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REGULAR ARTICLE

DETERMINANTS OF AGRICULTURAL OUTPUT IN SYRIA

*Adel Shakeeb MOHSEN *, Soo Y. CHUA, Che Normee CHE SAB*

Address:
Economics Programme, School of Social Sciences, Universiti Sains Malaysia, 11800 USM, Penang, Malaysia
*Corresponding author; Email: adelmhsen@hotmail.com

ABSTRACT

This study investigates the determinants of agricultural output in Syria, 1980-2010. The Johansen cointegration test results indicate that agricultural outputs are positively related to the capital, food exports, expenditure and arable land, and negatively related to the oil price. Arable land has the biggest effect on agricultural outputs. The Granger causality test indicates bidirectional short-run causality relationships between capital, food exports, expenditure, arable land and agricultural outputs, and unidirectional short-run causality relationship running from oil price to agricultural outputs. There are also unidirectional long-run causality relationships moving from agricultural outputs to gross fixed capital formation of agriculture, oil price, food exports and arable land. However, there is no long-run causality relationships between final consumption expenditure and agricultural outputs. The result indicates that it is important to speed up the land reclamation process and encourage the investment in the agricultural sector.

Keywords: Syria, agricultural output, VAR, cointegration test, Granger causality test
JEL: O11, E20

INTRODUCTION

Syria is a middle-income developing country with a diversified economy. The agricultural sector is one of the largest contributors to GDP and it plays a major role in Syria's economic development for achieving national food security, promoting Syrian trade and providing jobs for the rural people.

Vegetables and livestock production are the main productions of the agricultural sector in Syria. The major agricultural products include wheat, barley, cotton, maize, potatoes, lentils, tobacco, apples, citrus, chickpeas, sugar beet, onions, peanuts, olives, grapes, and tomatoes (**El-Quqa et al., 2007**). Moreover, the main agricultural export items are cotton, cereals, fruits, vegetables, and tobacco. Cotton is at the number one position of Syrian agricultural exports. Besides, cotton is the second most important cash crop (after wheat) (**Beintema et al., 2006**).

Syria's initial agricultural strategy is to achieve self-sufficiency in the main food staples such as wheat and barley. The state owns most of the agro-processing plants and monopolizes foreign trade in major crops. This also helps to stem rural migration. In the late 1980s and 1990s, the government revised its strategy, and this modification was done in a series of structural adjustment measures such as reduction of subsidies and downsizing the public sector (**Raphaeli, 2007**). The government upgraded the agricultural infrastructure, passed many laws to encourage private and public investment in the agriculture sector, and provided loans to farmers and farm companies to increase and improve agricultural output. Besides, Syrian private sector has a big percentage share of the agricultural production, which is carried out by many relatively small farm units. However, processing of the agriculture products as well as the fertilizer distribution are monopolized by the public sector. On the other hand, sustained capital investment, subsidized inputs, infrastructure development, and price supports led Syria to move from an importer to an exporter of many agricultural products such as cotton, wheat, vegetables and fruits. Moreover, the government's investments in irrigation system in northern and north-eastern Syria were one of the main reasons for the expansion of agricultural output and exports in the country (**Raphaeli, 2007**). According to the **Central Bureau of Statistics (2011)**, the total area of cultivable land has grew from 5905 thousand hectares in year 2000 to 6012 thousand hectares in 2009.

As shown in Figure 1, the value of agricultural sector output in Syria dropped from SYP 132233 million in 1980 to SYP 118267 million in 1984. This decline was mainly due to the drought, salinization of agricultural lands, internal migration from the countryside to the cities and the failure of the agricultural policy due to the bureaucracy in the state's institutions. In the second half of the 1980s, the state took some actions to improve the agriculture sector such as improving its agricultural policy, reducing the bureaucracy, and encouraging the private sector to invest in agriculture projects (**Dagher, 2000**). This led to the increase in agricultural output during the second half of the 1980s, but in 1987 and 1989, agricultural output declined due to the rise of the oil prices.

In the 1990s, the value of agricultural output increased continuously from SYP 136269 million in 1991 to SYP 223749 million in 2000. However, it dropped to SYP 197218 million and SYP 204771 million in 1997 and 1999 respectively, due to the drought and increase in the oil price. In the first decade of the 21st century, the agricultural output increased from SYP 241896 million in 2001 to SYP 292457 million in 2006. However, it declined in the second half of this decade because of the drought and the increase in the fertilizer and fuel prices. This eventually led to the rise in production costs and weakened the competitiveness of agricultural products. The government developed a number of projects to motivate agricultural investment, provided indirect support to the agricultural sector, and also created the Agricultural Support Fund in 2008 (**NAPC, 2008**).

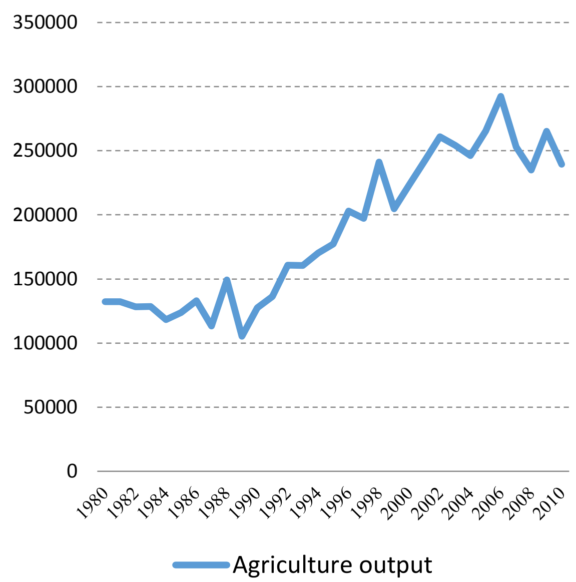

Figure 1 Agriculture sector output in Syria, at constant 2000 prices, in million Syrian pounds, 1980 - 2010
Source: Central Bureau of Statistics

Given this backdrop, the aim of this study is to investigate the determinants of the agricultural output in Syria during the period 1980 to 2010. The dependent variable in this study is the agricultural output. While, gross fixed capital formation of agriculture, oil price, food exports, final consumption expenditure, and arable land are the independent variables. The organization of this study is as follows, the next section is the literature review. The third section provides a brief discussion on the methodology. The fourth section reports the empirical results and the last section concludes the study.

PREVIOUS STUDIES

Agricultural production is a main source of economic growth in most developing countries. A number of studies have investigated the determinants of agricultural production. However, most of these studies including **Reilly et al. (1993), Viglizzo et al. (1995), Eitzinger et al. (2001), Isik and Devadoss (2006), Lhomme et al. (2009), Lordemann and Aguilar (2009), Khanal (2009), Enete and Amusa (2010), Enete et al. (2011), Salvo et al. (2013), Poudel and Kotani (2013), Siwar et al. (2013), Hasan et al. (2013), and Melkonyan and Asadoorian (2014)** tested the effect of natural factors like climate change, desertification, flooding, drought, and rain on agricultural output. Besides, a number of others researchers such as **Melkonyan and Asadoorian (2014), Ali et al. (2011), El Benni et al. (2012), and Fulton (2015)** tested the effect of agricultural policy on the agricultural production.

However, studies that investigated the economic factors were limited. **Muhammad-Lawal and Atte (2006)** found that increase in food import negatively affects agricultural production in Nigeria, because the local farmers faced unfair competition from foreign producers who used production technology that are more advance than local farmers. However, population growth rate affects positively the agricultural production, because increases in population will create more labour to work in farms, which lead to increase in agricultural output. The economic growth also affects positively on the agricultural production since most economic activity are related to the agriculture production in the country. The consumer prices have positive effects on the agricultural production because increases in prices motivate farmers to increase the supply of products, which lead to more agricultural production. Lastly, government expenditure has a positive influence on the agricultural production. Besides, **Hye et al. (2010)** also found that agricultural prices, government spending on agriculture sector, labour force and fixed capital in the agricultural sector have positive and significant effect on the agricultural production in Pakistan. **Usman and Arene (2014)** found that total capital flight, political instability, interest rate differential, macroeconomic instability, and the annual variability of consumer price index exhibit negative relationships with agricultural growth in Nigeria, while the external debt shocks and foreign direct investment have positive relationships with agricultural growth. However, the effect of the total capital flight, macroeconomic instability, and the annual variability of consumer price index on the agricultural growth in Nigeria is insignificant. In a recent study, **Chisasa (2015)** found that bank credit, land, labour and rainfall have positive effect on the agricultural output in South Africa.

This study fills the gap in the literature by investigating the macroeconomic determinants of agriculture output in Syria. The findings of this study are expected to provide valuable insights for policymakers and economists in rebuilding the country after the war.

METHODOLOGY

The agriculture sector is one of the main sectors that contributed significantly to the economic growth of Syria. An increase in capital investment in agricultural activities can play an important role in improving and increasing agricultural output. However, changes in the world oil price may affect the prices of equipment that are used in the agriculture production process, which may in turn affect the agricultural output in the country. Based on the export-led growth theory, food export growth leads farmers and food producers to increase and improve their production. Moreover, increases in the final consumption expenditure encourage farmers to increase their agricultural production to satisfy the expanding domestic demand and increased consumption. The expansion of arable land may also bolster the ability of farmers to increase the volume of their production.

The agricultural output model consists of six variables: agricultural output, gross fixed capital formation of agriculture, oil price, food exports, final consumption expenditure, and arable land. Agricultural output is our dependent variable. The model is presented by Eq. 1.

$$lnAO = \alpha + \beta_1 lnGFCFA + \beta_2 \, lnOP + \beta_3 \, lnFX + \beta_4 \, lnFCE + \beta_5 \, lnARL + \varepsilon_t \qquad (1)$$

where α is the intercept, β_1, β_2, β_3, β_4, and β_5 are the coefficients of the model, lnAO is agricultural outputs in real value (millions of SYP), lnGFCFA is gross fixed capital formation of agriculture in real value (millions of SYP), lnOP is oil price (US dollars per barrel), lnFX is the food exports in real value (millions of SYP), lnFCE is final consumption expenditure in real value (millions of SYP), lnARL is the arable land (hectares), and ε_t 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 relationship between the agriculture output and the other independent variables in the model. If the variables are not cointegrated, the Granger causality tests will be conducted based on the Vector Autoregression (VAR) model to determine the long and short run causality relationships among the variables. However, if the Johansen test results indicate cointegration among the variables, then the Granger causality tests will be based on the Vector Error Correction Model (VECM). This model will be subjected to the statistical diagnostic tests, namely, the normality, serial correlation, heteroskedasticity and Ramsey RESET tests to ascertain the statistical adequacy of the model before running the Granger causality tests. Beside, the model stability tests, namely, the cumulative sum (CUSUM) and cumulative sum of squared (CUSUMSQ) tests will also be applied to determine whether the parameters of the model are stable over the period of the study.

Lastly, impulse response functions (IRF) and variance decomposition (VD) analysis will be used to help in determining whether the independent variables play any important role in explaining the variation of agricultural output at the short and long run forecasting horizons.

This study uses annual time series data of Syria from 1980 to 2010. The data were collected from the Central Bureau of Statistics in Syria, and the World Bank. All variables in this study are in real value. Besides, all data are expressed in the natural logarithmic form.

EMPIRICAL RESULTS AND DISCUSSION

From the results of the ADF unit root test in Table 1, we can see that all the six 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).

Johansen Cointegration Test Results

Since 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. Based on the minimum Akaike Information Criterion (AIC), the optimal number of lags is two. Table 2 shows that there are six cointegration equations based on the trace test, and two cointegration equations based on the maximum eigenvalue test. In other words, the results indicate that there are long-run relationships among the variables in the system comprising lnAO, lnGFCFA, lnOP, lnFX, lnFCE, and lnARL.

After having found cointegration relationships among the variables, the cointegrating equation was normalized using the real agriculture output. From Table 3, the long-run lnAO equation can be written as the Eq. 2.

Table 1 ADF unit root test results

ADF	Level			First difference		
	Intercept	Trend and intercept	None	Intercept	Trend and intercept	None
lnAO	-0.499878	-1.884339	1.672603	-9.873101 ***	-9.681567 ***	-9.429101 ***
lnGFCFA	-2.268603	-3.270032	1.452471	-3.740994 ***	-3.897356 **	-3.523281 ***
lnOP	-0.522746	-1.637071	0.492299	-5.903488 ***	-6.575602 ***	-5.929094 ***
lnFX	-1.641427	-2.872372	1.745529	-3.781951 ***	-3.7993 **	-3.82097 ***
lnFCE	0.893232	-1.505545	1.637211	-4.67756 ***	-6.333146 ***	-4.498167 ***
lnARL	-1.960938	-1.941406	-1.297412	-7.015683 ***	-7.533606 ***	-6.537875 ***

Note: *** Denotes significance at the 1 per cent level, and ** at the 5 per cent level.
Source: Authors' estimations

Table 2 Johansen cointegration test results

No. of CE(s)	Trace Statistic	Prob	Max-Eigen Statistic	Prob
r = 0	220.3674 ***	0.0000	87.54949 ***	0.0000
r ≤ 1	132.8179 ***	0.0000	69.32288 ***	0.0000
r ≤ 2	63.49500 ***	0.0058	23.84268	0.1798
r ≤ 3	39.65231 **	0.0155	17.85876	0.1861
r ≤ 4	21.79356 **	0.0305	11.17549	0.2391
r ≤ 5	10.61807 **	0.0263	10.61807 **	0.0263

Note: *** Denotes significance at the 1 per cent level, and ** at the 5 per cent level
Source: Authors' estimations

Table 3 Cointegration equation normalized with respect to AO

lnAO	lnGFCFA	lnOP	lnFX	lnFCE	lnARL	C
1.000000	-0.449433	0.788517	-0.248462	-1.483515	-2.796758	71.03476
	(0.03284)	(0.03877)	(0.02006)	(0.04699)	(0.44106)	(8.12285)

Source: Authors' estimations

$$lnAO = -71.0347 + 0.44943\, lnGFCF - 0.78851\, lnOP + 0.24846\, lnFX + 1.48351\, lnFCE + 2.79675\, lnARL \quad (2)$$

The cointegration equation given by equation (2) shows that lnAO is positively related to lnGFCFA, lnFX, lnFCE and lnARL, while lnAO is negatively related to lnOP.

The coefficient for lnGFCFA indicates that when gross fixed capital formation of agriculture increases by one percent, agricultural outputs will increase by 0.45 percent. Capital that is invested in agricultural activities can be used for buying agricultural equipment such as tractors, tillage, harvesters, chemical fertilizers, and seeds, which can improve the quality and quantity of agricultural production in the country. Moreover, the government created the Agricultural Support Fund in 2008 to support the farmers with money that they need in the agricultural activities, and the Syrian agricultural bank gives loans to farmers and farm companies to increase and improve their agricultural output. Our result agrees with **Hye et al. (2010)** who found that fixed capital in the agricultural sector has a positive and significant effect on the agricultural performance.

The coefficient for lnOP reveals that when oil prices increases by one percent, agricultural outputs will decrease by 0.79 percent. Any increase in oil prices will increase the prices of fuel, chemical fertilizers, and other agricultural equipment, and that will in turn increase the cost of agriculture production, which affects negatively the agricultural output in the country.

The coefficient for lnFX indicates that when food exports increases by one percent, agricultural outputs will increase by 0.25 percent. Agriculture exports are one of the main sources of foreign exchange earnings, and food exports is one of the major Syrian exports. The returns from food exports motivate farmers and food producers in Syria to increase and improve their production through importing agricultural equipment and food production equipment, which help in increasing and improving agricultural output in the country. Moreover, exporting to foreign markets will increase the degree of competition, which leads producers to pay more attention to the quality of their production. The rise in food exports also boosts the local demand for the agricultural products by the food producers who use these products as raw materials or semi-finished products in their food production activities. This in turn will motivate farmers to increase and improve their production to meet the increase in the demand.

The coefficient for lnFCE shows that when final consumption expenditure increases by one percent, agricultural outputs will increase by 1.48 percent. Final consumption expenditure includes the expenditure of agricultural and industrial products in the country. Boosting the expenditure on agricultural products causes an increase in the demand for these products, which leads farmers to increase their agricultural output to meet the increases in demand. On the other hand, some industries like clothes, textile and food industries depend on agricultural raw materials or semi-finished products in their production activities. Hence, any increase in the expenditure of these products drives producers to increase their production, which in turn leads to an increase in the use of agricultural output in the production activities, and that will lead to the increase in the demand for agricultural products, which in turn motivates farmers to increase their production. Moreover, it is known that food and textile industries output constitutes about 51-61% to total manufacturing output in Syria (**Naser et al., 2006**).

Finally, the coefficient for lnARL indicates that when arable land increases by one percent, agricultural outputs will increase by 2.8 percent. Expansion of arable land increases the ability of farmers to increase their production, which in turn leads to an increase in the volume of agricultural output in the country. This shows that the Syrian government's efforts on land reclamation, creating appropriate infrastructure for agricultural production activities and increasing the area of agricultural land in the country have the desired outcome of improving the quantity of agricultural production in the country. For instance, the Syrian government's investment in irrigation systems in northern and northeastern Syria is one of the main reasons for the expansion of agricultural output in Syria.

Statistical Diagnostic Tests Results

Since the variables in the model are cointegrated, the Granger causality tests will be based on the estimated VECM. However, before testing for Granger causality, it is essential to subject the VECM to a number of diagnostic tests, namely, the normality, serial correlation, heteroskedasticity 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 4. The VECM with lnGDP, lnFCE and lnARL as the dependent variables pass the normality, homoskedastic (BPG and ARCH) and Ramsey RESET tests, but do not pass the serial correlation LM test. However, the VECM with lnGFCF, lnOP and lnFX as the dependent variables pass the normality, serial correlation, homoskedastic (BPG and ARCH) and Ramsey RESET tests. The serial correlation problem may be due to insufficient number of lags in the VECM. However, with the limited number of observations, it is not possible to increase the lag length. Therefore, the serial correlation problem is corrected using the Newey-West HAC standard errors before proceeding with the t and F tests for long-run and short-run Granger causality.

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, and vice versa. The results of the stability tests are shown in Figure 2. They indicate 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.

Granger Causality Tests Results

After the VECM was subjected to the residual diagnostics tests, the Granger causality tests based on the VECM are used to examine the short and long run causality relationships among the variables in the model. The F-test results show the significance of the short-run causal effects, while the significance of the coefficient of the lagged error correction term [ect(-1)] shows the long-run causal effect.

Table 4 Results of the statistical diagnostic tests on the VECM

	dependent variables					
	lnAO	lnGFCFA	lnOP	lnFX	lnFCE	ARL
JB test	0.129750	0.811295	2.449111	1.299511	0.552655	1.958542
	(0.937184)	(0.666545)	(0.293888)	(0.522173)	(0.758564)	(0.375585)
LM test	1.412602(2)**	0.639066(2)	0.061405(2)	0.522766(2)	2.249561(2)**	5.738547(2)**
	(0.0046)	(0.1557)	(0.8615)	(0.1846)	(0.0001)	(0.0004)
BPG test	1.295742	1.042666	1.164017	2.241111	1.756172	1.348980
	(0.3421)	(0.3933)	(0.3381)	(0.1870)	(0.3202)	(0.2981)
ARCH test	0.306353(1)	0.042033(1)	1.595627(2)	1.946277(2)	0.130668(1)	0.027088(1)
	(0.5665)	(0.8312)	(0.2053)	(0.1531)	(0.7071)	(0.8641)
RESET test	1.508221(1)	0.476320(1)	0.289953(1)	1.731672(1)	0.199950(1)	0.247918(1)
	(0.2741)	(0.5075)	(0.6001)	(0.2247)	(0.6851)	(0.6305)

Note: ** Denotes significance at the 1 percent level, and * at the 5 per cent level
Source: Authors' estimations

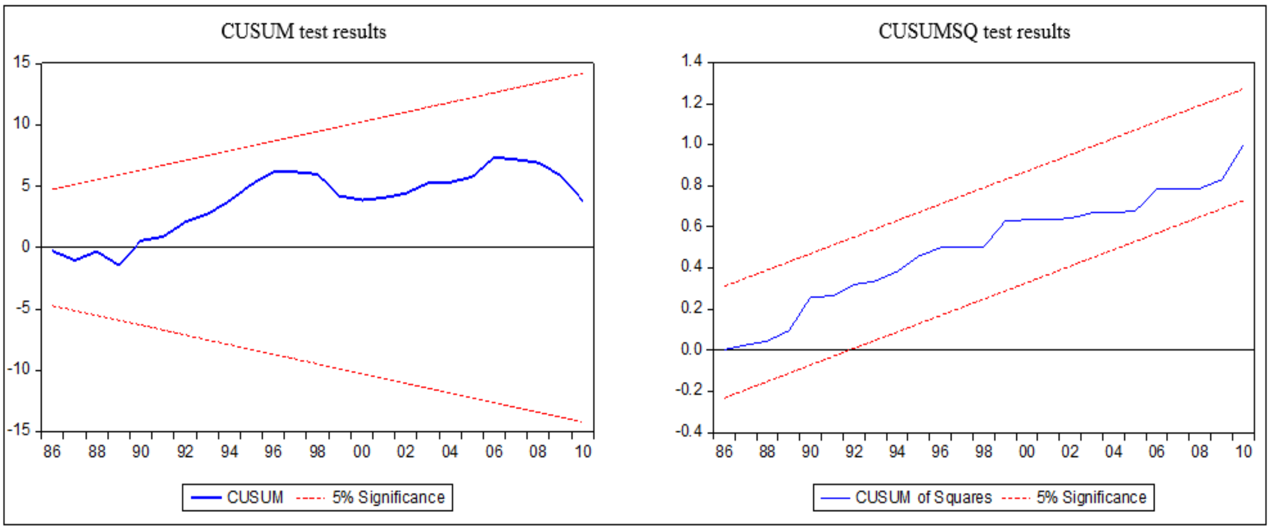

Figure 2 CUSUM and CUSUMSQ test results

Table 5 shows that there is a bidirectional short-run causality relationship between lnGFCFA and lnAO. Capital supplies farmers with funds that can help them to buy seeds, chemical fertilizers, and machines that can be used in agricultural activities, and changes in agricultural output cause changes in the returns from agricultural production, which in turn affects the gross fixed capital formation of agriculture. Furthermore, there is a bidirectional short-run causality relationship between lnFX and lnAO. Exports motivate farmers to increase their agricultural output in order to make more profits, and changes in agricultural output cause changes in export allocation, which affects the food exports.

Results of Table 5 also show a bidirectional short-run causality relationship between lnFCE and lnAO. With increases in the final consumption expenditure, farmers will increase their production to meet the increases in the local demand. Besides, when agricultural output increases, the agricultural output that is available for consumption will increase too, which leads to a rise in the final consumption expenditure in the country. Moreover, there is a bidirectional short-run causality relationship between lnARL and lnAO. With increases in the acreage of agricultural land, the ability to increase the agricultural production in the country will increase too, and when the agricultural output is not sufficient in the country, that drives the government to reclaim new agricultural land in order to increase the agricultural output. There is also evidence of a unidirectional short-run causality relationship running from lnOP to lnAO, implying that changes in oil prices affect the agricultural output through changes in the cost of production.

There are unidirectional long-run causality relationship running from lnAO to lnGFCFA, lnOP, lnFX and lnARL, but there is no long-run causality relationship between lnAO and lnFCE. Besides, the speed of adjustment coefficient indicates that the lnAO adjusted relatively slowly to changes to the underlying equilibrium relationship since the parameter estimate of ect shows that economic agents removed 18.93% of the resulting disequilibrium each year.

Impulse Response Functions (IRF) 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 a ten-year forecast horizon. There are many options for transforming the impulses. The generalized impulse response functions (GIRF) will be used in this study.

Figure 3 shows the response of lnAO when there is a shock to lnGFCFA. It responds positively in the first four years, then there is no significantly responses in the 5th, 6th and 7th year, after that it will respond positively in the following years. This reflects the important role of capital in agricultural production activities, and the exploitation of capital in the agricultural production activities must be improved in the future to still have a positive effect on the agricultural output in the country.

Besides, when there is a shock to lnOP, lnAO will respond negatively in the following years, because the cost of agricultural production will increase. Moreover, when there is a shock to lnFX, lnAO will respond negatively in the second year, and then it will respond positively and gradually die down in the following years. This shows the important role of food exports in supporting agricultural production in the country through motivating farmers and food producers to increase their production in order to achieve higher profits from exporting. Furthermore, when there is a shock to lnFCE, lnAO will respond positively, but the effect is small and eventually dies down. Lastly, lnAO will respond negatively to a future shock in lnARL. Hence, it is important to use modern technology in the agricultural production activities, in addition to creating adequate infrastructure to improve and increase agricultural production in the country.

Variance Decomposition (VD) Analysis Results

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 results of the error variance decompositions for the agricultural output model over a 10-year horizon are given in Table 6.

Table 5 Granger causality test results

	Independent variables						
	∑Δ lnAO	∑ Δ lnGFCFA	∑Δ lnOP	∑Δ lnFX	∑Δ lnFCE	∑Δ lnARL	ect(-1)
Δ lnAO	-	10.65 (4)**	23.05 (4)**	34.39 (2)**	45.66 (3)**	12.19 (3)**	-0.83
ΔlnGFCFA	3.36 (2)**	-	4.63 (3)**	17.77 (2)**	5.16 (3)**	5.34 (2)**	-2.34**
Δ lnOP	0.11 (2)	0.72 (2)	-	3.23 (2)**	1.83 (2)	1.64 (3)	-2.59**
Δ lnFX	5.84 (2)**	7.02 (3)**	0.99 (4)	-	0.77 (2)	0.75 (2)	-2.83**
Δ lnFCE	2.99 (3)**	3.72 (4)**	3.746 (4)**	3.67 (3)**	-	2.90 (2)*	-1.12
Δ lnARL	6.07 (3)**	14.15 (2)**	19.06 (2)**	0.62 (3)	2.83 (2)*	-	-3.11**

Notes: ect(-1) represents the error correction term lagged one period. The numbers in the brackets show the optimal lag based on the AIC. Δ 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: Authors' estimations

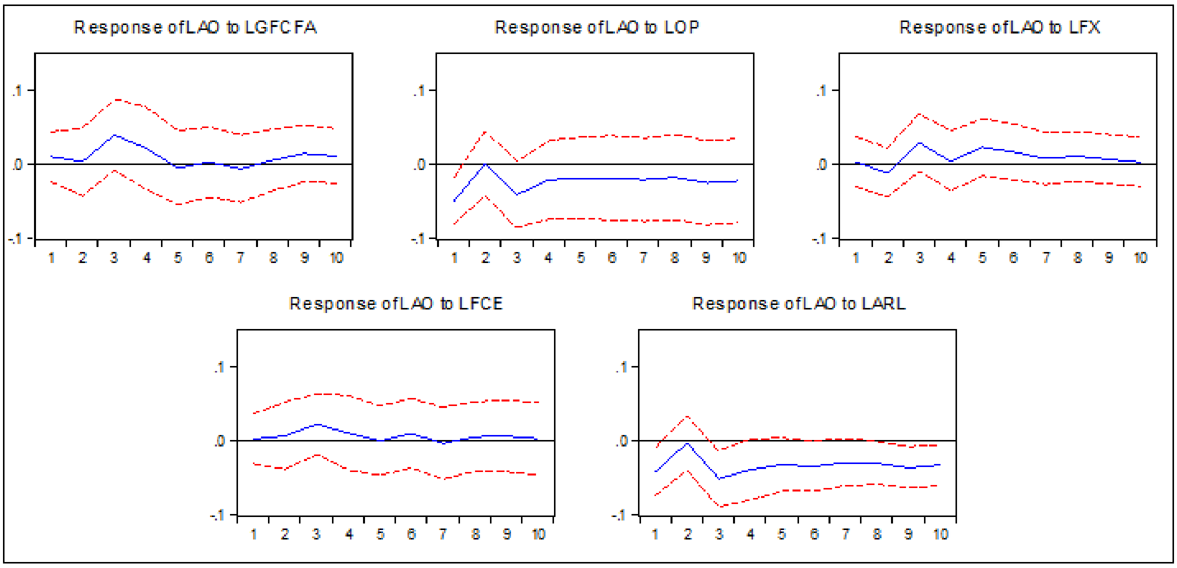

Figure 3 Generalized impulse response functions (GIRF) results

Table 6 Variance decomposition (VD) analysis

Period	S.E.	lnAO	lnGFCFA	lnOP	lnFX	lnFCE	lnARL
1	0.091582	100	0	0	0	0	0
2	0.096012	93.75517	0.054038	1.504833	4.097377	0.200109	0.388477
3	0.124738	78.05757	7.365741	2.788495	8.310834	2.489833	0.987529
4	0.136021	78.85203	7.714212	2.419481	7.033089	2.234821	1.74637
5	0.146549	76.4246	7.079783	2.420805	8.594236	2.098356	3.382225
6	0.155105	75.6764	6.329037	2.309717	8.624992	2.650623	4.409232
7	0.162772	76.05369	6.179978	2.260785	8.026437	2.407548	5.071563
8	0.167581	75.88603	5.848429	2.134887	7.948262	2.438213	5.744181
9	0.173522	75.81556	5.831341	2.124434	7.544229	2.328742	6.355697
10	0.177909	75.48002	5.752156	2.184498	7.229283	2.228112	7.125932

Source: Authors' estimations

The most important source of variation in agricultural output forecast error is its own innovations, which account for 75% to 95% of the total variation over the 10-year forecast horizon, while the other variables in the system (lnARL, lnGFCFA, lnOP, lnFX, and lnFCE) account for the remaining 5% to 25%. This indicates that a large proportion of the variation in agricultural output is attributed to its own shocks rather than innovations from the other variables over the10-year horizon. In fact, there are no major changes in the contribution of the other variables. At the 10-year horizon, both lnARL and lnFX shocks have almost the same explanatory power (7.1% and 7.2% respectively), lnOP and lnFCE shocks have 2.2%, while 5.8% of the variation in lnAO is explained by lnGFCFA.

CONCLUSION

This study investigates the determinants of agricultural output in Syria, using annual time series data from 1980 to 2010. The model has six variables, with the agricultural outputs as the dependent variable and gross fixed capital formation of agriculture, oil price, food exports, final consumption expenditure, and arable land as the independent variables. The Johansen cointegration tests indicates that agricultural outputs is positively related to gross fixed capital formation of agriculture, food exports, final consumption expenditure and arable land. While, agricultural outputs is negatively related to oil price. Furthermore, from the Granger causality tests, we find that there are unidirectional long-run causality relationships moving from agricultural outputs to gross fixed capital formation of agriculture, oil price, food exports and arable land. However, there is no long-run causality relationships between final consumption expenditure and agricultural outputs. While in the short run, there are bidirectional short-run causality relationships between gross fixed capital formation of agriculture, food exports, final consumption expenditure, arable land and agricultural outputs. There is also evidence of unidirectional short-run causality relationships running from oil price to agricultural outputs.

The impulse response functions indicates that when there is a shock in gross fixed capital formation of agriculture, agricultural outputs will respond positively in the first four years, then there is no significantly responses in the 5th, 6th and 7th year, after that it will respond positively in the following years. Besides, the response of agricultural outputs to the shock in oil price and arable land is expected to be negative in following years. Furthermore, when there is a shock in food exports, agricultural outputs will respond negatively in the second year, after that it will respond positively in the following years. Besides, when there is a shock in final consumption expenditure, agricultural outputs will respond positively in the following years. Moreover, the variance decomposition analysis showed that over a ten-year forecast horizon, 7.12%, 5.75%, 2.22%, 2.18% and 7.22% of agricultural outputs forecast error variance are explained by arable land, gross fixed capital formation of agriculture, final consumption expenditure, oil price and food exports shocks, respectively. On the other hand, the results of the CUSUM and CUSUMSQ tests show that the parameters are stable over the period of the study. That is, there are no structural changes.

Based on the findings of this study, the Syrian government should encourage the investment in the agricultural sector, and exploit the capital in the best way to improve the productivity of this sector, which contributes to the development of the agricultural sector in the country. Furthermore, it is important to improve the quality and quantity of food exports and raise the level of its competitiveness in local and global markets, which increase the returns of the agricultural sector in Syria. It is also important that the Syrian government speed up the land reclamation process in order to increase the area of agriculture land in the country. Syrian government should also create appropriate infrastructure for the agricultural production activities and introduce modern technology in the agricultural production activities to improve the quantity and quality of the agricultural production in Syria. Finally, the government should work to improve the living standard of its citizens, and that will encourage the local consumption in the country, which in turn will motivate the farmers and food producers to increase their production in the country, and that will reflect positively on the economic growth in Syria.

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