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The Relationship between Consumer Price Index and Producer Price Index in China

binbin shen
sbinbin1217@siu.edu

THE RELATIONSHIP BETWEEN CONSUMER PRICE INDEX AND PRODUCER PRICE INDEX IN CHINA

by

Binbin Shen

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The consumer price index (CPI) and the producer price index (PPI) are important indicators of price monitoring and analysis. The accurate relationship between PPI and CPI is essential for monitoring and managing inflation. In theory, consumer price index and the producer price index should exist in a sequence and conduction relationship. But the data shows that in the short term, PPI and CPI may not have the positive relationship. This paper will use the data of consumer price index and the producer price index between 2011 and 2017 in China. The result shows that there does not have any relationship between the growth rate of CPI and the growth rate of PPI.

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CHAPTER 1

INTRODUCTION

Consumer price index (CPI) and producer price index (PPI) have important reference value for inflation (deflation) measure, macroeconomic early warning and economic cycle analysis. CPI reflects the cost of living of the residents, the producer price index reflects the production costs of the enterprise. According to economic theory, the producer price index (PPI) is the leading indicator of consumer price index, and CPI has feedback mechanism for PPI. The operation of the two types of price indicators by the economic factors of the common impact, and through a certain channel or way to form a link, their trends and fluctuations in the trend there should be a certain order and conduction relationship, the majority of the situation should be Change in the same direction, only in time, the range may vary. As PPI represents the price of upstream production areas, while the CPI represents the price of downstream consumption areas, When the price of raw materials and other inputs changed, the corresponding changes in the price of intermediate products, which affect the final product price changes, affecting consumer price changes (Clark, 1995). This conduction relationship is described as a "cost-driven" conduction process. Silver and Wallace (1980) estimated the lagging distribution parameters between PPI and CPI in the United States, and concluded that PPI conducts to CPI. Cushing and McGarvey (1990) also argue that there is a one-way relationship between PPI and CPI in the United States, where changes in PPI are transmitted to CPI, but CPI changes are not transmitted to PPI. In addition, Furlong and Ingenito (1996), Weinhagen (2002), Kyrtsou and Labys (2006) have similar views based on US data. From the lead demand theory, the consumer demand for the final product will also

determine the demand for intermediate products. Therefore, the final rise in commodity prices will also promote the price of intermediate products, the performance of the CPI to PPI conduction. Colclough and Lange (1982) show that changes in the final consumer price will affect the price of intermediate products. From a wage perspective, Lown and Rich (1997) argued that the rise in CPI would eventually increase the PPI. Akdi et al. (2006) studies in Sweden, the UK, and Canada show that there is a short-term process of CPI conduction to PPI.

Chinese economists on the relationship between CPI and PPI research results are not the same. Liu (2005), Cai (2008) argue that PPI changes are ahead of the CPI changes, and He (2008), Dong (2009), Liu (2005) and Liu (2011) believes that China's inflation is a "demand-driven" type, mainly exist the relationship between CPI and PPI. Related research on the relationship between PPI and CPI conduction relationship is quite different, an important reason is that the transition period of China's economic and social changes in different periods of driving price fluctuations are not the same factors, the impact of price transmission factors is more complex, which leads to the transmission mechanism of CPI and PPI has significant non-linear characteristics. In addition, the adjustment of monetary policy, international oil price fluctuations, macroeconomic regulation and control may have an asymmetric non-linear effect on price transmission.

CHAPTER 2

LITERATURE REVIEW

Shahbaz et al. (2009) used the ARDL model to test the results of the test in Pakistan to confirm the bi-directional relationship between the CPI and PPI. Akcay's (2011) test of data in Germany also confirms the two-way conduction relationship. But at the same time, because PPI and CPI concerns the price of the product is not the same, CPI and PPI may also run independently. Dorestani and Arjomand (2006) studied the data from 1960 to 2005 of United States, suggesting that there is no conduction relationship existed in the long run. Bustinza (2008) also found that the relationship between CPI and PPI was very weak.

Liu (2005) using correlation analysis and regression analysis, analyzing the relationship between the consumer price index (CPI) and the producer price index (PPI) (including the producer price index and the producer price index of the means of subsistence) and the purchase price index of raw materials, fuel and power in different aspects. The results showed that there was a high linear correlation between PPI and CPI. PPI impact on the CPI has a significant lag, but the PPI will eventually pass to the CPI rise. In the long term, PPI volatility is generally greater than the volatility of CPI, but the overall direction of change is often consistent or close. He (2005) analyzed the differences and links between the different price indices, by carefully observing the changes in the price index and the use of China 's macroeconomic quarterly model (China-EQM), The error correction model between the industrial producer price index and the raw material purchase price index is established, and the beneficial conclusion is drawn that the price conduction law of the upstream and downstream industries does not change. Zhang (2007) constructed the long-term dynamic

relationship between consumer price index, commodity retail price index, industrial producer price index and raw material, fuel and power purchase price index by using second order single covariance vector autoregressive model. The analysis of the model shows that the CPI determines the long-term trend of the price index in the system in the long run, and establishes the short-term relationship between the exponential autocorrelation model of the first-order single covariance vector. In the short term, the change in the purchase price index for raw materials, fuels and power is the driving force behind changes in other price indices.

In addition, Chen (2008) analyzed the influence of macroeconomic variables on price level and the relationship between indicators by using Granger causality test and K2L information and time difference correlation analysis. and do a further study on China's price transmission. Analyzes the transmission mechanism of the upstream price to the consumer price and the transmission price of the means of production to the classified consumer price. The analysis shows that in the market-oriented industry, the price transmission works; and some government-controlled or monopoly industries, the price transmission does not work. These conclusions provide an important basis for the government to formulate macro-control policies. He (2008) using the CPI and PPI data from January 2001 to July 2008, and analyzing the relationship between the two indices, get the conclusion that consumer price index is the Granger reason for the change of producer price index, there is only one-way causality between them. During the period of study, the domestic demand for inflation in the consumer price index is relatively greater than the supply factor.

Chinese scholars study the transmission mechanism of producer price and consumer price from different aspects, draws a lot of conclusions that will benefit the government in

formulating macroeconomic policies. But the above studies do not take into the impact of monetary policy transmission mechanism on producer prices and consumer price transmission mechanisms into consideration. Caporale and Pittis (1997) pointed out that the use of two-variable vector autoregressive model to test Granger causality will be affected by the third variable z_t. They examined how a two-variable VAR system containing x_t and y_t was affected by a third variable outside of the system. When z_t will cause the variable to change, the use of incomplete two-variable VAR system to test the causal relationship will not be able to draw a valid conclusion.

CHAPTER 3

METHODS, DATA, RESULTS

The data of this research paper is collected from International Monetary Fund. These data of consumer price index and the producer price index between 2011 and 2017 in China. Both of the CPI and PPI are based on the base year 2010.

According the data in the Table 1, the consumer price index is increasing all across the time. However, the data of producer price index is decreasing at first than increasing at the last two years. It looks that consumer price index and the producer price index do not have any relationships. A regression model of consumer price index on producer price index will be used to check if the dependent and independent have the linearity relationship. Making a hypothesis test for this regression model to analyze their relationships. Using F test for the regression model to test the slope between the dependent and independent variables. Getting the F value from the regression analysis to compare with the critical value which can be found from the table of F critical values. Reject null hypothesis in favor of alternative if the F statistic exceed its critical value.

On the other hand, plotting each dependent variable with independent variable, get the line of regression function by using abline(regmod). These lines will look very clearly for readers to get the conclusions. The regression result is:

```
> regmod=lm(CPI~PPI)
> summary(regmod)
Call:
lm(formula = CPI ~ PPI)
```

Residuals:

Min	1Q	Median	3Q	Max
-5.2515	-1.3044	-0.3603	0.8894	5.7844

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	195.38405	5.53558	35.30	<2e-16	***
PPI	-0.88057	0.05854	-15.04	<2e-16	***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.18 on 76 degrees of freedom

Multiple R-squared: 0.7486, Adjusted R-squared: 0.7453

F-statistic: 226.3 on 1 and 76 DF, p-value: < 2.2e-16

Checking the critical value of F is 2.77, getting 226.3>2.77, so reject the null hypothesis. Thus, the slope is not equal to zero. Looking at the graph of regression function:

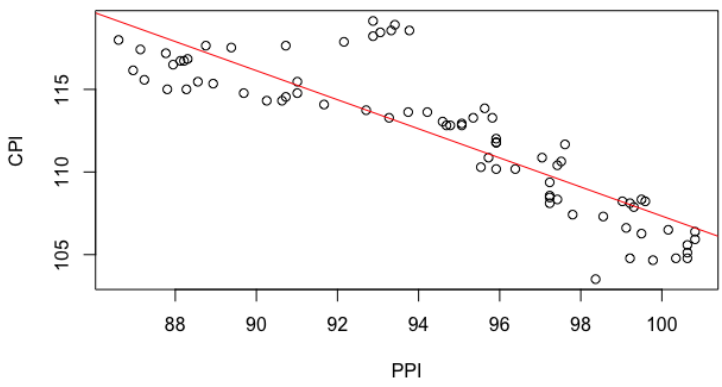

Figure 1 – Scatter Plot with the line of Regression function

There exists a red line of the regression model on this plot graph, this means that consumer price index and the producer price index have a negative linearity relationship.

In order to do further study on the relationship between CPI and PPI, Granger causality test is used in this research. Causality refers to the dependency between dependent variables and independent variables. The resulting variable is decided by the variable which as a causal, and the casual variable causes the change of resulting variable. Here CPI and PPI are two series to be tested for Granger causality test. The test can get the result whether PPI Granger causes CPI or vice versa. At the first test, the null hypothesis is PPI does not cause CPI, then the PPI would be the independent variables, and the CPI would be the dependent variables. The result of the first Granger causality is that:

> grangertest(cPI~pPI, order=2)

Granger causality test

Model 1: cPI ~ Lags(cPI, 1:2) + Lags(pPI, 1:2)

Model 2: cPI ~ Lags(cPI, 1:2)

Res.Df	Df	F	Pr(>F)
1	70		
2	72	-2	0.4678 0.6283

The F value is 0.4678 in the 2 degree of freedom. However, the critical value of F is 3.15 which is bigger than 0.4678, and the P value is 0.6283 which is larger than 0.05. Thus, the result cannot reject the null hypothesis, PPI does not cause CPI. The null hypothesis is CPI does not cause PPI at the second Granger test, then the CPI would be the independent variables, and the PPI would be the dependent variables. The result of the second Granger

causality is that:

```
Granger causality test

Model 1: pPI ~ Lags(pPI, 1:2) + Lags(cPI, 1:2)

Model 2: pPI ~ Lags(pPI, 1:2)

  Res.Df Df      F Pr(>F)

1     70

2     72 -2 3.6309 0.0316 *

---

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The F value is 3.6309 in the 2 degree of freedom. However, the critical value of F is 3.15 which is smaller than 3.6309, and the P value is 0.0316 which is smaller than 0.05. Reject the null hypothesis, the result of Granger causality tests show that CPI causes PPI and PPI does not cause CPI.

For a more accurate understanding of the relationship between PPI and CPI, this paper will also compare the relationship of the growth rate of PPI and CPI. The growth rate of CPI is equal to (CPI-lag(CPI,k=-1))/lag(CPI,k=-1), and the growth rate of PPI is equal to (PPI-lag(PPI,k=-1))/lag(PPI,k=-1). A regression model will be used on these two growth rates. The result shows that:

```
> regmod2=lm(growthrate1~growthrate2)

> summary(regmod2)

Call:

lm(formula = growthrate1 ~ growthrate2)
```

Residuals:

Min	1Q	Median	3Q	Max
0	0	0	0	0

Coefficients: (1 not defined because of singularities)

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0	0	NA	NA
growthrate2	NA	NA	NA	NA

Residual standard error: 0 on 77 degrees of freedom

This result shows that there does not have any relationship between the growth rate of CPI and the growth rate of PPI.

Table 1 – Data of CPI and PPI

Indicator	Consumer Prices	Producer Prices
	Index	Index
Scale	Units	Units
Base Year	2010=100	2010=100
2011M01	103.52	98.37
2011M02	104.78	99.21
2011M03	104.66	99.78
2011M04	104.78	100.35
2011M05	104.78	100.63
2011M06	105.12	100.63

2011M07	105.58	100.63
2011M08	105.93	100.82
2011M09	106.39	100.82
2011M10	106.50	100.16
2011M11	106.27	99.50
2011M12	106.62	99.12
2012M01	108.23	99.03
2012M02	108.11	99.21
2012M03	108.34	99.50
2012M04	108.23	99.59
2012M05	107.88	99.31
2012M06	107.31	98.55
2012M07	107.42	97.80
2012M08	108.11	97.23
2012M09	108.46	97.23
2012M10	108.34	97.42
2012M11	108.57	97.23
2012M12	109.37	97.23
2013M01	110.41	97.42
2013M02	111.67	97.61
2013M03	110.64	97.52

2013M04	110.87	97.04
2013M05	110.18	96.38
2013M06	110.18	95.91
2013M07	110.29	95.54
2013M08	110.87	95.72
2013M09	111.79	95.91
2013M10	111.79	95.91
2013M11	111.79	95.91
2013M12	112.02	95.91
2014M01	113.28	95.82
2014M02	113.86	95.63
2014M03	113.28	95.35
2014M04	112.82	95.06
2014M05	112.94	95.06
2014M06	112.82	94.78
2014M07	112.82	94.69
2014M08	113.05	94.59
2014M09	113.63	94.22
2014M10	113.63	93.74
2014M11	113.28	93.27
2014M12	113.74	92.71

2015M01	114.09	91.67
2015M02	115.46	91.01
2015M03	114.77	91.01
2015M04	114.54	90.73
2015M05	114.31	90.63
2015M06	114.31	90.25
2015M07	114.77	89.69
2015M08	115.35	88.93
2015M09	115.46	88.56
2015M10	115.00	88.27
2015M11	115.00	87.80
2015M12	115.58	87.24
2016M01	116.15	86.96
2016M02	117.99	86.60
2016M03	117.42	87.14
2016M04	117.19	87.77
2016M05	116.73	88.13
2016M06	116.50	87.95
2016M07	116.73	88.22
2016M08	116.84	88.30
2016M09	117.65	88.75

2016M10	117.53	89.38
2016M11	117.65	90.73
2016M12	117.88	92.16
2017M01	119.14	92.88
2017M02	118.91	93.41
2017M03	118.57	93.77
2017M04	118.57	93.33
2017M05	118.45	93.06
2017M06	118.22	92.88

CHAPTER 4

CONCLUSIONS

This paper applies the regression model and Granger causality test on the data of consumer price index and the producer price index between 2011 and 2017 in China. The result of the regression model on CPI and PPI indicate that these two variables have the negative linear relationship. The Granger causality test shows that CPI causes PPI and PPI does not cause CPI. Also, the regression model on the growth rate of CPI and the growth rate of PPI point out that there does not have any relationship between the growth rate of CPI and the growth rate of PPI. These results look unexpected for the economists. It is expected that the producer price index relates to the cost of goods, and the consumer price index relates the price of goods, so apparently these two indexes have positive relationship. Normally, economic theory shows that the producer price index (PPI) is the leader of consumer price index, and CPI can give feedback mechanism to PPI. However, these situation does not exist in China between 2011 and 2017, because of the adjustment of monetary policy, price fluctuations of international oil, and control of macroeconomic policy. According to the research, the data of CPI and PPI between 2011 and 2017 in China have the negative linear relationship, but only CPI Granger cause PPI, and the growth rate of them do not have linear relationship. The relationship between consumer price index and the producer price index still requires economists and scholars to continue to use data and methods to explore.

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VITA

Graduate School
Southern Illinois University

Binbin Shen

516926608@qq.com

Southern Illinois University Carbondale
Bachelor of Arts, Economics, May 2016

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"Thomas and Chany Chung Endowed Scholarship" for the 2014-2015 academic year
"Thomas and Chany Chung Endowed Scholarship" for the 2015-2016 academic year.

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