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Balance of paymemts constraint in Argentine economic development. A new economic cycle driven by commodities?

La restricción de balanza de pagos en el desarrollo económico argentino: ¿hacia un nuevo ciclo ligado a las materias primas?

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Abstract

This paper analyses the balance of payments constraint in the Argentine economy in the period 2002-2011. Cointegration techniques are employed to estimate Thirlwall´s (1979) model. We analyse the roles of both the total and commodities exports. Therefore, the aim of the paper is to analyse the Argentine external vulnerability during the post-Convertibility period when commodity prices played an important role in accelerating Argentine exports. The results show that the external restriction to growth from the balance of payments position has relaxed, permitting high economic growth rates since 2002, with commodities playing a central role in this process.

Keywords: External Vulnerability; Thirlwall; Commodities; Cointegration.

Resumen

En este trabajo se analiza la restricción de balanza de pagos en la economía argentina durante el periodo 2002-2011. Empleando técnicas de cointegración se valida el conocido modelo de Thirlwall (1979) tanto para el conjunto del comercio exterior como, específicamente, para los productos básicos. El objetivo es, por tanto, analizar la vulnerabilidad externa a través de la evolución de la restricción de balanza de pagos post-convertibilidad y el papel que las commodities, cuyos precios han mostrado máximos históricos a finales de la década pasada, han jugado en dicha restricción. Los resultados confirman el relajamiento de la restricción externa, cuando la comparamos con etapas anteriores del desarrollo argentino, y el papel central de las exportaciones de commodities.

Palabras clave: Restricción externa; Thirlwall; Materias primas; Cointegración.

JEL Classification: C22, C32, F31, F43.

1. Introduction

The Argentine economy has exhibited, in the long run, one of the lowest growth rates in Latin America and one of the highest volatilities in its growth path. In fact, between 1950 and 2010 the cumulative annual growth of the country was 2.8%, with only the Republic of Uruguay, at a rate of 2.2%, having a lower growth rate during this long period[1]. Looking at the period from 1900-2010, Argentina shows a cumulative annual growth rate, in this case per capita, of only 1.16%, the lowest among the continent's larger countries. The volatility, on the other hand, has risen. During the long period of 1900-2010, the variance of the GDP per capita was fourth out of the eight largest countries on the continent, while during the decades of the 90s and 2000, it was second on the continent, behind Venezuela.

In 2002 the Argentine economy suffered its deepest recession since 1914. The GDP dropped 12% that year and the economy experienced an important economic reconfiguration in relation to the policies implemented in 1991, when the Law of Convertibility was passed. In the period of Convertibility, one of the central problems was the generation of exports to sustain foreign currency payments, especially after 1998 (Gerchunoff and Ramos, 2005).

Subsequently, between 2003 and 2011, the Argentine economy experienced a growth in economic activity higher than 8% -unprecedented in the recent economic history of the country- which has allowed the job market situation to improve, and, in general, to improve the deteriorated social situation following the crisis of 2002.

This volatile economic dynamic has been studied in depth. Currently, the debate over the Argentine economy is centered on three aspects (Santarcángelo, 2012): the first one focuses on whether the recent economic boom is sustainable in the long run, or merely an upturn in the country's economic cycle; the second focuses on the ruptures and continuities with respect to the previous Convertibility regime, and the third aspect on whether the new dynamic of the economy can be characterized as a new import substitution strategy.

[1] The data used was obtained from the University of Groningen, Groningen Growth and Development Centre database. It is measured in purchasing power parity in dollars 1990. Countries used as a comparison are: Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Jamaica, Mexico, Peru, Santa Lucia, Trinidad and Tobago, Uruguay and Venezuela. Data available at http://www.conference-board.org/data/economydatabase/ http://www.conference-board.org/data/economydatabase/

The first aspect is probably the most relevant of the three, at least from the point of view of more pragmatic economic policy. The dynamics of the external sector is one of the factors of debate in relation to explanations for the economy's current rapid growth and its ability for continued growth in the future. Along this line, some analyses indicate that the intense economic recovery of the post-Convertibility regime economy is principally due to a favorable international context, in which high prices of raw materials and low international interest rates are the key to explaining this dynamism; it is the well-known "tailwind." On the contrary, other studies, recognizing the positive role in the growth within the international context, point to the main explanatory factor residing in a pragmatic economic policy focused on the stabilization of domestic financial markets, the maintenance of a competitive exchange rate, and the raising of tax revenues, among others (Frankel and Rapetti, 2007).

From the long-term point of view, Argentine economic development has shown a dynamic of expansions and contractions related to its balance of payments position over the course of time. Thus, phases of expansion, and the deterioration of the country's external position, were followed by periods of recession and external adjustment, showing the economic cycles of *stop and go* in which the external sector plays a central role in the determination of income (Braun and Joy, 1968; Díaz Alejandro, 1970; Canitrot, 1981; Matesanz *et al*., 2007; Fugarolas and Matesanz, 2008)[2].

In this study, the role the external sector has played in the economic growth of the Argentine economy in the last half century is analysed in a comparative historical overview. The central idea is to compare studies that have been carried out within the framework of the well-known balance of payments constraint model, proposed in its first version by Anthony Thirlwall (Thirlwall, 1979) and later developed in various directions. The basic idea of this now traditional model is that the dynamics of the current account of the balance of payments is a limiting factor in the long-term development of countries in an increasingly integrated world economy.

The study is structured in the following manner. The next section presents the simple balance of payments constraint model and the economic policy implications that arise from it. The different extensions that have been developed over time are also presented in this section. The third section makes a succinct review of the empirical studies that have been carried out applying the model to the Argentine economy. The fourth section presents current estimations of the model that allow conclusions to be drawn on the debate over the sustainability of the current growth phase of the economy. Additionally, this section introduces the role that commodities have had in the current post-Convertibility period in restricting economic growth due to the balance of payments position in Argentina. Finally, conclusions and final thoughts are presented.

[2] Other analyses have tended to highlight the role of other aspects, such as the functioning of the financial markets or the process of capital accumulation (Della Paolera and Taylor, 2003; Taylor, 1994, among others).

2. The Balance of Payments Constraint Model

As Anthony Thirlwall (Thirlwall, 2011) points out in a recent paper that reviews the history, extensions, debates and problems of his original model, the specification published in 1979 incorporates, in one simple formula made up of only two variables, diverse ideas about economic development introduced in a multitude of previous works: Engel's law on the elasticity of commodities; Harrod's foreign trade multiplier; Prebisch-Singer's hypothesis on the deterioration of terms of trade for countries specializing in primary export sectors; Verdoon-Kaldor's notion which shows that acceleration in economic growth accelerates productivity growth; the paradox of Kaldor, who showed that countries presenting deterioration in their price competitiveness observed at the same time an increase in their export share in the world market; and the literature regarding export driven growth, among other contributions.

Thirlwall's balance of payments constraint model demonstrated that, in the long run, no country could grow faster than the theoretical growth rate that guarantees balance of payments equilibrium, unless it is able to permanently finance growing current account deficit, a situation that, in general, is not possible. As Thirlwall (2003) demonstrates, the model implies that a mere increase in the supply of resources does not necessarily imply the growth of a country, if, at the same time, it does not improve its balance of payments position. If exports remain static and imports rise, the deficit in the balance of payments would be unsustainable, demand would have to contract, and resources would remain underutilized. This is the central idea of the balance of payments constraint model in its simplest form, as presented by Thirlwall [1979]. This model emerges from the dynamic formalization of Harrod's foreign trade multiplier [1933], which establishes that the level of an economy's income must be identical to the level of exports divided by the marginal propensity to import. To this end, Thirlwall departs from the balance of payments equilibrium condition given by:

$$PX = P^{*}M \tag{1}$$

where X and M, are the volume of exports and imports, respectively; P and P^{*} represent import and export prices, respectively. Equation (1) is just the balance of payments accounting identity when no capital flows are considered. Demand functions for exports and imports may be expressed as follows:

$$X = A\left(\frac{P}{P*}\right)^{\eta}\left(Y^{*}\right)^{\varepsilon} \tag{2}$$

$$M = B\left(\frac{P*}{P}\right)^{\gamma}\left(Y\right)^{\pi} \tag{3}$$

Where *A* and *B* are constants; *Y* and *Y** represent domestic and external income, respectively; $\eta < 0$ and $\gamma < 0$ denote the price elasticities of demand for exports and imports, and $\varepsilon > 0$ and $\pi > 0$ the income elasticities of exports and imports, respectively. Taking logs and derivatives with respect to time the dynamic versions of equations (2) and (3) are obtained

$$x = \eta(p - p^*) + \varepsilon y^* \tag{4}$$

$$m = \gamma(p^* - p) + \pi y \tag{5}$$

where lower-cases express growth rates. Substituting equations (4) and (5) into equation (1) we obtain the expression that determines the output growth rate consistent with the balance of payments equilibrium of an open economy:

$$y_{BP} = \frac{(1 + \eta + \gamma)(p - p^*) + \varepsilon y^*}{\pi} \tag{6}$$

Substituting the expression $\varepsilon\ \gamma^*$ from equation (4) into equation (6), the growth rate that ensures the balance of payments equilibrium γ_{BP} is given by a linear combination of the growth rate of exports and the terms of trade:

$$y_{BP} = \frac{x + (1 + \gamma)(p - p^*)}{\pi} \tag{7}$$

Finally, if it is assumed, as Thirlwall (1979) suggests, that relative prices stay constant in the long run, i.e. *(p-p*)*, then the equation (6) reduces to

$$y_{BP} = \frac{\varepsilon y^*}{\pi} \tag{8}$$

or

$$y_{BP} = \frac{x}{\pi} \tag{9}$$

Expression (9) is referred to as "Thirlwall's Law" in the literature, and establishes that, in the long run, the growth rate of a country's economy is determined by its international payments position. As such, the only component of

autonomous demand, the external sector, and exports in particular, determine the sustainable growth of the economy.

Thirlwall's simple model has undergone different specifications over time in order to include other economic aspects relevant to the theoretical growth rate compatible with the balance of payments equilibrium: Thirlwall and Hussain (1982) extended the model with the inclusion of terms of trade and capital flows; McCombie and Thirlwall (1997) and Moreno-Brid (1998-1999) extended the model to include the external debt dynamic; Nell (2003) included in the model the idea of disaggregating the exports in function of markets of destination; Araujo and Lima (2007), Gouvêa and Lima (2010) and Cimoli *et al.* (2010), among others, included in the model the sectoral disaggregation of exports, with the objective of analyzing the influence of the different sectors (from a technological perspective) on the balance of payments constraint. In Thirlwall (2011), both a revision of extensions of the model, as well as numerous empirical contributions made to the different versions can be found.

Insofar as this study analyses the influence of Argentine commodity exports in the balance of payments constraint, the sectoral contributions are the most interesting extensions of the model for our goals. The most commonly followed strategy has been to carry out estimations for the income elasticity of imports and the growth rate compatible with the balance of payments equilibrium for disaggregated export sectors, with the objective of analyzing the influence of these sectors in the balance of payments constraint. In any case, the logic of the model is the inclusion in equation (9), or in one of the extended models, of those variables that determine the growth rate of exports and the income elasticity of imports. Standing out, among other factors, are the productive structure, the patterns of internal and external demand, technological patterns, the existence or not of commercial barriers of a different type, or the level and stability of the real exchange rate (CEPAL, 2012).

The following section presents a review of the empirical studies involving the Argentine case that utilize one of the versions of Thirlwall's model in the last decades. To analyse the role of high commodity prices in recent years, an estimation of the model (specified in the following section) is carried out for the period 2002-2011 in which separately both the overall exports and commodity exports are included.

3. Applications of the model to the Argentine economy

Table 1 presents the results of recent studies that have applied some version of Thirlwall's model for the analysis of the balance of payments constraint in Argentina.

The work of López and Cruz (2000) applies the simple model contained in equation (9). Through VAR models, the authors estimate the income elasticity of imports that ensures balance of payments equilibrium, h, which is the estimation carried out through equation (9). On the other hand, they estimate

the income elasticity of imports, $\hat{h}$, through a typical equation that includes the volume of imports, domestic growth and the real exchange rate. In the case of Argentina, the authors observe that the income elasticity of imports that would ensure the balance of payments equilibrium is lower than the estimated income elasticity of imports. As a consequence, for the period under consideration, Argentina would exhibit an inconsistent position of balance of payments disequilibrium reflected in a higher income elasticity of "real" imports than that which would ensure balance of payments equilibrium.

Meanwhile, Holland *et al.* (2004) analyse the balance of payments constraint in various Latin American countries applying equation (7). Through VAR models the authors validate Thirlwall's model for Argentina in the period 1969-2000. They observe a high income elasticity of imports and consequently find that the (slow) economic growth for this period of 30 years has been limited by the balance of payments position.

Along this same line, Fugarolas and Matesanz (2008)[3] estimate the model based on equation (7) for two periods. As seen in table 1, in the model that does not include the crisis of 2002, the real growth of the economy was higher than the estimated balance of payments equilibrium, while in the model that extends to 2003 it was lower. The results suggest that the economic downturn and the end of Convertibility reflected the inconsistencies of the previous economic dynamics in relation to the balance of payments. This interpretation is in line with the results of López and Cruz (2000), although contrary to those exhibited in the work of Holland *et al.* (2004).

Gouvêa and Lima's study (2010) compares the basic model contained in equation (9) with a multi-sectoral model that considers the different impacts of export sectors, classified by technological content, in the balance of payments constraint[4]. In the Argentine case, the authors validate both models for the period 1962-2006, obtaining theoretical growth rates compatible with the external equilibrium which are close to the actual rates of the economy. For Argentina, both of the rates are the lowest in the group of countries analysed (Brazil, Columbia, Mexico, South Korea, Malaysia, Singapore and the Philippines).

[3] Matesanz *et al.*, (2007) compare the balance of payments constrained growth between Argentina and Mexico. This study is an extension of these two papers focusing this time on the role of commodity exports in the Argentinean external vulnerability since the Convertibility collapse in 2002.

4 In their model, Gouvêa and Lima (2010) do not show in their results the effects of this sectoral disaggregation in the balance of payments constraint, as shown in CEPAL (2012).

Table 1. Applications of the balance of payments constraint model to Argentina

	$\hat{h}$	h	$\hat{y}$	y	$\hat{u}$	u
López and Cruz (2000) (1965-1996)	2,8	2,4				
Holland et al. (2004) (1969-2000)	4,07		2,26	2,12		
Fugarolas and Matesanz (2008)	4,81 4,82					
(1968-2000)			1,98	2,06		
(1968-2003)			2,01	1,72		
Gouvêa and Lima (2010) (1962-2006)			3,24	2,7	1,3	1,16
	a	*b*	*c*	*d*	*e*	*f*
CEPAL (2012) (1962-2008)	0,7	1,95	0,95	1,72	1,48	0,9

Notes: *h and* $\hat{h}$ are, respectively, the equilibrium and estimated elasticities of imports; and y, are, respectively, the estimated equilibrium and actual growth rates; $\hat{u}$ and u are, respectively, the estimated equilibrium and actual growth rates of the output per capita. *a, b, c, d, e* and *f* are, respectively, the income elasticities of the exports of commodities, manufacturing exports based on natural resources, low (*c*), medium (*d*) and high (*e*) technology manufacturing exports and other export sectors (*f*). The period of analysis is presented in parenthesis.

Similar conclusions are reached in the CEPAL study (2012) for the same sectors in the period 1962-2008. In this work it is also shown that the ratio between the income elasticity of exports and imports is lower for Argentina than for Brazil and Mexico in the same period (these being significantly lower than in South Korea and Malaysia). Though this study does not explicitly calculate the theoretical growth rate compatible with the external equilibrium, from the dynamic of both elasticities it is inferred that related rates should be the lowest in the group of countries used for comparison. Both results confirm the basic conclusion of Fugarolas and Matesanz (2008), Holland *et al.* (2004) and López and Cruz (2000); one of the main explanations for the (slow) growth of the Argentine economy since the sixties is its balance of payments behavior which imposes a restriction on long run economic growth.

4. An analysis of the impact of commodities on the balance of payments constraint in Argentina.

As can be deduced from the previous section, the balance of payments constraint on Argentine economic growth has been a central element in the economic growth of the country, as much so in the long term to explain the slow growth of the country in the last decades, as in the short and medium

term to inquire into the causes of the recurring currency crises the country has suffered.

The approximation proposed by the traditional model, in Anthony Thirlwall's version, on the balance of payments constraint, is based to a certain extent on an aggregate monetary approach. As already noted, in the model, growth is limited by the availability of foreign currency, which is supplied by exports, employed to finance imports. However, in this scheme, the role of the different export sectors is not analysed separately. In the current moment of high commodity prices, this is a central topic for the analysis of the contribution of disaggregated export sectors. Recent efforts in this direction are the studies of Gouvêa and Lima (2010) and CEPAL (2012). In these studies the authors observe that the export of commodities has shown lower income elasticity in the Argentine economy and, as such, has tended to accentuate the balance of payments constraint in the country. In contrast, the industrial sectors, especially those of medium technological intensity, have been characterized as sectors of higher export activity and higher income elasticity, having assumed a relaxation of external constraint.

However, these studies analyse long periods of Argentine economic development[5], and therefore the effect of the sharp price increase of raw materials in recent years remains diluted, even more so considering that both studies used a linear methodology to estimate export functions.

In this study we have carried out an application of Thirlwall's model based on equations (7) and (9), taking into consideration both the effect of terms of trade (equation 7) and the classical model without this variable (equation 9). Beginning from equation (7), by means of cointegration analysis, the following log-linear model has been estimated:

$$ln Y_{BP_t} = \beta_o + \beta_1 ln X_t + \beta_2 ln(P^*/P)_t + \varepsilon_t \quad (10)$$

where, $\beta_1 = 1/\pi$ and $\beta_2 = 1 + \gamma/\pi$, the terms of trade, $TOT = P^*/P$, are calculated as the price of exports divided by the price of imports, measured in common currency, and ε_t is a white noise term.

In the same manner, starting from equation (9), the model to estimate is that represented by equation (11)[6]:

$$ln Y_{BP_t} = \beta_0 + \beta_1 ln X_t + \varepsilon_t \quad (11)$$

[5] In the case of Gouvêa and Lima (2010) the period under analysis is 1962-2006, while in the work of CEPAL (2012) the period analysed is 1962-2008.

[6] The role of capital flows has not been considered in this study. After the Argentine external debt default in January 2002, the access to international capital flows for the Argentine economy has been strongly limited. Additionally, net capital flows have shown one of the most volatile period in Argentinean recent history (Frenkel and Rapetti, 2007; Pesce, 2008).

where, again, $\beta_1 = 1/\pi$ and ε_t is the random error term with white noise.

The analysis was carried out using quarterly data from the Argentine economy for the period between the first quarter of 2002 and the fourth quarter of 2011[7]. The variables used were: real exports, measured by a volume index (National Institute of Statistics and Censuses, INDEC), the real gross domestic product, measured by a volume index (International Monetary Fund, IMF), and terms of trade as export prices over import prices, expressed in US dollars (INDEC). Additionally, to investigate the role of commodities, the functional forms (10) and (11) have been estimated taking into consideration the volume of real exports of commodities (INDEC).

Table 2. Argentina. Real GDP, exports, imports, terms of trade (various periods). Cumulative annual growth rates

	y (1)	x (1)	x_{vol} (1)	x_{pb} (1)	x*pbvol* (1)	*m* (1)	π (2)	*TOT* (3)
1968-2000*	2,06	9,4	n.a.	n.a.	n.a.	9,7	4,71	-0,17
1986-2001	1,8	9,4	8,2	6,1	5,7	10,2	5,67	-0,04
2002-2011	8,8	17	8	18,5	6,92	24	2,73	4,3

Source: Elaborated by the authors with data from IMF and INDEC

(1) Real GDP growth rates, total nominal exports, total real exports, exports of nominal commodities, exports of real commodities and real imports, respectively.

(2) Implicit elasticity of imports ($\pi = m/y$).

(3) Terms of trade *(TOT = P*/P)*.

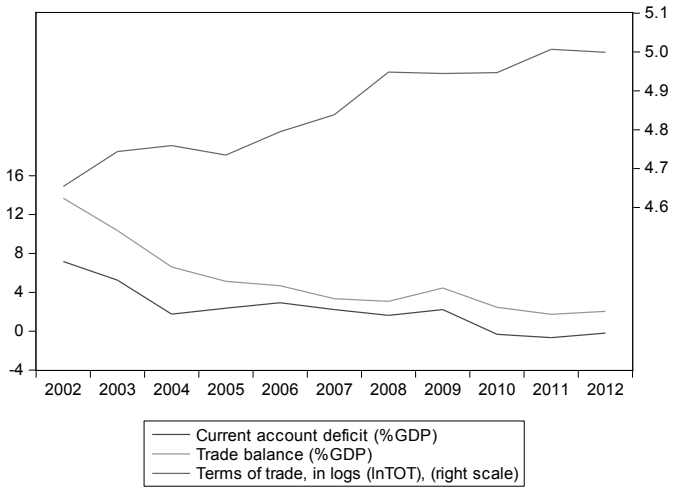
* Source: Fugarolas and Matesanz (2008)

Table 2 presents the annual growth rates of the variables involved in our analysis since 1986, displaying two sub-periods: 1986-2001 and 2002-2011. Upon comparison of the two periods referenced in the table, various important factors can be observed. First, the increase in growth rates in the post-Convertibility period, being especially relevant the increase in output, the improvement in terms of trade, and the rise in value of imports and exports. Interestingly, while the growth in value of exports is significant, in the case of volume the increase is much more modest, a fact that is confirmed upon observing the strong improvement of terms of trade for Argentina in the period. Interesting enough, when comparing total exports with exports of commodities

[7] As long as the previous mentioned investigations have analysed longer periods, we focus on the Post-convertibility stage to study the sustainability of the recent Argentine economic growth from the balance of payments point of view. Even though Thirlwall´s model represents the balance of payments equilibrium growth in the long run, the model has been successfully applied to shorter periods (see Thirlwall, 2011, for a review including countries, periods and methodologies).

it is observed that while in nominal terms exports of commodities show higher rates of growth, in volume it happens the opposite; the volume of total exports shows a higher rate of growth. This situation reflects that export prices for Argentina impact more intensely in commodities, as expected. Additionally, a fall in the implicit elasticity of imports is observed, in spite of its significant rise in the period 2002-2011. Thirlwall's model should yield different values, with respect to the estimates carried out for previous periods, as much for the estimation of income elasticity of imports as for the theoretical growth rate that ensures the balance of payments equilibrium.

Figure 1. Argentina. Current account deficit, trade balance and terms of trade (2002-2012)



Source: Terms of trade (INDEC), current account deficit and trade balance (CEPAL)

Figure 1 shows the terms of trade, the trade balance and the current account balance as percentage of the GDP. As clearly seen, the crisis of 2002 boosted sharply the current account surplus to 7% of the GDP that year. A declining tendency is observed afterwards and from 2010 on Argentine has obtained low deficits. The same dynamic is observed for trade balance nevertheless trade of goods has shown surpluses during the whole period under analysis (reaching 14% of the GDP in 2002). This tendency of current account and trade balance surpluses to diminish has been hand in hand with increasing terms of trade during the whole period under analysis. Even though international price market conditions have been favourable for Argentine trade its external position has lost impetus through time.

In the model estimation, it was confirmed that the variables present unit roots for which we opted for a cointegration analysis[8], which allows for testing the existence of stationary linear combinations among the series. The latter, also called cointegration equations, can be interpreted as the relationship of long-term equilibrium between the different variables that form the equation.

Specifically, the cointegration analysis was carried out via the Johansen and Juselius (1990) procedure which, on the basis of vector autoregressive (VAR) models with Gaussian errors, applies maximum likelihood methods in order to test the existence of cointegrating equilibrium relationships by means of the trace and the maximum eigenvalue statistics. Finally, the procedure allows for the coefficients of the cointegration vector to be estimated.

Table 3 presents the results by applying the methodology that has been briefly described[9]. Four models were considered:

Model 1 $$lnY_{BP_t} = \beta_o + \beta_1 \ln X_t + \beta_2 \ln(P^*/P)_t + \varepsilon_t$$

Model 2 $$lnY_{BP_t} = \beta_o + \beta_1 \ln Xpb_t + \beta_2 \ln(P^*/P)_t + \varepsilon_t$$

Model 3 $$\ln Y_{BP_t} = \beta_0 + \beta_1 \ln X_t + \varepsilon_t$$

Model 4 $$\ln Y_{BP_t} = \beta_0 + \beta_1 \ln Xpb_t + \varepsilon_t$$

Models 1 and 2 are derived from equation (10) and as such include the terms of trade, while models 3 and 4 are based on equation (11), excluding terms of trade. On the other hand, models 1 and 3 include total exports, while the other two models carry out the analysis incorporating the exports of commodities, x_{pb}, in place of the total volume of exports. In this fashion, models 2 and 4 represent a "hypothetical" and unreal situation as whether all Argentine exports are commodities. These two hypothetical models allow us to isolate the effects of commodities in the balance of payments constraint growth and, therefore, allow for comparison to the real situation including all exports (models 1 and 3). All the models are based on the "classic" version of Thirlwall's model, which uses the volume of exports.

Various relevant conclusions can be made from the cointegration analysis (see table 3). First, the most important conclusion observed is the dramatic increase experienced by growth rates compatible with the balance of payments

[8] Even when a direct estimation of the functional relationships of growth rates might possible, this regression analysis, in which the variables are differenced to the point of achieving stationarity, can result in loss of information.

[9] The information corresponding to the analysis of the stationarity of the variables, the estimation of the VAR model, the cointegration test results, and other aspects of the methodology are in the Appendix.

equilibrium, y_{BP}, compared to those obtained in previous studies. The highest rate previously estimated is that produced by the work of Gouvêa and Lima (2010) for the lengthy period 1962-2006. In this case the estimated value does not reach 3.5% per year (see table 1), whereas in our work the estimated rates, for all models analysed, exceed 9.5%, being even higher than 11% per year for model 2[10]. In this sense, the post-Convertibility period is considered a phase in which the external balance of payments constraint relaxes, allowing for increased growth of the Argentine economy compatible with the balance of payments (in line with, among others, Santarcángelo, 2012; Bianco *et al.*, 2007).

Table 3. Argentina. The Johansen and Juselius Test. Estimated cointegration equations

	Coefficients of cointegration			Elasticity		
	$\hat{\beta}_0$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\pi}$	y_{BP}	y
Model 1 (***X***; ***TOT***)	-3,29	0,88 (18.55)	0,80 (10.93)	4,60	9,91	8,8
Model 2 (***Xpb***; ***TOT***)	-7,03	0,64 (9.08)	1,70 (13.77)	6,35	11,29	8,8
Model 3 (***X***)	-1,40	1,31 (9.44)	-	3,03	9,82	8,8
Model 4 *(Xpb)*	-3,70	1,55 (4.15)	-	2,58	10,04	8,8

Note: The coefficients are normalised for the GDP, β_1 and β_2 representing the elasticity of exports and terms of trade; ***t***-statistic between parenthesis; π the income elasticity of imports (the inverse of β_1, once has been annualised) and y_{BP} indicates the growth rate of the estimated output consistent with the balance of payments equilibrium. It should be noted that y_{BP} is estimated from the calculated coefficients of cointegration in Models 1-4. Results have been annualized in order to make easier the comparison with more traditional studies on this topic.

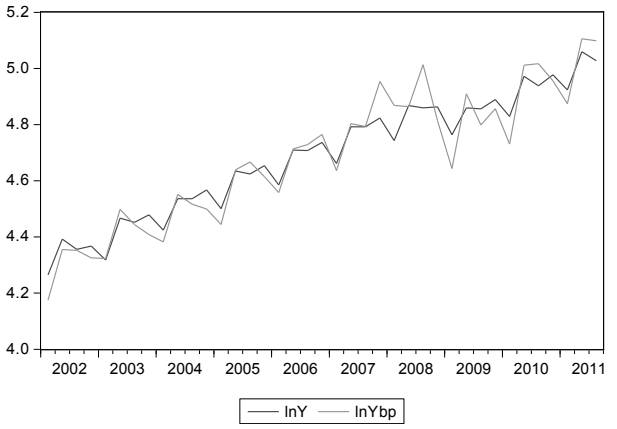
Second, higher theoretical growth rates are achieved when considering the export of commodities, models 2 and 4, in place of total volume exported. In addition to this result, table 2 shows that, as much as for volume as for value, commodity exports have grown more quickly than total exports after the Convertibility collapse, something that did not occur previously. Therefore, in the post 2001 phase, overall exports increased, distancing the external constraint due to foreign revenue generated by exports which allowed financing the economic growth with no foreign indebtedness. The role of commodities is central to explain the expansion of exports as they substantially increase in value and volume, as much for the overall exports in the period 2002-2011, as in the previous period 1986-2001. However, the volume growth of total exports remains

[10] The income elasticity of imports, π, and the equilibrium and actual growth rates, yBP and y, respectively, have been annualized, since the estimation produces quarterly rates due to the regularity of the data used.

approximately stable between the two periods, 1986-2001 and 2002-2011 (see table 2). The results, in fact, indicate that if the overall exports had continued at the same rate as the exports of commodities, the Argentine economy could have grown at rates superior to 10%, without tensions in the balance of payments. In any case, the real growth rate has been lower than the estimated one, for which the tensions, up until the end of 2011, have not manifested in the overall economy. Thus, a new aspect in the current period of the Argentine economy is the important role of commodities in its export behavior that has contributed to creating an external sector capable of avoiding balance of payments growth constraint and allowing for rates unseen in previous decades.

Third, it is relevant to point out that model 2, which includes the exports of commodities and the terms of trade, presents an income elasticity of imports compatible with an even higher output growth (like the estimated growth rate of equilibrium of balance of payments). In this sense, the model shows that the export of commodities is capable of financing a higher volume of imports per unit of output than the overall exports. This result reinforces the central role of commodity exports in the long-run growth capacity of the economy, without confronting early limitations due to external disequilibrium.

Figure 2. Argentina. Estimated and effective income (model 1)



In the models that include the terms of trade, it is confirmed that in the case of the export of commodities, the coefficient of the terms of trade is positive and higher than that of overall exports. This result shows that the terms of trade, in the case of basic product exports, are more important for the growth of the economy compatible with external equilibrium than in the case of the overall exports. To the extent that commodity prices have experienced a long

period of high prices, this elevated coefficient indicates that, as it cannot be otherwise, these prices have been central to the export dynamic of commodities.

Finally, in order to confirm the existence of a relationship of stable equilibrium between the effective income level, *lnY*, and that deriving from the condition of external equilibrium, lnY_{BP}, (see Alonso, 1999 or Alonso and Garcimartín, 1999), we analysed cointegration of both variables. Additionally, if the coefficient corresponding to lnY_{BP} in the normalized vector is not significantly different from unity, it could be assumed that the evolution of both variables follows the same trend in the long term. From an economic point of view, this could be interpreted as the existence of a growth path in equilibrium, around which the effective evolution of income fluctuates.

Results are reported in Table 4. For Models 1, 2 (just at the marginal 1% significance level) and 4, the estimate corroborates the existence of long-term relationship between the variables *lnY* and lnY_{BP}. Additionally, the application of the Wald test to the restriction $\beta_1 = 1$ allows us no rejecting the hypothesis that the coefficient of lnY_{BP} is equal to unity. The results confirm the existence of the external restriction in the Argentine case for the period under analysis. Figure 2 displays, for Model 1, both the effective income, *lnY*, and the estimated external equilibrium income, lnY_{BP}. We can observe a close path in both variables for the whole period, arising some differences around the financial crisis.

Table 4. Analysis of stable equilibrium. Johansen test and Wald test. Results

	Johansen and Juselius test		Coefficients of cointegration		
	Number of cointegration relations	Trace statistic	$\hat{\beta}_0$	$\hat{\beta}_1$	Wald test
Model 1	None At most 1	28,034 (p = 0) 3,811 (p = 0,051)	0,056	0,988 (*t*-sta = 31,909)	0,150 (p = 0,699)
Model 2	None At most 1	26,647 (p = 0) 5,843 (p = 0,020)	0,402	0,915 (*t*-sta = 13,991)	1,710 (p = 0,191)
Model 3	None	12,681(p = 0,127)	--	--	--
Model 4	None At most 1	15,950(p = 0,043) 3,347(p = 0,067)	-0,284	1,059 (*t*-sta = 4,252)	0,056 (p = 0,813)

Note: The coefficients are normalised for the *lnY*; estimated VAR(5) according to information criteria. Johansen test (model allowing for a linear deterministic trend in data, and intercept (no trend) in cointegration equation). For brevity we report results for trace test; results for maximum eigenvalue statistics are similar.

5. Conclusions

The growth of the Argentine economy has been one of the slowest and most volatile in Latin America since the 1960s. One of the explanations for this unsuccessful dynamic, at least from a macroeconomic point of view, has been the external vulnerability confronted by the economy reflected in the growth constraint imposed by the balance of payments (Braun and Joy, 1968; Díaz Alejandro, 1970; Canitrot, 1981; Matesanz *et al*., 2007; Fugarolas and Matesanz, 2008). In this sense, one of the central problems to Argentine development has been, and remains, achieving some output stability, avoiding its characteristic dynamic of advances and setbacks from the last half century (Gerchunoff and Ramos, 2005).

However, since the collapse of the Convertibility regime, the Argentine economy has experienced one of its phases of highest economic growth in recent history. One of the debates regarding this economic phase derives from the sustainability of this recent successful performance, which has shown an annual growth rate close to 9%. It can be argued that this successful performance could be driven by an international environment of low interest rates, high prices of commodities, and increased availability of financing for developing countries. If this "tail wind" runs out the positive international economic conditions for the Argentine economy could imply an end to the intense expansion after 2002.

Recently the analysis of the balance of payments constraint has been carried out within the framework of Thirlwall (1979) and Thirlwall and Hussain's (1982) model, confirming not only the slow growth of the economy, but also the importance of this constraint on the crisis and the end of Convertibility (CEPAL, 2012; Gouvêa and Lima, 2010; Fugarolas and Matesanz, 2008; Holland *et al*., 2004; López and Cruz, 2000). However, none of these studies have explicitly analysed the dynamic after the fall of the Convertibility phase, or the role of the export of commodities in this same period. This study has attempted to fill this gap.

Through the application of cointegration techniques to Thirlwall's model, two central conclusions have been reached in respect to the balance of payments constraint and the role of commodities in the Argentine economy for the period 2002-2011.

In the first place, one can clearly observe a dramatic relaxation in the balance of payments constraint that the Argentine economy has suffered since, at least, the 1960s. Specifically, the external dynamic in the 2002-2011 period in Argentina would have allowed the country to grow at a rate close to 10% without tensions in financing the balance of payments, a higher rate than that which is actually seen in the economy (slightly more than 8% per year). Additionally, the terms of trade during this period have been relevant in explaining this external dynamic (as demonstrated by its positive and significant coefficient, see table 3). Terms of trade are defined as much in terms of international prices as in the dynamic of the nominal exchange rate of the Argentine peso, since terms of trade are valued in dollars.

In the second place, it can be observed that the export of commodities, as much in volume as in value, has accelerated in the post-Convertibility phase, while the overall exports have done so in value but not in volume (see table 2). Thus, the balance of payments constraint associated with the export of commodities, such as the theoretical income elasticity of exports, shows improved performance. Specifically, our analysis shows that, if the total exports would had followed the commodities dynamic, the economy would have been able to grow at rates exceeding 11% without tensions in the balance of payments, a higher rate than that seen for the overall exports. In the same line, the imports by unit of output could have been higher than in the case of the overall exports, indicating the central role of this segment of Argentine exports.

The central conclusion of this study is the important role that commodities have had in relaxing the external constraint of Argentine growth after the fall of the Convertibility regime. However, the entire external sector has pushed in the direction of increasing the growth boundaries that traditionally imposed the balance of payments on the economic expansion of the country. Again terms of trade are central to understand the performance of the Argentine economy. Its evolution have been central elements in the external vulnerability of the country. In terms of the debate over the sustainability of the (elevated) Argentine economic growth, this work shows that commodities and terms of trade have been a relevant factor, though not the only one, as the entire external sector has exhibited a positive performance. In any case, our results show that Argentine economic growth in 2002-2012 period has been balance of payments constrained and, therefore, the traditional external vulnerability is still working even though international market conditions have permitted output to grow at extremely high rates for recent Argentine economic history.

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Appendix. Methodological information

In a first stage, stochastic time series properties are studied. We apply both unit root (ADF test, implemented following the sequential procedure proposed by Dolado *et al*., 1990), and stationarity (KPSS) tests as a means to reinforce the conclusions[11] of both kinds of tests and to obtain robust results (Tables A.1 and A.2). Results show that all series included in the study present a unit root in levels form but not in first difference and, therefore, all of them are integrated of order one, *I(*1). *ln*(*Y*), according to the ADF test, contains two unit roots, while the KPSS concludes that the series is *I*(1). This contradiction could be imputable to the deficient power of the unit root test.

Table A.1. ADF test

	Model (intercept + trend)				Model (intercept)				Model (none)	
Variable	*k*	t_{tc}	τ_β	φ_3	*k*	t_c	τ_μ	φ_1	*k*	t_{nc}
ln(Y)	4	-3.142	2.997**	8.987**	-	n.a.	n.a.	n.a.	-	n.a.
Δ*ln(Y)*	4	-2.428	-0.592	0.351	4	-2.410	2.283	5.210**	3	-0.346
ln(TOT)	0	-3.531	2.945**	8.675**	-	n.a.	n.a.	n.a.	-	n.a.
Δ*ln(TOT)*	0	-6.160**	n.a.	n.a.	-	n.a.	n.a.	n.a.	-	n.a.
ln(X)	5	-2.254	1.882	3.542	4	-1.382	1.447	2.093	3	2.759
Δ*ln(X)*	2	-9.927*	n.a.	n.a.	-	n.a.	n.a.	n.a.	-	n.a.
ln(Xpb)	5	-2.938	1.582	2.495	6	-1.678	1.696	2.870	6	0.658
Δ*ln(Xpb)*	5	-3.737**	n.a.	n.a.	-	n.a.	n.a.	n.a.	-	n.a.

Notes: *k* is the lag length chosen in order to remove serial correlation in the residuals. In our case it was selected according to an automatic criterion based on SIC (maxlag = 9), and also autocorrelation of the residuals was examined. Subscripts tc, c and nc indicate if trend and intercept, intercept, or none is included. τ_β, φ_3, τ_μ, φ_1 denote statistics for individual or joint significance of trend and intercept assuming unit root. ** and * indicate rejection at the 5 and 1% significance level respectively according to MacKinnon (1996) critical values.

n.a.: non available.

Table A.2. KPSS test

Variable	*l*	Model (intercept + trend)	*l*	Model (intercept)
ln(Y)	3	0.210**	5	0.762*
Δ*ln(Y)*	10	0.114	10	0.177
ln(TOT)	1	0.081	5	0.747*
Δ*ln(TOT)*	14	0.169**	14	0.279

[11] This strategy is followed, among others, in Delgado and Presno (2010).

ln(X)	1	0.158**	5	0.692**
Δ*ln(X)*	9	0.112	11	0.187
ln(Xpb)	9	0.095	2	0.406***
Δ*ln(Xpb)*	11	0.197**	11	0.228

Notes: For the consistent estimation of the long-run variance we considered the Bartlett kernel depending on the bandwidth parameter l chosen according to the Newey-West automatic bandwidth selection method. ***, ** and * indicate rejection at the 10, 5 and 1% significance level respectively according to Kwiatkowski *et al.* (1992) critical values.

Next, the cointegration analysis was implemented by the Johansen test, which applies maximum likelihood to a VAR model assuming that the errors are Gaussian. In a first stage we estimated a VAR model with the appropriate lag length (Tables A.3 and A.4).

Table A.3. VAR. Lags

	Model 1					Model 3				
Lag	LR	FPE	AIC	SC	HQ	LR	FPE	AIC	SC	HQ
0	n.a.	4.52e-07	-6.099	-5.560	-5.915	n.a.	0.000195	-2.868	-2.509	-2.746
1	161.829	1.94e-09	-11.563	-10.620*	-11.242	153.191	1.04e-06	-8.104	-7.565*	-7.920
2	12.108	2.07e-09	-11.538	-10.191	-11.079	7.771	9.90e-07*	-8.167	-7.449	-7.923*
3	6.1549	2.80e-09	-11.302	-9.551	-10.705	2.168	1.17e-06	-8.022	-7.125	-7.716
4	6.487	3.74e-09	-11.133	-8.978	-10.398	2.206	1.37e-06	-7.887	-6.810	-7.520
5	22.673*	1.70e-09*	-12.115*	-9.556	-11.242*	10.905*	1.05e-06	-8.197*	-6.940	-7.769
	Model 2					Model 4				
Lag	LR	FPE	AIC	SC	HQ	LR	FPE	AIC	SC	HQ
0	n.a.	3.87e-06	-3.951	-3.412	-3.767	n.a.	0.002	-0.628	-0.269	-0.506
1	163.348	1.57e-08*	-9.471	-8.528*	-9.150*	159.242	7.90e-06	-6.080	-5.541*	-5.896
2	13.131	1.60e-08	-9.489	-8.142	-9.030	9.714*	6.95e-06*	-6.218*	-5.500	-5.973*
3	4.807	2.32e-08	-9.188	-7.438	-8.591	1.068	8.57e-06	-6.028	-5.130	-5.721
4	6.686	3.06e-08	-9.030	-6.876	-8.296	5.634	8.63e-06	-6.048	-4.971	-5.681
5	20.043*	1.65e-08	-9.837	-7.278	-8.965	6.194	8.34e-06	-6.123	-4.866	-5.694

* indicates lag order selected by the criterion. LR (sequential modified likelihood ratio test statistic), FPE (final prediction error), AIC (Akaike information criterion), SC (Schwart criterion), HQ (Hannan-Quinn criterion). For Models 2 and 3 we found different conclusions depending on the criteria. In these cases, we analysed the residuals for both lags. Attending to this criterion we selected 5 and 2 lags for Models 2 and 3, respectively.

n.a.: non available.

Table A.4. VAR. Residuals

	Model 1 (5 lags)	Model 2 (5 lags)	Model 3 (2 lags)	Model 4 (2 lags)
Autocorrelation test. H_0: No autocorrelation				
Lags	LM-statistic	LM-statistic	LM-statistic	LM-statistic
1	3.832 (0.922)	4.791 (0.852)	2.859 (0.582)	3.821 (0.431)
2	18.001 (0.035)	19.128 (0.024)	5.567 (0.234)	4.607 (0.330)
3	6.644 (0.674)	4.304 (0.890)	1.933 (0.748)	3.232 (0.520)
4	8.446 (0.490)	6.458 (0.693)	1.308 (0.860)	1.453 (0.835)
5	6.855 (0.652)	7.527 (0.582)	8.324 (0.080)	5.424 (0.247)
6	9.642 (0.380)	6.451 (0.694)	2.303 (0.680)	3.304 (0.508)
7	7.253 (0.611)	9.422 (0.399)	2.680 (0.613)	4.418 (0.352)
8	11.219 (0.261)	6.607 (0.678)	7.408 (0.116)	7.684 (0.104)
Normality test. H_0: Normality				
JB_{CHOL}	6.182 (0.403)	4.611 (0.595)	2.424 (0.658)	2.585 (0.629)
JB_{URZ}	21.700 (0.653)	21.636 (0.657)	4.866 (0.846)	4.307 (0.890)
Heteroscedasticity test. H_0: Homoscedasticity				
White	180.43 (0.477)	181.388 (0.457)	19.209 (0.741)	19.010 (0.751)

Figures in parentheses represent p-values associated with the tests.

Finally, Table A.5 reports results for the Johansen and Juselius (1990) cointegration procedure. It confirms the existence of cointegrating equilibrium relationships.

Table A.5. Johansen and Juselius cointegration test

Model 1			Model 3	
Number of cointegration relations under H0	Trace statistic	Maximum eigenvalue statistic	Trace statistic	Maximum eigenvalue statistic
None	49.955 (0)	42.259 (0)	20.036 (0.009)	19.606 (0.006)
At most 1	7.695 (0.499)	6.218 (0.585)	0.430 (0.512)	0.430 (0.512)
At most 2	1.477 (0.224)	1.477 (0.224)	--	--
Model 2			Model 4	
Maximum eigenvalue statistic	Trace statistic	Maximum eigenvalue statistic	Trace statistic	Maximum eigenvalue statistic
None	55.316 (0)	41.905 (0)	31.875 (0)	31.515 (0)
At most 1	13.412 (0.101)	9.690 (0.233)	0.360 (0.549)	0.360 (0.549)
At most 2	3.722 (0.054)	3.722 (0.054)	--	--

Attending to the characteristics of the series, we opted for a model allowing for a linear deterministic trend in data, and intercept (no trend) in cointegration equation.

Figures in parentheses represent p-values computed according to MacKinnon-Haug-Michelis (1999).