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Documento de Trabajo

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1997



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EXPORTS AND ECONOMIC GROWTH:

THE ROLE OF COINTEGRATION AND ECONOMIC STRATEGY.

THE CHILEAN CASE.

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Abstract

Many studies try to test the exports cause growth hypothesis, with very mixed results. In this paper, I argue that one should not expect an unambiguous answer to the question, because the relationship is conditional on economic policy. I show that in Chile, where others have found no causation, that exports do Granger-cause growth one the sample is limited to the post-reform era and proper techniques are employed.

Classification code: 110, 420.

Key words: exports, growth, Granger- causality, cointegration, economic strategy.

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1. INTRODUCTION.*

The impact of exports on economic growth has occupied an important place in the debates on economic policy in the last decades. Theory predicts that exports have a positive impact on economic growth through different mechanisms (Balassa, 1978; Chenery and Strout, 1966; Grossman and Helpman, 1991; Helpman and Krugman, 1985; Krueger, 1980). One prominent approach to the evaluation of this link has involved the use of time series analysis¹, however the studies of developing countries have produced mixed results.

In this paper, I argue that one should not expect an unambiguous empirical answer, because the relationship is conditional on economic policy. Countries do not follow the same economic strategy, and they have changed their strategies at different points of the time². Therefore, time series should reflect these differences. On one hand, if a country follows an inward-looking strategy, exports should not have a positive impact on economic growth, because the policy is adopted to disconnect the growth path from the shocks in the world market. On the other hand, if a country adopts an outward-oriented strategy, exports should increase economic growth, because policy is linking the country's growth rate to the world market evolution. I show that in Chile, where others have found no causation, that exports do Granger-cause growth once the sample is limited to the post-reform era and proper techniques are used.

This paper is structured as follows. In the rest of this section I review the recent literature, focusing on the results obtained and the empirical technique employed. In section 2, I describe econometric technique and data employed. Section 3 presents unit root and cointegration tests results. Section 4 contains causality test results. Finally, summary and final comments are in Section 5.

Many studies try to identify the relationship between GDP and exports, but they do not consider the change of economic strategy. Jung and Marshall (1985) summarize pre-1983 empirical work. Those studies basically find that exports increase GDP. Studies done at the end of 1960s and early 1970s use simple OLS (GDP on exports) to test this relationship. In the 1970s and early 1980s, due to awareness about stationarity requirements, studies focus on growth rates to see if exports growth affects GDP growth.

* I would like to thank Prof. Douglas Nelson and Prof. Kevin Grier for their advice and comments. I am responsible for any errors.

¹ Jung and Marshall (1985), Chow (1987), and Bahmani-Oskooee and Alse (1993), among others.

² Sachs and Warner (1995) present the year of opening the economy for more than 50 countries.



The main problem in those studies was that they did not test for direction of causality. In fact the causal relationship between exports and GDP could be in either direction³.

Studies after 1983 explicitly test for the direction of causality. These studies use the Granger-causality test (Granger(1969) or Sims(1972) tests) which examines the contribution made for a variable in the improvement of the forecast of another variable⁴. Jung and Marshall (1985), Chow (1987), and Ahmad and Kwan (1991) all explicitly test the direction of causation. The results are mixed. Jung and Marshall find that out of 37 countries, only in four cases does export growth Granger-cause GDP growth. Chow studies 8 countries, in 6 he finds reciprocal causality between export growth and manufactured output growth. Only in one case, Mexico, he does find export growth causing output growth, and in the Argentinean case, he finds no relationship between the variables. Ahmad and Kwan find no causality between GDP growth and exports growth, in either direction for 47 African countries.

Recently, Bahmani-Oskooee and Alse (1993), Ahmad and Harnhirun (1995) point out that the methodology used trying to test causality was not appropriate to estimate the long-run relationship between GDP and exports. If the variables are cointegrated, causality tests based on growth rates require an error correction term (Engle and Granger, 1987), which captures the long-run equilibrium. Therefore, the previous studies have a missing variable in their equations if GDP and exports are cointegrated (but cointegration testing was not done in those studies). Using the error correction representation, Bahmani-Oskooee and Alse (1993) find bi-directional causality between export growth and output growth in 8 countries where variables are cointegrated, but they did not perform causality test for Malaysia because variables were not cointegrated. Ahmad and Harnhirun (1995) analyze ASEAN countries, they find that only for Singapore the variables are cointegrated and that the causality is bi-directional. Their methodology is an improvement; however their point of view that cointegrated series are needed to perform causality test is misleading. The fact that two series are cointegrated means that an error correction term must be included in the first difference equation, but if they are not cointegrated, it does not imply that a causality test can not be performed, it only implies that the error correction term is not needed.

³ As Jung and Marshall (1985) point out, export growth can affect GDP growth through: "... First, export growth may represent an increase in demand for the country's output... Second, an increase in exports may loosen a binding foreign exchange constraint and allow increases in productive intermediate imports and hence result in the growth of output. Third, export growth may result in enhanced efficiency and thus may lead to greater output." In the other direction, GDP growth can increase export growth. For instance, if an industry grows faster than the domestic demand for its goods, and the producers turn to foreign markets to sell them, the output growth is increasing exports.

⁴ In fact it is not testing the "philosophical" causality relationship between the variables (export growth and GDP growth), but it is the econometric tool available to find the direction of causation.



The objective of this paper is to evaluate the Granger-causality relationship between GDP growth and exports growth in the case of Chile after analyzing properties of time series from 1950 to 1993. The Chilean case is interesting to analyze, because of the magnitude of the change in economic strategy. From late 1930s to 1973, following the experience of the Great Depression when the country suffered a large contraction because the world market for its exports collapsed, Chile adopted an inward-looking strategy, as other Latin American countries did, the objective was isolate the economy from external shocks. During this period, tariff and nontariff barriers had an anti-export bias and substitution of domestic production for imports was practiced (Riveros, 1994). A military coup in September 1973 brought the adoption of a new economic strategy. The military government started an intensive economic reform. Openness of the economy to international markets was a central element, with output growth based on export growth an explicit objective (Riveros, 1994). Nontariffs barriers were eliminated in 1973-74, and tariffs were reduced from 100% on average in 1973 to a uniform tariff of 10% in 1979, and non-traditional exports were promoted.

Chile is one of the 37 countries analyzed by Jung and Marshall (1985). They do not find causality from exports growth to GDP growth in Chile, using as a sample period of 1963 to 1981. That period includes 11 years under the import-substitution strategy and 8 years under the export-promotion strategy, thus it is possible to get no causality because they do not consider the break point in 1973. Moreover, they do not test for cointegration between the variables before performing the causality test, which makes a difference in the test setup.

2. METHODOLOGY

Because many time series data are non-stationary, testing for unit-root and cointegration is needed as a first stage. In the case of cointegrated series, the lagged residuals from static regression should be used as an error correction term in the first difference equation (Engle and Granger, 1987). In this paper, I use the augmented Dickey-Fuller test to analyze the trend stationary of the variables(H_0). If the null hypothesis is rejected, I test stationarity of the first difference. I test for cointegration using the 'Johansen Procedure' (Johansen, 1988, Johansen and Juselius, 1990), which is more powerful than testing stationarity of residuals from OLS regression. Moreover, because the 'Johansen Procedure' is based on a VAR, it does not matter which is the dependent variable (log of exports or log of GPD) in the cointegrating vector. The critical values are corrected for sample size (Reinsel and Ahn, 1988, 1992).



Granger-causality is tested using the following representation:

$$\text{GDPG}_t = \mathbf{a}_0 + \sum_{i=1}^p \mathbf{a}_{1i} * \text{GDPG}_{t-i} + \sum_{i=1}^q \mathbf{a}_{2i} * \text{EXPG}_{t-i} + \mathbf{a}_3 * Z_{t-1} + u_{1t}, \quad (1)$$

$$\text{EXPG}_t = \mathbf{b}_0 + \sum_{i=1}^p \mathbf{b}_{1i} * \text{GDPG}_{t-i} + \sum_{i=1}^q \mathbf{b}_{2i} * \text{EXPG}_{t-i} + \mathbf{b}_3 * Z_{t-1} + u_{2t}, \quad (2)$$

where GDPG and EXPG represent GDP and exports annual growth rate respectively, and p and q are optimal lags for GDPG and EXPG. Z is the error correction term, estimated from the cointegrating vector given by the 'Johansen Procedure':

$$Z_t = \mathbf{c}_1 * \text{LGDP}_t + \mathbf{c}_2 * \text{LEXP}_t, \quad (3)$$

where LGDP and LEXP are the natural logarithm of GDP and exports.

If the series are not cointegrated \mathbf{a}_3 and \mathbf{b}_3 will equal to zero. Causality tests are performed using standard F-statistics, excluding EXPG and GDPG variables in equations 1 and 2, respectively. If the series are cointegrated, causality tests also exclude Z in both equations (See Table 1).

The tests are performed, for three sample periods: full sample (1950-1993), import-substitution period (1950-1973), and export-promotion period (1974-1993). In addition, the export-promotion period is tested for all sub-sample ending in 1993.

If causality from exports growth to GDP growth is not rejected, I can estimate a VAR (equations 1 and 2) to measure the impact of export growth on GDP growth. However, if the exports and GDP (in logs) are cointegrated, I can estimate the VAR at the level (Hamilton, 1994) to compute the impulse response on GDP.

The data used in this paper are annual series of GDP and exports for 1948-1993, in millions of Chilean pesos of 1977, published by Banco Central de Chile.



3. UNIT ROOT AND COINTEGRATION TESTS.

Tables 2 and 3 present results for unit root and cointegration tests, respectively. GDP and exports are not trend stationary in the levels, in all three periods tested. At the first difference, both variables are stationary, therefore, I conclude that both variables have unit roots.

Cointegration tests show that variables are not cointegrated for the combined period (1950-1993). However, when the pre-reform and post-reform periods are analyzed separately, the result differs. During the import-substitution period, variables are not cointegrated, but in the export-promotion period, the variables are strongly cointegrated (significant at 5%), then I conclude that there is one cointegrating vector in 1974-1993 period.⁵

The result of the cointegration test, suggest that an error correction term should be included in the causality test for the export promotion period, and no extra term is required for the import substitution era and for the full sample. An obvious interpretation of this cointegration test is that, during the post-reform period, exports and GDP are moving closer, but I can not say that export growth is Granger-causing GDP growth. I address this question directly in the next section.

4. CAUSALITY TEST.

Using the methodology described in section 2, Granger-causality tests are performed. Table 4 presents the significance level for the null hypothesis that export growth (GDP growth) does not Granger-cause GDP growth (exports growth). Tests for the full sample and the import-substitution period do not include the error correction term, because the variables were not found to be cointegrated in those periods.

⁵ In addition I perform cointegration tests for different sub-periods ending in 1993. Appendix 1 shows that cointegration disappears after 1975 and returns in 1980. This fact can be a consequence of exchange rate policy in the late 1970s. The exchange rate was used as a stabilization tool, producing an overvaluated Chilean peso negatively affected exports. At the same time, the capital account was opened then the country used foreign debt to growth in the late 1970s early 1980s (Riveros, 1994). When these years have less weight in the tests, the cointegration between the variables appears again (after 1979).



GDP growth does not Granger-cause exports growth in all periods tested, but export growth Granger-causes GDP growth in the export promotion period. If the error correction term is not included, this causation disappears, which demonstrates how important the role of cointegration is in causality tests.

To evaluate whether Granger-causality from export growth to GDP growth is just the result of the error correction term, I perform Granger-causality tests that include an error correction term for the full sample and pre-reform period. In table 5, it can be seen that I reject Granger-causality in either direction for the period 1950-1993. However, for the pre-reform period, I do not reject causality from GDP growth to exports growth at the 5% level; therefore, the Granger-causality from export growth to GDP growth, with the error correction term, is only present during export promotion period.

Evaluating Granger-causality in the post-reform period, I use different sub-sample ending in 1993. Appendix 1 also shows that Granger-causality from GDP growth to export growth is present in none on the periods tested. However, export growth Granger-causes GDP growth in 8 out of 12 tests. Twice causality disappears. First, when the sample period starts in the late 1970s the significance levels are slightly above 10%. As I mention in the previous section, from 1979 to 1982 the real exchange rate was overvalued, hurting exports, but it does not affect GDP growth because the country had access to external loans, then the negative effect of exports on GDP growth was off-set for accessibility to foreign resources and the causality disappeared. That means that it is important to recognize the influence of other variables that should be included in the VAR representation to capture their effects. However, I do not include them in the analysis, because the objective is to demonstrate the importance of the change in economic strategy and cointegration of exports and GDP in the result of Granger-causality test of GDP growth and export growth as it has been done in the 1980s. Second, after 1983 causality disappears again, which can be a result of working with so few observations.

Jung and Marshall (1985) find no causation from exports growth to GDP growth for the Chilean case with data from 1963 to 1981⁶. However, two main differences exist between their procedure and the one used in this paper. First, I include a break point in 1973, because there was a change in the economic strategy. Second, I include an error correction term in the post-reform era, because the variables are cointegrated. Thus, I find that the inward-looking strategy accomplished its objective, disconnected the growth path from international market evolution, then exports play no role promoting GDP growth. On the other hand, the export promotion strategy established a Granger-causation



relationship from exports growth to GDP growth in the Chilean case. However, this test is not telling how export growth is affecting GDP growth.

Finally, I estimate the effect of exports on GDP during the export promotion period. Since the variables are cointegrated at the level, I estimate the following VAR in levels:

$$LGDP_t = A_0 + A_1 *Trend + A_2 *LGDP_{t-1} + A_3 *LGDP_{t-2} + A_4 *LEXP_{t-1} + A_5 *LEXP_{t-2} + e_{1t} \quad (4)$$

$$LEXP_t = B_0 + B_1 *Trend + B_2 *LGDP_{t-1} + B_3 *LGDP_{t-2} + B_4 *LEXP_{t-1} + B_5 *LEXP_{t-2} + e_{2t} \quad (5)$$

The results are presented in table 6. Using the VAR representation (equations 4 and 5), I compute the impulse response function with standard errors. Figure 1 shows the response to a shock of one standard deviation on LGDP. The effect is positive and disappears after the fourth year.

5. SUMMARY AND FINAL COMMENTS.

In this paper, I make two contributions to previous studies. First, testing for causality using growth rates. If the variables are cointegrated at the level, an error correction term must be included in the first difference equation to test for Granger-causality. If they are not cointegrated, the error correction term is not required and the test can be performed. Second, change in the country's economic strategy can affect the result of cointegration and causality tests.

Having presented these observations, I test for causality between GDP growth and export growth in the Chilean case. I find that during the import-substitution period (1950-1973), no Granger-causality exists in either direction. In the export-promotion period (1974-1993), there exists Granger-causality from export growth to GDP growth, which is present in most of the sub-periods tested after 1974.

To improve our understanding, I make two suggestions. First, it would be useful to analyze other countries where there was a change in their growth strategy from import-substitution to exports promotion. Unfortunately, most of these cases occurred recently, and there is not enough data to perform the tests. In the Chilean case, there are a similar number of years before and after reform to compare the results, but there are still few

⁶ I get same result using their methodology and sample period.



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years to capture the long run relationship in the cointegration test. In addition, we should look for an explanation of the link between export growth and GDP growth. In this sense, models in which exports lead investment are an alternative to test (Baldwin and Seghezza, 1996). The basic hypothesis is that a dynamic export sector induces investment in the country, having as a consequence a positive impact in the economic growth. In this case, the causality test could be picking up only the traditional investment-growth relationship.



APPENDIX 1: Cointegration and Causality Tests Sub-periods Ending in 1993 ⁽¹⁾

Period	$H_0: r = 0^{(2)}$	$H_0: r = 1^{(3)}$	GDP ==> Exports	Exports ==> GDP
Significance level of F-statistic ⁽⁵⁾				
1974-93	21.84**	0.10	0.7642	0.0047***
1975-93	22.63***	0.16	0.6041	0.0198**
1976-93 ⁽⁴⁾	9.81	----	0.7868	0.0518*
1977-93 ⁽⁴⁾	8.77	----	0.5163	0.0598*
1978-93 ⁽⁴⁾	8.55	----	0.4516	0.1013
1979-93 ⁽⁴⁾	8.37	----	0.2794	0.1175
1980-93	16.08*	0.13	0.5990	0.0005***
1981-93	21.75**	0.90	0.1671	0.0008***
1982-93	28.89***	0.62	0.2337	0.0001***
1983-93 ⁽⁴⁾	15.79	----	0.1891	0.0690*
1984-93	20.37**	2.50	0.8206	0.1898
1985-93	19.62*	2.61	0.9426	0.2214

(1) r = number of cointegrating vectors. Test include one lag of first difference.

(2) Standard Critical values: * 10% significance level = 13.31, ** 5% significance level = 15.34, and *** 1% significance level = 19.69. They are corrected upwards by $N/(N-kp)$, where N is the number of observations, k is the number of variables in the system, and p the number of lags.

(3) Standard Critical values: * 10% significance level = 2.71, ** 5% significance level = 3.84 and *** 1% significance level = 6.64. They are corrected upwards by $N/(N-kp)$, where N is the number of observations, k is the number of variables in the system, and p the number of lags.

(4) Variables are not cointegrated, then causality tests do not include error correction term.

(5) * significant at 10%. ** significant at 5%. *** significant at 1%.



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Table 1: Causality test

	EXPG == => GDPG	GDPG == ==> EXPG
non-cointegrated	Ho: $a_{2i} = 0$ $i = 1, q$	Ho: $b_{1i} = 0$ $i = 1, p$
cointegrated	Ho: $a_{2i} = a_3 = 0$ $i = 1, q$	Ho: $b_{1i} = b_3 = 0$ $i = 1, p$

Table 2: Unit Root Test

	Full Sample 1950-1993 ⁽³⁾	Import-Substitution 1950-1973 ⁽⁴⁾	Export-Promotion 1974-1993 ⁽⁵⁾
At levels ⁽¹⁾ :			
-GDP	-2.35	-1.90	-1.94
-Exports	-1.35	-1.83	-1.42
First-Diff. ⁽²⁾ :			
-GDP	-4.09***	-3.67**	-4.29***
-Exports	-6.42***	-6.58***	-5.03***

(1) Include constant, trend, and two lags of the LGDP and LEXP.

(2) Include constant and one lag of the first difference.

(3) Critical Values levels: * 10% significance level = -3.19, ** 5% significance level = -3.514, and *** 1% significance level = -4.178. Critical Values first difference: * 10% significance level = -2.60, ** 5% significance level = -2.93, and *** 1% significance level = -3.59.

(4) Critical Values levels: * 10% significance level = -3.24, ** 5% significance level = -3.61, and *** 1% significance level = -4.40. Critical Values first difference: * 10% significance level = -2.63, ** 5% significance level = -2.99, and *** 1% significance level = -3.73.

(5) Critical Values levels: * 10% significance level = -3.27, ** 5% significance level = -3.66, and *** 1% significance level = -4.50. Critical Values first difference: * 10% significance level = -2.65, ** 5% significance level = -3.02, and *** 1% significance level = -3.81.



Table 3: Cointegration Test ⁽¹⁾

Hypothesis		Full Sample 1950-1993	Import-Substitution 1950-1973	Export-Promotion 1974-1993
Ho: $r = 0$ ⁽²⁾	Trace	5.72	13.06	21.84**
Ho: $r = 1$ ⁽³⁾	Trace	--	--	0.10

(1) r = number of cointegrating vectors. Test include one lag of first difference.

(2) Standard Critical values: * 10% significance level = 13.31, ** 5% significance level = 15.34, and *** 1% significance level = 19.69. They are corrected upwards by $N/(N-kp)$, where N is the number of observations, k is the number of variables in the system, and p the number of lags.

(3) Standard Critical values: * 10% significance level = 2.71, ** 5% significance level = 3.84 and *** 1% significance level = 6.64. They are corrected upwards by $N/(N-kp)$, where N is the number of observations, k is the number of variables in the system, and p the number of lags.

Table 4: Causality Test
Significance Levels for F-statistic

Null Hypothesis	Full Sample ⁽¹⁾ 1950-1993	Import-Substitution ⁽¹⁾ 1950-1973	Export-Promotion ⁽²⁾ 1974-1993
Exports \Rightarrow GDP	0.7919	0.4688	0.0047***
GDP \Rightarrow Exports	0.2422	0.9438	0.7643

(1) Tests do not include error correction term, because variables are not cointegrated. Include one lag of EXPG and GDPG.

(2) Tests include error correction term. *** significant at 1%. Include one lag of EXPG and GDPG.



Table 5: Causality Test Including Error Correction Term for Full Sample and Pre-Reform. Significance Levels for F-statistic

Null Hypothesis	Full Sample ⁽¹⁾	Import-Substitution ⁽¹⁾
	1950-1993	1950-1973
Exports \Rightarrow GDP	0.1096	0.4384
GDP \Rightarrow Exports	0.5529	0.0404**

(1) Tests include error correction term, although variables are not cointegrated. Include one lag of EXPG and GDPG.

** significant at 5%.

Table 6: Estimation of the VAR in Levels.⁽¹⁾
(1975-1993).

	<i>Constant</i>	<i>Trend</i>	<i>LGDP_{t-1}</i>	<i>LGDP_{t-2}</i>	<i>LEXP_{t-1}</i>	<i>LEXP_{t-2}</i>
LGDP	-2.178	0.001	0.553	-0.328	0.408	-0.012
(0.091)	(0.090)	(0.086)	(2.030)	(1.462)	(1.866)	
LEXP	-75.318	0.041	0.329	-0.126	0.215	0.123
(0.614)	(2.007)	(2.018)	(0.781)	(0.362)	(0.635)	

(1) In parenthesis, absolute value of t-statistics.

Figure 1: Response of LGDP to One S.D. Innovation +/- 2 S.E.
Sample Period: 1975-1993.

