THIRLWALL'S LAW WITH AN EMPHASIS ON THE RATIO OF EXPORT/IMPORT INCOME ELASTICITIES IN LATIN AMERICAN ECONOMIES DURING THE TWENTIETH CENTURY*

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Resumen: Con base en una especificación estocástica que enfatiza el papel de la relación de las elasticidades ingreso de las exportaciones e importaciones, aplicamos el modelo de crecimiento restringido por la balanza de pagos a 19 países de América Latina entre 1900 y 2000. Posterior a la presentación de la "Ley de Thirlwall" verificamos la existencia de una relación de largo plazo entre cada una de las economías seleccionadas y la de Estados Unidos, para analizar el corto plazo estimamos un modelo de parámetros cambiantes mediante el Filtro de Kalman. Los resultados sugieren una reducción del tamaño del coeficiente relevante a lo largo del siglo XX, lo que representa una característica inesperada y negativa del modelo de desarrollo implantado en la región.

Abstract: Using stochastic specifications that emphasize the role of the ratio of export/import income elasticities, this paper applies the balance-of-payments constraint model to nineteen Latin American countries from 1900 to 2000. The paper begins with a brief presentation of Thirlwall's well-known model. Immediately following this, we verify the existence of a long run relationship between developing economies on one hand, and the US economy on the other. To explore the short term evolution of the quantitative link between economies, a time varying model is estimated by means of an algorithm known as a Kalman filter. Mainly, the results show a diminishing the ratio of export/import income elasticities over the years, which represents an unexpected and serious feature of the new economic strategy that has already been implanted in the region.

Clasificación JEL: C22, E12, F00

Palabras clave: ley de Thirlwall, Latinoamérica, Kalman, Thirlwall's law, Latin America, Kalman.

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1. Introduction

The aim of this study is to test the balance of payments constrained growth model using stochastic specifications that emphasize the role of the ratio of export/import income elasticities (Davidson, 1990-91) for nineteen Latin American economies from 1900 to 2000. The paper begins with a brief presentation of Thirlwall's well-known model. Immediately following this, using the Johansen procedure we identify the long-run value of the ratio of export/import income elasticities and, recognizing that we are in the presence of a time varying parameter, we draw on a state-space representation to determine its evolution over time. Concluding remarks are in the final section.

2. Theoretical Framework

Thirlwall's model can be represented by three equations:

$$x = \eta \left(p_d - p_f\right) + \pi w \tag{1}$$

$$m = \varphi \left(p_f - p_d\right) + \xi y \tag{2}$$

$$\left(p_d + x\right) = \left(p_f + m\right) \tag{3}$$

with $\eta, \varphi < 0$ and $\pi, \xi > 0$. Here, x, m, w, and y are the growth rates of real exports, imports, rest of the world income, and domestic income respectively, and $(p_d - p_f)$ is the growth rate of relative prices measured in a common currency. Equations (1) and (2) are standard export and import demand functions. Price elasticities of exports and imports are η and φ respectively. Income elasticities of exports and imports are π and ξ respectively. It is worthwhile to highlight that both income elasticities reflect the non-price aspects of competition (McCombie and Thirlwall, 1994, p. 265; Bairam and Dempster, 1991, p. 1720). Equation (3) assumes that the current account is continuously balanced.

Substituting equations (1) and (2) into (3) gives the balance of payments constrained growth model rate of real domestic income, designated by y_b:

$$y_b = \frac{\pi w + \left(\eta + \varphi + 1\right)\left(p_d - p_f\right)}{\xi} \tag{4}$$

As Thirlwall (1979, p. 49) points out, if the assumption can be made that the Marshall-Lerner condition is exactly satisfied or if relative prices measured in a common currency do not change over the long run, equation 4 can be reduced to:

$$y_b = \frac{\pi w}{\xi} \tag{5}$$

In reference to equation (5), Davidson clarifies:

"...the rate of growth a nation can maintain without running into a *ceteris paribus* balance of payments problem depends on the rest of the world's real economic growth and the relevant income elasticities for imports and exports..." (1990-1991, p. 300).

The policy implications of equation (5) are relevant in the sense that in an open economy, pertinent economic management is the one that manipulates the income elasticities of exports and imports.

"...A successful economic policy that increases the value of π and/or reduces the value of ξ, relaxes the balance of payments constraints and, eventually, accelerates economic growth..." (Bairam and Dempster, 1991, p. 1720).

Allowing a stochastic residual term (u_t), equation (5) can be written as:

$$y_{b,t} = \alpha w_t + u_t \tag{6}$$

Here $\alpha = \frac{\pi}{\xi}$ is the coefficient. It is expected to be positive, and the larger it is, the better. Its vector autoregressive (VAR) form is the following:

$$\begin{aligned} y_{j,t} &= \alpha_0 + \alpha_i y_{US,t-i} + \alpha_i y_{j,t-i} + u_{j,t} \\ y_{US,t} &= \beta_0 + \beta_i y_{US,t-i} + \beta_i y_{j,t-i} + u_{US,t} \end{aligned} \tag{7}$$

Where j represents each of the 19 Latin American countries selected, i indicates the number of lags required, y is the natural logarithm of the real gross domestic product, and u_t are $iid\ N(0, \Omega)$ processes. The following section presents results of econometric estimations of equation (6) under the form of vector autoregressive (VAR) models with cointegration, and of state-space representations, for the selected developing economies.

3. Econometric Results and Discussion

As a preliminary step for evaluating equation (6), table 1 provides background information about selected countries. Certainly, the analyzed time period for each economy depends on the availability of information. According to the World Bank, two countries listed belong to the category of "low income" (less than 735 US dollars), nine to the "lower middle income" (between 736 and 2 935 US dollars), and eight to the "upper middle income" (between 2 936 and 9 075 US dollars).

During the 20th century we found two specific developing strategies implemented in Latin America. The first one corresponds to a model based on protecting national markets and on state intervention. Under the second one, the tendency has been for the market to replace regulation, private ownership to replace public ownership, and competition, including that from foreign goods and investors, to replace protection. For each economy, the precise cut-off year was determined based on a trade index –see Lora (2001) for details– and considering the trough of its business cycle.

The question about the order of integration of the variables is relevant in order to apply the Johansen procedure into a balanced VAR model. The state of the art econometrics does not accept the use of the Augmented Dickey-Fuller test and the Phillips-Perron tests, because of their size distortion and their low power (Maddala and Kim, 2002, chapter 4). Thus, we applied the DF-GLS test (Elliott, Rothenberg and Stock, 1996) and the Perron-Ng test (Perron and Ng, 1996). As expected, the results show that the Latin American and US economies are integrated of order one.

Once it is clear that the analyzed variables are non stationary, we can proceed with the estimation of VAR models for real gross domestic product of the selected countries and of US. As was established in the previous section, the relevant parameters represent elasticities. Therefore, a log-log functional form was chosen. In order to check their statistical adequacy, misspecification tests were applied, and their stability was verified by means of the long run matrix.[1]

[1] "Consider the impact of a shock to innovation in one of the equations of a VAR; does the response to this shock (eventually) die out as we get further away in time from the date of the shock? If the answer is yes the model is stable; if not the model is unstable...A stable model is thus well behaved in the sense that the impact of a shock is calculable and finite. This is particularly important in the context of what is known as multiplier analysis" (Patterson, 2000, pp. 601-602). According to Lütkepohl (1991), the estimated VAR is stable if all roots of the

Table 1

Income per-capita, average growth rate (D) of GDP (Y), exports (X) and imports (M), and degree of openness of selected countries

Country and Region	Year	Income per capita		Periods and subperiods	D(Y)	D(X)	D(M)	X+M/Y
		1970 PPP US dollars	US dollars					
	1900	487	138	1900-2000	3.2	5.31	5.16	26.34
	1989	1,098	2,389	1900-1989	3.14	4.79	3.67	27.73
Argentina	2000	1,420	7,675	1989-2000	3.71	9.64	18.01	15.11
	1960	190	133	1960-2000	3.36	7.54	8.12	32.72
	1986	272	652	1960-1986	3.22	8.34	8.53	33.34
Bolivia	2000	327	996	1986-2000	3.63	6.07	7.34	31.36
	1902	107	37	1902-2000	4.41	6.04	6.57	23.3
	1988	848	2,186	1902-1988	4.75	6.31	5.91	24.46
Brazil	2000	883	3,493	1988-2000	1.84	3.84	10.46	14.95
	1940	493	225	1940-2000	3.9	8.55	9.35	30.4
	1975	734	708	1940-1975	3.19	7.19	8.6	20.67
Chile	2000	1,631	4,638	1975-2000	4.91	10.48	10.4	44.36
	1936	307	85	1936-2000	4.26	8.4	8.14	23.3
Colombia	1991	872	1,256	1936-1991	4.48	8.66	7.85	22.53

characteristic AR polynomial have a modulus of less than one and lie inside the unit circle.

Table 1

(continued)

Country and Region	*Year*	*Income per capita*		*Periods and subperiods*	*D(Y)*	*D(X)*	*D(M)*	*X+M/Y*
		1970 PPP US dollars	*US dollars*					
	2000	878	1,921	1991-2000	2.95	6.84	9.97	28.31
	1950	373	322	1950-2000	5.27	9.73	10.37	54.49
	1985	751	1,486	1950-1985	5.57	8.39	9.49	50.74
Costa Rica	2000	966	3,926	1985-2000	4.59	12.92	12.45	62.75
	1947	175	120	1947-2000	5.48	8.32	9.76	42.08
	1991	484	1,037	1947-1991	5.31	4.82	8.59	38.42
Dominican Rep.	2000	722	2,313	1991-2000	6.28	27.2	15.69	57.82
	1939	165	25	1939-2000	4.61	10.97	10.19	34.86
	1987	479	1,101	1939-1987	5.22	11.94	11.95	31.53
Ecuador	2000	492	1,076	1987-2000	2.39	7.44	3.94	46.94
	1950	275	198	1950-2000	3.59	7.34	9.09	48.25
	1989	356	943	1950-1989	3.35	4.91	8.45	47.92
El Salvador	2000	476	1,983	1989-2000	4.47	16.39	11.37	48.24
	1923	251	107	1923-2000	3.88	7.16	7.87	5.82
	1985	488	1,405	1923-1985	3.92	7.11	7.41	6.03
Guatemala	2000	588	1,675	1985-2000	3.69	7.38	9.82	4.96

Table 1

(continued)

Country and Region	*Year*	*Income per capita*		*Periods and subperiods*	*D(Y)*	*D(X)*	*D(M)*	*X+M/Y*
		1970 PPP US dollars	*US dollars*					
	1954	123	81	1954-2000	1.08	4.92	6.91	28.57
	1992	105	227	1954-1992	1.21	3.17	4.73	28.3
Haiti	2000	90	446	1992-2000	0.45	13.63	17.87	29.41
	1925	228	94	1925-2000	3.21	5.92	7.47	52.1
	1990	314	641	1925-1990	3.19	5.53	6.8	48.6
Honduras	2000	320	910	1990-2000	3.33	8.44	11.93	73.79
	1930	305	133	1930-2000	4.77	9.3	10.63	22.97
	1986	1,046	1,630	1930-1986	5.14	7.78	8.81	17.86
Mexico	2000	1,334	5,807	1986-2000	3.34	15.63	18.2	42.89
	1958	291	258	1958-2000	2.2	5.41	7.7	59.61
	1991	175	423	1958-1991	1.8	4.11	7.1	53.09
Nicaragua	2000	191	473	1991-2000	3.67	10.35	9.92	81.85
	1946	511	318	1946-2000	4.32	13.27	7.89	59.77
	1989	921	2,080	1946-1989	4.2	14.9	6.9	49.04
Panama	2000	1,266	3,465	1989-2000	4.8	7.11	11.85	100.51

Table 1

(continued)

Country and Region	*Year*	*Income per capita*		*Periods and subperiods*	*D(Y)*	*D(X)*	*D(M)*	*X+M/Y*
		1970 PPP US dollars	*US dollars*					
	1950	293	208	1950-2000	4.06	8.66	9.7	31.76
	1986	548	1,453	1950-1986	4.56	8.09	9.79	22.26
Paraguay	2000	545	1,404	1986-2000	2.79	10.14	9.46	54.48
	1942	256	66	1942-2000	3.69	8.1	9.25	30.64
	1990	454	1,575	1942-1990	3.22	6.65	7.21	31.66
Peru	2000	564	2,085	1990-2000	4.13	7.66	9.75	25.96
	1955	975	929	1955-2000	1.62	5.86	6.13	26.81
	1984	969	1,511	1955-1984	0.8	5.73	4.16	25.19
Uruguay	2000	1,419	6,004	1984-2000	3.13	6.1	9.8	30.31
	1920	135	64	1920-2000	5.32	9.03	7.23	44.24
	1989	980	2,270	1920-1989	5.79	9.05	7.28	44.37
Venezuela	2000	995	5,017	1989-2000	2.41	8.85	6.87	43.87
	First year	313	186	Period	3.8	7.89	8.29	35.68
	Year cut	626	1,314	1st part	3.79	7.24	7.54	32.83
Average	Last year	795	2,911	2nd part	3.5	10.32	11.32	44.1

Sources: Latin American Centre at Oxford University (http://oxlad.qeh.ox.ac.uc/serch.php) Bureau of Economic Analysis, and Angus Maddison (http://www.eco.rug.nl/~Maddison/). Annual database used is available from the author.

Specifically, the following tests were applied: multivariate residual autocorrelation tests based on Box-Pierce/Ljung-Box Q-statistics (Lütkepohl, 1991) and on LM statistics (Johansen, 1995), the multivariate extension of the Jarque-Bera residual normality test using –as factorization matrix– the inverse square root of residual covariance matrix (Urzúa, 1997), and extensions of White's (1980) test for systems of equations as discussed by Kelejian (1982).[2]

To determine the lag length of the VAR models, we weighed the information criterions –Akaike, Schwarz, and Hannan-Quinn–, and positive/negative results of diagnostic statistical tests. Specifically, the lag length for Ecuador was one, for Argentina, Chile, El Salvador, and Mexico it was two, for Colombia, Costa Rica, Haiti, Panama, Peru and Uruguay it was three, for Brazil, Dominican Republic, Guatemala, Honduras, Nicaragua and Venezuela it was four, and for Paraguay it was five. Table 2 shows relevant outcomes.

The estimated ratios of export/import income elasticities are consistent with figures obtained by other authors. Bairam (1993) reports 1.20 for Colombia. Senhadji (1997), and Senhadji and Montenegro (1998) reveal 1.008, 1.275 and 0.566 for Argentina, Colombia and Haiti respectively. Lopez and Cruz (2000), and Guerrero (2003) state 1.692 and 1.640 for Mexico, respectively. Lastly, Moreno-Brid and Perez (2003) report 1.94 and 1.50 for Costa Rica and El Salvador, respectively.

The content of table 2 represents positive evidence for Thirlwall's Law under the form of expression (6). The long run co-movement between domestic and US economies reinforces our belief that the balance of payment constraint represents a mayor force driving the economic growth process. In other words, results positively support –let me propose– "the rest of the world lead growth hypothesis...". As a matter of fact, statistical tests (Johansen, 1995, chapter 8) indicate –as expected– that the US economy is weakly exogenous with respect to Latin American countries.[3]

Noticeably, the estimated ratios of export/import income elasticities were useful to simulate the observed economic growth rates. Certainly, the difference between observed and balance of payments

[2] Econometric tests were implemented using automatic routines of *E-views* and *PcFIML*. Indeed, the complete set of statistical results - which includes unit root tests, system tests, and information tests for 19 VAR models - is huge. It is available from the author.

[3] The accepted restrictions were imposed on the α matrix –which includes the adjustment coefficients. Thus, if we so wished, it would be valid to estimate single-equation error correction models.

constrained economic growth rates is a consequence of the influence of terms of trade and capital in/outflows (Thirlwall and Hussain, 1982).

To examine the annual behavior of the export/import income elasticity ratios, we split equation (6) under the form of state-space representation (Hamilton, 1994, chapter 13). In the observation equation (8), the export/import income elasticity ratios are specified as time-varying coefficients, and in the state equation (9) as first order autoregressive processes.

Table 2

Normalized cointegrating coefficients, US economy average growth rate, and observed and simulated average GDP growth rates for selected countries

Country	$\hat{\alpha}$	$D(Y_{US})$	$D(Y_{Observed})$	$D(Y_b)$	*Gap*
Argentina	1.121	3.466	3.097	3.887	-0.789
Bolivia	0.971	3.349	3.216	3.251	-0.035
Brazil	1.7	3.361	4.434	5.713	-1.279
Chile	1.024	3.155	3.937	3.231	0.706
Colombia	1.418	3.822	4.277	5.421	-1.144
Costa Rica	1.306	3.447	5.078	4.5	0.578
Dominican Rep.	1.141	3.383	4.805	3.859	0.947
Ecuador	1.327	3.61	4.65	4.79	-0.14
El Salvador	1.363	3.357	3.473	4.575	-1.102
Guatemala	1.552	3.483	3.906	5.407	-1.501
Haiti	0.669	3.538	1.046	2.366	-1.321
Honduras	0.943	3.664	3.04	3.455	-0.415
Mexico	1.505	4.088	5.136	6.154	-1.018
Nicaragua	1.698	3.415	1.657	5.797	-4.141
Panama	1.038	3.392	4.783	3.521	1.261
Paraguay	1.474	3.399	4.31	5.009	-0.7
Peru	1.235	3.429	3.636	4.236	-0.6
Uruguay	1.25	3.452	1.871	4.315	-2.444
Venezuela	1.476	3.49	4.794	5.152	-0.358

Notes: In all cases, trace test and max-eigenvalue test indicate one cointegration equation.

$$y_{j,t} = \xi_t y_{US,t} + u_{j,t} \tag{8}$$

$$\xi_{t+1} = \lambda_0 + \lambda_1 \xi_t + u_{t+1} \tag{9}$$

The system of equations (8) and (9) was estimated using a forecast recursive algorithm known as a Kalman filter. Figure 1 shows results for the nineteen economies.

It is plausible to group selected economies into four categories. One distinctive country is Chile. It seems that there is a link between the early implementation of economic liberalization policies and the increasing ratio of export/import income elasticities. During the eighties and nineties, which include periods of armed conflict, sensibility to US economy growth rate increased in Central American countries and the Dominican Republic. For the first four economies of the region, Brazil, Mexico, Argentina and Colombia, the external performance was negative. Unfortunately, Bolivia, Ecuador, Haiti, Paraguay, Peru, Uruguay and Venezuela, all exhibited the same result.

Figure 1
Short-run behavior of the export/import income elasticities ratios

Figure 1
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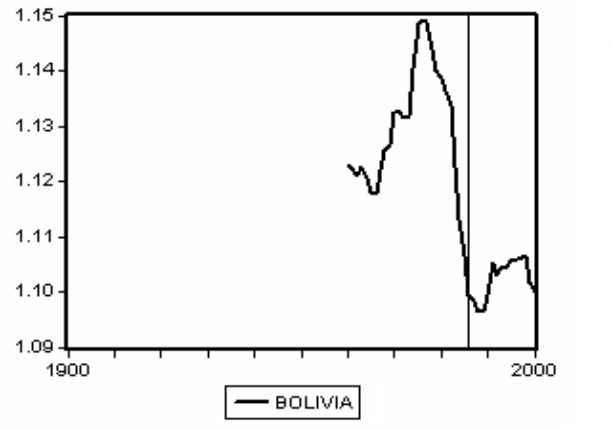

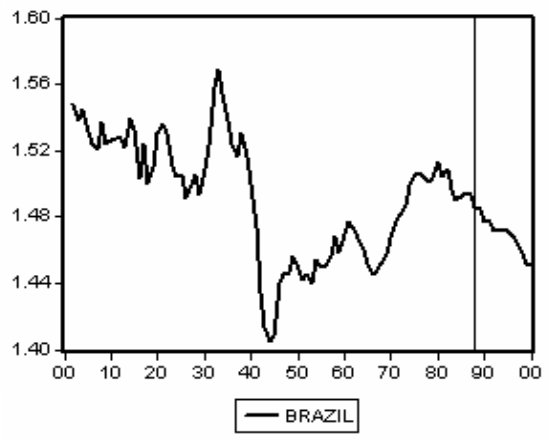

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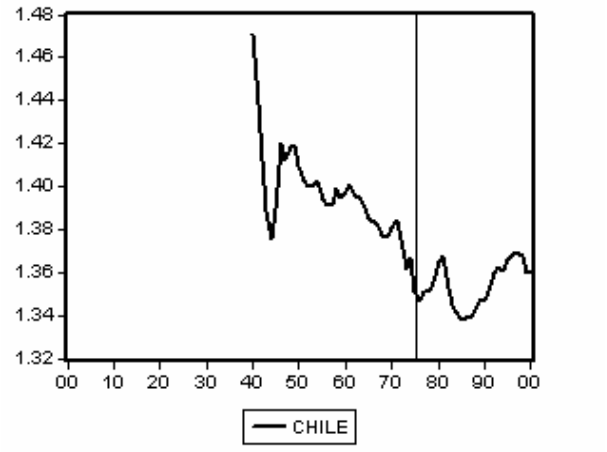

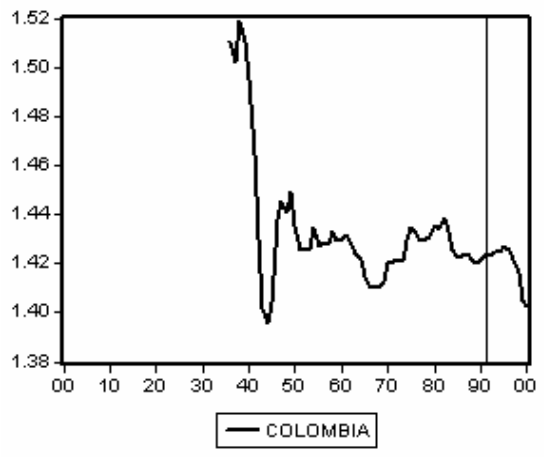

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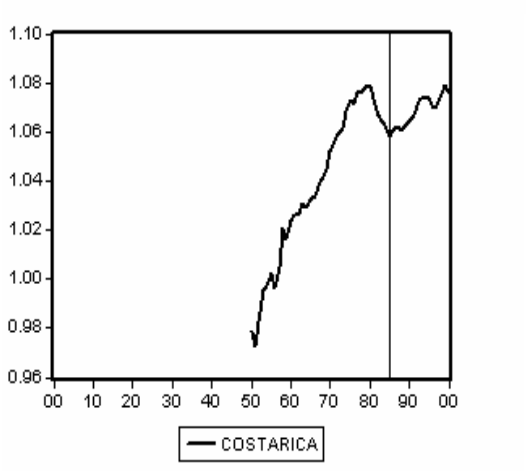

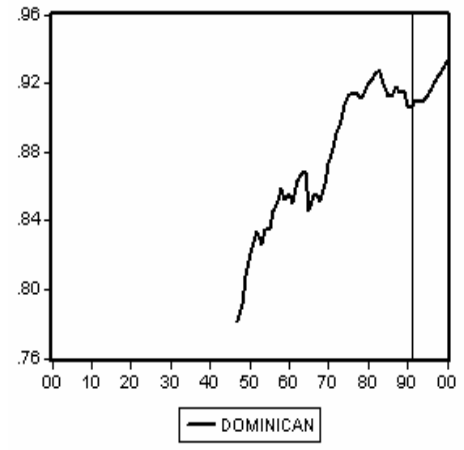

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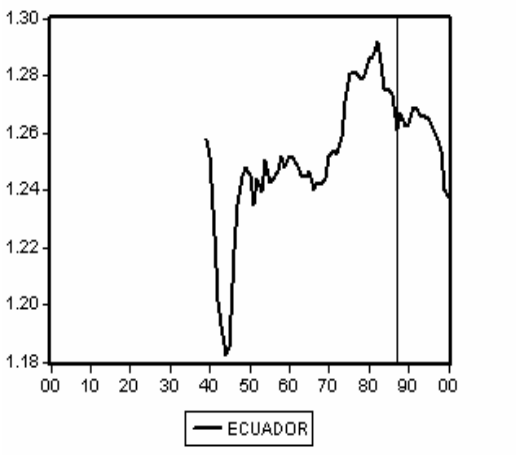

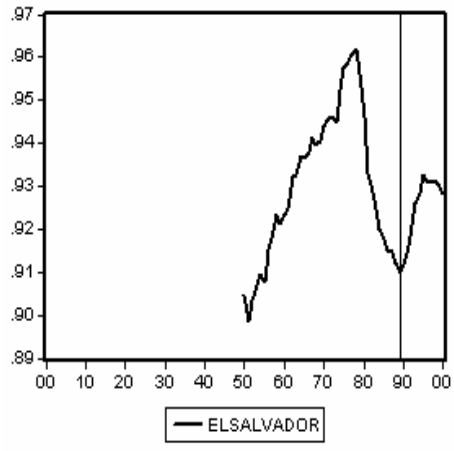

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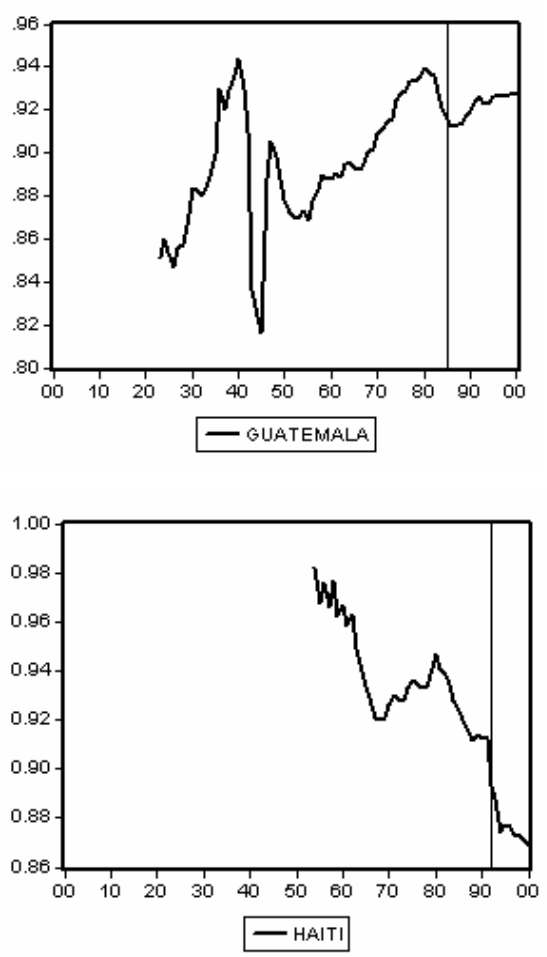

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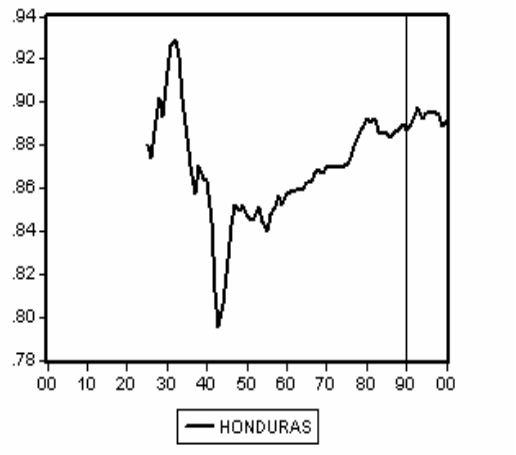

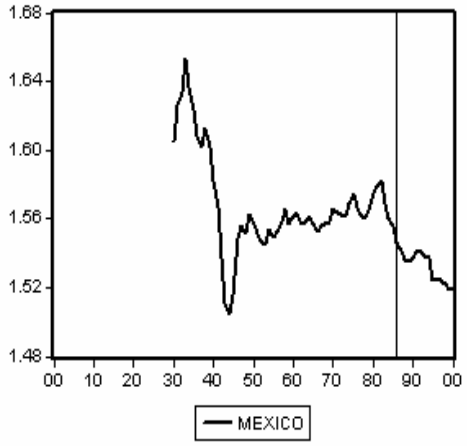

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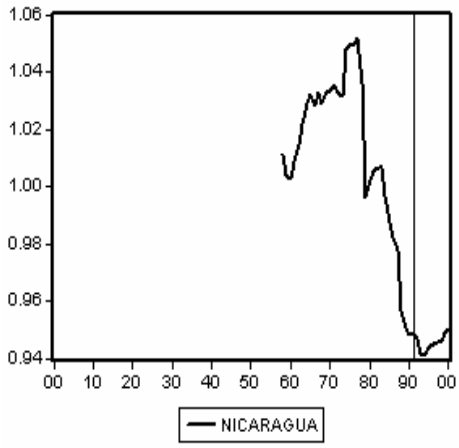

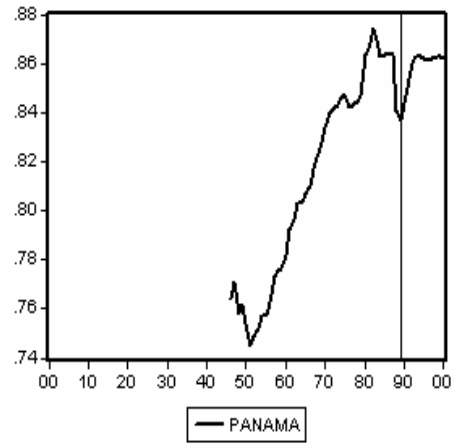

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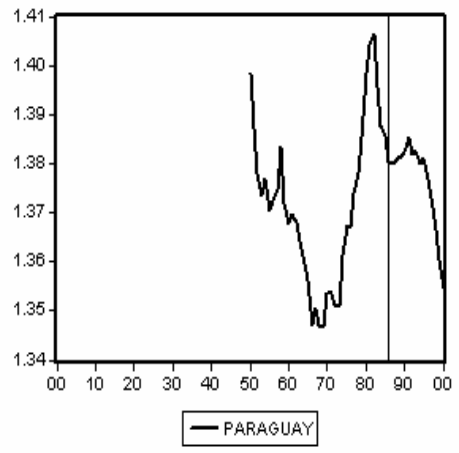

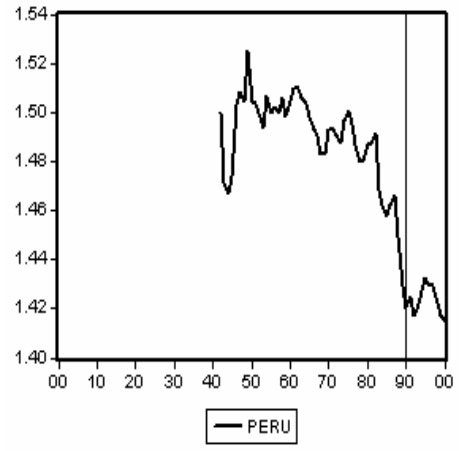

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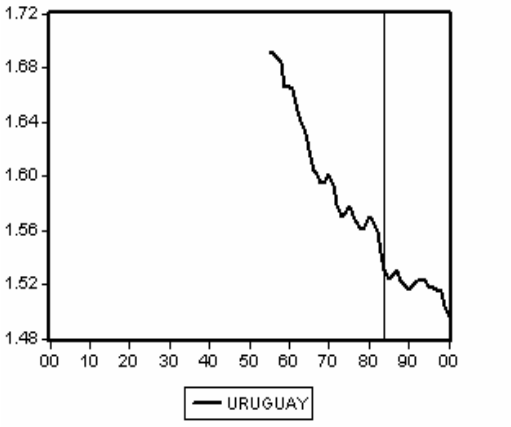

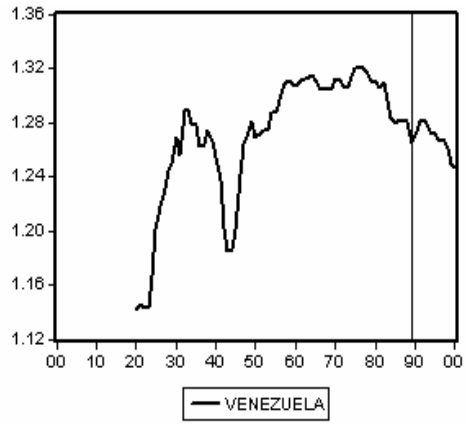

Note: vertical lines indicate the cut-off years.

4. Concluding Remarks

The findings suggest the existence of a link among Latin American and US economies during the twentieth century. This represents a piece of empirical evidence in favor of "the rest of the world lead growth hypothesis".

During the analyzed period, the annual evolution of the export/import income elasticities ratio is somewhat different for the nineteen selected economies. Nevertheless, for the four major countries of the region -and others-, this ratio declines noticeably over the last two decades. On the other hand, Chile –the fifth major economy– was the first country in Latin American to implement economic liberalization measures and, fortunately, has relaxed its balance of payments constraint. In this sense, and looking at what is happening right now around the world, the region needs to make a second effort in order to improve its efficiency.

Finally, from a broader perspective equation (6) emphasizes the dependency of Latin American countries on US. Indeed, it is not desirable for the region to discontinue or even to reverse the economic reform process, but recent disillusionment with the results of this process has been growing in our countries, see Lora and Panizza (2002), among others.

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