The impact of fluctuating oil prices on inflation in Algeria

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Inflation, Purchasing Power, Consumption Price Index, Range Effect, Leverage Effect, Auto-Regressive Vector Method.

Abstract
As Algeria is an oil-rich country having its revenues entirely linked to hydrocarbon exports, tensions in the oil market might engender risks of macroeconomic imbalances. Bearing in mind the importance of oil for the world economy and its fallout during a prolonged surge of its prices, it would be interesting to investigate the relationship inflation-oil prices, which is a point of contrast among economists. At first, we will display theoretical background of inflation and the inflation patterns in Algeria, before putting evidence of strategic issues of the oil revenues in Algeria. We will finish by an econometric analysis via a VAR model of the eventual relationship between oil prices and inflation in Algeria. This article aims to answer the question: "What's the impact of oil price fluctuations on inflation in Algeria?

I. INTRODUCTION

In a world full of problems, wars and crises; oil is ranked among all-economies as of paramount importance. Its nickname "black gold" suffices to highlight the importance of this principal commodity, being necessary and limited, and at the origin of several political conflicts in recent years.

Far from politics, oil is the most important input and the first world's source of energy, 35% of world's energy sources. Actually, oil market is unpredictable continuous instability of its prices, engendering high risks of volatile economic indicators, among them we privilege inflation; the rising general level of prices is considered as a disaster for modern economies, because of its costly economic and social burden and has the primordial attention when gauging the state of the economy and the life standard.

Given the importance of oil in the world economy and bearing in mind the fallout of a continuous price surge that might be, it would be interesting to investigate the relationship inflation-oil prices, which is a point of contrast among economists. For some, the effect of oil prices variations on inflation is low and does not deserve to be mentioned, whereas for others, these variations are a major risk on the general level of prices, as for negative backslides of the second oil shock where oil prices went threefold.

For the case of an oil-producer country (Algeria), we will analyze the possible impact of Sahara Blend oil price fluctuations on inflation. In fact, this analysis takes its importance from the structure of the Algerian economy, based on oil and gas revenues. For instance, Algeria is the world tenth oil producer, and its oil exports share on GDP was 75% in 2011. From this, this article deals with the following question: What's the impact of oil prices' fluctuations on an important economic factor: inflation?

II. Identify, Research And Collect Idea

1. Presentation of The Variables

To study the impact of oil prices' fluctuations on inflation, we chose monetary variables as determinants of inflation and oil variables, these are presented as follows:

– Monetary variables: The interest rate is the annual remuneration in percentage for a placement or paid for a loan. The inflation rate which is the irreversible and steady rise in the general level of prices, leads to a loss of the money value, translated by a drop in its purchasing power.
– Oil variables: Oil price and the share of oil exports to the wealth created in a country, including foreign companies (%GDP).

The inexistence of quarterly and monthly data for several variables (interest rate, share of oil exports) obliged us to use yearly data for the period 1980 to 2011.

2. Analysis of the stationary series and determination of the integration order

Studying stationary allows determining the integration order of each series, for this aim we apply the Dickey and Fuller tests to see the type of non-stationary of each one. If we find they are deterministic stationary (DS) we should differentiate d times to make them stationary, in the case where series are trend stationary (TS), we remove the trend to make it stationary.

For the series of inflation rate (IPC_t), the graph show mixed variations *(Fig.1)*; we derive from the partial autocorrelation function (PAC) a significant peak at lag h=1 (prob<0.05), moreover, the autocorrelation function (AC) has a fast exponential mitigated decrease. This means dependence between variables at least until the fifth lag, which is a characteristic of a non-stationary series. To confirm these findings and the type of non-stationary, we apply the Augmented Dickey & Fuller *(Fig.2).*

2.1. Non-stationary Test « Augmented Dickey-Fuller» on the series IPC_t.

Applying the Augmented Dickey-Fuller (ADF) strategy on IPC_t requires selecting an optimal number of lags P, permitting to whiten residuals of the general model.

a. The choice of the optimal number of lags :

Selecting the number of lags « P » is based on the minimization of the two information criteria: *Akaike **I**nformation **C**riterion* ***(AIC)*** and/or *Schwarz **I**nformation **C**riterion* ***(SIC)***.

	Model 1		Model 2		Model 3	
	AIC	*SIC*	*AIC*	*SIC*	*AIC*	*SIC*
P OPTIMAL	0	0	0	0	0	0

(Tab.1) : Number of lags selection, series IPC_t

Adopting the parsimony principle, which consists of choosing $P_{OPTIMAL}= min\ \{AIC, SIC\}$, leads to retain: ***P=0*** lags, so to have uncorrelated residuals (white noise).

b. ADF strategy on IPC_t

Using the ADF test strategy, we begin by estimating the general model (model 3) including a constant, a linear trend, without lagged terms in first difference, the model is written as follow: $\Delta IPC_t = \emptyset IPC_{t-1} + c + \beta_t + \varepsilon$

Results for (model 3) show the trend is not significant because its t-statistics, in absolute value, equals 1.098, below the critical value tabulated by Dickey & Fuller (2.79) at 5% level, so we accept the hypothesis $H_0 : \beta = 0$, model (3) isn't the good one.

We pass further to estimate the *(model 2)*: $\Delta IPC_t = \emptyset IPC_{t-1} + c + \varepsilon$. Results show insignificant constant because its t-statistics is lower than its critical value tabulated by Dickey & Fuller (1.44<2.54) at 5% level, so we accept $H_0 : C = 0$. That is we test model (1) too:

$\Delta IPC_t = \emptyset IPC_{t-1} + \varepsilon$ and we find the Dickey-Fuller statistics (-1.23) greater than the tabulated value at 5% level (-1.95) and the associated probability of the Dickey-Fuller statistics is 0.195 greater than 0.05. In that case, we accept the null hypothesis ($H_0 : \phi = 0$), that is the existence of unit roots and hence, the non-stationary of the series.

We find at the end, a non-stationary series IPC_t, having a stochastic trend and it seems to have, at least, one unit root that should be removed by differentiating to correct the non-stationary.

2.2. Differentiation of the series

Differentiating the series IPC induces $DIPC_t = IPC_t - IPC_{t-1} = \Delta IPC_t$.

We apply the augmented Dickey & Fuller test on $DIPC_t$ which requires choosing an optimal number of lags P.

	Model 1		Model 2		Model 3	
	AIC	*SIC*	*AIC*	*SIC*	*AIC*	*SIC*
$P_{OPTIMAL}$	0	0	0	0	0	0

(Tab.2) : Number of lags selection, series $DIPC_t$

Parsimony principle suggests retaining $P_{OPTIMAL} = 0$

a. Figure of the differentiated series $DIPC_t$:

The figure could inform on an eventual stationary, in mean and in variance, of the series. To confirm this, we apply the Augmented Dickey & Fuller test on $DIPC_t$.

b. ADF strategy on $DIPC_t$:

The model test the *(model 3)* with P = 0 with : $\Delta^2 IPC_t = \emptyset \Delta IPC_{t-1} + c + \beta_t + \varepsilon_t$. We found a non-significant trend because its Student statistic, in absolute value is 0.004, lower than its critical value tabulated by Dickey & Fuller (2.79) at 5% level of significance. So we accept $H_0 : \beta = 0$.

Estimates of *(model 2)* $\Delta^2 IPC_t = \emptyset \Delta IPC_{t-1} + c + \varepsilon_t$ shows a non-significant constant because $\left| t_{\hat{c}} \right|$ = 0,319 below the value tabulated by Dickey & Fuller (2.54) at 5% level. This obliges to estimate model (1) $\Delta^2 IPC_t = \emptyset \Delta IPC_{t-1} + \varepsilon_t$ where the value of ADF statistics (-5.17) is lower than the critical value (-1.95) at 5% level, tabulated by Dickey & Fuller. In consequence, we strongly reject the null hypothesis $H_0 : \phi = 0$, the existence of unit roots. The series $DIPC_t$ is stationary and the initial series *IPCt* follows a DS-type non-stationary affected by a stochastic trend. In other words, IPC_t is integrated of order 1.

On the same scenario, we studied the series PP_t, $PEXPP_t$ et INT_t, and results gave evidence of stationarity after the first differentiation. They have the same order of integration.

3. Modeling and forecasting using VAR models :

In this section, we analyze the multivariate time series (VAR) of N variables and p lags order, VAR(p) written in a vector-representation [8] :

$$X_t = \phi_0 + \phi_1 X_{t-1} + \cdots + \phi_p X_{t-p} + \varepsilon_t$$

$$X_t = \begin{pmatrix} x_{1_t} \\ . \\ . \\ . \\ x_{N_t} \end{pmatrix} \quad \varepsilon_t = \begin{pmatrix} \varepsilon_{1_t} \\ . \\ . \\ . \\ \varepsilon_{N_t} \end{pmatrix} \quad \phi_0 = \begin{pmatrix} a_1^0 \\ . \\ . \\ . \\ a_N^0 \end{pmatrix} \quad \phi_p = \begin{pmatrix} a_{1p}^1 & a_{1p}^2 & . & . & . & a_{1p}^N \\ . & . & & & & . \\ . & . & & & & . \\ . & . & & & & . \\ a_{Np}^1 & a_{Np}^2 & . & . & . & a_{Np}^N \end{pmatrix}$$

Where ε_t is a white noise having its variance-covariance matrix Σ_ε. We can write [1]:

$$\left(I - \phi_1 L - \phi_2 L^2 - \cdots - \phi_P L^P\right) X_t = \phi_0 + \varepsilon_t \qquad \textit{with:} \qquad \phi(L) = I - \sum_{i=1}^{p} \phi_i L^i$$

so: $\phi(L) X_t = \phi_0 + \varepsilon_t$

III. Results

1. Modeling and Estimating VAR model

We have four stationary series (DPP_t, $DIPC_t$, $DPEXPP_t$, $DINT_t$) *(Fig.4)*, from 1980 to 2011. The chronic (Y_{it} i = 1,4) being stationary, it is possible to modelize it using a VAR process.

1.1. Selection of the optimal lag order P

First step consists of determining the P-th order of the VAR process, for this end, we have estimated VAR process for values of p ranging from 1 to 3, and we should retain the model having the least values for information criteria (Akaike and Schwarz) with and without a constant.

	1	2	3
AIC	7,27	7,96	7,33
SIC	8,217	9,676	9,827

(Tab.3): Selecting the number of lags of the VAR estimation (with a constant)

	1	2	3
AIC	7,63	8,1157	7,90
SIC	8,39	9,638	10,20

(Tab.4): Selecting the number of lags of the VAR estimation (without a constant)

We have estimated various VAR for P-1 to 3 after several trials, we concluded to retain P=1 (with constant) which minimize the two information criteria. Before beginning VAR modelization, we should run the Johansen test to check about the presence of a cointegration relationship between the four series, as the series have the same order of integration $I_{(1)}$.

1.2. Johansen co-integration test :

We will estimate the co-integration of four series, based on the hypothesis 3.
The given results are summarized in *(Fig.5)* ; we test H_0 : r=0 against H_1 : r>0. The Johansen statistic is $\lambda_{trace\,(0)} = 46{,}02 < 47{,}86$ at the significance level of 5%. This indicates the three series are not co-integrated. We proceed by estimating the VAR(1) model.

1.3. Estimating VAR(1) :

Following *(Fig.6)*, the first part represents the estimation where each column corresponds to an equation of VAR model, EViews software reports on each estimated coefficient, its standard deviation between parenthesis and the associated t-statistics between brackets; the second part shows the statistics associated to a standard OLS-regression calculated equation by equation (i.e calculated using the estimated residuals of each equation); the third part displays the associated statistics of a standard OLS-regression for the VAR model as a whole. From the table below, we can write the following equations :

$$\begin{cases} D\hat{P}P_t = -0{,}2811 DPP_{t-1} + 0{,}037 DIPC_{t-1} - 3{,}2448 DPEXPP_{t-1} - 83{,}073 DINT_{t-1} + 3{,}07696 \\ DI\hat{P}C_t = 0{,}1310 DPP_{t-1} + 0{,}1587 DIPC_{t-1} - 5{,}5354 DPEXPP_{t-1} - 69{,}3876 DINT_{t-1} + 1{,}78406 \\ D\hat{P}P_t = -0{,}0058 DPP_{t-1} - 0{,}0031 DIPC_{t-1} - 0{,}05487 DPEXPP_{t-1} - 0{,}4671 DINT_{t-1} + 0{,}42976 \\ D\hat{P}P_t = -0{,}00016 DPP_{t-1} + 0{,}000904 DIPC_{t-1} + 0{,}00068 DPEXPP_{t-1} - 0{,}4609 DINT_{t-1} + 0{,}0002 \end{cases}$$

The variance-covariance matrix of the residuals is :

$$\hat{\Sigma}\hat{\varepsilon}_t = \begin{pmatrix} 122{,}747 & 2{,}768 & 1{,}2618 & 0{,}000322 \\ 2{,}768 & 34{,}915 & 0{,}4866 & 0{,}02178 \\ 1{,}2617 & 0{,}4866 & 0{,}0557 & -0{,}00021 \\ 0{,}00032 & 0{,}0218 & -0{,}00021 & 7{,}82E-05 \end{pmatrix}$$

1.4. Checking VAR(1) stationarity :

The inverse of the four roots of the AR part belongs to the complex unity circle *(Fig.7)* ; Hence, the VAR is stable (stationary).

1.5. Residuals analysis :

Correlograms on the diagonal represent the autocorrelations (h from 1 to 12) of each variable, and the other correlograms are crossed correlograms showing cross-correlations (h from 1 to 12) between variables *(Fig.8)*. The analysis of the diagonal correlograms shows all the terms within the confidence interval, deducing the lack of correlation of each variable's residuals which constitute white noises.

Observing cross-correlograms of residuals, we conclude that some terms lie outside the confidence interval, so the process is not a white noise. We can derive that the associated residuals of the VAR (1) do not constitute a white noise vector. After validation of the VAR (1), we pass to the analysis of its dynamic by detecting causality between variables, the analysis of shocks and variance decomposition of the forecasting error.

1.6. Granger causality test :

We have tested the null hypothesis of non-causality between the four variables; we recall that we cannot reject the null hypothesis of non-causality for probabilities greater than 5% significance level. (Fig.9) shows we can conclude that DIPC variable cause, in the sense of Granger, the variable DINT, because its probability-value is less than the 5% threshold and all other hypotheses of non-causality are accepted, because their associated probability exceed 5%.

1.7. Analysis of shocks and impulse response function of the VAR:

Generally, we notice that shocks are temporary, meaning the variables will retrieve their equilibrium in the long run. All the impulse functions converge to 0, which is a confirmation of the stationary (stability) of the VAR model. We retain the following results from the above functions:

- ***Impact of a shock on DPP_t*** *: The feedback on the variable DPP_t equals 11.079, then impacting the three variables; The variable $DIPC_t$ remains at its initial level (0,00) in period 1, but hit negatively (-0.339) in the second period and grows to reach its equilibrium; the variable $DINT_t$ stays at its initial level (0.00)in the first period then reacts negatively in the second period (-0.468) and third period (-0.1796), and finally it goes down to reach its equilibrium; the variable $DPEXPP_t$ stays in its initial level (0.00) in the first period, then affected negatively in the second period (-0.589), before growing in the third period and falling to its equilibrium.*
- ***Impact of a shock on $DIPC_t$:*** *The impact of a shock on $DIPC_t$ equals 5.904, then impacts three variables; the variable DPP_t is affected positively in the first and second period (0.249) and*

(0.850) then decrease to reach its equilibrium; the variable $DINT_t$ stays at its initial level in the first period, then decrease in the second (-0.217), to reach its equilibrium level; the variable $DPEXPP_t$ stays in its initial level (0.00) in the first period but decrease in the second (-1.004), before reaching its equilibrium.

– ***Impact of a shock on $DINT_t$:*** *The feedback of a shock on $DINT_t$ equals 0.0080, impacting the three variables; DPP_t is affected instantly positively in the first period ($2{,}91 * 10^{-5}$) the decrease in the second period (-0.0023) before reaching its equilibrium; the variable $DIPC_t$ is affected positively in the first and second period (0.0037) and (0.0071) respectively, then diminish to its equilibrium; the variable $DPEXPP_t$ stays at its initial level (0.00) in the first period then (0.00012) in the second one, before falling to its equilibrium.*

– ***Impact of a shock on $DPEXPP_t$:*** *The feedback of a shock on $DPEXPP_t$ equals 0.1814, impacting the three variables; DPP_t is affected instantly positively in th first period (0.1139), then diminish in the second (-0.0710) before increasing in the third (0.025) then falling to its equilibrium. The variable $DIPC_t$ is affected positively in the first period (0.0776), then decrease in the second period (-0.0078) and continue to slow until reaching its equilibrium; the variable $DINT_t$ is affected by a negative way in the first period (-0.0616), then diminish in the second period (-0.00037), before reaching 0.00111, to slow down to its equilibrium level.*

In our case, we are interested in the impact of the following variables : oil prices (PP), share of oil exports on GDP (PEXPP) and the interest rate (INT) on the variable inflation rate (IPC), the *(Fig.11)* summarizes the response of the inflation rate on shocks to other three variables. *(Fig.11)* permits to conclude that a shock on variables ***PP***, ***INT***, ***PEXPP*** does not have an effect on the variable IPC, because all figures start from the origin.

1.8. Analysis of the variance decomposition :

– ***Variance decomposition of the variable DPP_t*** *: the variance of the forecast error of DPP is due at 99% on average to its own innovations, 0.22% to $DIPC_t$, 0.17% to $DINT_t$ and 0.24% to $DPEXPP_t$. This result explains that oil prices are the most exogenous variable among the four variables; its fluctuations are not influenced by any other variable.*

– ***Variance decomposition of the variable $DIPC_t$*** *: the variance of the forecast error of $DIPC_t$ is due at 95% on average to its own innovations, 2% to DPP_t, 0,45% to $DINT_t$ and finally at 2,52% to $DPEXPP_t$. It confirms the result obtained from the impulse responses analysis, the inflation rate impacts independently the three other variables.*

– ***Variance decomposition of the variable $DINT_t$*** *: the variance of the forecast error of $DINT_t$ is due at 53,5% on average to its own innovations, 44,65% to $DIPC_t$, 1,4% to DPP_t and finally at 0,45% to $DPEXPP_t$. Similarly, as for the causality case, this result shows fluctuations of interest rates are influenced by inflation rate.*

– ***Variance decomposition of the variable DPEXPPt*** *: the variance of the forecast error of DPEXPPt is due at 54% on average to its own innovations, 10% to DIPCt, 29,6% to DPPt and finally 6,23% to DINTt. The predominance of oil prices in GDP is real, its fluctuations hit directly imports.*

2. Forecasts :

We have calculated the 2012 forecasts; results are shown below (Tab.5)

	IPC	INT	PP	PEXPP
2012	9%	4%	113,29 Mds/b	76,12%
2012*	10,67%	3,6%	110,28 Mds/b	75,42%

** calculated Forecasts*

(Tab.5) ¦ Forecasts year 2012

By comparing the vales of our forecasts to realizations, we find a 1% error margin for all series, which reinforce our method of forecasts.

IV. Conclusion

Oil is crucial to the Algerian economy. Given the impact it might have on economic variables, we have proposed an empirical analysis of the relationship oil prices-inflation. We saw that inflation is a wide-spread phenomenon hitting all economic segments, like Algerian economy which experienced several episodes of high inflation. In this way, numerous efforts were provided by the Algerian state to monitor inflation peaks, which fell from their 31% level between 1992 and 2000. On inflation determinants in Algeria, we examined using an econometric study, the prevailing relationship between oil price and inflation, for this aim we chose VAR methodology which draws the following findings:

- Lack of a causality relationship between oil prices and inflation,
- Impulse response functions found the inexistence of any impact of oil prices on inflation.
- Inflation reacts independently to oil prices.

That is, we deduct at the end that oil prices do not influence inflation, which means they are not a determinant of inflation concerning the Algerian case. Hence, we recommend this study for importing countries suspecting an inflationist impact of oil prices.

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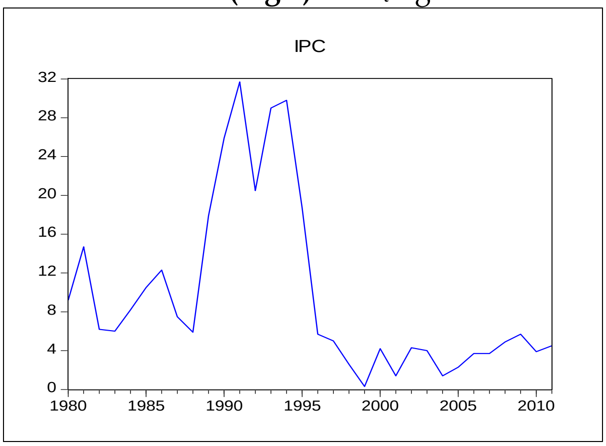
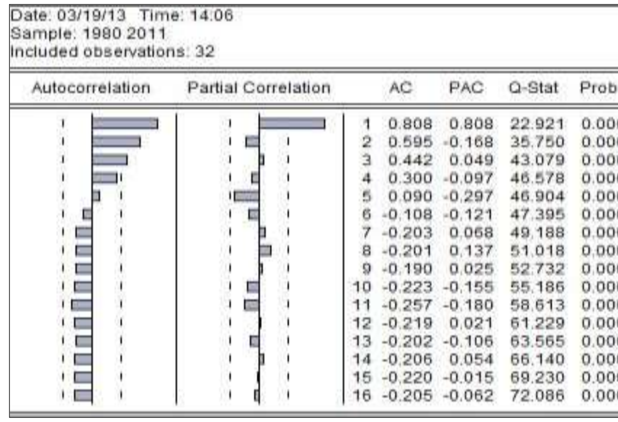
Appendices

(Fig.1) : IPC$_t$ figure



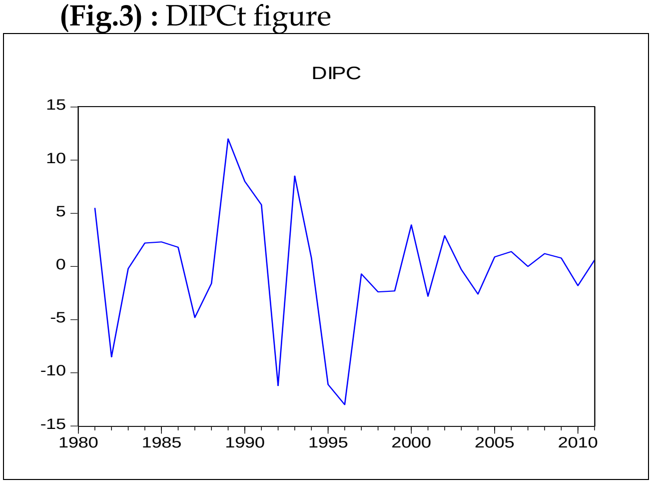
(Fig.2) : Correlogram of IPC$_t$



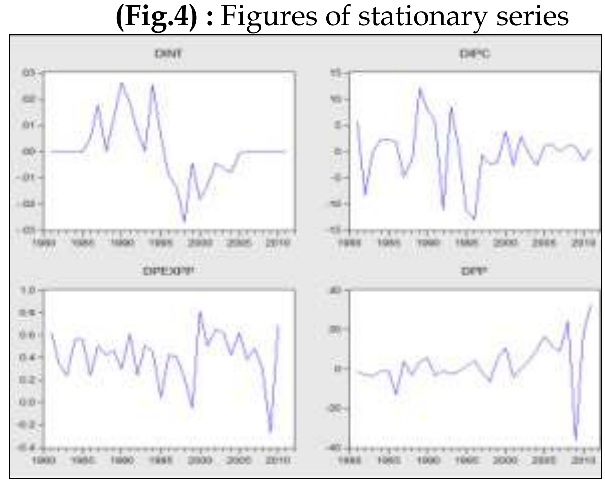
Date: 03/19/13 Time: 14:06
Sample: 1980 2011
Included observations: 32

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.808	0.808	22.921	0.000
		2	0.595	-0.168	35.750	0.000
		3	0.442	0.049	43.079	0.000
		4	0.300	-0.097	46.578	0.000
		5	0.090	-0.297	46.904	0.000
		6	-0.108	-0.121	47.395	0.000
		7	-0.203	0.068	49.188	0.000
		8	-0.201	0.137	51.018	0.000
		9	-0.190	0.025	52.732	0.000
		10	-0.223	-0.155	55.186	0.000
		11	-0.257	-0.180	58.613	0.000
		12	-0.219	0.021	61.229	0.000
		13	-0.202	-0.106	63.565	0.000
		14	-0.206	0.054	66.140	0.000
		15	-0.220	-0.015	69.230	0.000
		16	-0.205	-0.062	72.086	0.000

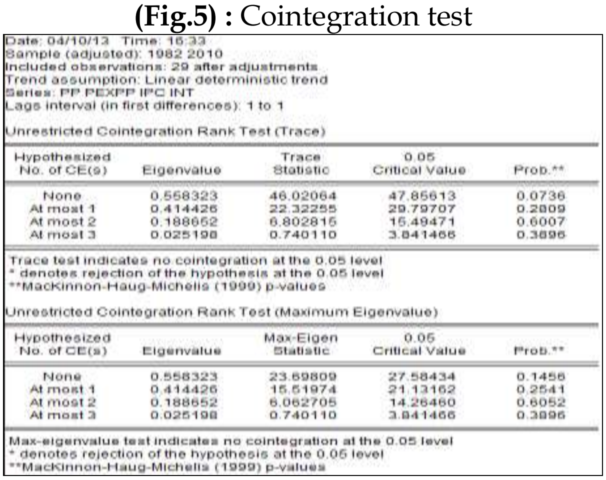
(Fig.3) : DIPCt figure



(Fig.4) : Figures of stationary series



(Fig.5) : Cointegration test



Date: 04/10/13 Time: 16:33
Sample (adjusted): 1982 2010
Included observations: 29 after adjustments
Trend assumption: Linear deterministic trend
Series: PP PEXPP IPC INT
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.558323	46.02064	47.85613	0.0736
At most 1	0.414426	22.32255	29.79707	0.2809
At most 2	0.188652	6.802815	15.49471	0.6007
At most 3	0.025198	0.740110	3.841466	0.3896

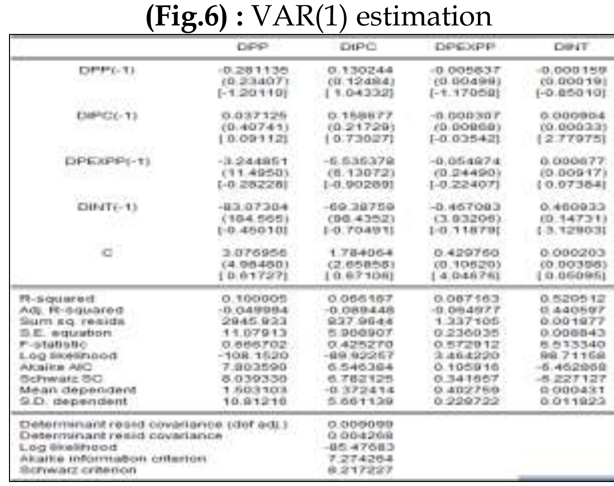
Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.558323	23.69809	27.58434	0.1456
At most 1	0.414426	15.51974	21.13162	0.2541
At most 2	0.188652	6.062705	14.26460	0.6052
At most 3	0.025198	0.740110	3.841466	0.3896

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

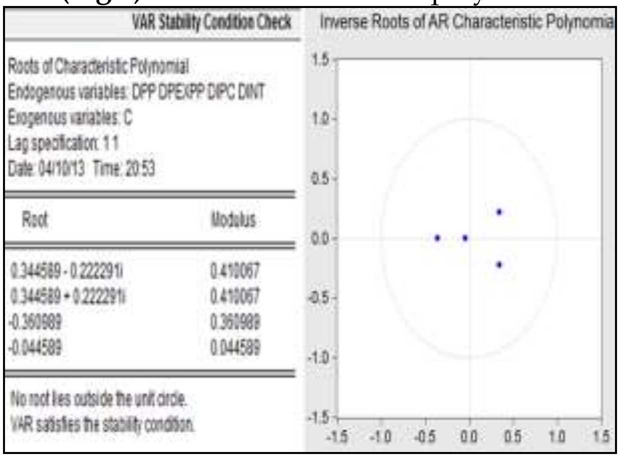
(Fig.6) : VAR(1) estimation



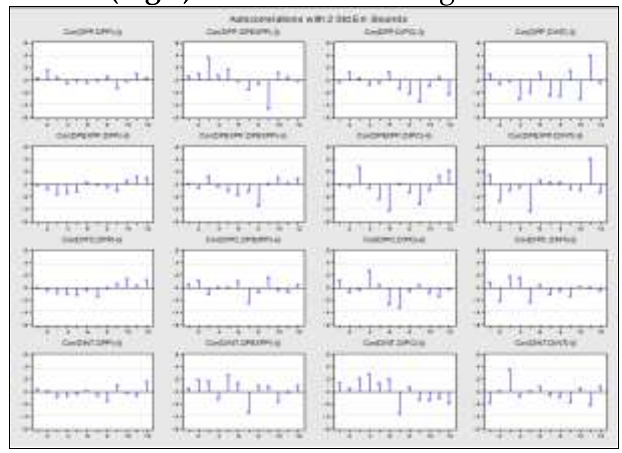
	DPP	DIPC	DPEXPP	DINT
DPP(-1)	-0.281135	0.130244	-0.005837	-0.000159
	(0.23407)	(0.12484)	(0.00498)	(0.00019)
	[-1.20110]	[1.04332]	[-1.17058]	[-0.85010]
DIPC(-1)	0.037125	0.158677	-0.000307	0.000904
	(0.40741)	(0.21729)	(0.00868)	(0.00033)
	[0.09112]	[0.73027]	[-0.03542]	[2.77975]
DPEXPP(-1)	-3.244851	-5.535378	-0.054874	0.000677
	(11.4950)	(6.13072)	(0.24490)	(0.00917)
	[-0.28226]	[-0.90289]	[-0.22407]	[0.07384]
DINT(-1)	-83.07304	-69.38759	-0.467083	0.460933
	(184.565)	(98.4352)	(3.93206)	(0.14731)
	[-0.45010]	[-0.70491]	[-0.11879]	[3.12903]
C	3.076956	1.784064	0.429760	0.000203
	(4.98460)	(2.65858)	(0.10620)	(0.00398)
	[0.61727]	[0.67108]	[4.04676]	[0.05095]
R-squared	0.100005	0.066187	0.087163	0.520512
Adj. R-squared	-0.049994	-0.089448	-0.064977	0.440597
Sum sq. resids	2945.923	837.9644	1.337105	0.001877
S.E. equation	11.07913	5.908907	0.236035	0.008843
F-statistic	0.666702	0.425270	0.572912	6.513340
Log likelihood	-108.1520	-89.92257	3.464220	98.71158
Akaike AIC	7.803590	6.546384	0.105916	-6.462958
Schwarz SC	8.039330	6.782125	0.341667	-6.227127
Mean dependent	1.503103	-0.372414	0.402759	0.000431
S.D. dependent	10.81216	5.661139	0.229722	0.011923

Determinant resid covariance (dof adj.)	0.009099
Determinant resid covariance	0.004268
Log likelihood	-85.47683
Akaike information criterion	7.274264
Schwarz criterion	8.217227

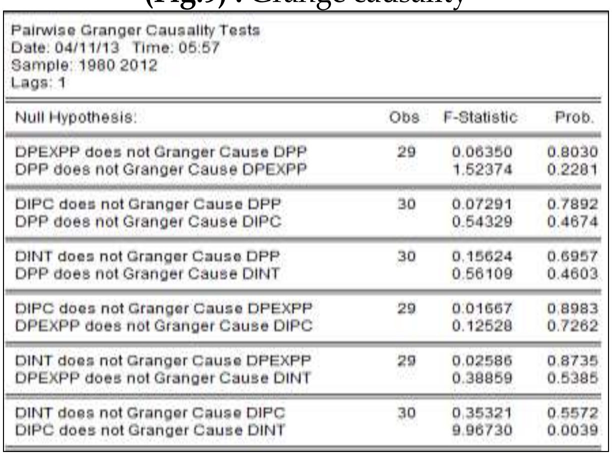
(Fig.7): inverted roots of AR polynoms



(Fig.8) : Residuals correlograms



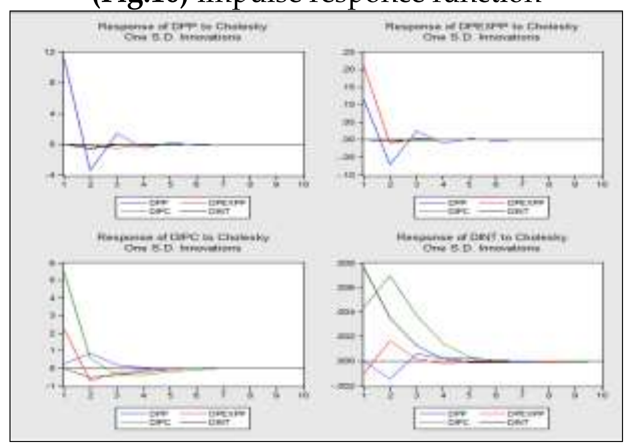
(Fig.9) : Grange causality



Pairwise Granger Causality Tests
Date: 04/11/13 Time: 05:57
Sample: 1980 2012
Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
DPEXPP does not Granger Cause DPP	29	0.06350	0.8030
DPP does not Granger Cause DPEXPP		1.52374	0.2281
DIPC does not Granger Cause DPP	30	0.07291	0.7892
DPP does not Granger Cause DIPC		0.54329	0.4674
DINT does not Granger Cause DPP	30	0.15624	0.6957
DPP does not Granger Cause DINT		0.56109	0.4603
DIPC does not Granger Cause DPEXPP	29	0.01667	0.8983
DPEXPP does not Granger Cause DIPC		0.12528	0.7262
DINT does not Granger Cause DPEXPP	29	0.02586	0.8735
DPEXPP does not Granger Cause DINT		0.38859	0.5385
DINT does not Granger Cause DIPC	30	0.35321	0.5572
DIPC does not Granger Cause DINT		9.96730	0.0039

(Fig.10) impulse responce function



(Fig.11) : Response of IPC to shocks on PP, PEXPP