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A VECM Analysis of the Relations the CPI, PPI, GDP Per Capita, Exchange Rate in the Republic of Azerbaijan

Revana I. Davudova[1,2*]

[1]ANAS Institute of Economics, H. Javid ave, 115, AZ1143, Baku, Azerbaijan Republic.
[2]ANAS Institute of Control Systems, B. Vahabzadeh st, 9, AZ1141, Baku, Azerbaijan Republic.

Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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ABSTRACT

Aims: The study focuses on an empirical analysis of a macroeconomic indicators system, that reflect the level and pace of a country's socio-economic development, such as CPI, PPI, GDP per capita, exchange rate, taking into account the consequences of the COVID19 pandemic and oil prices on the example Republic of Azerbaijan.
Study Design: The study consists of four sections. It includes Introduction, Literature Review, Methodology, Results and Discussion and Conclusion.
Place and Duration of Study: The study was conducted for 4 months of 2020 in the department of "Mathematical support of economic research" of the Institute of Economics of Azerbaijan National Academy of Sciences.
Methodology: Within the dynamic VEC model, taking into account the COVID19 pandemic and oil prices, the long-run and short-run effects of macro indicators system on each other were studied by means of causality, impulse responses and variance decomposition on the monthly statistics covering the period 2015M01-2020M07 for the Republic of Azerbaijan.
Results: Calculations based on the established stable VEC (5) model revealed that there is a long-term causal relationship from the triad (CPI, PPI, Ex_Rate) to all endogenous variables. There are a short-term bi-directional causal relationship between CPI and GDP_Per_Capita and between PPI

**Corresponding author: E-mail: revanadavudova@gmail.com*

and Ex_Rate. From PPI and Ex_Rate to GDP_Per_Capita; from Ex_Rate to CPI, there are a unidirectional short-term causal relationship.

Conclusion: Summarizing the results, we can write the following long-term expressions: the change a) in the GDP_per_Cap is influenced by the PPI and CPI variables negatively, and Ex_Rate – positively; b) in the CPI is influenced by the GDP_per_Cap and PPI variables negatively, and Ex_Rate – positively; c) in the PPI is influenced by the Ex_Rate and CPI variables negatively, and GDP_per_Cap – positively, so that the negative influence of the CPI is greater; d) in the Ex_Rate is influenced by the PPI and CPI variables negatively, and GDP_per_Cap – positively. Has been also identified that the indicator PPI has a more negative effect on changes in GDP_per_Cap, CPI and Ex_Rate.

Keywords: CPI; PPI; GDP per Capita; exchange rate; VECM; impulse response; variance decomposition.

ABBREVIATIONS

GDP_Per_Cap : GDP per Capita
CPI : Consumer Price Index
PPI : Producer Price Index
Ex_Rate : Exchange Rate
VECM : Vector Error Correction Model
OP : Brent oil price
IRF : Impulse response function

1. INTRODUCTION

Macroeconomic indicators, such as CPI, PPI, GDP per Capita, Exchange Rate, etc., reflect the level and dynamics of socio-economic development. They are an important factor in assessing the effectiveness of the county's economic policy. A high CPI indicates inflation, which may cause negative consequences for the country's economic development and people's lives. Maintaining an appropriate CPI is a key and complicated problem for all countries in the world. PPI reflects the dynamics of changes in the price of the national product and encloses all stages of production. Gross domestic product per capita (GDP per Capita) is an indicator of the level of economic activity and quality of life of the population in certain countries and regions for a certain period. The level and dynamics of this indicator indicate the level and dynamics of economic growth and development of the country, but this indicator reflects only the average value.

Macroeconomic indicators such as inflation, unemployment, GDP, including GDP per Capita, etc. characterize the directions of development of the country's economy and affect the exchange rate. Since high inflation and unemployment always have a negative impact on the national currency, while the growth of production, on the contrary, supports and strengthens the national currency. And exchange rates, directly or indirectly, affect many key economic variables like interest rates, Portfolio's Investment Returns, retail prices, consumer price and Labor prospects. An Analysis and forecasting of basic macroindicators, such as Exchange Rate, Consumer Price Index, Producer Price Index, Inflation, unemployment, etc. are important and plays a real role in the adoption of economic policy decisions.

The COVID19 pandemic, which began in China at the end of 2019 and spread to other countries, necessitated the introduction of restrictive measures in the Republic of Azerbaijan from March 2020. The fall in oil prices due to the pandemic also had a serious impact on the economy of the Republic of Azerbaijan as an exporter of carbohydrates. Comparing changes in macroindicators (GDP_Per_ Capita, CPI, PPI and Exchange Rate) compared to the corresponding period of the previous year, we see that in the first half of 2019, compared to the corresponding period of 2018, GDP_Per_Cap, CPI and PPI grew by an average of 1.81%, 2.07% and 5.29%, respectively, while oil prices fell by an average of 5.18%. The exchange rate of the Azerbaijani Manat (AZN) remained unchanged. In the first half of 2020, compared to the corresponding period of 2019, GDP_Per_Cap, PPI and oil prices fell by an average of 10.8%, 38.68% and 36%, respectively. And CPI grew by 6.04%, while the exchange rate of the Azerbaijani Manat (AZN) practically did not change.

The study of the relationships among CPI, PPI, GDP per Capita and the exchange rate and the impact of oil prices on them, especially in the context of the COVID pandemic, is relevant and of particular interest to the Republic of Azerbaijan, one of the oil exporters.

2. LITERATURE REVIEW

Several studies have been devoted to the study of the interactions and joint dynamics of macroeconomic indicators. In the context of the COVID19 pandemic, it is relevant to study the consumer price index, consumer price index, exchange rate and the impact of oil prices on them. In [1,2] is devoted to the study of the relations between economic growth rate, consumption, investment, public expenditure norms, economic growth rate, general index of structural effectiveness and other macroeconomic indicators of the balanced and unbalanced open economy, respectively. Macroeconomic indicators' interrelations of the open economy have been investigated in the fields of interval analysis. The study [3] focuses on the analysis of the relationships among Gross Domestic Product, Cash in Circulation, Interest Rate, Price Index and Oil Prices by applying VEC analysis.

S.J.Li, G.O.Tang and others autors by establishing the VEC model with monthly data of China's, investigated the relationship between the consumer price index (CPI) and the producer price index (PPI) using the Johansen cointegration test and the impulse response function. It was determined that there is a long run cointegration relationship between CPI and PPI. In addition, it is concluded that a two-way causality relationship exists between CPI and PPI [4]. Lee K. and Chen J used the STR (Smooth Transition Regression) model to study the nonlinear relationship between the CPI in China and the world oil price. The results show that the change of CPI in current period has a positive effect to the next period, and the non-linear effect of international oil price almost completely reveals the changing characteristics of CPI [5]. The VEC model was used to study the impact of the US consumer price index, the US dollar index, the Dow-Jones industrial index, the Federal Reserve rate, and the price of gold on the price of Bitcoin based on monthly statistics of 2011-2016. As a result of empirical analysis, influencing greater of the US dollar index on the price of Bitcoin than the price of gold was defined [6]. In [7] explores the spillover effects of external shocks on inflation and GDP for Croatia on a quarterly basis for the period 2000Q2-2010Q1. Impulse responses and variance decomposition of the estimated VAR model with block-exogenous restrictions point to external factors as the main determinants of domestic inflation and domestic economic activity. Cao L. and Zhou X. studied the development of the Chinese economy using VAR model based on four typical indicators from 1996 to 2008, including GDP, CPI, money supply (M2) and seven-day interbank interest rates [8]. Wei R., Du J. Kang K. investigated the relationship between CPI and ship maintenance hourly rate on annual data from 1979 to 2009 for Chine with the establishment VAR model. Granger causality, impulse response function and variance decomposition of indicators have been studied, and empirical results have shown that there is a long run equilibrium relationship between factors [9].

3. METHODOLOGY

The research is devoted to the analysis of multiple time series GDP per Capita (GDP_Per_Cap), consumer price index (CPI), producer price index (PPI) and the exchange rate (Ex_Rate) using a dynamic model based on monthly statistics from the State Statistical Committee of the Republic of Azerbaijan [10], the Central Bank of the Republic of Azerbaijan [11] and Trading Economics [12] for the period 2015M01-2020M07. To the best of my knowledge, this research is the first attempt in the literature to analyze the long-run and short-run relations among theese macroindicators in economy of Republic of Azerbaijan. The interrelationships of macroindicators are studied within the framework of the VEC (Vector Error Correction) model taking into account the situation with COVID19. VEC models, describe the relationship between *I(1)* non-stationary time series, which must be integrated of cointegration order and there are the method of constructing models using data in which variables have a long run stochastic trend, also known as cointegration, and this approach is useful for assessing both the short run and long run impact of one time series on another. The term "error correction" refers to the fact that the deviation of the last period from the long run equilibrium, an error, affects its short run dynamics. Thus, the VEC model estimates the rate at which the dependent variable returns to equilibrium after changing other variables.

The vector error correction model has the form [13]:

$$\Delta W_t = A\,B' W_{t-1} + \sum_{i=1}^{q} B_i\,\Delta W_{t-i} + CX_t + \varepsilon_t, t = 1,2,\cdots,T,$$

where ΔW_t is the first difference of the variables in vector W, $\Pi = A\,B'$ is a coefficient matrix of cointegrating relationships, B_i is a coefficient matrix of the lags of differenced variables of W, X is a vector of exogenous variables, q is the lag order and $\varepsilon_t \sim N(0,\Omega)$ is an error (innovation) term with zero mean and variance-covariance matrix Ω. Equality $B'W_{t-1} = 0$ is the long-term equilibrium relationship between variables. The rank of matrix B, which is the number of long-term relationships, is assessed using the Johansen test. Note that the series under consideration may contain a nonzero mean, or trend. Similarly, cointegration equations can contain a constant and a trend.

VECM with a predetermined number of cointegrating relationships, a finite number of lagging differences, deterministic conditions, and exogenous variables can be defined, estimated, and used to predict, analyze causation, and impulse responses of endogenous variables [14,15].

This study examines the relations between GDP_Per_Cap, CPI, PPI and Ex_Rate. The list of variables includes exogenous variables consisting of a dummy variable and Brent crude oil prices (OP). The dummy variable reflects the COVID19 pandemic situation since the first quarter of 2020. In research were studied stationarity, integration of these time series, cointegration relations between them and the VECM was established using the Johansen procedure using Eviews 11 SV [16].

The stationarity and integration of the considered series were determined using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, respectively, known as "unit root tests". ADF and PP tests the null hypothesis that a unit root is present in a time series sample.

The Augmented Dickey-Fuller test for a unit root assesses the null hypothesis of a unit root using the model

$$y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^{p} c_i\, \Delta y_{t-i} + \varepsilon_t$$

where Δ is the difference operator, such that $\Delta y_t = y_t - y_{t-1}$, p is the number of lagged difference terms, and user specified, ε_t is a mean zero innovation process. The null hypothesis of a unit root is "$H_O : \gamma = 1$." Under the alternative hypothesis, $\gamma < 1$. Variants of the model allow for different growth characteristics. The model with $\beta = 0$ has no trend component, and the model with $\alpha = 0$ and $\beta = 0$ has no drift or trend. A test that fails to reject the null hypothesis, fails to reject the possibility of a unit root.

The Phillips-Perron model is

$$y_t = c + \delta t + \rho y_{t-1} + e_t,$$

where e_t is the innovations process. The test assesses the null hypothesis under the model variant appropriate for series with different growth characteristics ($c = 0$ or $\delta = 0$).

Determination of the cointegration relations, which is a characteristic of nonstationary series and the estimation of the cointegration rank was carried out by the Johansen Methodology [8].

Johansen's methodology takes its starting point in the vector autoregression (VAR) of order p given by

$$y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t\,,$$

where y_t is an $n \times 1$ vector of variables that are integrated of order one – commonly denoted $I(1)$ and ε_t is an $n \times 1$ vector of innovations. This VAR can be re-written as

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

where

$$\Pi = \sum_{i=1}^{p} \mathrm{A}_i - I \quad \text{and} \quad \Gamma_i = -\sum_{j=i+1}^{p} \mathrm{A}_j\,.$$

If the coefficient matrix Π has reduced rank $r < n$, then there exist $n \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta' y_t$ is stationary. r is the number of cointegrating relationships, the elements of α are known as the adjustment parameters in the vector error correction model and each column of β is a cointegrating vector. Johansen proposes two different likelihood ratio tests of the significance of these canonical correlations and thereby the reduced rank of the Π matrix: the trace test and maximum eigenvalue test, shown in following equations respectively [17].

$$J_{trace} = -T \sum_{i=r+1}^{n} \ln\left(1 - \hat{\lambda}_i\right) \quad \text{and}$$
$$J_{max} = -T \ln\left(1 - \hat{\lambda}_{r+1}\right).$$

The analysis of the created VEC model was carried out using the impulse responses function and the forecast error variance decomposition. Impulse responses are of interest in econometric studies. Impulse response function (IRF) of a dynamic system is its output when presented with a brief input signal, called an impulse. They are computed in practice using the $MA(\infty)$ representation of the VAR(p) process [17]:

$$y_t = \mu + \varepsilon_t + \psi_1\varepsilon_{t-1} + \psi_2\varepsilon_{t-2} + \cdots.$$

Thus, the matrix ψ_S has the interpretation $\frac{\partial y_{t+S}}{\partial \varepsilon_t} = \psi_S$ that is, the row i, column j element of ψ_S identifies the consequences of one unit increase in the jth variable's innovation at date $t(\varepsilon_{j\,t})$ for the value of the ith variable at time $t+s(y_{i\,t+S})$, holding all other innovations at all dates constant. $\frac{\partial y_{i\,t+S}}{\partial \varepsilon_t}$ as a function of s is called the impulse response function. It describes the response of $y_{i\,t+S}$ to a one-time impulse in $y_{j\,t}$ with all other variables earlier held constant.

The variance decomposition indicates the amount of information each variable contributes to the other variables in the autoregression. It determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables.

4. RESULTS AND DISCUSSION

4.1 Empirical analysis

4.1.1 Stationarity, integration and cointegration

The results of the ADF stationarity test for macroindicators such as GDP_Per_Cap, CPI, PPI, Ex_Rate based on monthly data 2015M01-2020M07 are given in Table 1, and the results of the Phillips-Perron test for determining integration are given in Table 2.

Table 1. ADF Fisher Unit Test on GDP_Per_Cap, CPI, PPI, EX_Rate

Null Hypothesis: Series has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, maxlag=10)			
Test critical values:	1% level	-4.12	
	5% level	-3.49	
	10% level	-3.17	
Augmented Dickey-Fuller test statistics:		**t-Statistic**	**Prob*.**
	GDP_Per_Cap	-1.19	.90
	CPI	-1.39	.86
	PPI	2.01	1.00
	Ex_Rate	-2.53	.31

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

Source: Compiled by the author based on the results of tests carried out in EViews 11

Table 2. Phillips-Perron Unit Test on D(GDP_Per_Cap), D(CPI), D(PPI), D(EX_rate)

Null Hypothesis: Series has a unit root Exogenous: Constant, Linear Trend Bandwidth: 2 (Newey-West automatic) using Bartlett kernel			
Test critical values:	1% level	-4.11	
	5% level	-3.48	
	10% level	-3.17	
Phillips-Perron test statistics:		**Adj. t-Stat**	**Prob*.**
	D(GDP_Per_Cap)	-11.02	.00
	D(CPI)	-7.05	.00
	D(PPI)	-10.68	.00
	D(Ex_Rate)	-8.59	.00

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

Source: Compiled by the author based on the results of tests carried out in EViews 11

It can be seen from Table 1 that the ADF test values of the series GDP_Per_Cap, CPI, PPI and Ex_Rate are greater than the t-statistic thresholds of the test levels of 1%, 5%, and 10%, and the probability P values are all greater than .10: $P_{GDP\_Per\_Cap} = .9 > .01\ (Cr.Val_{GDP\_Per\_Cap} = -1.19 > -4.12)$, $P_{CPI} = .86 > .01\ (Cr.Val_{CPI} = -1.39 > -4.12)$, $P_{PPI} = 1. > .01\ (Cr.Val_{PPI} = 2.01 > -4.12)$ and $P_{Ex\_Rate} = .31 > .01\ (Cr.Val_{Ex\_Rate} = -2.53 > -4.12)$. Thus, the null hypothesis cannot be rejected, so GDP_Per_Cap, CPI, PPI and Ex_Rate are non-stationary series.

The differenced series are D(GDP_Per_Cap), D(CPI), D(PPI) and D(Ex_Rate). It can be seen from Table 2 that the PP test value is less than the Adj.t -statistic threshold of 1%, 5% and 10% of the test level: $Cr.V_{GDP\_Per\_Cap} = -11.02 < -4.11$; $Cr.V_{CPI} = -7.05 < -4.11$; $Cr.V_{PPI} = -10.68 < -4.11$, $Cr.V_{Ex\_Rate} = -8.59 < -4.11$; and the probability P value is less than .01: $P_{GDP\_Per\_Cap} = P_{CPI} = P_{PPI} = P_{Ex_{Rate}} = .00 < .01$, which means the series D(GDP_Per_Cap), D(CPI), D(PPI) and D(Ex_Rate) are considered to be stationary series: $(GDP\_Per\_Cap, CPI, PPI, Ex\_Rate) \sim I(1)$. The series GDP_Per_Cap, CPI, PPI and EX_Rate are first order single-order series, indicating that the two may have a long term cointegration relationship.

The results of Johansen's cointegration test with the account of the influences of exogenous variables $X = (OP, Dummy)$ are given in Table 3. Given the lowest value of the AIC criterion ($AIC_{Low} = 19.33$) from this table we obtain that the cointegration rank being equal to 2 and it is possible to determine that under these conditions the model is specified with constant and linear trend :

$$"H*: \Delta w_t = A*(B'w_{t-1} + c_O + d_O t) + c_1 + \sum_{i=1}^{n} B_i \Delta w_{t-i} + DX_t + \varepsilon_t " \quad (1)$$

where n the number of lags and $n = 5$.

The cointegration equations of the model are as follows (Fig. 1):

$$Z_{t-1}^{(1)} = EC_{t-1}^{(1)} = GDP\_Per\_Cap_{t-1} - 0.24 \cdot PPI_{t-1} - 287.41 \cdot Ex\_Rate_{t-1} - 2.77t + 0.81;$$

$$Z_{t-1}^{(2)} = EC_{t-1}^{(2)} = CPI_{t-1} + 0.75 \cdot PPI_{t-1} - 13.02 \cdot Ex_{Rate_{t-1}} - 0.52t - 181.48.$$

Table 3. Johansen cointegration test summary

Series: GDP_PER_CAP CPI PPI EX_RATE					
Exogenous series: OP DUMMY					
Selected (0.05 level*) Number of Cointegrating Relations by Mode					
Data Trend:	None	None	Linear	Linear	Quadratic
Rank or	No Intercept	Intercept	Intercept	Intercept	Intercept
No. of CEs	No Trend	No Trend	No Trend	Trend	Trend
Trace	1	1	1	1	1
Max-Eig	1	1	1	1	1
*Critical values based on MacKinnon-Haug-Michelis (1999)					
Information Criteria by Rank and Model					
Akaike Information Criteria by Rank (rows) and Model (columns)					
0	20.33	20.33	20.20	20.20	20.30
1	19.90	19.65	19.55	19.36	19.44
2	19.94	19.62	19.66	19.33*	19.40
3	20.11	19.81	19.82	19.51	19.54
4	20.31	20.04	20.04	19.75	19.75

Source: Compiled by the author based on the results of tests carried out in EViews 11

4.1.2 Estimation and analysis VECM

Based on the above tests, VEC (5) model for the Republic of Azerbaijan based on the monthly indicators 2015M1-2020M7 can be written as follows, where $n = 5, rank = 2$.

$$\Delta GPC_t = -1.01(GPC_{t-1} - 0.24\, PPI_{t-1} - 287.41 ExR_{t-1} - 2.77t + 0.81) - 5.97(CPI_{t-1} + +0.75\, PPI_{t-1} - 13.02 ExR_{t-1} - 0.52t - 181.48) + 0.27\Delta GPC_{t-1} + 0.29\Delta GPC_{t-2} +$$

$$+0.65\Delta GPC_{t-3} + 0.09\Delta GPC_{t-4} - 0.11\Delta GPC_{t-5} + 8.49\Delta CPI_{t-1} + 7.1\Delta CPI_{t-2} + 8.88\Delta CPI_{t-3} -$$
$$-6.98\Delta CPI_{t-4} - 11.85\Delta CPI_{t-5} + 2.22\Delta PPI_{t-1} + 3.01\Delta PPI_{t-2} + 3.17\Delta PPI_{t-3} + 1.59\Delta PPI_{t-4} +$$
$$+2.67\Delta PPI_{t-5} - 427.45\Delta ExR_{t-1} - 485.72\Delta ExR_{t-2} - 488.64\Delta ExR_{t-3} - 133.66\Delta ExR_{t-4} -$$
$$-3.25\Delta ExR_{t-5} - 90.98 + 2.23OP - 96.05Dummy\_P;$$

$$\Delta CPI_t = -0.006(GPC_{t-1} - 0.24\ PPI_{t-1} - 287.41ExR_{t-1} - 2.77t + 0.81) - 0.17(CPI_{t-1} +$$
$$+0.75\ PPI_{t-1} - 13.02ExR_{t-1} - 0.52t - 181.48) + 0.003\Delta GPC_{t-1} - 0.003\Delta GPC_{t-2} +$$
$$+0.01\Delta GPC_{t-3} - 0.01\Delta GPC_{t-4} + 0.01\Delta GPC_{t-5} + 0.04\Delta CPI_{t-1} + 0.37\Delta CPI_{t-2} + 0.2\Delta CPI_{t-3} -$$
$$-0.002\Delta CPI_{t-4} - 0.006\Delta CPI_{t-5} + 0.09\Delta PPI_{t-1} + 0.11\Delta PPI_{t-2} + 0.09\Delta PPI_{t-3} + 0.09\Delta PPI_{t-4} +$$
$$+0.03\Delta PPI_{t-5} + 7.76\Delta ExR_{t-1} - 3.77\Delta ExR_{t-2} - 9.33\Delta ExR_{t-3} - 5.88\Delta ExR_{t-4} -$$
$$-2.21\Delta ExR_{t-5} - 1.51 + 0.04OP - 0.77Dummy\_P; \quad (2)$$

$$\Delta PPI_t = -0.02(GPC_{t-1} - 0.24\ PPI_{t-1} - 287.41ExR_{t-1} - 2.77t + 0.81) - 0.52(CPI_{t-1} +$$
$$+0.75\ PPI_{t-1} - 13.02ExR_{t-1} - 0.52t - 181.48) + 0.02\Delta GPC_{t-1} - 0.02\Delta GPC_{t-2} +$$
$$-0.02\Delta GPC_{t-3} + 0.03\Delta GPC_{t-4} + 0.005\Delta GPC_{t-5} + 0.17\Delta CPI_{t-1} + 0.65\Delta CPI_{t-2} + 0.12\Delta CPI_{t-3} -$$
$$+0.24\Delta CPI_{t-4} - 0.2\Delta CPI_{t-5} - 0.21\Delta PPI_{t-1} - 0.06\Delta PPI_{t-2} + 0.15\Delta PPI_{t-3} + 0.39\Delta PPI_{t-4} +$$
$$+0.13\Delta PPI_{t-5} - 6.7\Delta ExR_{t-1} - 15.07\Delta ExR_{t-2}8.78\Delta ExR_{t-3} - 45.1\Delta ExR_{t-4} -$$
$$-4.02\Delta ExR_{t-5} - 1.58 + 0.07OP - 36.56Dummy\_P;$$

$$\Delta ExR_t = 0.0004(GPC_{t-1} - 0.24\ PPI_{t-1} - 287.41ExR_{t-1} - 2.77t + 0.81) - 0.009(CPI_{t-1} +$$
$$+0.75\ PPI_{t-1} - 13.02ExR_{t-1} - 0.52t - 181.48) - 0.0003\Delta GPC_{t-1} - 0.0003\Delta GPC_{t-2} +$$
$$-0.0002\Delta GPC_{t-3} - 0.0003\Delta GPC_{t-4} - 6.94e - 5\Delta GPC_{t-5} + 0.01\Delta CPI_{t-1} + 0.01\Delta CPI_{t-2} +$$
$$+0.006\Delta CPI_{t-3} + 0.0002\Delta CPI_{t-4} - 0.002\Delta CPI_{t-5} + 0.005\Delta PPI_{t-1} + 0.007\Delta PPI_{t-2} +$$
$$+0.007\Delta PPI_{t-3} + 0.004\Delta PPI_{t-4} + 0.003\Delta PPI_{t-5} - 0.41\Delta ExR_{t-1} - 0.41\Delta ExR_{t-2} - 0.3\Delta ExR_{t-3}$$
$$- 0.29ExR_{t-4} - 0.2\Delta ExR_{t-5} + 0.13 - 0.002OP - 0.08Dummy\_P.$$

here, for simplicity, the variables GDP_Per_Cap and Ex_Rate are denoted by GPC and ExR, respectively.

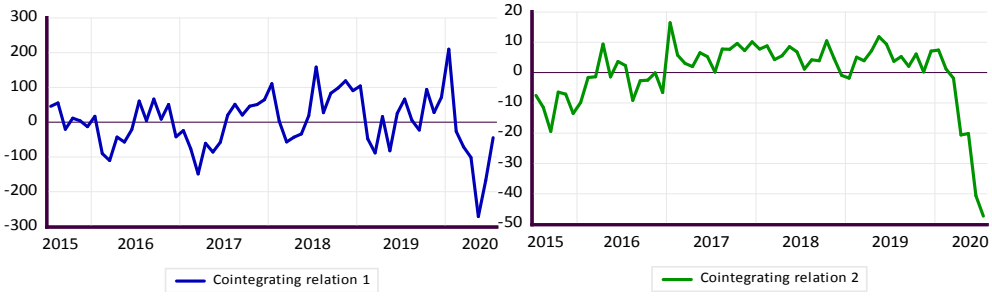

Fig. 1. Cointegration relations of VECM (5)

The stationarity of the VAR and VEC models can be checked using the inverse roots of the characteristic Polynomial of the model. The estimated VAR is stable (stationary) if all roots of the characteristic Polynomial have modulus less than one and lie inside the unit circle. There will be $k * p$ roots, where k is the number of endogenous variables and p is the largest lag. But for VECM with k-endogenous variables and r cointegrating relations, then $k - r$ roots should be equal to one [14,15].

As shown in Fig. 2, the two inverse roots of the characteristic Polynomial are equal to one and the rest have modulus less than one. So, the created VEC(5) model is stable.

4.1.3 Impulse responses

An impulse response function traces the response to a one-time shock in the innovation. A shock to the i-th variable not only directly affects the i -th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR and VEC. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. Table 4 and Fig. 3 shows the impulse responses over the short run (6 months), medium run (12 - 24 months) and over the long run (48 months).

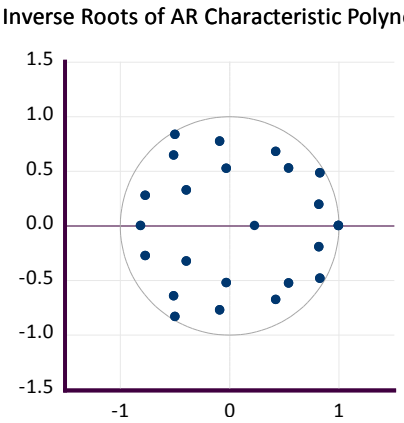

Fig. 2. Inverse roots of AR characteristic equation of the VECM(5)

A1) The positive shock of the CPI did not affect the GDP per capita in the first month, the reaction of GDP_Per_Cap was positive until the 4th month, and negative in the long term and towards the end of the short term. The minimum value of this IRF is -17.43 on the 6th month.

A2) GDP_Per_Cap's response to a positive shock of PPI, although zero in the first month, was almost negative in the short and long term, with the lowest response value of -19.75 on the fifth month.

A3) GDP per Capita did not respond to the positive shock of the exchange rate in the first month, but in the following three months the reactions were negative. The smallest value of IRF was -10.32 on the 13th month, and the maximum 21.37 on the 20th month. GDP_per_Capita's response to Ex_Rate was positive in the long run.

Let's consider the İmpulse reactions of the CPI indicator:

B1) The positive shock of GDP_Per_Cap caused a negative reaction in the CPI from the 1st month and almost in the short and long term, while in the medium term there is a positive reaction. The minimum value of the impulse response function (IRF) of CPI was -.64 on the 3rd month, and the maximum value was .21 on the 19th month.

B2) Although CPI did not respond to the positive shock of PPI on the first month, IRF showed a rapid decline in the short term, reaching a low of -2.62, and was negative in the long term.

B3) To the shock of Ex_Rate, although IR of CPI was zero at the start of the study period, it was positive throughout the entire period except months 5th and 7th. The maximum IRF was .91 on month 12th and the IRF stabilized by almost level .5 from the beginning of the long term.

Consider the responses of PPI to the shocks of indicators:

C1) IRF of PPI to the shock of the GDP_Per_Cap was positive at the level of 1.45 in the beginning of the survey period and negative at the level of -1.54 on the second month. The IRF has been positive in the medium and long term.

C2) A positive shock of CPI caused a negative reaction of PPI during the entire study period, so the IRF score was -.76 on the first month. The minimum value of IRF is -2.47 on the 5th month, and the maximum value is -0.81 on the 7th month.

C3) Although the innovation of PPI response function of Ex_Rate has some positive values in the short term, most of the values of this IR function are negative. IRF had a maximum value of 1.89 on the 4th month and minimum value of -1.83 on the 5th month.

The exchange rate reacted weakly positively to the shock of GDP_Per_Cap and weakly negatively to the shocks CPI and PPI. So that,

D1) The positive shock of GDP_Per_Cap caused the maximum response of PPI (.03) on the 7th month and the minimum response (.009) on the 11th month.

D2) Although the response of Ex_Rate to a positive shock of CPI was positive (0.029) on the

1st month, it turned negative from the 6th month and got its lowest value (-0.017) on the 12th month.

D3) Although the positive shock of PPI caused to weakly positive response of Ex_Rate on the 1st month (.003), and IRF declined rapidly in the short term and reached its lowest value on 8th month (-.055). The maximum effect of PPI is approximately -.035 in the long term.

4.1.4 Variance Decomposition

Impulse response analysis provides information on the size of shock effects on domestic variables, a variance decomposition shows the extent to which these shocks are responsible for the volatility of variables (of prediction errors) [7]. Variance decomposition of error forecast expresses the percentage of shock impact of one indicator to the another error forecast. Variance Decomposition of error forecast of the developed model VEC(5) is given in Table 5 and Fig. 4 over a 5 year period.

It can be seen from Table 5 and Fig. 4 that: a) the impact of CPI to GDP_Per_Capita does not exceed 9.13% throughout the horizon, while in the short and medium run the impact of the Exchange Rate and PPI are almost 20% and 23%, respectively; in the long run, they are almost 28% and 24%, respectively;

Table 4. Impulse response to Cholesky one S.D. (d.f. adjusted) innovations

Response of GDP_Per_Capita				
Period	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	52.93	0.00	0.00	0.00
6	-6.68	-17.43	0.30	16.28
12	9.30	-0.31	-1.20	2.15
24	10.24	-1.21	-4.07	1.02
36	9.92	-1.90	-5.90	2.06
48	9.44	-2.40	-7.10	3.03
60	8.88	-2.72	-7.92	3.86
Response of CPI				
Period	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	-0.28	1.61	0.00	0.00
6	-0.10	1.38	-1.25	-0.07
12	-0.47	0.90	-2.61	0.91
24	-0.25	0.92	-2.28	0.66
36	-0.18	0.97	-2.28	0.58
48	-0.12	1.00	-2.27	0.53
60	-0.09	1.02	-2.26	0.50
Response of PPI				
Period	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	1.45	-0.76	6.57	0.00
6	-0.53	-1.82	2.42	-0.26
12	0.09	-1.95	2.23	0.29
24	0.13	-1.72	2.39	0.002
36	0.25	-1.67	2.37	-0.08
48	0.32	-1.63	2.39	-0.14
60	0.37	-1.61	2.39	-0.17
Response of Ex_Rate				
Period	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	0.01	0.03	0.003	0.06
6	0.02	-0.01	-0.03	0.02
12	0.01	-0.02	-0.04	0.03
24	0.02	-0.01	-0.03	0.03
36	0.02	-0.01	-0.04	0.02
48	0.02	-0.01	-0.03	0.02
60	0.02	-0.01	-0.03	0.02

Source: Compiled by the author based on calculations performed in EViews 11

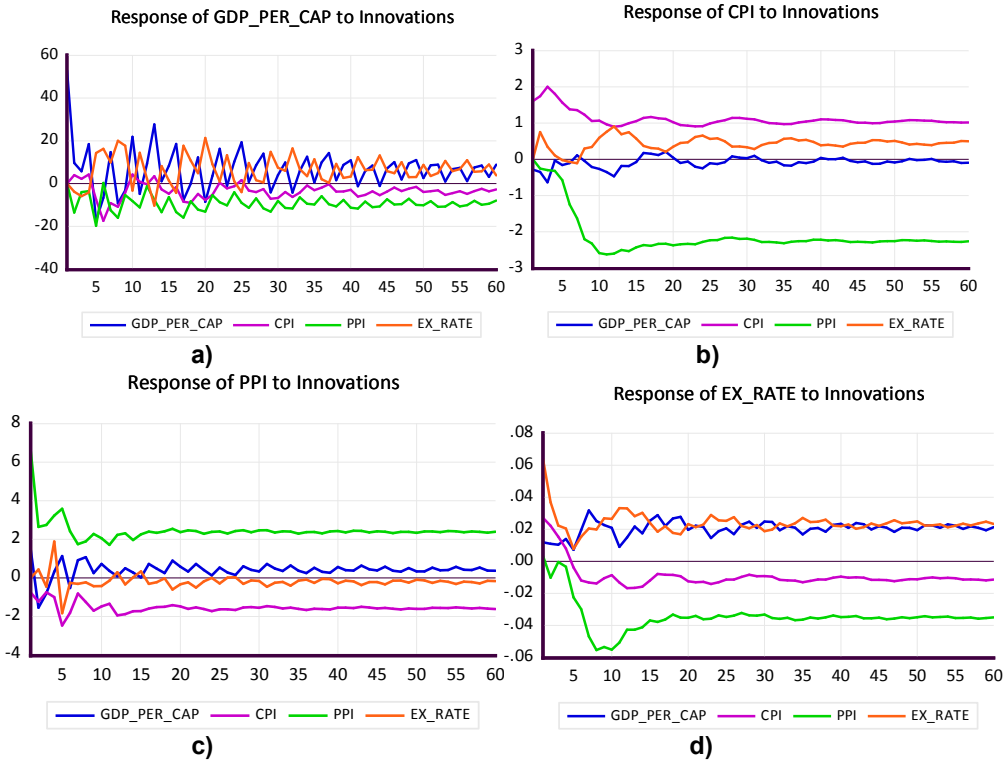

Fig. 3. Impulse responses of macroeconomic indicators

b) the impact of GDP_Per_Capita on changes in the CPI is almost non-existent throughout the horizon (0.53%), while the impact of the Exchange Rate is very weak, is around 4%. Although the impact of shock of PPI to CPI is not very large in the short run (≈20%), in the medium and long run the CPI volatility is 70% and 76%, respectively;

c) the impacts of GDP_Per_Capita and Exchange Rate on changes in PPI are very weak, by being 3.5% and 2%, respectively. It can be determined that the shock of CPI affects the PPI by 20% in the short term and about 26% in the long term;

d) the variance of the Exchange Rate can be explained by a shock of 16% CPI in the short run, but its effect is reduced to 6% in the medium and long run. The shock of GDP_Per_Capita has an upward effect on the Exchange Rate, up to 17% throughout the horizon. The shock of PPI can explain the volatility of the Exchange Rate almost 40% in the short term, and in the medium and long term almost 52%.

Denote through μ_S^R and δ_S^R the positive and negative effects of factor R on factor S, respectively. We can summarize the analysis of estimated VECM(5) in the following results:

- PPI and CPI are negative, and Ex_Rate - positively affects the change in GDP_per_Cap:

$$\delta_{GDP\_Per\_Cap}^{PPI} < \delta_{GDP\_Per\_Cap}^{CPI} < \mu_{GDP\_Per\_Cap}^{Ex\_Rate};$$

- GDP_per_Cap and PPI are negative, and Ex_Rate - positively affects the change in CPI:

$$\delta_{CPI}^{PPI} < \delta_{CPI}^{GDP\_Per\_Cap} < \mu_{CPI}^{Ex\_Rate};$$

- CPI and Ex_Rate are negative, and GDP_per_Cap - positively affects the change in PPI:

$$\delta_{PPI}^{CPI} < \delta_{PPI}^{Ex\_Rate} < \mu_{PPI}^{GDP\_Per\_Cap};$$

- CPI and PPI are negative, and GDP_per_Cap - positively affects the change in Ex_Rate:

$$\delta_{Ex\_Rate}^{PPI} < \delta_{Ex\_Rate}^{CPI} < \mu_{Ex\_Rate}^{GDP\_Per\_Cap}.$$

Table 5. Variance decomposition using Cholesky (d.f. adjusted) factors

Variance Decomposition of GDP_Per_Capita					
Period	**S.E.**	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	52.93	100.00	0.00	0.00	0.00
6	71.78	70.15	7.73	11.69	10.43
12	89.24	56.72	7.99	15.52	19.78
24	113.20	49.68	7.42	19.96	22.94
36	127.12	46.11	7.23	22.99	23.67
48	137.47	43.42	7.13	25.63	23.83
60	146.16	41.21	7.07	27.86	23.85
Variance Decomposition of CPI					
Period	**S.E.**	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	1.63	3.03	96.97	0.00	0.00
6	4.56	3.10	83.20	10.30	3.40
12	7.99	1.75	38.57	55.48	4.19
24	12.17	0.96	25.20	69.95	3.90
36	14.97	0.69	22.57	73.02	3.72
48	17.35	0.54	21.18	74.67	3.61
60	19.44	0.44	20.35	75.67	3.54
Variance Decomposition of PPI					
Period	**S.E.**	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	6.77	4.59	1.26	94.15	0.00
6	10.68	5.95	11.43	76.14	6.48
12	12.42	6.17	16.80	71.83	5.20
24	16.01	4.92	22.32	69.17	3.59
36	18.93	4.23	24.28	68.72	2.77
48	21.43	3.82	25.43	68.46	2.29
60	23.68	3.55	26.16	68.32	1.97
Variance Decomposition of Ex_Rate					
Period	**S.E.**	**GDP_Per_Cap**	**CPI**	**PPI**	**Ex_Rate**
1	0.07	2.86	14.88	0.20	82.06
6	0.10	9.22	15.56	14.18	61.05
12	0.19	11.19	7.76	49.30	31.75
24	0.26	15.28	6.91	50.75	27.06
36	0.31	16.58	6.39	51.11	25.92
48	0.35	17.23	6.11	51.43	25.23
60	0.39	17.62	5.93	51.64	24.80

Source: Compiled by the author based on calculations performed in EViews 11

4.2 Variance Decomposition Using Cholesky (d.f.adjusted) Factors

The analysis based on the monthly statistics 2003M01-2019M10 for Turkey showed that there is a co-integration relation between CPI, PPI and Exchange rate; bi-directional relation between CPI and Exchange rate and uni-directional causality from Exchange rate to PPI [18]. Based on the model for monthly values (2001m1-2016m12) of indicators, it was found that there are bi-directional long-term and short-term influences between CPI and Exchange rate [19]. In our study has been identified, that for the economy of Azerbaijan there is a co-integration relationship for the triad (CPI, PPI, Exchange Rate) and this co-integration equation is significant for the all analyzed indicators, but the share of PPI in this relation is greater than that of CPI. And between PPI and Exchange Rate there is bi-directional causality, and uni-directional causality from Exchange Rate to CPI. The results [4] show that there is a long-term equilibrium cointegration relationship between CPI and PPI in China for the monthly values 2008m1-2018m12 of indicators, but this influence is not large, and the current CPI will be adversely affected by the previous CPI and the positive impact of the previous PPI, the current PPI will be positively affected by the previous phase of CPI and the previous phase of PPI. Based on the nonlinear STR model taking into account 1990M01-2011M1 monthly values of indicators it has been determined that previous CPI have a

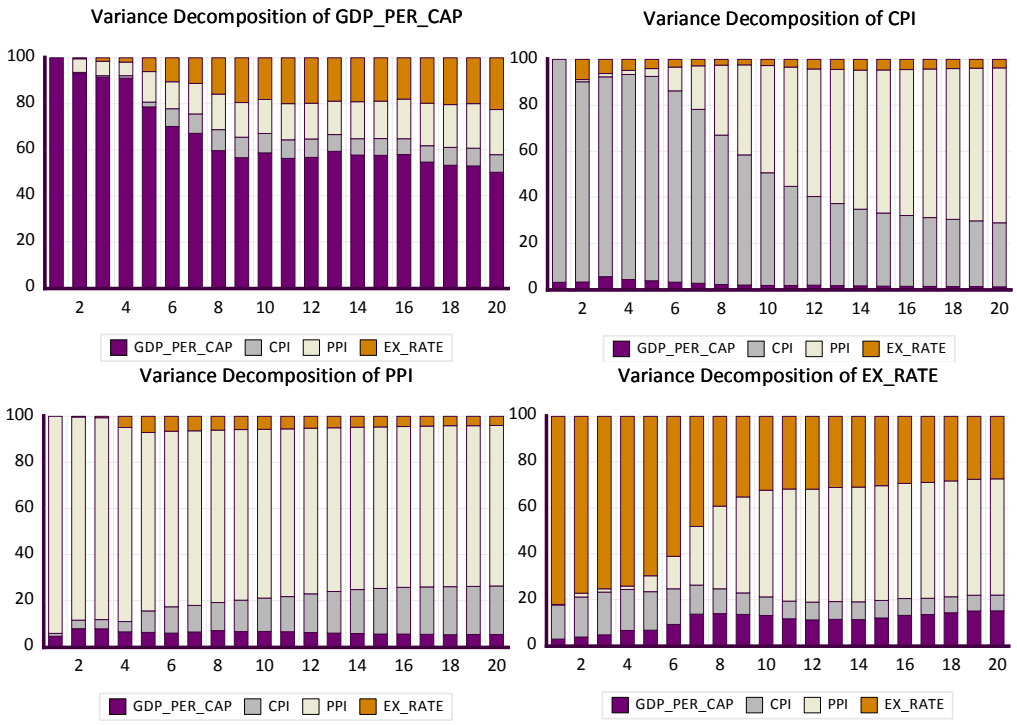

Fig. 4. Variance decomposition using Cholesky (d.f. adjusted) factors

positive effect on the current CPI [5]. In our research, revealed that the impact of previous phase CPI prices on current phase CPI is positively.

In addition, there are a long-term and short-term influences from each variable CPI, PPI and Exchange Rate to GDP per Capita, but there is uni-directional short-run causality from GDP per Capita to CPI.

5. CONCLUSION

In this study, the impact of the consumer price index, producer price index, GDP per Capita, and exchange rate were studied using the VEC model, taking into account oil prices and the COVID19 pandemic. We can summarize the research results as follows:

1) It was revealed that multiply time series (GDP_Per_Cap, CPI, PPI, Ex_Rate) are not stationary, but are integrated of the first order.
2) There are two cointegration relationships that show a long-term stable relationship for GDP_Per_Cap, CPI, PPI and Ex_Rate processes taking into account the oil price and the impact of the COVID pandemic.
3) The stability of the model was determined by the inverse roots of characteristic polynomial of VECM(5).
4) Analyzing impulse responses and variance decomposition, we found that an increase in the production price index negatively affects other indicators, an increase in the Exchange Rate will lead to an increase in GDP and CPI per Capita, and a decrease in PPI; It was found that an increase in CPI negatively affects other macrovariables at the lower level.

Based on the analysis carried out in this study, it can be said that a decrease in the price index for products in the Republic of Azerbaijan may affect the strengthening of the local currency, the Azerbaijani Manat (AZN), which, in turn, may not lead to an increase in the consumer price index. The strengthening of the country's economy reduces exports, but at the same time allows the purchase of imported equipment and technology. The positive effect of strengthening the country's currency includes: stabilization, lower interest rates, inflow of financial capital, incentives for imports, access of local companies to imported technologies and the possibility of organizing joint production.

It should be noted that the Azerbaijani government has identified the areas most affected by the pandemic and provided them with financial support to cause less damage.

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COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

1. Musayev AF, Davudova RI, Musayeva AA. Application of interval analysis in evaluation of macroeconomic impacts of taxes. 13th international conference on theory and application of fuzzy systems and soft computing — ICAFS-2018. Advances in Intelligent Systems and Computing, Springer, Cham. 2018;896: 627-634.
DOI: 10.1007/978-3-030-04164-9_82
2. Davudova RI. Investigation of unbalanced open economy system by using ınterval mathematics for the case of Azerbaijan Republic. 10th International Conference on Theory and Application of Soft Computing, Computing with Words and Perceptions - ICSCCW-2019. Advances in Intelligent Systems and Computing, Springer, Cham. 2019;1095: 565-573.
DOI: 10.1007/978-3-030-35249-3_72
3. Davudova RI. Empırıcal analysıs of the relatıonshıp among the GDP, cash ın cırculatıon, ınterest rate, oıl prıces and prıce ındex: on the example of the Republıc of Azerbaıjan. Audit 2. Special Issue. 2020;28(2):74-85.
Available:http://auditjournal.az/en/articles/56
4. Li SJ, Tang GQ, Yang DC, Du SX. Research on the relationship between CPI and PPI based on VEC Model. Open Journal of Statistics. 2019; 9:218-229.
Available: https://m.scirp.org/papers/91757
5. Li K, Chen J. A study of the nonlinear relation between CPI and international oil price based on STR model. Advances in computer science, environment, ecoinformatics, and education. CSEE 2011. Communications in Computer and Information Science. Springer, Berlin, Heidelberg. 2011;217:324-329.
DOI: 10.1007/978-3-642-23339-5_59
6. Yechen Zhu, David Dickinson, Jianjun Li. Analysis on the influence factors of Bitcoin's price based on VEC model. Financial Innovation. 2017;3:3.
DOI: 10.1186/s40854-017-0054-0
7. Ivo Krznar, Davor Kunovac. Impact of external shocks on domestic inflation and GDP. Working Papers 26, The Croatian National Bank, Croatia. Zagreb; 2010.
Available:https://www.hnb.hr/repec/hnb/wpaper/pdf/w-026.pdf
8. Cao Lu, Zhou XinImpulse. Response function analysis. An application to macroeconomy data of China. D-level Essay in Statistics. Department of Economics and Society, Högskolan Dalarna, Sweden; 2010.
Available:http://www.statistics.du.se/essays/D10_Xinzhou_lucao.pdf
9. Wei Ru-xiang, Du Jun-gang, Kang Cen-cheng. Dynamic influence analysis of the CPI on ship maintenance hourly rate based on VAR model. MSIE 2011;594-599.
Available:http://toc.proceedings.com/10641webtoc.pdf
10. Available:https://www.stat.gov.az/news/macroeconomy.php?page=1&lang=en
11. Available:https://www.cbar.az/page-40/statistical-bulletin?language=en
12. Available:https://tradingeconomics.com/azerbaijan/indicators
13. Johansen S. Likelihood-based inference in cointegrated vector autoregressive models / Oxford University Press; 1996.
Available:https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.457.3521&rep=rep1&type=pdf
14. Helmut L, Markus K. VECM analysıs ın JMulTi. 2005;5:1-40.
Available:http://www.jmulti.de/download/help/vecm.pdf
15. Bannikov VA. Vector autoregressive models and correction of regression residuals (EVıews). Applied Econometrics. Russian. 2006;3:96-129.
Available:https://cyberleninka.ru/article/n/vektornye-modeli-avtoregressii-i-korrektsii-regressionnyh-ostatkov-eviews
16. EViews 7 User's Guide II. Quantitative micro Software, LLC; 2010.

Available:http://schwert.ssb.rochester.edu/a425/ev72.pdf
17. Hjalmarsson E, Österholm P. Testing for cointegration using the johansen methodology when variables are nearintegrated. IMF Working Paper. Western Hemisphere Division; 2007.
Available:https://www.imf.org/external/pubs/ft/wp/2007/wp07141.pdf
18. Usupbeyli A, Ucak S. The effects of exchange rates on CPI and PPI. Business and Economics Research Journal. 2020; 11(2):323-334.
DOI: 10.20409/berj.2020.252
19. Ghauri S, Ahmed RR, Vveinhardt J, Qureshi KS. The effects of remittances on inflation (CPI and WPI) and exchange rate: A case of Pakistan. Romanian journal of economic forecasting. 2019;22(2):146-165.
Available:https://www.researchgate.net/publication/334544001_The_effects_of_remittances_on_inflation_CPI_and_WPI_and_exchange_rate_A_Case_of_Pakistan

APPENDIX

Table A1. Estimated VECM(5)

Vector Error Correction Estimates
Date: 10/01/20 Time: 17:51
Sample (adjusted): 2015M07 2020M07
Included observations: 61 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	**CointEq1**	**CointEq2**		
GDP_PER_CAP(-1)	1.000000	0.000000		
CPI(-1)	0.000000	1.000000		
PPI(-1)	-0.242504	0.754375		
	(1.81345)	(0.22781)		
	[-0.13373]	[3.31147]		
EX_RATE(-1)	-287.4097	-13.02345		
	(59.0850)	(7.42231)		
	[-4.86434]	[-1.75464]		
@TREND(15M01)	-2.768313	-0.519986		
	(0.71403)	(0.08970)		
	[-3.87705]	[-5.79717]		
C	0.806433	-181.4780		
Error Correction:	**D(GDP_PER_CAP)**	**D(CPI)**	**D(PPI)**	**D(EX_RATE)**
CointEq1	-1.007741	-0.006390	-0.023585	0.000436
	(0.21959)	(0.00677)	(0.02808)	(0.00029)
	[-4.58918]	[-0.94355]	[-0.83999]	[1.50080]
CointEq2	-5.971593	-0.174140	-0.523267	-0.009049
	(2.33427)	(0.07199)	(0.29847)	(0.00309)
	[-2.55822]	[-2.41880]	[-1.75316]	[-2.92748]
D(GDP_PER_CAP(-1))	0.272972	0.003022	-0.021767	-0.000293
	(0.18668)	(0.00576)	(0.02387)	(0.00025)
	[1.46226]	[0.52482]	[-0.91192]	[-1.18520]
D(GDP_PER_CAP(-2))	0.286202	-0.002740	-0.020936	-0.000343
	(0.16926)	(0.00522)	(0.02164)	(0.00022)
	[1.69087]	[-0.52483]	[-0.96732]	[-1.53252]
D(GDP_PER_CAP(-3))	0.646783	0.011433	-0.016331	-0.000178
	(0.18604)	(0.00574)	(0.02379)	(0.00025)
	[3.47662]	[1.99252]	[-0.68653]	[-0.72337]
D(GDP_PER_CAP(-4))	0.090760	0.009595	0.033264	-0.000288
	(0.17612)	(0.00543)	(0.02252)	(0.00023)
	[0.51534]	[1.76640]	[1.47716]	[-1.23554]
D(GDP_PER_CAP(-5))	-0.105802	0.010185	-0.004641	-6.95E-05
	(0.16476)	(0.00508)	(0.02107)	(0.00022)
	[-0.64215]	[2.00425]	[-0.22029]	[-0.31843]

D(CPI(-1))	8.489677	0.037717	-0.171112	0.012201
	(5.66449)	(0.17471)	(0.72429)	(0.00750)
	[1.49875]	[0.21589]	[-0.23625]	[1.62661]
D(CPI(-2))	7.095579	0.365233	0.651799	0.009568
	(5.77023)	(0.17797)	(0.73781)	(0.00764)
	[1.22969]	[2.05225]	[0.88343]	[1.25225]
D(CPI(-3))	8.879523	0.203653	0.117742	0.006306
	(5.66057)	(0.17459)	(0.72379)	(0.00750)
	[1.56866]	[1.16649]	[0.16268]	[0.84125]
D(CPI(-4))	-6.981854	-0.001602	0.240320	0.000164
	(4.94716)	(0.15258)	(0.63257)	(0.00655)
	[-1.41129]	[-0.01050]	[0.37991]	[0.02508]
D(CPI(-5))	-11.85109	-0.005550	-0.200435	-0.001560
	(4.43856)	(0.13690)	(0.56753)	(0.00588)
	[-2.67003]	[-0.04054]	[-0.35317]	[-0.26542]
D(PPI(-1))	2.221607	0.085442	-0.211742	0.005100
	(1.75899)	(0.05425)	(0.22491)	(0.00233)
	[1.26300]	[1.57492]	[-0.94144]	[2.18971]
D(PPI(-2))	3.014807	0.108331	-0.060611	0.007084
	(1.71452)	(0.05288)	(0.21923)	(0.00227)
	[1.75839]	[2.04862]	[-0.27647]	[3.12003]
D(PPI(-3))	3.171221	0.092453	0.154853	0.006542
	(1.60403)	(0.04947)	(0.20510)	(0.00212)
	[1.97703]	[1.86879]	[0.75502]	[3.07997]
D(PPI(-4))	1.587874	0.093538	0.388760	0.004170
	(1.50080)	(0.04629)	(0.19190)	(0.00199)
	[1.05802]	[2.02077]	[2.02586]	[2.09817]
D(PPI(-5))	2.674344	0.028601	0.128304	0.002814
	(1.04183)	(0.03213)	(0.13321)	(0.00138)
	[2.56698]	[0.89009]	[0.96315]	[2.03960]
D(EX_RATE(-1))	-427.4516	7.760975	-6.698391	-0.413191
	(134.218)	(4.13960)	(17.1617)	(0.17773)
	[-3.18476]	[1.87481]	[-0.39031]	[-2.32483]
D(EX_RATE(-2))	-485.7195	-3.767423	-15.07284	-0.413549
	(150.199)	(4.63251)	(19.2052)	(0.19889)
	[-3.23383]	[-0.81326]	[-0.78483]	[-2.07926]
D(EX_RATE(-3))	-488.6357	-9.330852	8.776951	-0.296787
	(158.529)	(4.88940)	(20.2702)	(0.20992)
	[-3.08232]	[-1.90838]	[0.43300]	[-1.41380]
D(EX_RATE(-4))	-133.6557	-5.884125	-45.09748	-0.294392
	(130.099)	(4.01255)	(16.6350)	(0.17227)
	[-1.02734]	[-1.46643]	[-2.71100]	[-1.70885]
D(EX_RATE(-5))	-3.248411	-2.212597	-4.024869	-0.195731
	(120.367)	(3.71241)	(15.3907)	(0.15939)
	[-0.02699]	[-0.59600]	[-0.26151]	[-1.22801]
C	-90.97825	-1.513519	-1.582388	0.129507
	(56.5236)	(1.74332)	(7.22737)	(0.07485)
	[-1.60956]	[-0.86818]	[-0.21894]	[1.73026]
OP	2.231023	0.042390	0.066258	-0.001570
	(0.95830)	(0.02956)	(0.12253)	(0.00127)
	[2.32812]	[1.43421]	[0.54074]	[-1.23704]
DUMMY_P	-96.05245	-0.789696	-36.56318	-0.077418
	(49.1978)	(1.51738)	(6.29066)	(0.06515)

	[-1.95237]	[-0.52043]	[-5.81229]	[-1.18836]
R-squared	0.733131	0.523663	0.695243	0.459909
Adj. R-squared	0.555218	0.206106	0.492071	0.099848
Sum sq. resids	100842.9	95.92704	1648.718	0.176825
S.E. equation	52.92628	1.632373	6.767402	0.070084
F-statistic	4.120727	1.649034	3.421950	1.277308
Log likelihood	-312.5738	-100.3630	-187.1101	91.67048
Akaike AIC	11.06799	4.110263	6.954429	-2.185917
Schwarz SC	11.93311	4.975375	7.819541	-1.320805
Mean dependent	3.878689	0.783443	-1.486885	0.010775
S.D. dependent	79.35927	1.832052	9.495560	0.073869
Determinant resid covariance (dof adj.)		1258.027		
Determinant resid covariance		152.6092		
Log likelihood		-499.5713		
Akaike information criterion		19.98595		
Schwarz criterion		23.79244		
Number of coefficients		110		

Table A2. VEC stability condition check

Roots of Characteristic Polynomial
Endogenous variables: GDP_PER_CAP CPI PPI EX_RATE
Exogenous variables: OP DUMMY_P
Lag specification: 1 5
Date: 10/01/20 Time: 22:23

Root	Modulus
1.000000	1.000000
1.000000	1.000000
-0.496558 + 0.833563i	0.970256
-0.496558 - 0.833563i	0.970256
0.829407 - 0.482518i	0.959551
0.829407 + 0.482518i	0.959551
0.821068 - 0.194416i	0.843772
0.821068 + 0.194416i	0.843772
-0.507408 + 0.644823i	0.820524
-0.507408 - 0.644823i	0.820524
-0.768035 - 0.276197i	0.816187
-0.768035 + 0.276197i	0.816187
-0.809862	0.809862
0.425464 + 0.678400i	0.800779
0.425464 - 0.678400i	0.800779
-0.086028 - 0.773024i	0.777796
-0.086028 + 0.773024i	0.777796
0.543711 + 0.526578i	0.756906
0.543711 - 0.526578i	0.756906
-0.026691 + 0.523417i	0.524097
-0.026691 - 0.523417i	0.524097
-0.392843 - 0.324930i	0.509809
-0.392843 + 0.324930i	0.509809
0.232964	0.232964

VEC specification imposes 2 unit root(s)

Table A3. Table 4. Impulse response to cholesky One S.D. (d.f. adjusted) innovations

Response of GDP_PER_CAP:				
Period	**GDP_PER_CAP**	**CPI**	**PPI**	**EX_RATE**
1	52.92628	0.000000	0.000000	0.000000
2	9.654657	3.970234	-13.57534	-3.812288
3	5.731950	2.208186	-3.989113	-5.914250
4	18.46371	4.265075	-3.487464	-4.187256
5	-17.37761	-7.438641	-19.74795	14.32436
6	-6.679921	-17.43425	0.299867	16.27865
7	14.73926	-9.110000	-12.49223	9.937397
8	-9.264021	-10.88877	-15.98688	20.06433
9	-3.193438	-4.202071	-5.352454	17.69589
10	21.87815	4.239738	-8.157822	-3.282877
11	-4.830308	0.863685	-11.17631	14.41255
12	9.300861	-0.311385	-1.197221	2.148230
13	27.67731	3.468109	-7.601032	-10.31601
14	1.093366	-2.709448	-13.36294	8.200794
15	8.343621	-4.773539	-6.301500	1.368654
16	18.55939	-1.587975	-13.29699	-4.370258
17	-7.753061	-8.483897	-15.93273	17.70091
18	-0.058735	-9.025680	-8.301997	10.74837
19	12.27005	-4.796380	-12.18369	4.841380
20	-8.519584	-7.685382	-13.15911	21.36880
21	3.600507	-5.228943	-5.391793	9.073213
22	16.30431	0.440093	-8.711747	0.998628
23	-1.123964	-2.246226	-10.18477	13.31306
24	10.24490	-1.213750	-4.074154	1.022645
25	19.34463	1.654714	-8.979806	-3.977697
26	0.811146	-3.298797	-11.31859	9.631852
27	8.581492	-3.976336	-6.911325	1.555446
28	14.02182	-2.578167	-11.60108	0.542797
29	-4.122844	-7.113301	-13.15948	14.83657
30	3.961122	-6.708633	-8.132160	7.419403
31	9.885265	-3.907845	-11.40137	5.980342
32	-4.249283	-6.267567	-11.61635	16.45156
33	5.914657	-4.227993	-6.413309	6.760078
34	12.56810	-0.890384	-9.425997	3.460864
35	0.541115	-3.094307	-9.814000	11.38106
36	9.915183	-1.903472	-5.899771	2.061188
37	14.28693	-0.271167	-9.658969	0.379886
38	1.591673	-3.729013	-10.66645	9.252127
39	8.717463	-3.712744	-7.650022	2.635802
40	10.86800	-2.923010	-11.25866	3.305476
41	-1.223349	-6.063135	-11.70323	12.37166
42	5.876777	-5.318642	-8.388939	6.305964
43	8.422200	-3.650795	-11.05220	6.474111
44	-1.096958	-5.419228	-10.68420	13.17921
45	7.089531	-3.745839	-7.347530	5.829418
46	10.08266	-1.820579	-9.794681	4.849453
47	1.941916	-3.486221	-9.596550	9.983009
48	9.436749	-2.396182	-7.095077	3.034261
49	11.01141	-1.515709	-9.950048	3.045197
50	2.589961	-3.911177	-10.13695	8.715567
51	8.550947	-3.544886	-8.201106	3.541906
52	8.850458	-3.160984	-10.88870	4.907823
53	0.954236	-5.298298	-10.73814	10.59145

54	6.790766	-4.489614	-8.647049	5.816563
55	7.399540	-3.562047	-10.70359	6.786053
56	1.180524	-4.833690	-10.09518	10.95227
57	7.532399	-3.503663	-8.025613	5.499369
58	8.430395	-2.445439	-9.922011	5.741804
59	3.111991	-3.653800	-9.452631	8.930125
60	8.879982	-2.722378	-7.920770	3.859923
		Response of CPI:		
Period	**GDP_PER_CAP**	**CPI**	**PPI**	**EX_RATE**
1	-0.284270	1.607430	0.000000	0.000000
2	-0.347548	1.742581	-0.254442	0.753330
3	-0.636294	2.006009	-0.298210	0.348402
4	-0.033198	1.807217	-0.319996	0.107116
5	-0.158789	1.568967	-0.573323	-0.022004
6	-0.104005	1.380981	-1.246427	-0.072125
7	0.110263	1.357644	-1.628836	-0.107461
8	-0.044585	1.233162	-2.205776	0.299405
9	-0.212954	1.058464	-2.323430	0.339657
10	-0.264477	1.067672	-2.588831	0.596712
11	-0.351034	0.963803	-2.626529	0.759843
12	-0.469273	0.899133	-2.605060	0.907145
13	-0.182248	0.922607	-2.504034	0.691109
14	-0.187613	0.997182	-2.533811	0.748901
15	-0.074628	1.053790	-2.430197	0.572050
16	0.176542	1.144774	-2.365233	0.368254
17	0.154585	1.170729	-2.388298	0.310940
18	0.118819	1.132352	-2.334609	0.292766
19	0.209092	1.114086	-2.330560	0.206314
20	0.045649	1.025274	-2.374129	0.347485
21	-0.100677	0.947147	-2.344919	0.452276
22	-0.059521	0.930660	-2.335842	0.469778
23	-0.204697	0.911517	-2.346959	0.618096
24	-0.247286	0.916113	-2.279512	0.657417
25	-0.107312	0.990648	-2.233748	0.562891
26	-0.128097	1.040676	-2.230463	0.579532
27	-0.078435	1.080875	-2.168127	0.498130
28	0.083829	1.143363	-2.161077	0.349974
29	0.046784	1.145001	-2.196688	0.355946
30	0.032697	1.119257	-2.192451	0.332161
31	0.097411	1.105538	-2.224957	0.282385
32	-0.026716	1.051170	-2.282962	0.394634
33	-0.096500	0.999052	-2.280227	0.452825
34	-0.065818	0.990471	-2.294713	0.462396
35	-0.164405	0.971707	-2.315447	0.568159
36	-0.175579	0.974268	-2.276679	0.580075
37	-0.080600	1.019580	-2.260207	0.519664
38	-0.105150	1.043823	-2.259718	0.538690
39	-0.063701	1.068284	-2.221405	0.479476
40	0.040864	1.105815	-2.219538	0.387389
41	0.003094	1.102122	-2.241287	0.403261
42	0.004238	1.085880	-2.232033	0.378903
43	0.044642	1.078945	-2.253246	0.351031
44	-0.043410	1.042686	-2.285241	0.427744
45	-0.077277	1.012724	-2.276818	0.455178
46	-0.055682	1.010119	-2.286115	0.460142
47	-0.125974	0.997319	-2.295998	0.531100
48	-0.123099	1.001458	-2.267348	0.528694

49	-0.062637	1.031202	-2.259083	0.491073
50	-0.087343	1.044160	-2.257987	0.508265
51	-0.053905	1.060165	-2.231665	0.464561
52	0.010192	1.083763	-2.233779	0.409613
53	-0.022679	1.078658	-2.247162	0.426025
54	-0.015333	1.069346	-2.239459	0.405642
55	0.009119	1.065669	-2.255602	0.390801
56	-0.053033	1.041473	-2.274797	0.443582
57	-0.066430	1.024576	-2.267527	0.454473
58	-0.052542	1.024215	-2.275689	0.458459
59	-0.101860	1.015145	-2.281136	0.505799
60	-0.092464	1.019217	-2.261685	0.497766
		Response of PPI:		
Period	**GDP_PER_CAP**	**CPI**	**PPI**	**EX_RATE**
1	1.449796	-0.758270	6.566647	0.000000
2	-1.542429	-1.232487	2.643131	0.437750
3	-0.807187	-0.747876	2.743433	-0.453561
4	0.319220	-0.996810	3.233458	1.888148
5	1.130181	-2.467683	3.584966	-1.831929
6	-0.525510	-1.816313	2.422766	-0.260844
7	0.915546	-0.810348	1.747846	-0.309646
8	1.075742	-1.250807	1.893624	-0.230879
9	0.253116	-1.698777	2.276798	-0.434896
10	0.722528	-1.477296	2.059518	-0.425464
11	0.366937	-1.341895	1.714258	-0.146705
12	0.085212	-1.946729	2.227633	0.293100
13	0.501117	-1.877633	2.318185	-0.336412
14	0.276508	-1.728610	1.960678	0.023984
15	0.021020	-1.723455	2.261755	0.335274
16	0.725536	-1.596732	2.401570	-0.308822
17	0.477218	-1.515919	2.334560	-0.221104
18	0.248004	-1.501285	2.416041	-0.020345
19	0.893146	-1.414601	2.548575	-0.600403
20	0.581706	-1.477016	2.370328	-0.333595
21	0.328109	-1.607620	2.465597	-0.230841
22	0.725738	-1.527682	2.431494	-0.501507
23	0.407693	-1.612002	2.288304	-0.178096
24	0.130300	-1.724218	2.385543	0.001551
25	0.535412	-1.626084	2.409635	-0.290622
26	0.278324	-1.631202	2.299759	0.010019
27	0.152889	-1.665014	2.429273	0.034120
28	0.603465	-1.535837	2.475732	-0.308793
29	0.413065	-1.514111	2.367385	-0.131926
30	0.336248	-1.548863	2.467978	-0.155765
31	0.721966	-1.463159	2.476008	-0.460961
32	0.489184	-1.505289	2.348258	-0.252108
33	0.356340	-1.583930	2.415285	-0.212606
34	0.643068	-1.545725	2.402398	-0.403103
35	0.373607	-1.604918	2.292687	-0.146105
36	0.249330	-1.668199	2.371560	-0.084581
37	0.525452	-1.603768	2.383293	-0.257972
38	0.313238	-1.618573	2.310073	-0.053419
39	0.267250	-1.633829	2.409568	-0.065400
40	0.566394	-1.542890	2.426786	-0.280136
41	0.401044	-1.545082	2.361636	-0.141192
42	0.379050	-1.562829	2.441492	-0.183749
43	0.635169	-1.502855	2.434750	-0.374165

44	0.442707	-1.538849	2.355558	-0.213504
45	0.389559	-1.585287	2.412914	-0.214720
46	0.580006	-1.554368	2.394789	-0.335892
47	0.371583	-1.598928	2.325139	-0.147910
48	0.324399	-1.634177	2.388688	-0.136169
49	0.506948	-1.587582	2.384459	-0.246588
50	0.338807	-1.604853	2.338921	-0.095684
51	0.337556	-1.610368	2.410985	-0.126940
52	0.532042	-1.549655	2.410892	-0.261858
53	0.394571	-1.559552	2.369660	-0.151482
54	0.406302	-1.567812	2.428248	-0.200094
55	0.570539	-1.527091	2.413654	-0.316453
56	0.419788	-1.557221	2.364638	-0.194949
57	0.410965	-1.582819	2.408859	-0.216329
58	0.533531	-1.559850	2.388498	-0.289745
59	0.377143	-1.593883	2.346407	-0.154573
60	0.371632	-1.611901	2.393794	-0.167929

Response of EX_RATE:

Period	GDP_PER_CAP	CPI	PPI	EX_RATE
1	0.011847	0.027036	0.003115	0.063489
2	0.010901	0.022116	-0.010224	0.036775
3	0.010375	0.015384	-0.000491	0.022304
4	0.013943	0.008004	-0.003413	0.020477
5	0.007170	-0.003899	-0.022590	0.007735
6	0.019569	-0.012029	-0.029925	0.015329
7	0.031729	-0.013254	-0.046943	0.020458
8	0.025117	-0.013877	-0.055445	0.019854
9	0.022650	-0.010563	-0.053473	0.026820
10	0.020899	-0.008658	-0.055148	0.026521
11	0.009003	-0.013293	-0.050750	0.033204
12	0.014839	-0.016778	-0.042710	0.032989
13	0.021728	-0.016637	-0.042679	0.028151
14	0.017483	-0.015877	-0.041212	0.030239
15	0.025336	-0.012043	-0.036921	0.023977
16	0.028812	-0.007907	-0.037867	0.018417
17	0.022047	-0.008370	-0.036318	0.021895
18	0.026695	-0.008512	-0.033293	0.017714
19	0.027706	-0.009333	-0.035152	0.016866
20	0.019608	-0.012544	-0.035262	0.023250
21	0.022190	-0.013104	-0.034118	0.021258
22	0.021487	-0.012841	-0.036167	0.022870
23	0.014480	-0.014184	-0.035836	0.028878
24	0.018812	-0.013076	-0.033726	0.025525
25	0.020542	-0.011400	-0.034736	0.025204
26	0.016980	-0.011453	-0.033949	0.027579
27	0.022789	-0.009725	-0.032243	0.022025
28	0.024716	-0.008403	-0.033773	0.020625
29	0.020885	-0.009365	-0.033928	0.022658
30	0.024843	-0.009218	-0.033305	0.018785
31	0.024562	-0.009600	-0.035434	0.019753
32	0.019403	-0.011625	-0.035907	0.023601
33	0.021865	-0.011942	-0.035290	0.021808
34	0.020986	-0.012090	-0.036786	0.023756
35	0.016791	-0.013137	-0.036413	0.027069
36	0.020257	-0.012283	-0.035069	0.024437
37	0.020813	-0.011334	-0.035797	0.024758
38	0.018486	-0.011432	-0.035053	0.025983

39	0.022700	-0.010239	-0.033861	0.022176
40	0.023355	-0.009547	-0.034866	0.021845
41	0.020898	-0.010234	-0.034670	0.022964
42	0.023871	-0.009995	-0.034179	0.020263
43	0.023157	-0.010276	-0.035576	0.021295
44	0.019888	-0.011560	-0.035598	0.023574
45	0.021916	-0.011598	-0.035160	0.022154
46	0.020928	-0.011735	-0.036182	0.023716
47	0.018332	-0.012402	-0.035751	0.025648
48	0.020965	-0.011730	-0.034935	0.023702
49	0.020877	-0.011194	-0.035520	0.024230
50	0.019429	-0.011294	-0.034917	0.024899
51	0.022437	-0.010461	-0.034233	0.022294
52	0.022410	-0.010118	-0.034993	0.022444
53	0.020884	-0.010598	-0.034747	0.023080
54	0.023075	-0.010365	-0.034501	0.021205
55	0.022237	-0.010607	-0.035475	0.022176
56	0.020245	-0.011426	-0.035359	0.023507
57	0.021839	-0.011352	-0.035128	0.022419
58	0.020886	-0.011486	-0.035844	0.023663
59	0.019346	-0.011911	-0.035452	0.024746
60	0.021285	-0.011407	-0.034989	0.023341

Cholesky Ordering: GDP_PER_CAP CPI PPI EX_RATE

Table A4. Variance decomposition using cholesky (d.f. adjusted) factors

Variance Decomposition of GDP_PER_CAP:					
Period	**S.E.**	**GDP_PER_CAP**	**CPI**	**PPI**	**EX_RATE**
1	52.92628	100.0000	0.000000	0.000000	0.000000
2	55.75832	93.09789	0.507006	5.927640	0.467468
3	56.54744	91.54515	0.645445	6.261007	1.548402
4	59.88662	91.12650	1.082691	5.921389	1.869420
5	67.37129	78.65686	2.074584	13.27079	5.997771
6	71.78127	70.15498	7.726586	11.69201	10.42643
7	75.54863	67.13889	8.429265	13.28917	11.14267
8	81.05640	59.63097	9.127257	15.43456	15.80722
9	83.30540	56.60166	8.895529	15.02526	19.47755
10	86.68187	58.64838	8.455255	14.76323	18.13314
11	88.71559	56.28673	8.081519	15.68119	19.95056
12	89.23624	56.71817	7.988708	15.51674	19.77639
13	94.36823	59.31888	7.278502	14.52372	18.87890
14	95.70643	57.68469	7.156530	16.06990	19.08887
15	96.40387	57.60213	7.298540	16.26549	18.83383
16	99.17957	57.92480	6.921369	17.16527	17.98856
17	102.6443	54.65088	7.145158	18.43543	19.76853
18	103.9315	53.30552	7.723422	18.61966	20.35139
19	105.5803	53.00424	7.690458	19.37431	19.93099
20	109.1267	50.22466	7.694717	19.58961	22.49101
21	109.8196	49.70040	7.824639	19.58425	22.89070
22	111.3699	50.46955	7.609870	19.65470	22.26588
23	112.6523	49.33703	7.477364	20.02715	23.15846
24	113.2016	49.67838	7.416461	19.96277	22.94239
25	115.2737	50.72467	7.172841	19.85839	22.24409
26	116.2774	49.85756	7.130022	20.46455	22.54787
27	116.8764	49.88699	7.172884	20.60503	22.33509
28	118.3141	50.08648	7.047102	21.06874	21.79767
29	120.2461	48.60750	7.172417	21.59483	22.62525

30	121.0000	48.11085	7.390714	21.77826	22.72017
31	122.1464	47.86696	7.354989	22.24265	22.53540
32	124.0269	46.54381	7.389013	22.45049	23.61669
33	124.5887	46.35033	7.437681	22.51343	23.69856
34	125.6262	46.58884	7.320371	22.70612	23.38467
35	126.5608	45.90509	7.272423	22.97328	23.84921
36	127.1166	46.11296	7.231391	22.98824	23.66741
37	128.2820	46.51931	7.101050	23.13941	23.24023
38	129.1204	45.93233	7.092536	23.52229	23.45284
39	129.7202	45.96017	7.109017	23.65306	23.27775
40	130.7351	45.94041	7.049058	24.02887	22.98166
41	131.9847	45.08324	7.127249	24.36230	23.42721
42	132.6383	44.83632	7.217969	24.52280	23.42291
43	133.5711	44.60984	7.192210	24.86613	23.33182
44	134.7578	43.83426	7.227821	25.05873	23.87919
45	135.3215	43.74426	7.244347	25.14518	23.86621
46	136.1482	43.76307	7.174518	25.35829	23.70412
47	136.9088	43.29830	7.159866	25.56865	23.97318
48	137.4713	43.41591	7.131774	25.62621	23.82611
49	138.3119	43.52360	7.057359	25.83319	23.58585
50	139.0357	43.10637	7.063212	26.09652	23.73390
51	139.6295	43.11551	7.067713	26.21999	23.59679
52	140.4542	43.00777	7.035612	26.51401	23.44261
53	141.3642	42.46038	7.085791	26.75074	23.70310
54	141.9814	42.32079	7.124312	26.88959	23.66531
55	142.7823	42.11594	7.106853	27.15075	23.62645
56	143.6433	41.61930	7.135144	27.32015	23.92541
57	144.2119	41.56458	7.138018	27.41486	23.88254
58	144.9329	41.49043	7.095648	27.61145	23.80247
59	145.5942	41.16005	7.094313	27.78270	23.96294
60	146.1560	41.21337	7.074575	27.86323	23.84882

Variance Decomposition of CPI:

Period	S.E.	GDP_PER_CAP	CPI	PPI	EX_RATE
1	1.632373	3.032655	96.96735	0.000000	0.000000
2	2.540524	3.123498	87.08071	1.003071	8.792726
3	3.330693	5.466875	86.93807	1.385222	6.209836
4	3.804540	4.197519	89.19480	1.769091	4.838591
5	4.158194	3.659709	88.90495	3.381998	4.053348
6	4.557114	3.099113	83.20436	10.29671	3.399815
7	5.028648	2.593238	75.62091	18.94807	2.837777
8	5.636051	2.070663	64.98703	30.40102	2.541285
9	6.200359	1.828864	56.61030	39.16099	2.399847
10	6.834649	1.654901	49.03072	46.57705	2.737329
11	7.432401	1.622484	43.14284	51.87476	3.359910
12	7.992402	1.747829	38.57448	55.48387	4.193816
13	8.456402	1.607732	35.64780	58.33033	4.414133
14	8.917474	1.490040	33.30725	60.52795	4.674760
15	9.320434	1.370395	31.76780	62.20582	4.655981
16	9.692373	1.300414	30.77146	63.47828	4.449852
17	10.05670	1.231527	29.93750	64.60210	4.228875
18	10.39085	1.166670	29.23059	65.56209	4.040652
19	10.71115	1.136045	28.59038	66.43386	3.839707
20	11.02448	1.074101	27.85320	67.34880	3.723895
21	11.32032	1.026604	27.11646	68.16551	3.691424
22	11.60587	0.979339	26.44157	68.90323	3.675856
23	11.89366	0.962139	25.76478	69.50289	3.770190
24	12.16503	0.961013	25.19523	69.94785	3.895909

25	12.42124	0.929240	24.80261	70.32595	3.942204
26	12.67665	0.902383	24.48717	70.61649	3.993949
27	12.91592	0.872948	24.28867	70.84229	3.996089
28	13.15021	0.846183	24.18687	71.04115	3.925793
29	13.38631	0.817819	24.07282	71.25012	3.859235
30	13.61486	0.791169	23.94724	71.47132	3.790278
31	13.84291	0.770268	23.80251	71.71919	3.708034
32	14.07478	0.745458	23.58249	72.00657	3.665481
33	14.30075	0.726639	23.33117	72.29137	3.650824
34	14.52502	0.706426	23.08124	72.57204	3.640296
35	14.75234	0.697243	22.80925	72.81620	3.677299
36	14.97102	0.690778	22.57129	73.01715	3.720787
37	15.18407	0.674346	22.39321	73.19821	3.734235
38	15.39653	0.660528	22.23909	73.34608	3.754302
39	15.60010	0.645069	22.13142	73.47208	3.751428
40	15.80076	0.629458	22.06267	73.59102	3.716860
41	16.00202	0.613728	21.98554	73.71327	3.687459
42	16.19782	0.598987	21.90665	73.84079	3.653570
43	16.39316	0.585538	21.82086	73.98073	3.612868
44	16.59006	0.572407	21.70098	74.13251	3.594095
45	16.78251	0.561474	21.57027	74.28256	3.585699
46	16.97393	0.549958	21.44066	74.43061	3.578771
47	17.16620	0.543093	21.30059	74.56155	3.594772
48	17.35272	0.536513	21.17820	74.67455	3.610735
49	17.53650	0.526602	21.08243	74.77710	3.613869
50	17.71958	0.518206	20.99626	74.86368	3.621852
51	17.89711	0.508884	20.93268	74.94070	3.617733
52	18.07315	0.499050	20.88647	75.01552	3.598967
53	18.24922	0.489622	20.83475	75.09128	3.584354
54	18.42166	0.480567	20.78348	75.16990	3.566052
55	18.59391	0.471729	20.72866	75.25515	3.544459
56	18.76680	0.463876	20.65649	75.34431	3.535325
57	18.93660	0.456825	20.58042	75.43295	3.529803
58	19.10591	0.449521	20.50467	75.52070	3.525102
59	19.27527	0.444448	20.42330	75.59997	3.532286
60	19.44084	0.439172	20.35175	75.67114	3.537932

Variance Decomposition of PPI:

Period	S.E.	GDP_PER_CAP	CPI	PPI	EX_RATE
1	6.767402	4.589545	1.255461	94.15499	0.000000
2	7.541459	7.878863	3.681845	88.10236	0.336931
3	8.112744	7.798251	4.031378	87.56666	0.603712
4	8.996249	6.467669	4.506158	84.13019	4.895986
5	10.22288	6.230914	9.316494	77.44981	7.002779
6	10.67802	5.953257	11.43254	76.13601	6.478193
7	10.89339	6.426562	11.53833	75.72974	6.305373
8	11.18154	7.025182	12.20265	74.74495	6.027216
9	11.54771	6.634758	13.60515	73.96722	5.792868
10	11.85229	6.669769	14.46847	73.23394	5.627828
11	12.05704	6.537778	15.21990	72.78921	5.453111
12	12.41844	6.167507	16.80436	71.83209	5.196049
13	12.78598	5.971627	18.00865	71.04889	4.970838
14	13.05338	5.774348	19.03207	70.42398	4.769607
15	13.36373	5.509506	19.82154	70.05537	4.613587
16	13.69410	5.527592	20.23627	69.79161	4.444529
17	13.98403	5.417217	20.58098	69.71467	4.287140
18	14.27256	5.230595	20.86368	69.78997	4.115757
19	14.60687	5.367790	20.85750	69.67624	4.098475

20	14.88658	5.320660	21.06547	69.61775	3.996121
21	15.18008	5.163622	21.38032	69.58985	3.866214
22	15.47446	5.188980	21.54920	69.43627	3.825545
23	15.73187	5.087721	21.89974	69.29835	3.714196
24	16.00539	4.921945	22.31815	69.17157	3.588337
25	16.27864	4.866272	22.57300	69.05997	3.500754
26	16.52336	4.751568	22.88390	68.96667	3.397863
27	16.78451	4.613160	23.16140	68.93207	3.293366
28	17.04897	4.596441	23.25994	68.91883	3.224792
29	17.28445	4.529160	23.39783	68.92966	3.143346
30	17.53224	4.438823	23.52159	68.97658	3.063015
31	17.78721	4.477229	23.52875	68.95103	3.042994
32	18.01299	4.439445	23.64095	68.93283	2.986776
33	18.24780	4.364059	23.78988	68.92209	2.923976
34	18.48565	4.373499	23.88083	68.84891	2.896770
35	18.70060	4.313450	24.07154	68.77835	2.836664
36	18.92588	4.228728	24.27882	68.72092	2.771532
37	19.15160	4.204913	24.41115	68.65921	2.724731
38	19.36081	4.140704	24.58533	68.60704	2.666925
39	19.58040	4.066980	24.73324	68.59122	2.608558
40	19.80053	4.058877	24.79353	68.57670	2.570895
41	20.00516	4.016455	24.88542	68.57457	2.523551
42	20.21848	3.967294	24.96054	68.59332	2.478839
43	20.43324	3.980969	24.97959	68.57891	2.460539
44	20.63190	3.950714	25.05715	68.56805	2.424090
45	20.83767	3.908024	25.14350	68.56140	2.387070
46	21.04302	3.908092	25.20078	68.52494	2.366187
47	21.23515	3.868314	25.31379	68.48948	2.328415
48	21.43436	3.819650	25.42671	68.46426	2.289372
49	21.63228	3.804994	25.50217	68.43218	2.260665
50	21.82031	3.763811	25.60550	68.40689	2.223796
51	22.01504	3.721031	25.68959	68.40142	2.187954
52	22.20872	3.713802	25.73034	68.39200	2.163860
53	22.39316	3.683926	25.79328	68.38986	2.132938
54	22.58347	3.654466	25.84235	68.39820	2.104992
55	22.77271	3.656749	25.86430	68.38949	2.089462
56	22.95271	3.633069	25.92051	68.38239	2.064032
57	23.13765	3.606773	25.97579	68.37752	2.039911
58	23.32075	3.602698	26.01688	68.35698	2.023441
59	23.49616	3.574871	26.09004	68.33742	1.997669
60	23.67624	3.545335	26.15817	68.32406	1.972427

Variance Decomposition of EX_RATE:

Period	S.E.	GDP_PER_CAP	CPI	PPI	EX_RATE
1	0.070084	2.857326	14.88097	0.197515	82.06419
2	0.083526	3.714986	17.48721	1.637430	77.16037
3	0.088423	4.691519	18.63105	1.464167	75.21327
4	0.092240	6.596169	17.87423	1.482442	74.04716
5	0.095629	6.699022	16.79591	6.959561	69.54551
6	0.103937	9.215639	15.55736	14.18056	61.04644
7	0.120862	13.70734	12.70797	25.57296	48.01173
8	0.137475	13.93265	10.84119	36.03141	39.19475
9	0.151996	13.61832	9.351752	41.85277	35.17716
10	0.165406	13.09608	8.170813	46.45786	32.27525
11	0.176904	11.70804	7.707836	48.84502	31.73910
12	0.186304	11.19081	7.760648	49.29599	31.75255
13	0.195120	11.44241	7.802170	49.72605	31.02937
14	0.203083	11.30389	7.813560	50.02147	30.86109

15	0.209684	12.06323	7.659156	50.02164	30.25597
16	0.215947	13.15373	7.355418	50.23706	29.25379
17	0.221332	13.51378	7.144893	50.51501	28.82632
18	0.226263	14.32310	6.978364	50.50217	28.19637
19	0.231452	15.12109	6.831606	50.56993	27.47737
20	0.236423	15.17978	6.828867	50.69025	27.30111
21	0.241196	15.43125	6.856384	50.70446	27.00791
22	0.246238	15.56718	6.850423	50.80657	26.77583
23	0.251321	15.27581	6.894638	50.80553	27.02402
24	0.255883	15.27649	6.912124	50.74731	27.06407
25	0.260519	15.35942	6.859833	50.73528	27.04547
26	0.264957	15.25976	6.818740	50.69123	27.23027
27	0.268963	15.52654	6.747908	50.62973	27.09582
28	0.273109	15.87772	6.639235	50.63334	26.84970
29	0.277087	15.99329	6.564218	50.68941	26.75308
30	0.280965	16.33666	6.491884	50.70483	26.46663
31	0.285101	16.60834	6.418286	50.78906	26.18432
32	0.289206	16.59024	6.398925	50.89875	26.11208
33	0.293227	16.69444	6.390523	50.96097	25.95407
34	0.297466	16.71972	6.374857	51.04805	25.85737
35	0.301661	16.56777	6.388449	51.09532	25.94846
36	0.305594	16.58350	6.386625	51.10554	25.92433
37	0.309586	16.61050	6.356995	51.13294	25.89956
38	0.313400	16.55656	6.336256	51.14687	25.96032
39	0.316983	16.69723	6.298184	51.13834	25.86624
40	0.320636	16.84947	6.244135	51.16207	25.74433
41	0.324158	16.90095	6.208872	51.20035	25.68983
42	0.327608	17.07780	6.171870	51.21614	25.53418
43	0.331192	17.19911	6.135300	51.26758	25.39801
44	0.334724	17.19105	6.125764	51.32234	25.36084
45	0.338204	17.25901	6.117953	51.35233	25.27070
46	0.341803	17.27239	6.107665	51.39718	25.22277
47	0.345333	17.20285	6.112398	51.42344	25.26131
48	0.348732	17.23053	6.106956	51.42935	25.23317
49	0.352171	17.24714	6.089319	51.44731	25.21624
50	0.355483	17.22591	6.077296	51.45773	25.23906
51	0.358678	17.31169	6.054565	51.45599	25.17776
52	0.361916	17.38676	6.024891	51.47442	25.11393
53	0.365064	17.41545	6.005712	51.49644	25.08240
54	0.368173	17.51536	5.983956	51.50842	24.99226
55	0.371360	17.57455	5.963257	51.54053	24.92167
56	0.374502	17.57314	5.956714	51.57086	24.89929
57	0.377616	17.61895	5.949238	51.58907	24.84274
58	0.380798	17.62661	5.941220	51.61666	24.81551
59	0.383917	17.59527	5.941320	51.63405	24.82936
60	0.386969	17.62143	5.934894	51.64053	24.80314

Cholesky Ordering: GDP_PER_CAP CPI PPI EX_RATE

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