Original Research Article

Testing for the Mean Reversion of Chinese Coal Stock Prices

ABSTRACT

Aims: The main purpose of this paper is to test if prices ofcoal firm stocks in the Chinese A-Share market fluctuate around a long-term trend.
Study design: Existence of a unit root implies that a macroeconomic variable isnonstationary and a shock to the market may have imposed a permeant effect on the long-run trend. The variable willbe not mean-reverting. To improve the test robustness, conventional unit root tests must be conducted in line with structural break tests. Acomparison of the unit roots of stock prices of two coal producing and processing firms in China's Shanxi Province may lead us to conclude whether the market is trend-reverting.
Place and Duration of Study: The study usedstock prices of two coal-related firms that come from Shanxi Province, China. The Shanxi Coking Co., Ltd registers in Lingfeng.The Shanxi Xishan Coal and Electricity Power Co., Ltd registers in Taiyuan. Data was the monthly prices. The data period was from August 1996 to July 2014 for the Shanxi Coking, and from July 2000 to October 2015 for the Shanxi Xishan Coal and Electricity Power.
Methodology: The paper conducted a unit root test applyingregular ADF and PP techniques. Also, it carried out a structural break test using the Perron test and the Zivot-Andrews test (Model C).
Results: Tests suggest that prices of two coal stocks are stationary series and these two seriescontain a shift between2007 and 2008.The coal stock market may be weak-form efficient.
Conclusion: Dramatic coal price fluctuations in China have not produced an enduring effect on prices of the coal stocks examined in the study. The coal-electricity price linkage could account for the trend reversion of coal firm stock prices.Investors could profit to some extent from trading on coal equities. However, the paper suggests more and panelunit root tests for coal stock prices.

Keywords: A-Share market, break date, coal firm, long memory,permanent effect, stock price

1. INTRODUCTION

Institutions and individuals can trade on energy related stocks, which is an indirect investment in energy property. Whether investor incorporates energy firm stocks into their portfolios in part depends on the quantity and type of price fluctuationsover time. A shock to the energy stock price series may leave a permeantcomponent in the series trend, and so the pricecanrarely return to its long-run equilibrium[1].In other words, energy prices would be not mean-reverting, which is inconsistent with classical economics[2].If stock prices do not contain a unit root and thereby being stationary, they fluctuate around a long-run path and fluctuations can be predictable. So investors may run a trivial risk of trading on the stocks. Additionally, a unit root implies the weak form of the efficient market hypothesis (EMH)[3].

China is the largest coal consumer in the world. Following sudden changes of sizabledomestic demand for primary fuel energy or following a shock like the Wen Chuan Great Quake in 2008, prices of coal and coal products rise or decline sharply over time. Meanwhile, coal stock pricesfluctuate sharply. About forty coal producing and processing firms are trading on the Chinese A-Share Market. In August and early September, the coal stock price in the A-share market normally has a sharp increase because the market predicts thatthe upcoming winterwill consume much more coal or coke for winter warming than Summer and Autumn, which produces a rational expectation of rocketing coal prices.

This paper mainly aims to test for the mean reversion of prices of coal stocks in the A-share market in China.Two coal firmcases are examined.

Shanxi is one of the largest coal producers in China. In 2012, China produced 443.23 million tons of coke. Of which Shanxi Province contributed 19.43% (86.12 million tons)[4]. The representative coal production firms include Shanxi Coking Co., Ltd (hereafter Shanxi Coking) and Shanxi Xishan Coal and Electricity Power Co., Ltd (henceforthXishan Coal and Power).

Shanxi Coking was established in August 1996. It produces coke and coke chemical products, and ammonium sulfate (for agricultural uses). The company also conducts methanol production, sales, and management. Coke production contributes 70.74% of the firm's 2016 total income. Shanxi Coking was listedon the Chinese A-Share Market on August 8, 1996. There are 665.683 million shares trading in the A-Share market. On March 10, 2017, the firm's market capitalization was RMB5.28 billion. Its stock price surged between September 2007 and February 2008 (Figure 1)[5].

Xishan Coal and Power was established in April 1999. It produces coal, and processes and sells coal products like coke. The firm also purchases and sells electricity. Coal and coke production contribute 49.02% and 23.10% of the company's 2016 total income, respectively. Xishan Coal and Power was listed on July 26, 2000. There are 3.1512 billion shares trading on the Chinese A-Share market. On March on the A-Share Market on 10, 2017, the market capitalization was RMB28.68 billion. The firm's stock price surged in September 2007 (Figure 2)[5].

Therefore, by a visual inspection of Figures 1 and 2, stock prices of these two coal-related companies might contain a shift around September 2007.

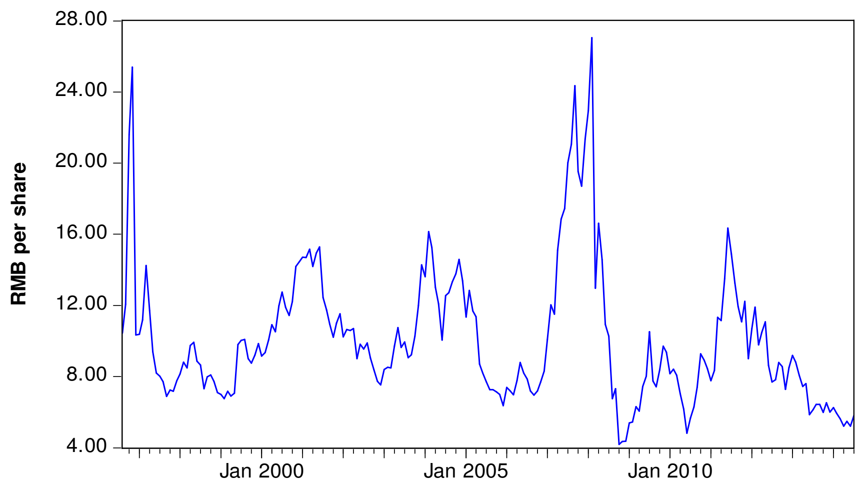


Fig. 1.Shanxi cokingstock prices on the A-share market, China (1996-2014)

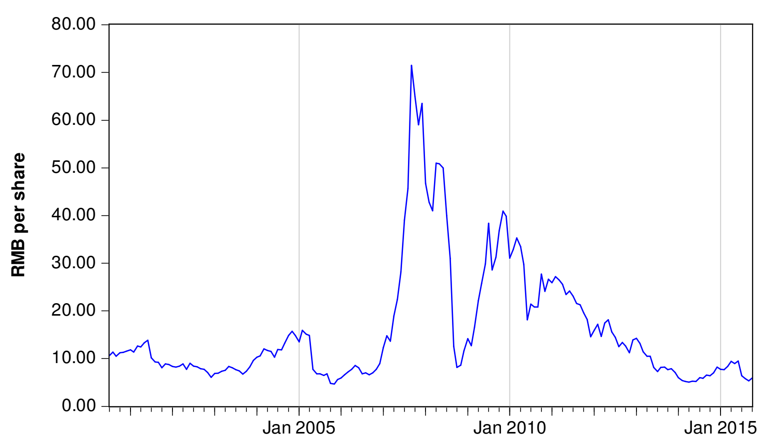


Fig. 2. Shanxi Xishan coal and electricity power stockprices on the A-share market, China (2000-2015)

2. LITERATURE REVIEW

A nonstationary time series can be decomposed into a permanent component (random walk) and a transitory or cyclical (stationary) process [1]. So a unit root suggests a stochastic nonstationarity or random shocks, which have a persistent effect on future prices of the variable [6]. The variable will tend to be not mean- (or trend) reverting, which contrasts with classical macroeconomic theories. The presence of a unit root in a macroeconomic series variable also implies long memory and so persistence in the variable. The macroeconomic shock persistence can be estimated by a fractional differencing and cumulative impulse response analysis [7, 8]. The persistence claim can be used to deal with macroeconomic fluctuations. [2].

In econometrics, nonstationary time series variables will lead to spurious regressions if the variables of interest contain a unit root (or unit roots) and not cointegrated [9, 10]. For a first-differenced vector-autoregressive model (VAR), regressions are valid if all variables contain a unit root and not cointegrated. However, an error-correction model (ECM) must be constructed if all variables are (1) and cointegrated [10].
In the view of the efficient market hypothesis (EMH) [11-13], the unit root normally shows market efficiency. The stationarity is consistent with the weak form of the EMH; nonetheless, serial autocorrelations can supply evidence for return predictability[3, 14]. Empirically, literature has related the unit root and predictability of stock prices to the EMH, e.g. [14, 15].

Hence, an investigation of the unit root of macroeconomic variables has been a routine. Most used conventional unit root test techniques include the augmented Dickey-Fuller (ADF) test [16, 17], the Phillips-Perron (PP) test [18], the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test [19], among others. Allowing for a one-time shift, the Perron test [20, 21] and the Zivot-Andrews technique [22] test for the hypothesis of a unit root against the alternative trend stationarity. These techniques are usually complemented.

Stock indices in the United States, the United Kingdom, Germany, Japan, France, Italy, and Canada contain a unit root. Hence, in the long term, post-World War II stock prices in these developed economies may not be forecastable. The ADF, KPSS, and variance ratio tests are used to examine the UK futures price variables. These tests suggest that the three UK financial markets,the UK FTSE100 futures (stock index futures), Long Gilt (bond futures), and Short Sterling (interest rate futures) contain a unit root[23].Using the Zivot-Andrews test [22], Narayan and Smyth find that stock prices in South Korea contain a unit root[24]. Nonlinear unit root tests show that Borsa Istanbul stock price index series area non-stationary process and thus Turkish stock market follows the EMH[25].

There isn't a permanent component in stock prices in the US stock market, since the series examined is nearly I(0) [15]. A nonlinear unit root test shows that the South Korea's stock pricedoes not contain a unit root [14].

For testing for the integrated property of energy prices, unit root tests are conducted often by allowing for structural breaks. Eleven natural resource real price series from 1870-1990 do not have a unit root. These findings show that natural resource prices are stationary around deterministic trends with structural breaks[26]. Allowing for two-time shifts on the trend function, many countries' oil consumption and oil prices are found to be I(0) [27]. Crude oil prices contain unit roots and are linked. There exists strong evidence of threshold effects in the adjustment process to the long-run equilibrium[28].

Futures prices of the daily crude oil, heating oil, and unleaded gasoline did not contain a unit root. The test allowed for a one-time break both in the intercept and in the slope at an unknown time[29].Furthermore, energy futures prices for the more recent period from January 3, 1994 to June

30, 2005 show long memory and that the specific form of long memory is anti-persistence, characterized by the variance of each series being dominated by high frequency components[30].

3. DATA AND METHODS

3.1Methods

The study tests for the hypothesis of a unit root against the alternative: a stationary process without a unit root. Conventional methods of testing for a unit root include the ADF test [16, 17], the PP test [18], the KPSS test [19], and the Elliott-Rothenberg-Stock (ERS) test [31]. The paper employs the ADF and PP tests.

Nonetheless, Figures 1 and 2 indicate that two series might have a shift in both the level and the slope. A structural break on the trend function of a series could lead to incorrect inferences for conventional unit root tests [20, 21, 32, 33]. So, applying Model C proposed in [20], this study conducted a break date test. Taking the shift as unknown a priori, Model C can be in the form of [21]:

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

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}^{*}.

Two specific tests using Model C are the Perron test [21] and the Zivot-Andrews test [22]. The study used the two tests. The former rejects the null hypothesis of a unit root more often than the latter [21].

3.2Data

We collected the stock prices of the Shanxi Coking (*SHANXI COKING*) and the Xishan Coal and Power (*XISHAN COAL POWER*). Stock prices were the closing values of the last trading day for each month. Access to the data can use the trading system http://www.dfzq.com.cn/dfzq/i/orientsec-software.jsp. Table 1 is a description of the data.

Table 1.Descriptive statistics for the raw data

Energy firms:	**Shanxi Coking Co., Ltd**	**Shanxi Xishan Coal and Electricity Power Co., Ltd**
Variable	*SHANXI COKING*	*XISHAN COAL POWER*
Mean	10.13	16.04
Median	9.19	11.41
Max	27.05	71.49
Min	4.20	4.68
Std. Dev.	3.85	12.79
Skewness	1.62	1.97

Kurtosis	6.49	6.88
Jarque-Bera (*P*-value)	203.79(0.00)	234.37(0.00)
Period	August 1996 to July 2014	July 2000 to October 2015
Observations	216	184

4. RESULTS AND DISCUSSIONS

4.1 Empirical results

For *SHANXI COKING,* the null of a unit root can be rejected at the 1% level. For *XISHAN COAL POWER*, the null can be rejected at the 5% level (Table 2).

For *SHANXI COKING*, the estimated α equaled to 18.38 (Perron test in Table 3) and 24.59 (Zivot-Andrews test in Table 4). The Perron testshowed a change in November 2008,and the Zivot-Andrews test indicated a change in October 1999. So these two tests consistently rejected the null hypothesis of a unit root and suggested a break.

For *XISHAN COAL POWER,*the estimated α equaled to 15.43 (Perron test in Table 5) and 16.03 (Zivot-Andrews test in Table 6). The Perron testshowed a change in September2007,and the Zivot-Andrews test indicated a change in August2007. Also, these two tests consistently rejected the null hypothesis and proposed a break. These two tests suggested a similar break date particularly.

Anyway, testssuggest that a unit root hypothesis for the variables *SHANXI COKING* and *XISHAN COAL POWER* canbe rejected, but both may contain a breakpoint in the trend.

Table 2. The unit root tests

Log variable	Period	Method	Level	*k*	First difference	*k*
SHANXI COKING	Aug 1996-July 2014	ADF	-7.63***	1		
		PP	-8.29***	7		
XISHAN COAL POWER	July 2000-Oct 2015	ADF	-3.97**	1		
		PP	-4.14***	6		

**All tests encompass an intercept as well as a trend according to [34, 35]. The lag k was decided using the t test for the ADF test [36] and the Newey–West (NW) bandwidth technique for the PP test [37]. *, **, and ***denote rejection of the null of a unit root at the levels of 10%, 5% and 1% , respectively.*

Table 3. The break date test for log *SHANXI COKING*: Perron Model C

Parameter & variable	Coefficient	Standard error	*t*-Statistic	*P*-value	T_b
θ	0.11	0.16	0.70	0.49	
β	0.00	0.00	-0.03	0.97	

γ	0.00	0.00	-0.91	0.36	
δ	0.34	0.15	2.28	0.02	
α	0.81	0.04	18.38	0.00	November 2008
t-1	0.04	0.07	0.54	0.59	
t-2	0.20	0.07	2.82	0.01	
t-3	0.15	0.07	2.02	0.05	
t-4	0.16	0.07	2.21	0.03	
t-5	0.18	0.07	2.62	0.01	
t-6	-0.09	0.07	-1.31	0.19	
t-7	0.15	0.07	2.33	0.02	
t-8	0.15	0.06	2.36	0.02	
t-9	0.03	0.06	0.54	0.59	
t-10	0.12	0.07	1.82	0.07	
Intercept	0.44	0.10	4.42	0.00	
R-squared	0.87	Mean dependent var	2.24		
Adjusted R-squared	0.86	S.D. dependent var	0.34		
S.E. of regression	0.13	Akaike info criterion	-1.22		
Sum squared resid	3.04	Schwarz criterion	-0.96		
Log likelihood	140.64	Hannan-Quinn criteria	-1.11		
F-statistic	82.69	Durbin-Watson stat	1.99		
Prob(F-statistic)	0.00				

**Variable was in logarithms. t–1, t–2, ..., t – k denote lagged terms. The trimming portion is 0.15 [38]. Truncation lag k (between 2 and 14) were selected following [21, 36, 39]. T_b is the break date. t-statisticfor t – k equals or above 1.60.*

Table 4.The break date test for log *SHANXI COKING*: Zivot-Andrews Model C

Parameter & variable	Coefficient	Standard error	*t*-Statistic	*P*-value	T_b
θ	0.08	0.05	1.51	0.13	
β	0.00	0.00	-0.53	0.59	
γ	0.00	0.00	0.34	0.74	

α	0.84	0.03	24.59	0.00	Oct. 1999
t-2	0.01	0.07	0.19	0.85	
t-3	0.16	0.06	2.43	0.02	
t-4	0.07	0.06	1.03	0.31	
t-5	0.16	0.06	2.64	0.01	
t-6	0.21	0.06	3.52	0.00	
Intercept	0.38	0.10	3.69	0.00	
R-squared	0.86	Mean dependent var		2.24	
Adjusted R-squared	0.85	S.D. dependent var		0.33	
S.E. of regression	0.13	Akaike info criterion		-1.20	
Sum squared resid	3.36	Schwarz criterion		-1.04	
Log likelihood	136.37	Hannan-Quinn criteria		-1.14	
F-statistic	132.01	Durbin-Watson stat		1.96	
Probe(F-statistic)	0.00				

**Notes are the same as in Table 3.*

Table 5.The break date test for log *XISHAN COAL POWER*: Perron Model C

Parameter & variable	Coefficient	Standard error	*T*Statistic	*P*-value	T_b
θ	0.71	0.18	3.84	0.00	
β	0.00	0.00	1.85	0.07	
γ	-0.01	0.00	-3.91	0.00	
δ	0.00	0.17	0.00	1.00	
α	0.79	0.05	15.43	0.00	September 2007
t-1	0.34	0.08	4.25	0.00	
t-2	0.16	0.08	1.97	0.05	
t-3	0.09	0.08	1.05	0.30	
t-4	0.00	0.08	0.02	0.99	
t-5	0.26	0.08	3.17	0.00	
t-6	-0.11	0.08	-1.36	0.18	

t-7	0.10	0.08	1.25	0.21
t-8	0.12	0.08	1.45	0.15
t-9	-0.01	0.08	-0.10	0.92
t-10	0.00	0.08	0.03	0.98
t-11	0.19	0.08	2.44	0.02
Intercept	0.40	0.12	3.28	0.00
R-squared	0.95	Mean dependent var	2.55	
Adjusted R-squared	0.95	S.D. dependent var	0.66	
S.E. of regression	0.15	Akaike info criterion	-0.81	
Sum squared resid	3.66	Schwarz criterion	-0.50	
Log likelihood	86.99	Hannan-Quinn criteria	-0.69	
F-statistic	187.15	Durbin-Watson stat	1.88	
Prob(F-statistic)	0.00			

**Notes are the same as in Table 3.*

Table 6. The break date test for log *XISHAN COAL POWER*: Zivot-Andrews Model C

Parameter & variable	Coefficient	Standard error	*t*-Statistic	*P*-value	T_b
θ	0.24	0.09	2.66	0.01	
β	0.00	0.00	1.86	0.07	
γ	-0.01	0.00	-4.01	0.00	
α	0.79	0.05	16.03	0.00	August 2007
t-1	0.34	0.08	4.37	0.00	
t-2	0.16	0.08	1.99	0.05	
t-3	0.09	0.08	1.06	0.29	
t-4	0.00	0.08	0.02	0.99	
t-5	0.26	0.08	3.19	0.00	
t-6	-0.11	0.08	-1.38	0.17	
t-7	0.10	0.08	1.27	0.20	

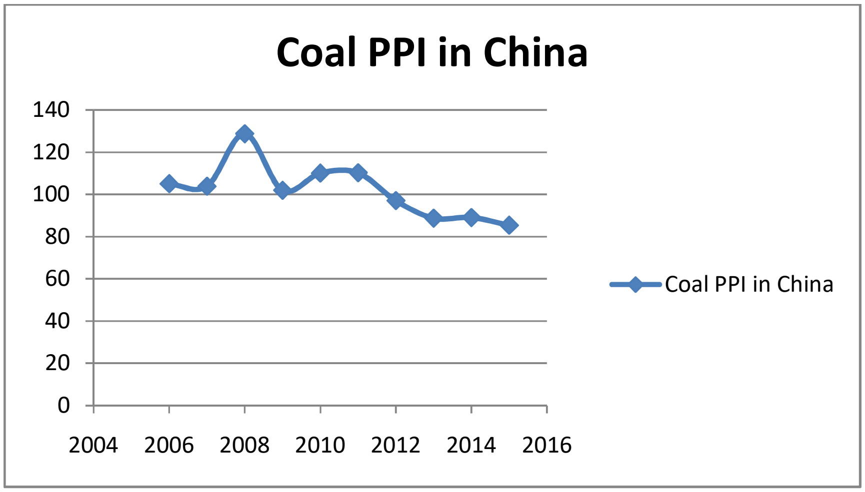
t-8	0.12	0.08	1.45	0.15
t-9	-0.01	0.08	-0.10	0.92
t-10	0.00	0.08	0.03	0.98
t-11	0.19	0.08	2.45	0.02
Intercept	0.40	0.12	3.40	0.00
R-squared	0.95	Mean dependent var		2.55
Adjusted R-squared	0.95	S.D. dependent var		0.66
S.E. of regression	0.15	Akaike info criterion		-0.83
Sum squared resid	3.66	Schwarz criterion		-0.53
Log likelihood	86.99	Hannan-Quinn criteria		-0.71
F-statistic	200.91	Durbin-Watson stat		1.88
Prob(F-statistic)	0.00			

**Notes are the same as in Table 3.*

4.2Discussions

The discussion focuses on (1) why the two series examined have no unit roots. (2) Practical implications: for policy and macroeconomic forecasting, for investors. (3) Shortcomings.

Prices of two coal firm stocks do not contain a unit root and so being mean- or trend-reverting.This is inconsistent with the results of [40] who find that most macroeconomic variables are I(1). Over the past ten years, China's coal consumption has grown dramatically,and coal prices havefluctuated sharply and experienced a shock in 2008 (Figure 3). However, these have not produced a permeant effect on the corresponding coal stock price. The study attributes this to a coal-electricity price linkage (CEPL) mechanism set up in the end 2004[41]. China's electricity prices are mostly decided by the government, particularly National Development and Reform Commission of China (NDRC). CEPLestablishes thatthe government will adjust electricity prices if the change in coal prices over the past six months is 5 percent or above. So, according to CELM,coal prices are an exogenous variable of electricity prices. Despite this, In turn, rigid electricity prices may have curbed the volatility of coal prices[42].Information on coal prices tending to be long-term stability arising from the CEPLmust be transmitted to the A-share market and absorbed by coal stocks, which has reduced the volatility of coal stock prices.



(Data Source: National Development and Reform Commission[43])

Fig. 3. Coal mining and washing industry PPI in China (last year = 100)

The previous study suggests that a sudden change occurred in the Chinese A-Stock market in early 2007. The China Petroleum listing in 2007 might be a shock to the change[44]. So, the study argues that the A-share market crash in 2007 and the China Petroleum listing event may result in a change in the price trend of two coal firmsexamined in this study.

Stationary coal stock prices with no unit roots imply the weak form of the EMH.So, investors can to some extent gain from trading on coal stocks on the A-Share market.

5. CONCLUSION

China is the largest coal consumer in the world. Coal firm stocks may beassets that bring long-run returns for investors.This paper tested for the mean reversion of coal stock prices in the A-share market in China. In order to improve the test robustness, the study conducted aDickey-Fuller *t* test (ADF) and a non-parametricPP test.These tests suggest that two coal stock price series do not contain a unit root.Therefore, coal stock prices are stationary I(0) and trend-reverting, suggesting thatcoal price fluctuations may nothave produced an enduring effect on the coal stock price. The stock price contains no long memory or persistence. The coal-electricity price linkage may account for the stationarity of coal stock prices.

Also, both the Perron and the Zivot-Andrews structural break testsrejected the null of a unit root. These two testssuggest a shiftoccurredbetween 2007 and 2008 in two price series. The study argues that the A-Share market crash and the China Petroleum listing event in 2007 may be a shock to coal stocks.

The weak form of coal stock prices in the A-Share marketimplies that investors could to some extent receive returns from trading on coal stocks.

This study recommends that subsequent studies test for unit roots for stock pricesof more coal firms. Especially panel unit root and structural break tests are advised. Also, Granger causality tests can be applied to a justification of a specific event impact.

REFERENCES

1. Beveridge S, Nelson CR. A new approach to decomposition of economic time series into permanent and transitory components with particular attention to measurement of the 'business cycle'. J. Monet. Econ. 1981, 7(2): 151-174.
2. Campbell JY, Mankiw NG. Permanent and transitory components in macroeconomic fluctuations. Amercian Economic Review. 1987, 77(77): 111-117.
3. Groenewold N. Share market efficiency: Tests using daily data for australia and new zealand. Appl. Finan. Econ. 1997, 7(6): 645-657.
4. National Bureau of Statistics of China. China statistical yearbook. China Statistical Press. 2016; Accessed 15 October. Available: http://data.stats.gov.cn/easyquery.htm?cn=C01.
5. Sohu. Sohu stock. 2017; Accessed 20 March. Available: http://stock.sohu.com.
6. Perron P. Trends and random walks in macroeconomic time series : Further evidence from a new approach. Journal of Economic Dynamics & Control. 1986, 12(2): 297-332.
7. Granger CWJ, Joyeux R. An introduction to long-memory time series models and fractional differencing. J. Time Ser. Anal. 1980, 1(1): 15-29.
8. Diebold FX, Rudebusch GD. Long memory and persistence in aggregate output. J. Monet. Econ. 1989, 24(2): 189-209.
9. Granger CWJ, Newbold P. Spurious regressions in econometrics. Journal of Economics. 1974, 2(2): 111-120.
10. Engle RF, Granger CWJ. Cointegration and error correction: Representation, estimation and testing. Econometrica. 1987, 55(2): 251-276.
11. Fama EF. Efficient capital markets: A review of theory and empirical work. J. Financ. 1970, 25(2): 383-417.
12. Laffer AB, Ranson RD. Some practical applications of the efficient-market concept. Financial Management (1972). 1978, 7(2): 63-75.
13. Fama EF. Efficient capital markets: Ii. J. Financ. 1991, 46(5): 1575-1617.
14. Hasanov M. Is south korea's stock market efficient? Evidence from a nonlinear unit root test. Appl. Econ. Letters. 2009, 16(2): 163-167.
15. Caporale GM, Gil-Alana LA. Fractional integration and mean reversion in stock prices. Quart. Rev. Econ. Finance. 2002, 42(3): 599-609.
16. Dickey DA, Fuller WA. Distribution of the estimators for autoregressive time series with a unit root. J. Amer. Stat. Assoc. 1979, 74(386): 427-431.
17. Dickey DA, Hasza DP, Fuller WA. Testing for unit roots in seasonal time series. J. Amer. Stat. Assoc. 1984, 79(386): 355-365.
18. Phillips PCB, Perron P. Testing for a unit root in time series regression. Biometrika. 1988, 75(2): 335-346.
19. Kwiatkowski D, Phillips PC, Schmidt P, Shin Y. Testing the null hypothesis of stationarity against the alternative of a unit root: How sure are we that economic time series have a unit root? J. Econometrics. 1992, 54(1): 159-178.
20. Perron P. The great crash, the oil price shock, and the unit root hypothesis. Econometrica. 1989, 57(6): 1361-1401.
21. Perron P. Further evidence on breaking trend functions in macroeconomic variables. J. Econometrics. 1997, 80(2): 355-385.
22. Zivot E, Andrews DWK. Further evidence on the great crash, the oil-price shock, and the unit-root hypothesis. J. Bus. Econ. Statist. 1992, 10(3): 251-270.
23. Evans T. Efficiency tests of the uk financial futures markets and the impact of electronic trading systems. Appl. Finan. Econ. 2006, 16(17): 1273-1283.
24. Narayan PK, Smyth R. Is south korea's stock market efficient? Appl. Econ. Letters. 2004, 11(11): 707-710.
25. Gozbasi O, Kucukkaplan I, Nazlioglu S. Re-examining the turkish stock market efficiency: Evidence from nonlinear unit root tests. Econ. Modelling. 2014, 38(1): 381-384.
26. Lee J, List JA, Strazicich MC. Nonrenewable resource prices: Deterministic or stochastic trends? Journal of Environmental Economics & Management. 2005, 51(3): 354-370.

27. Gallo A, Mason P, Shapiro S, Fabritius M. What is behind the increase in oil prices? Analyzing oil consumption and supply relationship with oil price. Energy. 2010, 35(10): 4126-4141.
28. Fattouh B. The dynamics of crude oil price differentials. Energy Econ. 2010, 32(2): 334-342.
29. Serletis A. Unit root behavior in energy futures prices. Energy J. 1992, 13(2): 7-14.
30. Elder J, Serletis A. Long memory in energy futures prices ☆. Rev. Finan. Econ. 2006, 17(2): 146-155.
31. Elliott G, Rothenberg TJ, Stock JH. Efficient tests for an autoregressive unit root. Econometrica. 1996, 64(813-836.
32. Perron P. Testing for a unit root in a time series with a changing mean. J. Bus. Econ. Statist. 1990, 8(2): 153-162.
33. Sen A. On unit-root tests when the alternative is a trend-break stationary process. J. Bus. Econ. Statist. 2003, 21(174-184.
34. Hamilton HD. Time series analysis. first. Princeton University Press: Princeton, New Jersey; 1994.
35. Hendry DF, Juselius K. Explaining cointegration analysis: Part i. Energy J. 2000, 21(1): 1-42.
36. Ng S, Perron P. Unit root tests in arma models with data dependent methods for the selection of the truncation lag. J. Amer. Stat. Assoc. 1995, 90(429): 268-281.
37. Newey WK, West KD. A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. Econometrica. 1987, 55(3): 703-708.
38. Banerjee A, Lumsdaine RL, Stock JH. Recursive and sequential tests of the unit root and trend break hypothesis: Theory and international evidence. J. Bus. Econ. Statist. 1992, 10(3): 271-287.
39. Ng S, Perron P. Lag length selection and the construction of unit root tests with good size and power. Econometrica. 2001, 69(6): 1519-1554.
40. Nelson CR, Plosser CR. Trends and random walks in macroeconmic time series : Some evidence and implications. J. Monet. Econ. 1982, 10(2): 139-162.
41. Jiao JL, Ge HZ, Wei YM. Impact analysis of china's coal-electricity price linkage mechanism: Results from a game model. J. Pol. Modeling. 2010, 32(4): 574-588.
42. Liu MH, Margaritis D, Zhang Y. Market-driven coal prices and state-administered electricity prices in china. Energy Econ. 2013, 40(2): 165-175.
43. National Development and Reform Commission. Price index: Ppi by industrial sector. 2017; Accessed Available: http://data.stats.gov.cn/easyquery.htm?cn=C01.
44. Zou G, Yan X, Chau KW. 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. 2016, 62(1743-1748.