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Balance of Payments Constrained Growth in China: An Application of the Autoregressive Distributed-Lag Modelling Approach

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Abstract

This paper applies the balance of payments constrained growth (BPCG) model to the Chines economy using data from the Organization for Economic Co-operation and Development (OECD) over the period 1982-2011. The long-run income elasticity of demand for imports, the relative price elasticity of demand for imports and the adjustment speed parameter from the import demand equation are estimated. The computation of the parameters is conducted through the autoregressive distributed-lag econometric modelling technique (ARDL). The short-run adjustments are obtained by using a vector error correction model. We found that estimated average growth rate forecasted by the BPCG model approaches the average real growth rate over the analyzed period.

Balance of payments constrained growth, Chinese economy, economic growth, income elasticity of demand for imports.

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Introduction

Thirlwall (1979) proposed the BPCG model, which is aimed at analyzing the relationship between the balance of payments and economic growth. The model shows that the balance of payments might constraint the production rate of growth, as it can set a boundary on economic growth in a certain level of demand to which supply can be adapted. A rise in national production, requiring an increase in imports, can lead to a deficit in the balance of payments. The solution could be a depreciation of the real exchange rate or a demand reduction, in order to guarantee the sustainability of the external deficit. Consequently, an unsustainable external deficit eventually must be corrected, which can reduce the production growth.

Assuming that the real exchange rate is maintained relatively constant, the concept of the balance of payments constrained growth is defined as the ratio of the growth rate of exports to the income elasticity of demand for imports. Only when the rate of growth of the real gross domestic product (GDP) turns out to be lower than balance of payments constrained growth rate, it will be possible for a country to reach sustainable growth, and therefore, simultaneously, the balance of payments will remain in equilibrium. This condition, also known as the Thirlwall's law, is equivalent to the dynamic Harrod foreign trade multiplier, introduced by Harrod (1933). It implies that if the rate of growth of a country is higher than the balance of payment constrained growth rate, it will cause an external deficit and will reduce the expected rate of growth, and vice versa, if the rate of growth of a country is lower, it will obtain an external surplus. These concepts are analogues to the results presented by Krugman (1989), who found that the countries growing to higher rates have a larger income elasticity of demands for exports than for imports.

The Thirlwall's model has been widely tested and proved since it was proposed.

The model provides a useful approximation to the economic rate of growth in both developed countries and emerging economies. In recent years the BPCG model has been applied in its different forms, in wide range of studies, across countries. In this respect, Beko (2003) studied the Slovenian case; India is analyzed by Razmi (2005); The Brazilian economy is analyzed by Bértola et al. (2002), Ferreira y Canuto (2003), Jayme (2003), Carvalho et al. (2008), Carvalho y Lima (2009), Britto y McCombie (2009), and by Alcantara y Strachman (2014), while Irland is examined by Garcimartín et al. (2008). The Argentinian case is studied by Fugarolas and Matesanz (2008) and Chena (2014); Felipe et al. (2010) explored the Pakistani case; Soukiazis y Antunes search the Portuguese economy (2011); and the Mexican economy was examined by Moreno-Brid (2002, 2003), Guerrero de Lizardi (2003, 2006), Pacheco-López y Thirlwall (2004), Pacheco-López (2005), Cardero y Galindo (2005), among others. The majority of these papers support the balance of payments constrained growth hypothesis.

Among the studies exploring group of countries we could highlight Holland et al. (2004) who analyzed a group of ten Latin American economies; Kvedaras (2005) explored a group of ten Eastern European economies; Pacheco-López and Thirlwall (2006) examined 16 countries from Latin America; Gouvea and Lima (2016) also explored the Latin American region through a group of four countries and contrasted the results with a group of four Asian economies; Bagnai (2010) analysed a sample of OECD countries; Garcimartín et al. (2010) studied Portugal and Spain; and Gouvea and Lima (2013) analyzed a panel for 90 countries.

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In particular, in this paper, we test the BPCG model in the Chinese economy, applying recent cointegration techniques to study the long-run restriction, imposed by the foreign exchange requirements needed for economic growth. The analyzed period is from 1982-2011.

The methodology applied is an autoregressive distributed lag technique (ARDL) in which we explore the cointegration among the variables.

The structure of the paper is organized as follows: Section two presents the theoretical basic model derived from the Thirlwall's growth law. Section three shows the econometric model applied in the study. Section four presents the results. Finally section five provides conclusions and policy implications.

The growth law by Thirlwall

Thirlwall states that demand restrictions are valid for most of the countries and they occur before supply restrictions. Consequently, for an open economy demand represents the main restriction to growth and therefore, the economic performance is subject to the balance of payments behaviour. The main idea behind the BPCG model is that a country cannot grow at a rate higher than that consistent with the current account equilibrium, because is not possible to sustain deficit in the balance of payments during a long period of time, as it has to be financed with short-run capital inflows, which leads to an increase in the ratio of net external debt to GDP. If a country attempts to finance its deficit over the long-run through inflows of foreign capital, the international financial markets will press the national currency, and hence, conditions are created to collapse the exchange rate; in other words, there would be a scenario of depreciation and inflation.

As a result, the economic growth rate for any economy, in the long-run, must be consistent with the balance of payments equilibrium (McCombie, 2003; Panico, 2003; Thirlwall, 2003).

The BPCG model by Thirlwall, analyses the effect of exports demand on economic growth and introduces the concept of balance of payments constraint.

The fundamental idea is that for every open economy, demand for exports constitutes the main component of autonomous demand; in this sense, economic growth over the long-run will be supported on exports growth. It should be noticed that exports affect demand not only directly, but also indirectly since consumption and investment grow faster. Hence, if we consider both effects, we can realise that exports increase (x) determines production growth (y).

The exports rate of growth can be represented as follows: $x = \eta\left(p_d - p_f\right) + \varepsilon(z)$, where p_d and p_f are domestic and foreign prices respectively, z is foreign income, ε (>0) is the income elasticity of demand for imports and η (<0) is the price elasticity of demand for exports. The domestic prices are considered as an endogenous factor, while income and foreign prices are exogenous factors.

Thirlwall (2003) introduced the analysis of economic growth and the balance of payments constraint. He made it by taking the equation that represents the exports rate of growth, added the import demand equation and the balance of payments equilibrium condition.

The export demand and import demand equations are defined respectively as follows:

$$x = \eta\left(p_d - p_f - er\right) + \varepsilon(z \qquad (1)$$

$$m = \psi\left(p_f + er - p_d\right) + \pi(y) \qquad (2)$$

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Where π (>0) is the income elasticity of demand for imports, ψ (<0) represents the price elasticity of demand for imports, er is the exchange rate and y is the GDP rate of growth.

The equilibrium condition in the current account, written in rate of change is defined as follows:

$$p_d + x = p_f + m + er \quad (3)$$

By substituting the exports and imports demand equations in the equation of the current account equilibrium condition, we obtain the national income rate of growth, which is consistent with the balance of payments equilibrium:

$$p_d + \eta(p_d - p_f - er) + \varepsilon(z) = p_f + \psi(p_f + er - p_d) + \pi(y) + er \quad (4)$$

After conducting algebraic transformations in Equation (4), it is possible to obtain an expression that represents GDP growth, which is consistent with current account equilibrium:

$$y = ((1 + \eta + \psi)(p_d - p_f - er) + \varepsilon(z))/\pi \quad (5)$$

According to Thirlwall (2003), Equation (5) represents the following:

- An improvement in the terms of trade $(p_d - p_f - er) > 0$ has the potential to restore the rate of growth consistent with the balance of payments equilibrium;
- If domestic prices increase more than foreign prices, there will be a reduction in the rate of growth, consistent with the balance of payments equilibrium, that is, if the sum of the negative price elasticities is greater than one: $1 + \eta + \psi) < 0$;
- A depreciation of the local currency $(er > 0)$, will cause an increase in the rate of growth, consistent with the balance of payments equilibrium, if the sum of the price elasticities is greater than one;
- The rate of growth of a country (y) is associated to the rate of growth of another country (z), because the rate of growth that a country can reach, keeping the balance of payments equilibrium, will depend on the income elasticity of demand for exports (ε);
- The rate of growth of a country, consistent with the balance of payments equilibrium, is inversely related to the demand for imports;

Assuming that the relative prices[1] remain constant[2], the rate of growth consistent with the balance of the payments equilibrium becomes:

1 The relationship between the prices of two goods or two services is called relative price. The relative price of the good X in relation to the good Y, implies the relationship of the price of good X with respect to the price of good Y, in other words: Px,y = Px/Py. This ratio shows the amount of units of good Y that is forgone in order to obtain one more unit of good X. A relative price is an opportunity cost.

2 If the relative prices remain constant, the trade balance does not change in the short-run; however, in a trade balance deficit scenario, a depreciation of the local currency can lead to the equilibrium or even surplus as follows: With the depreciation, the country obtains more local currency by foreign currency, consequently the nominal exchange rate increases and so do the relative prices. The price of imports in local currency increases and therefore, demand for imports falls; on the other hand, the price of exports in foreign currency decreases and its demand rises. In this scenario, if the Marshall-Learner condition is satisfied, the net exports increase and the trade balance improves. An appreciation of the national currency causes a decrease in the relative prices and this leads to an increase in imports demand and to a decrease in exports demand, which deteriorates the trade balance. To sum up, depreciation causes less competitive imports, as the relative prices move against imports and in favour of national products; in contrast, an appreciation leads to a change in relative prices in favour of imports and against local production.

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If we take as the proxy of z the exports rate of growth x Equation (6) is transformed to:

$$Y_t^* = \varepsilon(z_t) / \pi \quad (6)$$

$$Y_t^* = x_t / \pi \quad (7)$$

Equation (7) is known as the Thirlwall's growth law, and shows that the rate of growth of any country, in the long-run, it is constrained by the equilibrium in the current account of the balance of payments.

Econometric model

In general, the Thirlwall´s law is tested by comparing the real GDF effective rate of growth with the rate of growth forecasted through Equation (7), where the income elasticity of demand for imports, determines, to a greater extent, the result. Expressing in logs the long-run relationship variables of the import demand function, we have:

$$LM_t = \alpha + \pi LY_t + \beta LRP_t + \omega_t \quad (8)$$

Where LM_t is the real imports log, LY_t is the real income log, LRP_t is the real prices log (it is defined as the ratio of national prices to foreign prices), and ω_t is the error term.

Recent advances in econometrics suggest that the short-run dynamic adjustment process should be added to the long-run relationship in Equation (8). In this context, Equation (8) is expressed as a Vector Error Correction model, as suggested by Pesaran et al. (2001):

$$\Delta LM_t = b_0 + \sum_{i=0}^{m1} b_{1i}\,\Delta LM_{t-i} + \sum_{i=0}^{m2} b_{2i}\,\Delta LY_{t-i} + \sum_{i=0}^{m3} b_{3i}\,\Delta LRP_{t-i}$$

$$+ b_4 LM_{t-1} + b_5 LY_{t-1} + b_6 LRP_{t-1} + v_t \quad (9)$$

This approach is known as an ARDL model.

One characteristic of these models is that they produce unbiased long-run coefficients estimations; regardless some of the explanatory variables are endogenous (Pesaran y Shin, 1999). Another advantage is that in the estimation through the bounds testing approach it is possible to use integrated variables of order one I (1) and order cero I(0) in the same equation.

What is not possible to apply is the Johansen approach, because when the model is specified it is important the all the variables have the same integration order.

The ARDL models presented, as error correction models, provide short and long-run coefficients simultaneously. The short-run effects are obtained from the estimation of parameters that belong to the variables in first differences. The long-run effects are obtained from the estimations of b_5 and b_6, which are normalised using b_4. The model also incorporates the adjustment coefficient. In an error correction model it is the long-run lagged error term. In order to explore whether the variables adjustment tends to a long-run equilibrium, the estimations from b_4, b_5 and b_6 are used to obtain an error correction term (ECT), this term substitutes the lagged variables in levels from Equation (9) and therefore we have:

$$\Delta LM_t = c_0 + \sum_{i=0}^{m1} c_{1i}\,\Delta LM_{t-i} + \sum_{i=0}^{m2} c_{2i}\,\Delta LY_{t-i} + \sum_{i=0}^{m3} c_{3i}\,\Delta LRP_{t-i}$$

$$+\lambda ECT_{t-1} + \mu_t \quad (10)$$

In Equation (10), λ represents the adjustment coefficient parameter. The equation is estimated taking into account the same lags as before.

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If the coefficient from the $ECT_{t-1}$is negative and statistically significant, it indicates the existence of cointegration among the variables but, the main finding is a long-run trend towards the equilibrium.[3]

Results

In this paper, we use time series data over the period 1982-2011[4]. The variables from Equation (8) fulfil the requirement to be I (1) the most. It is worth noting that if any of the variables would be I (2), the results obtained from the cointegration procedure by Pesaran et al. (2001) were not be consistent and efficient. The following unit root tests were applied to the series: augmented Dickey-Fuller (ADF) (1979, 1981), Phillips-Perron (PP) (1988), and Elliott-Rothenberg-Stock (ERS) (1996). The results from the tests confirmed that the series are stationary either in levels or first differences. It can be seen in Table 1 that the variables are integrated of order 1, but not superior, which validates the application of the bounds test suggested by Pesaran et al. (2001).

Variables	ADF	PP	ERS
LM_t	0.1580	0.2794	14.83149
LY_t	0.0762	0.5422	18.81679
LRP_t	0.4427	0.5123	29.77162
ΔLM_t	0.0034**	0.0032**	1.728792**
ΔLY_t	0.0021**	0.0077**	1.037210**
ΔLRP_t	0.0006**	0.0006**	1.640388**

Table 1 Unit root test

Notes: The unit root test specification, for the variables in levels, includes constant and deterministic trend. The specification for the variables in first differences includes constant but no trend.
** Indicates rejection of the Null Hypothesis and evidence that the time series is stationary at 90 per cent of statistical significance.
Δ Represents first differences.

3 The fact that λ is negative and statistically significant means that the dependent variable moves over time towards is long-run equilibrium value.

4 The definition and data source is provided in the Appendix.

In order to verify if the there is a cointegrated and long-run relationship among the variables in Equation 8 two stages estimation was performed. Firstly the statistical sufficiency of the model was satisfied and hence, we proceed to estimate the optimal number of lags in the first differences variables by using the information criteria from Hannan-Quinn, Schwarz and Akaike; in addition, we applied the conventional diagnostic tests. In the second stage we verify the presence of cointegration.

Pesaran et al. (2001) propose two cointegration tests. First, they provide critical value bounds for the corresponding t test, with upper and lower bounds, which are based on whether the variables in the equation are all cointegrated of order 0 (lower bound) or 1 (upper bound). There is cointegration when the absolute value of the test statistic exceeds the upper limit. Second, they suggest an F test for the significance of the variables in levels, under the null hypothesis that the speed of adjustment and the coefficients of Equation 9 jointly equal cero. Moreover, they provide the lower and upper critical values for the tests. Cointegration is accepted when the absolute values from the F and t statistics are larger than the upper bound (see Table 2).

Long-run relationship: F/t (LM l LY, LRP)

	95% LB	95% UB	97.5% LB	97.5% UB
F statistic 5.82	3.79	4.85	4.41	5.52
t statistic -4.02	-2.86	-3.53	-3.13	-3.80

Table 2 Bounds tests

Notes: Both the statistics from the t and F test are larger than the upper bound at 5% and 2.5% levels of statistical significance (values taken form Pesaran et al. 2001, Tables CI (iii) y CII (iii)). The Null Hypothesis is there is no cointegration among the variables imports, GDP and relative prices. The bounds testing procedure indicates that the Null can be rejected, which implies that there is cointegration among the variables.

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The ARDL model for the period 1982-2011was estimated through the Ordinary Least Squared method. The short and long-run coefficients are presented in Tables 3 and 5 respectively. The statistically significant coefficients have the expected sign. The corresponding statistical test are illustrated in Tables 4 and 6, they show that there are no normality problems, autocorrelation, heteroskedasticity and misspecification.

Regressors	Coefficient	Probability
Constant	-9.07	0.00
LY_t	1.49	0.00
LPR_t	-0.59	0.00

Table 3 Cointegration results through the ARDL for the long-run import demand equation

Note: LM is the dependent variable

$\bar{R}^2$	0.99	
RSS	0.12	
Statistic F	958.28	(0.00)
Statistic DW	1.89	
Breusch-Godfrey LM (2)	0.77	(0.47)
Jarque-Bera	1.09	(0.57)
Breusch-Pagan-Godfrey	0.98	(0.43)
Harvey	2.23	(0.09)
Glejser	2.00	(0.12)
Arch (1)	0.95	(0.33)
White	2.04	(0.10)
RESET (1)	0.10	(0.91)

Table 4 Tests statistics for the long-run import demand equation

Notes: RSS indicates residual sum of squares. ρ-value in parenthesis.

From Table 3, it is possible to see that the long-run income elasticity of demand for imports is 1.49, that is to say, an increase of 1 percent in the real GDP will lead to an increase of 1.49 percent of the imports. The long-run price elasticity of demand for imports is -0.59, in other words, a 1 percent upturn in the relative prices causes a reduction of 0.59 percent in real imports.

The speed of adjustment is -0.40, it means that the import demand equation will adjust 40 percent in one year when is not in equilibria, it implies that the convergence towards the equilibrium will take 2.5 years.

Regressors	Coefficient	Probability
Constant	-0.16	0.08
ΔLY_t	2.77	0.00
ΔLY_{t-1}	0.14	0.86
ΔLPR_t	-0.55	0.00
ΔLPR_{t-1}	0.11	0.43
TCE_{t-1}	-0.40	0.03

Table 5 Cointegration results through ARDL for the short-run import demand

Note: The dependent variable is ΔLMt

$\bar{R}^2$	0.74	
RSS	0.07	
Statistic F	8.44	(0.00)
Stadistic DW	2.00	
Breusch-Godfrey LM (2)	0.18	(0.83)
Jarque-Bera	0.04	(0.97)
Breusch-Pagan-Godfrey	0.61	(0.76)
Harvey	1.89	(0.12)
Glejser	1.03	(0.45)
Arch (1)	1.43	(0.24)
White	1.45	(0.24)
RESET (1)	0.83	(0.41)

Table 6 Tests statistics for the short-run import demand equation

Notes: RSS indicates residual sum of squares. ρ-value in parenthesis

We use overlapping periods of 15 years, following Atesoglu (1993a, 1993b, 1994) in order to verify the validity of the Thirlwall´s law for the Chinese economy over the period 1982-2011. This long time periods are taken due to the long-run relationship between the balance of payments and the GDP rate of growth, stablished in the BPCG model. The average rate of growth of effective export demand and the real effective GDP are taken in periods of 15 years, commencing in 1983-1997 and finishing in 1997-2011.

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The estimation of the balance of payments constrained real growth (Y_t^*) was obtained from Equation 7 with a long-run estimation of the income elasticity of demand for imports ARDL equal to 1.49. The results are presented in Table 7, in which it is possible to observe that the average real effective rate of growth is close to the estimated average rate of growth.

However, there are periods where difference between the two rates of growth expands. For instance, the periods located at the beginning of Table 7, commencing with the period 1983-1997 and up to the period 1990-2004, indicate an increasing divergence between the real effective rate of growth and the forecasted rate of growth. Nevertheless, after these periods, the two rates of growth tend to converge.

This trend does not occur over the periods 1995-2009, 1996-2010, 1997-2011, in which there is divergence. Only in these last three periods the real effective rate of growth is larger than the forecasted rate of growth, this fact is directly associated to a substantial reduction of the real exports rate of growth in these periods, compared to the high rates of growth recorded in the previous periods.

Periods	Effective rate of growth of *X*	Effective rate of growth of *Y*	Forecasted rate of growth of *Y**	Difference *Y*-Y*
1983-1997	19.11	10.61	12.83	2.22
1984-1998	19.07	10.41	12.80	2.39
1985-1999	17.65	9.90	11.85	1.95
1986-2000	17.87	9.57	12.00	2.43
1987-2001	16.98	9.53	11.39	1.87
1988-2002	16.08	9.36	10.79	1.43
1989-2003	17.73	9.28	11.90	2.62
1990-2004	19.73	9.68	13.24	3.56
1991-2005	18.19	10.18	12.21	2.03
1992-2006	18.20	10.46	12.21	1.75
1993-2007	18.03	10.45	12.10	1.65
1994-2008	18.05	10.16	12.11	1.95
1995-2009	12.25	9.91	8.22	-1.68
1996-2010	13.32	9.88	8.94	-0.94
1997-2011	13.11	9.83	8.80	-1.03

Table 7 Annual average rate of growth, effective and constrained by the balance of payments, 1983-2011

Associated to the structural reforms that fostered trade and financial openness of the Chinese economy since 1979, (Chen et al. 1995; Kanbur y Zhang, 2005), in the periods that finalise in 1997 up to 2008, the average real rate of growth was kept below the potential of the balance of payments.

Nevertheless, over the last three periods 1995-2009, 1996-2010 and 1997-2011, the Chinese average rale rate of growth is located slightly higher than the forecasted value. During these periods the Chinese economy grew above the balance of payments potential, which is in keeping with the large capital inflows captured after 2000. These facts would confirm the Thirlwall and Hussein statements (1982), in the sense that over a long time period, the rate of growth of a country could be higher than its equilibrium rate of growth as a result of substantial capital inflows.

For the whole time period studied in the paper 1982-2011, the GDP rate of growth, in average, is 11.42 percent a year; this figure closely approximates the average real rate of growth of the GDP, which is 10.24 percent a year. This finding is consistent with Razmi (2005), who analysed the case of India, and with Gouvea and Lima (2010) and Blecker and Ibarra (2013) who studied the case of the Mexican economy. They found that the balance of payments constrained growth model accurately replicates the average real rate of growth when long time periods are considered.

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In summary, the results from Table 7, confirm that the Thirlwall´s law holds for the Chinese economy.

Conclusions

The aim of this paper was to test the validity of the BPCG hypothesis for the Chinese economy, over the period 1982-2011.

After exploring the time series econometric properties and using the econometric technique known as ARDL approach we find support to assert that there is a stable long-run relationship between real imports, real GDP and relative prices. The cointegration vector was also used in a vector error correction specification to study the short-run relationship dynamic. The estimate of the long-run income elasticity of demand for imports is 1.49 and the price elasticity of demand for imports is -0.59.

We found that the average rate of growth obtained from the BPCG model (11.42 percent) is closed to the average real rate of growth (10.24 percent) over the period 1982-2011. However, substantial differences emerged when individual 15 years periods were considered. Hence, the analysis found more support for the BPCG model in a long-run perspective. However, the short-run elasticities were also statistically significant.

The Thirlwall (1979) BPCG model estimates the rate of economic growth consistent with the balance of payment equilibrium. This paper provides evidence showing that the Chinese economy, over the most of the analyzed period, grew at a rate that did not exceed the rate of growth consistent with external equilibrium but, along the last three periods 1995-2009, 1996-2010 and 1997-201, kept a rate of growth higher than that in keeping with the external equilibrium.

This finding suggests that the country will not be able to sustain its current rate of growth without facing balance of payment problems in the short-run. As a result, the monetary authority has to conduct a gradual exchange rate depreciation of the currency.

At the same time, it is possible that China improves its balance of payments situation, through the implementation of innovative policies that foster quality and by diversifying the exportable goods and services.

These policies will allow not only the increase of the exports rate of growth, but also will reduce the country´s propensity to import.

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