	08-Aug-01	95.56	620 (RMB6.49/share)
Sinopec Shanghai Petrochemical Co., Ltd.	600688	Shanghai	88 Jinyi Road, Jinshan District, Shanghai	08-Dec-93	29.25	127 (RMB4.33/share)

Sources from (Sohu, 2017)

Table-2. Comparison of Main Businesses of Listed Petrochemical Enterprises in the A-Share Market, China

Firm name	Scope of businesses	Main business	Share of total income	Income (RMB million)
PetroChina Company Limited	Oil, natural gas exploration, and production; storage and sale of crude oil; storage and sales of refined oil; production of dangerous chemicals; gas operation, the operation of hazardous chemicals, gas stations, filling stations, water transport, and road transport.	Sales	50.49%	1285702
		Refining and Chemical	22.62%	576046
		Exploration and production	15.66%	398794
		Natural gas and pipelines	9.49%	241633
		Other (supplement)	1.72%	43807
		Headquarters and others	0.01%	302
China Petroleum and Chemical Corporation	Non-coal mines (oil, natural gas, etc.), hazardous chemicals (ethylene, propylene, butadiene, naphtha, etc.), heavy oil, rubber and other petrochemical raw materials and products production, storage, pipeline transportation, sales; oil refining; petrol, kerosene, diesel wholesale business and retail business	Marketing and distribution	30.73%	1108279
		Others	28.20%	1017073
		Refining	26.91%	970403
		Chemical	8.76%	315932
		Exploration and production	4.55%	163960
Sinopec Shanghai Petrochemical Co., Ltd.	Crude oil processing, petroleum products, chemical products, synthetic fibers and monomers, plastics and products, needle textile raw materials and products, catalyst preparation and waste recovery, electric hot water supply, water treatment, railway loading and unloading, inland transportation, own housing leasing	Refined oil products	45.27%	35261.72
		Petrochemical products trade	26.44%	20596.95
		Resin and plastic	12.93%	10072.76
		Intermediate petrochemical products	11.70%	9112
		Synthetic fiber	2.46%	1915.24
		Other products	0.53%	413.63
Sinopec Shandong Taishan Petroleum Co., Ltd.	Petrol, diesel oil, kerosene wholesale and retail; natural gas retail; general cargo; lubricants, fuel oil, asphalt, petroleum additives, chemical products (excluding hazardous chemicals)	Gasoline	55.18%	1527
		Diesel	40.475	1120
		Natural gas	0.47%	12.9

Sources from (Sohu, 2017)

China Petroleum and Chemical Corporation (hereafter Sinopec, SINOPEC for the firm stock price variable) was established on February 25, 2000. Its businesses include oil and gas processing, marketing, exploration, and exploitation. This firm was listed on August 8, 2001. The firm's stock price appeared to move upwards from 2002 to 2007, with a peak in October 2007. The price has moved downwards after 2007 (Figure-1).

Sinopec Shanghai Petrochemical Company Limited (henceforth Sinopec Shanghai, SINOPEC SHANGHAI PETRO for the firm stock price variable) was established in 1993. The company produces intermediate petrochemicals and petroleum products, chemical raw materials, synthetic resin and plastics, synthetic materials and synthetic fiber. The Sinopec Shanghai Petrochemical is currently one of China's largest oil refining and chemical industry integrations. Its stock prices appeared to rise gradually since 1995 (Figure-2) and reached their summit in September 2007. The random trend of stock prices may contain a change around 2007.

Sinopec Shandong Taishan Petroleum Company Limited (henceforward Sinopec Taishan, SINOPEC TAISHAN PETRO for the firm stock price variable) was listed on the A-Share Market in December 1993. The company mainly

conducts the wholesale and retail of petrochemical products. These products include gasoline, diesel oil, kerosene, natural gas retails, general cargo, lubricants, fuel oil, asphalt, and petroleum additives. Sinopec Shandong Taishan Petro is a small-sized firm regarding its market cap. Its stock prices seem to grow slowly, and the shift in the trend appears to be not distinctive (Figure-3).

Figure-1. Sinopec Firm Stock Prices (RMB/Share) on the A-Share Market, China (2002-2014)

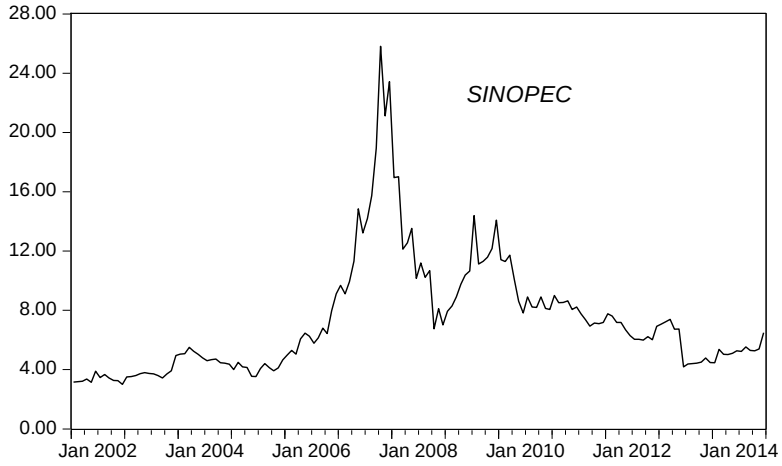


Figure-2. Sinopec Shanghai Petro firm stock prices (RMB/share) on the A-Share market, China (1994-2015)

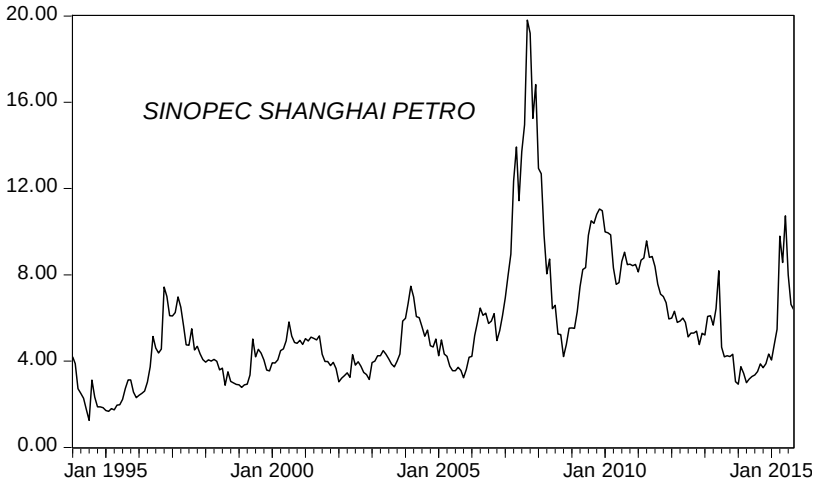
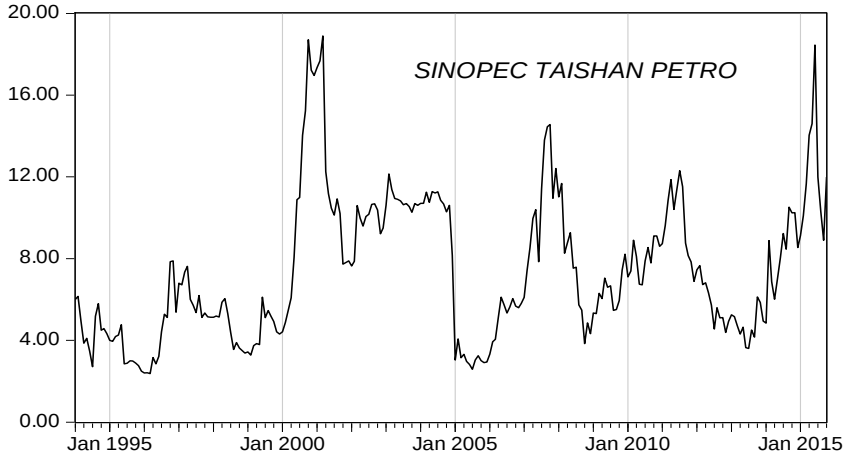


Figure-3. Sinopec Taishan Petro Firm Stock Prices (RMB/share) on the A-Share Market, China (1994-2015)



2. Methods

The paper selected three listed petrochemical firms in the Chinese A-share market. Perron (1989) proposes three models (Models A, B, and C) to test for the change in the trend function. Model A allows for a shift in the level. Model B allows for a slope change. Model C incorporates the two changes in the level and slope. The study selected

Model A, B, or C based on the data and took the change as endogenous. The test procedures applied were the Zivot-Andrews test and the Perron test (Perron, 1997; Zivot and Andrews, 1992). The Perron test rejects the null hypothesis more often than the Zivot-Andrews test (Perron, 1997). The mixed IO Model C in Perron (1997) is formulated as:

$$y_t = \mu + \theta DU_t + \beta t + \gamma DT_t + dD(TB)_t + \alpha y_{t-1} + \sum_{i=1}^{k} \Delta y_{t-i} + \varepsilon_t \quad (1)$$

Where $D(TB)$ and DU represents a change in the level and a change in the slope, respectively. $DT = tDU$, t is the trend. Under the null hypothesis, $\mu \neq 0$ (in general), $\beta = 0$, $\theta = 0$ (except in Model C), $\gamma = 0$, $d \neq 0$, and $\alpha = 1$. Under the alternative hypothesis of trend-stationary, $\mu \neq 0$, $\beta \neq 0$, $\theta \neq 0$, $\gamma \neq 0$ (in general), $d = 0$, and $\alpha < 1$. The null is tested using the t-statistic for $\alpha = 1$. The break date T_b is endogenously selected by minimizing the t-statistic for $\alpha = 1$; the minimal is termed t_α^*.

To enhance the test robustness, the study tested for a unit root using the augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979; Dickey *et al.*, 1984; Harris, 1992) and the Phillips-Perron (PP) test (Phillips and Perron, 1988; Schwert, 1989a). These two tests show different finite sample properties (Schwert, 1989).

3. Data

Data were stock prices of three petrochemical firms. Monthly prices were the closing figures on the last trading day of each month. Prices were spot transaction prices measured in nominal RMB each share. Three price series variables covered different periods to obtain the longest phase for each series (Table-3). Series were downloaded from an online trading system: <http://www.dfzq.com.cn/dfzq/i/orientsec-software.jsp>. Three stock price series were plotted respectively (Figures-1, 2, 3).

Table- 3. Descriptive Statistics for the Raw Data

Energy firms:	**China Petroleum and Chemical Corporation**	**Sinopec Shanghai Petrochemical Co., Ltd**	**Sinopec Shandong Taishan Petroleum Co., Ltd**
Price variable	*SINOPEC*	*SINOPEC SHANGHAI PETRO*	*SINOPEC TAISHAN PETRO*
Mean	7.29	5.26	7.37
Median	6.28	4.76	6.69
Max	25.81	19.81	18.89
Min	3.01	1.25	2.37
Std. Dev.	3.98	2.89	3.47
Skewness	1.84	1.85	0.85
Kurtosis	7.44	7.84	3.55
Jarque-Bera	217.03	404.38	35.15
P-value	0.00	0.00	0.00
Period	Jan 2002-Dec 2014	Jan 1994-Sept 2015	Jan 1994-Oct 2015
Observations	156	261	262

Price is measured in RMB each share.

4. Econometrical Results and Discussions

By a visual inspection of Figures-1, 2, and 3, prices of three petrochemical firms appear to contain a level change as well as a slope change. So, we tested for a break date using the Model C in the following analysis. For each of the three series, we conducted both the Zivot-Andrews test and the Perron test (Tables-4, 5, 6, 7, 8, and 9). We conclude the break date as follows.

Breakpoint tests for log *SINOPEC* (Tables-4 and 5). The Zivot-Andrews test showed a change occurred in April 2007. The Perron test showed the break in March 2007. In Table-10, the ADF test showed a unit root for log *SINOPEC*, whereas the PP test showed no. Also, the null hypothesis $\alpha = 1$ was rejected in Table-4 (statistically significant $\alpha = 0.57$) as well as in Table-5 (statistically significant $\alpha = 0.53$). So, the variable did not contain a unit root. In line with a visual inspection of Figure-1, I suggest that a trend variation occurred around April 2007.

Break-date tests for log *SINOPEC SHANGHAI PETRO* (Tables-6 and 7). The Zivot-Andrews test showed a change occurred in December 2004. The Perron test indicated a shift in February 2007. These two tests suggested a distinct shift. In Table-10, the ADF test showed no unit roots for log *SINOPEC SHANGHAI PETRO*, whereas the PP test showed a unit root, which implied that the variable might contain a unit root. Additionally, the $\alpha \approx 1$ was

statistically significant in Table-6 ($\alpha = 0.89$) as well as in Table-7 ($\alpha = 0.81$). So, I suggest that log *SINOPEC SHANGHAI PETRO* has a unit root against the alternative: a shift.

Breakpoint tests for log *SINOPEC TAISHAN PETRO* (Tables-8 and 9). The Zivot-Andrews test showed a change in December 2004. The Perron test indicated a shift in November 2004. In Table-10, both the ADF test and the PP test consistently showed a unit root for log *SINOPEC TAISHAN PETRO*. Moreover, the $\alpha \approx 1$ was statistically significant in Tables-8 and 9 ($\alpha = 0.79$). So, I suggest that log *SINOPEC TAISHAN PETRO* contains a unit root against the alternative: a structural break.

Table- 4. The Break Date Test For Log SINOPEC: Zivot-Andrews Model C

Parameter & variable	**Coefficient**	**Standard Error**	***t*-Statistic**	***P*-value**	T_b
θ	0.32	0.08	4.18	0.00	
β	0.01	0.00	4.30	0.00	
γ	-0.01	0.00	-5.08	0.00	
α	0.57	0.08	7.22	0.00	April 2007
t-1	0.09	0.09	0.97	0.33	
t-2	0.32	0.09	3.71	0.00	
t-3	0.21	0.09	2.27	0.02	
t-4	0.29	0.09	3.22	0.00	
t-5	0.25	0.09	2.81	0.01	
t-6	0.02	0.08	0.22	0.83	
t-7	0.16	0.08	1.96	0.05	
t-8	0.08	0.08	0.93	0.35	
t-9	0.12	0.08	1.49	0.14	
t-10	0.18	0.09	2.12	0.04	
t-11	0.20	0.08	2.31	0.02	
Intercept	0.45	0.09	4.91	0.00	
R-squared	0.95	Mean dependent var	1.93		
Adjusted R-squared	0.94	S.D. dependent var	0.45		
S.E. of regression	0.11	Akaike info criterion	-1.54		
Sum squared resid	1.45	Schwarz criterion	-1.21		
Log likelihood	126.88	Hannan-Quinn criteria.	-1.41		
F-statistic	159.04	Durbin-Watson stat	1.93		
Prob(F-statistic)	0.00				

Variable was in logarithmic values. t–1, t–2, ..., t – k denotes the lagged term. The trimming fraction is 0.15 (Banerjee *et al.*, 1992). Truncation lag orders k (between 2 and 14) were selected (Ng and Perron, 1995;2001; Perron, 1997). Tb is the possible break date selected. t-statistic for $t - k \geq 1.60$.

Table-5. The Break Date Test For Log SINOPEC: Perron Models C

Parameter & variable	**Coefficient**	**Standard Error**	***t*-Statistic**	***P*-value**	T_b
θ	1.08	0.20	5.53	0.00	
β	0.01	0.00	4.28	0.00	
γ	-0.01	0.00	-5.26	0.00	
d	-0.14	0.12	-1.19	0.24	
α	0.53	0.08	6.73	0.00	March 2007
t-1	0.10	0.09	1.13	0.26	
t-2	0.35	0.09	4.01	0.00	
t-3	0.23	0.09	2.53	0.01	
t-4	0.29	0.09	3.26	0.00	
t-5	0.24	0.09	2.73	0.01	
t-6	0.04	0.08	0.45	0.65	
t-7	0.17	0.08	2.01	0.05	
t-8	0.08	0.08	1.00	0.32	
t-9	0.15	0.08	1.80	0.07	
t-10	0.20	0.08	2.38	0.02	
t-11	0.20	0.08	2.37	0.02	
Intercept	0.50	0.09	5.32	0.00	
R-squared	0.95	Mean dependent var	1.93		
Adjusted R-squared	0.94	S.D. dependent var	0.45		
S.E. of regression	0.11	Akaike info criterion	-1.56		
Sum squared resid	1.40	Schwarz criterion	-1.21		
Log likelihood	129.16	Hannan-Quinn criteria.	-1.42		
F-statistic	152.95	Durbin-Watson stat	1.95		

Notes are the same as in Table-4

Table-6. The Break Date Test For Log *SINOPEC SHANGHAI PETRO*: Zivot-Andrews Model C

Parameter & variable	Coefficient	Standard Error	*t*-Statistic	*P*-value	T_b
θ	0.05	0.03	1.55	0.12	
β	0.00	0.00	0.93	0.35	
γ	0.00	0.00	-1.35	0.18	
α	0.89	0.03	32.43	0.00	December 2004
t-1	0.05	0.06	0.77	0.44	
t-2	0.15	0.06	2.43	0.02	
t-3	0.10	0.06	1.68	0.09	
t-4	0.11	0.06	1.95	0.05	
t-5	0.09	0.06	1.54	0.13	
t-6	-0.08	0.06	-1.30	0.19	
t-7	0.00	0.06	0.05	0.96	
t-8	0.02	0.06	0.41	0.68	
t-9	0.14	0.06	2.32	0.02	
Intercept	0.13	0.04	3.52	0.00	
R-squared	0.93	Mean dependent var	1.62		
Adjusted R-squared	0.92	S.D. dependent var	0.45		
S.E. of regression	0.13	Akaike info criterion	-1.25		
Sum squared resid	3.78	Schwarz criterion	-1.05		
Log likelihood	170.37	Hannan-Quinn criteria	-1.17		
F-statistic	226.75	Durbin-Watson stat	2.02		
Prob(F-statistic)	0.00				

Notes are the same as in Table-3

Table-7. The Break Date Test for Log *SINOPEC SHANGHAI PETRO*: Perron Models C

Parameter & variable	Coefficient	Standard Error	*t*-Statistic	*P*-value	T_b
θ	0.52	0.14	3.75	0.00	
β	0.00	0.00	2.59	0.01	
γ	0.00	0.00	-3.61	0.00	
d	0.03	0.13	0.22	0.83	
α	0.81	0.04	22.11	0.00	February 2007
t-1	0.09	0.06	1.37	0.17	
t-2	0.19	0.06	2.99	0.00	
t-3	0.13	0.06	2.28	0.02	
t-4	0.14	0.06	2.51	0.01	
t-5	0.13	0.06	2.27	0.02	
t-6	-0.04	0.06	-0.62	0.54	
t-7	0.04	0.06	0.67	0.50	
t-8	0.06	0.06	0.98	0.33	
t-9	0.17	0.06	2.81	0.01	
Intercept	0.21	0.04	4.77	0.00	
R-squared	0.93	Mean dependent var	1.62		
Adjusted R-squared	0.92	S.D. dependent var	0.45		
S.E. of regression	0.12	Akaike info criterion	-1.28		
Sum squared resid	3.61	Schwarz criterion	-1.07		
Log likelihood	176.10	Hannan-Quinn criteria	-1.20		
F-statistic	220.25	Durbin-Watson stat	2.03		
Prob(F-statistic)	0.00				

Notes are the same as in Table-4

Table-8. The Break Date Test For Log *SINOPEC TAISHAN PETRO*: Zivot-Andrews Model C

Parameter & variable	Coefficient	Standard Error	*t*-Statistic	*P*-value	T_b
θ	-0.17	0.05	-3.40	0.00	
β	0.00	0.00	3.56	0.00	
γ	0.00	0.00	-2.29	0.02	
α	0.79	0.04	19.54	0.00	December 2004
t-1	0.04	0.07	0.62	0.54	
t-2	0.12	0.07	1.84	0.07	
t-3	0.09	0.06	1.37	0.17	
t-4	0.23	0.07	3.53	0.00	
t-5	0.10	0.07	1.57	0.12	
t-6	0.12	0.06	1.87	0.06	
t-7	0.11	0.06	1.77	0.08	
t-8	0.01	0.06	0.09	0.93	
t-9	0.18	0.06	2.83	0.01	
t-10	-0.06	0.06	-0.92	0.36	

t-11	0.08	0.06	1.22	0.22	
t-12	0.11	0.06	1.79	0.07	
Intercept	0.23	0.05	4.24	0.00	
R-squared	0.90	Mean dependent var		1.91	
Adjusted R-squared	0.89	S.D. dependent var		0.48	
S.E. of regression	0.15	Akaike info criterion		-0.83	
Sum squared resid	5.56	Schwarz criterion		-0.59	
Log likelihood	120.11	Hannan-Quinn criteria		-0.73	
F-statistic	133.03	Durbin-Watson stat		1.93	
Prob(F-statistic)	0.00				

Notes are the same as in Table-4

Table-9. The Break Date Test for Log *SINOPEC TAISHAN PETRO*: Perron Models C

Parameter & variable	**Coefficient**	**Standard Error**	***t*-Statistic**	***P*-value**	T_b
θ	0.04	0.08	0.44	0.66	
β	0.00	0.00	3.83	0.00	
γ	0.00	0.00	-2.53	0.01	
d	-0.12	0.16	-0.77	0.44	
α	0.79	0.04	19.54	0.00	November 2004
t-1	0.04	0.07	0.67	0.50	
t-2	0.12	0.06	1.84	0.07	
t-3	0.09	0.06	1.38	0.17	
t-4	0.23	0.06	3.54	0.00	
t-5	0.10	0.07	1.60	0.11	
t-6	0.12	0.06	1.92	0.06	
t-7	0.12	0.06	1.84	0.07	
t-8	0.01	0.06	0.09	0.92	
t-9	0.19	0.06	2.91	0.00	
t-10	-0.06	0.06	-0.90	0.37	
t-11	0.08	0.06	1.25	0.21	
t-12	0.11	0.06	1.80	0.07	
Intercept	0.22	0.05	4.21	0.00	
R-squared	0.90	Mean dependent var	1.91		
Adjusted R-squared	0.90	S.D. dependent var	0.48		
S.E. of regression	0.15	Akaike info criterion	-0.84		
Sum squared resid	5.46	Schwarz criterion	-0.58		
Log likelihood	122.20	Hannan-Quinn criteria	-0.73		
F-statistic	127.01	Durbin-Watson stat	2.02		
Prob(F-statistic)	0.00				

Notes are the same as in Table-4

Both the ADF and PP tests show that *SINOPEC SHANGHAI PETRO* and *SINOPEC TAISHAN PETRO* contained a unit root (Table-4). The ADF test indicates that *SINOPEC* contained a unit root but the PP test does not suggest the existence of a unit root.

Table-10. The Unit Root Tests

Log variable	**Period**	**Method**	**Level**	***k***	**First difference**	***k***
SINOPEC	Jan 2002-Dec 2014	ADF	-3.43	1	-4.50***	13
		PP	-3.58**	5		
SINOPEC SHANGHAI PETRO	Jan 1994-Sept 2015	ADF	-3.57**	9		
		PP	-3.39	7	-16.89***	6
SINOPEC TAISHAN PETRO	Jan 1994-Oct 2015	ADF	-3.38	10	-5.29***	9
		PP	-3.31	7	-17.22***	6

All tests contain an intercept as well as a trend according to (Hamilton, 1994; Hendry and Juselius, 2000). The value of a lag order (k) was decided using the t test for the ADF test (Ng and Perron, 1995) and the Newey–West (NW) bandwidth technique for the PP test (Newey and West, 1987). *, **, and ***denote rejection of a unit root at the levels of 10%, 5% and 1% , respectively.

Tests showed that only log *SINOPEC* contained a break occurred in their trend function around April 2007. Hence, the PetroChina listing shock in November 2007 appeared to have played a role in the break. However, the other two petroleum and chemical firms' stock prices do not contain a shift.

Regarding outstanding shares and market cap (Table-1), PetroChina and Sinopec are the two largest and leading state-owned energy enterprises in China. Sinopec Shanghai can be a medium-sized firm, and Sinopec Taishan is a small-sized one. Regarding main business structure, Sinopec contains the most similarities with PetroChina compared with the other two companies (Table-2). Main businesses can be disaggregated into three categories. (1)

Exploration and production: PetroChina's income from this type accounts for 16% of its total income, Sinopec accounts for 4.6%. However, Sinopec Shanghai and Sinopec Taishan do not have such a business type. (2) Refining and chemical products: Sinopec Shanghai, Sinopec and PetroChina receive about respective 61%, 36% and 23% of the total income from this type; this type does not contribute any share to Sinopec Taishan's income. (3) Sales of refined and chemical products contribute 50%, 31%, 26%, 100% of the firm's total income to PetroChina, Sinopec, Sinopec Shanghai and Sinopec Taishan, respectively. In all, with considerable sizes, PetroChina and Sinopec are the comprehensive energy enterprise. Their businesses focus on petroleum and natural gas exploration and production, refining and chemical product making, and related energy product sales. A huge difference between Sinopec Shanghai or Sinopec Taishan and PetroChina is that the former two firms is not sizable and do not perform energy exploration and production. So, the similarity between energy firms may account for the structural break occurred in the price trend. We suggest that a high degree of similarity of Sinopec with PetroChina leads to the PetroChina listing shock has produced a significant effect on the trend change in Sinopec's stock prices.

5. Conclusion

This paper proposes that the November 2007 PetroChina listing shock has caused a trend change in stock prices of petroleum and chemical firms. Hence, the study selected three firms to examine their stock price changes. Methods applied were the mixed structural break techniques: the Zivot-Andrews test and the Perron test. Model C was introduced. Accompanied are the conventional ADF and PP tests.

Tests used monthly stock prices of three petrochemical firms listed in the A-Share Market in China. Tests suggest a shift for Sinopec occurred around April 2007. So, the break date suggested is very close to the PetroChina listing date: November 2007. So, the similarity between energy firms may account for the structural break occurred in the price trend. The study suggests that a high degree of similarity of Sinopec with PetroChina can account for a significant shock of the PetroChina listing to Sinopec's stock prices on the trend function.

However, to justify the proposition, testing for structural breaks for more petrochemical firms' stock prices in the Chinese A-share market needs to be performed in the future.

References

Banerjee, A., Lumsdaine, R. L. and Stock, J. H. (1992). Recursive and sequential tests of the unit root and trend break hypothesis: Theory and international evidence. *Journal of Business and Economic Statistics,* 10(3): 271-87.

Bondia, R., Ghosh, S. and Kanjilal, K. (2016). International crude oil prices and the stock prices of clean energy and technology companies: Evidence from non-linear cointegration tests with unknown structural breaks. *Energy,* 101: 558-65.

Broadstock, D. C., Wang, R. and Zhang, D. (2014). Direct and indirect oil shocks and their impacts upon energy related stocks. *Economic Systems,* 38(3): 451-67.

Dickey, D. A. and Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association,* 74(386): 427-31.

Dickey, D. A., Hasza, D. P. and Fuller, W. A. (1984). Testing for unit roots in seasonal time series. *Journal of the American Statistical Association,* 79(386): 355-65.

Hamilton, H. D. (1994). *Time series analysis.* Princeton, New Jersey; Princeton University Press.

Harris, R. I. D. (1992). Testing for unit roots using the augmented dickey-fuller test : Some issues relating to the size, power and the lag structure of the test. *Economics Letters,* 38(4): 381-86.

Hendry, D. F. and Juselius, K. (2000). Explaining cointegration analysis: Part I. *Energy Journal,* 21(1): 1-42.

Newey, W. K. and West, K. D. (1987). A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica,* 55(3): 703-08.

Ng, S. and Perron, P. (1995). Unit root tests in arma models with data dependent methods for the selection of the truncation lag. *Journal of the American Statistical Association,* 90(429): 268-81.

Ng, S. and Perron, P. (2001). Lag length selection and the construction of unit root tests with good size and power. *Econometrica,* 69(6): 1519-54.

Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica,* 57(6): 1361-401.

Perron, P. (1997). Further evidence on breaking trend functions in macroeconomic variables. *Journal of Econometrics,* 80(2): 355-85.

Phillips, P. C. B. and Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika,* 75(75): 335-46.

Schwert, G. W. (1989). Tests for unit roots: A monte carlo investigation. *Journal of Business & Economic Statistics,* 7: 147-59.

Schwert, G. W. (1989a). Tests for unit roots: A monte carlo investigation. *Journal of Business & Economic Statistics,* 7(2): 147-59.

Sohu (2017). Sohu stock. 2017. Available: http://stock.sohu.com.

Zivot, E. and Andrews, D. W. K. (1992). Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. *Journal of Business and Economic Statistics,* 10(3): 251-70.

Zou, G., Yan, X. and Chau, K. W. (2016). Price discovery from the chinese a-share market: Trend break tests using the perron mixed model c. *Advances in Social Science, Education and Humanities Research,* 62: 1743-48.