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ANALYSIS OF CPI TO PPI ON CHINESE DATA

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ABSTRACT

This paper collects the monthly data of the price index of 36 cities in China from January 2015 to July 2013. Based on VAR model, empirical analysis is made on the collected data .The results show that there really have some relationships between CPI and PPI on Chinese data. First, there exists mutually Granger causality between CPI and PPI. Second, there is a long-term equilibrium relationship between CPI and PPI. Third, CPI and PPI will immediately produce a response on the impact of random disturbances in the system, and the differences between them are the length of the reaction, such as, the disturbance response on PPI to CPI is obvious, and that on CPI to PPI is NOTobvious. The influence degree on PPI to CPI is about 49%, and the influence degree on CPI to PPI is about 2.9%.

INTRODUCTION

CPI is the starting point of an industrial chain, and represents the relative number of the changes in downstream consumer goods price. PPI is the end point of an industrial chain, and represents the relative number of the changes in upstream factory price. The content of CPI is closely related to the life of consumers, which not only affects the government to develop a variety of economic policies, but also directly affects the living standards of the residents. The value of PPI is that it measures the change of ex-factory price of industrial products, and it helps to study the influence of ex-factory price of industrial products on the national economy and the people's life. CPI and PPI are two important indicators to measure inflation and deflation. In general, PPI is the first indicator of CPI. PPI reflects the initial price of industrial products into the field of circulation, while the CPI reflects the final price of consumer goods in circulation to the hands of consumers. The conduction relationship between PPI and CPI is that the change of PPI which will cause the change of CPI in the same direction. But there is also another possibility in that the conduction relationship between them will appear a reverse change, the reason is that rising consumer demand will lead to the rising prices of consumer goods, thus promote the upstream raw material prices, eventually resulting in higher PPI. Studies have shown that there is a positive conduction between CPI index and PPI index (Chen Jianqi, 2008), some scholars also said that there is no significant conduction relationship between them (He Liping *et al*., 2008), there is no uniform conclusion. As the market economy develops in the direction of globalization, and the transition from a government to a service-oriented government, a clear understanding of the relationship between the CPI and the PPI can help the government understand the macroeconomic trends and help cope with the complex and volatile global economic environment. On the other hand, it can also help control inflation from the source and stabilize prices. It is significant for the formulation of economic policies and keep the steady development of economy and society. This paper uses the CPI and PPI monthly data from January 2013 to July 2015 in China to establish a vector auto-regressive model and use the quantitative analysis method to analyze the relationship between them. In order to get the relationship between them. The main efforts to get the relationship between them from the perspective of empirical and analysis of the relationship.

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Previous Studies on CPI to PPI in China

On the basis of price transmission mechanism, some scholars use the correlation coefficient matrix or linear regression method to study the relationship between CPI and PPI, which are more concentrated in the early relationship analysis. CPI and PPI are generally considered non-stationary series, unable to establish a model directly. At the same time, some scholars consider the relationship between CPI and PPI on the basis of long-term and short-term relationship, using co-integration analysis method and establishing of error correction model to study the relationship between them. Mahdavi and Zhou's study show that there is a long-term equilibrium relationship between CPI and PPI. They used a co-integration test method, the results of the test for the existence of co-integration relationship (Mahdavi and Zhou, 1997). On the basis of considering the causal relationship between CPI and PPI, some scholars use the Granger causality test to study whether there is causality between CPI and PPI. Huang Zhilin selected the monthly data of CPI and PPI from January 2005 to December 2013 in Shenzhen to study the relationship between CPI and PPI using the non-linear Granger causality test. Silver and Wallace selected the monthly data of CPI and PPI in America, and used Granger causality test method for empirical analysis, the results of the study was the same as Chen Yu's (Lew and Wallace, 1980). T. E. Clark selected CPI and PPI data in America to establish a vector auto-regressive model, and found that the price transmission mechanism from the PPI to CPI is not significant, there is no positive conduction relationship from PPI to CPI (Todd E.Clark, 1995). Chen Jian, Mei Mei analyzed the relationship between CPI and PPI, the results showed that CPI and PPI is Granger reasons, and can predict the future trend for each other (Chen Jian and Mei Mei, 2009). Xiao Songhua and Wu Xu's research showed that PPI can cause CPI, which indicated that the trend of CPI can be predicted by PPI (Xiao Songhua and Wu Xu, 2009). Song Jinqi and Shu Xiaohui established VAR model, analyzed the relationship between CPI and PPI, and the results showed that the positive conduction relationship between PPI and CPI is not significant during the short term but significant during the long term (Wang Guirong, 2009).

VAR vector auto-regressive model and linear relation analysis

Normal Expression of VAR Model

The normal expression of the VAR model is:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots A_p Y_{t-p} + \ldots + B_0 X_t + \ldots + B_r X_{t-r} + \varepsilon_t \quad t=1,2,\ldots n \quad (1)$$

In the model (1), Y_t is an endogenous variable, Y_{t-p} (t = 1,2 ..., p) is a lagged endogenous variable, X_{t-r} (t = 0,1, ..., r) is an exogenous variable vector, p and r are respectively the lag order of Y_t and X_{t-r}. A_t and B_i are coefficient matrices, which correspond to the parameter matrix to be estimated.

Model Basic of CPI to PPI

The vector of the auto-regressive model is established, and the model expression is as below:

CPI = C(1,1) * CPI(-1) + C(1,2) * CPI(-2) + C(1,3) * CPI(-3) + C(1,4) * PPI(-1) + C(1,5) * PPI(-2) + C(1,6) * PPI(-3) + C(1,7)

PPI = C(2,1) * CPI(-1) + C(2,2) * CPI(-2) + C(2,3) * CPI(-3) + C(2,4) * PPI(-1) + C(2,5) * PPI(-2) + C(2,6) * PPI(-3) + C(2,7)

Unit root test

In this paper, we use ADF (Augmented Dick-Fuller) test method to test the stability of time series. Eviews6.0 is used to carry out unit root test for CPI and PPI.

Table 1. The result of ADF unit root test

Test variables	ADF test values	The critical value of each significant level			Conclusion
		1%	5%	10%	
CPI	-0.08	-2.71	-1.96	-1.61	(Accept)No-stable
ΔCPI	-4.45	-2.71	-1.96	-1.61	(Refuse) Stable
PPI	-1.04	-2.71	-1.96	-1.61	(Accept)No-stable
ΔPPI	-4.07	-2.71	-1.96	-1.61	(Refuse) Stable

It can be seen from Table 1 that the ADF test value of the original sequence of CPI is -0.08, more than the critical value of -2.71 at the significant level of 1%, more than the critical value of -1.96 at the significant level of 5%, greater than critical value of -1.61 at the significant level of 10%, accepting a hypothesis that the CPI has at least one unit root, indicating that the original sequence is non-stationary series. The ADF test value of CPI (ΔCPI) after first-order differential is -4.45, less than the critical value of -2.71 at the significant level of 1%, less than the critical value of -1.96 at the significant level of 5%, less than the critical value of -1.61 at the significant level of 10%, rejecting a hypothesis that the CPI has at least one unit root, indicating that the sequence is stationary. The ADF test value of the original sequence of PPI is -1.04, more than the critical value of -2.71 at the significant level of 1%, more than the critical value of -1.96 at the significant level of 5%, greater than the critical value of -1.61 at the significant level of 10%, accepting a hypothesis that the PPI has at least one unit root, indicating that the original sequence is non-stationary series. The ADF test value of PPI (ΔPPI) after first-order differential is -4.07, less than the critical value of -2.71 at the significant level of 1%, less than the critical value of -1.96 at the significant level of 5%, less than the critical value of -1.61at the significant level of 10%, rejecting a hypothesis that the PPI has at least one unit root, indicating that the sequence is stationary. The original sequence of CPI and PPI are non-stationary time series, but both are first-order monotonic stationary time series. Both of them follow the same order, which shows that the VAR model is stable.

Determination of the order lag of the model

In the selection of the lagging degree of the model, it is generally determined by the rule that the minimum value of the five criteria, including the modified LR test statistic, final prediction error, Akaike information, Schwartz information, and Hanna-Quine information. As can be seen from the above table, the value of modified LR test statistic is 24.96378, the value of final prediction error is 23.47156, the value of Akaike information criterion is 8.822565, the value of Schwartz information criterion is 9.112285, and the value of Hanna-Quinn information criterion is 8.837401, where the corresponding lag length is 3, so the lag order of the VAR model is 3.

Table 2. Determination of the order lag of the model

Hysteresis Length	Likelihood Number	Modified LR test statistic	Final prediction error	Akaike information	Schwartz information	Hanna-Quine information
0	-79.94285	NA	96.29610	10.24286	10.33943	10.24780
1	-60.37064	2.380780	42.39860	9.296330	9.972345	9.330948
2	-62.48689	2.878737	30.82609	9.060861	9.543729	9.085588
3	-64.58052	24.96378*	23.47156*	8.822565*	9.112285*	8.837401*

Table 3. Results of model parameter estimation

	CPI	PPI
CPI(-1)	-0.135432	0.012704
	(0.33780)	(0.33331)
	(-0.40092)	(0.03812)
CPI(-2)	0.101564	0.208396
	(0.33102)	(0.32662)
	(0.30682)	(0.63804)
CPI(-3)	-0.210570	0.095459
	(0.26507)	(0.26155)
	(-0.79439)	(0.36498)
PPI(-1)	-0.949951	0.640520
	(0.43718)	(0.43136)
	(-2.17293)	(1.48489)
PPI(-2)	0.213012	0.294578
	(0.68797)	(0.67882)
	(0.30962)	(0.43396)
PPI(-3)	0.658377	0.306504
	(0.56994)	(0.56236)
	(1.15517)	(0.54503)
C	133.0990	-56.82154
	(76.0533)	(75.0417)
	(1.75008)	(-0.75720)
goodness of fit	0.474975	0.794324
Adjusted goodness of fit	0.124959	0.657207
F statistic	1.357008	5.793022

Table 4. The results of co-integration test

Null hypothesis	Eigea statistics	Trace statistics	5% critical value	P	Conclusion
No	0.458722	18.79102	15.49471	0.2018	Refuse
Up to one	0.080331	1.339858	3.841466	0.2471	Do not refuse

Table 5. The results of Granger causality test

Null hypothesis	Lag order	F Statistical Inspection Quantity	p	Conclusion
PPI is not the Granger causal relationship of CPI	3	5.653009	0.0592	refuse
CPI is not the Granger causal relationship of PPI	3	0.143712	0.0307	refuse

Parameter estimation

According to the above test, the lag order of the model is 3, using E-Views6.0 to estimate the parameters of VAR model. It can be seen from the above table that the goodness-of-fit of the CPI equation in the model is 0.474975, the value of adjusted goodness of fit is 0.124959, the goodness of fit of the PPI equation is 0.794324, the value of adjusted goodness of fit is 0.657207, these values are greater than 0.1 (10% confidence level), indicating that the explanatory power of the equation is relatively good.

Co-integration Test

The result of unit root test shows that the original sequences of CPI and PPI are non-stationary series, but the sequence after first-order difference is stable, which is in accordance with the condition of co-integration test. Using Johansen co-integration test method to carry out the test, the results are as follows. The results of the co-integration test show that when the original hypothesis is "no co-integration relation", the value of the trace statistic is 18.79102, which is greater than the critical value of 15.49471 at the significance level of 5%. The null hypothesis is rejected; Co-integration test shows that the model has a co-integration relationship, CPI and PPI are non-stationary time. The co-integration test shows that there is a co-integration relationship between CPI and PPI, and indicating that there is a long-term equilibrium relationship between them.

CPI and PPI relationship analysis

Granger causality test

The Granger causality test solves the problem of whether one of the several time series variables can cause another. Before the Granger causality test, whether the time series is stationary sequence or not, the previous research shows that the CPI and PPI are not stationary series, and the difference is the first order single whole stationary series. Co-integration tests are usually performed prior to the Granger causality test. It is generally accepted that causal relationships exist only between variables with long-run equilibrium relationships. It should be

noted that causality does not mean that a variable is the cause of another variable, but refers to the past information of a variable to help predict another variable. The co-integration test shows that there exists a co-integration relationship between CPI and PPI, which indicates that there is a long-term equilibrium relationship between CPI and PPI, which is in line with the Granger causality test. We use Eviews6.0 to analyze the Granger causality between two economic time series variables: CPI and PPI.

The test results show that when the null hypothesis is "PPI is not the Granger causality of CPI", the probability P is 0.0592 at the F statistic test is 5.653009, less than 10%, rejecting the null hypothesis and the hypothesis "PPI is the Granger causality of CPI" was established;When the null hypothesis is "CPI is not the Granger causality of PPI", the probability P is 0.0307 at the F statistic test is 0.143712 , less than 10%, rejecting the null hypothesis and the hypothesis "CPI is the Granger causality of PPI" was established; Through the Granger causality test, it is concluded that they are Granger causality, PPI is the cause of Granger causality of CPI, and CPI is also the cause of Granger causality of PPI. The results show that the past information of CPI can help to predict PPI, and the past information of PPI can also help to forecast CPI.

Impulse response function analysis

The impulse response function of the collected data was analyzed by Eviews6.0. The impulse response function obtained by imposing a standard deviation noise on the CPI is shown in Fig.1, and the impulse response function obtained by imposing a standard deviation noise on the PPI is shown in Fig.2.

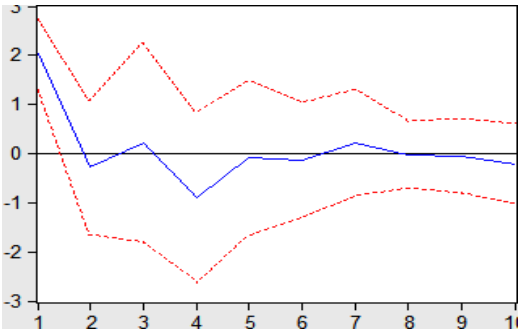

Fig.1. Impulse result of a standard deviation noise (CPI to PPI)

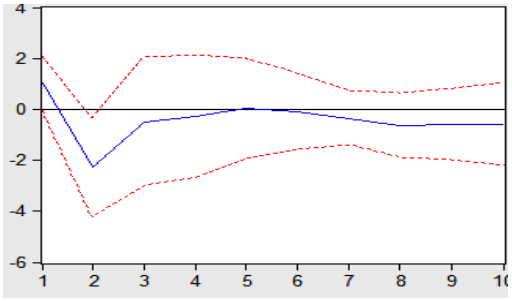

Fig.2. Impulse result of a standard deviation noise (PPI to CPI)

The impact of the CPI on the impulses from the PPI is evident, and the impact of the shocks is essentially eliminated in the 8th period. The impact of the PPI on the impulse from the CPI immediately responds, and the impact of the shock is essentially eliminated in the fifth period. It can be seen that the response time of the CPI to the impact from the PPI is longer than the response time of the PPI to the impact from the CPI. It is shown that in the system, whether the impact of the random disturbance of the CPI or PPI, the CPI and the PPI will respond to the impact from the other side, the difference is that the reaction time is different.

Analysis of Variance Decomposition

Analyzing the variance of the collected data by Eviews 6.0.

Table 6. CPI's variance decomposition

Period	S.E.	CPI	PPI
1	0.544712	100.0000	0.000000
2	0.800922	98.65999	1.340013
3	0.9883006	98.49611	1.503892
4	1.082345	90.40508	9.594921
5	1.182835	82.54158	17.45842
6	1.395265	76.59387	23.46486
7	1.570350	71.53514	28.40613
8	1.742376	66.98908	33.01092
9	3.092520	59.17281	40.82719
10	3.147717	58.10581	41.89419
11	3.210645	56.95997	43.04003
12	3.285805	55.67589	44.32411
13	3.373174	54.29020	45.70980
14	3.475597	52.79647	47.20353
15	3.594533	51.21982	48.78018
16	3.732496	51.40080	49.69937
17	3.891662	50.08316	49.59920
18	4.074653	50.30063	49.91684
19	4.284087	50.09476	49.90524
20	4.522834	50.09628	49.90372

From the results of the variance decomposition in Tab.6, it can be seen that the influence coefficient of CPI is mainly from its own during the period of 1-3. From the fourth period, PPI has an impact on CPI, and the degree of disturbance is increasing. The influence of PPI on the perturbation of CPI was stable at about 49% at the period of 16. It is shown that the influence of PPI on the perturbation of CPI and the influence of CPI on its perturbation are basically the same.

Table 7. PPI's variance decomposition

Period	S.E.	CPI	PPI
1	2.266288	0.000000	100.0000
2	3.213613	0.009342	99.99066
4	3.388832	2.638998	97.36100
5	3.390202	3.093252	96.90675
6	3.395045	3.005736	96.99426
7	3.421599	2.844126	97.15587
8	3.482556	2.764062	97.23594
9	3.533279	2.805054	97.19495
10	3.590736	2.867202	97.13280
11	3.637023	2.913506	97.08649
12	3.696821	2.919283	97.08072
13	3.772999	2.912397	97.08760
14	3.874894	2.906511	97.09349
15	3.995780	2.909804	97.09020
16	4.137956	2.916569	97.08343
17	4.300848	2.922672	97.07733
18	4.492764	2.925413	97.07459
19	4.718639	2.926271	97.07373
20	4.984832	2.926613	97.07339

As can be seen from Tab.7, within 20 periods, the influence coefficient of PPI decomposition mainly comes from its own. The influence of CPI on PPI was stable at about 2.9% during the period of 11, which indicated that the influence of PPI on PPI was greater than the influence of CPI on PPI. CPI has a faster perturbation reaction on PPI, from the fourth period

began to have a significant reaction, and the effect is obvious. PPI has a slower response to CPI, and the effect of CPI on PPI is not obvious.

Conclusion

Unit root test shows that the original sequence of CPI and PPI is non-stationary series, it became the stationary sequence after a first-order difference. Co-integration test results show that there is a co-integration relationship between the model, the long-term equilibrium relationship exists between CPI and PPI. The causality analysis of Granger shows that there is a Granger causality relationship between CPI and PPI. The past information of CPI can predict the PPI, at the same time the past information of PPI can predict the CPI. The results of the pulse corresponding functions and the decomposition of variance showed that the reaction of CPI to PPI is quicker, and the reaction is obvious from the fourth period. The effect of PPI on CPI is slower, and the effect of CPI on PPI is not obvious.

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