Export Led Growth Hypothesis Revisited: A Panel Cointegration Approach

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Abstract

Numerous studies in the literature have tried to test whether export growth causes economic growth or economic growth causes export growth. The statistical approach has been one of applying Granger or Sims causality tests to data drawn from an individual country. In order to increase the power of existing tests, in this paper, we pool data from 61 developing countries over 1960-99 period and employ panel unit root tests and panel cointegration technique to establish the long-run relation between exports and output. Cointegration receives support in a model in which export is the dependent variable.

Keywords: Expert growth, Granger causality test, Cointegration.

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I. Introduction

Policy makers in many developing countries are puzzled whether they should concentrate on formulating policies that are designed to be export-promotion oriented or import-substitution oriented. If export growth could contribute to economic growth, the former policies are advocated. However, if economic growth causes export growth, then the latter is advocated. Of course economic theory supports both views that there could be bi-directional causality between export growth and economic growth. An increase in exports is said to result in an increase in domestic output via the so called multiplier effect. On the other hand, an increase in production could result in a decrease in costs due to realization of economies of scale. Decreased costs in turn, could stimulate exports.

Empirical studies investigating the relation between export growth and economic growth are inconclusive at best. These studies could be classified into fourth groups. The first group includes studies that use cross-sectional data. The list includes Kravis (1970), Michalopoulos and Jay (1973), Voivodas (1973), Michaely (1977), Balassa (1978a, 1978b, 1985), Heller and Porter (1978), Tyler (1981), Feder (1983), and Kavoussi (1984). In general, these studies provide support for the positive relation between export growth and economic growth. However, they fail to detect any causality from one variable to the other due to the nature of data. The second group includes studies that use time-series data but standard estimation technique such as ordinary least square. The list includes Ram (1987), Salvatore and Hatcher (1991) and Sengupta (1993). Like cross-sectional studies in the first group, these studies do not test direction of causality from one variable to another. The third group includes studies that actually employ the concept of Granger's (1969) or Sim's (1972) causality using time-series data. The list in this group includes Jung and Marshall (1985), Chow (1987), Ahmad and Kwan (1991), Bahmani-Oskooee et al. (1991), Hutchison and Singh (1992) and Dodaro (1993). In general, these studies have failed to provide strong support for either export led growth or growth led exports hypothesis.

Since introduction of cointegration and error-correction modeling by Engle and Granger (1987), the emphasis has shifted to establishing integrating properties of export and output and the cointegrating properties of their long-run relationship. Studies that use cointegration and error-correction modeling techniques constitute the fourth group. The list in this group includes only a limited number of studies. They are: Bahmani-Oskooee and Alse (1993), Kugler and Dridi (1993), Van Den Berg and Schmidt (1994), and Ahmad and Harnhirun (1995). These studies provide some support for bi-directional causality

Since for developing countries the real GDP data comes out in an annual frequency beginning with 1960, forty some annual observations may not be enough to investigate the relation between exports and output. Furthermore, due to low frequency data many of the recent tests may not have enough power to support one hypothesis over another. An alternative approach would be to increase the number of observations by pooling time-series data across as many countries as possible. Therefore, in this paper we try to establish the long-run relationship between exports and output using annual data over 1960-99 period from 62 developing countries. The method is based on recent advances in panel unit root testing and panel cointegration. To this end, in Section II we first outline a simple model from the literature and discuss panel unit root test and panel cointegration techniques. Section III reports the empirical results. Finally Section IV concludes. Data definition and sources are cited in an appendix.

II. The Model

Although many of the earlier studies concentrated only on the relation between export growth and economic growth, in this paper we incorporate the relevance of other factors. Following Solow's (1957) growth model we assume that output (Y) depends upon factors of production, labor (L) and Capital (K) as outlined by equation (1):

$$Y = f\,(L, K), \qquad (1)$$

Following the literature we add exports (X) and imports (M) to equation (1) as other determinants of output. Although, we recognize that exports and imports are not proper arguments of the production function in that they are not production inputs in the neoclassical sense, they do influence a country's productivity. Indeed, imports may include raw materials as well as capital goods (inclusive of technology) that are used in production process. Adding X and M as other determinants of Y, equation (1) is rewritten as (2):

$$Y = f\,(L, K, X, M), \qquad (2)$$

A log linear version of equation (2) will be used in analysis.

III. The Methods and Results

In trying to establish the long-run relationship among the variables of equation (2), we use annual data from 62 developing countries over 1960-99 period.[1] Since the model uses panel data, in order to avoid spurious results obviously we must establish the integrating properties of each variables using panel unit root tests and the cointegrating properties of the relationship among all variables using panel cointegration tests.

Panel unit root tests have been developed on the same principles that underlie the conventional ADF test. While a test by Levin and Lin (1992) allows for heterogeneity of the intercepts across members of the panel, the one by Im, Pesaran, and Shin (1997) allows for heterogeneity in intercepts as well as in the slope coefficients. The Im, Pesaran, and Shin test is based on the following equation:

[1] *The list includes: Algeria, Argentina, Bangladesh, Benin, Bolivia, Burkina Faso, Burundi, Brazil, Cameroon, Chile, China (mainland), Colombia, Congo, Costa Rica, Cote d' Ivoire, Dominican Republic, Ecuador, Egypt, El Salvador, Gabon, Gambia, Ghana, Guatemala, Guinea Bisu, Guyana, Haiti, Honduras, Hungary, India, Indonesia, Israel, Jamaica, Kenya, Korea, Lesotho, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Morocco, Nicaragua, Niger, Nigeria, Pakistan, Papua New Guinea, Paraguay, Peru, Philippines, Rwanda, Senegal, South Africa, Sri Lanka, Swaziland, Thailand, Tongo, Trinidad & Tobago, Tunisia, Uruguay, and Zambia.*

$$\Delta y_{it} = \mu_i + \beta_i y_{i,t-1} + \sum_{k=1}^{p_i} \theta_{i,k} \Delta y_{i,t-k} + \gamma_i t + \varepsilon_{it} \qquad (3)$$

where i = 1, 2, …,N and t = 1,2,…,T.

The null hypothesis is $\beta_i = 0$, for all i's, while the alternative hypothesis is $\beta_i < 0$. The Im, Pesaran, and Shin statistic is, in principle, an average of the individual ADF statistics computed as:

$$\bar{t} = \frac{1}{N} \sum_{i=1}^{N} \frac{\hat{\beta}_i}{\hat{\sigma}_{\hat{\beta}_i}} \qquad (4)$$

In a further step, the above t-bar statistic is standardized so that it converges to a standard normal distribution, as N grows very large. The computation of this type of statistic as well as the determination of the order of integration for each variable completes the first phase of testing for cointegration.

In testing for panel cointegration we follow Pedroni (1995, 1997) and test for cointegration of homogeneous and heterogeneous panels with *multiple* regressors.

Following Pedroni (1999), consider the following model:

$$y_{it} = \alpha_i + \beta_i t + \gamma_{1i} x_{1i,t} + \gamma_{2i} x_{2i,t} + \ldots + \gamma_{Mi} x_{Mi,t} + e_{i,t} \qquad (5)$$

for i = 1, 2, …,N cross-sections; t = 1,2,…,T observations; and m = 1,2,…,M regressors.

In the above equation, α_i represents the fixed effect or the individual-specific effect that is allowed to vary across individual cross-sectional units. At the same time, the slope coefficients γ_{mi} and the time effect β_i are modeled heterogeneously just like the intercept terms. The two statistics developed by Pedroni that are adopted in this study, differ in that the first is considered to be a within-dimension statistic or panel t-statistic, while the second is a between-dimension statistic or group t-statistic. Their labels are based on the way the autoregressive coefficients are manipulated to arrive at the final statistic. While the panel-t is constructed from estimators that pool the autoregressive coefficient across different individuals for unit root tests on the estimated residuals, the group-t is built on estimators that merely average the individually estimated coefficients for each *i*.

In constructing these statistics we need to take the following steps:

1- Upon the inclusion of all appropriate fixed effects, time trends, or common time dummies, compute the residuals $\hat{e}_{i,t}$ from the panel regression (4).

2- Compute the residuals $\hat{c}_{i,t}$ of the following differenced regression:

$$\Delta y_{it} = b_{1i}\Delta x_{1i,t} + b_{2i}\Delta x_{2i,t} + \ldots + b_{Mi}\Delta x_{Mi,t} + c_{i,t}$$

3- Compute $\hat{L}^2_{11i}$, , representing the long run variance of $\hat{c}_{i,t}$ as follows:

$$\hat{L}^2_{11i} = \frac{1}{T}\sum_{t=1}^{T}\hat{c}^2_{i,t} + \frac{2}{T}\sum_{s=1}^{k_i}\left(1-\frac{s}{k_i+1}\right)\sum_{t=s+1}^{T}\hat{c}_{i,t}\hat{c}_{i,t-s}$$

4- Save the residuals of the ADF test for $\hat{e}_{i,t}$ as $\hat{u}_{i,t}$ and compute the following variances for these residuals:

$$\hat{s}^2_i = \frac{1}{T}\sum_{t=1}^{T}\hat{u}^2_{i,t} \quad \text{and} \quad \tilde{s}^2_{N,T} = \frac{1}{N}\sum_{t=1}^{T}\hat{s}^2_i$$

As a last step, construct the final statistics:

$$Panel-t = \left[\hat{s}^2_{N,T}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}^{-2}_{11i}\hat{e}^2_{i,t-1}\right]^{-1/2}\sum_{i=1}^{N}\sum_{t=1}^{T}\hat{L}^{-2}_{11i}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}$$

$$Group-t = N^{-1/2}\sum_{i=1}^{N}\left[\sum_{t=1}^{T}\hat{s}^2_i\hat{e}^2_{i,t-1}\right]^{-1/2}\sum_{t=1}^{T}\hat{e}_{i,t-1}\Delta\hat{e}_{i,t}$$

The above two statistics are standardized as: $\frac{\chi_{N,T} - \mu\sqrt{N}}{\nu} \Rightarrow N(0,1)$ where $\chi_{N,T}$ represents either of the above two statistics, while μ and ν are respectively mean and variance adjustment terms.[2]

The null of no cointegration is then tested based on the standard normal statistic just described. Under the alternative hypothesis, these two statistics diverge to negative infinity. Hence the left tail of the normal distribution is employed to reject the null. More details about the critical values or the approximate standardization can be found in Pedroni (1999).

Table 1 reports the results of panel unit root tests. It is clear from Table 1 that no matter which test we consider, the calculated ADF statistic for each variable is greater than the critical value of –1.96 from the standard t-table. Therefore, the null hypothesis of non-stationarity cannot be rejected.

Table 1: Panel Unit Root Test Results

Variable	Levin Lin ADF	Im, Pesaran and Shin ADF
Ln Y	4.11	4.09
Ln X	4.78	3.45
Ln L	7.86	9.22
Ln K	0.94	-1.27
Ln M	2.98	1.88

Now that we have established that all variables are non-stationary, what remains to be done is to estimate the panel t and group t statistics for the stationarity of the residuals in the OLS regression of one variable on the others. To determine whether the results are sensitive to the

2 *For a more intuitive explanation of the approach see Bahmani-Oskooee and Miteza (2002).*

lag order in the ADF test, we carry out the analysis for different order of lags. Table 2 reports the results.

Table 2: Panel Cointegration Test Results.

	Panel t				Group t			
Dependent Variable 2 Lag	1 Lag	2 Lag	3 Lags	4 Lag	1 Lag	2 Lags	3 Lags	4 Lags
Ln X	-4.12	-3.88	-3.42	-2.89	-6.48	-6.40	-5.65	-4.92
Ln Y	-0.03	0.38	0.41	-0.26	-0.26	0.38	0.08	-0.31
Ln L	1.59	2.05	0.98	1.21	2.63	3.15	2.60	2.61
Ln K	-6.38	-6.21	-5.52	-5.18	-8.26	-7.84	-7.07	-6.70
Ln M	-3.79	-3.23	-2.45	-3.22	-7.39	-6.71	-5.41	-5.47

From Table 2 we gather that when export, i.e., Ln X is the dependent variable, regardless of number of lags, our estimated Panel t and Group t statistics are much less than the critical value of -1.96 at the usual 5% level, indicating stationary residuals in the regression of Ln X on all other variables or cointegration among all variables. However, when output (Ln Y) is the dependent variable, exactly opposite holds. Thus, we may conclude that in order to export more, developing countries must aim at policies that promote economic growth. Note that cointegration is also supported when Ln K or Ln M are dependent variable. This implies that policies that are oriented toward stimulating economic growth will also support capital formation as well as higher imports.

IV. Summary and Conclusion

Numerous studies in the literature have tried to test whether export growth contributes to economic growth or the relation is other way around. There are basically three groups of studies that address this issue. Early studies relied upon cross-sectional data and avoided to account for country specific factors. To remove this short coming, the second group concentrates on an individual country and use time-series data and ordinary least square technique. With the existing literature on the evidence of unit roots in time series data, the finding of this group could be considered spurious. To overcome the spurious regression problem, the third group use stationary time-series data from an individual country and Granger or Sims causality tests to establish the direction of causation in the short-run.

No matter which group we consider, the results are mixed and in most instances do not provide strong support for the relation between export growth and economic growth in developing countries. One source of the problem we conjecture to be the short span of data on real GDP figures in developing countries. To increase the number of observations, thus the power of existing tests, in this paper we employ panel data from 61 developing countries over 1960-99 period and panel cointegration technique. The results show that when export is used as dependent variable in the regression analysis, there is evidence of cointegration, thus, a long-run relationship among the variables of the model. However, cointegration disappears when output is used as dependent variable. The implication is that growth oriented policies should boost also exports in the long run.

Appendix
Sources and Definitions of the Variables

Sources:

All data are annual over the period 1960 – 1999• and collected from World Development Indicators (WDI, 2001) by the World Bank.

Y, Gross Domestic Product in Constant 1995 US $.

K, Gross Capital Formation in Constant 1995 US $.

L, Total Labor Force in Thousands.

X, Exports of Goods and Services in Constant 1995 US $.

M, Imports of Goods and Services in Constant 1995 US $.

Definitions:

1. Series: GDP (constant 1995 US$) (NY.GDP.MKTP.KD)

GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant 1995 U.S. dollars. Dollar figures for GDP are converted from domestic currencies using 1995 official exchange rates. For a few countries where the official exchange rate does not reflect the rate effectively applied to actual foreign exchange transactions, an alternative conversion factor is used. For more information, see WDI table 4.1.

• except for the following 11 countries: Burkina Faso: 1965-1999; The Gambia: 1966-1999; Guinea Bisu: 1970-1999; Mali: 1967-1999; Morocco: 1965-1999; Swaziland: 1970-1999; Tunisia: 1961-1999; China (mainland): 1970-1999; India: 1970-1999; Papua New Guinea: 1961-1999, Hungary: 1970-1999

2. Series: Exports of goods and services (constant 1995 US$) (NE.EXP.GNFS.KD)

Exports of goods and services represent the value of all goods and other market services provided to the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude labor and property income (formerly called factor services) as well as transfer payments. Data are in constant 1995 U.S. dollars. For more information, see WDI table 4.10.

3. Series: Imports of goods and services (constant 1995 US$) (NE.IMP.GNFS.KD)

Imports of goods and services represent the value of all goods and other market services received from the rest of the world. They include the value of merchandise, freight, insurance, transport, travel, royalties, license fees, and other services, such as communication, construction, financial, information, business, personal, and government services. They exclude labor and property income (formerly called factor services) as well as transfer payments. Data are in constant 1995 U.S. dollars. For more information, see WDI table 4.10.

4. Series: Gross capital formation (constant 1995 US$) (NE.GDI.TOTL.KD)

Gross capital formation (gross domestic investment) consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and “work in progress.” According to the 1993 SNA, net acquisitions of valuables are also considered capital formation. Data are in constant 1995 U.S. dollars. For more information, see WDI table 4.10.

5. Series: Labor force, total (SL.TLF.TOTL.IN)

Total labor force comprises people who meet the International Labor Organization definition of the economically active population: all people who supply labor for the production of goods and services during a specified period. It includes both the employed and the unemployed. While national practices vary in the treatment of such groups as the armed forces and seasonal or part-time workers, in general the labor force includes the armed forces, the unemployed, and first-time job-seekers, but excludes homemakers and other unpaid caregivers and workers in the informal sector. For more information, see WDI table 2.2.

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