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Export-Led Growth in Malaysian Agriculture: A VAR Approach

AHMAD ZAINUDDIN ABDULLAH
Faculty of Economics and Management,
Universiti Pertanian Malaysia,
43400 UPM Serdang, Selangor Darul Ehsan, Malaysia.

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ABSTRAK

Kertas ini mengkaji hubungan diantara eksport-pertumbuhan bagi sektor pertanian dengan menggunakan model tiga-angkubah vektor autoregressi (VAR). Model ini telah diuji dengan tiga prosedur penyebab yang berbeza : penyebab Granger, teknik Hsiao dan varians dekomposisi. Hasil kajian menunjukkan pertumbuhan keluaran dalam negeri kasar menyebabkan eksport dalam dua daripada tiga ujian yang digunakan.

ABSTRACT

This paper investigates the export-growth relationship for the Malaysian agricultural sector using a three-variable vector autoregressive (VAR) model. The model was subjected to three different causality tests procedure: Granger causality, Hsiao's technique and variance decomposition. The results indicate that growth of gross domestic product (GDP) causes exports in two of the three test procedures employed.

INTRODUCTION

The causal relationship between agricultural exports and growth in Malaysia is investigated in this paper. Over the years, the contribution of agriculture has been declining and was eventually surpassed by the manufacturing sector in 1987. Despite the decline, agriculture is likely to remain important. The formulation of the national agriculture policy, and its subsequent revision, clearly underscores the importance of this sector. The present approach emphasises more on capital-intensive operations which would at least maintain agriculture's contribution to the Malaysian GDP. It is known that agriculture in Malaysia is a labour intensive industry.

Initially Malaysia allowed an import-substitution strategy to realize a high growth rate. Subsequently it followed the recommendations of the OECD and NBER studies of the 1960's and 1970's which suggested that an import substitution policy would show significantly less growth than would a policy based on export promotion.[1] The country then embarked on a strategy based on export promotion with confidence.

Previous studies on the export-growth relationship were based on cross-country studies, and on time series studies which produced mixed results. In the case of Malaysia, a study by Habibullah and Yusoff (1990) concluded that the agricultural sector causes growth. However, this result and other studies based on the causality method have to be interpreted with great care before any general causal ordering can be made. Most of the previous studies based their results on contemporaneous correlations and regressions. A high correlation between two variables does not necessarily imply the existence of a causal relationship between them. In fact, an observed high correlation between exports and growth is not surprising, as exports are a component of aggregate demand in a Keynesian identity. Exports contribute to economic growth only through capital formation (Kavoussi, 1984). Therefore, the direction of causation is difficult to judge. The establishment of causal ordering is very important for less developed countries (LDCs). If export (X) expansion is found to cause growth (Y), then export led growth is favourable.

[1] See Little, Scitovsky and Scott (1970) for OECD study. Bhagwati (1978) and Krueger (1978) are synthesis of the NBER study.

On the other hand, if reverse causality is found, the less developed countries have to achieve a threshold development before expanding their export sector (Michaely, 1977). Bidirectional causality indicates that exports and growth reinforce each other. Results based on a specific country study are very important as the adoption of a wrong policy can prove costly to a developing country. In fact, Sharma *et al* (1991) found that there were no two identical results among the five industrialized countries they studied.

To date a number of studies have investigated the direction of causality in a bivariate context (Jung and Marshall 1985, Chow 1987, Kwan and Cotsomitis 1990, Habibullah and Yusoff 1990), with very few using multivariate framework (Kunst and Marin, 1989, Sharma *et al.* 1991). This study employs a vector autoregressive (VAR) technique to investigate the nature of the causal relationship between exports (X) and growth (Y). To remove spurious correlation, the direction of causation between export and growth is investigated with the presence of a third variable Z.

The paper is organized as follows: Section II describes the causal relationship among the variables included in the study; Section III presents the methodology. Section IV describes the data and discusses the results, which is followed by a brief summary and conclusion in Section V.

CAUSALITY : THEORETICAL ANALYSIS

There are two approaches to empirical investigation of the relationship between export expansion and economic growth. The first is based on Ram's (1985) claim that exports can have a positive impact on economic growth due to a better allocation of resources and that exports also can cause economies of scale and externalities and stimulate growth[2]. The other approach is based on a "two-gap" model of growth where increase in exports causes an increase in imported capital goods which in turn raises the growth rate of capital formation and thus stimulates growth (Voivodas 1973; Williamson 1978; Fajana 1979). While export expansion can lead to growth, it is also plausible that economic growth causes export expansion[3]. Recently, Helpman and Krugman (1985) have suggested a bidirectional causality between export and growth. According to this theory, rapid growth leads to efficient allocation of resources due to comparative advantage and allows for the exploitation of economies of scale. Once economies of scale are realized, the costs of exportable goods will decline and hence exports will be more competitive in the world market. Therefore the causal relationship may run in both directions and often tends to be self reinforcing[4]. This suggests that factors other than exports can also cause growth.

In this study, capital is included as a third variable that could explain growth. Traditionally, on the basis of neoclassical growth theories, it is believed that capital stocks lead to output growth, which in turn leads to further capital formation via the acceleration process. In the case of Malaysia, we may consider capital as endogenous to the growth process and the labour input as exogenous as there is a surplus of labour in the economy.

METHODOLOGY AND VAR SPECIFICATION

A wide range of studies in economics have used Granger-causality (1969) tests[5]. The central theme of this test is that a variable X is said to cause Y if Y is better predicted by using past values of X (which are contained in the information set that includes both X and Y) than by not using them. In order to draw a meaningful causal link between X and Y, one must consider as many factors as possible in the information set. These may include such internal factors as composition and direction of exports, investment activities and external factors such as the economic growth of developed countries and so on. Most of the studies mentioned above use Granger tests in a bivariate context. Extending the test to a multivariate framework involves the inclusion of the new variables and lag associated with them,

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[2] Views shared by Tyler (1981); Feder (1983).

[3] See Jung and Marshall (1985).

[4] Kunst and Marin, (1989), and Jung and Marshall, (1985) did not support this hypothesis.

[5] See Sims (1972) money and income, public expenditures and national income, Singh and Sahni (1984), and Islam and Rafiquzzaman (1991) who investigate property tax and intermunicipal migration relationship in Canada.

which exhausts the degrees of freedom rather quickly. But as noted by Hsiao (1982) and Luthkepohl (1982), the exclusion of a third variable may lead to spurious correlations. Hence in this paper, a multivariate framework is used to investigate the causal relationship between exports and growth in Malaysia. As noted by Sharma *et al.* (1991), a VAR method has an advantage over other techniques because it considers all possible causal influences of the variables included in the system.

A specification of a three variable VAR model is expressed as:

$$\begin{bmatrix} X_t \\ Y_t \\ Z_t \end{bmatrix} = \begin{bmatrix} \varphi_{10} \\ \varphi_{20} \\ \varphi_{30} \end{bmatrix} + \begin{bmatrix} \varphi^l_{11} \varphi^l_{12} \varphi^l_{13} \\ \varphi^l_{21} \varphi^l_{22} \varphi^l_{23} \\ \varphi^l_{31} \varphi^l_{32} \varphi^l_{33} \end{bmatrix} \begin{bmatrix} X_t \\ Y_t \\ Z_t \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{bmatrix} \qquad (1)$$

The entry $\varphi^l_{ij}(L)$ has the following interpretation. The superscript l indicates the optimal lag of variable j in equation i and L is a lag operator. φ_{i0} (i = 1, 2, 3) and μ_{it} (i = 1, 2, 3) are constant and white noise error terms respectively. To test for *prima-facie* causation between i^{th} and j^{th} variables, zero restrictions on parameters are tested. For example, j^{th} variable *prima-facie* cause i^{th} variable if and only if $\varphi_{ij} \neq 0$, and the i^{th} variable is said to *prima-facie* cause j^{th} variable if $\varphi_{ji} \neq 0$. Hsiao (1982) has noted that if the j^{th} variable *prima-facie* causes the k^{th} variable and k^{th} variable *prima-facie* causes the i^{th} variable, then the j^{th} variable *prima-facie* causes the i^{th} variable indirectly. Thus, the model accounts for both direct and indirect causal relationship in the variable of interest. The model is derived from a covariance stationary process which has a constant mean and autocovariances.

One of the main requirements in applying a Granger-causality test is the stationarity of the data. For the model to be covariance stationary, the time series considered must be constant in both mean and autocovariances. To achieve stationarity, the data are filtered by using suitable methods (e.g. Sims' filter, Hsiao's technique, first differencing, etc.). Otherwise, drawing causal influences will present potential problems (Granger and Newbold 1974). Although several VAR studies have used non-stationary data directly, Ohanian (1988) has shown that the use of non-stationary series may lead to spurious inferences. In this study, a standard tool in time series analysis is used to convert the data into stationary time series. However, the issue of determining the optimal lag length in Model (1) is still elusive[6]. The sequential method suggested by Hsiao (1979, 1981) which combines Granger causality and Akaike's minimum final prediction error(FPE) is used to determine the optimal lag. Hsiao (1981) has noted that use of the FPE balances the risk of bias when a lower lag is chosen against the risk of increased variance when a higher order is chosen. Furthermore, this technique does not constrain the lag from being the same and it is also equivalent to applying an F-test with varying significance levels. The procedure to determine the optimal lag length for each variable is outlined below :

i) Regress Y on its own lagged values up to the order m where m is fixed a priori, that is,

$$Y_t = \varphi_{10} + \sum_{l=1}^{m} \varphi_{11.l} Y_{t-l} + \mu_1 \qquad t = 1, \ldots, n \quad (1)$$

ii) For each m, Final Prediction Error is given by

$$\text{FPE}\ (l) = [(n + l + 1)/(n - l - 1)]\ \ (\text{SSR}\ (l)/n)$$

where n is the sample size, and SSR is the residual sum of square. The FPE(l) which gives the minimum value is chosen to be the optimal lag length for Y. Let l in this case be q.

iii) Next, the optimal lag length for the other variables is determined. This is done by estimating

$$Y_t = \varphi_{10} + \sum_{j=1}^{q} \varphi_{11.j} Y_{t-j} + \sum_{l=1}^{v} \varphi_{12.l} X_{t-l} + \mu_{1t} \qquad t = 1, \ldots, n \ (3)$$

and

$$Y_t = \varphi_{10} + \sum_{j=1}^{q} \varphi_{11.j} Y_{t-j} + \sum_{l=1}^{v} \varphi_{13.l} Z_{t-l} + \mu_{1t} \qquad t = 1, \ldots, n \ (4)$$

For each (3) and (4), FPE (q, l) is calculated by

$$\text{FPE}(l) = [(n+q+l+1)/(n-q-l-1)]\ \text{SSR}(q,l)/n$$

[6] Sims (1980) has noted that increasing the lag length will increase the number of parameters to be estimated by the square of the number of parameters to be estimated by the square of the number of the variables and this will exhaust degress of freedom rather quickly.

The hypothesis of unidirectional causality between Y and X (or Z), X (or Z) and Y, and test of independence is done using a standard likelihood ratio (LR) test[7].

iv) Having established the bivariate causality results, and following the Caines *et al* (1981) specific gravity criteria, the order of each variable in equation (2) is determined. The one with the lowest FPE is added first to the equation (2). Let the optimal lag for variable (X) that yielded the lowest FPE be r. Hsiao (1979, 1981) has recommended a comparison between FPE(q) and FPE(q, r). If FPE(q) < FPE(q, r) then X does not *prima-facie* cause Y. Variable X is dropped from equation (2). On the other hand if FPE (q) > FPE (q, r) then X *prima-facie* causes Y and thus variable X is added to the equation (2). Similar steps are taken for variable Z in equation 2. Sharma *et al.* (1991) have noted that VAR analysis is sensitive to the order of the variables. Hence the above procedure is appropriate for reducing any bias arising from misordering of the variables.

v) After the analysis from step (i) to (iv) is performed, all the equations are estimated using Zellner's (1962) iterative seemingly unrelated regressions technique.

Most of the data analyses using the VAR technique are centered on variance decomposition and impulse response functions which are generated from the moving average representation of an autoregressive process. The moving-average representation of a VAR model involves a linear combination of past and current innovations of the variables in the system. If the innovations are contemporaneously correlated, the model's variance can be decomposed. A standard way of doing this is to orthogonalize the μ_{it} in (1). Sims (1980, 1982) has noted that variance decomposition is useful in checking the causal influences in the system, and in fact the strength of Granger-causality can be measured through this decomposition. It decomposes the variance due to the innovations in own variables as well as other variables. A variable is strictly exogenous if it is 100% due to its own innovation. On the other hand, if its variation is partly due to innovations of another variable, there is evidence of weak causation. For example, if growth is explained by only a small portion of another variable's forecast error variance, then it is a case of weak *prima-facie* cause. If the result of a VAR variance decomposition is sensitive to the order of the variables, the specific gravity criterion described in step (iv) is used to guide the ordering of the variables. Hence there are three different orderings for the variance decomposition.

DATA REQUIREMENTS AND ESTIMATION RESULTS

Annual data for GDP, agriculture export and gross capital formation for the 1960-1989 period used in this study are taken from the International Financial Statistics Yearbook (1990) and World Tables (various issues). The shares of export and gross capital formation are then used to investigate the relationship between the variables. As causality testing requires stationary data, the Box-Jenkins technique was used. To determine the optimal lag for each series, we then employed Akaike's FPE. For example, for agricultural exports, we found the optimal lags for each series are 1 for Y, 1 for X and 1 for Z. Following Hsiao's technique, these are then treated as controlled variables while variables X and Z, Y and Z and X and Y are manipulated variables in equations Y, X and Z respectively. Based on this optimal lag we investigated Granger's causality in both bivariate and trivariate contexts, Hsiao's causality and Sim's variance decomposition. As the forecast error variance is sensitive to the order of the variables, the above procedure is used to order the variables in each equation. The final specified model for agricultural primary exports is

$$\begin{bmatrix} X_t \\ Y_t \\ Z_t \end{bmatrix} = \begin{bmatrix} \varphi_{10} \\ \varphi_{20} \\ \varphi_{30} \end{bmatrix} + \begin{bmatrix} \varphi^1_{11}(L) & \varphi^4_{12}(L) & \varphi^1_{13}(L) \\ 0 & \varphi^1_{22}(L) & 0 \\ 0 & 0 & \varphi^1_{33}(L) \end{bmatrix} \begin{bmatrix} X_t \\ Y_t \\ Z_t \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \end{bmatrix} \quad (5)$$

[7] The likelihood ratio test is $-2 \ln \lambda = -2\{LR - LU\}$ where LR is the loglikelihood function for the restricted model and LU is the loglikelihood function for the unrestricted model. It has a χ^2 distribution with degrees of freedom equal to the number of restrictions under the null hypothesis. This is a large sample result.

The models were then estimated using Zellner's (1962) SURE. Results for the causality tests in both bivariate and trivariate cases are reported in Table 1. In the bivariate cause we found that growth causes exports. However, this unidirectional causality seems to be quite weak as the level of significance for the LR test is only at 10% level. When we extend the model to include capital formation we found there is discrepancy in the results. By using Hsiao's technique we found that both growth and capital cause exports. However, in the case of Granger's multivariate, it does not indicate any direction of causation. We report the decomposition of the FEV in Table 2. The extent of causation is checked by using the following procedure (see Sharma *et al.* 1991). *Prima-facie* causality is conventionally defined as weak if forecast error variance (FEV) of one variable is between 1% and 5% in another variable and moderate if it lies between 6% and 14%. On the other hand, *prima-facie* causality is strong if FEV is between 15% and 24% and is considered very strong if FEV accounts for more than 25%. Our results are similar to those derived by Hsiao's technique. It shows 14.37% of the forecast error variance of exports can be explained by innovations in growth and 4.33% in capital. Thus the causal relation is rather moderate and weak respectively. It appears that both growth and capital are exogenous as they are not explained by innovations in other variables.

TABLE 1
Agricultural export

Hyphothesis	Likelihood ratio	Degrees of freedom	Conclusion
Bivariate Causality Results			
$\varphi^1_{12}(L) = 0$	8.89*	4	Y—/—> X
$\varphi^2_{21}(L) = 0$	0.92	1	X—/—> Y
Trivariate Causality Results			
$\varphi^1_{12}(L) = 0$	7.42	4	Y—/—> X
$\varphi^1_{13}(L) = 0$	0.61	1	Z—/—> X
$\varphi^2_{21}(L) = 0$	0.96	1	X—/—> Y
$\varphi^1_{23}(L) = 0$	0.43	1	Z—/—> Y
$\varphi^1_{31}(L) = 0$	0.24	1	X—/—> Z
$\varphi^2_{32}(L) = 0$	0.96	1	Y—/—> Z

* Significant at 10% level

Hsiao's Sequential Technique

FPE Comparison	Conclusion
$FPE_{xy}(q, r) < FPE_x(q)$	Y causes X
$FPE_{xz}(q, r) < FPE_x(q)$	Z causes X
$FPE_{yx}(q, r) < FPE_y(q)$	Y does not cause Y
$FPE_{yz}(q, r) < FPE_y(q)$	Z does not cause Y
$FPE_{zx}(q, r) < FPE_z(q)$	X does not cause Z
$FPE_{zx}(q, r) < FPE_z(q)$	Y does not cause Z

TABLE 2
FEV decomposition for agricultural export

Variables Explained	Steps Ahead	Explained by innovations in Y	X	Z
Y	8	100.00	0.00	0.00
X	8	14.37	81.30	4.33
Z	8	0.00	0.00	100.00

SUMMARY AND CONCLUSIONS

Concentrating on agricultural exports of Malaysia, this paper examines the causal relationship between Malaysia's exports and growth. The direction of causation is investigated in both bivariate and multivariate context by using vector autoregressive (VAR) models. This model is then subjected to three different test procedures: Granger's causality test, Hsiao's technique and variance decomposition. The results indicate no bidirectional causality between the variables investigated. However unidirectional causality is found in the bivariate model where growth causes exports and in the multivariate model where both growth and capital cause exports. The results are not similar when different causality test procedures are employed in the multivariate context. From the results we can draw some tentative conclusions. It appears that capital utilization in the agricultural sector is still very small. In order to improve this sector's competitiveness and to maintain its contribution to the Malaysian economy, effort has to be made to ensure greater capital utilization. Furthermore, with a projected moderate increase in world growth, this task seems inevitable.

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