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Empirical Analysis of the Relationship between CPI and PPI Based on VAR Model

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Abstract: CPI and PPI are important economic indicators of China, and they are also an important basis for the government to formulate monetary policies and economic plans. Based on the VAR model, this paper selects the data from 1990 to 2016 using eviews software to empirically analyze the data. Through the Granger causality test, the relationship between CPI and PPI is found. PPI is the one-direction Granger reason for CPI. And CPI is not the Granger reason for PPI. Through the analysis of the impulse response function, it is found that CPI plays a role in promoting its own growth, and PPI has a positive effect on the growth of CPI.

Keywords: CPI, PPI , VAR model

I. Introduction

CPI is the abbreviation of Consumer Price Index, which refers to the consumer price index in China's price index system. It is a barometer of inflation. It is a measure of the relative price of a group of representative consumer goods and services. The number reflects the changes in the price level of consumer goods and services purchased by households. It is an important indicator for macroeconomic analysis and decision-making, monitoring and regulation of total price levels, and national economic accounting. PPI is the abbreviation of Producer Price Index, which refers to the "producer price index" according to international practice, including the industrial product ex-factory price index and the industrial product intermediate input price index. In China, PPI actually refers to the ex-factory price index of industrial products in China's price index system. The PPI in this paper refers to the ex-factory price index of industrial products. The ex-factory price index of industrial products is an indicator reflecting the trend and the range of changes in the total ex-factory price of all industrial products. Both CPI and PPI have their own calculation methods and uses, but there is a close relationship between those. A clear analysis of the relationship between the two can make a basic judgment on China's macroeconomic performance and play an important role in the formulation of macroeconomic policies. Quantitative analysis of CPI and PPI data also contributes to our understanding of current economic development.

Todd E Clark [2] (1995) Accepted industrial goods price Japanese consumer goods price PPI sum CPI arrival amount. firstly Recumbent the basic salary theory, and Solve exaggerated productivity system. Conventional theory says there is an effective path, So that the upstream industrial prices can drive the downstream consumer prices and can predict the downstream consumer prices. LiuMin, zhang yanli and Yang yanbin [3] (2005) found that there was a linear correlation between PPI an d CPI based on the correlation coefficient between CPI and the producer price index of production materials and the producer price index of living materials respectively, and that the change of PPI would definitely influence t he change of CPI.He liping (2008) used the method of granger causality test to study the relationship between CPI and PPI, and concluded that CPI was the granger cause of PPI in a single direction. Jianmingping [(2009) established a regression model between CPI and PP based on the time-delay in the conduction process of PPI to CPI, and conducted in-depth analysis on the transmission mechanism of both. The results showed that PPI had no significant impact on CPI, which indicated that the transmission of price changes of upstream industrial products to CPI was basically in effective. Deng yueming, li xingxu et al. (2011) found that CPI promoted their own growth.The relationship between CPI and PPI has been a topic discussed by many scholars. Different people have different views. So this paper uses the VAR model to study the relationship between CPI and PPI in China.

II. Empirical Analysis

This paper selects the monthly data of China's CPI and PPI from 1990 to 2016, and establishes a VAR model to analyze the relationship between CPI and PPI in China. The first sequence of the VAR model is tested for stationarity. If the original sequence is not stable and is not stable after the difference, then the establishment of the VAR model will be meaningless.

2.1 Stationary test of time series

When performing sequence analysis, should determine that the object must be a stationary sequence, so first perform a unit root test on the data. It was found by Eviews software that the first-order differential data of CPI and PPI was found to be a stationary sequence when performing unit root test, as shown in Figure 1 and Figure 2.

Null Hypothesis: D(CPI) has a unit root
Exogenous: None
Lag Length: 2 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.208350	0.0026
Test critical values:	1% level	-2.669359	
	5% level	-1.956406	
	10% level	-1.608495	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(CPI,2)
Method: Least Squares
Date: 07/15/18 Time: 21:44
Sample (adjusted): 1994 2016
Included observations: 23 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CPI(-1))	-0.944077	0.294256	-3.208350	0.0044
D(CPI(-1),2)	0.330035	0.222230	1.485107	0.1531
D(CPI(-2),2)	-0.041090	0.203497	-0.201919	0.8420

R-squared	0.500499	Mean dependent var	-0.334783
Adjusted R-squared	0.450549	S.D. dependent var	5.095953
S.E. of regression	3.777373	Akaike info criterion	5.617042
Sum squared resid	285.3709	Schwarz criterion	5.765150
Log likelihood	-61.59598	Hannan-Quinn criter.	5.654291
Durbin-Watson stat	2.152145		

Figure 1 Stability test results of CPI

Null Hypothesis: D(PPI) has a unit root
Exogenous: None
Lag Length: 0 (Automatic - based on SIC, maxlag=6)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.612983	0.0000
Test critical values:	1% level	-2.660720	
	5% level	-1.955020	
	10% level	-1.609070	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(PPI,2)
Method: Least Squares
Date: 07/15/18 Time: 21:45
Sample (adjusted): 1992 2016
Included observations: 25 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(PPI(-1))	-1.140460	0.203183	-5.612983	0.0000

R-squared	0.567588	Mean dependent var	0.068000
Adjusted R-squared	0.567588	S.D. dependent var	9.538637
S.E. of regression	6.272420	Akaike info criterion	6.549379
Sum squared resid	944.2380	Schwarz criterion	6.598135
Log likelihood	-80.86724	Hannan-Quinn criter.	6.562902
Durbin-Watson stat	2.014082		

Figure 2 Stability test results of PPI

2.2 Test of the model

Using software Eviews to determine the lag order based on the values of LR test statistic, final prediction error (FPE), AIC information criterion, SC information criterion and HQ information criterion, according to Fig. 3, it is found that P-1 has 5 % statistic significant, so Determine the lag order of the VAR model to be 1st order.

VAR Lag Order Selection Criteria
Endogenous variables: PPI CPI
Exogenous variables: C
Date: 07/15/18 Time: 21:53
Sample: 1990 2016
Included observations: 25

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-146.4295	NA	492.1054	11.87436	11.97187	11.90141
1	-128.4491	31.64555*	161.1761*	10.75593*	11.04846*	10.83706*
2	-124.9728	5.562078	169.5249	10.79782	11.28537	10.93305

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Figure 3 Lag order of the VAR model

2.3 Parameter Estimation

Estimate the model using Eviews and get the following results:

	PPI	CPI
PPI(-1)	0.818042	0.578089
	(0.32863)	(0.19880)
	[2.48925]	[2.90796]
CPI(-1)	-0.265803	0.147235
	(0.39450)	(0.23864)
	[-0.67378]	[0.61698]
C	46.37491	29.09562
	(20.5794)	(12.4489)
	[2.25346]	[2.33720]
R-squared	0.396650	0.677461
Adj. R-squared	0.344184	0.649415
Sum sq. resids	774.6083	283.4519
S.E. equation	5.803329	3.510555
F-statistic	7.560236	24.15464
Log likelihood	-81.01779	-67.94870
Akaike AIC	6.462907	5.457592
Schwarz SC	6.608072	5.602757
Mean dependent	103.3500	104.3308
S.D. dependent	7.166157	5.928964

Figure 4 VAR model building results

From the results of the VAR model output, we can see that the PPI lags the impact of the first phase on its own parameter estimate is 0.82, and the significance level is higher. The impact of the CPI lag phase I on the PPI is -0.26, and the value of the t statistic is 0.39. The impact of the PPI lag phase I on CPI is quite significant. The parameter estimate is 0.578 and its t statistic is about 0.2. This shows that for every 1 percentage point increase in PPI, it will increase the CPI of the next year by 0.578 percentage points. The parameter estimate of the impact of CPI lag on itself is 0.15, and the value of t statistic is 0.24, indicating that CPI plays a role in promoting its own growth. The regression results also include the standard OLS regression statistic for each equation. It can be seen that the values for each equation are large, indicating that the equation fits the dependent variable better. The F test value is also relatively large, indicating that the degree of interpretation of the equation is also significant. The values of AIC and SC are relatively small, indicating that the determination of the lag order is basically reasonable.

2.4 System stability test

The results obtained using Eviews are shown in Figure 5. All points fall within the unit circle, indicating that the system is stable.

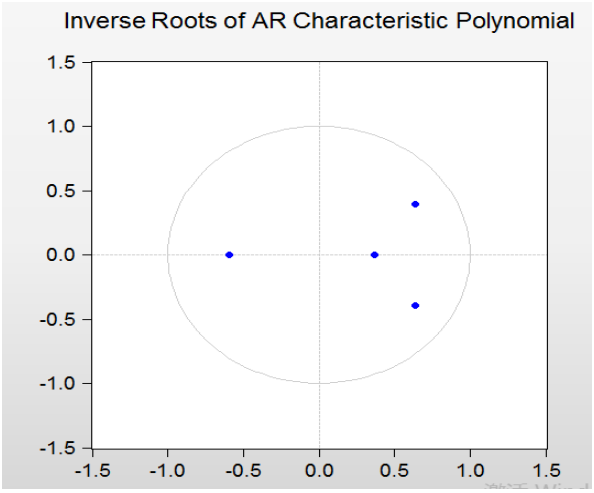

Figure 5 Test of the model about stability

2.5 Granger causality test

The Granger causality test was performed using Eviews, and the results are shown in Figure 6.

VAR Granger Causality/Block Exogeneity Wald Tests
Date: 07/15/18 Time: 21:57
Sample: 1990 2016
Included observations: 26

Dependent variable: PPI

Excluded	Chi-sq	df	Prob.
CPI	0.453975	1	0.5005
All	0.453975	1	0.5005

Dependent variable: CPI

Excluded	Chi-sq	df	Prob.
PPI	8.456223	1	0.0036
All	8.456223	1	0.0036

Figure 6 Results of Grainger causality test

In the first table of Figure 6, the chi-square statistic of the LR test is relatively small, and the corresponding P-value is greater than the significance level of 10%; in the second table, the chi-square statistic of the LR test is relatively large. The corresponding P value is less than 10% significance level. It can be preliminarily concluded that PPI is the Granger causality causing CPI changes, but CPI is not a Granger causal relationship that causes PPI changes.

2.6 Impulse response analysis

In the VAR model, an endogenous variable is affected not only by the impact but also by the dynamic structure of the model to other endogenous variables. The impulse response function can analyze this dynamic feature of the VAR model, each endogenous variable will change its impact on the impact, and the response of other endogenous variables to the shock. Next, the model is analyzed by the pulse influence function, and the impact of the standard deviation innovation is applied to the random disturbance items of CPI and PPI respectively, and then how the two influences are analyzed. As can be seen from the figure, the impact of CPI on a standard deviation of PPI immediately responded strongly, reaching a peak in the second period, and then the effect slowly decreased and stabilized. This shows that the change in PPI will positively drive the change of CPI, that is, the change of upstream product price will be transmitted to the downstream product.

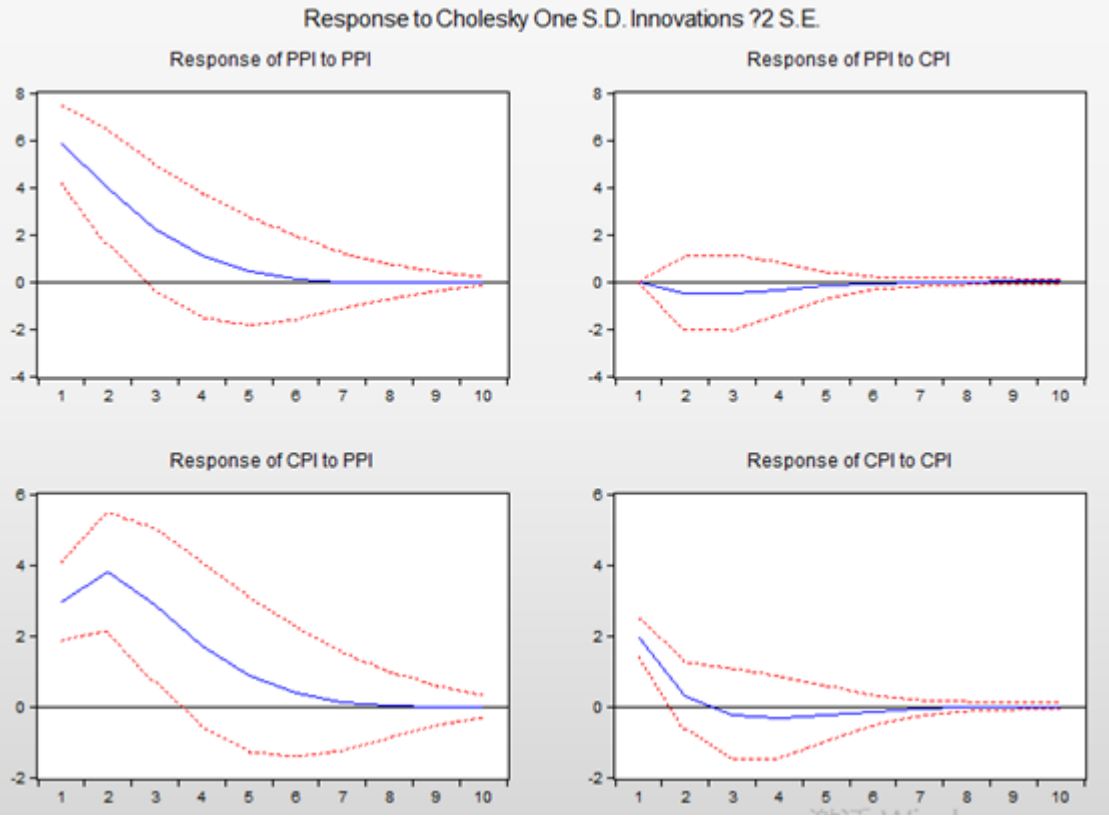

Figure 7 Impulse response diagram

2.7 Variance decomposition

Variance decomposition is to further evaluate the importance of different structural impacts by analyzing the contribution of each structural impact to changes in endogenous variables. The Eviews software uses the variance decomposition method to analyze the contribution of structural shocks to changes in CPI and PPI. It can be seen from the results of the PPI variance decomposition of Fig. 8 that the change of PPI is basically caused by the impact of its own disturbance term, and the impact of the CPI equation is only 1%, so the majority of the change of PPI was caused by itself; from the results of CPI variance decomposition, it can be seen that the contribution rate of the PPI equation innovation to the CPI change reaches 90% in the 10th period, and has been increasing from the 1st to the 10th, and the CPI equation is new. The impact of the impact of interest on its own changes is only 10%, which indicates that the change in CPI is mainly caused by PPI, and CPI itself has a certain role.

Variance Decomposition of PPI:

Period	S.E.	PPI	CPI
1	5.803329	100.0000	0.000000
2	7.048535	99.47173	0.528266
3	7.412119	99.07718	0.922824
4	7.497066	98.89601	1.103992
5	7.511372	98.83645	1.163555
6	7.512781	98.82229	1.177705
7	7.512868	98.82008	1.179923
8	7.512965	98.81995	1.180052
9	7.513043	98.81997	1.180029
10	7.513078	98.81996	1.180035

Variance Decomposition of CPI:

Period	S.E.	PPI	CPI
1	3.510555	69.85745	30.14255
2	5.171533	85.80919	14.19081
3	5.910859	88.95193	11.04807
4	6.162873	89.56178	10.43822
5	6.229131	89.63126	10.36874
6	6.241978	89.61968	10.38032
7	6.243581	89.61102	10.38898
8	6.243677	89.60880	10.39120
9	6.243715	89.60867	10.39133
10	6.243756	89.60880	10.39120

Cholesky Ordering: PPI CPI

Figure 8 Varlance decomposition results

III. Conclusion

This paper selects China's 1990 CPI and PPI annual data, establishes VAR model, and finds that PPI is the one-way Granger cause of CPI through Granger causality test. Analysis by the impulse response containing function, the PPI changes have a positive impact on CPI. Through variance decomposition, 90% of CPI changes are caused by PPI, 10% is caused by itself; PPI changes are mainly caused by themselves. CPI and PPI are two important indicators of China's macro economy. They play an important role in the formulation of macroeconomic policies. In the real economic complex system, there are many uncertainties that may occur at any time, affecting the changes of the two price indices. Therefore, an analysis of the relationship between the two is more conducive to the formulation of China's macroeconomic policies and the realization of the goal of stabilizing prices.

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