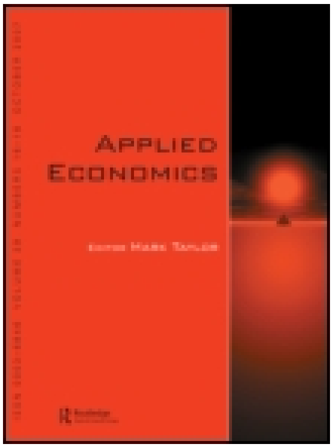

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Trade openness and economic growth: is growth export-led or import-led?

Titus O. Awokuse [a]
[a] Department of Food and Resource Economics , University of Delaware , 207 Townsend Hall, Newark, Delaware 19717, USA E-mail:
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Trade openness and economic growth: is growth export-led or import-led?

Titus O. Awokuse

Department of Food and Resource Economics, University of Delaware, 207 Townsend Hall, Newark, Delaware 19717, USA
E-mail: kuse@udel.edu

Most previous investigations have only focused on the effect of export expansion on economic growth while ignoring the potential growth-enhancing contribution of imports. This article re-examines the relationship between trade and economic growth in Argentina, Colombia, and Peru with emphasis on both the role of exports and imports. Granger causality tests and impulse response functions were used to examine whether growth in trade stimulate economic growth (or vice versa). The results suggest that the singular focus of past studies on exports as the engine of growth may be misleading. Although there is some empirical evidence supporting export-led growth, the empirical support for import-led growth hypothesis is relatively stronger. In some cases, there is also evidence for reverse causality from gross domestic product growth to exports and imports.

I. Introduction

The potential benefit of outward-oriented trade policy for economic growth has been the subject of many empirical investigations. Although several studies have demonstrated the theoretical economic relationship between trade and economic growth, disagreements still persists regarding the causal direction and magnitude of the effects (Bhagwati, 1978; Edwards, 1998). The vast majority of this literature focuses on the causal effect of export on economic growth. The main question in the export-led-growth debate is whether an export-driven outward orienting trade policy is preferable to an inward orienting trade policy in stimulating economic growth. Some researchers argue that causality flows from exports to economic growth and denotes this as the export-led growth (ELG) hypothesis. The reverse causal flow from economic growth to exports is termed growth-led exports (GLE). The third alternative is that of import-led growth (ILG) which suggests that economic growth could be driven primarily by growth in imports.

Despite the potentially important role of imports and import competition, relatively little attention has been devoted to the causal relationship between imports and economic growth. Most studies on the effect of trade openness on growth have primarily focused on the role of exports and have mostly ignored the contribution of imports. However, some recent studies have shown that without controlling for imports, any observed causal link between exports and economic growth may be spurious and thus misleading (Esfahani, 1991; Riezman *et al*., 1996; Thangavelu and Rajaguru, 2004). Imports may be very important to economic growth since significant export growth is usually associated with rapid import growth. Furthermore, the export-growth analyses that exclude imports may be subject to the classic omitted variable problem. The fundamental causal

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relationship may actually be between imports and economic growth.

Although numerous empirical studies have investigated the role of exports in economic growth, they largely focused on Asian economies, with few studies including Latin America countries. Earlier in their economic development paths, many Latin American economies mostly followed protectionist trade policies emphasizing the import-substitution industrialization strategy. The current prevailing view among most development economists is that the import-substitution approach is detrimental to economic growth as it inherently fosters production inefficiencies and encourages rent-seeking behaviour. In recent years, many Latin American countries have experienced major macroeconomic and trade policy reforms with emphasis on market liberalization and trade openness. The few existing empirical investigations of the effect of openness on growth in this region have produced mixed and inconclusive results (Riezman *et al*., 1996; Xu, 1996; Bahmani-Oskooee and Niroomand, 1999; Richards, 2001).

This study investigates the causal relationship between trade and economic growth for three Latin American economies (Argentina, Colombia and Peru) within an integrated framework that explores the role of both exports and imports. This study makes contributions to the literature in several ways. First, in contrast to most previous studies of the ELG hypothesis, this study extends the traditional neoclassical growth model by estimating an augmented production function that explicitly tests for the effect of both exports and imports on economic growth. Real exports and imports are included as two of the endogenous variables in the cointegrated vector autoregression (VAR) model. This modelling framework also makes it possible to test for both the ELG and ILG hypotheses for these Latin American economies. Second, the article also adopts recent advances in time series modelling by specifying causal models based on vector error correction models (Toda and Phillips, 1993). Thus, in addition to testing for Granger causality between exports, imports and growth, long-run behaviour could also be investigated via cointegration and impulse response function (IRF) analyses.

The rest of this article is organized as follows. Section II provides a brief theoretical and empirical overview of the trade and growth relationship. Section III discusses the analytical framework and some methodological issues. Section IV presents empirical findings and Section V contains the concluding remarks.

II. Exports, Imports and Economic Growth

Theoretical framework

The relationship between exports and economic growth has been attributed to the potential positive externalities derived from exposure to foreign markets. More specifically, exports can be viewed as an engine of growth in three ways. First, export expansion can be a catalyst for output growth directly as a component of aggregate output. An increase in foreign demand for domestic exportable products can cause an overall growth in output via an increase in employment and income in the exportable sector. Second, export growth can also affect growth indirectly through various routes such as: efficient resource allocation, greater capacity utilization, exploitation of economies of scale and stimulation of technological improvement due to foreign market competition (Helpman and Krugman, 1985). Export growth allows firms to take advantage of economies of scale that are external to firms in the nonexport sector but internal to the overall economy. Third, expanded exports can provide foreign exchange that allows for increasing levels of imports of intermediate goods that in turn raises capital formation and thus stimulate output growth (Balassa, 1978; Esfahani, 1991).

Relative to the case for ELG, expanded imports have the potential to play a complementary role in stimulating overall economic performance. It is plausible to assume that the effect of imports on economic growth may be different from that of exports. For instance, in many small open developing economies, imports provide much needed factors of production employed in the export sector. Also, the transfer of technology from developed to developing countries via imports could serve as an important source of economic growth. Endogenous growth models show that imports can be a channel for long-run economic growth because it provides domestic firms access to foreign technology and knowledge (Grossman and Helpman, 1991; Coe and Helpman, 1995). Foreign R&D knowledge could be an important source of productivity growth as cutting-edge technologies are usually bundled with imported intermediate goods such as computers, precision machines and equipments. Thus, foreign imports are sources of technology-intensive intermediate factors of production (Lawrence and Weinstein, 1999; Mazumdar, 2001). In a sense, imports as a medium of technology transfer may play a more significant role on economic growth than exports.

In addition, beyond serving as a vehicle for technology transfer, imports can also affect productivity growth through its effect on domestic innovation via import competition. An increase in import penetration exposes the domestic firms to foreign competition. Although the impact of import penetration may differ across domestic industries, imports are important to productivity growth because increased imports of competing products spur innovation as domestic producers respond to the technological competitive pressure from foreign competition (Lawrence and Weinstein, 1999).

Review of the empirical literature

Since trade theory does not provide a definitive guidance on the causal relationship between trade and output growth, the debate is usually informed by inferences based on anecdotal intuition and empirical analyses. There is extensive literature focusing on the relationship between trade and growth with many espousing the advantages of outward-oriented trade policies. These studies emphasize the benefits of export promotion over the disadvantages of inward-oriented trade policies of import substitution industrialization adopted by several developing countries post-World War II (Balassa, 1978). They cite as evidence the success of the outward-oriented Asian economies (e.g. Hong Kong, Korea, Singapore and Taiwan) in contrast to the economic failures of inward-oriented developing countries (e.g. India and Latin America). Most Latin American countries maintained their inward-oriented trade policies until the 1980s when they were forced by international lending agencies (e.g. International Monetary Fund and the World Bank) to adopt comprehensive structural adjustment programs that emphasized economic reforms and market liberalization policies.

The volumes of empirical evidence on the ELG hypothesis have shown that there is a notable link between gross domestic product (GDP) growth and export growth. But controversies still surround the direction of causality. Although most studies focus on developing countries (Balassa, 1978; Sheehey, 1992), several researchers have also examined the ELG hypothesis for industrialized countries (Sharma *et al.*, 1991; Ghartey, 1993; Awokuse, 2003, 2006; Dar and Amirkhalkhali, 2003). While some researchers found evidence in support of the ELG hypothesis, others either found evidence in support of the alternative GLE hypothesis or in several cases the empirical evidence indicated a bi-directional causal relationship (Van den Berg and Schmidt, 1994; Xu, 1996; Riezman *et al.*, 1996; Giles and Williams, 2000).

Earlier studies that analysed the link between trade and economic growth primarily focused on the role of exports and most adopted a bivariate correlation modelling framework. Later, several cross-county studies examined the export-growth nexus within a neoclassical growth modelling framework (Balassa, 1978; Ram, 1987). Most of these cross-sectional studies found a significant and positive relationship between export performance and national output growth. For instance, Jung and Marshall (1985) applied Granger causality tests to data from 37 developing countries and found weak support for the ELG hypothesis. In a similar causality study by Chow (1987), he found strong bi-directional causal relationship between export growth and industrial growth in eight newly industrializing countries.

However, results from earlier studies using ordinary least squares regression and simple correlation coefficient tests have significant limitations as the correlations may be spurious because they failed to account for the data's dynamic time series properties (e.g. unit roots and cointegration). Also, the results are limited to showing only that exports growth and GDP growth are correlated, but could not provide information on the direction of causality. The issue of causality is dynamic in nature and is best examined using a dynamic time series modelling framework. Furthermore, the implicit assumption of same production function across different types of economies may be unrealistic as the level of technology may vary across countries.

Aided by recent advancements in time series modelling techniques (cointegration and error correction models), there has been an increase in country-specific studies focusing on the relationship between export performance and economic growth (Biswal and Dhawan, 1998; Richards, 2001; Awokuse, 2003, 2006). These more recent studies address the methodological issues of non-stationarity of variables and explicitly accounts for the existence of long-run cointegrating relationships by correctly applying error correction modelling (ECM) techniques. In general, empirical evidence from these studies of the ELG hypothesis has been mixed. While several of these studies have documented empirical evidence supporting the existence of a long-run relationship between exports and economic growth some others have rejected the ELG hypothesis.

In the context of Latin American economies, several earlier cross-sectional studies included these countries (Jung and Marshall, 1985; Ram, 1987). However, few recent country-specific studies have examined the relationship between exports and economic growth in Latin America using an augmented neoclassical production function and modern time series econometric techniques (Van den Berg and Schmidt, 1994; Richards, 2001). For example, Bahmani-Oskooee *et al*. (1991) applies bivariate Granger causality tests to examine the ELG hypothesis for 20 developing countries over 1951–1987 (annual data) and found that Peru's data supports the ELG hypothesis while a bi-directional causal relationship was found for the Dominican Republic and Paraguay. Van den Berg and Schmidt (1994) also investigated the ELG hypothesis for 16 Latin American countries and found cointegration in 11 of the 16 countries examined. Specifically, they found a positive and significant effect of exports on economic growth in Colombia and Peru, but no significant effect was found for Argentina. In another study involving 32 developing countries (including some from Latin America), Xu (1996) used bivariate Granger causality tests and error correction models to examine export and economic growth relationships. He found support for the ELG hypothesis in Colombia, but not for Argentina.

Riezman *et al*. (1996) investigated the ELG hypothesis for 126 countries. Using annual data over 1950–1990, they found 'that standard methods of detecting ELG using Granger causality tests may give misleading results if imports are not included in the system being analysed'. In bivariate causality analysis, the ELG hypothesis was confirmed for only 16 of the 126 countries and the number of cases increased to just 30 after controlling for imports. In the case of Latin American countries, they found support for the ELG hypothesis for only four countries (Costa Rica, Honduras, Suriname and Uruguay). No significant ELG evidence was found for the three countries in this current study (Argentina, Colombia and Peru). It would be interesting to examine if these results still hold for post-1990 Latin American data.

III. Analytical Framework and Methodological Issues

Early empirical formulations tried to capture the causal link between exports and GDP growth by incorporating exports into the aggregate production function (Balassa, 1978; Sheehey, 1992). This article expands on the growth equation by including other potentially relevant variables such as exports and imports. Accordingly, the aggregate production function is expressed as:

$$Y = F[(K, L); X, M] \tag{1}$$

where Y represents real GDP growth, K, L, X and M represent real gross capital, labour, real exports and real imports, respectively. The causal linkage between trade and output growth is a long-run behavioural relationship that requires estimation techniques appropriate for long-run equilibria. Hence, it is necessary to first test for cointegration, prior to Granger causality analysis.

Multivariate cointegration and error correction modelling

This section provides a brief discussion of the two methodological approaches adopted in this study. Since the cointegration and error correction methodology is fairly commonplace and well-documented elsewhere (Engle and Granger, 1987; Johansen and Juselius, 1990; Johansen, 1991), only a brief overview is provided here. Johansen and Juselius (1990) modelled time series as reduced rank regression in which they computed the maximum likelihood estimates in the multivariate cointegration model with Gaussian errors. The model is based on the error correction representation given by:

$$\Delta Z_t = \mu + \sum_{i=1}^{p-1} \Gamma_i \Delta Z_{t-k} + \Pi Z_{t-1} + \varepsilon_t \tag{2}$$

where Z_t is an (nx1) column vector of p variables, μ is an (nx1) vector of constant terms and Π represent coefficient matrices, Δ is a difference operator, k denotes the lag length and $\varepsilon_t \sim N(0,\sum)$. The coefficient matrix Π is known as the impact matrix, and it contains information about the long-run relationships.

After pre-testing to determine the order of integration for each of the variables under observation, Johansen's methodology requires the estimation of Equation 2 and the residuals are then used to compute two likelihood ratio test statistics: the trace test and maximal eigenvalue (λ-max) test. The trace test considers the hypothesis that the rank of Π is less than or equal to r cointegrating vectors (i.e. there are at most r cointegrating vectors), and it is expressed as:

$$\text{Trace} = -T \sum_{i=r+1}^{n} \ln(1 - \lambda_i) \tag{3}$$

Alternatively, the maximal eigenvalue test (λ-max) computes the null hypothesis that there are exactly r cointegrating vectors in the system and it is given by:

$$\lambda\text{-max} = -T \ln(1 - \lambda_r) \tag{4}$$

The distributions for these tests are not given by the usual chi-squared distributions. The asymptotic critical values for the two likelihood ratio tests are calculated via numerical simulations (Osterwald-Lenum, 1992). The null hypothesis is rejected when the estimated likelihood ratio tests statistic exceeds the critical values. Since each of the two tests have their strengths and limitations, it is preferable to make inference using both tests (Cheung and Lai, 1993, p. 326).

Granger causality and generalized impulse response analysis

According to Granger's representation theorem (Engle and Granger, 1987), a cointegrated system can be expressed and estimated as an ECM. The ECM framework is appealing because it allows for the determination of the direction of causation between exports, imports, and output growth while providing estimates on both short-run and long-run casual patterns. Cointegration provides information about long-run relationships among the variables while Granger causality tests provide information on short-run dynamics. Using the error-correction model (ECM) formulation in Equation 2, the coefficient matrix Π re-introduce the long-run information in the levels of the variables that is lost in first differencing, and thus provide an additional channel for detecting causal linkages. In addition, the standard Granger causality test could be performed by testing the joint significance of the coefficient matrix. Thus, in an ECM framework, there are two potential channels for testing causal relationships between exports, imports and economic growth.

However, it is well recognized that, like standard VAR, the individual coefficients of an ECM can be difficult to interpret. According to Lutkepohl and Reimers (1992), IRF can also be used to summarize the relationships between variables in a cointegrated system. As shown by Riezman *et al*. (1996), after the detection of causal patterns, the strength of the causal relationships could be investigated by analysis of forecast error variance decompositions (FEVD) and/or IRF. To ensure that the vector ECM innovations are not correlated contemporaneously, the generalized impulse response functions (GIRF), proposed by Koop *et al*. (1996) and Pesaran and Shin (1998), was used in this study to identify the structure of the VAR innovations.

This GIRF approach is preferable to the traditional application of Choleski or Bernanke (1986) factorization of the reduced form error covariance matrix. This is because the Choleski method is sensitive to the ordering of the variables when the residual covariance matrix is nondiagonal. Although the Bernanke factorization method is less restrictive than the Choleski method, it still requires the use of *a priori* knowledge from economic theory to achieve identification. Thus, these two identification schemes can be subjective and arbitrary, as theory does not always yield a clear identifying causal structure. In contrast, the GIRF approach is invariant to the alternative orderings of the variables in the VAR system. Koop *et al*. (1996) showed that GIRFs are unique and explicitly reflect the historical patterns of the observed correlation among the different shocks. Under the generalized VAR approach, ΔX_t is rewritten as the infinite moving average version of Equation 2, or

$$\Delta Z_t = \sum_{i=0}^{\infty} C_i \varepsilon_{t-i}, \quad t = 1, 2, \ldots, T \tag{5}$$

The (scaled) GIRF which measures the effect on ΔZ_{t+n} of the shock to the jth equation in Equation 2 can be specified as follows:

$$\psi_j(n) = \sigma_{jj}^{-1/2} C_n \sum e_j, \quad n = 0, 1, 2, \ldots \tag{6}$$

where σ_{jj} is jjth element in the variance-covariance matrix $\sum$, and e_j is $m \times 1$ vector with unity as its jth row and zeros elsewhere.

IV. Empirical Analysis and Results

Data and unit root properties

Data was obtained for three Latin American countries: Argentina, Colombia and Peru. The data set consists of observations for real GDP growth (GDP), real exports (Exports), real imports (Imports), gross capital formation as proxy for capital (Capital), and labour force (Labour). The data set, obtained from the International Monetary Fund database, is quarterly and covers the periods January 1993, April 2002 (for Argentina), January 1994, April 2002 (for Colombia) and January 1990, April 2002 (for Peru), respectively. All variables are in natural logarithms.

An important question pertinent to time series data is whether each variable is stationary in levels or stationary after first differencing. Classical regression via ordinary least squares estimation may yield spurious relationships and are therefore inappropriate if the series are nonstationary. Visual inspection of plots of the variables in levels suggests that the series are linearly trended implying that they are potentially nonstationary. However, additional formal unit root tests are needed for more concrete conclusions. The once common method of obtaining stationarity of the variable through first differencing is not recommended as this process fails to account for potential long-run information contained in the data (Engle and Granger, 1987). If the data series are stationary after first differencing, then it may be necessary to test for cointegration.

Two univariate unit root tests were examined for each of the variables. First, the augmented Dickey–Fuller (ADF, 1979) test for the null hypothesis of nonstationarity (unit roots) was applied. However, due to the well-known low power of ADF tests, the Kwiatkowski, Phillips, Schmidt and Shin (henceforth, KPSS) test, proposed by Kwiatkowski *et al.* (1992), was also used to test for the null hypothesis of stationarity. The combination of ADF and KPSS makes it possible to test for both the null hypotheses of nonstationarity and stationarity, respectively. This approach is very robust in determining the presence of unit roots. Table 1 presents the results for both the ADF and KPSS tests. Overall, the combination of the results from both the ADF and KPSS tests suggest that the variables are integrated of order one. This implies the possibility of cointegrating relationships among the variables.

Cointegrated VAR and Granger causality results

Table 2 provides the results for the Johansen trace and maximal eigenvalue (λ-max) tests for cointegration based on a VAR using an optimal lag length of two. Results from the trace test indicate that there are one, two, and two cointegrating vectors at the 5% significance level for Argentina, Colombia, and Peru, respectively. Similar evidence is provided by the maximal eigenvalue test suggesting the existence of cointegrating relationships among the variables for all three countries. The existence of cointegrating relationships implies that an ECM specification is appropriate. Furthermore, the residuals from the ECM specification are white noise. To examine the dynamic relationships between exports, imports and output growth, in Latin America, a five-variable quarterly ECM was estimated. First, Wald tests for Granger causality based on the vector ECM specification were performed. Then, GIRFs are generated from the VECM. The empirical findings from GIRFs are then compared with Granger causality test results.

Table 3 reports the results of Granger causality tests based on the error correction models. Each column represents an ECM equation for each of the five variables in the system. The Granger causality results are given as the *F*-statistics (probability in parentheses) for the joint significance of the lagged independent variables in the ECM equations. The last row contains the t-statistics for the error-correction terms. For each variable in the system, at least one channel of causality is active: either in the short-run through the joint tests of lagged-differences (*F*-statistics) or through a statistically significant lagged error-correction term (*t*-statistics). This latter channel is provided by the ECM specification. A significant lagged error correction term (ECT) coefficient implies that past equilibrium errors plays a role in determining current outcomes. The short-run dynamics are captured by the individual coefficients of the differenced terms. The results highlight the differences in the roles of exports and

Table 1. Tests for unit root

	Argentina		Columbia		Peru	
Variable	ADF	KPSS	ADF	KPSS	ADF	KPSS
Levels						
GDP	0.387	0.198**	−2.605	0.126*	−2.539	0.161**
Exports	−1.639	0.113	−0.412	0.779**	−0.515	0.852**
Capital	−0.279	0.193**	−2.205	0.110	−2.246	0.215**
Labour	−2.053	0.093	−1.700	0.169**	−0.920	0.147**
Imports	−2.702	0.186**	−3.394	0.166**	−3.008	0.217**
1st Differences						
GDP	3.395**	0.106	−4.505**	0.182	−4.480**	0.130
Exports	−6.643**	0.040	−3.616**	0.278	−10.139**	0.302
Capital	−3.065**	0.111	−5.944**	0.103	−3.301**	0.192
Labour	−6.190**	0.116	−5.951**	0.127	−2.453	0.209
Imports	−5.808**	0.236	−4.976**	0.172	−6.260**	0.146

Notes: ** and * denotes rejection of the null hypothesis of unit roots for ADF tests and KPSS tests at 5% and 10% significance levels.
Critical values at the 5% and 10% levels of significance for the ADF (with linear trend) are: −3.549 and −3.207, respectively and for KPSS (with linear trend) are: 0.146 and 0.119, respectively.

imports on economic growth for each of the three Latin American countries.

In the case of Argentina, the ELG hypothesis is not supported by the data as there is neither short-run nor long-run causation from exports to GDP growth. The lagged ECT coefficient estimates for Argentina are not statistically significant indicating the absence of a long-run relationship between exports and GDP growth. In contrast, the results support the hypothesis of short-run causality from imports to GDP growth at the 5% level of significance ($p = 0.0226$). Also, the reverse short-run causation from GDP growth to imports is also supported ($p = 0.0282$).

For Colombia, the lagged ECT parameter in the GDP equation (see column 1) is significant at the 5% level. The statistically significant error correction term indicate empirical evidence in support of long-run causal relationship from exports and imports to GDP growth. However, in the short-run, there is no Granger causality from exports to GDP growth ($p = 0.3921$). Interestingly, there is evidence supporting short-run Granger causality from imports to GDP growth in Colombia ($p = 0.0577$). This result highlights the relative importance of imports to economic growth both in the short-run and in the long-run. In addition, there is a reverse causal flow from GDP growth to imports both in the short-run ($p = 0.0000$) and in the long-run.

The results for Peru also suggest that imports are relatively more important than exports to GDP growth. Specifically, there is no Granger causality from exports to GDP growth, but there is causality from imports to GDP growth ($p = 0.0656$). This further emphasizes the lack of empirical support for the ELG hypothesis in all three countries. It is also notable to examine the individual equations for both exports and imports in order to investigate the nature of the interactions between both variables. The results show that Granger causality only goes from imports to exports in both Colombia and Peru (not vice versa). This is additional evidence of the importance of the inclusion of the import variable in ELG model specifications. Overall, Granger causality test results suggest that imports play a much more important role on economic growth in these countries than exports. So, for these three Latin American countries, import appears to be 'the engine of growth'.

Generalized impulse responses (GIRF)

Using the previously estimated VECM system in Equation 2, the causal analysis is extended by examining impulse response functions. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. Thus, GIRFs could provide more insight into how shocks to exports and imports affect economic growth (and vice versa). Figures 1–3 provide results for the GIRFs for Argentina, Colombia and Peru, respectively. For completeness, impulse responses are provided for each of the five variables in the system. However, emphasis is placed only on the relationships between

Table 2. Johansen cointegration test results

	Argentina	Columbia	Peru	
Cointegrating rank (r)	Trace statistics	Trace statistics	Trace statistics	C(5%)
$r = 0$	79.477**	85.245**	119.299**	69.819
$r \leq 1$	44.272	49.793**	51.564**	47.856
$r \leq 2$	23.826	22.956	24.057	29.797
$r \leq 3$	7.274	9.339	11.631	15.495
$r \leq 4$	2.267	3.672	2.308	3.841
	λ-max statistics	λ-max statistics	λ-max statistics	C(5%)
$r = 0$	35.206**	35.452**	67.734**	33.877
$r \leq 1$	20.446	26.838	27.508	27.584
$r \leq 2$	16.552	13.616	12.425	21.132
$r \leq 3$	5.007	5.667	9.323	14.265
$r \leq 4$	2.267	3.672	2.308	3.841

Notes: ** Denotes rejection of the null hypothesis of cointegration rank r at the 5% significance level. r denotes the number of cointegrating vectors for cointegration test with constant within and outside the cointegrating vectors. Johansen's cointegration test follows a sequential process for the determination of the number of cointegration vectors. We stop at the first r where we fail to reject the null hypothesis. The critical values (C(5%)) for the tests are taken from Osterwald-Lenum.

Table 3.. Granger causality test results based on error correction models (ECM)

Indep. variables	Dependent variables GDP	Exports	Capital	Labour	Imports
Argentina					
GDP	–	3.1704	1.0674	0.0936	7.1384
		(0.2049)	(0.5864)	(0.9543)	(0.0282)
Exports	2.4912	–	2.6516	0.1152	1.2182
	(0.2878)		(0.2656)	(0.9440)	(0.5438)
Capital	2.5842	4.3812	–	0.3781	9.2485
	(0.2747)	(0.1118)		(0.8278)	(0.0098)
Labour	1.6455	0.5827	0.9637	–	0.0355
	(0.4392)	(0.7472)	(0.6176)		(0.9824)
Imports	7.5821	1.9698	6.8497	0.2125	–
	(0.0226)	(0.3735)	(0.0326)	(0.8992)	
Lagged ECT	[−1.1570]	[0.3622]	[0.2579]	[−0.5492]	[1.4470]
Columbia					
GDP	–	1.3107	6.8496	0.3660	24.9273
		(0.5193)	(0.0326)	(0.8328)	(0.0000)
Exports	1.8722	–	1.2801	3.3344	0.1545
	(0.3921)		(0.5273)	(0.1888)	(0.9257)
Capital	13.9017	8.8822	–	1.8037	14.9213
	(0.0010)	(0.0118)		(0.4058)	(0.0006)
Labour	7.0089	7.4712	4.2729	–	7.2338
	(0.0301)	(0.0239)	(0.1181)		(0.0269)
Imports	5.7050	6.0423	0.2839	1.1783	–
	(0.0577)	(0.0487)	(0.8677)	(0.5548)	
Lagged ECT	[−2.2491]	[−3.0625]	[0.7478]	[−0.1243]	[−2.8616]
Peru					
GDP	–	0.2217	11.8745	0.2392	2.7812
		(0.8951)	(0.0026)	(0.8873)	(0.2489)
Exports	0.7933	–	2.2711	0.4927	0.4900
	(0.6726)		(0.3212)	(0.7817)	(0.7827)
Capital	11.2520	2.1768	–	0.5035	3.9912
	(0.0036)	(0.3368)		(0.7774)	(0.1359)
Labour	0.5146	1.5363	1.9532	–	0.6076
	(0.7731)	(0.4639)	(0.3766)		(0.7380)
Imports	5.4488	13.0971	4.9784	0.3210	–
	(0.0656)	(0.0014)	(0.0830)	(0.8517)	
Lagged ECT	[−0.3597]	[4.1509]	[−1.5816]	[1.9378]	[0.4463]

Notes: Figures in final row are estimated t-statistics for each cointegration equation. All other values are asymptotic Granger causality F-tests, values in parentheses are p-values.

the variables of interest in the study: exports, imports and GDP growth. The simulation in the GIRF covers 20 quarters in order to reflect a typical business cycle and ensure adequate time for tracing the effect of the shocks to variables in the system.

Figure 1 shows the impulse responses of each variable to innovations from each of the other variables for Argentina. In the first panel containing the response of GDP, a positive shock to real exports resulted in an initial ‘small’ negative, response from GDP growth which became positive after four quarters. In contrast, the response of GDP growth to a shock in imports is relatively larger and positive throughout. In order to check for reverse causality from GDP to exports and imports, the responses of exports and imports are reported in the second and third panels, respectively. The results indicate that exports responded negatively to a positive shock in GDP growth while imports had a positive response (see Fig. 1, Panels 2 and 3). In Argentina, although there is some support for ELG at longer horizon, the effect of imports on growth appears to be much stronger. This finding reinforces the results from the Granger causality analysis which provided support for the ILG argument.

Figure 2 presents the results from impulse response analysis for Colombia. First, there is no evidence in support of ELG as the response of real GDP growth

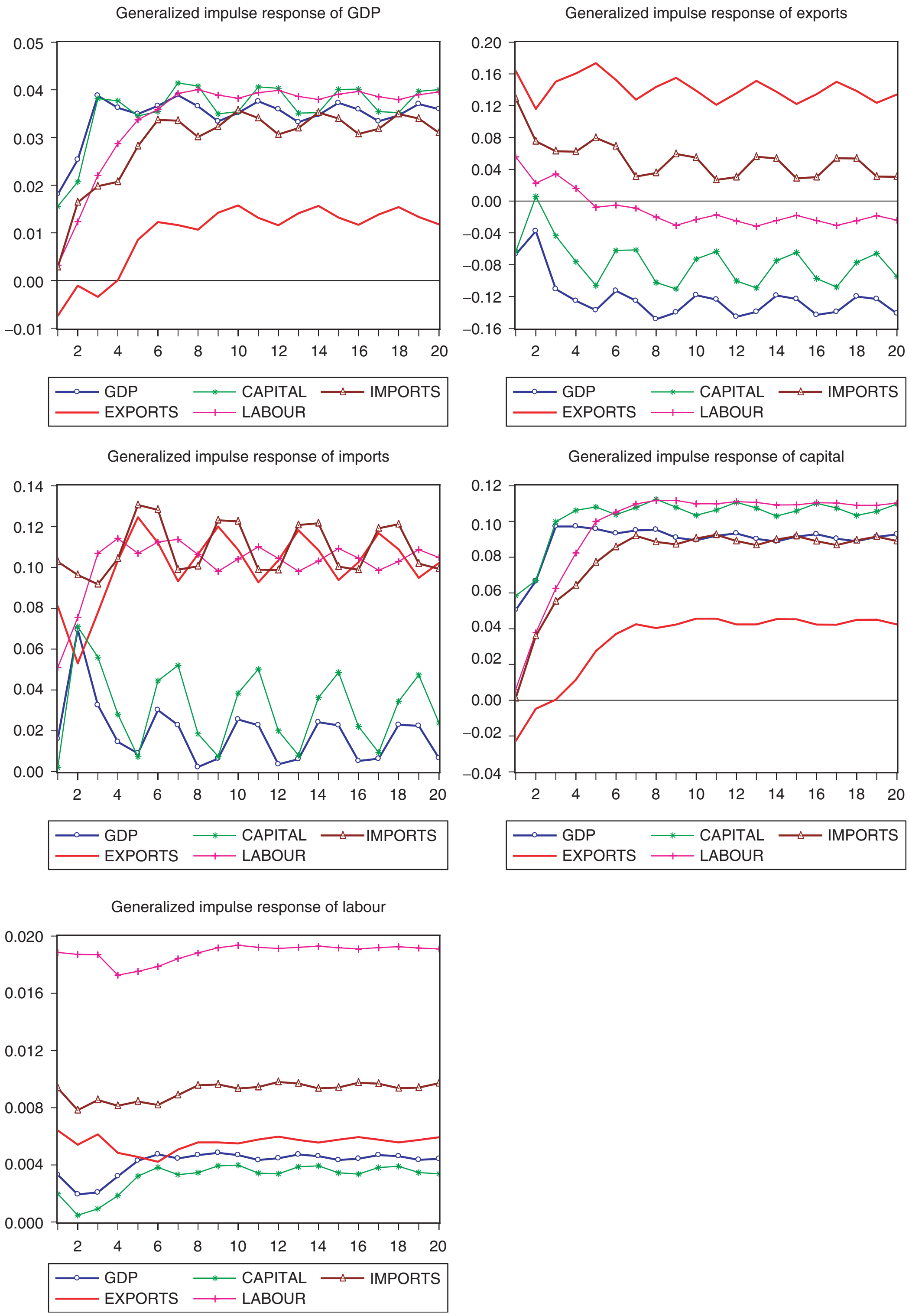

Fig. 1. Generalized impulse responses to one SE shock in ECMs for Argentina

to innovations in real exports is not significantly different from zero at all horizons. In contrast, the evidence appears to confirm ILG as a shock to imports has a positive and significant effect on output growth. Once again, there is feedback causal effects from GDP growth to trade as both exports and imports respond positively to innovations in output growth. This result is consistent with our earlier findings from Granger causality tests which provided evidence supporting ILG and further highlights the

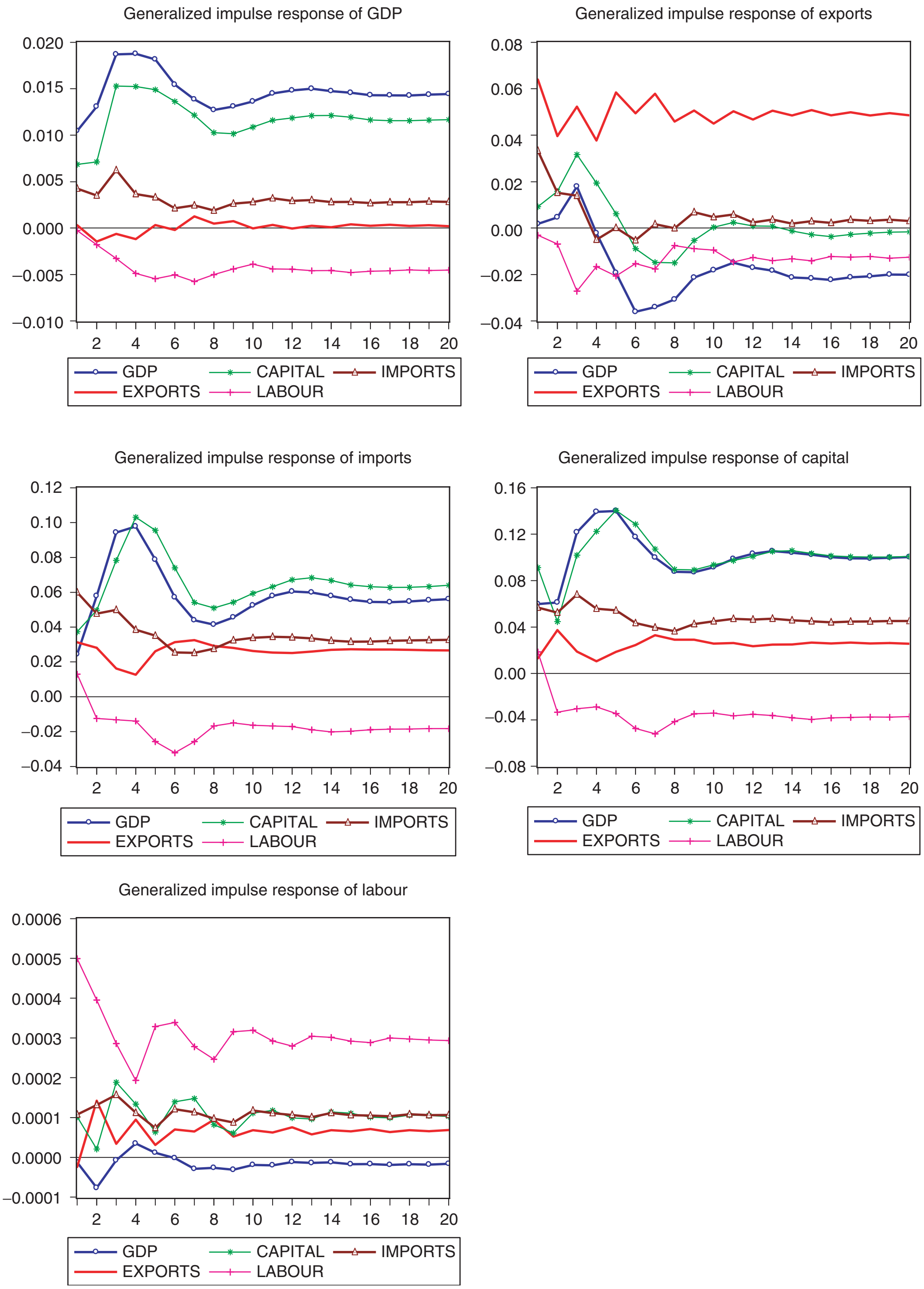

Fig. 2. Generalized impulse responses to one SE shock in ECMs for Colombia

insignificant role of exports in Colombia's economic growth.

Figure 3 reports the impulse response results for Peru. The results show that a one SD positive shock in real exports elicits a persistently positive response from real GDP growth. Although a bit smaller, real GDP response to a positive shock to imports is also significantly positive. Thus, in the case of Peru, there is empirical evidence in support for both the ELG and ILG hypotheses. As indicated before, output growth also has a positive and significant impact on both exports and imports.

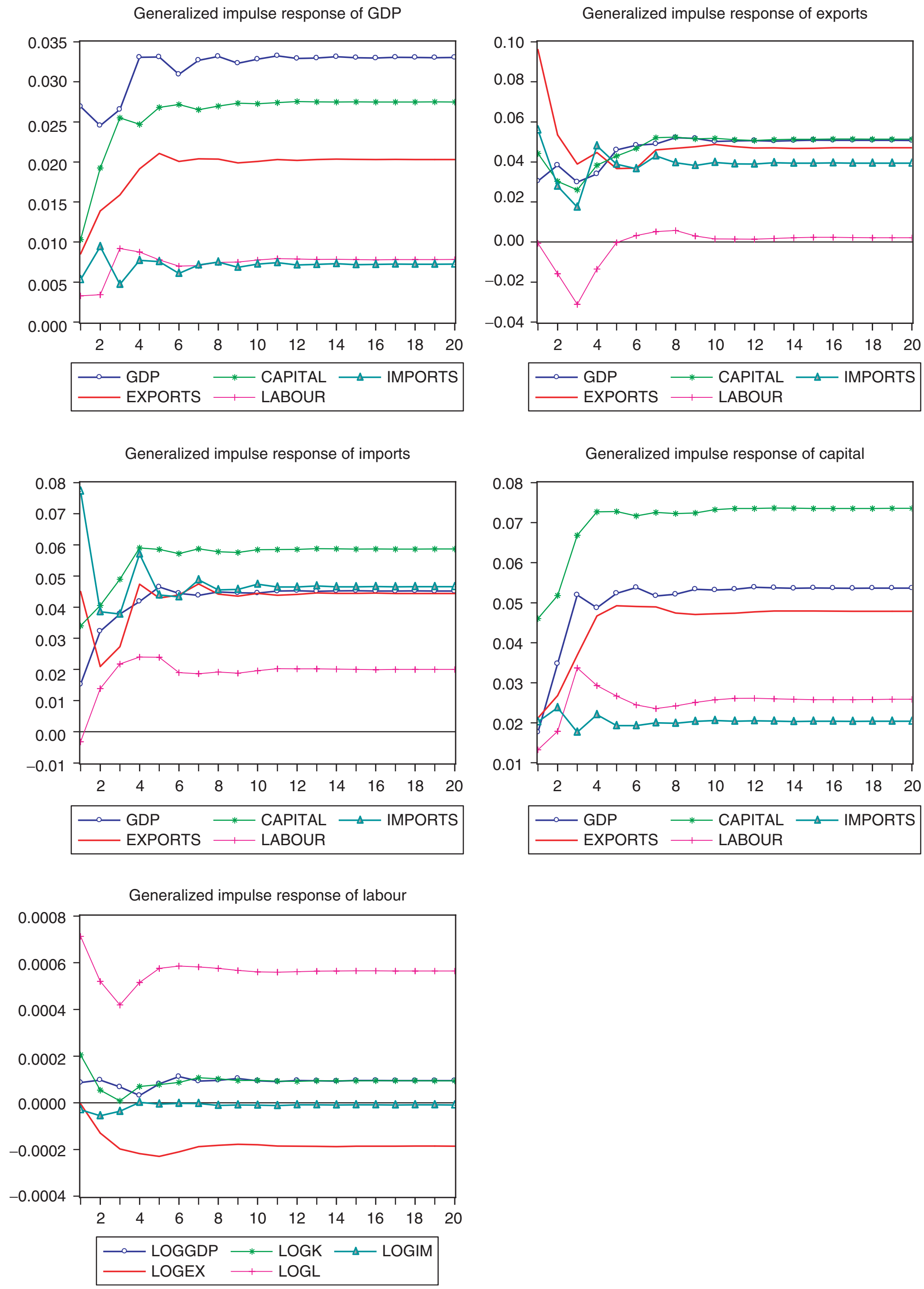

Fig. 3. Generalized impulse responses to one SE shock in ECMs for Peru

Overall, the Granger causality test results confirm the significance of the contribution of imports to economic growth and provide no empirical support for the ELG hypotheses. In addition, the extension of the analyses to include impulse response analysis indicates that at longer horizons, exports also play some role in stimulating economic growth. However, the totality of the results points to the very important role of imports in driving economic growth in Latin America. This current finding of significant causal effects from imports to economic growth is consistent with earlier results found by

Thangavelu and Rajaguru (2004) which also showed significant causal flow from imports to labour productivity for several developing Asian economies.

V. Concluding Remarks

In recent years, there has been much attention devoted to the role of international trade as an engine of growth. Economic theory suggests that both the export and import sectors can contribute to economic growth. However, most previous investigations have only focused on the role of the export sector while ignoring the potential growth-enhancing contribution of the import sector. This article contributes to this literature by using a neoclassical growth modelling framework and multivariate cointegrated VAR methods to investigate the contribution of both exports and imports to economic growth in selected Latin American countries (Argentina, Colombia and Peru).

The analysis focused on the dynamic causal relationship between real GDP growth, real exports, real imports, gross capital formation as proxy for capital, and the labour force. Given the results from two unit root tests, the Johansen's multivariate cointegration test was estimated and the results suggest the existence of a long-run equilibrium relationship between the variables in the system for all three countries. Following Toda and Philips (1993), Granger causality tests within an ECM framework was employed to investigate the ELG and ILG hypotheses. Then, to complement the Granger causality tests, impulse response function analysis was also conducted.

In the Granger causality testing framework, the results show that the ELG hypothesis could not be supported in any of the three countries. In contrast, the study found empirical evidence in support of a bi-directional causal relationship between imports and GDP growth for Argentina and Colombia. Furthermore, there is also evidence in support of the ILG hypothesis for Peru. Empirical results from the impulse response analysis further confirm the important role of imports in stimulating Latin American economic growth. However, the impulse responses also provide some support for the ELG hypothesis for Argentina and Peru. Another important finding in this study is the strong empirical evidence in support of growth-driven exports and imports for each of the three countries.

In summary, this study's results confirm that the exclusion of imports and the singular focus of many past studies on just the role of exports as the engine of growth may be misleading or at best incomplete. Current empirical evidence from selected Latin American countries provides empirical support for both ELG and ILG hypothesis. In some cases, there is also evidence for reverse causality from GDP growth to exports and imports. Overall, this study shows that the strength of the effect of imports on growth is relatively stronger than the effect of exports. Thus, it is reasonable to conclude that for several Latin American countries both exports and imports play a very important role in stimulating economic growth.

There are several policy implications of this finding for Latin America and other developing countries. First, export promotion as a strategy for economic growth would only be partially effective if import restrictions are maintained. Second, import openness is very important to economic growth as it complements the role of exports by serving as a supply of intermediate production inputs needed in the export sector. Third, developing economies with limited technological endowment could benefit from access to foreign technology and knowledge from developed countries via imports (Grossman and Helpman, 1991; Coe and Helpman, 1995). As evident from the experiences of large developing countries that adopted the import-substitution growth strategy, large scale import restrictions can be a constraint to economic growth. Finally, it is recommended that future empirical research focusing on the impact of trade liberalization should explicitly account for the role of imports in stimulating economic growth. It may be useful to extend the analytical framework used in this study to other developing countries.

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References

Awokuse, T. O. (2003) Is the export-led growth hypothesis valid for Canada?, *Canadian Journal of Economics*, **36**, 126–36.

Awokuse, T. O. (2006) Export-led growth and the Japanese economy: evidence from VAR and directed acyclic graphs, *Applied Economics*, **38**, 593–602.

Bahmani-Oskooee, M. and Niroomand, F. (1999) Openness and economic growth: an empirical investigation, *Applied Economics Letters*, **6**, 557–61.

Bahmani-Oskooee, M., Mohtadi, H. and Shabsigh, G. (1991) Exports, growth and causality in LDCs: a re-examination, *Journal of Development Economics*, **36**, 405–15.

Balassa, B. (1978) Exports and economic growth: further evidence, *Journal of Development Economics*, **5**, 181–9.

Bhagwati, J. (1978) *Anatomy and Consequences of Exchange Control Regimes: Liberalization Attempts and Consequences*, Ballinger Publishing, Cambridge, MA.

Bernanke, B. (1986) Alternative explanations of the money-income correlation, *Carnegie-Rochester Conference Series on Public Policy*, **25**, 49–100.

Biswal, B. and Dhawan, U. (1998) Export-led growth hypothesis: cointegration and causality analysis for Taiwan, *Applied Economics Letters*, **5**, 699–701.

Cheung, Y. W. and Lai, K. S. (1993) Finite-sample sizes of Johansen's likelihood ratio tests for cointegration, *Oxford Bulletin of Economic and Statistics*, **55**, 313–28.

Chow, P. C. Y. (1987) Causality between export growth and industrial development: empirical evidence from newly industrialized countries, *Journal of Development Economics*, **28**, 265–76.

Coe, T. and Helpman, E. (1995) International R&D spillovers, *European Economic Review*, **39**, 859–87.

Dar, A. and Amirkhalkhali, S. (2003) On the impact of trade openness on growth: further evidence from OECD countries, *Applied Economics*, **35**, 1761–6.

Dickey, D. A. and Fuller, W. A. (1979) Distribution of the estimators for autoregressive time series with a unit root, *Journal of the American Statistical Association*, **74**, 427–31.

Engle, R. F. and Granger, C. W. J. (1987) Cointegration and error correction: represent estimation, and testing, *Econometrica*, **55**, 251–76.

Edwards, S. (1998) Openness, productivity and growth: what do we really know?, *Economic Journal*, **108**, 383–98.

Esfahani, S. H. (1991) Exports, imports, and economic growth in semi-industrial countries, *Journal of Development Economics*, **35**, 93–116.

Ghartey, E. E. (1993) Causal relationship between exports and economic-growth – some empirical evidence in Taiwan, Japan and the United States, *Applied Economics*, **25**, 1145–52.

Giles, J. A. and Williams, C. L. (2000) Export-led growth: a survey of the empirical literature and some non-causality results, Part 1, *Journal of International Trade and Economic Development*, **9**, 261–337.

Grossman, G. and Helpman, E. (1991) *Innovation and Growth in the Global Economy*, MIT Press, Cambridge, MA.

Helpman, E. and Krugman, P. (1985) *Market Structure and Foreign Trade*, MIT Press, Cambridge, MA.

Johansen, S. (1991) Estimation and hypothesis test of cointegrating vectors in Gaussian vector autoregressive models, *Econometrica*, **59**, 1551–80.

Johansen, S. and Juselius, K. (1990) Maximum likelihood estimation and inference on cointegration with applications for the demand for money, *Oxford Bulletin of Economics and Statistics*, **52**, 169–210.

Jung, S. W. and Marshall, P. J. (1985) Exports, growth and causality in developing countries, *Journal of Development Economics*, **18**, 1–12.

Koop, G., Pesaran, M. H. and Potter, S. M. (1996) Impulse response analysis in nonlinear multivariate models, *Journal of Econometrics*, **74**, 119–47.

Kwiatkowski, D., Phillips, P. C. B., Schmidt, P. and Shin, Y. C. (1992) Testing the null hypothesis of stationarity against the alternative of a unit-root – how sure are we that economic time-series have a unit-root, *Journal of Econometrics*, **54**, 159–78.

Lawrence, R. Z. and Weinstein, D. E. (1999) Trade and growth: import-led or export-led? Evidence from Japan and Korea. NBER Working Paper No. 7264.

Lutkepohl, H. and Reimers, H. E. (1992) Impulse response analysis of cointegrated systems, *Journal of Economic Dynamics and Control*, **16**, 53–78.

Mazumdar, J. (2002) Imported machinery and growth in LDCs, *Journal of Development Economics*, **65**, 209–24.

Osterwald-Lenum, M. (1992) A note with quantiles of the asymptotic distribution of the maximum likelihood cointegration rank test statistics, *Oxford Bulletin of Economics and Statistics*, **54**, 461–72.

Pesaran, H. H. and Shin, Y. (1998) Generalized impulse response analysis in linear multivariate models, *Economics Letters*, **58**, 17–29.

Ram, R. (1987) Exports and economic growth in developing countries, *Economic Development and Cultural Change*, **36**, 51–72.

Richards, D. G. (2001) Exports as a determinant of long-run growth in Paraguay, 1966-96, *Journal of Development Studies*, **38**, 128–46.

Riezman, R. G., Summers, P. M. and Whiteman, C. H. (1996) The engine of growth or its handmaiden? A time series assessment of export-led growth, *Empirical Economics*, **21**, 77–113.

Sharma, S. C., Norris, N. M. and Chung, D. W. (1991) Exports and economic growth in industrialized countries, *Applied Economics*, **23**, 697–707.

Sheehey, E. J. (1992) Exports and growth: additional evidence, *Journal of Development Studies*, **28**, 730–34.

Thangavelu, S. M. and Gulasekaran, R. (2004) Is there an export or import-led productivity growth in rapidly developing Asian countries? A multivariate VAR analysis, *Applied Economics*, **36**, 1083–93.

Toda, H. Y. and Phillips, P. C. B. (1993) Vector autoregression and causality, *Econometrica*, **63**, 1367–93.

Van den Berg, H. and Schmidt, J. R. (1994) Foreign trade and economic growth: time series evidence from Latin America, *Journal of International Trade and Economic Development*, **3**, 121–30.

Xu, Z. (1996) On the causality between export growth and GDP growth: an empirical re-investigation, *Review of International Economics*, **4**, 172–84.