Are Exports an Engine of Growth in Pakistan?

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I. Introduction:

It is generally believed that for a developing country export performance plays a pivotal role in providing the much-needed impetus for economic growth. Export led growth has been put forward as the efficient alternative to inward–orientation strategies of development because it is believe to lead to higher total-factor-productivity growth and encourage foreign direct investment. The pressure of competing in the world markets may also lead to better product quality and force domestic producers to reduce inefficiencies. Foreign exchange liberalisation, an important component of the export led growth strategy, is likely to reduce the allocative inefficiencies of exchange control.

In Pakistan, there has been an attempt to pursue an export-led growth strategy for the past decade, however with a little success. Pakistan's export earnings have been stuck at around US$ 8-9 billion since the mid-1990s -- around 13% of the GDP. Its share in world trade has been stagnant at less than 0.2% of world trade. Export growth rates have fluctuated from year to year, averaging only 3% (in nominal dollar terms) during the past two and a half decades. One of the chronic problems with Pakistan's exports has been the limited export base with heavy reliance on low value-added cotton and cotton-based textile products, which make up 60-70% of merchandise exports.[2] Other factors that have led to the poor export performance include: falling unit prices of a wide range of exports, including commodity exports and low value cotton manufactured goods; issues of gaining deeper access in the US and European markets, which are the dominant export markets for Pakistani textiles; and a wide range of behind the border policies, particularly the heavy reliance of trade related taxes in the tax structure, high interest rates during the 1990s, a fairly intrusive regulatory environment for businesses and exporters, and problems of poor governance and political/sectarian violence that affected the larger export

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[2] The impact of cotton is fairly sizable both for the export sector as well as the economy. It is estimated that for a shortfall of every one million bales in cotton production, Pakistan loses roughly half a percent of GDP growth.

centres. It is quite clear that Pakistan's export competitiveness, which can be defined as its ability to achieve sustained high rate of export growth, has been affected by these exogenous and endogenous factors resulting in stagnating exports.

Pakistan, which used to be relatively high growth economy (average growth rates of around 6% during the 1980s), also witnessed a steady decline in its GDP growth rates over the 1990s -- 5% during the first half of the 1990s and then to less than 4% in the latter half of the 1990s. The reasons for the slow growth were political, economic and financial shocks. But more importantly, a number of unresolved structural problems such as low tax base, inflexible public expenditures and a heavy debt burden that limited the fiscal space for public sector led investments. The private sector has been constrained by a difficult investment climate due to excessive regulations and government interventions, an uncertain economic policy environment and pervasive governance problems. There has been an attempt in the past few years to turn around the economy and to bring about structural changes. A major focus of the economic and structural reforms has been to make exports as an engine of growth.

In this backdrop, we want to ascertain the evidence for or against the export-led growth hypothesis for Pakistan. We have followed the New Growth Theory in this paper and used two different approaches a) the standard method of Granger causality and b) a production function approach using Vector Auto-regression (VAR) model to analyse the issues. The Granger-causality test for detecting the export-led growth hypothesis has been carried out beyond the standard (two-variable) method, although most studies have typically focused on the bi-variate relationship between income and exports.[3] The idea is to take into account other important and relevant macro-economic variables that might have some bearing on the export-income relationship. However, the New Growth Theory suggests, that studies that do not consider the endogenous nature of growth process, are subject to simultaneity bias results. The VAR model has been used to correct for the simultaneity bias that may be present in the Granger causality approach.

Using time series quarterly data for Pakistan for the period 1975 to 1998, we find that omitting important macro-economic variables from the analysis may either mask or overstate the

[3] Exceptions are Serlitis(1992), who includes imports; Ghartey (1993), who includes the terms of trade and the capital stock; and Marin (1989), who study the causal relationship between productivity, export growth, terms of trade and OECD output.

Granger causality between variables. The Granger causality results reject the hypothesis of export-led growth. Our results show that exports do not lead to income growth in any of the eight Granger causality equations. On the contrary, income leads exports in almost all the equations. Second, contrary to what is generally believed in Pakistan and what is also shown elsewhere, imports do not play any role in export-income relationship in case of Pakistan.[4] Third, both investment and energy have emerged as important variables in the export-income relationship. The results of the 5-variable VAR model using Seemingly Unrelated Regression (SUR) technique confirm the main findings of the Granger causality (OLS) analysis. The SUR results also indicate that in case of Pakistan the hypothesis of export-led growth cannot be supported.

The plan of the paper is as follows: Section II presents the review of literature. In section III we have discussed the Granger Causality technique and the results of the analysis. Section IV presents the methodology used in the VAR model using seemingly unrelated regression (SUR) technique and the results of the SUR analysis. Section V concludes the paper.

II. Review of Literature

Export led growth has been put forward as the rationale and efficient alternative to import substitution industrialisation and inward–orientation strategies of development. Outward orientation is said to lead to higher total-factor productivity growth (Ram, 1987, Kavonssi**,** 1984**,** Bhagwati, 1978, Krueger, 1978); encourages foreign direct investment (Balasubramanyam, et. al., 1996). The pressure of competition in the world market may lead to better product quality and force domestic producers to reduce inefficiencies. Foreign exchange liberalisation, an important component of the export led growth strategy, is likely to reduce the allocative inefficiencies of exchange control (Bhagwati 1978, Krueger 1978). The export-oriented scenario of growth has drawn on a vast body of empirical research in the past two decades (Solvatore and Hatcher 1991; Dollar, 1990; Mochose, 1989; Ram, 1987, 1985; Balassa, 1985, 1978; Feder, 1983; Kavonssi, 1984, Krueger, 1978; Tyler 1981; Willamson, 1978; Michaely, 1977; Voivodas, 1973).

The debate between import substitution and export promotion as strategies for fostering industrialisation and hence economic growth and development is long standing. Import

[4] Reizman and Whiteman (1996) have shown that imports play an important role in the export-growth relationship in many countries that they have analysed.

substitution strategy can be couched in terms of the “infant industry argument”. In contrast, export-led growth strategy entails a neutral strategy with no bias against exports. The evidence in support of export-led growth strategy reported by the World Bank in its World Development Reports of 1993 and 1987 is generally consistent with much of the literature on the matter. However its major shortcoming is the failure to support the argument of export promotion econometrically. Despite their limitations, these findings are significant and serve to highlight a number of fundamental factors. First, there is no doubt that some of the more dynamic LDCs, particularly, the South East Asia “Tigers”, rely to a substantial degree on world markets and have made substantial inroads in these markets they have developed a comparative advantage in a wide array of manufactures. However, as argued by Bradford (1986) whether this is accomplished strictly by getting the prices right is open to debate. Bradford argues that in Korea, Taiwan and Singapore, the evolution of the production structure and the composition of exports were not left to the market, but was the result of deliberate government design. If such is the case the recent experience of these countries suggests not a neutral policy but the creation of price and resource allocation distortion favouring production for the export market at the expense of domestic consumption.

With very few exceptions, previous studies[5] of export-led growth have not addressed the role and importance of other macro-economic variables, like imports, investment, exchange rate, energy etc. Shan & Sun (1998) tried to improve further the methodology of testing the export-led growth hypothesis. They went beyond the traditional two variable relationship by building a VAR model in the production function context. Their results are robust in the sense that they are consistent with each other for different lags. They claimed that the findings of a bi-directional causality between growth and exports in case of China, to some extent, is coincident with the conclusions of Ghartey (1993) that economic growth causes exports growth in a country if it is relatively closed and is endowed with abundant natural resources. Shan & Sun concluded that export-led hypothesis, defined as unidirectional causal ordering from exports to industrial output is rejected in case of China. However, it does not mean that exports do not play an important role in the Chinese economy, but that both exports and industrial output contribute positively to each other in the course of economic development (Shan & Sun, 1998).

[5] Serletis (1992) included lagged values of import growth in his paper. Riezman & Whiteman (1996) also estimated export–income relationship including import growth for nine Asian countries.

It should be noted that the literature on the causality between export and growth is very "statistical", with economics taking a back seat. In our present work there are two distinct features that clearly stand out compared to earlier studies in general and work done on Pakistan in particular. First, we have gone beyond the traditional two-variable relationship by building a VAR model in the production function context to avoid possible specification biases. Second, we have tested the export-led growth hypothesis while controlling for not only imports but also for number of other macro-economic variables that might have some effect on the export-growth relationship. This is done to avoid producing spurious causality results. We have used both simple OLS as well as SUR to estimate the augmented growth equation.

III Export-Growth Relationship: Granger Causality Approach

The export led growth hypothesis has been the subject of considerable research in the last two decades, yet the link between exports and economic growth (GDP) remain a subject of debate. The so-called "New Growth Theory" has resulted in some reappraisal of the determinants of growth in modelling the role played by exports in the growth process. This new development has given an additional twist to the literature on export-led growth study.

Since the seminal paper of Jung and Marshall (1985), many refinements have been used in assessing the empirical evidence for export led growth. These refinements include modifications of the standard Granger causality test, including tests for optimal lag structure, tests for non-stationarity and/or co-integration between variables, and inclusion of other relevant variables besides exports and GDP.

We begin by employing Granger's (1969) causality test to analyse the interrelationship between exports, income, imports, investment, and energy. We have conducted four sets of tests. First, we test the bi-variate causality relationship between every pair of variables using the standard two-variable approach, as specified below:

$$\mathrm{x}_t = \sum_{j=1}^{p} a_j x_{t-j} + \sum_{j=1}^{p} b_j y_{t-j} + \mathrm{u}_t \qquad (1)$$

$$\mathrm{y}_t = = \sum_{j=1}^{p} c_j x_{t-j} + \sum_{j=1}^{p} d_j y_{t-j} + \mathrm{v}_t \qquad (2)$$

where x_t denote exports and y_t denote income growth (measured in terms of gdp).

We estimate the above mentioned two equations by ordinary least squares. The hypothesis that exports causes income growth, if supported by data, should imply that the null hypothesis that $c_j = 0$ (for all j) be rejected.[6] Similarly if income causes exports than the null hypothesis that $b_j=0$ (for all j) should be rejected.

Tests for Integration and co-integration

Before proceeding with our analysis of the data, we have followed the standard practice of the time series analysis and have tested for the order of integration and co-integration of all the variables included in these two analyses. The results of the Augmented Dickey Fuller (ADF) test are presented in Table 1. These results show that all the variables are integrated of order 1, I(1) at 95 per cent critical value.[7] The ADF results on the first difference of these variables indicate that an integration of order 2, I(2) specification at 95 per cent critical value in all cases can be rejected. The results of the co-integration tests indicate that the null hypothesis of no co-integration among any of these variables cannot be rejected (Appendix A).

[6] Wald test is used to test the joint significance of the lags.
[7] We have carried out these tests both before and after de-trending and seasonally correcting all the variables.

Table 1: Unit root and co-integration tests

Variables	Augmented Dickey Fuller Test			
	Level		1st Difference	
	AFD Test	Order of Integ.	AFD Test	Order of Integ.
Rstexp	-1.9794 ***(-2.896)***	I(1)	-2.912 ***(-2.896)***	I(0)
Rsrgdp	-2.031 ***(-2.896)***	I(1)	-2.976 ***(-2.896)***	I(0)
Rstimp	-2.5372 ***(-2.896)***	I(1)	-3.276 ***(-2.896)***	I(0)
Rsinvst	-2.0497 ***(-2.896)***	I(1)	-2.991 ***(-2.896)***	I(0)
Rsenerg	-2.2228 ***(-2.896)***	I(1)	-4.6409 ***(-3.464)***	I(0)

Rstexp = Pakistan's total exports (first differenced)
Rsgdp = Pakistan's real gross domestic product (first differenced)
Rswtimp = Pakistan's imports (first differenced)
Rsenerg = Energy consumption (first differenced)
Rsinvst = Investment (first differenced)

Results of bi-variate causality analysis

In the bi-variate analysis, we test eight different causal relationships among various variables. Results of the bi-variate analysis are presented in Table 2. The choice of lag structure is based on Akaike Information Criteria, (AIC) and Schwartz Criteria, (SC). The optimal lag structure is three and both AIC and SC criterion is minimised at third lag structure.[8] Our results show that exports do not lead income but income causes exports. In other words the hypothesis of export-led growth can be rejected in case of Pakistan.

[8] Wald test is used to test the joint significance of the lags.

Table 2: Results of bi-variate causality analysis

Variables	Direction of Causality	Chi-square Statistics	Chi-square (Probability)	Result
Income (Y) & Exports (X)	X → Y	4.7420	0.192	No causality
	Y → X	7.9694	0.047*	**Y causes X**
Export (X) & Imports (M)	X → M	6.5365	0.088**	**X causes M**
	M → X	0.8744	0.832	No causality
Income (Y) & Imports (M)	Y → M	5.4722	0.1400	No causality
	M → Y	0.8744	0.832	No causality
Export (X) & Investment (I)	X → I	2.4955	0.476	No causality
	I → X	10.8363	0.0130*	**I causes X**
Income (Y) & Investment (I)	Y → I	1.8590	0.602	No causality
	I → Y	4.2380	0.237	No causality
Export (X) & Energy (E)	X → E	2.3457	0.504	No causality
	E → X	2.0762	0.557	No causality
Income (Y) & Energy (E)	Y → E	5.6880	0.128	No causality
	E → Y	7.8888	0.048*	**E causes Y**

* at 5% Chi-square critical value (Wald Statistics)
* * at 10% Chi-square critical value (Wald Statistics)

The other significant relationships between pairs of variables include export and import, investment and export, and energy and income. In all the three cases, we find unidirectional causality. Export causes imports, investment causes exports, and energy causes income. Pakistan has been an energy-deficient country and a net importer of oil. Energy has always been short in the country relative to demand, as manifested in relatively high domestic prices of petroleum products and visible constraints in electricity supply (e.g. frequent load shading, black-outs and brown-outs) which seriously affect economic activity, especially industrial growth. Recent World Bank comparison show that electricity tariffs for commercial supplies are 12 cents per KWH in Pakistan versus 11 cents/KWH in Sri Lanka, 9 cents/KWH in Bangladesh, 6 cents/KWH in Thailand, 4 cents/KWH in Jordan and 5 cents/KWH in Egypt. Similarly, Pakistan also has higher tariff for industrial users of electricity compared to competitors. Industrial tariffs average 6 cents per KWH in Pakistan versus 6 cents/KWH in Bangladesh, 4 cents/KWH in Thailand, and 3 cents/KWH in both Jordan and Egypt. Our results indicate that energy could be one of the major factors in determining growth of GDP in Pakistan.

Growth has also been constrained by low savings and investment in Pakistan. The investment to GDP ratio has hovered at around 17-18 percent during the 1970s to 1990s, and has fallen to 16% in the past 3 years. Foreign direct investment has ranged between US$ 300-400 million per annum historically, with the exception of a couple of years during mid-1990s when investments reached a maximum of US$ 1.1 billion in private power plants. This investment constraint has led to slow growth in both industry and agriculture, and consequently the country has not been able to produce enough surpluses that can be exported. Therefore, enhancing investment could have an important effect in accelerating export growth in Pakistan.

Our results show that export causes imports, which is somewhat counter-intuitive. More than 75% of Pakistan's imports are unrelated to the export sector. Moreover, the bulk of exports are based on domestically produced cotton and cotton related manufactured goods. The proportion of manufactured exports in total exports from Pakistan has experienced a rising trend over the last two decades; but it is unlikely that as merchandise exports increases it could lead to increased imports. This result could be because we have not included other relevant variables in the analysis. We see in further analysis of Granger casualty, involving more than two variables, this result disappears.

Results of tri-variate causality analysis

The second set of tests examines the trivariate (three-variable) Granger causality.[9] The idea is to test the joint influence of two variables on the third variable. We will use imports, investment and energy one by one with exports and output. The joint trivariate causality model is specified as:

[9] The three set of tri-variate causality include income, export and investment; income, export and energy; and income, export and import.

$$x_t = \sum_{j=1}^{p} a_j x_{t-j} + \sum_{j=1}^{p} b_j y_{t-j} + \sum_{j=1}^{p} e_j m_{t-j} + u_t \quad (3)$$

$$y_t = \sum_{j=1}^{p} c_j x_{t-j} + \sum_{j=1}^{p} d_j y_{t-j} + \sum_{j=1}^{p} f_j m_{t-j} + v_t \quad (4)$$

$$m_t = \sum_{j=1}^{p} q_j m_{t-j} + \sum_{j=1}^{p} r_j y_{t-j} + \sum_{j=1}^{p} s_j x_{t-j} + w_t \quad (5)$$

where m_t denote imports.[10] The null hypotheses to be tested in trivariate case are:

H_1: $c_j = 0$, j = 1 ....p (exports fail to Granger cause output in the three variable universe).

H_2: $b_j = 0$, j = 1 ....p (output fail to Granger cause exports in the three variable universe)

H_3: $f_j = 0$, j = 1 ....p (imports fail to Granger cause output in the three variable universe)

H_4: $e_j = 0$, j = 1 ....p (imports fail to Granger cause exports in the three variable universe)

as well as similar hypotheses regarding s_j and r_j.

Our results clearly indicate that export do not cause income in any of the three different combinations that we have analysed under tri-variate Granger causality (table 5.4). Similarly, the tri-variate results confirm the results of the bi-variate Granger causality that in most cases, incomes lead exports in Pakistan. Other significant results includes unidirectional causality from investment to export, and energy to exports. Another important point to note about these tri-variate causality results is that imports has no significance in the export-income relationship in Pakistan.

[10] Similarly, tri-variate causality with for investment and energy respectively.

<u>Table 3 Results of tri-variate causality analysis</u>

Variables	Direction	Chi-square Statistics	Chi-square (Probability)	Results
Export (X), Income (Y) And Imports (M)	X → Y	4.0700	0.254	No causality
	Y → X	7.3439**	0.062	**Y causes X**
	X → M	3.9522	0.267	No causality
	M → X	0.5285	0.913	No causality
	Y → M	2.9536	0.399	No causality
	M → Y	0.3624	0.948	No causality
Export (X), Income (Y) And Investment (I)	X → Y	3.2029	0.361	No causality
	Y → X	5.5949	0.114	No causality
	X → I	2.1263	0.547	No causality
	I → X	8.6594	0.034	**I causes X**
	Y → I	1.5147	0.679	No causality
	I → Y	2.4247	0.436	No causality
Export (X), Income (Y) And Energy (E)	X → Y	2.4703	0.481	No causality
	Y → X	12.245*	0.007	Y causes X
	X → E	2.9576	0.398	No causality
	E → X	7.5805*	0.056	**E causes X**
	Y → E	5.4310	0.143	No causality
	E → Y	5.4577	0.141	No causality

* at 5% Chi-square critical value (Wald Statistics)
* * at 10% Chi-square critical value (Wald Statistics)

Results of four-variable causality analysis

In the third set of tests, we will estimate four-variable Granger causality.[11] Again using the OLS method we estimate the following equations:

$$\mathbf{x_t} = \sum_{j=1}^{p} a_j x_{t-j} + \sum_{j=1}^{p} b_j y_{t-j} + \sum_{j=1}^{p} e_j m_{t-j} + \sum_{j=1}^{p} g_j k_{t-j} + \mathbf{u_t} \qquad (6)$$

$$\mathbf{y_t} = \sum_{j=1}^{p} c_j x_{t-j} + \sum_{j=1}^{p} d_j y_{t-j} + \sum_{j=1}^{p} f_j m_{t-j} + \sum_{j=1}^{p} h_j k_{t-j} + \mathbf{v_t} \qquad (7)$$

$$\mathbf{m_t} = \sum_{j=1}^{p} q_j x_{t-j} + \sum_{j=1}^{p} r_j y_{t-j} + \sum_{j=1}^{p} s_j x_{t-j} + \sum_{j=1}^{p} l_j K_{t-j} + \mathbf{w_t} \qquad (8)$$

$$\mathbf{k_t} = \sum_{j=1}^{p} n_j k_{t-j} + \sum_{j=1}^{p} z_j m_{t-j} + \sum_{j=1}^{p} p_j y_{t-j} + \sum_{j=1}^{p} o_j x_{t-j} + \mathrm{t_t} \qquad (9)$$

where k_t denotes investment. The additional null hypotheses to be tested in four-variable case are

H_1: $g_j = 0$, j = 1 ....p (investment fail to Granger cause exports in the four variable universe).
H_2: $h_j = 0$, j = 1 ....p (investment fail to Granger cause output in the four variable universe)
H_3: $l_j = 0$, j = 1 ....p (investment fail to Granger cause imports in the four variable universe)
H_4: $p_j = 0$, j = 1 ....p (output fail to Granger cause investment in the four variable universe)

as well as similar hypotheses regarding n_j,z_j and o_j.

Results of the four-variable Granger causality are presented in table 4. It is clear from the table that there is only one significant change in the relationship among various variables, compared to findings of bi- and tri-variate causality equations, otherwise the findings of bi- and tri-variate analysis are more or less unchanged. As shown in table 4, in case of four variable causality (involving income, export, import and investment), neither export cause income nor income cause exports. However, in all the other cases results indicate that income lead exports.

[11] The three set of equations in four-variable causality besides export and gdp includes; investment and energy, investment and imports, and energy and imports.

Table 4: Results of four-variable causality analysis

Variables	Direction	Chi-square Statistics	Chi-square (Probability)	Results
Export (X), Income (Y) And Imports (M) & Investment (I)	X → Y	2.8183	0.420	No causality
	Y → X	5.3642	0.147	No causality
	X → M	3.8428	0.279	No causality
	M → X	1.5400	0.673	No causality
	Y → M	2.9732	0.396	No causality
	M → Y	0.5266	0.913	No causality
	X → I	2.0774	0.557	No causality
	I → X	9.4725	0.024	No causality
	Y → I	1.6080	0.658	No causality
	I → Y	2.8065	0.422	No causality
Export (X), Income (Y) And Imports (M) & Energy (E)	X → Y	1.5228	0.677	No causality
	Y → X	9.0599*	0.029	**Y causes X**
	X → M	3.9113	0.271	No causality
	M → X	0.3829	0.944	No causality
	Y → M	3.5009	0.321	No causality
	M → Y	1.0915	0.779	No causality
	X → E	4.1509	0.246	No causality
	E → X	6.5421**	0.088	**E causes X**
	Y → E	5.9498	0.114	No causality
	E → Y	6.0444	0.109	No causality
Export (X), Income (Y) And Investment (I) & Energy (E)	X → Y	1.6022	0.659	No causality
	Y → X	10.9956*	0.012	**Y causes X**
	X → I	2.1348	0.545	No causality
	I → X	10.1352*	0.017	**I causes X**
	Y → I	0.6027	0.896	No causality
	I → Y	3.0695	0.381	No causality
	X → E	2.6069	0.456	No causality
	E → X	9.4864*	0.023	**E causes X**
	Y → E	6.5601**	0.087	**Y causes E**
	E → Y	5.7582	0.124	No causality

* at 5% Chi-square critical value (Wald Statistics)

Results of five-variable causality analysis

Finally, on the similar pattern, we analyse five-variable Granger causality.[12] Results of the five-variable Granger causality are presented in table 5. Table 5 also gives comparison of the results of two-, three-, four-, and five-variable Granger causality analysis.

There are few important points that emerge from the results presented in table 5. First, the hypothesis of export-led growth is rejected in case of Pakistan. Our results show that exports do not lead to income growth in any of the eight Granger causality equations that we have estimated (column 2). On the contrary, income leads exports in all most all the equations. The only exception is a tri-variate causality involving investment with income and exports. Only in this case income does not Granger cause exports. However, in the subsequent analysis where more variables are included income do lead exports.[13]

Second, contrary to what is generally believed in Pakistan and what is also shown in other studies, imports do not play any role in export-income relationship in case of Pakistan.[14] We find no Granger causality from imports to either exports or income in any of the eight equations that we have examined. Similarly, income do not Granger cause imports while exports Granger cause imports only in two variable export-import relationship.[15]

Third, both investment and energy have emerged as important variables in the export-income relationship in Pakistan. Our results indicate that in case of both energy and investment there is a uni-directional causality from investment/energy to exports. These results generally hold across all the equations. The only exception is a two-variable, export-energy relationship where neither export Granger causes energy, nor energy Granger causes exports. As far as the income-energy relationship is concerned, our results show that there is no Granger causality between income and energy in any of the eight equations except in a two-variable income-energy relationship. Here income Granger cause energy. These results support our contention that omitting important variables can under or over state causality between the variables. In

[12] The set of equations in five-variable causality besides export and GDP includes; investment, energy, and imports.
[13] In 4-, and 5-variable cases.
[14] Reizman and Whiteman (1996) have shown that imports play an important role in the export-growth relationship in many countries that they have analysed.
[15] At 10 per cent critical value.

case of energy-export relationship two-variable causality has under stated the results, while in case of energy-income relationship it has overstated the causality results.

In short we can conclude that in case of Pakistan our results of Granger-causality analysis do not support the hypothesis of export-led growth. On the other hand the analysis clearly supports the growth-led export hypothesis. Omitting important variables can over or under state causality results. Investment and energy appear to be more important variables than imports in the export-income relationship.

Table 5: Results of Granger causality analysis for 2-, 3-, 4-, and 5-variable Granger causality (OLS)

Granger-Causality	X $\rightarrow$ Y	Y $\rightarrow$ X	X $\rightarrow$ M	M $\rightarrow$ X	Y $\rightarrow$ M	M $\rightarrow$ Y	X $\rightarrow$ I	I $\rightarrow$ X	Y $\rightarrow$ I	I $\rightarrow$ Y	X $\rightarrow$ E	E $\rightarrow$ X	Y $\rightarrow$ E	E $\rightarrow$ Y
2-variable Exp.& Income	4.7420 [0.192]	7.9694* [.047]	6.5365** [.088]	.87440 [.832]	5.4722 [.140]	.87446 [.832]	2.4955 [.476]	10.8363* [.013]	1.8591 [.602]	4.2380 [.237]	2.3457 [.504]	2.0762 [.557]	5.6880 [.128]	7.8888* [.048]
3-variable with Imp.	4.0700 [.254]	7.3439** [.062]	3.9522 [.267]	.52855 [.913]	2.9536 [.399]	.36245 [.948]								
3-variable with Invst.	3.2029 [.361]	5.9491 [.114]					2.1263 [.547]	8.6594* [.034]	1.5147 [.679]	2.7247 [.436]				
3-variable with Energ.	2.4703 [.481]	12.2453* [.007]									2.9576 [.398]	7.5805* [.056]	5.4310 [.143]	5.4577 [.141]
4-variable with Im. & Inv	2.8183 [.420]	5.3624 [.147]	3.8428 [.279]	1.5400 [.673]	2.9732 [.396]	.52658 [.913]	2.0774 [.557]	9.4725* [.024]	1.6080 [.658]	2.8065 [.422]				
4-variable with Im.&Enr	1.5228 [.677]	9.0599* [.029]	3.9113 [.271]	.38289 [.944]	3.5009 [.321]	1.0915 [.779]					4.1509 [.246]	6.5421** [.088]	5.9498 [.114]	6.0444 [.109]
4-variable with Inv.& Enr	1.6022 [.659]	10.9956* [.012]					2.1348 [.545]	10.1352* [.017]	.60275 [.896]	3.0695 [.381]	2.6069 [.456]	9.4864* [.023]	6.5601** [.087]	5.7582 [.124]
All 5-variable (Inv.,Eng., Imp)	1.5176 [.678]	9.6952* [.021]	3.8120 [.282]	.77579 [.855]	3.6217 [.305]	1.1368 [.768]	1.9539 [.582]	10.6013* [.014]	.75009 [.861]	3.2212 [.359]	2.5545 [.466]	7.3987** [.060]	5.3409 [.148]	4.6271 [.201]

* at 5% Chi-square critical value (Wald Statistics)

* * at 10% Chi-square critical value (Wald Statistics)

figures in the parenthesis are probabilities

4. Export-Growth Relationship: Seemingly Unrelated Regression (SUR) Model:

Many researchers have used Granger non-causality testing procedures to study the export-income relationship.[16] However, one common problem with these studies is their arbitrary choice of the lag length (see, for example, Jung et al., 1985; Chow, 1987; Ghartey, 1993). Furthermore, most of the studies have applied F-test statistics for the causality test (for example, Marin, 1992; Jin and Yu, 1996; Riezman et al., 1996). It is now well established in the literature of econometrics that the F-statistics is not valid if time series are integrated (e.g., if they are I(1) variables) as argued by Enders (1995), Gujarati (1995), and Zapata and Rambaldi (1997).

As far as the model specification is concerned, some studies have utilised a simple two-variable relationship (e.g., Chow, 1987; Xu, 1996); some other studies have applied an export-augmented neo-classical production function, incorporating the influence of the so-called 'New Growth Theory' to include other variables, such as education, technological change, and energy consumption.[17] It should be pointed out that the approach of using a simple two-variable framework in the causality test may be subject to a possible specification bias (Gujarati, 1995; Xu, 1996). In particular, Riezman et al., (1996) have pointed out an important finding that 'standard methods of detecting export-led growth using Granger-causality tests may give misleading results if imports are not included'.

Another problem that has been ignored and/or has not been dealt with properly in the literature is that exports, via the national income accounting identity, are themselves a component of output. This problem is due to the endogeniety of the export growth variable within a output growth equation. Therefore, any studies, which do not consider the endogenous nature of the growth process, to a large extent, are subject to simultaneity bias and hence will yield unreliable conclusions (Shan & Sun, 1998).

[16] Granger (1981, 1988) has introduced the concept of causality in the framework of bivariate VAR, defining Y is said to be Granger-caused by X if the information in the past and the present X helps to improve the forecasts of the Y variable.
[17] Some of the similar treatments incorporating new growth theory are Tyler (1981), Ram (1985), and Burney (1996).

The Model

We closely follow the procedure developed by Toda and Yamamoto (1995). This procedure utilises a modified WALD (MWALD) test for restrictions on the parameters of a VAR(k), where k is the lag length in the system. This test has an asymptotic χ^2 distribution when a VAR($k+d_{max}$) is estimated (where d_{max} is the maximal order of integration suspected to occur in the system.

Rambadli and Doran (1996) have proved that MWALD method for testing Granger-causality can be computationally simple by using a Seemingly Unrelated Regression (SUR). In order to clarify the principle, let us consider the simple example of a bivariate (p=2) model, with one lag (k=1). That is,

$$x_t = A_0 + A_1 x_{t-1} + e_t,$$

or more fully,

$$\begin{bmatrix} x_{1t} \\ x_{2t} \end{bmatrix} = \begin{bmatrix} a_{1o} \\ a_{2o} \end{bmatrix} + \begin{bmatrix} a_{11}^{(1)} & a_{12}^{(1)} \\ a_{21}^{(1)} & a_{22}^{(1)} \end{bmatrix} \begin{bmatrix} x_{1,t-1} \\ x_{2,t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

where $E(e_t) = 0$ and $E(e_t e_t') = \Sigma$, and x_{1t} and x_{2t} are two variables .

To test that x_2 does not Granger cause x_1, we will test the parameter restriction $a_{12}^{(1)} = 0$

If now we assume that x_{1t} and x_{2t} are I(1), a standard t-test is not valid. Following Doladaro and Lutkepohl (1996), we test $a_{12}^{(1)} = 0$ by constructing the usual Wald test based on least square estimates in the augmented model:

$$\begin{bmatrix} x_{1t} \\ x_{2t} \end{bmatrix} = \begin{bmatrix} a_{1o} \\ a_{2o} \end{bmatrix} + \begin{bmatrix} a_{11}^{(1)} & a_{12}^{(1)} \\ a_{21}^{(1)} & a_{22}^{(1)} \end{bmatrix} \begin{bmatrix} x_{1,t-1} \\ x_{2,t-1} \end{bmatrix} + \begin{bmatrix} a_{11}^{(2)} & a_{12}^{(2)} \\ a_{21}^{(2)} & a_{22}^{(2)} \end{bmatrix} \begin{bmatrix} x_{1,t-2} \\ x_{2,t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix}$$

On the similar pattern, we have therefore built a five-variable VAR system in SUR form:

$$\begin{bmatrix} Y_t \\ X_t \\ M_t \\ I_t \\ E_t \end{bmatrix} = A_0 + \sum_{p=1}^{3} A_1 \begin{bmatrix} Y_{t-p} \\ X_{t-p} \\ M_{t-p} \\ I_{t-p} \\ E_{t-p} \end{bmatrix} + \begin{bmatrix} e_y \\ e_x \\ e_m \\ e_i \\ e_e \end{bmatrix} \qquad (10)$$

where	Yt = GDP	(first differenced)
	Xt = Exports	(first differenced)
	Mt = Imports	(first differenced)
	It = Investment	(first differenced)
	Et = Energy	(first differenced)
	e = Error term	
	n = 3 (lag length)	

An advantage of using VAR model, following the recent literature on 'New Growth Theory', is that it can overcome the issue of simultaneity bias. Gujarati (1995) points out that the VAR model is a truly simultaneous system in that all the variables are regarded as endogenous considering the feedback effects in the system.

To examine the first causality (from exports to income) we should test whether x_t appears in the first equation of the VAR system (10). The null hypothesis to be tested in this regard would be

$$H_0: \; a_{12}^{(1)} = a_{12}^{(2)} = a_{12}^{(3)} = \ldots\ldots\ldots\ldots\ldots \; a_{12}^{(n)} = 0$$

where $a_{12}^{(i)}$ are the coefficients of exports for the ith lag in the first equation of the system (10). The existence of causality from exports to income can be established by rejecting the null hypothesis. This can be ascertained by looking at the significance of the WALD statistics for the group of the lagged independent variables identified above.

The similar restrictions and the testing procedure can be applied to examine the second causality (i.e. income to exports). This involves testing the following linear restriction in the VAR system:

$$H_0:\ a_{21}^{(1)} = a_{21}^{(2)} = a_{21}^{(3)} = \ldots\ldots\ldots\ldots\ldots a_{21}^{(n)} = 0$$

where $a_{21}^{(i)}$ are the coefficients of income (GDP) for the ith lag in the second equation of the system (10). The existence of causality from income to exports can be established by rejecting the null hypothesis. This can be ascertained by looking at the significance of the WALD statistics for the group of the lagged independent variables identified above. Similar procedure has been adopted for the other three equations in the system.

Results of SUR Analysis:

The results of the 5-variable VAR model estimated using Seemingly Unrelated Regression technique are presented in table 6. The advantage of using SUR, as mentioned earlier, is that it takes care of the possible simultaneity bias in the equations. Results of the SUR analysis confirm the main findings of the earlier analysis.[18] However, out of 14 causalities that we have tested in Granger causality (OLS) analysis, the SUR analysis gives contradicting results in five cases. These results indicate that true relationships between variables can only be ascertained after controlling for simultaneity bias.

[18] Granger-causality (OLS) results.

The SUR results also indicates that in case of Pakistan the hypothesis of export-led growth cannot be supported, while the hypothesis of growth-led export is upheld by the SUR analysis. In order to avoid unnecessary repetition and conserve space we present and compare only those results that are different from Granger causality (OLS) results (table 5).[19] These results reveal some very important causal relationships among different variables, which Granger causality in OLS failed to pick.

SUR results show that exports Granger cause imports, investment, and energy. On the other hand income Granger cause energy, and investment Granger cause income. As shown in table 6, there is only one significant relationship that is common in the two analyses and that is income leading exports.

Table 6: Comparison of SURE results with Granger causality (OLS) results

	Simultaneous equation SURE analysis	Granger causality analysis[20]
	Chi-square (Prob.)	Chi-square (Prob.)
X ⟶ Y	1.527 (0.1539)	1.5176 [0.678]
Y ⟶ X	10.344* (0.0158)	9.6952* [0.021]
X ⟶ M	7.8106* (0.0500)	3.8120 [0.282]
X ⟶ I	14.319* (0.0025)	1.9539 [0.582]
I ⟶ Y	7.3042* (0.0628)	3.2212 [0.359]
X ⟶ E	14.741* (0.0020)	2.5545 [0.466]
Y ⟶ E	15.162* (0.0016)	5.3409 [0.148]

Wald statistics significant at 5% critical value

[19] Complete results are presented in appendix B.
[20] Five-variable case

V. Conclusion

In order to evaluate the evidence for or against the export-led growth hypothesis we have presented an analysis of a time series data for Pakistan. We have carried out this analysis beyond the standard (two-variable) method of detecting export-led growth using Granger Causality test. Following the New Growth Theory, we have taken in to account other important and relevant macro-economic variables (e.g. investment, imports, and energy) that might have some bearing on the export-income relationship.

We have examined the issue of export-income relationship using two different techniques (OLS & SUR). There are a few important points that emerge from the analysis of export-income relationship using the Granger Causality (OLS) approach. First, our results show that exports do not lead income in any of the Granger-causality tests. On the contrary, income lead exports in all most all the tests. Second, contrary to what is generally believed in Pakistan, imports do not play any role in the export-income relationship. Third, investment and energy have emerged as important variables in the export-income relationship. In short it can be concluded that in case of Pakistan the hypothesis of export-led growth is not supported by the Granger-causality analysis. Results of 2-, 3-, 4- and 5-variable Granger causality reveals that omitting important variables can over or under state causality results. Investment and energy are more important variables than imports in the export-income relationship.[21]

Following the New Growth Theory, which argues that studies that do not consider the endogenous nature of growth process are subject to simultaneity bias and hence will yield unreliable conclusions, we have built and estimated a five-variable VAR system in SUR form. According to Gujarati (1995) the VAR model is a truly simultaneous system in that all the variables are regarded as endogenous. Results of the SUR analysis confirms our earlier results i.e. exports do not lead income, but income leads exports.

[21] We are aware that the conventional Granger-causality approach is merely a statistical exercise. It does not explain the behavioural aspect of the relationship between export and income which should be studied in a structural model, comprising of two equations and analyse them by using two stages least square estimation technique.

In both the approaches that we have used, our results tend to reject the hypothesis of export-led growth in case of Pakistan. On the other hand according to these results, income leads exports. Investment and energy are the two variables that emerge as important factors in explaining the export-income relationship. Surprisingly and contrary to what is generally believed and what is also shown in few other studies, import has no significant role in this relationship. These results imply that Pakistan would have to improve its investment climate for both domestic and foreign investors in order to generate growth and improve export performance. Efforts should be made to reduce energy prices, which are relatively higher in Pakistan compared to its export-competitors, and enhance energy usage, as a way to promoting both economic growth and exports.

Although we have analysed the export and growth relationship at a rather aggregated macro-level, our broad findings are supported by micro-level studies, including a recent study assessing the investment climate in Pakistan by the World Bank[22]. It was found that only 20% of the firms were in the exporting business in Pakistan compared to around 40 percent each in India and China. The main constraints given for the poor investment climate and slow growth of businesses in this survey were: an intrusive regulatory environment; low availability and higher prices of basic utilities such as power, telephone, etc; poor trade facilitation such as delays in custom clearances; limited access to formal sector financing for small businesses. More importantly the law and order problems and political uncertainty have also resulted in impeding business and economic growth in the country. For the export sector, another big factor that affects export competitiveness is the inherent anti-export bias in the tax and trade regime. According to one estimate it is 15-20% more attractive for businesses to supply to the domestic market than to export because of tariffs and tax incentives. All these factors not only impede overall growth, but as suggested by our results, also slow down growth of exports.

[22] World Bank (2003).

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Appendix A: Complete results of the SURE analysis

Estimation Method: Iterative Seemingly Unrelated Regression

Sample: 1976:4 1998:2
Convergence achieved after: 4 weight matricies, 5 total coef iterations

	Coefficient	Std. Error	t-statistic	Prob.
C(1)	-0.00509	0.012561	-0.40484	0.6858
C(2)	-0.33783	0.102668	-3.29048	0.0011
C(3)	-0.15476	0.104674	-1.47847	0.1402
C(4)	-0.1195	0.100029	-1.19462	0.233
C(5)	-0.19458	0.442169	-0.44006	0.6602
C(6)	0.455882	0.446706	1.02054	0.3082
C(7)	1.101093	0.450888	2.442055	0.0151
C(8)	-0.08399	0.147212	-0.57053	0.5687
C(9)	-0.27681	0.16247	-1.70377	0.0893
C(10)	-0.22094	0.158858	-1.39082	0.1652
C(11)	-0.62012	0.14406	-4.30457	0
C(12)	-0.27239	0.170415	-1.59838	0.1109
C(13)	0.21149	0.146506	1.443556	0.1498
C(14)	-0.08849	0.223562	-0.39583	0.6925
C(15)	-0.55722	0.204677	-2.72241	0.0068
C(16)	0.253389	0.210621	1.203057	0.2298
C(17)	-0.00125	0.002398	-0.52295	0.6013
C(18)	0.020648	0.01952	1.057769	0.2909
C(19)	-0.005	0.019689	-0.25402	0.7996
C(20)	-0.00454	0.019843	-0.22873	0.8192
C(21)	-0.57948	0.086526	-6.69715	0
C(22)	-0.63646	0.088299	-7.20795	0
C(23)	-0.57153	0.089553	-6.38203	0
C(24)	-0.01661	0.029294	-0.56698	0.5711
C(25)	0.003977	0.03248	0.122432	0.9026
C(26)	0.006576	0.031376	0.209588	0.8341
C(27)	0.022116	0.028276	0.782151	0.4347
C(28)	0.032761	0.033234	0.985753	0.3249
C(29)	0.051918	0.028289	1.835268	0.0673
C(30)	-0.03136	0.044813	-0.69984	0.4845
C(31)	0.068208	0.04115	1.657551	0.0983
C(32)	0.044469	0.042339	1.050329	0.2943
C(33)	0.002186	0.008534	0.256164	0.798
C(34)	0.158024	0.069473	2.274603	0.0235

Appendix A Continue				
C(35)	0.070141	0.070074	1.000952	0.3175
C(36)	0.136589	0.070623	1.93405	0.0539
C(37)	-0.6742	0.307949	-2.18931	0.0292
C(38)	-0.27802	0.314262	-0.88468	0.3769
C(39)	-0.401	0.318723	-1.25814	0.2092
C(40)	-0.31908	0.104258	-3.06046	0.0024
C(41)	-0.2452	0.115598	-2.12115	0.0346
C(42)	0.079291	0.111667	0.710069	0.4781
C(43)	0.040441	0.100635	0.401862	0.688
C(44)	0.188517	0.118283	1.593785	0.1119
C(45)	0.081049	0.100681	0.805001	0.4214
C(46)	0.130505	0.159492	0.818251	0.4138
C(47)	-0.17344	0.146453	-1.18424	0.2371
C(48)	0.06452	0.150685	0.428176	0.6688
C(49)	0.004541	0.008105	0.560273	0.5756
C(50)	-0.11742	0.06598	-1.77964	0.076
C(51)	-0.06353	0.066551	-0.95454	0.3405
C(52)	-0.23911	0.067072	-3.56496	0.0004
C(53)	-0.06085	0.292464	-0.20805	0.8353
C(54)	-0.09216	0.298461	-0.30878	0.7577
C(55)	0.317002	0.302697	1.047259	0.2957
C(56)	-0.22353	0.099016	-2.25751	0.0246
C(57)	-0.14345	0.109785	-1.30665	0.1922
C(58)	-0.03681	0.106052	-0.34708	0.7287
C(59)	-0.44614	0.095575	-4.66797	0
C(60)	0.038338	0.112335	0.341281	0.7331
C(61)	-0.3563	0.095619	-3.72626	0.0002
C(62)	-0.0982	0.151473	-0.64833	0.5172
C(63)	-0.19038	0.13909	-1.36878	0.1719
C(64)	-0.06081	0.143109	-0.42489	0.6712
C(65)	0.003726	0.005768	0.645945	0.5187
C(66)	0.124849	0.046958	2.658771	0.0082
C(67)	-0.09199	0.047364	-1.94226	0.0529
C(68)	0.006055	0.047735	0.126845	0.8991
C(69)	0.593157	0.208145	2.849726	0.0046
C(70)	0.679558	0.212413	3.199237	0.0015
C(71)	0.176437	0.215428	0.819009	0.4133
C(72)	0.204025	0.070469	2.895246	0.004
C(73)	0.072698	0.078134	0.930435	0.3528
C(74)	0.110821	0.075477	1.468276	0.1429
C(75)	0.163605	0.06802	2.405243	0.0167

Appendix A Continue

C(76)	0.169248	0.079948	2.116962	0.035
C(77)	-0.04037	0.068052	-0.59326	0.5534
C(78)	-0.2533	0.107802	-2.34965	0.0193
C(79)	-0.33509	0.098989	-3.38512	0.0008
C(80)	0.030535	0.10185	0.299808	0.7645

Determinant residual covariance 5.15E-13

Equation: **DRSTEXP**=C(1)+C(2)*DRSTEXP(-1)+C(3)*DRSTEXP(-2)+C(4)*DRSTEXP(-3)+C(5)*DRSGDPTSN(-1)+C(6)*DRSGDPTSN(-2)+C(7)*DRSGDPTSN(-3)+C(8)*DRSTIMP(-1)+C(9)*DRSTIMP(-2)+C(10)*DRSTIMP(-3)+C(11)*DRSLINVST(-1)+C(12)*DRSLINVST(-2)+C(13)*DRSLINVST(-3)+C(14)*DRSENERG1(-1)+C(15)*DRSENERG1(-2)+C(16)*DRSENERG1(-3)

Observations: 87

R-squared	0.495637	Mean dependent var	-0.00129
Adjusted R-squared	0.362129	S.D. dependent var	0.154964
S.E. of regression	0.123765	Sum squared resid	1.041609
Durbin-Watson stat	2.069654		

Equation: **DRSGDPTSN**=C(17)+C(18)*DRSTEXP(-1)+C(19)*DRSTEXP(-2)+C(20)*DRSTEXP(-3)+C(21)*DRSGDPTSN(-1)+C(22)*DRSGDPTSN(-2)+C(23)*DRSGDPTSN(-3)+C(24)*DRSTIMP(-1)+C(25)*DRSTIMP(-2)+C(26)*DRSTIMP(-3)+C(27)*DRSLINVST(-1)+C(28)*DRSLINVST(-2)+C(29)*DRSLINVST(-3)+C(30)*DRSENERG1(-1)+C(31)*DRSENERG1(-2)+C(32)*DRSENERG1(-3)

Observations: 87

R-squared	0.687838	Mean dependent var	-0.00043
Adjusted R-squared	0.621889	S.D. dependent var	0.039928
S.E. of Reg	0.024552	Sum squared resid	0.042798
D/W stat	1.942177		

Equation: **DRSTIMP**=C(33)+C(34)*DRSTEXP(-1)+C(35)*DRSTEXP(-2)+C(36)*DRSTEXP(-3)+C(37)*DRSGDPTSN(-1)+C(38)*DRSGDPTSN(-2)+C(39)*DRSGDPTSN(-3)+C(40)*DRSTIMP(-1)+C(41)*DRSTIMP(-2)+C(42)*DRSTIMP(-3)+C(43)*DRSLINVST(-1)+C(44)*DRSLINVST(-2)+C(45)*DRSLINVST(-3)+C(46)*DRSENERG1(-1)+C(47)*DRSENERG1(-2)+C(48)*DRSENERG1(-3)

Appendix B Continue

Observations: 87

R-squared	0.244887	Mean dependent var	0.00146
Adjusted R-squared	0.085357	S.D. dependent var	0.091368
S.E. of regression	0.087381	Sum squared resid	0.54212
Durbin-Watson stat	1.94239		

Equation: **DRSLINVST**=C(49)+C(50)*DRSTEXP(-1)+C(51)*DRSTEXP(-2)+C(52)*DRSTEXP(-3)+C(53)*DRSGDPTSN(-1)+C(54)*DRSGDPTSN(-2)+C(55)*DRSGDPTSN(-3)+C(56)*DRSTIMP(-1)+C(57)*DRSTIMP(-2)+C(58)*DRSTIMP(-3)+C(59)*DRSLINVST(-1)+C(60)*DRSLINVST(-2)+C(61)*DRSLINVST(-3)+C(62)*DRSENERG1(-1)+C(63)*DRSENERG1(-2)+C(64)*DRSENERG1(-3)

Observations: 87

R-squared	0.880973	Mean dependent var	0.002844
Adjusted R-squared	0.855827	S.D. dependent var	0.21856
S.E. of regression	0.082988	Sum squared resid	0.488973
Durbin-Watson stat	1.918199		

Equation: **DRSENERG1**=C(65)+C(66)*DRSTEXP(-1)+C(67)*DRSTEXP(-2)+C(68)*DRSTEXP(-3)+C(69)*DRSGDPTSN(-1)+C(70)*DRSGDPTSN(-2)+C(71)*DRSGDPTSN(-3)+C(72)*DRSTIMP(-1)+C(73)*DRSTIMP(-2)+C(74)*DRSTIMP(-3)+C(75)*DRSLINVST(-1)+C(76)*DRSLINVST(-2)+C(77)*DRSLINVST(-3)+C(78)*DRSENERG1(-1)+C(79)*DRSENERG1(-2)+C(80)*DRSENERG1(-3)

Observations: 87

R-squared	0.419889	Mean dependent var	0.00331
Adjusted R-squared	0.297331	S.D. dependent var	0.070458
S.E. of regression	0.059062	Sum squared resid	0.247669
Durbin-Watson stat	1.887028		

Wald Test of joint significance of the coefficients:

Null Hypothesis:	C(5)=0 C(6)=0 C(7)=0	Null Hypothesis:	C(37)=0 C(38)=0 C(39)=0
Chi-square	10.3447	Chi-square	4.884912
Probability	0.015852	Probability	0.180421
Null Hypothesis:	C(8)=0 C(9)=0 C(10)=0	Null Hypothesis:	C(46)=0 C(47)=0 C(48)=0
Chi-square	2.4406	Chi-square	2.742652
Probability	0.486122	Probability	0.433028
Null Hypothesis:	C(11)=0 C(12)=0 C(13)=0	Null Hypothesis:	C(50)=0 C(51)=0 C(52)=0
Chi-square	17.45495	Chi-square	14.3192
Probability	0.00057	Probability	0.002501
Null Hypothesis:	C(14)=0 C(15)=0 C(16)=0	Null Hypothesis:	C(53)=0 C(54)=0 C(55)=0
Chi-square	11.72425	Chi-square	2.151577
Probability	0.00839	Probability	0.541549
Null Hypothesis:	C(18)=0 C(19)=0 C(20)=0	Null Hypothesis:	C(56)=0 C(57)=0 C(58)=0
Chi-square	1.527002	Chi-square	5.58378
Probability	0.676053	Probability	0.133713
Null Hypothesis:	C(22)=0 C(23)=0 C(24)=0	Null Hypothesis:	C(62)=0 C(63)=0 C(64)=0
Chi-square	0.485194	Chi-square	2.0098
Probability	0.922132	Probability	0.570375

Appendix B Continue			
Null Hypothesis:	C(26)=0 C(27)=0 C(28)=0	Null Hypothesis:	C(66)=0 C(67)=0 C(68)=0
Null Hypothesis:	C(26)=0 C(27)=0 C(28)=0	Null Hypothesis:	C(66)=0 C(67)=0 C(68)=0
Chi-square	7.304286	Chi-square	14.74151
Probability	0.062806	Probability	0.002051
Null Hypothesis:	C(30)=0 C(31)=0 C(32)=0	Null Hypothesis:	C(75)=0 C(76)=0 C(77)=0
Chi-square	5.256913	Chi-square	8.549242
Probability	0.153923	Probability	0.035925
Null Hypothesis:	C(34)=0 C(35)=0 C(36)=0	Null Hypothesis:	C(69)=0 C(70)=0 C(71)=0
Chi-square	7.810621	Chi-square	15.16297
Probability	0.050092	Probability	0.001683
Null Hypothesis:	C(43)=0 C(44)=0 C(45)=0	Null Hypothesis:	C(72)=0 C(73)=0 C(74)=0
Chi-square	3.120094	Chi-square	9.253031
Probability	0.373477	Probability	0.026109

Appendix-C:

Results of the Cointegration Tests

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
****
***
91 observations from 1975Q4 to 1998Q2. Order of VAR = 3.
List of variables included in the cointegrating vector:
TEXPORT TIMPORT GDPSQ ENERGY INVST
List of eigenvalues in descending order:
.25349 .12807 .096584 .086948 .024425
****
***

Null	Alternative	Statistic	95% Critical Value	90% Critical Valu
r = 0	r = 1	26.6037	33.6400	31.0200
r<= 1	r = 2	12.4710	27.4200	24.9900
r<= 2	r = 3	9.2431	21.1200	19.0200
r<= 3	r = 4	8.2775	14.8800	12.9800

****
***
Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Cointegration LR Test Based on Trace of the Stochastic Matrix
****
***
91 observations from 1975Q4 to 1998Q2. Order of VAR = 3.
List of variables included in the cointegrating vector:
TEXPORT TIMPORT GDPSQ ENERGY INVST
List of eigenvalues in descending order:
.25349 .12807 .096584 .086948 .024425
****
***

Null	Alternative	Statistic	95% Critical Value	90% Critical Valu
r = 0	r>= 1	58.8456	70.4900	66.2300
r<= 1	r>= 2	32.2419	48.8800	45.7000
r<= 2	r>= 3	19.7709	31.5400	28.7800
r<= 3	r>= 4	10.5278	17.8600	15.7500

****
***
Use the above table to determine r (the number of cointegrating vectors).

Cointegration with unrestricted intercepts and no trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria
****
***

91 observations from 1975Q4 to 1998Q2. Order of VAR = 3.
List of variables included in the cointegrating vector:
TEXPORT TIMPORT GDPSQ ENERGY INVST
List of eigenvalues in descending order:
.25349 .12807 .096584 .086948 .024425
****

Rank	Maximized LL	AIC	SBC	HQC
r = 0	527.0158	472.0158	402.9672	444.1590
r = 1	540.3177	476.3177	395.9702	443.9025
r = 2	546.5532	475.5532	386.4177	439.5925
r = 3	551.1747	475.1747	379.7620	436.6816
r = 4	555.3135	476.3135	377.1345	436.3009

****
AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion
HQC = Hannan-Quinn Criterion