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Evidence on the Export-Led Growth Hypothesis: The Jordanian Case

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ABSTRACT

This paper examines the export-led growth hypothesis using Jordanian monthly data over the period 1997.03 - 2003.12. The univariate Autoregressive Integrated Moving Average (ARIMA) models are used to filter real exports and industrial production index series to white noise. The cross-correlation function is used in testing the independence hypothesis of exports and industrial production index by employing Koch-Yang test at different lag lengths. The results provide empirical evidence supporting the export-led hypothesis in the short-run only at the 5% level of significance. However, this relationship tends to support the hypothesis of independence when longer lags are used. The result based on Granger test shows a unidirectional causation from export to industrial production index at 10% level of significance. These findings lend support to the export-oriented strategy pursued by Jordan over the sample period examined.

KEYWORDS: Granger-causality, Koch-Yang Test, Independence, ADF Test, Data Stationarity.

INTRODUCTION

Since the mid of 1985, there has been considerable interest in testing for export-led growth using time series data and employing Granger-causality (Gupta, 1985; Jung and Marshall1, 985; Jin, 1995; Henriques and Sadorsky, 1996; Jin and Yu, 1996; Levin and Raut, 1997; Islam, 1998; Giles and Williams, 2000a and 2000b). In general, these studies present no uniform relationship between exports and real output. Furthermore, even the rich collection of theoretical models was not capable of fully explaining and reconciling the diversity of empirical results (BekÕ, 2003).

The export-growth relationship provides relevant information about different competing paradigms. First, openness is likely to provide greater access to investment goods, and hence increasing openness may raise long-run growth. Second, relaxing trade barriers may attract more foreign direct investment. Due to increased international competition, this process may discourage domestic investment, and in this case the output effect of the two driving forces is ambiguous (Levine and Renelt, 1992). Third, protection could raise the long-run growth if government intervention in trade encourages domestic investment along the lines of comparative advantage (Grossman and Helpman; 1992). Fourth, some writers argue that free trade may represent the primary source of economic downturns. This argument is basically based on the notion that trade liberalization and openness are likely to be associated with tariff cut, which will reduce relative prices of domestic manufacturers. In this case, manufacturing goods domestically becomes less attractive than importing foreign goods, and domestic economy may suffer a loss (Batra, 1992; Batra and Slottje, 1993; Leamer, 1995).

This paper investigates the dynamic relationship between real exports and the industrial production index using Jordanian monthly and not seasonally- adjusted data from March 1997 until December 2003, when the Bureau of Statistics altered the manner in which it computes the industrial production index.

The study has two main advantages over most previous studies. First, most of the previous studies conducted on export-led growth have used a demand-side framework and focused on the aggregative relationship between exports and economic growth. In

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small open economies, total exports may constitute only a small proportion of their aggregate economic activity and therefore the demand side analysis does not always seem to provide a convincing framework. The major problem here is not the dearth of external demand, but the shortage of domestic supply which can compete effectively in the international market (Singh, 2003). In this paper, the export-growth relationship is examined by using an advanced and efficient methodology that allows detecting the direction of causation. Therefore, the results obtained will help us to assess the effectiveness of the export-oriented strategy pursued by Jordan over the entire sample period examined.

Second, most of the previous empirical studies conducted on export-growth relationship were based on the notion of Granger causality and using annual time series data. Using annual data may not detect the possible relationships that may exist between the variables used in testing for links between exports and economic growth. The monthly data used in this study allows us to carry out the time series analysis, which basically consumes a large number of degrees of freedom.

This study consists of five sections. The next section reviews the most important and recent literature cited on the export-led growth hypothesis. The third section sets the mathematical model that is used in examining the relationship between export and real output. The fourth section discusses the empirical findings. Finally, Section five concludes.

LITERATURE REVIEW

Empirical research on the exports-output linkages has produced mixed results for the existence of any causal relationship between export growth and output growth. The problem with some of the previous studies is that their conclusions are based on regression models containing nonstationary variables, which yield spurious relationship and less efficient OLS parameters. On the other hand, a large number of previous studies have focused mainly on estimated models using cross-sectional data based on the implicit assumption that countries have common characteristics. In practice, countries differ in their institutional, political and economic structure, and in their reactions to external shocks. Thus, the estimates from cross-country regressions are misleading because they do not consider country-specific effects (Abdulnasser and Manuchehr, 2000).

In a most recent study, Abual-Foul (2004) tested the export-led growth hypothesis using the Jordanian case over the period 1976-1997, through using three bivariate models and employing annual data. The empirical results indicate a unidirectional causation from exports to output, and thus lending support to the export-oriented growth strategy pursued by Jordan over the period studied (Kanaan and Kardoosh, 2002).

Singh (2003) employed an extended version of Mankiw, Romer, and Weil's (1992) model to examine the effects of exports on output *per capita* for a panel of ten industries in the manufacturing sector in India for the period 1974 - 1994. The empirical results show that the industries with low output *per capita* tend to lag behind the industries with relatively high output *per capita*, rejecting the convergence hypothesis. The panel data analysis was supplemented with the time series analysis. The cointegration test results show the absence of any long-run equilibrium relationship between total factor productivity and exports.

Jin (2000a) examined the effect of openness on economic growth for rapidly growing economies in East Asia. He examined the dynamics of openness and growth relations by employing VAR techniques. The effect of openness on output growth is evaluated through the computation of impulse response functions and variance decompositions. The results do not strongly support the new growth theories in which increasing openness affects long-run growth through its impact on technological improvement.

Jin (2000b) also investigated the validity of the export-led growth hypothesis for the four largest provinces in Korea using monthly data over the period 1987:1-1996:7. A bivariate causal model is employed to investigate the short-run dynamic causal orderings between provincial exports and output. The final prediction error criterion is employed to select optimal lag lengths for each variable in each equation. The results show evidence supporting the export-led growth hypothesis in a bivariate causal model. In addition to this finding, the terms of trade and national output shock variables are found to have significant effects on economic growth for all provinces.

Vohra (2001) examined the role of export-growth linkage for India, Pakistan, Philippines, Malaysia, and Thailand using annual time series data for the period

1973-93. The empirical results indicate that exports have a positive impact on economic growth, in the middle-income group when a country has achieved some level of economic development. The empirical results signify the importance of pursuing liberal and free market policies as in Malaysia, Philippines, and Thailand by undertaking aggressive export expansion strategies and by attracting foreign direct investments. It also provides a lesson to less-developed countries such as India and Pakistan, namely, that they need to avoid employing restrictive and regulatory policy measures, which are less beneficial to their economic growth.

BekÕ (2003) explored the nature of the relationship between exports and real output in Slovenia for the period 1992-99 using the conditional causality technique. The results yield evidence supporting bidirectional causality between production in manufacturing and exports. Such two-way causalities also appear most often at the level of sectoral flows. Among the thirteen manufacturing sectors where some type of causality was found, seven were marked by a bidirectional link. The evidenced bidirectional causality of the export-output relation for Slovenia at the aggregate as well as the manufacturing/ sectoral level suggests that any characterization of a small country's growth as export driven may be at least perfunctory.

Abdulnasser and Manuchehr (2000) investigated the long-run causal relationship between real exports and real output using quarterly and seasonally adjusted data for Nordic countries (1977.1 to 1996.1 for Denmark, 1975.1 to 1994.4 for Finland, 1975.1 to 1996.1 for Norway, and 1980.1 to 1995.2 for Sweden). On the basis of Johansen's maximum likelihood procedure and augmented Granger causality tests, it is concluded that exports and output are causally related in the long run. Based on the estimated results, it can also be concluded that real output Granger-causes export growth in the case of Denmark. For Finland, Norway, and Sweden, causality runs from both directions. These causality directions are also confirmed by impulse response functions and variance decompositions.

METHODOLOGY

In this paper, we use the methodology proposed by Koch and Yang (1986) to examine the dynamic relationship between real exports (X_t) and real output (Y_t). In this framework, the bivariate time series (X_t and Y_t) can be expressed as

$$\begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \begin{pmatrix} F_{11}(B) & F_{12}(B) \\ F_{21}(B) & F_{22}(B) \end{pmatrix} \begin{pmatrix} e_t \\ u_t \end{pmatrix} \qquad (1)$$

where e_t and u_t are independent white noise innovations and the $F_{ij}(B)$ are convergent rational functions in B, the backshift operator ($B^i X_t = X_{t-i}$). The individual series, X_t and Y_t, can also be filtered with the appropriate univariate Autoregressive Integrated Moving Average (ARIMA, henceforth) models necessary to reduce them to white noise, e_t and u_t:

$$\begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \begin{pmatrix} \psi_{11}(B) & 0 \\ 0 & \psi_{22}(B) \end{pmatrix} \begin{pmatrix} e_t \\ u_t \end{pmatrix} \qquad (2)$$

where $\psi_{ii}(B)$ are also convergent rational function in B. Now if X_t and Y_t are related through $F_{12}(B)$ or $F_{21}(B)$, then e_t and u_t are also related. Hence, the cross-correlation function between the residuals of these estimated ARIMA models (the $\hat{e}_t$ and the $\hat{u}_t$) provides relevant information about the dynamic relationship between X_t and Y_t.). Given no observation on $\hat{e}_t$ and $\hat{u}_t$, the cross-correlation function can be estimated as

$$r_{\hat{e}_t \hat{u}_t} = \left[\sum_{t=1}^{n} \hat{e}_t^2 \sum_{t=1}^{n} \hat{u}_t^2\right]^{-1/2} \sum_{t=K}^{n} \hat{e}_t \hat{u}_t \qquad (3)$$

$$k = \pm 0, 1, 2, \ldots\ldots, M.$$

On the basis of this correlation function, Koch and Yang (1986) suggested a formal statistic r^*_i in which information is incorporated about a possible pattern among successive coefficients. The strength of this test is that it distinguishes one cross-correlation function with estimated coefficients that are small in magnitude and randomly distributed about zero from another cross-correlation function coefficients that are small in magnitude but arranged in a distinct pattern. This statistic is defined as:

$$r^*_i = n \sum_{K=-M}^{M-i} \left[\sum_{L=0}^{i} r_{\hat{e}\hat{u}}(K+L)\right]^2 \qquad (4)$$

$$i = 0, 1, 2, \ldots\ldots, M\text{-}1$$

where r^*_i is approximately distributed as $\beta_i\chi^2_{vi}$. The parameter, β_i and $_{vi}$, depend on the moments of r^*_i as follows:

βi = tr(AiAi)/tr(Ai), and νi = tr(Ai)2/tr(AiAi) (5)

As shown by Koch and Yang, this approximate distribution is simple to apply. The individual eigenvalues of A_i need not be calculated. Only the sum of eigenvalues and the sum of squared eigenvalues are necessary. Furthermore, the nature of matrix A_i allows straightforward calculation of these sums, as follows:

$$tr(A_i) = 2(M + 1)(i+1) - (i+1)^2 \quad (6)$$

$$tr(A_iA_i) = 2\Sigma\ [2M+i-3(j-1)]\ j^2+(2M+1-2i)(i+1)^2 \quad (7)$$

i = 0,1,2, ……..,M-1.

The model is estimated using Jordanian monthly data for the period 1997.03-2003.12. The model variables include exports from goods deflated by the consumer price index (1995 = 100), industrial production index (1995= 100). The data are obtained from various issues of Central Bank monthly Bulletins.

EMPIRICAL RESULTS

The present study employs the univariate ARIMA models to independently filter the original time series to white noise. Since the theory behind ARIMA estimation applies only to stationary time series, the Augmented Dickey-Fuller (1981) (ADF) test is used to test for stationarity of the time series used in this study. The failure to properly transform nonstationary data into stationary data can result in model misspecification thus leading to incorrect inferences (Enders, 1995).

Since the sample includes monthly and not seasonally adjusted data, a 1st and a 12th difference are applied to the natural log of the data. With six lagged difference terms, the ADF test was carried out. In this paper, we use three choices in running the ADF test regression. One is whether to include an intercept term in the regression. Another is whether to include a linear trend in addition to the intercept. The third is to exclude both intercept and linear trend. As reported in table (1) the results of the ADF test reject the existence of a unit root hypothesis of stationarity.

Table 1: Augmented Dickey-Fuller Tests for Real Exports (X) and Industrial Production Index (Y).

X	Intercept		Trend and intercept		None	
Lag	ADF	AIC [d]	ADF	AIC	ADF	AIC
1	-8.76[a]	-3.87	-8.70[a]	-3.84	-8.82[a]	-3.90
2	-7.31[a]	-3.88	-7.30[a]	-3.86	-7.36[a]	-3.91
3	-6.55[a]	-3.88	-6.60[a]	-3.87	-6.58[a]	-3.91
4	-5.73[a]	-3.88	-5.75[a]	-3.86	-5.76[a]	-3.91
5	-3.32[b]	-3.92	-3.30[c]	-3.89	-3.34[a]	-3.95
6	-3.73[a]	-3.94	-3.66[b]	-3.91	-3.76[a]	-3.97
Y	**Intercept**		**Trend and intercept**		**None**	
Lag	**ADF**	**AIC**	**ADF**	**AIC**	**ADF**	**AIC**
1	-7.96[a]	-4.72	-7.89[a]	-4.69	-8.02[a]	-4.75
2	-6.01[a]	-4.70	-5.97[a]	-4.67	-6.07[a]	-4.73
3	-5.42[a]	-4.67	-5.38[a]	-4.64	-5.47[a]	-4.70
4	-5.97[a]	-4.72	-5.96[a]	-4.70	-6.03[a]	-4.75
5	-4.52[a]	-4.69	-4.46[a]	-4.66	-4.56[a]	-4.72
6	-3.89[a]	-4.64	-3.83[a]	-4.61	-3.92[a]	-4.67

a, b, and c denote significance at the 1%, 5%, and 10% levels, respectively.
d AIC refers to Akaike Information Criterion.

We now turn to the results of the univariate ARIMA that are used to filter each time series independently to white noise. The chosen univariate ARIMA models are reported in table (2). These models are employed to filter the original time series, X and Y to e and u, respectively.

Table 2: Univariate ARIMA Models Estimation.

Dependent Variable: (1-B)(1-B12)LnX_t			Dependent Variable: (1-B)(1-B12)LnY_t		
Variable	**Coefficient**	**S. Error**	**Variable**	**Coefficient**	**S. Error**
AR(1)	-0.678	0.106	MA(4)	-0.273	0.077
AR(5)	-0.181	0.092	MA(12)	-0.582	0.057
SAR(2)	-0.456	0.137	SMA(1)	-0.584	0.089
MA(7)	-0.307	0.114			
MA(12)	-0.593	0.115			
SMA(4)	-0.303	0.144			
χ^2_{18}	11.467 (0.873)		χ^2_{21}	16.040 (0.778)	
n	82		n	82	

a χ^2 refers to Ljung –Box statistic, which is distributed as χ^2 with degrees of freedom equal to the number of autocorrelations less the number of autoregressive and moving average. In this study the number of autocorrelation is taken to be 24. Figures in parentheses are significance levels.

The univariate residual cross-correlation function, r_{eu}, reflecting this relationship is presented in table (3). Cross-correlations are calculated relating the empirical distributed lag for 24 months in each direction. Asymptotic standard errors ($S(r) = \sqrt{(n- |k|)^{-1/2}}$) for judging the significance of individual coefficients are also calculated, where (n -|k|) is the number of residuals minus the number of free parameters in the model.

In determining the existence of a relationship, observe that significant coefficients appear at lags 0 and 6. All other coefficients remain within the 95% confidence bands. These two coefficients may not necessarily imply a substantive relationship between export growth and industrial production index, since at the 95% level of confidence we would expect 3 of these 47 coefficients to be significantly different from zero. On the other hand, there is a distinct pattern in the coefficients at positive lags, as 8 of the first 9 coefficients in that direction are positive. This pattern may suggest that an increase in exports will positively affect output over the next 8 months. This result supports the export-led growth hypothesis.

Table 3: Univariate Residual Cross-correlation Functions for Real Exports and Industrial Production Index.

k	**r_{eu}**	**S(r)[1]**	**k**	**r_{eu}**	**S(r)**
-24	0.035	0.13	0	0.327	0.11
-23	0.111	0.13	1	0.042	0.11
-22	-0.036	0.13	2	0.218	0.11
-21	-0.123	0.13	3	0.107	0.11
-20	-0.003	0.13	4	0.019	0.11
-19	-0.089	0.13	5	-0.028	0.11
-18	-0.169	0.13	6	0.325	0.11
-17	0.126	0.12	7	0.038	0.12
-26	-0.152	0.12	8	0.006	0.12
-15	0.092	0.12	9	-0.176	0.12
-14	-0.033	0.12	10	-0.209	0.12
-13	-0.029	0.12	11	-0.008	0.12
-12	-0.110	0.12	12	-0.007	0.12
-11	-0.054	0.12	13	0.000	0.12

-10	0.032	0.12	14	0.036	0.12
-9	0.122	0.12	15	0.064	0.12
-8	-0.025	0.12	16	-0.054	0.12
-7	-0.185	0.12	17	-0.001	0.13
-6	0.069	0.11	18	0.001	0.13
-5	-0.080	0.11	19	0.008	0.13
-4	-0.061	0.11	20	-0.087	0.13
-3	0.138	0.11	21	-0.000	0.13
-2	-0.095	0.11	22	-0.113	0.13
-1	0.021	0.11	23	0.130	0.13
0	0.327	0.11	24	0.115	0.13

To investigate whether the apparent relationship indicated by this pattern can be measured statistically, the r^*_i statistics have been calculated for three different lag lengths: M = 18, 15, and 12. The relevant results are reported in table (4). With M = 12, each successive value of the statistics (ri/βi), i = 5, 6, 11, rejects independence at the 10% level, and at 5% level for i = 7, 9, and 10. On the other hand, with M = 15, each successive value of the statistic (for i = 7, 8,…,14) indicates a rejection of independence hypothesis at 10% level of significance. Observe that with M = 18, the test fails to reject independence at the 5% significance level.

Table 4: The Results of Koch-Yang Test: Testing the Independence between Real Export and Industrial Production Index.

i	M =12 months			M =15 months			M =18 months		
	ν_i	ri/βi	α	ν_i	ri/βi	α	ν_i	ri/βi	α
0	25	28.71	0.28	31	30.00	0.52	37	34.67	0.58
1	16.2	19.69	0.23	20.2	20.51	0.43	24.2	20.69	0.66
2	11.2	14.47	0.21	14	15.26	0.36	16.9	15.80	0.47
3	8.3	12.11	0.15	10.5	12.76	0.24	12.7	12.88	0.38
4	6.5	7.86	0.25	8.3	10.75	0.22	10.1	11.07	0.35
5	5.3	9.48	0.09	6.8	9.49	0.15	8.3	9.76	0.28
6	4.4	9.08	0.06	5.7	9.16	0.10	7	9.46	0.22
7	3.8	8.33	0.04	4.9	8.49	0.08	6	8.59	0.20
8	3.2	7.58	0.06	4.2	7.70	0.09	5.2	6.92	0.23
9	2.8	6.89	0.03	3.7	6.99	0.07	4.6	6.24	0.18
10	2.5	6.22	0.04	3.3	6.42	0.09	4.1	5.91	0.21
11	2.2	5.65	0.06	2.9	5.96	0.05	3.7	5.51	0.14
12				2.6	5.53	0.06	3.3	5.22	0.16
13				2.4	5.04	0.08	3	4.90	0.18
14				2.2	4.54	0.09	2.7	4.58	0.10
15							2.5	4.26	0.12

The next step involves testing Granger-causality between
real export and industrial production index. Once again, a 1st and a 12th difference are applied to the natural log of the data to achieve stationarity. Table (5) reports the Granger-causality results based on uniform lag structure. The F-statistic for the lag values of the independent variables presented in table (5) indicate that there is a unidirectional short-run causal effect from exports to industrial production index at 10% level of significance. This finding is consistent with the results of the Koch-Yang test. The empirical findings support the export-oriented growth strategy pursued by Jordan over the sample period examined.

Table 5: Granger Causality Results.

Hypothesis	Lags	NO. of Observations	F	Probability
Y does not Granger Cause X X does not Granger Cause Y	1	67	0.61 0.69	0.44 0.41
Y does not Granger Cause X X does not Granger Cause Y	2	66	0.25 3.10	0.78 0.05
Y does not Granger Cause X X does not Granger Cause Y	3	65	1.22 2.06	0.39 0.12
Y does not Granger Cause X X does not Granger Cause Y	4	64	1.13 2.13	0.35 0.09
Y does not Granger Cause X X does not Granger Cause Y	5	63	0.78 0.85	0.57 0.52
Y does not Granger Cause X X does not Granger Cause Y	6	62	0.45 0.93	0.81 0.48
Y does not Granger Cause X X does not Granger Cause Y	7	61	0.66 0.86	0.72 0.56
Y does not Granger Cause X X does not Granger Cause Y	8	60	0.94 0.73	0.50 0.68
Y does not Granger Cause X X does not Granger Cause Y	9	59	1.46 0.50	0.19 0.88
Y does not Granger Cause X X does not Granger Cause Y	10	58	1.47 0.50	0.19 0.88
Y does not Granger Cause X X does not Granger Cause Y	11	57	1.78 0.50	0.10 0.89
Y does not Granger Cause X X does not Granger Cause Y	12	56	1.33 0.68	0.25 0.75

CONCLUSIONS

An extensive literature exists on testing the causal relationship between exports and growth using bivariate time series models. This study investigates the dynamic relationship between real exports and industrial production index using Jordanian monthly and not seasonally adjusted data over the period 1997.03 - 2003.12. The augmented Dickey-Fuller test is carried out to test for stationarity. The univariate ARIMA models are used to filter each time series independently to white noise, and the cross-correlation functions are estimated. This function suggests that an increase in exports will positively affect output over the next 8 months. This result supports the export-led growth hypothesis. In its crudest form, the cross-correlation function indicates that the significant effects are, in general, positive in the short run. The long-run effects are, however, insignificantly different from zero.

Furthermore, the independence hypothesis of exports and growth was examined using Koch-Yang test of independence. With M = 12 and 15, the results indicate a rejection of independence hypothesis at 5% and 10% level, while with M = 18, the hypothesis of independence is not rejected. While causal implication of the export-led growth hypothesis is supported in a bivariate causal model, the result tends to support the hypothesis of independence between exports and real output when longer lags are used. The Granger-causality between real export and industrial production index is also carried out. The F-statistic for the lag values of the independent variables indicates that there is a unidirectional short-run causal effect from exports to industrial production index at 10% level of significance.

Overall, the results are consistent with the conventional view that the growth of exports raises aggregate demand. In the short run, output is affected although there are no long-run effects. These findings support the export-oriented growth strategy pursued by Jordan over the sample period examined.

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شواهد على صحة فرضية قيادة الصادرات للنمو: دراسة الحالة الأردنية

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ملخـص

تختبر الدراسة فرضية قيادة الصادرات للنمو الاقتصادي من خلال استخدام بيانات شهرية عن الأردن تغطي الفترة الزمنية 1997.03-2003.12. تم استخدام نموذج السلاسل الزمنية (ARIMA) لتقدير حدود الخطأ (white noise) المرافقة لسلسلتي الصادرات الحقيقية والرقم القياسي للإنتاج الصناعي وذلك بغرض تقدير دالة الارتباط التقاطعية (Cross-correlation function)، التي استخدمت بدورها في اختبار كوك- يانغ. أظهرت نتائج اختبار كوك- يانغ تأثير الصادرات على الرقم القياسي للإنتاج الصناعي في الأجل القصير وعلى مستوى معنوية 5%، وميل العلاقة بين هذين المتغيرين إلى الاستقلالية مع طول الفترة الزمنية التي يتم على أساسها الاختبار.وجاءت نتائج اختبار جرانجر مؤيدة للنتائج السابقة لكن عند مستوى معنوية 10%، وهذه النتائج تنسجم مع استراتيجية الأردن التي تستند إلى تشجيع الصادرات.

الكلمـات الدالـة: سببية جرانجر، اختبار كوك- يانغ، الاستقلالية، اختبار ديكي- فولر، استقرار البيانات.

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