Asian Economic and Financial Review
ISSN(e): 2222-6737 /ISSN(p): 2305-2147

journal homepage: http://www.aessweb.com/journals/5002

OIL PRICE SHOCKS-MACRO ECONOMY RELATIONSHIP IN TURKEY

Feride Ozturk[1]

[1]*Department of International Trade and Business, Bülent Ecevit University, Zonguldak, Turkey*

ABSTRACT

This paper analyzes the impact of oil price shocks on the selected macroeconomic variables in Turkey for the period of 1990Q1-2011Q4. Vector Autoregression (VAR) models and bivariate Granger causality tests are applied to determine the oil price shocks - macro economy relationship. The empirical findings show that both symmetric and positive oil price shocks decrease industrial production, money supply, and imports while the negative oil price shocks increase imports. Granger causality analysis demonstrate that symmetric and positive oil price shocks Granger-cause industrial production and imports in Turkey.

Keywords: Oil prices, Macroeconomic variables, Variance decompositions, Impulse responses, Granger causality.

JEL Classifications: C22, E32, Q43.

Contribution/ Originality

This study contributes in the existing literature by analyzing the impact of oil price shocks on net oil importing developing Turkish economy. This study also departs from previous studies relating Turkish economy and oil price shocks by considering the effects of both positive and negative oil price shocks on industrial production, imports, inflation, and money supply in Turkey.

1. INTRODUCTION

The history of crude oil price indicates wide price swings in times of shortage or oversupply. Many countries experienced recession during the two oil crisis of 1970s and early 1980s. The crude oil price swings are observed during the last two decades as well. Europe Brent Spot Oil Price (Dollars per Barrel) was 20 dollars in January 1990 and it reached to 123 dollars in April 2011. The concern is that whether the hiking oil prices will drag economies into recession or

DOI: 10.18488/journal.aefr/2015.5.5/102.5.846.857
ISSN(e): 2222-6737 /ISSN(p): 2305-2147

not. Therefore, recently the effects of oil price changes on macroeconomic variables have had again an immense attention in the related literature.

Researchers have applied linear and nonlinear methodologies to measure the effects of oil price shocks on macroeconomic variables. Most of the empirical studies have focused on analyzing the impact of oil price shocks on advanced economies. Starting from this fact, this paper contributes oil price shocks literature by analyzing the impact of oil price shocks on net oil importing developing Turkish economy. This paper departs from previous studies relating Turkish economy and oil price shocks by considering the effects of positive and negative oil price shocks on the Turkish economy. Turkey's economy expanded over the past two decades, and hence its oil consumption has increased. With scarce domestic oil reserves, more than 90% of its crude oil consumption came from imports. As a net oil importing economy, Turkey’s economy is exposed to oil price shocks. Therefore, it is important to analyze the impact of oil price shocks on Turkish economy. Furthermore, understanding the effects of oil price shocks on the Turkish economy might help to define appropriate policies to diminish the adverse effects of these shocks.

In this paper, the symmetric and asymmetric effects of oil price shocks on industrial production, imports, inflation, and money supply in Turkey are analyzed for the period 1990Q1-2011Q4. VAR models and bivariate Granger causality tests are applied to determine the oil price-macro economy relationship. The empirical findings suggest that symmetric oil price shocks and positive oil price shocks have effects on macro-economic variables in Turkey.

This paper proceeds as follows. Section 2 presents the oil price shocks literature. In section 3, the data and methodology of the study is presented. Section 4 consists of the empirical test results and Section 5 concludes the paper.

2. LITERATURE REVİEW

The oil price shocks literature has mainly concerned with analyzing the relationship between oil price changes and macroeconomic variables such as output growth, inflation, government spending, imports, monetary aggregates, interest rates, wages, and employment. The empirical studies used both linear and nonlinear methodologies to analyze oil-shocks and macro economy relationship for the wide spectrum of countries.

Earlier studies mostly concentrated on analyzing the effects of oil shocks on developed economies. Hamilton (1983) found that 1948-1973 was characterized by a statistically significant relationship between changes in oil prices and changes in real GNP and unemployment in the US economy. Mork (1989) expanded Hamilton (1983) study including 1980s to his analysis and found that positive oil price shocks had negative effect on output while negative oil price shocks did not have expansionary effect on output. Hooker (1996) also confirmed Hamilton results and indicated that oil price changes had negative effect on the US GDP growth for the period 1948-1972. Mork *et al.* (1994) studied the economic response to the both positive and negative oil price shocks in seven OECD countries and showed that correlations with positive oil price shocks and output were negative and significant for most of the countries while correlations with negative oil price shocks were negative and significant only for the US and Canada. Hamilton (1996) used net changes in oil prices and found that net nominal oil price increases decreased the output of the US. Rodriguez and Sanchez (2009) applied both linear and nonlinear methodologies to the US, Germany, France, Italy, and the UK and found significant evidence of nonlinear effects of oil price shocks on real output and inflation. Cunado and Gracia (2003) investigated oil price shocks-macro economy relationship for many European countries for the period 1960-1999. They concluded that price shocks had permanent effects on inflation but only positive oil price shocks had negative short run influence on the industrial production. Cunado and Gracia (2005), in other study, found that oil price shocks Granger-cause economic growth in Japan, South Korea, and Thailand.

Following the leading approaches employed in literature, both symmetric and an asymmetric specification of real oil price changes are employed for the developing economies as well. Berument and Ceylan (2005) analyzed the effects of symmetric oil price shocks on industrial production of Middle East and North African countries over the period 1960-2003. They showed that oil price shocks increased the industrial production of Iraq, Jordan, Kuwait, Algeria, Oman, Syria, Tunisia, Qatar, Iran, and Oman. Olomola and Adejuma (2006) studied the effects of oil shocks on output, real exchange rate, money supply, and inflation in Nigeria over the period 1970-2003. Their empirical results indicated that the oil price shocks did not affect output and inflation but had strong effect on money supply and exchange rate. Sari and Soytas (2006) analyzed the effects of oil price shocks on industrial production, stock returns, and interest rates in Turkey for the period of 1987Q1 – 2004Q3. They conclude that oil price shocks do not seem to affect the macroeconomic variables in Turkey. Farzanegan and Markwardt (2009) studied the effects of asymmetric oil price shocks on an oil exporting Iranian economy from 1975Q2 to 2006Q4. Their empirical findings indicated that positive oil price shocks increased the real effective exchange rate, real imports, real GDP per capita, inflation and real government expenditures. On the other hand, the negative oil price shocks decreased the real effective exchange rate and real GDP per capita and increased the inflation and the real government expenditures. Kumar (2009) found that oil price shocks negatively affected industrial production of the Indian economy over the period 1975Q1-2004Q3. Chuku *et al.* (2010) investigated the effects of oil shocks on Nigerian economy between 1970Q1 and 2008Q4. They found that after the positive oil price shock output and inflation increased and oil prices Granger cause inflation. Mendoza and Vera (2010) analyzed the influence of oil price shocks on Venezuela during the period 1984Q1—2008Q3. They reported that oil shocks had positive and significant effects on output and the Venezuelan economy is more responsive to increases in oil prices than decreases.

3. DATA AND METHODOLOGY USED

The study uses five macroeconomic variables including real industrial production, real oil prices, real imports, consumer price index, and money supply. Quarterly data from 1990Q1 to 2011Q4 is used for Turkey. Real industrial production is used as measure of economic activity. Real oil prices in TL is calculated by converting Europe Brent Spot Oil Prices (Dollars per Barrel) by the TL/US dollar exchange rate and deflated by the wholesale price indices in Turkey. Consumer Price Index is used as a proxy for inflation rate. Central Banks responds to oil price shocks. Therefore, money supply is also included as monetary policy indicator. All variables are in logarithmic form. All Turkish data is taken from the Central Bank of Turkish Republic while Europe Brent Spot Oil Prices (Dollars per Barrel) data is taken from US Energy Information Agency.

The effects of oil price shocks on economic activity get immense attention by researches because of oil crisis of 1970s. The empirical studies on this issue concentrated on linear relationship between oil prices and real economic activity until the middle of 1980s. However, a six year long decline in oil prices weaken the linear relationship between oil prices and economic activity. Therefore, empirical studies included non-linear specification of oil prices as well (see, among others, (Mork, 1989; Hamilton, 1996; 2003; Rodriguez and Sanchez, 2004; Chuku *et al.*, 2010)) Following the leading approaches employed in this literature, both symmetric and an asymmetric specifications of real oil price changes are used in the present paper. Initially, symmetric quarterly changes of real oil prices are defined as follows:

$$\Delta LROP_t = LROP_t - LROP_{t-1}, \quad (1)$$

where, $LROP_t$ is the log real oil price in time t. An asymmetric specification of positive and negative rates of changes in real oil prices are calculated as follows:

$$\Delta LROPINCREASE_t = \max(0, \Delta LROP_t) \text{ and} \quad (2)$$

$$\Delta LROPDECREASE_t = \min(0, \Delta LROP_t) \quad (3)$$

Based on these calculations, the positive increases and the negative decreases in oil prices are defined as positive and negative oil price shocks, respectively.

As preliminary analysis stationary of variables are tested using two standard tests: ADF test by Dickey and Fuller (1979; 1981) and PP test by Phillips and Perron (1988). Both tests are applied with and without a time trend variable.

In this study the following p-lag VAR (p)) model is estimated:

$$Y_t = a_1 + \sum_{t=1}^{p} \emptyset_i Y_{t-1} + \varepsilon_t \quad (4)$$

where Y_t *is an nx1vector of five endogenous variables,* a is the nx1 intercept vector of VAR, $\emptyset_i$ is the ith nxn matrix of autoregressive coefficient vector for i= 1,2,3…,p, and $\varepsilon_{t=} \varepsilon_{1t}, \ldots, \varepsilon_{nt}$ is the nx1 vector of white noise process.

Next, using impulse response functions (IRFs), the dynamic responses of endogenous variables to one time shock to one of the system's variables is estimated. Thus IRFs indicate the direction and magnitude of effects of one variable on another. Further, a variance decomposition (VCD) analysis is carried out to interpret estimated VAR models. The VCD analysis shows how much of the forecast error variance of each of the variables is explained by exogenous shock to the one of the system's variables.

Finally, bivariate Granger causality tests are performed between real oil prices and macroeconomic variables to examine the short-run impacts of oil price shocks on the macro economic variables. Granger (1969) described a variable X_t as Granger causing another variable Y_t, if the inclusion of lagged values of X improves the forecast of Y, or equivalently if the coefficients on the lagged X's are statically significant. Absence of the Granger causality is tested by estimating the following VAR model:

$$Y_t = a_0 + a_1 Y_{t-1} + ... + a_p Y_{t-p} + b_1 X_{t-1} + ... + b_p X_{t-p} + u_t \quad (5)$$

$$X_t = c_0 + c_1 X_{t-1} + ... + c_p X_{t-p} + d_1 Y_{t-1} + ... + d_p Y_{t-p} + v_t \quad (6)$$

Testing the null hypothesis of H_0: $b_1 = b_2 = ... = b_p = 0$, is a test that *X does not* Granger-cause *Y*. Similarly, testing the null hypothesis of H_0: $d_1 = d_2 = ... = d_p = 0$, is a test that *Y does not* Granger-cause *X*. In each case, a *rejection* of the null hypothesis implies there is Granger-causality.

4. EMPIRICAL FINDINGS

As preliminary analysis, the properties of the variables are determined applying ADF test by Dickey and Fuller (1979; 1981) and PP test by Phillips and Perron (1988). Table 1 presents the results of these tests. The results of the ADF indicate that variables are non-stationary on levels but stationary at the first differences. Therefore, the variables of the model follow an I(1) process. The results of PP tests generally support the ADF test results.

Table-1. Unit root tests

ADF Test	**With constant**		**With constant and trend**	
Variable	Level	Difference	Level	Difference
LCPI	-3.72*	-0.96	1.03	-4.65*
LIP	-0.33	-3.90**	-1.53	-11.65*
LM2	-3.43**	-2.04	0.66	-5.99*
LROP	-2.43	-9.41*	-3.04	-9.48*
LRIMP	-1.13	-5.77*	-3.65**	-5.74*
LROPDECREASE	-9.49*	-10.48*	-9.52*	-10.42*
LROPINCREASE	-9.70*	-8.49*	-9.64*	-8.44*
PPP Test	**with constant**		**with constant and trend**	
Variable	**Level**	**Difference**	**Level**	**Difference**
LCPI	-5.14*	-3.91*	0.52	-7.92*
LIP	-0.09	-19.41*	-4.84*	-18.89*
LM2	-3.82*	-4.06*	0.91	-5.98*
LROP	-2.38	-11.89*	-4.04**	-12.43*
LRIMP	-0.97	-11.11*	-3.80**	-11.05*
LROPDECREASE	-9.57*	-41.30*	-9.70*	-40.91*
LROPINCREASE	-9.71*	-56.65*	-9.65*	-60.01*

*, **, and *** indicate that the test statistics is statistically significant at 1%, 5%, and 10% levels, respectively. SIC is used to choose optimal lag length of ADF test while Bartlett Kernal spectral estimation method with Newey-West bandwidth.

In order to capture the effects of oil price shocks on Turkish economy three unrestricted VAR models are estimated. The estimated VAR models are in the following orders:

For the symmetric change in real oil prices (IP, ROP, RIMP, INF, M2)

For the positive oil price shocks (IP, ROPINCREASE, RIMP, INF, M2)

For the negative oil price shocks (IP, ROPDECREASE, RIMP, INF, M2).

Considering the unit root test results, first log-differences of the real industrial production (IP), real oil prices in TL (ROP), real imports (RIMP), consumer price index (INF), and money supply (M2) are included into the estimations of the VARs. The optimal lag lengths of the estimated VARs are 2, 2, and 3, respectively. The optimal lag lengths are selected based on different criteria.

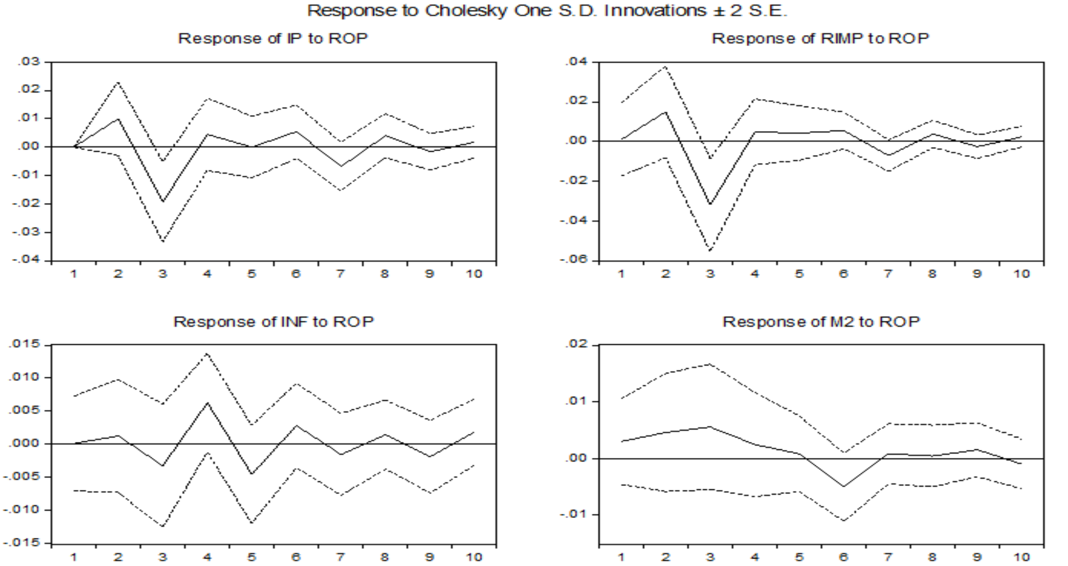

Figure-1. Responses of IP, RIMP, INF, and M2 to ROP shocks in symmetric definition

Figure 1 shows the IRFs of each variable to a one standard deviation shock to oil price for the period 1990Q1-2011Q4. After the one standard deviation shock in oil price, both industrial production and imports respond negatively and significantly in the third quarter.

Inflation responses positively and significantly to oil price shock and reaches it's maximum at the fourth quarter following the shock. The oil price shocks do not seem to have initial significant effect on money supply. However, negative response of money supply in the sixth quarter is statically significant.

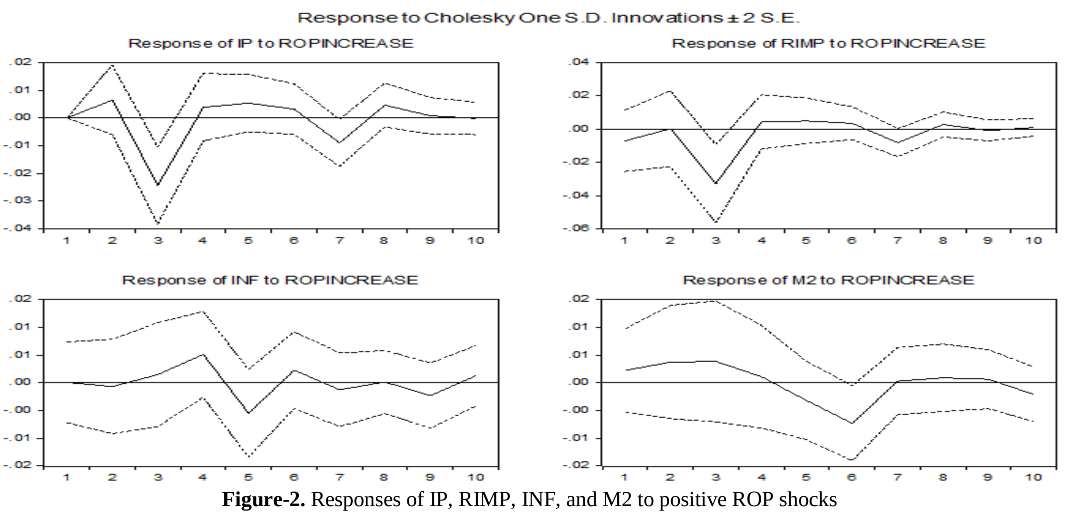

Figure-2. Responses of IP, RIMP, INF, and M2 to positive ROP shocks

Figure 2 shows the IRFs of each variable to a one standard deviation shock to positive changes in oil prices for the period of 1990Q1-2011Q4. The industrial production, imports, and money supply significantly decrease after the positive oil price shock.

The negative response of money supply indicates that the Turkish central bank tightens the money supply after positive oil price shocks. The response of inflation to positive oil price shock is initially insignificantly positive and then insignificantly negative.

Figure 3 demonstrates the IRFs of each variable to a one standard deviation shock to negative changes in oil prices for the period of 1990Q1-2011Q4.

Both industrial production and imports respond positively to the negative oil price shocks in the second quarter but only imports' response to negative oil shocks is statically significant. The negative oil price shocks cause inflation to decline but it is insignificant. Similarly, the response of money supply to the negative oil price shocks is statically insignificant.

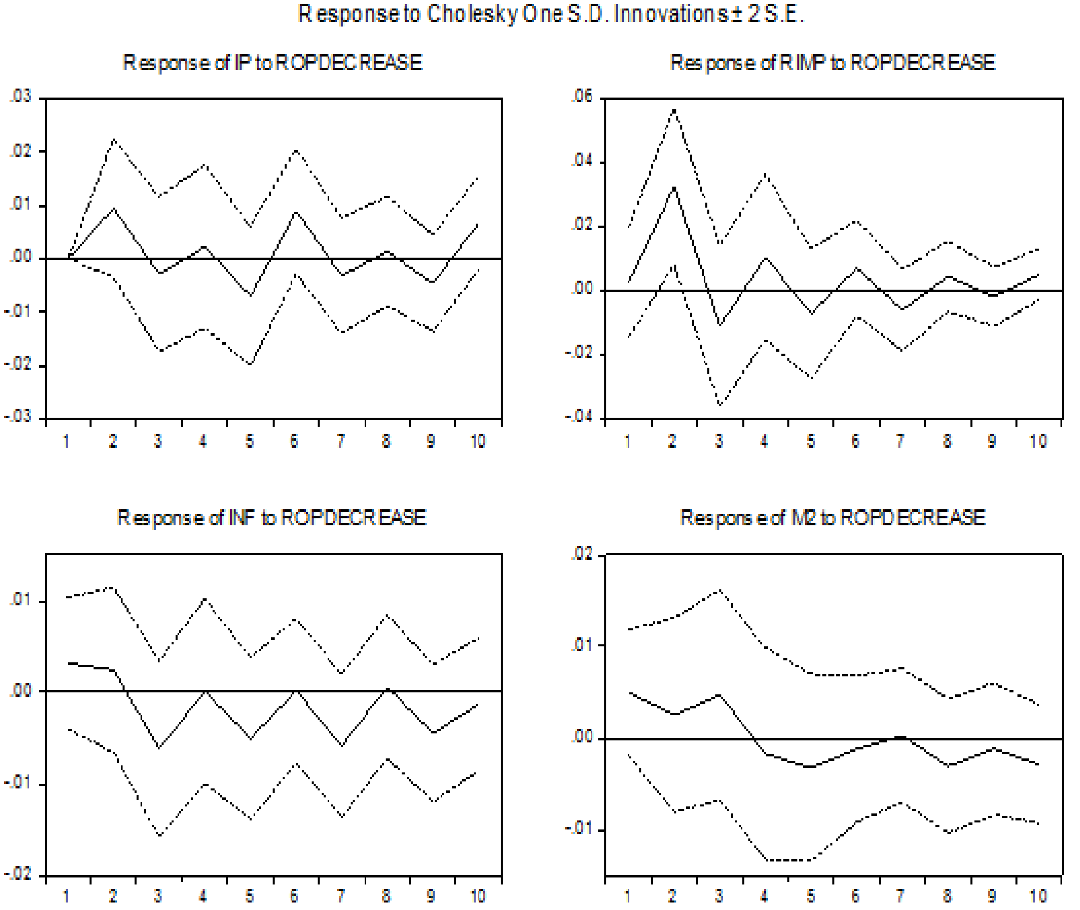

Figure-3. Responses of IP, RIMP, INF, and M2 to negative ROP shocks

VDCs indicate how much of a change in a variable is due to its own shock and how much due to shocks to the other variables of the model. For the oil price shock model the results of the VDCs over a 9 quarter time horizon are presented in Table 2. Cholesky ordering for the symmetric change in oil prices consists of IP, ROP, RIMP, INF, and M2. The oil price shocks' contribution to changes in forecast error variances in industrial production and in imports are approximately 9%. Table 2 shows that the quarterly forecast error variance of 2.73% (period 6) in inflation is due to oil price shocks. Similarly, the oil price shocks contribute to 2.78% (period 6) of forecast error variance of money supply.

Table-2. Estimated Variance Decomposition of the Variables for Cholesky ordering of IP, ROP, RIMP, INF, and M2

Quarter	S.E	IP	ROP	RIMP	INF	M2
Variance decomposition of IP						
1	0.052396	100	0	0	0	0
3	0.070742	64.47	9.39	9.30	12.55	0.99
6	0.078299	60.92	8.47	14.24	12.02	1.42
9	0.080570	58.52	9.02	14.53	13.25	1.71
Variance decomposition of RIMP						
1	0.099726	27.08	0	72.90	0	0
3	0.115597	21.75	9.35	56.50	2.77	1.88
6	0.118495	22.32	9.39	54.67	3.61	2.18
9	0.119683	22.06	9.71	53.80	4.48	2.21
Variance decomposition of INF						
1	0.033912	4.31	0	7.19	88.48	0
3	0.046040	9.56	0.57	8.81	60.58	1.92
6	0.054184	8.11	2.73	8.14	59.29	1.48
9	0.060035	7.65	2.44	7.62	60.30	1.53
Variance decomposition of M2						
1	0.035057	0.02	0.72	0.91	0.16	98.16
3	0.052382	1.99	2.22	5.58	12.00	48.21
6	0.057963	4.04	2.78	4.75	21.99	40.51
9	0.062119	4.04	2.50	5.74	25.61	31.65

Estimated VDCs for the positive real oil price shocks model are presented in Table 3. The estimations indicate that the positive oil price shocks' contribution to changes in forecast error variances in industrial production and in imports are on average 12% and 8%, respectively. The contribution of the positive oil price shocks to forecast error variances of inflation and money supply ranges from 0.2% to 2.16% and 0.40% to 2.95%, respectively.

Table 4 shows the VDCs analysis for the negative oil price shocks model. The contribution of negative oil price shocks to variations in the industrial production ranges from 2.25% to 4.01%. The negative oil price shocks are weaker than both oil price shocks and positive oil price shocks for explaining the variances of industrial production. The negative oil price shocks play an important role only on variations in imports. These shocks explain for about 9% changes in forecast error variances in imports. The contribution of the negative oil price shocks to forecast error variances of inflation and money supply ranges from 0.85% to 3.68% and 1.99% to 2.37%, respectively.

Table-3. Estimated Variance Decomposition of the Variables for the Cholesky ordering of IP, ROPINCREASE, RIMP, INF, and M2

Quarter	S.E	IP	ROPINCREASE	RIMP	INF	M2
Variance decomposition of IP						
1	0.051676	100	0	0	0	0
3	0.070383	61.18	12.80	7.32	16.20	0.73
6	0.077699	58.53	11.40	12.01	15.15	1.10
9	0.080427	55.83	12.22	12.46	16.24	1.33
Variance decomposition of RIMP						
1	0.122590	19.19	0.47	70.22	0	0
3	0.136049	23.63	8.36	56.30	4.29	1.79
6	0.140931	24.40	8.37	54.43	4.85	2.00
9	0.142284	24.12	8.71	53.47	5.72	2.03
Variance decomposition of INF						
1	0.101872	3.42	0	5.36	91.21	0
3	0.115931	8.15	0.12	7.34	64.45	1.92
6	0.118617	7.09	2.16	6.76	61.81	1.44
9	0.119903	6.90	1.95	6.41	61.95	1.34
Variance decomposition of M2						
1	0.034319	0.24	0.40	0.58	0.16	98.58
3	0.046070	2.59	1.25	4.27	12.42	49.22
6	0.054475	4.80	2.95	3.61	22.89	40.11
9	0.060384	4.70	2.59	4.57	26.18	34.97

Table-4. Estimated Variance Decomposition of the Variables for the Cholesky ordering of IP, ROPDECREASE, RIMP, INF, and M2

Quarter	S.E	IP	ROPDECREASE	RIMP	INF	M2
Variance decomposition of IP						
1	0.050442	100	0	0	0	0
3	0.065734	70.98	2.25	5.71	13.21	2.31
6	0.076400	60.64	3.96	14.95	12.05	3.14
9	0.081158	56.88	4.01	17.02	11.79	3.89
Variance decomposition of RIMP						
1	0.133275	35.46	0.06	64.47	0	0
3	0.139970	26.61	9.03	48.67	2.86	0.72
6	0.146957	25.94	9.24	49.26	3.70	0.99
9	0.149456	25.70	9.37	48.76	4.02	1.30
Variance decomposition of INF						
1	0.097966	6.95	0.85	6.98	85.20	0
3	0.114529	7.86	2.70	7.53	61.32	1.69
6	0.122882	8.52	2.79	8.53	58.03	1.93
9	0.124595	7.54	3.68	7.27	57.56	1.69
Variance decomposition of M2						
1	0.034408	1.91	2.37	0.30	2.21	93.19
3	0.044797	3.27	1.99	5.39	5.42	45.04
6	0.053465	3.21	2.04	4.77	13.30	37.92
9	0.060382	3.28	2.01	8.00	17.79	32.62

The results of Granger causality tests are presented in Table 5. From the results, it is observed that oil price shocks and positive oil price shocks Granger-cause industrial production and imports in the short-run.

Table-5. Granger –Causality tests results

	F-statistics	Probability
IP does not Granger Cause ROP	3.261	0.043
ROP does not Granger Cause IP	6.419	0.002
RIMP does not Granger Cause ROP	1.548	0.218
ROP does not Granger Cause RIMP	4.834	0.01
INF does not Granger Cause ROP	0.404	0.666
ROP does not Granger Cause INF	0.475	0.623
M2 does not Granger Cause ROP	0.397	0.673
ROP does not Granger Cause M2	0.055	0.946
IP does not Granger Cause ROPINCREASE	3.579	0.032
ROPINCREASE does not Granger Cause IP	7.316	0.001
RIMP does not Granger Cause ROPINCREASE	0.134	0.874
ROPINCREASE does not Granger Cause RIMP	4.686	0.01
INF does not Granger Cause ROPINCREASE	0.578	0.563
ROPINCREASE does not Granger Cause INF	0.500	0.607
M2 does not Granger Cause ROPINCREASE	0.422	0.656
ROPINCREASE does not Granger Cause M2	0.123	0.883
IP does not Granger Cause ROPDECEASE	2.337	0.08
ROPDECREASE does not Granger Cause IP	1.972	0.125
RIMP does not Granger Cause ROPDECREASE	1.481	0.226
ROPDECREASE does not Granger Cause RIMP	3.115	0.03
INF does not Granger Cause ROPDECREASE	0.664	0.576
ROPDECREASE does not Granger Cause INF	0.174	0.913
M2 does not Granger Cause ROPDECREASE	0.097	0.961
ROPDECREASE does not Granger Cause M2	0.609	0.61

5. CONCLUDING REMARKS

This paper examines the oil price shocks-macro economy relationship for Turkey over the 1990Q1-2011Q4 period. The symmetric and asymmetric effects of oil price shocks on industrial production, imports, inflation, and money supply are analyzed by estimating VAR models and bivariate Granger causality tests. IRFs indicate that the industrial production, imports, and money supply respond negatively and significantly to one standard deviation shock in oil prices. Inflation responses positively and significantly to one standard oil price shock. The industrial production, imports, and money supply significantly decrease after the positive oil price shock while the response of inflation to positive oil price shock is insignificant. On the other hand, the negative oil price shocks have positive and significant effect on imports. However, these shocks do not have any significant effect on the industrial production, inflation, and money supply.

The variance decomposition of the VAR analyses demonstrate that the oil price shocks' contribution to changes in forecast error variances in industrial production, imports, inflation, and money supply are approximately 9%, 9%, 2.73%, and 2.78%, respectively. The positive oil price shocks' contribution to changes in forecast error variances in industrial production and in imports are on average 12% and 8%, respectively. The contribution of the oil price shocks to forecast error variances of inflation and money supply ranges from 0.2% to 2.16% and 0.40% to 2.95%, respectively. The negative oil price shocks play an important role only on variations in imports. These shocks explain for about 9% changes in forecast error variances in imports.

Granger causality analysis show that oil price shocks and positive oil price shocks Granger-cause industrial production and imports in the short-run. In line with previous findings in the literature, this paper demonstrates that in the case of Turkey, oil shocks have an asymmetric effects on macroeconomic variables.

The empirical results of this paper provide policymakers a way of understanding the effects of oil price shocks on the Turkish economy. As a policy implication, since the empirical evidence indicates that both symmetric and positive oil price shocks decrease industrial production and money supply, the policy makers should apply polices keeping in mind the adverse effects of oil price shocks.

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