Capital Flows, Interest Payments and the Balance-of-Payments Constrained Growth Model; a theoretical and an empirical analysis *

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Abstract (revised version)

Within the Keynesian tradition it is recognized that the analytical framework known as the balance-of-payments constrained growth model (BPC-model) introduced by Anthony Thirlwall more than two decades ago, and further developed by him and N.Hussain was a path breaking contribution to understand the role of demand on the long-run growth performance of open economies. Recent contributions to this literature have revised the model in order to ensure that the pattern of foreign debt accumulation implicit in the economy's BPC-growth path is sustainable. In the present paper we extend one of the, say new BPC-model so that it explicitly captures the influence on foreign interest payments on the economy's long-run trajectory. Based on this model, the paper contrasts the formulation of the fundamental constraints on long-run economic growth -identified by Thirlwall and his associates- with the standard formulation of this constraint as a function of the real rate of interest on foreign debt. Using modern time-series techniques tailored for the study of long-term phenomena, the paper carries out econometric tests of the empirical relevance of the formulation of the BPC model here introduced -to reflect the influence of interest payments abroad- with that of other of its alternative, simpler versions.

1. Introduction

In Keynesian theory demand is seen as a fundamental determinant of the rate of expansion of economic activity. In particular, for the case of open economies, it identifies external demand as a binding constraint on the long-run rate of economic growth. This identification was first put forward by Anthony P.Thirlwall. He introduced a simple analytical model to show that, if a country's external indebtedness can not expand indefinitely, its long-run rate of economic growth will be restricted by its foreign trade performance; more precisely by the size of the income-elasticity of its imports and the pace of expansion of its exports (Thirlwall 1979). His contribution -here on referred to as the BPC-model- was later extended to allow for the influence of foreign capital flows on economic growth (Thirlwall and Hussain 1982). In recent years this model has been altered, once more, in order to ensure that the economy's long-run growth does not imply an explosive path of foreign indebtedness (McCombie and Thirlwall 1997, Moreno-Brid 1998-99).

Notwithstanding their relevance, these versions of the BPC-model have important shortcomings; one of them being that they do not explicitly capture the influence of foreign interest payments. The purposes of this paper are to introduce a revised version of this analytical model that overcomes this limitation and to contrast its empirical relevance with that of earlier formulations of the BPC-model.

The paper has four sections, including this introduction. The second section puts forward a revised version of the BPC-model to capture the influence of interest payments abroad on economic growth. This is done in two different ways: one based on Thirlwall’s original model and the other following Moreno-Brid (1998-99) approach to guarantee a sustainable path of external debt accumulation. The third section tests the empirical relevance of the BPC-model -in its original version and in its revised version here put forward - for the Mexican case using modern time-series techniques. The conclusions are presented in final section.

2. Foreign interest payments and BPC-growth: a theoretical analysis

Following Thirlwall and Hussain (1982), the BPC-model may be presented with only four equations: [1]

(2.1) dp*/p* + dm/m = è (dp/p + dx/x) + (1-è)(df/f + dp/p)

(2.2) è = px / p*m

(2.3) dx/x = ç (dp/p - dp*/p*) + ðdw/w

(2.4) dm/m = ö (dp*/p* - dp/p) + î dy/y

[1] Small-caps denote variables measured in constant prices; asterisks (*) denote variables measured in foreign prices. The notation “dz/z” denotes the rate of change of the variable “z”. To ease the exposition, the nominal exchange rate is assumed to be fixed and equal to one.

Equation 2.1 corresponds to the dynamic expression of balance-of-payments equilibrium, where “x” stands for real exports, “m” for real imports, “p” for domestic prices, “p*” for foreign prices, and “p f ” for the net inflow of foreign capital measured in local currency which is by definition, equal to the current account deficit. Note that, as mentioned above, this specification assumes away interest payments (as well as other factor services and unrequited transfers) from the balance of payments identity.

To simplify the model, the nominal exchange is taken to be fixed and made equal to one. Equation 2.2 defines the parameter “è” as the export/import ratio at the beginning of the period; in other words, it is given by the proportion of the import bill covered by export revenues. Equations 2.3 and 2.4 are standard export and import demand functions, but expressed in terms of their rates of growth, with “w” standing for the world’s real income, “y” for real domestic income, ç<0 and ð>0 for the price and income elasticities of exports, ö<0 and î>0 for the respective elasticities of imports.

As is well known, solving the system of Equations 2.1-2.4 gives the balance-of-payments constrained rate of growth of real domestic income “$\hat{y}_c$”:

$$(2.5)\quad \hat{y}_c = \frac{\text{èð}dw/w + (1\text{-è})(df/f) + (\text{èç}+\text{ö}+1)(dp/p - dp^*/p^*)}{\text{î}}$$

If the current account deficit is zero (i.e. è = 1), this equation is simplified as:

$$\text{ð}dw/w + (\text{ç}+\text{ö}+1)(dp/p - dp^*/p^*)$$

(2.6) ŷ$_c$ =

$$\frac{\quad}{\hat{\imath}}$$

In turn Thirlwall’s Law is derived by assuming either that the terms-of-trade are constant or that the Marshall-Lerner condition is satisfied (ç +ö = -1):

(2.7) ŷ$_c$ =

$$\frac{dx/x}{\hat{\imath}}$$

Now, to allow for the influence of foreign interest payments in the BPC-model, Equation 2.1 is substituted for the following balance of payments expression:

(2.8) $dp^*/p^*+dm/m =$ è$_1$ $(dp/p + dx/x)$ + è$_2$ $(d\,r/r + dp/p)$ + (1-è$_1$ -è$_2$)$(df/f + dp/p)$

where the total amount of net interest payments abroad measured in nominal terms is defined as “R”. Its magnitude in constant prices, “r”, is calculated with the price index of domestic output “p” (Thus, by definition r = R/p). In addition, the model’s Equation 2.2 must be substituted for the following two expressions:

(2.9) è$_1$ = $p\,x / p^*\,m$

(2.10) è$_2$ = $p\,r / p^*\,m$

Thus è$_1$, è$_2$ and (1 - è$_1$ - è$_2$) represent the proportions of the import bill financed respectively by i) export earnings, ii) net interest payments from abroad and iii) by foreign capital flows and the depletion of foreign reserves. [2]

Solving the system of Equations 2.3, 2.4, 2.8, 2.9 and 2.10 leads to the following expression of the economy's BPC-growth rate:

(2.11)

$$\hat{y}_c = \frac{è_1\, ðdw/w + è_2\, d\,r / r + (1-è_1 - è_2)df/f + (è_1\, ç + ö + 1)(dp/p - dp^*/p^*)}{î}$$

Equation 2.11 generalizes the formulation of Equation 2.5. The latter corresponds to the special case when $è_2 = 0$. If the terms-of-trade have insignificant long-run variations, this expression if simplified as:

$$(2.12)\quad \hat{y}_c = \frac{è_1\, ðdw/w + è_2\, d\,r / r + (1-è_1 - è_2)df/f}{î}$$

The modified version of Thirlwall's Law that allows for interest payments abroad is derived by assuming no current account deficit ($1-è_1-è_2 = 0$):

$$(2.13)\quad \hat{y}_c = \frac{è_1\, ðdw/w + (1-è_1)\, d\,r / r}{î}$$

[2]The balance of payments identity is expressed in nominal terms as: M = X + R + F, where "R" stands for the total of net interest payments abroad and the other variables have already been defined. Note that *a priori*, "R" may be positive or negative: in the latter case $è_2<0$.

Expressions 2.11 to 2.13 are, however, based on special assumptions concerning the behavior of foreign capital flows. Equation 2.13 rules out any influence of foreign capital flows on economic growth. Equations 2.11 and 2.12 do allow for such influence but do not ensure a sustainable long-run debt accumulation path.

Two different solutions have been put forward in the Post Keynesian literature to solve this problem.. The first one, suggested by McCombie and Thirlwall (1997, 1999) introduced in the BPC-model an additional equilibrium condition defined as a long-run constant ratio of the <u>stock</u> of external debt to domestic income:

$$(2.14) \qquad D^*/Y = k_1$$

where "k_1" is a constant parameter, "D* " is the total stock of external debt and "Y" is domestic income (measured in current prices in a common currency). The alternative approach, presented in Moreno-Brid (1998-99), adopted a different long-term equilibrium condition defined in terms of a constant ratio of the current account deficit to domestic income:

$$(2.15) \qquad \ddot{A}D^* / Y = k_2$$

where ÄD* stands for the increase in the stock of external debt (D*), [3] and “k_2” is a constant. This condition may be also written as:

(2.16) ÄD* / Y = (M -X - R) / Y = F / Y = k_2

Clearly, to satisfy 2.16 it is necessary that the long-run rates of growth of foreign capital inflows and of domestic income in nominal terms are equal:

(2.17) d F / F = d Y / Y or, equivalently, [4]

(2.18) df / f + dp/ p = dy/ y + dp/p

Incorporating Equation 2.18 into the extended BPC-model given as Equations 2.3, 2.4, 2.8, 2.9 and 2.10, and solving for dy/y gives a new expression of the BPC-growth rate of domestic income ($\hat{y}_b$):

(2.19)

$$\hat{y}_b = \frac{è_1 \, ðdw/w + è_2 \, d r / r + (è_1 ç + ö + 1)(dp/p - dp^*/p^*)}{î - (1-è_1 - è_2)}$$

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[3] Following standard notation ÄD* = D* - D^*_{-1}.

[4] Recall, that by definition , f = F/p and y = Y/ p

Thus, "$\hat{y}_b$" is determined by the initial proportion of the import bill covered by exports (è$_1$) and by net interest payments from abroad (è$_2$), by the income and price elasticities of exports (ð, ç) and of imports(î, ö), and by the rates of expansion of external demand (dw/w) and net interest payments from abroad measured in real terms (dr/r), as well as of the terms-of-trade ($dp/p - dp^*/p^*$). [5] Note that by construction, the trajectory of foreign debt accumulation implied by $\hat{y}_b$ is consistent with obtaining a long-run constant ratio of the current account deficit to domestic income.

Take notice too that Equation 2.19 extends the expression of the BPC-growth rate introduced in Moreno-Brid (1998-99):

$$(2.20)\quad \hat{y}_b = \frac{\text{è ð}\, dw/w \; + \; (\text{è ç} + \text{ö} + 1)(dp/p - dp^*/p^*)}{\text{î} - (1-\text{è})}$$

If the long-run terms-of-trade remain constant, the economy's BPC-growth rate given by Equation 2.19 is simplified to:

$$(2.21)\qquad \hat{y}_b = \frac{\text{è}_1\, dx/x \; + \text{è}_2\, d\, r\, /\, r}{\text{î} - (1-\text{è}_1 - \text{è}_2)}$$

In this case, if there are no significant net interest payments from abroad this

[5] If the nation is a net debtor in the international capital markets, the item "R" net interest payments from abroad is negative; that is, there is a net outflow of interest payments abroad.

expression leads to the corresponding version of Thirlwall's Law: [6]

(2.22) $$\hat{y}_b = \frac{\grave{e}\ dx/x}{\hat{\imath} - (1-\grave{e})}$$

where è denotes the proportion of the import bill covered by export revenues. [7] An alternative specification of Equation (2.15) is the stock/flow equilibrium conditions introduced as Equation (2.14). This condition may also be written as:

(2.23) $$d(D^*/Y) = 0$$

Or in terms of first differences:

(2.24) $$\ddot{A}D^*/ D^*_{-1} = \ddot{A}Y / Y_{-1}$$

Recall that by definition, the numerator in the left hand side is the current account deficit of the balance of payments "M - X + R' ", (to simplify the exposition the notation assumes a net <u>outflow</u> of interest payments abroad: R' >0). Thus, Equation 2.24 may be expressed as:

(2.25) $$(M - X)/ D^*_{-1} \quad + \quad R'/D^*_{-1} \quad = \quad \ddot{A}Y/Y_{-1}$$

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[6] Equation 7 coincides with the expression derived by McCombie and Thirlwall (1997) by imposing the alternative long-run equilibrium condition in terms of a fixed ratio of the <u>stock</u> of external debt to GDP, and constant terms-of-trade.

[7] An analysis of the stability properties of this version of the BPC-model may be found in Moreno-Brid (1998-99).

The overall amount of net interest payments abroad "R' " is equal to the product of the nominal interest rate (r') times the stock of foreign debt outstanding at the beginning of the period D^*_{-1}:

$$(2.26) \qquad R' = r' D^*_{-1}:$$

Substituting 2.26 in 2.25 leads to the following expression of the rate of growth of the economy consistent with a long-run constant ratio of the stock of external debt relative to nominal income:

$$(2.27) \qquad (M\text{-}X)/ D^*_{-1} + r' (D^*_{-1} /D^*_{-1}) = \quad \text{Ä}Y/Y_{-1}$$

And, since $Y = y\ p$, the conventional expression for the economy's rate of growth is derived:

$$(2.28) \qquad [Y/ D^*_{-1}] ((M\text{-}X)/Y) + [r' - \text{Ä}p/p_{-1}] = \quad \text{Ä}y/y_{-1}$$

This expression states that, in the long-run, the growth rate of domestic income in real terms ($\text{Ä}y/y_{-1}$) is equal to the real interest rate on foreign debt $[r' - \text{Ä}p/p_{-1}]$ plus another factor that depends on the trade deficit as a proportion of income and the foreign debt to income ratio. Typically it is interpreted as stating that, if the trade deficit is zero, the real rate of interest on foreign debt defines a lower bound for the economy's long-run rate of growth consistent with a <u>non-increasing</u> external debt to income ratio. This interpretation has been endorsed by Post Keynesian economists -*inter alia* McCombie and Thirlwall (1999)- as well as by mainstream economists (See Edwards 1995).

However, it is not clear in this model why would the economy's BPC-growth rate specified as Equation 2.11 would necessarily exceed the real rate of interest on foreign debt. In other words, although compliance with the stock/flow equilibrium conditions (specified in Expression 2.14) requires a long-run rate of growth of domestic income higher than or equal to the real interest rate on foreign debt, there is no mechanism to ensure that external demand and the economy's trade performance (as reflected in the trade elasticities in Equation 2.11) will achieve such a high rate of long-run economic expansion. In other words, when the stock/flow equilibrium condition is specified as Equation 2.14, there appears to be an ambiguity in the BPC-model thus extended to capture the influence of interest payments abroad.

Given this ambiguity, the empirical analysis carried out further below only considers the specification of the BPC-model here introduced as the set of Equations 2.3, 2.4, 2.8, 2.9, 2.10, with 2.15 defining its long-run stock/flow equilibrium as a constant proportion of the current account deficit relative to domestic income. Equations 2.21 and 2.22 put forward two simple solutions to this extended model. The former explicitly captures the influence of foreign interest payments on the economy's BPC-growth rate; the latter excludes it. The next section tests the empirical relevance of these two versions of the BPC-model and contrasts it with that of the simple model given as Thirlwall's Law (Equation 2.7). This empirical study will, hopefully help to show the relevance of the BPC-model –even in its different simple versions- as an analytical tool to understand the long-run economic growth performance of developing countries.

3. Empirical tests of the BPC-model [8]

3.1 Background. The applied analysis of the BPC-model here presented relies on the methodology put forward by McCombie 1997 and, thus, it gauges its empirical relevance by testing whether the long-run income-elasticity of import demand "$\hat{\imath}$" does not significantly differ from its hypothetical equilibrium value "$\hat{\imath}_H$". [9] To carry out this task, "$\hat{\imath}$" is estimated using time-series techniques tailored to study long-run phenomena. Now, this test requires defining $\hat{\imath}_H$ as the value of the income-elasticity of import demand that would equate the actual growth rate of the economy "dy/y" with its BPC-growth rate "$\hat{y}_b$" in the period under consideration. According to this testing procedure, if there is no significant difference between $\hat{\imath}$ and $\hat{\imath}_H$ the BPC-model is empirically relevant for the case in point.

Clearly, the conclusions are contingent on the underlying formulation of the BPC-growth rate $\hat{y}_b$. As mentioned above, we test the three alternative versions of it given by Equations 2.7, 2.22 and 2.21. The first one corresponds to the original

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[8] This section is a revised and extended version of chapter IV of Moreno-Brid (2001).

[9] For a comparative evaluation of alternative procedures to test the BPC-model see Thirlwall (1998) and McCombie (1997).

formulation of Thirlwall’s Law (based on the assumption of no long-run current account deficit). The second one consists of the revised version of the BPC-model that guarantees a sustainable path of foreign indebtedness. And the last one is its extension here constructed to explicitly capture the influence of foreign interest payments.

A key aspect is to calculate the corresponding hypothetical equilibrium values of the income-elasticity of imports. For the original version of Thirlwall’s Law, such equilibrium value is derived by, first, substituting in Equation 2.7 the actual value of “dy/y” instead of the BPC-rate “$\hat{y}_b$” and, then, by solving for î.. For notational purposes such value is subsequently here referred to as $î_T$:

(3.1) $$î_T = (dx/x) \,/\, (dy/y)$$

For the revised version of the BPC-model that is consistent with a notion of long-run equilibrium defined as a constant ratio of the current account deficit to nominal income but does not capture the influence of foreign interest payments, the hypothetical equilibrium elasticity through Equation 2.22. First, substitute in it the actual average growth rate of GDP “dy/y” for the BPC-growth rate “$\hat{y}_b$”, and then solve for î. The value thus obtained is here denoted as $î_x$:

(3.2) $$î_x = (1 - è) + [\, (è\ dx/x) \,/\, dy/y \,]$$

Finally for the revised BPC-model, introduced in the previous section, that explicitly allows for interest payments abroad, the hypothetical equilibrium elasticity of imports is derived in a similar way from Equation 2.21. It is here defined as $\hat{\imath}_{M}$ and equals:

$$(3.3) \quad \hat{\imath}_{M} = (1 - \grave{e}_{1} - \grave{e}_{2}) + [(\grave{e}_{1}\, dx/x + \grave{e}_{2}\, dr / r) / dy/y]$$

Note that the calculations of $\hat{\imath}_{T}$, $\hat{\imath}_{x}$ and $\hat{\imath}_{M}$ are all based on the assumption that relative prices are not important determinants of the economy’s long-run growth rate in the period of analysis. $\hat{\imath}_{T}$ may be interpreted as a special case of $\hat{\imath}_{x}$, which may in turn be seen as a special case of $\hat{\imath}_{M}$. Having thus explained the procedure to calculate the hypothetical income elasticity of imports corresponding to ehaxc of the three different versions of the BPC-model here considered, we proceed to econometrically estimate the actual long-run income elasticity of imports for the Mexican case.

3.2 Estimation of Mexico’s long-run import demand [10]

A. Methodological note

Econometric studies of imports are typically based on the “imperfect substitutes” model. The model is built upon the assumption that domestic and foreign goods are not perfect substitutes and concludes that import demand is determined by the importing country’s income, the own price of imports, and the domestic price of locally produced tradeable goods and services. In addition, monetary illusion is frequently assumed away and a zero-homogeneity restriction is imposed to guarantee that the foreign and the domestic price-elasticity of import demand have the same magnitude in absolute terms. Furthermore, an infinite elasticity of supply is generally taken for granted, thus validating the use of single-equation econometric methods to estimate import flows. [11] The standard functional specification of long-run import demand is:

$$(3.4) \qquad \ln(m_t) = \hat{a}_0 + \hat{a}_y \ln(y_t) + \hat{a}_p \ln(Pm_t / Pd_t) + \tilde{o}_t$$

where "$\tilde{o}_t$" stands for a white noise disturbance term, "m_t" for real imports and "y_t" for the real domestic income of the importing country. Pd_t and Pm_t stand respectively for domestic price indices of locally produced tradable output and of imported goods and services expressed in local currency. The parameters $\hat{a}_y \geq 0$ and $\hat{a}_p \leq 0$ correspond to the long-run income and price elasticities of import demand. Being an expression of a long-run equilibrium relation, the log-linear function in Equation 3.4 does not consider any short-run lagged influences. [12] Most empirical studies of Mexico's import demand have adopted this framework.

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[10] This section is based on parts of Chapter IV of Moreno-Brid (2001).

[11] Goldstein and Khan (1985) present a synthetic view of the imperfect and the perfect substitutes theoretical models. Houthakker and Magee (1969) is the classic work on the empirical estimation of long-run export and import functions. Caporale and Chui (1999), Krugman (1989), Márquez (1999) and Hooper et al (1998) estimate trade elasticities for OECD and other countries in recent periods.

[12] The concept of long-run equilibrium adopted in the BPC-literature is not the same as the theoretical notion of a steady-state growth path. The latter requires a unitary income elasticity of import demand to keep a constant import/output ratio in the steady state when relative prices Pm / Pd remain unaltered.

However given the country’s historic reliance –up until the late 1980s- on tariff and non-tariff barriers to shield its domestic market from foreign competition, it seems necessary to modify it to capture the effects of such protectionist measures. To capture their effects we included as regressors variables that mirror the incidence of non-tariff restrictions on trade flows. [13]

In general, earlier studies of Mexican imports applied econometric methods that pay insufficient attention to the stationarity properties of time series and, thus, their results suffer problems of spurious correlation, bias and inconsistency of the estimated parameters (Carone 1996, Enders 1995, Rao 1994). The exceptions are Galindo and Cardero (1999), López and Guerrero (1998), Senhadji (1998), and Sotomayor (1997). However, either their sample periods were too short and failed to consider Mexico’s era of trade liberalization. Or they applied single-equation methods whose results critically depend on the variable chosen to normalize the cointegrating relation (Maddala and Kim 1998).

The empirical analysis of Mexico’s long-term import demand carried out in this section applies Johansen’s cointegration methods and covers a period that extends from Mexico’s trade protectionist era in the 1960s to the implementation of trade liberalization since the mid-1980s and up until 1999 with NAFTA in its sixth year of operation. It explicitly allows for the effects of non-tariff restrictions on import demand. To capture this effect we use an index of the production-

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[13] For similar approaches see Salas 1982, 1988, Ize 1992 and Sotomayor 1997. Alternative approaches relying on “dummy” variables are adopted by Dornbusch and Werner 1994, and Sarmiento 1999.

weighted coverage of import licenses. This index avoids the downward bias inherent in the use of trade-weighted average coverage of licenses in situations where trade protection is very severe (Cameron *et al* 1999). [14] Other indicators of trade restrictions, like the average and dispersion of tariff rates or the indicators of the degree of exchange rate controls, may not be so useful for the present case. First of all, the impact of tariff rates is already taken into account in the estimation of import demand, through their effect on relative prices. Second, in the Mexican case, exchange rate controls were relevant only for a few years (Lustig and Ros 1987).

Denoting the index of the production-weighted coverage of import licenses as "q" and introducing it directly in the right hand side of Equation 3.4 leads to the following specification of long-run import demand:

$$(3.5) \quad \ln(m_t) = \hat{a}_0 + \hat{a}_y \ln(y_t) + \hat{a}_p \ln(p_t) + \hat{a}_q q_t + \tilde{o}_t$$

where for simplification purposes the ratio of relative prices Pm_t / Pd_t expressed in common local currency is denoted as "p_t". By construction the value of "q" falls between zero and one ($0 \leq q \leq 1$). It equals zero when all license requirements on

[14] Use of production-weighted indices of coverage of import licenses to mirror quantitative restrictions on foreign trade were common practice in the World Bank's Trade Policy Loans to Mexico in the 1980s (Ten Kate 1992).

imports have been eliminated, and it equals one when they are mandatory on every importable good or service. Given Mexico's commitment in the last fifteen years to liberalize its domestic market to foreign competitors, it seems reasonable to assume that the long-run value of "q" is zero. The expected sign of $\hat{a}_q$ is negative. To interpret this parameter it is useful to differentiate Equation 3.5 with respect to time and thus obtain the following expression for the long-run rate of growth of import demand:

(3.6)
$$\frac{dm}{m} = \hat{a}_y \frac{dy}{y} + \hat{a}_p \frac{dp}{p} + \hat{a}_q \frac{dq_t}{dt}$$

Therefore $\hat{a}_q$ represents the increase in the long-run rate of growth of import demand (dm/m) that *ceteris paribus* would be caused by the elimination of import licensing in a fully protected domestic market; that is when "dq" takes its minimum value (dq = -1).

Equation 3.5 is the basis for the estimation of Mexico's long-run import demand here conducted. [15] It was carried out with annual data because no quarterly data was available for some variables before 1980. The time-series for real imports and real GDP and in nominal terms were derived from National Accounts data published by the Instituto Nacional de Estadística, Geografía e

[15] The inclusion of "q" in log-level form in Equation 3.4 is not recommended because it would imply that, unless $\hat{a}_q = 0$, the elimination of import licenses *a fortiori* causes an unbounded increase in the long-run demand for imports in real terms, even assuming constant domestic income and relative prices.

Informática. The relative price was computed as the ratio of the implicit-price deflators of imports and of GDP. Data for “q”, the production-weighted index of the coverage of import permits for 1967-94, was obtained from Secretaría de Comercio y Fomento Industrial (SECOFI). And for 1995-99 it was calculated by the author based on official data. Lack of information on the incidence of import licenses on Mexico’s tradable output prior to 1967 impeded tracing the index “q” further back; thus limiting the estimation of Mexico’s long-run import demand to 1967-99.

B. Cointegration tests of Mexico’s demand for imports: 1967-99

Following standard procedure, the first step in the econometric analysis of Mexico’s import demand via Johansen methods was to apply Dickey Fuller and Augmented Dickey Fuller (DF & ADF) tests to examine the stationarity properties of the data. [16] Selection of the optimum lag “k” for the ADF tests was done with the Akaike Information (AIC) and the Schwarz Bayesian (SBC) criteria. The findings indicate that all four variables -i.e. the production-weighted coverage of import permits, and the log-levels of real GDP, real imports and relative prices- are I(1) processes and their first differences are I(0) processes (see Table 1).

Applying the Akaike Information and Schwartz Bayesian criteria, an optimum one year lag was identified for the unrestricted VAR system for import

[16] A synthetic description of Johansen’s testing procedure may be found in Enders (1995).

demand under the assumption of no deterministic trends (see Table 2). The variable “q” was assumed to be an exogenous I(1) process in the VAR. Such assumption does not rule out short-run effects among all the variables in the VAR-system (Pesaran and Pesaran, 1997) but implies that in the long-run the imposition of prior permit requirements on imports is not determined by the evolution of the endogenous variables (real GDP, real imports or relative prices). This assumption may be justified by the fact that in the last fifteen years, and independently of the evolution of domestic economic activity, Mexico has been persistently eliminating its licenses and quantitative restrictions to imports and refraining from imposing additional barriers to foreign trade. As a matter of fact even in the midst of the acute balance-of-payments crisis suffered in 1995, Mexico moved ahead in its trade liberalization strategy and continued honoring its commitments to NAFTA.

Lagrange Multiplier tests were conducted to check for residual serial correlation of the individual equations of the VAR(1) system. In all cases, the results could not reject the hypothesis of no serial correlation with a 5% critical level (see again Table 2). Johansen tests were applied on this VAR(1) system to estimate a cointegrating vector for Mexico’s import demand. No deterministic trend was assumed, but two different specifications for the intercept were explored. Under the assumption of an unrestricted intercept, the tests identified one cointegration vector for import demand. But two vectors were identified when the intercept was restricted to the cointegrating space. In such instance, the vector corresponding to the largest eigenvalue was chosen as the adequate estimate of

Mexico's long-run import demand, once checked that its cointegrating coefficients were consistent with the theoretical model of import demand.

The assumption regarding the intercept's specification, as restricted or unrestricted, did not lead to qualitatively different estimates for Mexico's long-run import demand in 1967-99 (See Table 3). Under either specification at least one cointegrating vector was identified. And the respective coefficients were very similar, reporting an estimated long-run income elasticity $\hat{a}_y$ around 1.8, a long-run price elasticity $\hat{a}_p$ close to -0.5 and an estimated parameter for the long-run effect of import permits $\hat{a}_q$ around -1.0. Individual significance of the cointegrating coefficients was tested by imposing over-identifying restrictions equalizing each one to zero. The results of the respective tests based on the likelihood ratio statistics (LRS) always rejected the null hypothesis of a zero income elasticity, $\hat{a}_y = 0$. They also rejected the null hypothesis of non-significant effects of import licenses, $\hat{a}_q = 0$. However, the tests could not reject the hypothesis that the price-elasticity of Mexico's import demand during 1967-99 was not-significantly different from zero: $\hat{a}_p = 0$. [17] (see Table 3, Part A).

Given this result, Mexico's long-run import demand was again estimated for 1967-99 but excluding the relative price variable from the VAR-system. The

[17] If the null hypothesis formulated as an over-identifying restriction on the coefficients of the normalized cointegration vector holds, the likelihood ratio statistic (LRS) is asymptotically distributed as a $÷^2$ with one degree of freedom (Pesaran and Pesaran 1997).

results of Johansen's tests assuming an unrestricted intercept identified one cointegrating vector among the log-levels of GDP and of imports and the index of non-tariff restrictions "q" (See Table 3, part B). The estimated long-run income elasticity of import demand was $\hat{a}_y = 1.772$, practically the same as the corresponding estimate obtained using the larger VAR-system.

The estimates for the long-run income elasticity here obtained are well within the range of earlier findings on Mexican import demand. However, the non-significance of the price elasticity contrasts with previous results. Such contrast may be due to the fact that earlier studies of Mexican imports focused on rather short periods, in which the influence of relative prices may have been relevant. Finally, our findings concerning the significantly negative influence of quantitative trade restrictions on its import demand are consistent with results of earlier studies of Mexican imports.

For the VAR-system that excluded relative prices, the application of Johansen's tests under the assumption of a restricted intercept led to results that were not satisfactory. They suggested the presence of specification problems in the VAR-system. Therefore the cointegrating vector estimated under the assumption of an unrestricted intercept for the trivariate VAR system was considered as our preferred results for Mexico's long-run import demand during 1967-99.

C. Testing the BPC-model for the Mexican economy

This section applies McCombie's procedure to examine the comparative adequacy, for the Mexican case, of Thirlwall's Law in its original version and in two other forms. As mentioned above, essentially it tests whether the long-run income-elasticity of Mexican imports î –estimated via cointegration analysis in

Figure 1 Mexico: Trade deficit and net interest payments abroad, 1967-1999
(Proportions of GDP, %)

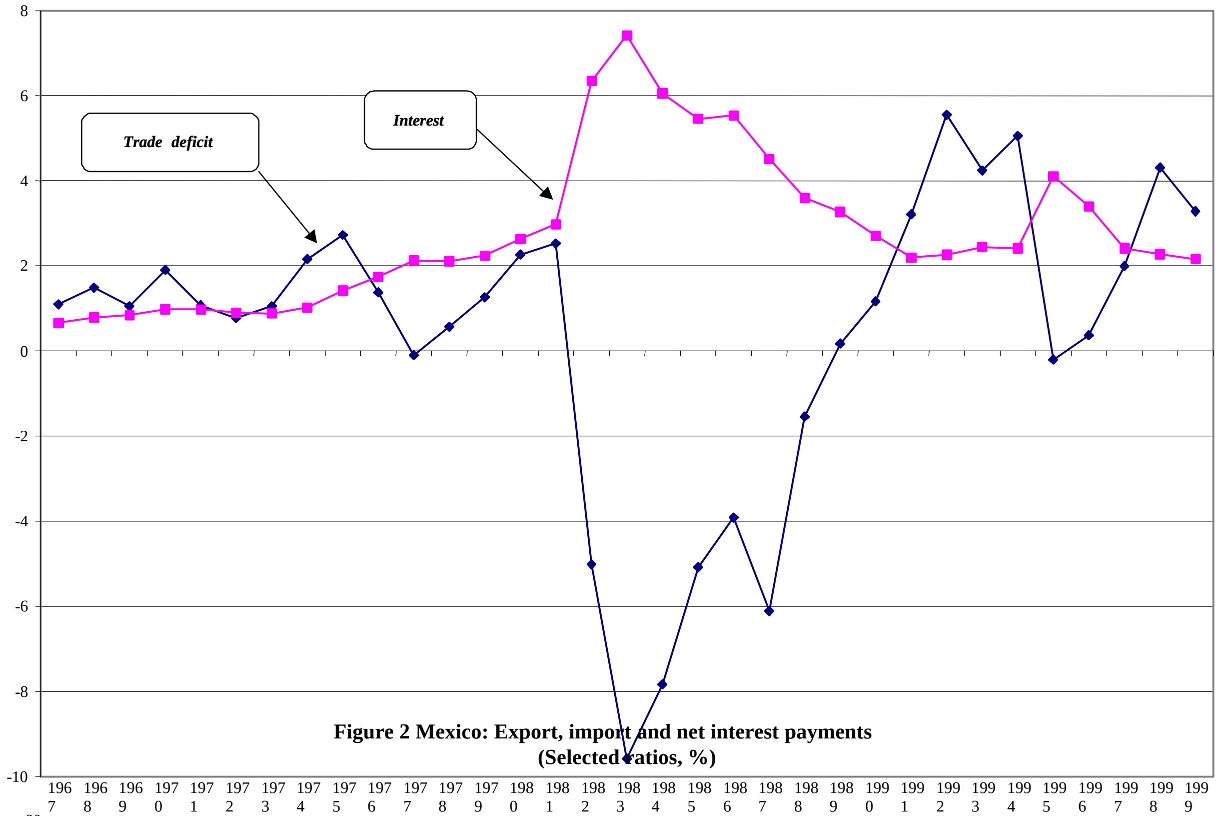
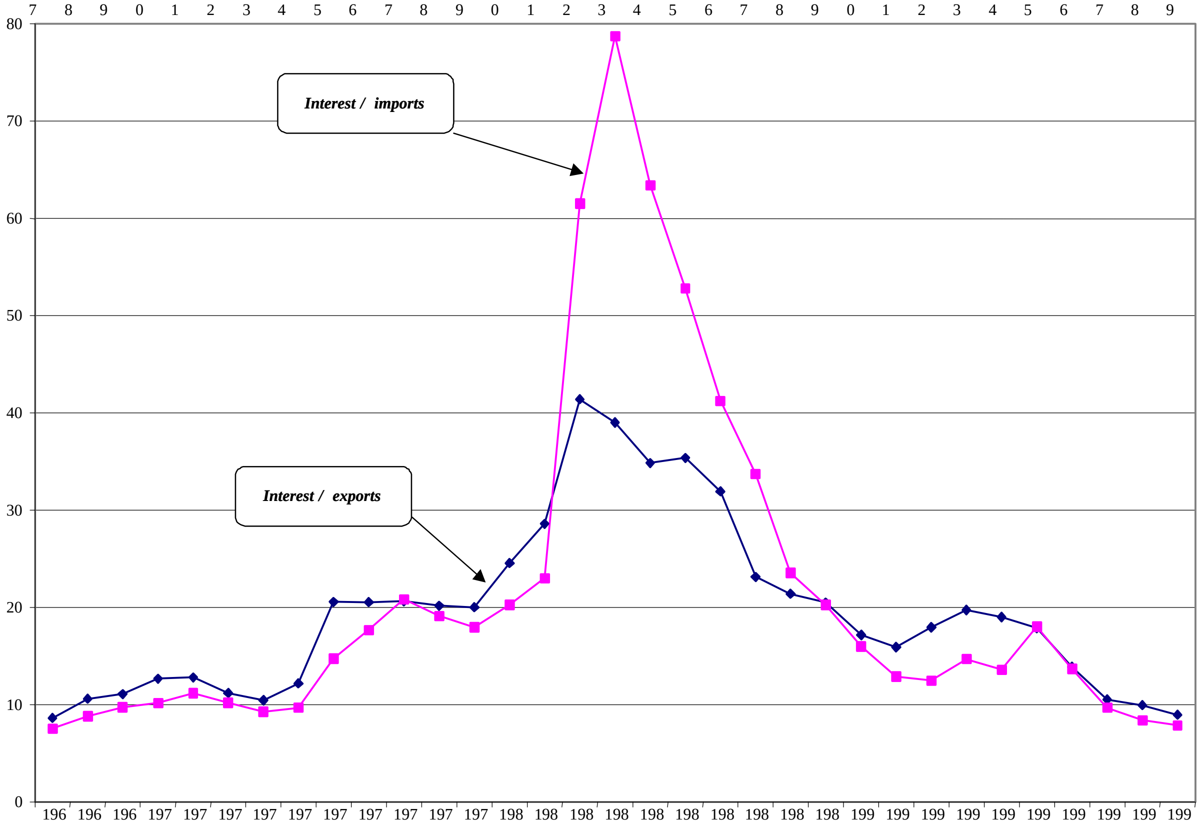


Figure 2 Mexico: Export, import and net interest payments
(Selected ratios, %)



the previous section- is significantly different from its hypothetical equilibrium value alternatively given by $\hat{\imath}_T$, $\hat{\imath}_x$ or by $\hat{\imath}_M$. Figures 1 and 2 illustrate the relevance of Mexico's foreign interest payments during 1967-99. Note in particular the vast amount they represented in the mid-1980 relative to exports and imports.

Using official data on the average annual rate of growth of Mexico's real GDP and real exports, Equations 3.1, 3.2 and 3.3 lead to the following estimates for the hypothetical equilibrium value of the income-elasticity of import demand during 1967-99: $\hat{\imath}_T$ is equal to 2.189, $\hat{\imath}_x$ to 1.991 and $\hat{\imath}_M$ to 1.913. These three figures are, apparently, not too distant from the estimated coefficient of 1.777 obtained as the long-run income elasticity of import demand via Johansen's techniques (See Table 4). Neither do they differ very much from the alternative estimate of the long-run income elasticity $\hat{\imath}$ = 1.772 derived by the cointegration tests applied on the trivariate VAR-system that excluded relative prices. However, the significance of such differences must be formally tested.

The LRS calculated to test the over-identifying restriction Ho: $\hat{\imath} = \hat{\imath}_T$ imposed on the cointegrating vector for the full VAR-system (including relative prices) reject the null hypothesis at a 5% critical level of significance (See Table 4). Such result suggests that Thirlwall's Law, in its original formulation, does not offer an adequate interpretation of Mexico's long-run economic growth during 1967-99. On the other hand, when adopting the alternative definition of the BPC-growth rate that allows for a long-run stock/flow equilibrium position, the conclusions of the LRS tests are the opposite. Indeed, their results could not reject the null hypothesis $\hat{\imath} = \hat{\imath}_x$ even at a 10% level of significance. Finally, the favorable results were even stronger for the tests carried out on the BPC-model that explicitly allowed for the influence of interest payments abroad and guaranteed a long-run constant ratio of the current account deficit to nominal income. Such result should perhaps not be surprising given the conspicuous amounts of interest payments that Mexico had to incur during an important part of the period analyzed.

Thus these results give strong support to the modified versions of Thirlwall's Law given as a relevant hypothesis for the Mexican case. These results may help to claim that the new generation of BPC-models recently introduced – including the relatively straight forward modification put forward in the second section of the present paper- may strengthen the empirical relevance of the theory of balance-of-payments constrained growth economies.

The results of the LRS tests on the cointegrating vector identified in the analysis of the trivariate VAR-system for 1967-99 (excluding relative prices) also support the conclusion that, for the Mexican case, the new generation of the BPC-model -particularly when explicitly capturing the influence of interest payments abroad- may be more relevant than the original one (See again Table 4);. Indeed, they did not reject the null hypotheses Ho: $\hat{\imath} = \hat{\imath}_x$ or that $\hat{\imath} = \hat{\imath}_M$. With p-values of 0.282 and 0.468, they strongly confirm the adequacy of the modified versions of Thirlwall's Law given by Equations 2.21 and 2.22 for the empirical analysis of

Mexico's long-run economic growth. However, the LRS test of the null hypothesis Ho: $\hat{\imath} = \hat{\imath}_T$ using the cointegrating vector estimated for the trivariate VAR-system - i.e. excluding relative prices- reported a p-value of 0.072. Such result rejects the null-hypothesis at the 10% critical level, though not at the 5% level. It gives support to the empirical adequacy of Thirlwall's Law in its original version; but somewhat weaker than to the one given to its revised versions expressed in Equations 2.21 and 2.22.

4. Conclusions

This paper introduced a simple extension of the BPC-model that allowed for the influence of interest payments abroad and simultaneously ensured a sustainable path of external debt accumulation. This model led to an expression of the economy's BPC-growth rate that are rather straight forward expressions of the ones derived in new versions of this model recently introduced in the Post Keynesian literature. The paper's empirical results show that the balance of payments was a binding constraint on Mexico's long-run economic growth in 1967-99. Moreover, they indicate that during these years foreign interest payments were an important determinant of Mexico's long-run economic growth. The results enhance the empirical relevance of the BPC-model. Hopefully, in its extended version, this BPC-model will be useful for the empirical study of long-run growth in other economies.

Statistical Appendix

Table 1
Mexico: Dickey Fuller and Augmented Dickey-Fuller tests on selected variables to estimate its long-run import demand, 1967-99

(A) Ä z_t = á + ñ z_{t-i} + Σk (ã$_i$ Äz_{t-i}) + î$_t$

(B) Ä z_t = á + ët + ñ z_{t-i} + Σk (ã$_i$ Äz_{t-i}) + î$_t$

	Lag "k" selected by AIC		Lag "k" selected by SBC	
Equation A	lag k	ADF	lag k	ADF
ln (y)	0	-3.187*	Same as AIC	
Ä ln (y)	0	-3.800*	Same as AIC	
ln (m)	2	-0.042	0	-0.099
Ä ln (m)	1	-4.668*	Same as AIC	
ln (p)	1	-2.652	0	-2.139
Ä ln (p)	1	-5.355*	Same as AIC	
q	1	-1.112	Same as AIC	
Ä q	0	-3.531*	Same as AIC	
Equation B	lag k	ADF	lag k	ADF
ln (y)	0	-1.774	Same as AIC	
Ä ln (y)	0	-4.338*	Same as AIC	
ln (m)	1	-2.867	Same as AIC	
Ä ln (m)	1	-4.651*	Same as AIC	
ln (p)	3	-2.095	0	-2.015
Ä ln (p)	1	-5.345*	Same as AIC	
q	1	-2.454	Same as AIC	
Ä q	0	-3.489*	Same as AIC	

Note: AIC = Akaike Information Criteria, SBC =Schwarz Bayesian Criteria, y = real GDP, m = real imports, p = ratio of implicit price deflators of imports relative to domestic output, q = production-weighted coverage of prior import licensing requirements. "Ä" stands for first differences. The asterisk '*' denotes significance with Dickey-Fuller's 5% critical values. Source: Own calculations with Microfit 4.0.

Table 2
Mexico: statistical specification of VAR-system to estimate long-run import demand
(based on annual data, 1967-99)

	Test statistics and optimal order for VAR-system			Order chosen	LM's serial-correlation tests for individual equations of VAR(1)-system (p-values)		
Period	AIC	SBC	ALR	k	ln (m)	ln (y)	ln(p)
1967-99	143.6 k=1	132.4 k=1	0.477 k =1	1	0.260	0.405	0.054

Notes: The VAR-system was estimated taking the production-weighted coverage of import licences as an I(1) exogenous variable. AIC = Akaike Information Criteria, SBC =Schwarz Bayesian Criteria, ALR = Adjusted Likelihood Ratio, LM = Lagrange-Multiplier test, y = real GDP, x = real exports, p= ratio of implicit price deflators of imports relative to domestic output. Source: Own calculations with Microfit 4.0.

Table 3: Mexico's long-term import demand, 1967-99

(Estimated with Johansen's cointegration procedures) [a]

ln (m) = á + $ñ_y$ ln(y) + $ñ_p$ ln(p) + $ñ_q$ q + õ

Part A. Results for VAR(1) system with three endogenous variables: ln(m), ln(y) and ln(p)

	Test on max eigenvalue			Test on trace			Cointegration vector and $÷^2$ test on the significance of $ñ_p$ and $ñ_q$
	H_0	H_1	LRS	H_0	H_1	LRS	
unrestricted intercept (á = 0)	r = 0	r = 1	48.7*	r = 0	r ≥ 1	67.7*	A_1. ln(m) = 1.777 ln(y) - 0.536 ln(p) - 1.044 (q)
							(0.12) (0.27) (0.16)
	r≤ 1	r = 2	14.1	r≤ 1	r ≥ 2	19.0	$÷^2$ [$ñ_p$=0] p-value = 0.193 $÷^2$ [$ñ_q$=0] p-value = 0.000
	r≤ 2	r = 3	4.9	r≤ 2	r = 3	4.9	
restricted intercept (á ≠ 0)	r = 0	r = 1	72.2*	r = 0	r ≥ 1	103.9*	A_2. ln(m) = 1.872 ln(y) - 0.577 ln(p) - 0.983 q - 6.52 [b]
							(0.15) (0.28) (0.15) (2.16)
	r≤ 1	r = 2	20.8*	r≤ 1	r ≥ 2	31.8*	$÷^2$ [$ñ_p$=0] p-value = 0.187 $÷^2$ [$ñ_q$=0] p-value = 0.000
	r≤ 2	r = 3	11.0	r≤ 2	r = 3	11.0	

Part B. Results for VAR(1) system excluding the relative price of imports ln(p)

	Test on max eigenvalue			Test on trace			Cointegration vector
	H_0	H_1	LRS	H_0	H_1	LRS	
unrestricted intercept (á = 0)	r = 0	r = 1	41.7*	r = 0	r = 1	49.9*	B_1. ln(m) = 1.772 ln(y) - 1.269 q
							(0.18) (0.19)
	r≤ 1	r = 2	8.3	r≤ 1	r = 2	8.3	
restricted intercept (á ≠ 0)	r = 0	r = 1	56.9*	r = 0	r = 1	75.2*	Not available [b]
	r≤ 1	r = 2	18.3*	r≤ 1	r = 2	18.3*	

Notes: (a) Tests carried out assuming no deterministic trend and taking the coverage of import licence requirements (q) as an exogenous I(1) process.

(b) In Part A, when two cointegrating vectors were identified, the one associated with the largest eigenvalue is here reported. In Part B, since there are only two endogenous variables there can be at most one linearly independent cointegrating relation between them. The identification of two such vectors by Johansen tests may reflect specification errors in the VAR system..

H_0 = null hypothesis, H_1= alternative hypothesis, r = number of cointegrating vectors, LRS = likelihood ratio statistics, y = real GDP, m = real imports, p = ratio of the implicit price deflators of imports relative to domestic output, q = production-weighted coverage of import licences. An asterisk (*) denotes significance with a 5% critical level. Asymptotic standard errors of the estimated cointegration coefficients are reported in parenthesis. Source: Own calculations with Microfit 4.0.

Table 4

Test of the empirical relevance of Thirlwall's Law (original and extended versions) for the Mexican economy , 1967-99

(based on McCombie's procedure)

VAR-system for import demand	Income elasticity of import demand				LRS-tests of equality of the long-run income-elasticity and its hypothetical equilibrium values (p-values) [a]		
	Johansen's cointegration coefficient	Hypothetical equilibria consistent with Thirlwall's Law as expressed in the:			null hypothesis		
		original BPC-model [b]	extended BPC-models [c]				
	î	î$_{T}$	î$_{x}$	î$_{M}$	î = î$_{T}$	î = î$_{x}$	î = î$_{M}$
A. With four variables ln(m), ln(y), ln(p) and q	1.777	2.189	1.991	1.913	0.048	0.177	0.337
B. With three variables [d] ln(m), ln(y) and q	1.772	2.189	1.991	1.913	0.072	0.282	0.468

Notes: (a) p-values of the ÷^{2} corresponding to the LRS to test the over-identifying restriction equalizing the cointegrating coefficient for the income-elasticity of import demand to its hypothetical equilibrium derived from three versions of Thirlwall's Law, (b) î$_{T}$ is derived from Equation 3.1, (c) î$_{x}$ is derived from Equation 3.2 taking è (the export/import ratio) reported for the beginning of the period. î$_{M}$ is derived from Equation 3.3 calculated with the values of è$_{1}$ and è$_{2}$ given by ratio of exports to imports and of interest payments abroad to imports reported at the beginning of the period, (d) Because the coefficient for price-elasticity in the cointegrating vector in the full VAR-system for 1967-99 was not significant, these tests were also conducted based on the cointegration vector estimated from the trivariate VAR-system (excluding relative prices). Source: Own

calculations with Microfit 4.0.

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