

# The Relationship Between Consumer Price and Producer Price Indices in Turkey

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## Abstract

In this study we analyze the relationship between the Consumer Price Index (CPI) and the Producer Price Index (PPI) in Turkey. We test long run, short run and causality relationship of these series. Johansen's cointegration tests present a long run relationship between these series. Vector error correction (VEC) model specification suggests these series move together. There is a unidirectional long run causality from CPI to PPI. On the other hand VEC Granger causality test indicates no causality in short run. Thus our results suggest demand pull inflation in long run.

**Keywords:** Co integration, Vector Error Correction Model and Price indices

**JEL Classification:** C32, E31

## Introduction

The change on consumer and producer prices is evaluated by price indices. Definition of price indices according to Turkish Statistical Institute (Turkstat) is given as flow. Consumer price index (CPI) is annually chained with annually updated weights. Main source of weights is Household Budget Surveys. CPI is compiled for whole country and for 26 statistical regions. CPI covers all household monetary consumption expenditure which takes place on the economic territory. Prices are the purchaser prices for the products the purchaser actually pays at the time of purchase including any taxes. Producer price index (PPI) is compiled for whole country. The PPI is not calculated separately for the regions. PPI is calculated by using chained Laspeyres index formulation. Prices are cash prices, as a amount received by producer from the purchaser for a unit of good produced as output, excluding VAT and all relevant taxes, retail and wholesale margins and separately invoiced transport and insurance (Turkish Statistical Institute, 2013). There are four different possible relationships between CPI and PPI: There is no relationship, there is a bidirectional relationship, there is a unidirectional relationship from PPI to CPI, and there is a unidirectional relationship from CPI

to PPI. All these four possibilities are shown in the previous studies Akcay, 2011 and Tiwari, 2012). On the other hand, the unidirectional relationship from PPI to CPI and unidirectional relationship from CPI to PPI stand out among these studies. The causality from PPI to CPI depends on supply effect. It is explained by production chain and cost push inflation in theory. When there is an increase for producer prices (agriculture, industry, mining, electricity, gas and water), raw materials is required for the production of intermediate goods which is needed for the production of final goods. Changes in prices of raw materials are passed through the prices of intermediate goods and final goods. As a result it affects the consumer prices (Clark, 1995). Therefore, changes in PPI lead or cause CPI. PPI and CPI connection is summarized by (Rogers, 1998). On the other hand, the opposite causality can be observed between CPI and PPI, which is explained by demand pull effect. Demand for final goods and services determine the demand for intermediate goods and raw materials. Thus, "the cost of production reflects the opportunity cost of resources and intermediate goods, which in turn reflects demand for the final goods and services" (Caporale, Katsimi, & Pittis, 2002). Consequently, consumer prices can affect producer prices (Cushing & McGarvey, 1990). Basically excess demand may increase prices which are called demand pull inflation. Demand pull inflation usually occurs in expanding economy (Barth & Bennett, 1975). Turkey is one of the fast growing economies in the period 2003-2013. It is an attracted economy for portfolio investment and foreign direct investments. We observe domestic currency stability and low interest rate in major period between 2003 and 2013.

After 2001 crisis, the independence of the Central Bank was granted between 2002-2005 implicit inflation targeting policy was conducted. During this period floating exchange rate regime increased, fiscal dominance weakened, and financial markets started to deepen and financial sector became less fragile. With the successful implementation of a mix of prudent monetary and fiscal policies, bank restructuring program and structural reforms, economic and financial stability were strengthened. These developments also contributed to credit expansion, mostly from the demand side, due to the remarkable fall in inflation and the associated reduction in nominal as well as real interest rates. We see that starting from 2003, banks have placed greater emphasis on private banking services, so the increase in credit cards and consumer credits has played a significant role in increasing credit volume (Basci, 2006). In 2006, inflation targeting regime has been started. After November 2010, in addition to price stability, Central Bank of Turkish Republic (CBRT) also introduced a new goal as financial stability. Turkey experienced rapid credit growth between 2010 and 2012. There have been several factors feeding into the credit expansion, including low global interest rates, increased supply of credit backed with the strong balance sheets of the domestic banking sector, as well as vigorous growth in output and employment (Kara, Kucuk, Tiryaki, & Yuksel, 2013). Subsequently policy implementations of CBTR encourage consumption and may cause demand pull inflation.

In this paper we attempt to provide empirical evidence on the short run and long run relationship between CPI and PPI for Turkey in the period of 2003 and 2013. During this period Turkey became one of the fastest growing economies. There was stable exchange, low interest rate, increasing government spending and current account but a decreasing in savings. Therefore, there can be demand pull inflation and causality from CPI to PPI. Therefore we expect demand pull effect which presents causality relationship from CPI to PPI. The paper is organized as follows; Section II reviews the literature. Section III describes empirical methodology, Section IV is the description of data, Section V presents empirical results, and the last section concludes the study.

### Literature review

There are four different possible relationships between two variables: There is no relationship, there is a bidirectional relationship, there is a unidirectional relationship from PPI to CPI, and there is a unidirectional relationship from CPI to PPI. All these four possibilities are shown in the previous studies for different countries and periods.

The first possibility, which is no causality between CPI and PPI, is investigated by Berument, Cilasun, & Akdi (2006), Sidaoui, Capistrán, Chiquiar, & Francia (2009) and Akcay (2011). Berument, Cilasun, & Akdi (2006) studied long and short run relationships between WPI and CPI by using monthly data for the period 1987:01 to 2004:08 in Turkey. They applied Engle and Granger, Johansen conventional and periodogram method. Results of periodogram method suggest that there is no cointegration between PPI and CPI in Turkey. Moreover, they found a short run relationship between WPI and CPI in Turkey. Sidaoui et al., 2009 investigated the relationship between PPI and CPI using monthly data for Mexico. They implied Engle-Granger and VECM to show short and long run causality between PPI and CPI. They found that Granger causality is from the PPI to the CPI in the long run but in the short run there is no causality between PPI and CPI. Akcay (2011) examined the causal relationship between PPI and CPI for the five selected European countries, using seasonally adjusted monthly data from August 1995 to December 2007. The results indicate that there is a unidirectional causality between producer price index and consumer price index, running from producer price index to consumer price index in Finland and France and bidirectional causality between two indices in Germany. In the case of the Netherlands and Sweden, no significant causality is detected.

Secondly bidirectional relationship between CPI and PPI is examined by Cushing & McGarvey (1990), Caporale et al. (2002), Akdi & Şahin, (2007) and Tiwari, Mutascu, & Andries, (2013). Cushing & McGarvey (1990) indicated bidirectional relationship between CPI and wholesale price index (WPI) by using Geweke's linear dependence and feedback model for USA in the period 1954 and 1987 by monthly data. Caporale et al. (2002) studied the relationship between consumer and producer prices in the G7 countries (United States, Canada, Germany, France, Italy, United Kingdom, and Japan) for period 1976-1999. The empirical results are consistent with the conventional wisdom according to which there is unidirectional causality running from producer to consumer prices. Their study indicates bidirectional causality (or even no significant links) only being found when the causality links reflecting the monetary transmission mechanism are ignored. Akdi & Şahin, (2007) investigated bidirectional causality between CPI and WPI in Turkey for period 1988 and 2007. They applied AD.F, PP and KPSS unit root test. (Tiwari et al., 2013) analyzed Granger-causality between the return series of CPI and PPI (i.e., inflation measured by CPI and PPI) for Romania, by using monthly data covering the period of 1991m1 to 2011m11. To analyze the issue in depth, this study decomposes the time-frequency relationship between CPI- and PPI-based inflation through a continuous wavelet approach. Their results provide strong evidence that there are cyclical effects from variables (as variables are observed in phase), while anti-cyclical effects are not observed. Tiwari, G, Arouri, & Teulon (2014) studied Granger-causality between the return series of CPI and PPI (i.e., inflation measured by CPI and PPI) for Romania, by using monthly data covering the period of 1991m1 to 2011m11. To analyze the issue in depth, this study decomposes the time-frequency relationship between CPI- and PPI-based inflation through a continuous wavelet approach. Their results provide strong evidence that

there are cyclical effects from variables (as variables are observed in phase), while anti-cyclical effects are not observed.

The third condition is the causality from PPI to CPI that depends on supply effect. It is explained by production chain and cost push inflation in theory. Clark (1995), Mohd Fahmi Ghazali (2009), Shahbaz & Nasir (2009) and Saraç & Karagöz (2010) presented unidirectional relationship from PPI to CPI. Clark (1995) figured out unidirectional relationship that runs from WPI to CPI. VAR analysis is applied for USA quarterly data between 1977 and 1994. Samanta and Mitra (1998) applied cointegration and Granger causality tests for two sub periods for India 1991-1995 and 1995-1998. Their results show a stable long-run relationship between CPI and WPI existed during 1991 to 1995, but not thereafter. Mohd Fahmi Ghazali (2009) used monthly data for CPI and PPI at constant prices of 2000 for the period from January 1986 to April 2007, for Malaysia. He found that there is a unidirectional causality from PPI to CPI. He has employed Engle Granger and Toda-Yamamoto causality tests. Shahbaz & Nasir (2009) studied CPI responds to a change in WPI with a time lag. Their results indicated that they are cointegrated in the long run, over 1982 to 2009. Saraç & Karagöz (2010) presented the relation from PPI to CPI for Turkey by applying Structural Break and ARDL Bounds Test. They implied monthly data from 1994-2009.

The causality from CPI to PPI is the fourth and the last possibility. It is explained by demand pull effect. Colclough & Lange (1982), Hamid, Thirunavukkarasu, & Rajamanickam, (2006), Fan, He, & Hu (2009), Shahbaz, Tiwari, & Tahir (2012) and Tiwari, (2012) reported unidirectional causality from CPI to PPI. Colclough & Lange (1982) examined the causal relationship between consumer and producer price changes for USA. The Sims and Granger causality tests are used to test for causality between consumer and producer prices. Both tests support the hypothesis of causality from consumer to producer prices. Hamid, Thirunavukkarasu, & Rajamanickam, (2006) presented unidirectional causality from CPI to PPI in USA for period three periods 1926-1945, 1946-1972 and 1973-2003. VAR analysis and Granger causality tests are applied to CPI, PPI and DJIA. Fan, He, & Hu (2009) analyzed the relationship between PPI and CPI using monthly data for China. The authors found a unidirectional causality between two indices that is running from CPI to PPI in China. Shahbaz, Tiwari, & Tahir (2012) reported the unidirectional causal relationship from CPI to WPI for Pakistan. Their results shows causality from CPI to WPI at lower, medium as well as higher level of frequencies reflecting long run, medium and short run cycles. Tiwari, (2012) examined Johansen and Juselius long run relation and Granger causality between the CPI and PPI for Australian. They implied analysis to the quarterly data from 1969q3 to 2010q4. Their findings suggest causality from consumers' price at an intermediate level of frequencies reflecting medium-run cycles, whereas producers' price does not Granger cause consumers' price at any level of frequencies.

### Methodology

To test long run relationship we apply the Johansen cointegration model. The model is developed (Johansen, 1991,1995) for a group where  $y_t$  is a k-vector of non-stationary I(1) variables,  $x_t$  is d-vector of deterministic variables such as time trend, seasonal dummies etc. and  $\varepsilon_t$  is a vector of innovations. VAR (p) model can be represented as:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + B x_t + \varepsilon_t$$

we may write VAR as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + Bx_t + \varepsilon_t$$

where  $\Pi = \sum_{i=1}^p A_i$  and  $\Gamma_i = -\sum_{j=i+1}^p A_j$

In our model  $y_t$  is comprised of consumer price index (CPI) and producer price index (PPI) variables. They are shown in a  $k$ -vector. If the coefficient matrix  $\Pi$  has reduced rank  $0 < r < k$ , then there exists  $k \times r$  matrices  $\alpha$  and  $\beta$  each with rank  $r$  such that  $\Pi = \alpha\beta'$  and  $\beta'y_t$  is  $I(0)$ .  $r$  is the number of the cointegrating relations and each  $\beta$  is the cointegrating vector. If the rank of  $\Pi$  is zero, there is no combination of  $y_t$  series that is stationary so the variables are not cointegrated. If there is a cointegration relationship between the variables, then elements of  $\alpha$  are the adjustment parameters in vector error correction model (VECM). The VAR system can be interpreted as representing VECM for long run endogenous variables:

$$\Delta y_t = c + \alpha\beta'y_{t-1} + \Gamma_1 \Delta y_{t-1} + Bx_t + \varepsilon_t$$

In the system  $c$  represents intercept.  $y_{t-1}$  is the error correction term (ECT), which is derived from long run cointegration relationship. If there is only one cointegration equation,  $r=1$ , elements of  $\beta_i$  equals to number of variables.  $\beta_i$  coefficients show the long run equilibrium relationships between levels of variables.  $\alpha_i$  coefficients show the amount of changes in the variables to bring the system back to equilibrium. It shows the short run changes occurring due to previous changes in the variables.  $\Gamma_i$  coefficients show the relationships between variable and their lags.  $B_i$  coefficients show the effect on the external events.

## Data

In this study, we aim to figure out the relationship between CPI and PPI in Turkey. We compose monthly data span from January 2003 to December 2013. Our data source is CBRT's Electronic Data Delivery System (EDDS). Appendix A provides the definitions and sources of the variables. We use both series as their logarithm.

[Insert figure 1 about here]

Figure 1 shows the time series plots of the logCPI and logPPI series. These series have similar slight fluctuation and increasing trends. That is, while showing an upward trend, the means of all variables have been altering. This may imply possibility of unit root for each the series. However, the nonstationarity of series must be assured by the unit root tests.

[Insert table 1 about here]

Table 1 reports the Dickey-Fuller (Dickey & Fuller, 1979) and Phillips-Peron (Phillips & Perron, 1988) Unit Root Tests for all series. Column A displays the series with an intercept term, Column B shows the intercept term and the time trend and Column C presents the tests on the first difference of the series for the Dickey-Fuller and Phillips-Peron Unit Root Tests. According to presented results we cannot reject the null hypothesis of a unit root in either series in levels (with and without time trend). On the other hand, the null hypothesis of a unit root in the differences of the series can be rejected. Thus, we conclude that series are nonstationary in levels and they are stationary in first difference at 1% significance level.

### **Empirical Evidence**

Firstly, according to previous studies we want to mention our expectation. Then we will present empirical results. There are four different possible relationships between two variables: There is no relationship, there is a bidirectional relationship, there is a unidirectional relationship from PPI to CPI, and there is a unidirectional relationship from CPI to PPI. All these four possibilities are shown in the previous studies due to Turkey's economic condition in the period 2003 to 2013. The causality from CPI to PPI is expected, which is related to demand pull inflation. Demand for final goods and services determine the demand for intermediate goods and raw materials. Thus, "the cost of production reflects the opportunity cost of resources and intermediate goods, which in turn reflects demand for the final goods and services" (Caporale et al., 2002). Consequently, consumer prices can affect producer prices (Cushing & McGarvey, 1990). Basically excess demand may increase prices which are called demand pull inflation. Demand pull inflation usually occurs in expanding economy (Barth & Bennett, 1975). Turkey is one of the fastest growing economies in the period 2003-2013. It is an attracted economy for portfolio and direct investments. There is also an increase in consumption, government expenses and current account but a decrease in savings. Depreciation or stability of domestic currency, high government spending, low interest rate and faster economic growth in other countries trigger demand pull inflation. Consequently we expect an impact from CPI to PPI.

### **Cointegration tests**

It was reported in the fourth section that both series are integrated in the same order. So there is a common trend. As Engle & Granger, 1987 pointed out, only variables with the same order of integration could be tested for cointegration. As a result we can analyze long run relationship with Johansen's cointegration test. According to final prediction error (FPE) and Akaike information criterion (AIC) lag order is 5. The model deterministic trend is selected as linear data trend and intercept with no trend based on Akaike information, and Schwarz criteria. Table 3 reports the results of Johansen's cointegration tests.

[Insert table 2 about here]

The test statistics, the trace test and Max-Eigen test at the 5% level, suggest that we can reject the null hypothesis that there is no cointegrating relationship between the series. Thus, the results present there is one cointegration equation between series at the 5% level. In other word it possible to construct one equation between logCPI and logPPI for long run relationship. Cointegration implies also causality exists between CPI and PPI. However, the test does not indicate the short run relationship and the direction of the causal relationship. Therefore, we use the VECM to detect the short run relationship and the direction of causality (Bélaïd & Abderrahmani, 2013).

### **Vector Error Correction Model Estimation**

We report that there is one cointegration equation between series. Thus, we may analyze of long run and short run relationship. Vector error correction model is applied to test short-run relationship. Similar to cointegration analysis we use lag order 5 and number of cointegration one for VECM. Test result is reported on table 3.

[Insert table 3 about here]

VECM reports that in cointegration equation the estimated coefficient of the logCPI is 0.0930391 with a t-statistics of -46.2865. This shows long run relationship between indices. And one unit increase of logCPI increases logPPI by 0.0930391 unit. Beside long run



relationship, there is also short run relationship. In error correction model coefficient of first difference of logPPI is -0.15156 which lies between 0 and -1 with t-statistic -3.30746. That reports statistically significance in 1% level. For robustness short run relationship we regress the logarithmic first differences of series each other with their error correction term and 5 lags. One period lag of cointegrated equation is residual and its coefficient is -0.15156 which lies between 0 and -1 with t-statistic -3.307460, probability 0.0013. This reports statistically significance in 1% level. These results present that there is a short run relationship between price indices. Figure 2 is the autocorrelation function (ACF) of the residuals for the VECM, where we used a lag order 5. The lag is shown along the horizontal, and the autocorrelation is on the vertical. The dot lines indicated bounds for statistical significance. None of ACF for residuals is significant which supports that our lag selection is valid.

[Insert figure 2 about here]

The evidence from cointegration and vector error correction models both long run and short run dynamics are significant. Therefore, our findings support validity of an equilibrium relationship between the series. Then we investigate direction of causality in long run and short run relationship. For long run causality, we implied a t-test to examine the significance of the ECTs. (Bélaïd & Abderrahmani, 2013).

Table 3 presents VECM results. That there are two error correction models. The first column presents the model in which logPPI is dependent variable. ECT coefficient is -0.15156 which lies between 0 and -1 with t-statistic -3.307460, probability 0.0013. This reports long run causality from logCPI to logPPI with statistically significance in 1% level. The second column presents the model in which logCPI is a dependent variable. ECT coefficient is 0.044444 which is bigger than zero with t-statistic 1.43640, probability 0.1536. Thus, there isn't long run causality from logPPI to logCPI. Our results, which indicates causality from CPI to PPI, is parallel to Colclough & Lange (1982), Hamid, Thirunavukkarasu, & Rajamanickam, (2006), Fan, He, & Hu (2009), Shahbaz, Tiwari, & Tahir (2012) and Tiwari, (2012) studies. We check short run causality from CPI to PPI by Wald test of regression model. Out of 12 coefficients, 6 of them belong to CPI. Wald test  $H_0$ : coefficients of CPI are zero. Chi-square value is 5.597063 with df=5 and probability 0.3474. Therefore we accept null hypothesis which presents that there is no short run causality from CPI to PPI. For validity of model we check serial correlation and ARCH effect. LM test R-squared probability is 0.9683 which indicates there is no serial correlation and heteroskedasticity ARCH test R-squared probability is 0.6278 which indicates there is no ARCH effect. We repeat causality analysis from PPI to CPI. Chi-square value is 2.616888 with df=5 and probability 0.7588. Therefore we accept null hypothesis which presents that there is no short run causality from PPI to CPI. Appendix B shows wald test results. For robustness of short run causality we examine VEC Granger causality.

[Insert table 4 about here]

VEC Granger causality test results report that there is no short causality for both directions. Since, probability values 0.3474 and 0.7588 are so much bigger than 0.05. Our findings are similar to Sidaoui, Capistrán, Chiquiar, & Francia (2009) in which they presented long run impact of PPI to CPI but there is no causality in short run.

## Conclusion

In this study we present the causal relationship between CPI and PPI for Turkey by using monthly time series for the period of 2003 to 2013. We employ econometric analysis, respectively; unit root test (ADF, PP), Johansen's cointegration test and VECM. Unit root test

results reports series are nonstationary in levels but stationary in first difference. Thus, we perform cointegration test. Johansen's cointegration test presented long run relationship between series. VECM indicates that there is unidirectional long run relationship from CPI to PPI for Turkey and linear unidirectional long run causality between variables. On the other hand VEC Granger causality test indicates no causality in short run.

Our findings emphasis on consumer price index as primary indicator for price changes. The change in CPI in short run does not affect PPI. Despite it impacts in long run. Excess demand may increase prices which are called demand pull inflation. Our results show demand pull inflation in long run for Turkey for the period 2003 to 2013.

#### Appendix A:

##### Data Sources

Variable	Definition	Code	Source
<i>PPI</i>	Producer Price Index (2003=100)	TP.FG.TF01	CBRT, EDDS
<i>Cpi</i>	General Price Index (Consumer Price) (2003=100)	TP.FG.J0: 0	CBRT, EDDS

#### Appendix B: VECM short run causality test

$$D(\text{LOGPPI}) = C(1) * ( \text{LOGPPI}(-1) - 0.930391035267 * \text{LOGCPI}(-1) - 0.358042949532 ) + C(2) * D(\text{LOGPPI}(-1)) + C(3) * D(\text{LOGPPI}(-2)) + C(4) * D(\text{LOGPPI}(-3)) + C(5) * D(\text{LOGPPI}(-4)) + C(6) * D(\text{LOGPPI}(-5)) + C(7) * D(\text{LOGCPI}(-1)) + C(8) * D(\text{LOGCPI}(-2)) + C(9) * D(\text{LOGCPI}(-3)) + C(10) * D(\text{LOGCPI}(-4)) + C(11) * D(\text{LOGCPI}(-5)) + C(12)$$

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.119413	(5, 114)	0.3541
Chi-square	5.597063	5	0.3474

Null Hypothesis:  $C(7)=C(8)=C(9)=C(10)=C(11)=0$

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	0.076300	0.143376
C(8)	-0.180493	0.140106
C(9)	0.025540	0.143738
C(10)	-0.146926	0.141005
C(11)	0.242406	0.143476

Restrictions are linear in coefficients.



$$D(CPI\_LOG) = C(13)*(PPI\_LOG(-1) - 0.930391035267*CPI\_LOG(-1) - 0.358042949532) + C(14)*D(PPI\_LOG(-1)) + C(15)*D(PPI\_LOG(-2)) + C(16)*D(PPI\_LOG(-3)) + C(17)*D(PPI\_LOG(-4)) + C(18)*D(PPI\_LOG(-5)) + C(19)*D(CPI\_LOG(-1)) + C(20)*D(CPI\_LOG(-2)) + C(21)*D(CPI\_LOG(-3)) + C(22)*D(CPI\_LOG(-4)) + C(23)*D(CPI\_LOG(-5)) + C(24)$$

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.523378	(5, 114)	0.7582
Chi-square	2.616888	5	0.7588

Null Hypothesis: C(14)=C(15)=C(16)=C(17)=C(18)=0

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(14)	0.066264	0.062556
C(15)	-0.037251	0.067250
C(16)	-0.054120	0.066667
C(17)	0.015154	0.065819
C(18)	-0.054477	0.064655

Restrictions are linear in coefficients.

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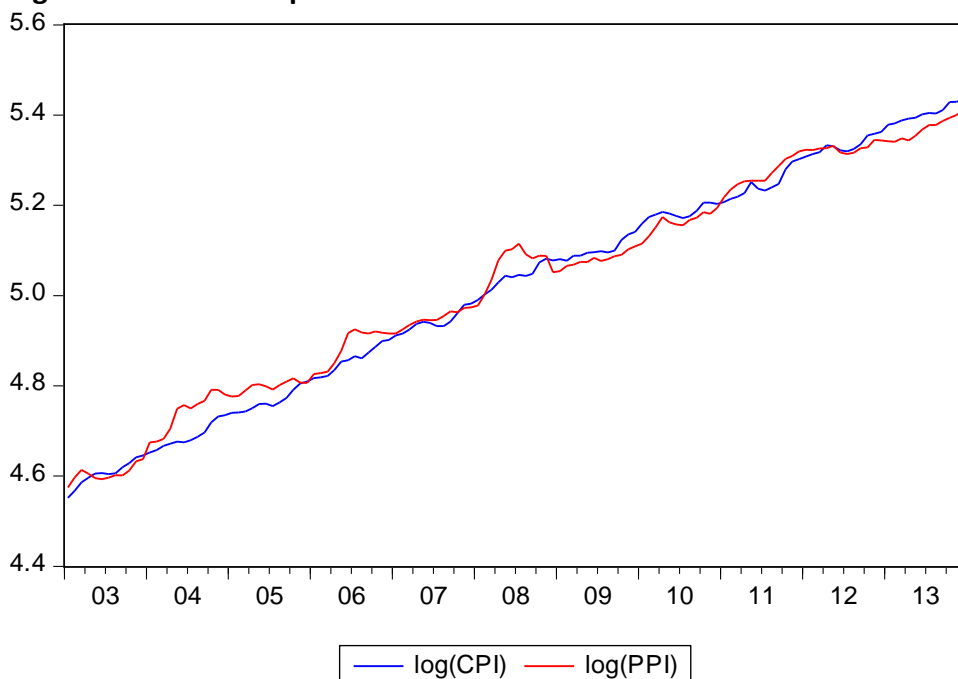
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**Figure 1: Time series plot of Price indexes**



**Table 1:**

*Unit Root Tests*

	A: Intercept		B: Intercept with Trend		C: Difference with Intercept	
	ADF	PP	ADF	PP	ADF	PP
log(CPI)	-0.8637	-2.6553	- 4.0675* *	-3.111358	- 8.543730* *	- 17.32444**
log(PPI)	- 0.71832 1	-1.001864	-3.37189	-2.965994	- 8.016840* *	- 8.010417**

Note: \* indicates the level of significance at 5% \*\* indicates the level of significance at 1%. The critical values are gathered from (MacKinnon, 1996) one-sided p-values.

**Table 2:**

*Johansen Cointegration test of price indexes*

Hypothesized No. of CE(s)	Lag order	Eigenvalue	Trace Statistic	Max-Eigen Statistic	Trace Prob.**	Max-Eigen Prob.**
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None *	5	0.137516	19.59586	18.64020	0.0114	0.0095
At most 1		0.007556	0.955651	0.955651	0.3283	0.3283

Trace and Max-eigenvalue tests indicate 1 cointegrating eqn(s) at the 0.05 level

\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

figure 2: ACF of residuals for VECM

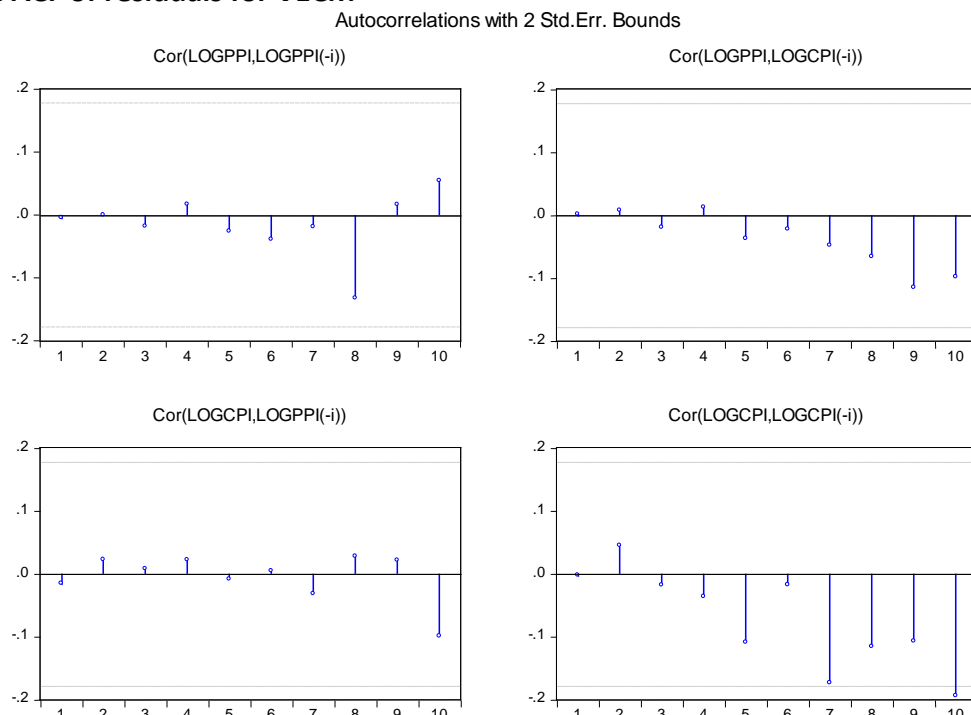


Table 3:

*Vector Error correction model*

Cointegrating Eq:	CointEq1	
LOGPPI(-1)	1.000000	
LOGCPI(-1)	-0.930391 (0.02010) [-46.2865]	
C	-0.358043	
Error Correction:	D(LOGPPI)	D(LOGCPI)
CointEq1	-0.151560 (0.04582) [-3.30746]	0.044444 (0.03094) [ 1.43640]

D(LOGPPI(-1))	0.390396 (0.09265) [ 4.21385]	0.066264 (0.06256) [ 1.05927]
D(LOGPPI(-2))	0.009599 (0.09960) [ 0.09638]	-0.037251 (0.06725) [-0.55392]
D(LOGPPI(-3))	0.035770 (0.09873) [ 0.36229]	-0.054120 (0.06667) [-0.81179]
D(LOGPPI(-4))	0.170447 (0.09748) [ 1.74857]	0.015154 (0.06582) [ 0.23024]
D(LOGPPI(-5))	-0.008300 (0.09575) [-0.08668]	-0.054477 (0.06466) [-0.84258]
D(LOGCPI(-1))	0.076300 (0.14338) [ 0.53217]	0.191506 (0.09681) [ 1.97816]
D(LOGCPI(-2))	-0.180493 (0.14011) [-1.28826]	-0.185302 (0.09460) [-1.95876]
D(LOGCPI(-3))	0.025540 (0.14374) [ 0.17769]	-0.027727 (0.09705) [-0.28568]
D(LOGCPI(-4))	-0.146926 (0.14101) [-1.04199]	-0.284112 (0.09521) [-2.98408]
D(LOGCPI(-5))	0.242406 (0.14348) [ 1.68952]	0.085583 (0.09688) [ 0.88341]
C	0.002576 (0.00226) [ 1.13942]	0.008425 (0.00153) [ 5.51884]
R-squared	0.230582	0.204926
Adj. R-squared	0.156340	0.128208
Akaike information criterion		-13.20191

Schwarz criterion -12.61665

Standard errors in ( ) & t-statistics in [ ] The 10%, 5%, and 1% critical value bounds for the t-test are (1.6572, 1.9793 and 2.6161 ).

Table 4:

*VEC Granger Causality*

VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(PPI\_LOG)

Excluded	Chi-sq	Df	Prob.
D(CPI_LOG)	5.597063	5	0.3474
All	5.597063	5	0.3474

Dependent variable: D(CPI\_LOG)

Excluded	Chi-sq	df	Prob.
D(PPI_LOG)	2.616888	5	0.7588
All	2.616888	5	0.7588