Linkages between Trade Openness, Capital, Oil Price and Industrial Outputs in Syria

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Abstract

This study attempts to test the effect of trade openness, capital and oil price on the industrial outputs in Syria over the period 1970-2010. The Johansen cointegration test indicates that capital is positively and significantly related to industrial outputs, while trade openness and oil price are negatively and significantly related to industrial outputs in the country. Capital has the biggest effect on the industrial outputs. The Granger causality test indicates unidirectional causality relationship running from oil price to industrial output and bidirectional causality relationships between trade openness, capital and industrial output in the long run. Besides, there are bidirectional causality relationship between capital and industrial output, and unidirectional causality relationships running from trade openness and oil price to industrial output in the short run.

Keywords: *Syria; industrial outputs; trade openness; capital; oil price; VAR*

JEL Classifications: *O11; E20*

Introduction

The industrial sector is one of the main sectors of the Syrian economy, and most important industries in Syria are oil refining, basic metal, metal products, chemicals, electricity, water, paper, foodstuffs and textiles (SIA, 2009). Based on the important role of the industrial sector in the Syrian economy, the government has been working to remove all obstacles facing manufacturing by issuing laws and regulations that encourage investment in the industrial sector, developing the infrastructure of the Syrian industry, creating an attractive investment climate, improving industrial productivity, using modern technology in industrial activities, improving the skill of workers in this sector, enhancing the export capacity of manufacturing enterprises, and improving the business environment and international competitiveness (Lahham, 2010). Furthermore, with declining oil production in Syria, the government is working to reduce its dependence on the oil sector and making the industrial sector the locomotive of economic growth in the country (SIA, 2009). In addition, the government is trying to improve this sector and increase its contribution to GDP by improving the performance of public sector industrial companies, and expansion to the participation of the private sector in industrial activities (Lahham, 2010). Furthermore, industrial cities were created to provide the necessary infrastructure and services for the establishment of industrial projects, which has encouraged the local and foreign investment to build large industrial projects in Syria. Moreover, to complete the economic and administrative reforms, the government worked to open up the Syrian economy to foreign trade and investment, modernize industry, upgrade productivity, and change the structure of the Syrian economy from an oil and agriculture based economy to an industrial economy (Kafri, 2010). Unfortunately, the war which started in 2011, has caused a huge damage to the Syrian economy, and created a new situation quite different than the one before 2011. Many factories have been destroyed, the infrastructure has been damaged, investment has declined, foreign trade has declined, and many oil wells have been controlled by the terrorists (SCPR, 2014).

Given this backdrop, the aim of this study is to test the effect of trade openness, capital and oil price on industrial outputs in Syria during the period 1970-2010, which may assist Syrian policy maker, after the war, to develop an economic plan that takes into account the effect of trade openness, capital and oil price on industrial outputs. The dependent variable in this study is the industrial outputs, while trade openness, capital and oil price are the independent variables. The organization of this study is as follows. The next section is the literature review and Section 3 provides a brief discussion on the methodology. Section 4 reports the empirical results, and the conclusion and recommendations are presented in Section 5.

Previous Studies

Many studies that tested the effect of trade openness, capital and oil price on industrial outputs of different countries. Corden (1974), Martin and Page (1983), Pack (1988), Tybout (1992), Harrison (1994), Tybout and Westbrook (1995), Pavcnik (2002), Muendler (2004), and Fernandes (2007) indicted that more open trade regimes lead to productivity improvements in the industrial sector. Adenikinju and Olofin (2000) also indicated that industrial sector development can be achieved by trade openness and policies of trade through scale efficiency. However, Tybout et al. (1991) found no evidence of increased productivity is following liberalization in Chile. Akbarian and Rafiee (2009) found that trade liberalization affects industrial concentration negatively in Iran and makes the market structure more competitive. Umer and Alam (2013) indicated that FDI and GDP have positive relationship with industrial sector growth in Pakistan, while trade openness and inflation have negative relationship with it. Furthermore, Dutta and Ahmed (2004) found that industrial growth in Pakistan is affected positively with real capital stock and the secondary school enrolment ratio, but it is negatively related with labour force, real exports, and the import tariff rate. Hosseini and Leelavathi (2013) also found that industrial value added in India is affected positively with real capital formation, and negatively with the labour force, real exports, the import tariff collection rate and the secondary school enrolment ratio. However, Umoru and Eborieme (2013) found that industrial production responded negatively to capital formation in Nigeria, but there is a positive relationship between trade liberalization, structural deregulation and industrial growth. Jiranyakul (2006) found that real exchange rate does not affect the industrial production in Thailand, while oil prices and real money supply affect it significantly and positively. Farzanegan and Markwardt (2007) also found that oil price affects positively the industrial output in Iran. However, Lee and Ni (2002) found that supply of oil-intensive industries and demand of other industries are reduced from oil price shocks.

Methodology

The vector autoregression (VAR) model will be used in this study. Our model consists of four variables: industrial outputs, trade openness, capital and oil price. Industrial outputs is the dependent variable. The model is presented as follows:

$$lnIO = \alpha + \beta_1\ OPEN + \beta_2\ lnGFCFI + \beta_3\ lnOP + \varepsilon_t \tag{1}$$

where α is the intercept, β_1, β_2, and β_3 are the slope coefficients of the model, lnIO is the natural log of the industrial output in real value (millions of SYP), OPEN is trade openness (the percentage of total exports and imports to GDP), lnGFCFI is the natural log of gross fixed capital formation of industry in real value (millions of SYP), lnOP is the natural log of oil price (US dollars per barrel), and εt is the error term.

The analysis begins with the unit root test to determine whether the time series data are stationary at levels or first difference. The Augmented Dickey Fuller (ADF) unit root test is used in this study to test for the stationary of the variables. After determining the order of integration of each of the time series, and if the variables are integrated of the same order, the Johansen cointegration test will be used to determine whether there is any long-run or equilibrium relationship between the industrial output and the other independent variables in the model. If we found that the variables are cointegrated, the Granger causality tests will be conducted based on the VECM to determine the causality relationships among variables. On the other hand, if there is no cointegration among the variables, the VAR model will be employed to test for short-run Granger causality between the variables. Furthermore, the VECM will be subjected to the statistical diagnostic tests, namely, normality, serial correlation, heteroskedasticity and Ramsey RESET tests to ascertain its statistical adequacy. Impulse response functions (IRF) test and variance decomposition (VD) analysis also will be used in this study to help in determining whether the independent variables play any important role in explaining the variation of industrial output at short and long forecasting horizons. Lastly, the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) of the recursive residuals will be used to determine whether the parameters of the model are stable over the period of the study.

This study uses annual time series data of Syria during the period from 1970 to 2010. This data collected from the Central Bureau of Statistics in Syria (CBS) and the World Bank (WB). All variables in this study are in real value. Besides, all data will be expressed in the logarithmic form, except OPEN.

Empirical Results and Discussion

From the results of the ADF unit root test in Table 1, we can see that all the variables are not stationary at the levels, but became stationary after first differencing at least at the 5 percent level of significance. This means that all the variables are integrated of order 1, that is, I(1).

Table 1. ADF unit root test results

ADF	Level			First difference		
	Intercept	**Trend and intercept**	**None**	**Intercept**	**Trend and intercept**	**None**
lnIO	-1.100081	-2.515726	3.005803	-8.836200***	-8.808157***	-7.514637***
OPEN	-1.831914	-2.484195	0.319275	-7.536732***	-7.446232***	-7.525128***
lnGFCFI	-2.455922	-2.558064	1.423804	-6.232455***	-6.217772***	-6.030086***
lnOP	-2.536151	-2.542084	1.285268	-5.252982***	-5.283319***	-4.902189***

Note: *** Denotes significance at the 1 per cent level, and ** at the 5 per cent level.
Source: made by the author through EViews 8.1

Johansen Cointegration Test Results

After determining that all the variables are stationary in the first difference, we can use the cointegration test to determine the presence of any cointegration or long-run relationship among the variables based on the Johansen cointegration test. But before running the cointegration test, we run the VAR model first to determine the optimal lag length. The maximum lag has been set to 5 in the lag length selection process. The optimal lag length selection is 5 lags.

After we have determined the number of lags, we proceed with the cointegration test for the model. Table 2 shows that there are four cointegration equations based on the trace and maximum eigenvalue tests. In other words, the results indicate that there is a long-run relationship between lnIO, OPEN, lnGFCFI, and lnOP.

Table 2. Johansen cointegration test results

No. of CE(s)	Trace Statistic	Probability	Max-Eigen Statistic	Probability
r = 0	119.4046***	0.0000	49.52453***	0.0000
r ≤ 1	69.88009***	0.0000	37.42665***	0.0002
r ≤ 2	32.45344***	0.0006	20.86978***	0.0076
r ≤ 3	11.58366**	0.0171	11.58366**	0.0171

Note: *** Denotes significance at the 1 per cent level, and ** at the 5 per cent level
Source: made by the author through EViews 8.1

After having found a cointegration relationship among the variables, the cointegrating equation was normalized using the real IO variable. Table 3 shows the normalized cointegrating vector.

Table 3. Cointegration equation normalized with respect to IO

lnIO	OPEN	lnGFCFI	lnOP	C
1.000000	0.164610	-5.838133	1.370820	112.2359
	(0.03751)	(1.67406)	(0.64702)	(38.1628)

Source: made by the author through EViews 8.1

From the Table 3, the long-run lnIO equation can be written as:

$$lnIO = -112.2359 - 0.164610\ OPEN + 5.838133\ lnGFCFI - 1.370820\ lnOP \quad (2)$$

The cointegration equation above shows that IO is negatively related to OPEN and OP, but positively related to GFCFI. The negative coefficient of OPEN indicates that when trade openness increases by one percent, industrial output will decrease by 0.16 percent. This outcome is expected since the quality, productivity and competitiveness of the Syrian industry in global markets are low, and there is a lack of modern management, technology, industrial R&D, training and skills in the industrial companies in Syria. Moreover, the Syrian producers prefer the local markets because they are provided with protection, the distribution in the local markets is easy, and they can make high profits without having to pay attention to quality. This makes Syrian industrial productions unable to compete with foreign products in the local and global markets after opening up the Syrian economy to foreign trade. Our finding is in line with Akbarian and Rafiee (2009) and Umer and Alam (2013).

The positive coefficient of lnGFCFI indicates that when gross fixed capital formation of industry increases by one percent, industrial output will increase by 5.84 percent. This suggests that gross fixed capital formation of industry has a vital role in supporting the industrial production in Syria through supporting the industrial production with machines, spare parts, semi-finished products and raw materials that can be used to improve and increase industrial outputs in the country. Our result agrees with the finding of Dutta and Ahmed (2004) and Hosseini and Leelavathi (2013). The negative coefficient lnOP indicates that when oil price increases by one percent, industrial output will decrease by 1.37 percent, because the boost in oil prices will increase the cost of industrial production, which affects negatively the industrial production in the country. It is known that oil is used in industrial companies as fuel for machines, to transport inputs to the factories, to transport industrial output to the markets, and it is also used as an input in the chemical industries. Lee and Ni (2002) also found that the rise in oil prices affects negatively the industrial production.

Granger Causality Tests Results

Since the variables in the model are cointegrated, the Granger causality tests based on the VECM are used to determine the short and long run causal relationships among the variables in the model. The Granger causality test results based on the VECM are shown in Table 4. The significance of the coefficient of the lagged error correction term shows the long run causal effect. It is clear that there are bidirectional short-run causality relationship between lnGFCFI and lnIO, and unidirectional short-run causality relationships running from OPEN and lnOP to lnIO. Besides, there are unidirectional long-run causality relationship running from lnOP to lnIO, and bidirectional long-run causality relationships between OPEN, lnGFCFI and lnIO. Furthermore, the speed of adjustment coefficient indicates that the lnIO adjusted relatively fast to changes to the underlying equilibrium relationship since the parameter estimate of ect shows that economic agents removed 69.65% of the resulting disequilibrium each year.

Table 4. Granger causality test results

	Independent variables				
	∑Δ lnIO	∑Δ OPEN	∑Δ lnGFCFI	∑Δ lnOP	ect(-1)
Δ lnIO	-	2.187061(3)*	3.541532(6)**	2.094162(4)*	-2.669109**
Δ OPEN	0.315351(4)	-	1.201328(3)	1.821391(5)*	-2.726515*
Δ lnGFCFI	4.602731(5)**	2.967160(4)*	-	3.117315(4)**	-2.861305**
Δ lnOP	1.160315(3)	0.190217(4)	2.204736(3)*	-	-0.376414

Notes: ect(-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. D represents the first difference. Only F-statistics for the explanatory lagged variables in first differences are reported here. For the ect(-1) the t-statistic is reported instead. ** denotes significance at the 5 per cent level and * indicates significance at the 10 per cent level.

Source: made by the author through EViews 8.1

Statistical Diagnostic Tests Results

It is important to subject the VECM to a number of diagnostic tests, namely, the normality, serial correlation, heteroskedasticity (BPG and ARCH) and Ramsey RESET tests to ascertain its statistical adequacy. A 5% level of significance will be used in all these tests. The results of the diagnostic tests are reported in Table 5. The VECM with lnIO, OPEN, lnGFCFI, and lnOP as the dependent variables pass the normality, serial correlation, heteroskedasticity (BPG and ARCH) and Ramsey RESET tests.

Table 5. Results of the statistical diagnostic tests on the VECM

	Probability			
The Depended Variables	lnIO	OPEN	lnGFCFI	lnOP
Normality tests	0.608643	0.378958	0.972594	0.337354
Serial correlation tests	0.412201	0.492203	0.604138	0.480131
Heteroskedasticity (BPG) test	0.6376	0.5728	0.6369	0.8398
Heteroskedasticity (ARCH) test	0.1023	0.6010	0.792506	0.4436
Ramsey RESET tests	0.9236	0.8026	0.4702	0.2653

Note: ** Denotes significance at the 1 percent level, and * at the 5 per cent level
Source: made by the author through EViews 8.1

Impulse Response Functions (IRF) Test Results

Impulse response functions (IRF) allow us to study the dynamic effects of a particular variable's shock on the other variables that are included in the same model. Besides, we can examine the dynamic behaviour of the times series over ten-year forecast horizon. There are many options for transforming the impulses. We will use the generalized impulse response functions (GIRF). Figure 1 shows that when there is a shock to lnGFCFI or lnOP, lnIO will respond positively in the following years. However, lnIO will respond positively to a shock in OPEN after 5 years, and the impact of the shock will not die down in the following years.

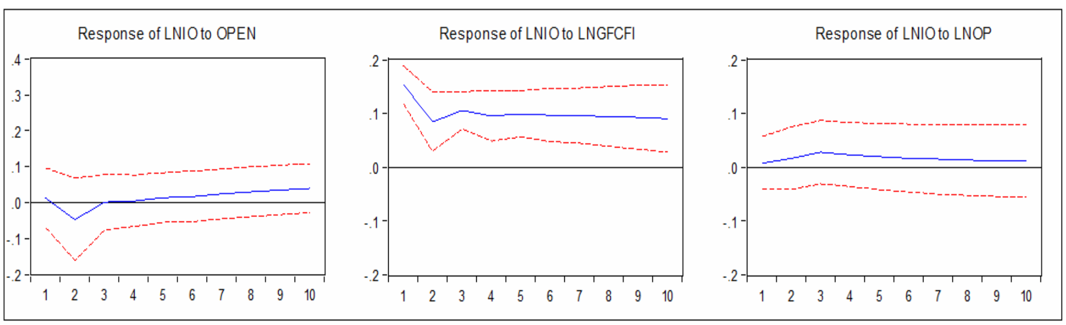

Fig. 1. Generalized impulse response functions (GIRF) results
Source: made by the author through EViews 8.1

Variance Decomposition (VD) Analysis Result

The variance decomposition (VD) for 1-year to 10-year forecast horizons will be applied to explain how much of the uncertainty concerning the prediction of the dependent variable can be explained by the uncertainty surrounding the other variables in the same model during the forecast horizon. The forecast error variance decompositions of the variables in our model are given in Table 6. In the first year, the error variance of lnIO is exclusively generated by its own innovations and has been decreasing since then for the various forecast horizons. However, at the 10-year forecast horizon, its own shocks contribute about 57% of the forecast error variance. On the other hand, OPEN, lnGFCFI and lnOP shocks explain 14%, 23% and 5% of the forecast error variance of lnIO respectively. Furthermore, the contributions of OPEN, lnGFCFI and lnOP in explaining lnGEX forecast error variance have increased during the 10-year forecast period.

Table 6. Variance decomposition (VD) analysis results

Period	S.E.	lnIO	OPEN	lnGFCFI	lnOP
1	6.696096	100.0000	0.000000	0.000000	0.000000
2	7.505655	97.87291	0.687124	0.012973	1.426993
3	8.277182	95.82118	1.057933	1.167416	1.953476
4	8.525334	92.99781	2.105454	2.377955	2.518778
5	8.765749	88.40314	2.497902	5.206269	3.892692
6	9.196512	80.31553	5.395930	9.636821	4.651717
7	9.606591	73.79284	7.515161	13.32907	5.362932
8	10.13194	66.61040	10.51114	17.31070	5.567765
9	10.56468	61.67318	12.54519	20.29612	5.485512
10	10.96917	57.49895	14.45021	22.82661	5.224238

Source: made by the author through EViews 8.1

Stability Test Results

The stability tests are used to determine parameter stability. The decision about parameter stability is based on the position of the plot relative to the 5% critical bound. The CUSUM and CUSUMSQ statistics are used in this study. If the plots of the CUSUM or CUSUMSQ stay inside the area between the two critical lines, then the parameters of the model are stable over the period of the study. The results of the stability test are shown in figures 2 and 3. It indicates that the position of both CUSUM and CUSUMSQ plots stay inside of the area between the two critical lines which means that the parameters are stable over the period of the study. In other words, there are no structural changes in the model.

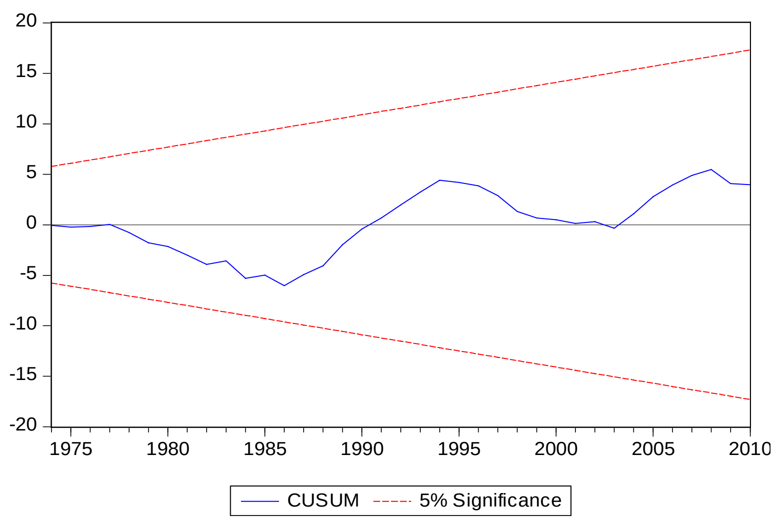

Fig. 2. CUSUM test results

Source: made by the author through EViews 8.1

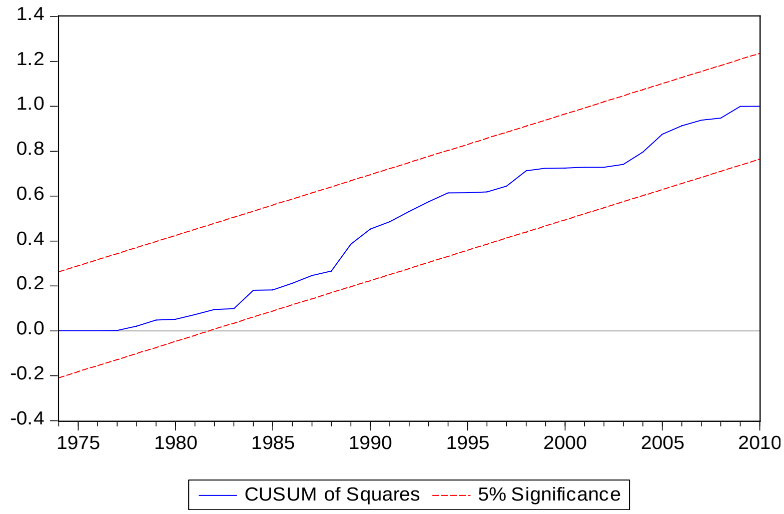

Fig. 3. CUSUMSQ test results

Source: made by the author through EViews 8.1

Conclusion

This study investigated the effect of trade openness, capital and oil price on the industrial outputs in Syria using annual time series data from 1970 to 2010. The model has four variables, with the industrial output as the dependent variable. The ADF unit root test, Johansen cointegration test, Granger causality test, impulse response functions (IRF), variance decomposition (VD) analysis, CUSUM test and CUSUMSQ test were used in this study. The ADF test results indicate all variables are I(1). The Johansen cointegration test showed that trade openness and oil price have a negative and significant long-run relationship with industrial output, but capital has a positive and significant long-run relationship with industrial output. Furthermore, from the Granger causality tests, we found that there are unidirectional long-run causality relationship running from oil price to industrial output, and bidirectional long-run causality relationships between trade openness, capital and industrial output. Besides, there are bidirectional short-run causality relationship between capital and industrial output, and unidirectional short-run causality relationships running from trade openness and oil price to industrial output. The impulse response functions (IRFs) indicated that industrial output will respond positively to a shock in trade openness after 5 years, and when there is a shock to capital or oil price, industrial output will respond positively in the following years. The VD analysis showed that over a ten-year forecasting horizon, trade openness, capital and oil price shocks explain 14%, 23% and 5% of the forecast error variance of industrial outputs, respectively. On the other hand, the results of the CUSUM and CUSUMSQ tests showed that the parameters are stable over the period of the study. Then there are no structural changes.

Based on the results of this study, it is vital for the Syrian government to increase the capital that is used in industrial activities, encourage the industrial investment in the country, improve the quality, productivity and competitiveness of the Syrian industry, and using of modern management, technology, industrial R&D, training and skills in the industrial companies in Syria.

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