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Abstract

This study applies the Balance of Payments Constrained Growth (BPCG) model to India, a large developing country with a relatively low trade to GDP ratio. Rather than assuming similar elasticities of substitution between goods produced in different regions, the study extends the model to relax these assumptions. Johansen's cointegration technique is employed to estimate trade parameters. Short-run adjustments are explored within a vector error correction framework. The average growth rates predicted by various forms of the BPCG hypothesis are found to be close to the actual average growth rate over the period 1950-1999, although individual decades display substantial deviations.

JEL classification: F43, F14, E12

Keywords: Balance of payments-related constraints, real exchange rates, Johansen's cointegration technique, strong form, weak form, trade multiplier, import compression.

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1. Introduction

The balance of payments constrained growth (BPCG) model, originally due to Thirlwall (1979), has generated considerable interest among Post Keynesian (and occasionally neo-classical) circles. Developed as a tool to study the constraint imposed by the need to generate foreign exchange, the model provides a parsimonious (if partial) explanation of the balance of payments-related demand side structural parameters that limit growth. The original model limited foreign exchange movements to those resulting from trade in goods and services. Thirlwall and Hussain (1982) and other contributors later added capital flows to the model.

This paper tests the BPCG model in the context of India. More specifically, the paper follows several recent studies in using cointegration techniques to study the long-run constraint imposed by foreign exchange requirements on the growth of the Indian economy. The period explored is 1950-1999. It departs from previous efforts in several ways. Firstly, it employs the Johansen cointegration procedure. This relatively new macroeconometric tool, which to our knowledge has not been used before to test the BPCG hypothesis in the context of India, allows us to estimate a multivariate system of equations using variables that are assumed to be jointly endogenous, thus avoiding possible simultaneity problems. Secondly, the paper makes simple analytical extensions to the model which take a more nuanced view of consumption and competition. For example, traditionally the BPCG hypothesis has been tested using trade equations that assume homogeneity and identical elasticities of substitution between goods from different regions. This paper proposes that the validity of these assumptions should be a matter of empirical testing rather than implicit assumption. Thirdly, our estimates of export elasticities implicitly take into account not only the competition between exporters from different regions but also that between producers in the selling country and those in the importing regions. Fourthly, we test both the "strong" and "weak" forms of the hypothesis. The weak form treats exports as a deterministic, non-stochastic variable while the strong form treats exports as a stochastic variable determined by relative prices and expenditures. Fifthly, unlike most previous studies of the hypothesis, we analyze both long- and short-run relationships. Sixthly, in place of world income, which is the variable typically used in the export equation, we use a weighted aggregate of total world imports. Finally, we test for both price and income effects. Our approach leads to some interesting results.

The rest of this paper is organized as follows. Sections 2 and 3 develop the basic theoretical model and present an overview of the relevant literature. Section 4 provides a short summary of recent developments in the Indian economy. Sections 5, 6 and 7 discuss some relevant conceptual issues and present simple analytical extensions to the basic BPCG model. Relative price indices are developed to reflect the spirit of these analytical extensions. Section 8 presents the empirical analysis. Finally section 9 concludes with a discussion of the results.

2. Theoretical Model

We start with the equation for balance of payments equilibrium:

$$PX + EF^* = P^* EM \tag{1}$$

where P and $P^*$are the domestic and foreign price levels, respectively, X is the real foreign demand for exports, M is the real domestic demand for imports, E is the nominal exchange rate (domestic currency price of foreign currency), and F^* is the value of *net* capital inflows measured in foreign currency. Next, we specify export and import demand equations which define trade volumes as functions of relative prices and a scale variable (typically domestic income, Y, in the case of imports and world income, W, in the case of exports):

$$X = \left(EP^*/P\right)^{\psi} W^{\eta}; \psi > 0, \eta > 0 \tag{2}$$

$$M = \left(EP^*/P\right)^{\phi} Y^{\varepsilon}; \phi < 0, \varepsilon > 0 \tag{3}$$

where η and ψ are the world income and price elasticities of demand for Indian exports, respectively, while ε *and* Φ are the Indian income and price elasticities of demand for imports, respectively. Solving equations (1), (2), and (3) simultaneously yields:

$$\hat{y} = \frac{\theta\eta\hat{w} + (1-\theta)(\hat{f}^* + \hat{e} - \hat{p}) + (\theta\psi - \phi - 1)(\hat{p}^* + \hat{e} - \hat{p})}{\varepsilon} \tag{4}$$

where the circumflexes indicate that the associated variables are in growth rate form, and θ

denotes the initial share of exports in the total net inflow of foreign exchange measured at current prices. A look at Indian data indicates that net capital flows have not been a major factor, with current account imbalances varying between 0 and ±2 percent of GDP, for almost the entire period. In other words, Θ can reasonably be assumed to approximate unity. Subsequent sections in this paper therefore, assume away net capital flows, yielding:

$$\hat{y}_b = \frac{\eta\hat{w} + (\psi - \phi - 1)(\hat{p}^* + \hat{e} - \hat{p})}{\varepsilon} \tag{5}$$

where $\hat{y}_b$ denotes the *balance of payments constrained growth rate.* Assuming that the rate of growth of exports is a deterministic/non-stochastic variable, and substituting the log-linear form of equation (2) into (5), enables us to express the growth rate in a more concise form:

$$\hat{y}_b = \frac{\hat{x} - (\phi + 1)(\hat{p}^* + \hat{e} - \hat{p})}{\varepsilon} \tag{6}$$

If the real exchange rate is stable, equations (5) and (6) simplify to:

$$\hat{y}_b = \eta\hat{w}/\varepsilon \tag{7}$$

and

$$\hat{y}_b = \hat{x}/\varepsilon \tag{8}$$

respectively. We can now restate the most parsimonious form of Thirlwall's model in words: *The long-run BPCG Rate equals the rate of growth of exports divided by the income elasticity of imports.* Notice that we can derive equation (7) from (5) in the special case where elasticity pessimism holds and the sum of the relevant price elasticities equals one.

Perraton (2003) distinguished between the "weak" and "strong" forms of the BPCG hypothesis. The former corresponds to equation (6) or equation (8) while the latter corresponds to equation (5) or equation (7), depending on whether the price effects are included or not. The weak form treats exports as a deterministic, non-stochastic variable while the strong form estimates the export equation separately, treating exports as a stochastic variable determined by relative prices and a scale variable. Traditionally, studies of the BPCG model have tested either equation (7) or (8). This assumes that variations in the terms of trade are either insignificant or that elasticity pessimism holds. In the light of recent empirical findings for developing countries, it does not seem appropriate to make either of these assumptions without testing for their validity. Firstly, the purchasing power parity hypothesis has generally been found not to hold, except during hyperinflationary periods, or in the very long run.[1] Secondly, and as a variant of the first point, the terms of trade for developing countries have either fluctuated or, in many cases, shown a secular decline over recent decades.[2] Thirdly, elasticity pessimism is no longer a popular view among economists.[3] We, therefore used (extended versions of) equations (5) and (6) for our empirical tests.

3. Literature Review

Houthakker and Magee (1969) have provided a basis for numerous comparisons of trade equations across countries.[4] Thirlwall (1979) used their finding of large inter-country variation in income elasticities to explain long-run growth rate differences between countries. In an open economy, the dominant constraint on demand, according to Thirlwall, is the external constraint. If a growing country runs into balance of payments problems before it reaches its short run capacity, then demand must be curtailed. Thus resources are underutilized. Technological progress is curtailed and the country's competitiveness suffers, worsening the balance of payments position. If, on the other hand, a country is able to expand demand up to the level of full utilization of resources without running into balance of payments problems, the pressure emanating from demand may raise the capacity growth rate through investment, technological progress, and increased factor supply. Thus:

> While a country cannot grow faster than its balance of payments equilibrium growth rate for very long, unless it can finance an ever-growing deficit, there is little stopping a country growing slower and accumulating large surpluses (p. 49).

Using trade functions of the Cobb-Douglas form, Thirlwall derived the BPCG rate, which he relates to the dynamic version of the Harrod trade multiplier. Thirlwall and Hussain (1982) extended the model to analyze the experience of developing countries that run current account deficits for prolonged periods. The evolution of capital flows, therefore, appears as an additional constraint on long-term growth in their model. Recently, McCombie and Roberts (2002) have argued that under reasonable assumptions regarding the sustainability of net foreign capital inflows as a ratio of national income, the inclusion of these inflows would not make a substantial contribution to loosening the balance of payments constraint.[5]

A number of country and region-specific studies have appeared since Thirlwall (1979).[6] In general, the long-run hypothesis has held up reasonably well, especially for developed countries. McCombie (1997) summarized the conclusions from a number of earlier studies.

4. Recent Economic Developments in India

The Industrial Policy resolution of 1948 laid the foundations of the import-substitution era in India. Prior to 1991, the Indian import regime was characterized by relatively heavy quantitative restrictions on imports and a highly protectionist tariff structure, with high tariffs on finished products and lower tariffs on intermediate and primary products.[7] The role of capital flows, including FDI, was also restricted through the use of a complex legal and regulatory framework.

In 1991, serious balance of payments problems developed as India faced a foreign reserve crunch. Although opinions differ as to the roots of the situation, the proximate causes are less controversial. The collapse of a major trading partner (the Soviet bloc), a fall in foreign exchange remittances due to the Gulf crisis, and the oil price hike ensuing from the Gulf War drastically worsened India's (already fragile) external finance situation. To contain the crisis, the government, in collaboration with the IMF, initiated a structural adjustment and stabilization program. The steps taken on the external front included devaluation, phased reduction in tariffs and quantitative restrictions on imports, abolition of import licensing, increased emphasis on encouraging foreign investment, and full exchange rate convertibility on the current account. As a result, the structure of the Indian economy has undergone changes, as the external sector has come to play a somewhat greater role. However, as Rodrik and Subramanian (2004) have noted, changes in the trends and levels of many major Indian macroeconomic variables predate the policy changes of the 1990s by several years.

5. A Brief Discussion of Some Conceptual Issues

Empirical studies following Houthakker and Magee (1969) typically estimate trade equations of the form presented in Section 2, the underlying assumption being that neither exports nor imports are perfect substitutes for domestic goods.[8] This raises several questions some of which are directly relevant to our study. The "imperfect substitutes" model may be a better approximation for an industrially advanced country that produces differentiated products than for a country whose exports almost entirely consist of homogeneous primary commodities. This may, however, not be a major problem in the Indian case considering that most of its exports have consisted of manufactures in recent decades.[9] The estimation of single equation trade models assumes that relative prices are exogenous to the estimation space. This may be a somewhat realistic assumption in the aggregate, although it may be more so for small relatively closed economies. Moreover, in the pervasive presence of quantitative restrictions, estimation of relative price effects becomes problematic.[10]

One major problem with specifications of trade functions in the typical CES form lies in using a single elasticity parameter for the real exchange rate. Since the real exchange rate represents the ratio of two price indices (expressed in the same currency), this amounts to constraining the influence of these to be equal in magnitude although opposite in direction. This assumption is implausible for several reasons, one being that different price indices are constructed differently. The assumption of homogeneity can also be questioned on the grounds that greater consumer familiarity with local firm reputation and quickly available servicing may tilt the balance in favor of domestic goods, at least in the short run. Firms from certain countries may enjoy an advantage due to past performance in certain sectors. Urbain (1992) noted that agents will use different information sets for each aggregate price index while forming their expectations.

Further exploration of the real exchange rate as typically used reveals that it is assumed that the elasticities of substitution between products from different countries are identical. In particular, it is assumed that the elasticity of substitution between products exported from developing and industrial countries is identical. Put differently, typical studies (including those of the BPCG hypothesis) assume that developing country exporters compete with other developing country producers and industrial country producers to an equal degree. Again, there are several reasons for questioning this approach. The level of industrial development of a country is widely understood to be a major determinant of the composition of its exports. Moreover, even when an industrial country and a developing country produce similar products, different consumer perceptions of quality are likely to render the assumption of identical elasticities of substitution invalid. Spilimbergo et al. (2003), found that export equations with two real effective exchange rates (REERs) - one for LDCs and another for industrial countries - perform better than those with a single aggregated REER. As shown below, a more nuanced approach that allows for different elasticities of substitution leads to interesting implications regarding the existence of international demand-side constraints on export-led growth.

Finally, trade flow responses to relative price differences may be different in the short run from those in the long run. A number of possible explanations such as production bottlenecks, contractual obligations, policy shocks, delayed information flows, the existence of a money illusion, and partial exchange rate pass-through in the short run can be cited.

6 Analytical Extensions

As discussed in the previous section, there are several reasons to suspect the validity of the homogeneity assumption in the real world. Once these assumptions are relaxed the import and export demand equations can be rewritten as:[11]

$$\hat{m} = -\phi_1(\hat{e} + \hat{p}^*) + \phi_2\hat{p} + \varepsilon\hat{y} \tag{9}$$

$$\hat{x} = \psi_1(\hat{e} + \hat{p}^*) - \psi_2\hat{p} + \eta\hat{w} \tag{10}$$

where ϕ_1 and ϕ_2 are the price elasticities of domestic demand for imports and for domestically produced import substitutes, respectively, ψ_1 is the price elasticity of world demand for importables, and ψ_2 is the price elasticity of world demand for Indian exports. *A priori* we would expect these parameters to be positive. Again, assuming balanced trade, solving equations (9) and (10) simultaneously, and excluding foreign capital flows, yields:

$$\hat{y}_b = \frac{\eta\hat{w} + (\psi_1 + \phi_1 - 1)(\hat{e} + \hat{p}^*) - (\psi_2 + \phi_2 - 1)\hat{p}}{\varepsilon} \tag{11}$$

Notice that equation (11) reduces to equation (5) if homogeneity holds. Next, recall that the export equation in section 2 considered one relative price only, namely that of India's exports relative to world exports. However, considering differential competitive effects in more detail requires modifying this equation. Consider an export function of the following form:

$$\hat{x} = \psi_1(\hat{e} + \hat{p}^*) - \psi_2\hat{p} + \psi_3(\hat{e} + \hat{p}') + \eta\hat{w} \tag{12}$$

where $\hat{p}'$ denotes the rate of change of the export price of developing countries. Next, suppose that λ_1 and λ_2 represent the shares of Indian exports going to industrialized and developing countries, respectively. Then, the weighted Indian REER can be expressed as a geometric mean of the two real exchange rates.

$$Q = \Pi_i (EP_i / P)^{\lambda_i},\ i = 1,2 \tag{13}$$

Note that if $\lambda_1 = 1$, that is if all Indian exports are sold in industrialized countries, then $\hat{q} = \hat{e} - \hat{p} + \hat{p}^*$. Repeating the same steps as before, while assuming away capital flows for simplicity, yields a new expression for the strong form of the BPCG rate:

$$\hat{y}_b = \frac{\eta\hat{w} + (\psi_1 + \phi_1 - \lambda_1)(\hat{e} + \hat{p}^*) + [\psi_3 - (1 - \lambda_1)](\hat{e} + \hat{p}') - (\psi_2 + \phi_2 - 1)\hat{p}}{\varepsilon} \tag{14}$$

which reduces to equation (11) if we assume that $\lambda_1 = 1$ and that the changes in the price level of other developing countries are negligible. Notice also that equation (14) implies a less stringent (and more nuanced) Marshall-Lerner condition for price changes in disaggregated trading partners as long as at least some exports are destined for each of the two partners. This is because a change in the price level of one partner has valuation effects (measured in terms of foreign goods) *only* on the proportion of exports destined for that partner. Finally, note that changes in Indian prices relative to other developing countries remain relevant – or in other words, competition with other developing country producers remains a consideration - even if *all* Indian exports are destined for industrial countries. Thus, the term $1\text{-}\lambda_1$ can be "loosely" interpreted as capturing the importance of Indian price competition with substitutes in developing countries while ψ_3 captures the *overall* price elasticity of international demand for developing country products.

7 Calculation of Relative Prices

The construction of relative indices for empirical use requires a number of decisions regarding what weighting scheme to employ and which price measures to use. We followed several studies cited above in deflating the unit import value index by a domestic price index. This arrangement attempts to capture competition between imports and domestically produced import substitutes. Following Houthakker and Magee (1969), we used the WPI as the domestic price index because it is derived from a basket of goods that generally contains a higher proportion of traded goods than other commonly used indices.

While considering exports, a country's REER would preferably reflect not only its price competitivess vis-à-vis the importing country but also its price competitiveness versus competing exporters to the same country. In other words, relative exchange rate index construction for exports involves the added complication of taking third party competition into account. The desire to minimize collinearity, not to mention the incentive to keep our analysis manageable, led us to follow Spilimbergo et al. (2003) in limiting the disaggregation to a weighted average of export prices for developing and developed countries. The weights were based on the proportion of Indian exports going to each group of countries.[12]

8. Empirical Analysis

The method of cointegration has, during the last few years, gained considerable popularity among economists as a tool for studying long-run relationships between variables. In the first step, the order of integration of each variable is established. In the second step, the presence of one or more stationary linear combination(s) or cointegrating vectors among the variables is explored. A list of the variables used in our empirical study, and their notation follows. The appendix provides the data sources.

Y_{REAL}: Index of Indian real GDP.
M_{REAL}: Index of Indian real imports.
X_{REAL}: Index of Indian real exports.
PM: Index of unit value of Indian imports.
WPI: Indian Wholesale Price Index.
PX: Index of unit value of Indian exports.
PX_{IND}: Index of unit value of exports from industrialized countries.
PX_{LDC}: Index of unit value of exports from developing countries.
X^{POT}: Index of World Export Potential.

The prefix *LN* before any of these variable names denotes the log value of that variable while the prefix *D* denotes the first-differenced value of that variable (or its log).

8.2. Unit Root Tests

The Autocorrelation Functions (ACFs), the Partial Autocorrelation Functions (PACFs), and the Ljung-Box Q statistics of the residuals of each variable suggested autocorrelation in the levels. ADF tests found all the series to have a unit root in levels. Moreover, the tests indicated a possible deterministic trend for all the series with the exception of the export price of industrial countries, the relative price of Indian imports, and Indian GDP.

8.3. Cointegration

We used the cointegration test developed by Johansen (1988). Johansen's procedure is VAR-based, consists of a maximum likelihood ratio test, and has the merit that it jointly models several endogenous variables in a VAR framework.[13] Moreover, it provides a reparametrization that is flexible enough to allow for asymmetric short-run responses to changes in domestic and foreign price variables while simultaneously imposing long-run homogeneity (if found econometrically acceptable).

8.3.1. Test of the "Weak" Form

Based on the Schwartz (SC) and Hannan-Quinn (HQ) information criteria, we selected a lag length of two in levels. The results of the cointegration analysis of the closed, unrestricted VECM, which are presented in table 1, were sensitive to the set of assumptions adopted although, significantly, each of the assumptions indicated at least one cointegrating relationship. Inspection of the plots of the first-differenced endogenous variables did not suggest a zero mean for any of the series. Moreover, we had no obvious reason to believe that any of the series are trend stationary. We therefore assumed that the level data have no deterministic trends and the cointegrating equations have intercepts. The trace statistics and maximum eigenvalues indicated one cointegrating vector.

Table 2 presents the results of the restricted/parsimonious Johansen cointegration test normalized on the real import term. The coefficients of all three variables were significant at the 5 percent level. Moreover, the signs were in accordance with our a priori expectations. The Likelihood Ratio (LR) test statistic suggested that the (over-identifying) equality restriction that the two price elasticities be equal in magnitude but opposite in sign could not be rejected at the 1% level. The coefficient of the Indian real GDP term indicated that this variable does not adjust significantly to short-run deviations from the equilibrium, suggesting weak exogeneity.[14] Conditioning on weakly exogenous variables often improves the statistical properties of the system. We tested the hypothesis that Indian real GDP is weakly exogenous by imposing the exclusion restriction on the corresponding elements of the matrix of loading coefficients. The joint restrictions (of homogeneity and weak exogeneity) could not be rejected at the 5 percent level. The elements of the cointegrating vector, which were virtually unchanged after the imposition of the new restriction,[15] can be expressed as:

$$m_t = 0.611 + 1.466 y_t - 1.296 pm_t + 1.296 wpi_t$$

The magnitudes and signs of the short-run adjustment parameters also remained practically unchanged, and indicated that when displaced from their equilibrium level, real imports converge to it in approximately 4 years.[16] Moreover, the domestic WPI also adjusted, albeit in the "wrong," i.e., disequilibrating direction. The coefficients of all three adjusting error correction terms were significant at the 5% level. In the case of import volumes, this may be explained partly by reactive government actions, such as quantitative restrictions, to slow the growth of imports when faced with current account deficits.[17] In the case of the unit import price, two possible explanatory mechanisms could be exchange rate management and the use of tariffs. Thus, in the short run, we see both quantity and price equilibrating adjustments. Moreover, the error correction coefficient was statistically significant and correctly signed, strengthening the evidence for cointegration.[18] However, the short-run dynamic adjustment parameters were insignificant.[19] This indicates that the traditional determinants of import volume have not played an important role in India in the short-run, and may either reflect policy interventions in the face of balance of payment constraints and/or data-related problems.

INSERT TABLES 1 AND 2 HERE

Figure 1, which shows a line graph of the residuals from the cointegrating relationship, provides support for stationarity.[20] The auto- and cross-residual correlograms of the parsimonious VECM, and tests for normality of residuals and first order autocorrelation did not indicate any problems. The eigenvalues of the companion matrix indicated 3 stochastic trends in the data, supporting our conclusion that the rank of the Π matrix equals one (4-3).

INSERT FIGURE 1 HERE

8.3.2. Test(s) of the "Strong" Form

Next, we tested the BPCG hypothesis in its strong form. This requires estimating the export demand equation. Data constraints for some variables forced us to reduce the sample period to 1956-1999. The scale variable typically used in tests of the BPCG hypothesis is world income in real terms. However, Muscatelli et al. (1994) among others, suggested using world export potential, proxied by total global real imports instead, since one would expect it to capture world demand for tradables better than world GDP. Moreover, one would expect this variable to better accommodate the fact that trade as a proportion of the world economy has increased over the last few decades,[21] and that trade-related barriers have fallen, on average, during the same period. We therefore used a trade-weighted world export potential index.[22]

The SC and HQ information criteria suggested a lag length of two in levels. Table 3 summarizes the results based upon each of the five sets of assumptions regarding the deterministic regressors. Again, we selected the model which assumes a linear trend in the data and an intercept but no trend in the cointegration space. An initial look at the data suggested a marked acceleration in the rate of growth of Indian exports beginning from 1986.[23] In order to capture any structural changes in the levels and/or trend, we included three dummy variables, *DU*, *DT*, and *DTB,* where *DU* = 1 for t ≥ 1986 and 0 otherwise, *DT* = t-1986 for t ≥ 1986 and 0 otherwise, while *DTB* = 1 for t = 1986 and 0 otherwise.[24] Note that these do not form part of the long-run vector. The trace statistics indicated the presence of three cointegrating vectors while the maximum eigenvalue tests indicated none. We proceeded with the assumption of 3 cointegrating vectors.

In order to identify the cointegrating vectors, we imposed economic structure through a series of restrictions. Table 4 presents estimates of the restricted VECM. Since we are mainly interested in the India's export demand behavior, we will limit our analysis to the first vector which represents India's export demand behavior over the period assuming homogeneity of degree zero in prices. The cointegrating relationship can be expressed as:

$$x_t = 0.503 + 0.812 x_t^{POT} - 0.823 px_t + 0.589 px_{LDC,t} + 0.233 px_{IND,t}$$

The signs of the coefficients were consistent with our a priori expectations. Indian exports increased with international expenditures, although at a slower pace. An increase in the domestic export price impacted Indian exports negatively. The coefficients on the other two export price indexes indicated that increase in foreign prices benefited Indian exporters, although the coefficient of the industrial country export price index was statistically insignificant. The results indicated that the elasticity of substitution of Indian exports is higher with respect to developing countries than with industrialized countries.

The likelihood ratio test established the weak exogeneity of the Indian export price and industrial country export price. The statistics for world export potential and the export price of developing countries, however, did not indicate weak exogeneity. The latter results are problematic. The ECM coefficient for Indian exports, although correctly signed, was statistically insignificant, weakening support for cointegration among the variables.

INSERT TABLES 3 AND 4 HERE

The VECM explained about 68 percent of the variation in the system. Estimates for the short-run dynamic adjustment parameters were statistically insignificant almost without exception. This re-emphasized doubts about the validity of traditional determinants of foreign trade volumes in the short-run context of India. One of the few interesting results emerging from the short-run estimates was the positive and statistically significant effect of a rise in industrial country export prices on Indian exports. Another was that the dummy variables included to pick up the effects of a structural change in the Indian export relationship in the mid-1980s were statistically significant. The case for such a change is further bolstered by a look at the residuals of the first cointegrating relationship (see figure 2) which show a tendency to drift in one direction starting from this period.

INSERT FIGURE 2 HERE

The roots (eigenvalues) of the companion matrix indicated that there were 2 stochastic trends in the data, supporting our initial conclusion that the rank of the Π matrix equals three (5-2). The auto- and cross-residual correlograms of the parsimonious VECM, and tests for normality of residuals and first order autocorrelation did not indicate any problems.

In brief, although the cointegrating vector of interest yielded reasonable long-run estimates, the results indicated that there might have been a structural change in Indian export behavior in the mid-1980s. In order to further explore the matter without reducing the degrees of freedom available too drastically, we split our time series into 2 sub-periods, 1956-1985 and 1970-1999. The rest of this section presents estimates for these sub-periods.

Period 1: 1956-85

The trace statistic from the unrestricted VECM indicated one cointegrating vector. Table 5 presents details of the restricted VECM estimation. The likelihood ratio test did not reject price homogeneity. Again, the signs of the estimated coefficients were consistent with our a priori expectations with the exception of the industrialized country export price, which, however, was not statistically significant at the 5% level. Of the three price coefficients, that on the developing country export price was the largest in magnitude. The results indicated that while all three price variables were weakly exogenous, the world export potential was not. Again, the latter result raises questions about the validity of the short-run dynamic adjustment estimates. A look at the error correction coefficient does not provide support for an equilibrating tendency on the part of the cointegrating relationship. The VECM explained about 43 percent of the variation in the system.

Period 2: 1970-99

The trace statistic from the unrestricted VECM indicated two cointegrating vectors. Given the purpose of this study, we discuss the first vector only. Table 6 presents details of the restricted VECM estimation. Unlike the previous cases, the likelihood ratio test did reject homogeneity. The signs of the coefficients were consistent with our expectations. The estimated expenditure elasticity was markedly higher than that for the earlier period. The estimated price elasticities, on the other hand, were small although only the own-price elasticity was significant at the 5% level. Unlike the previous cases, world export potential was found to be weakly exogenous. The results indicated that while the other two price variables were weakly exogenous, the industrial country export price was not. The error correction coefficient, although correctly signed and statistically significant, indicated an implausible magnitude. The VECM explained about 84% of the variation in the system.

INSERT TABLES 5 AND 6 HERE

8.4. The Validity of the BPCG Hypothesis in the Case of India

Table 7 contains some useful statistics for evaluating the presence of a long-run balance of payments constraint on Indian growth. The growth rates are averages for the respective time periods. The BPCG rates were calculated from equations (11) and (14) by substituting our estimates of the income and price elasticities (from tables 2, 4, 5, and 6). Let us first consider the weak form of the hypothesis. The growth rate predicted by the BPCG hypothesis (3.85 percent) is reasonably close to the actual average growth rate over the entire period 1950-99 (4.51 percent). The Indian economy thus grew at a somewhat higher rate than that hypothesized by the BPCG hypothesis. This could be interpreted as supporting the hypothesis that Indian growth was constrained on the demand side by the balance of payments.[25] The evidence, however, is much less convincing when we look at averages for sub-periods. For example, while the average actual growth rate was much higher than the average BPCG rate during the period 1956-85, the reverse is true for the period 1970-99. Furthermore, within the latter period, the three decades show markedly different behavior. Indeed the 1990s were reminiscent of the 1970s in that the balance of payments constraint seems to have loosened considerably and India seems to have followed the Japanese model of the 1950s and 1960s in growing slower than the BPCG rate while accumulating reserves. In this sense, at least, the 1990s seem to have provided some breathing space for foreign exchange intensive, technology-importing growth, even though much of the growth was in the services sector. The Indian economy grew at its fastest rate during the 1980s with increased public spending leading the way. This (along with some import liberalization) may have contributed to tightening the balance of payments constraint. That such a constraint did come into play was evident in 1991 when India faced balance of payments problems and briefly had to approach the IMF to tide over the situation.

INSERT TABLE 7 HERE

To explore the relative effects of income and price changes over the long run, we decomposed equation (11) into income and price components and calculated the contribution of each to the hypothesized balance of payments constraint. Rows 12 and 13 of table 7 capture these effects. The average contribution of relative price movements was negligibly small over the period 1950-99. Income changes overwhelmingly dominated in defining the BPCG constraint. Indeed the overall impact of price changes was to slightly tighten the constraint. Furthermore, these patterns continue to hold if we break the period under study into the two periods 1956-85 and 1970-99. However, if we break the data down further into decades, we find that the 1950s and the 1970s were exceptions to the overall trend in that relative price changes did play a significant role in setting the constraint.[26] The exceptional pattern in the 1970s is not surprising considering that that decade was marked by two major oil shocks and the breakdown of the Bretton Woods system of fixed exchange rates. Interestingly enough, the 1970s is the only decade in which price changes made a positive *and* relatively substantial contribution to loosening the constraint. This may be due to the average increase in international prices being greater than that in domestic Indian prices, thus discouraging imports.[27] Our admittedly superficial analysis tends to support this hypothesis. The unit import price increased on average by 15.11%, while the domestic WPI rose by only 9.98%.

Calculations based on estimation of the strong form of the BPCG hypothesis, on the other hand, present a somewhat different picture (see row 14). These calculations, which are based on equation (14), yield a BPCG rate of 4.11%, which is closer to the actual rate than that derived from the weak form. Again, the predicted rates were much farther from the actual ones for individual decades. While the predicted rate was within less than one percentage point of the actual one for the 1960s and 1990s, it was much higher for the 1970s and much lower for the 1980s.[28] Next, in order to examine the matter more closely by taking into account the acceleration of Indian exports starting from the mid-1980s, we used the (temporally) more disaggregated parameter estimates derived in the previous section. The results are reported in rows 15-24 of table 7. Using these sets of coefficients yielded a predicted growth rate for the 1980s that was significantly closer to the actual one. However, the predicted growth rate for the 1970s was even higher and farther apart. A look at rows 16 and 21, which present the components of the BPCG rate originating from changes in international expenditures, and at rows 17-19, and 22-24 which present the component originating from changes in prices, suggests one possible source of this exceptionally large deviation of the BPCG rate from the actual one. Notice that the 1970s is the only decade for which the price component is substantial (for all 3 prices), indeed larger than the expenditure component. Huge international price movements combined with the fact that as much as a quarter of Indian exports were destined for the Soviet Bloc countries – trade which was likely to be much less affected by international price signals – may partially explain the much higher growth rate predicted by the BPCG hypothesis for this period. Continuing in this vein, notice that removing the contribution of prices yields BPCG rates that approximate the actual rate much more closely.[29] Part of the explanation may also lie in the failure to take the supply side of exports into consideration, although the weak exogeneity of Indian export price lessens this concern.

Our results raise an important issue. Bairam (1997) concluded that while the income elasticities of import demand are independent of the level of development, those of export demand are not. This led Bairam to suggest that calculation of the BPCG rate should be based on the weak form of the hypothesis. Our analysis of the sub-periods provides some support to Bairam's overall conclusion, although perhaps for somewhat different reasons.[30] Our conclusions also get interesting support from another major empirical effort. Senhadji and Montenegro (1998b), who estimated *import* demand equations for 77 countries covering the period 1960-93 found significant and correctly signed parameter estimates for the income elasticity of Indian imports. However, a parallel study, Senhadji and Montenegro (1998a) which estimated *export* demand equations could not find valid estimates for India.

9. Concluding Remarks

The purpose of this study was to test the validity of the BPCG hypothesis for India, a large developing country with a relatively strong industrial base, for the period 1950-1999. After an exploration of the econometric properties of the time series, our analysis branched into two paths; one testing the weak form of the BPCG hypothesis and the other testing the strong form. Starting with the weak form, and using Johansen's cointegration technique, we found support for the existence of a stable long-run relationship between Indian real imports, real GDP, unit import price, and WPI. The cointegrating vector was then embedded in a VECM framework to study the dynamics of the relationship. The parameter estimates indicated that the homogeneity restriction could not be rejected. The estimated values of the long-run elasticities of demand for income were 1.47 for income, and 1.29 for the relative price elasticity. While the long-run income elasticity falls within the range of previous studies, the long-run price elasticity is much higher,[31] perhaps partly because previous estimates that did not employ simultaneous equation methods suffered from a simultaneity bias.[32]

The average BPCG rate was found to be close to the actual average growth rate (3.85 percent versus 4.51 percent) of the Indian economy over the period 1950-99. Substantial differences emerged, however, when we considered individual decades. Thus the study found more support for the BPCG model as a long-run hypothesis.[33] The finding that income was by far the dominant influence in determining the balance of payments constraint in the long run provided further support for the BPCG hypothesis. This, it should be emphasized, does not imply that the terms of trade should be ignored. These remain relevant, even if their impact is low on the import side. In the short run, however, income was not found to adjust significantly to disequilibria. To the extent that the income variable is prone to greater inertia, this finding may have theoretical justification. However, real imports, another quantity variable, were found to adjust rather rapidly. The pattern of adjustment of import prices and volumes may indicate policies sometimes described collectively as "import compression" by policy makers.

Turning to tests of the strong form of the model, again we used Johansen's cointegration method to test for the presence of a long-run relationship between the Indian export volume, world export potential, Indian export price, industrialized country export price, and developing country export price variables. The separation of the foreign price index into two separate measures, one for developing and the other for industrial countries, marks a departure from the typical assumption that the elasticity of substitution between goods from these two regions are the same. Our test supported the existence of a long-run linear relationship between these I(1) variables. The cointegrating relationship was then embedded in a VECM. While the identical elasticity of substitution restriction was rejected, homogeneity was not. The estimated long-run elasticities with respect to world export potential, Indian export price, developing country export price, and industrialized country export price were 0.81, 0.82, 0.59, and 0.23 respectively. Previous estimates have varied.[34] Again, the short-run elasticities turned out to be statistically insignificant. Moreover, tests failed to support weak exogeneity of the world export potential variable, raising concerns about the short-run estimates. The average BPCG rate for the entire period was found to be close to the actual rate. However, again the rates were markedly different for some decades. Indian exports experienced a significant acceleration starting from the mid-1980s. To explore whether this was the source of some of our concerns regarding the export demand estimates, we developed two sets of estimates, one for the period 1956-1985, and another for the period 1970-1999. The estimates suggested that India benefited from a higher elasticity of global demand for its products in the later period, perhaps partially due to previous technological upgrading, and partially to a change in trade policies.[35] Moreover, the traditionally specified determinants of exports were found to explain Indian export performance to a much greater degree during this period.

Our tests for homogeneity indicated that while it was generally acceptable over the long-run,[36] it was rejected in the short-run. This is consistent with our hypothesis that the factors causing differential responses to domestic and international price changes are likely to be more relevant in the short run. Moreover, the same kind of factors that make homogeneity less likely to hold in the short run may explain why the short-run determinants traditionally specified in trade equations were generally not found to be significant for India.

In brief, our analysis provided support to the BPCG hypothesis only over the long run. It also indicated a marked rise in the expenditure elasticity of world demand for Indian products in the second half of our sample period, which is likely attributable at least in part to the investment made during the earlier period in India's human and capital resources. The parameter estimates suggested that the Marshall-Lerner condition is satisfied for India, and that although income/expenditure effects dominated over the long-run, relative price movements should not be ignored. For example, large price movements may have caused the hypothesized BPCG relationship to break down in the 1970s.

On a related note, the relaxation of the assumption (common to all previous studies of the BPCG hypothesis) that the elasticity of substitution between products is independent of their region of origin provided some evidence that even though India exports most of its products to industrial countries, competition with other developing countries may have been relatively more important than competition with industrial country exporters.[37] This tentative finding has interesting implications for the possible existence of a fallacy of composition in a world where growth of global expenditures is likely to have limits, and where a number of developing countries simultaneously pursue export-led growth in the same global marketplace.[38]

While concluding our analysis, it may be useful to recall that a major portion of India's trade occurred with the former Soviet bloc countries. Moreover, the proportion of this trade was more significant on the (Indian) export side than the import side. That such trade may not have been significantly influenced by the standard determinants specified in trade equations provides one justification for treating these exports as exogenous and non-stochastic for most of the sample period. Possible evidence of import compression provides another, particularly given that a large proportion of developing country imports generally consist of intermediate and capital goods which are necessary ingredients for growth. Furthermore, the composition of India's trade over the period indicates much more stability on the import side than the export side. For instance, while the proportion of manufactures in Indian imports barely changed from 49 to 53 percent between 1970 and 1995, that of manufactures in Indian exports increased from 52 to 74 percent over the same period.[39] In the Indian case therefore, testing the BPCG model in its weak form may be more appropriate.

10. Appendix: Data Items and their Sources

Indian Real Imports (M_{Real}) and Indian Real Exports (X_{Real}): Collected from various editions of the UN's *International Trade Statistics Yearbook* (ITSY).
GDP Volume (Y_{Real}): Various editions of IMF's *International Financial Statistics*.
Indian Import Price (PM) and Indian Export Price (PX): Unit values of Indian imports and exports collected from various editions of the UN's ITSY.
Domestic Price Deflator (WPI): Wholesale price indices (WPIs) from various editions of IMF's *International Financial Statistics*.
Industrial country export price (PX_{IND}) and developing country export price (PX_{LDC}): Unit values of industrial and non-OPEC developing country export prices, respectively, collected from various editions of the UN's ITSY.
World Export Potential (X^{POT}): A weighted index of world exports (excluding exports from OPEC countries) collected from various editions of the UNCTAD's *Handbook of Statistics*.

Endnotes

[1]For example, Bahmani-Oskoee (1995) found that PPP held for only 8 of the 22 countries in their sample.
[2]See Sapsford and Chen (1998) for an interesting survey.
[3]Although at least one recent study, Alonso and Garcimartin (1998-99) does find evidence for it for most developed countries. Moreover, Muscatelli, et al. (1992) make a case for why low export price elasticities should not be surprising given for instance that firms devote a lot of resources to ensuring brand loyalty.

[4]For samples of more recent work, see Rose (1990, 1991), Reinhart (1995), and Senhadji et al. (1998a, 1998b).
[5]This does not, however, preclude the possibility that a sharp increase in capital inflows into a relatively small economy may enable the growth rate to exceed the BPCG rate for a few years, i.e., in the short run.
[6]See, for example, Bairam (1991, 1997); Alonso and Garcimartin (1998-99); Ansari and Xi (2000); Bertola et al. (2002); Perraton (2003).
[7] During most of this period India was classified by the World Bank as a "strongly inward-oriented" country. Interestingly enough, India's exports generally grew faster than its economy even during the 1970s and 1980s.
[8]If they were, *only* one price would be sufficient to capture all the relevant information in each case.
[9]Although one would also need to look at the more characteristics of those manufactured exports before reaching any reasonably firm conclusions. See Kaplinsky (1993), for example, for a discussion of the increasing "commoditization" of manufactures at the lower end of the technological ladder.
[10]Faini et al. (1992) found that import functions of the form discussed in this section work well when import controls are relatively stable over time.
[11]Thirlwall (1979) started from a similar specification before assuming identical own- and cross-price elasticities.
[12]These and other unreported econometric details and statistics are available on request from the author.
[13]And thus helps address some of the issues raised by Alonso and Garcimartin (1998-99).
[14]Mathematically, the joint pdf for two random variables *Yt* and *Xt* can be factorised into a conditional pdf and a marginal pdf. Or, $f(y_t, x_t) = f(y_t|x_t)\ f(x_t)$, where the small case represents the realizations of the random variables. When the information contained in the marginal pdf can be ignored without loss while utilizing the information contained in the conditional pdf for estimation of the parameters of interest, X_t is said to be weakly exogenous.
[15]Recall that we have 2 binding restrictions in this case; (1) that the price elasticities of demand are equal in magnitude but opposite in sign, and (2) that Indian real income does not adjust in the short run.
[16]This is a reasonably rapid speed of adjustment for a quantity variable, and may indicate policy responsiveness in pre-1990s India. Compare this with Rogoff (1996), which reported the consensus view that deviations from the PPP real exchange rate tend to damp out at a rate of roughly 15% per year.
[17] This phenomenon, sometimes known as "import compression" is particularly relevant for developing countries.
[18] The restriction of short-run price homogeneity was rejected at the 1% and 5% levels of significance.
[19]Except in the case of *D(LNWPI)* or domestic inflation, which did show a negative and statistically significant relationship with the lagged domestic growth rate.
[20]Although notice that the stationarity is much more obvious for the post-1970 era.
[21]In other words, exports and imports have, on the average, grown faster than world GDP.
[22]While oil exporting countries were excluded when constructing the unit value index for exports from developing countries, they were included while calculating the export potential. The former can be justified on the grounds that the export prices of oil exporting countries are heavily influenced by one commodity, i.e., oil, which plays an insignificant role, if any, in India's exports. However, there is no reason to exclude these countries while constructing the scale index since they form a significant source of global demand for exports.
[23] Note that this is before the introduction of the reforms of 1991.
[24] Indian export data indicates a marked acceleration beginning from 1986. A Chow breakpoint test on an OLS regression of the export equation rejected the null hypothesis of no structural change in 1986.
[25]Recall that while the BPCG hypothesis does not preclude countries growing slower than the BPCG rate, it does rule out countries growing much faster than the rate predicted by the BPCG constraint.
[26]Although the effects of income changes still dominated.
[27]The 1970s, of course, were marked by high inflation in large parts of the world. See Dell and Lawrence (1980) for a detailed study of the special nature of international price movements in the 1970s with a focus on 13 developing countries including India.
[28] Recall that the sample for the strong form started from 1956, which precludes analysis of the 1950s.
[29]See row 16 in the table.
[30]Our estimates of the strong form may have been affected both by inconstancy in the parameters and by the nature of India's trade partners. Specific conclusions would require more specific empirical analysis.
[31] For example, Houthakker and Magee (1969) estimated India's income elasticity for the period 1951-66 to be 1.43. Bairam (1997) estimated the income elasticity to be 0.96 (although it was not statistically) for the period 1961-85. Senhadji and Montenegro (1998b) estimated the income and price elasticities to be 1.33 and 0.12, respectively. Dutta and Ahmed (2001) exploring the period 1971-95, found the income and price elasticities to be 1.48 and 0.47, respectively. In a recent study, Perraton (2003) used data for the period 1973-95 to estimate an income elasticity of 1.46. The price elasticity was negligibly small and statistically insignificant.
[32]See Leamer and Stern (1970) and Goldstein and Khan (1985) for discussion of this issue.
[33]Note that this does not undermine the validity of the model which, as pointed out in section 2, originated as a long-run hypothesis.
[34] Perraton (2003) estimated income and price elasticities of 1.92 and 0.88, respectively, for the period 1973-95. Bairam (1991) estimated an income elasticity of 1.74 for the period 1961-85. In marked contrast to typical results for developing countries found in other studies (and for most other countries in his study), Rittenberg (1986)

found a low income elasticity (0.13) but high price elasticities (2.24 and 2.84 for cross and own-elasticity, respectively) for the period 1960-80. Roy (2002) estimated a world income elasticity of 0.69, and own and cross-price elasticities of 0.73 and 0.64, respectively, for the period 1960-97.

[35]Note that this finding is not inconsistent with a recent study, Rodrik and Subramanian (2004, p. 5), that concluded that ``the learning generated under the earlier [import substitution] policy regime" in India "and the manufacturing base created thereby provided a permissive environment for eventual takeoff [in the 80s] once the policy stance softened vis-à-vis the private sector."

[36] With the exception of the export relationship for the period 1970-99.

[37]In the sense that the elasticity of substitution of Indian export products is higher with respect to other developing countries than with respect to industrialized countries.

[38] See Blecker (2003) for an interesting discussion.

[39]See UNCTAD's *Handbook of International Trade and Development Statistics*, *1996-97*.

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Table 1. Import Equation: Summarized Results of Cointegration Rank Test with 2 Lags

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No intercept No trend	Intercept No trend	Intercept No trend	Intercept Trend	Intercept Trend
Trace	2	2	1	2	1
Max Eigenvalue	2	2	1	2	1

Significance level: 5 percent.
Series: $LN\ M_{Real}$, LNY_{Real}, $LN\ PM$, $LN\ WPI$

Table 2. Import Equation: VECM Estimation with Restrictions on the Price Elasticities and Loading Coefficients

Cointegration Restrictions:
$\beta_{11} = 1$, $\beta_{13} = -\beta_{14}$, $\alpha_{21} = 0$

Restrictions identify all cointegrating vectors
LR test for binding restrictions (rank = 1)
$\chi^2(2)$ 5.439 Probability 0.07

Cointegrating Eq:	**CointEq1**			
$LNM_{Real,t-1}$	1.000			
$LNY_{Real,\ t-1}$	-1.466 [-15.71]			
$LNPM_{t-1}$	1.296 [4.86]			
$LNWPI_{t-1}$	-1.296 [4.86]			
C	-0.611			
Error Correction:	**D($LNM_{Real,t}$)**	**D($LNY_{Real,t}$)**	**D($LNPM_t$)**	**D($LNWPI_t$)**
CointEq1	-0.267 [-4.70]	0.000	-0.249 [-5.25]	-0.090 [-5.00]
D($LNM_{Real,t-1}$)	-0.068 [-0.48]	-0.029 [-1.07]	0.091 [0.79]	-0.016 [-0.39]
D($LNY_{Real,\ t-1}$)	-0.117 [-0.14]	-0.057 [-0.36]	-1.090 [-1.64]	-0.878 [-3.52]
D($LNPM_{t-1}$)	0.015 [0.09]	0.010 [0.29]	-0.005 [-0.04]	0.029 [0.53]
D($LNWPI_{t-1}$)	-0.174 [-0.35]	0.043 [0.43]	0.306 [0.74]	0.092 [0.59]
C	0.064 [1.31]	0.044 [4.64]	0.068 [1.68]	0.093 [6.12]
R-squared	**0.340**	**0.042**	**0.446**	**0.489**
Adj. R-squared	0.262	-0.071	0.380	0.428
Sum sq. resids	0.989	0.038	0.679	0.095
S.E. equation	0.153	0.030	0.127	0.047

Note: t-stats in parenthesis.

Table 3. Export Equation: Summarized Results of Cointegration Rank Test with 2 Lags

Data Trend	None	None	Linear	Linear	Quadratic
Test Type	No intercept No trend	Intercept No trend	Intercept No trend	Intercept Trend	Intercept Trend
Trace	3	4	3	2	3
Max Eigenvalue	2	1	0	0	0

Significance level: 5 percent.
Series: $LN\ X_{Real}$, LNX^{POT}, $LN\ PX_{IND}$, $LN\ PX_{LDC}$, $LN\ PX$

Table 4. Export Equation (1956-99): VECM Estimation with Restrictions on the Price Elasticities and Loading Coefficients

Cointegration Restrictions:

$B_{11} = 1$, $\beta_{13} + \beta_{14} = -\beta_{15}$, 0, $\alpha_{51} = 0$, $\beta_{21} = 1$, $\beta_{22} = 0$, $\beta_{24} = -\beta_{25}$, $\alpha_{32} = 0$, $\beta_{32} = -1$, $\beta_{34} = 0$, $\alpha_{52} = 0$

Restrictions identify all cointegrating vectors

LR test for binding restrictions (rank = 3)

$X^2(1)$ 0.061 Probability 0.804

Cointegrating Eq:	*CointEq1*	**CointEq2**	**CointEq3**
$LN\ X_{Real,t-1}$	1.000	1.000	0.752 [5.23]
$LN\ X^{POT}_{t-1}$	-0.812 [-15.23]	0.000	-1.000
$LN\ PX_{t-1}$	0.823 [5.61]	-0.452 [-9.04]	1.339 [7.313]
$LN\ PX_{LDC,t-1}$	-0.589 [-2.99]	1.066 [2.45]	0.000
$LN\ PX_{IND,t-1}$	-0.233 [-0.98]	-1.066 [-2.454]	-1.261 [-6.13]
C	-0.503	-2.311	1.295

Error Correction:	**D($LN\ X_{Real,t}$)**	**D($LN\ X_t^{POT}$)**	**D($LN\ PX_t$)**	**D($LN\ PX_{LDC,t}$)**	**D($LN\ PX_{IND,t}$)**
CointEq1	-0.151 [-0.39]	0.523 [3.67]	0.466 [1.27]	0.771 [3.72]	0.000
CointEq2	-0.634 [-4.21]	-0.142 [-2.67]	0.000	-0.297 [3.52]	0.000
CointEq3	0.167 [0.64]	-0.252 [-2.64]	-0.505 [-2.15]	-0.545 [-3.40]	0.060 [0.87]
D($LN\ X_{Real,t-1}$)	0.052 [0.29]	-0.098 [-1.55]	-0.057 [-0.31]	0.072 [0.460]	0.009 [0.08]
D($LN\ X_{t-1}^{POT}$)	0.214 [0.42]	-0.218 [-1.23]	-0.186 [-0.36]	0.127 [0.29]	0.144 [0.44]
D($LNPX_{t-1}$)	-0.107 [-0.500]	-0.165 [-2.23]	0.010 [0.46]	0.053 [0.29]	0.001 [0.01]
D($LN\ PX_{LDC,t-1}$)	-0.649 [-1.74]	0.174 [1.35]	0.419 [1.12]	0.061 [0.19]	0.069 [0.28]
D($LN\ PX_{IND,t-1}$)	1.646 [3.96]	-0.050 [-0.35]	-0.649 [-1.55]	0.542 [1.512]	0.507 [1.90]
C	-0.068 [-0.74]	0.164 [5.21]	0.074 [0.81]	0.068 [0.87]	0.026 [0.45]
DU	-0.413 [-2.93]	-0.010 [-0.21]	0.132 [0.93]	-0.221 [-1.81]	0.017 [0.19]
DT	0.087 [2.40]	-0.031 [-2.48]	-0.011 [-0.29]	-0.002[-0.07]	-0.012 [-0.51]
DTB	0.287 [1.83]	-0.023 [-0.431]	-0.143 [-0.90]	0.177 [1.31]	0.096 [0.96]
R-squared	0.683	0.536	0.326	0.419	0.447
Adj. R-squared	0.570	0.371	0.086	0.213	0.252
Sum sq. resids	0.256	0.030	0.260	0.190	0.105
S.E. equation	0.090	0.031	0.091	0.078	0.058

Note: t-stats in parenthesis.

Table 5. Export Equation (1956-85): VECM Estimation with Restrictions on the Price Elasticities and Loading Coefficients

Cointegration Restrictions:

$\beta_{11} = 1$, $\beta_{13} + \beta_{14} = -\beta_{15}$, $\alpha_{31} = 0$, $\alpha_{41} = 0$, $\alpha_{51} = 0$

Restrictions identify all cointegrating vectors

LR test for binding restrictions (rank = 1)

χ^2 (4)	4.578	Probability	0.333

Cointegrating Eq:	**CointEq1**
$LN\ X_{Real,t-1}$	1.000
$LN\ X^{POT}_{t-1}$	-0.779 [-11.89]
$LN\ PX_{t-1}$	0.746 [4.58]
$LN\ PX_{LDC,t-1}$	-0.904 [-2.29]
$LN\ PX_{IND,t-1}$	0.158 [0.34]
C	-0.335

Error Correction:	**D($LN\ X_{Real,t}$)**	**D($LN\ X_t^{POT}$)**	**D($LN\ PX_t$)**	**D($LN\ PX_{LDC,t}$)**	**D($LN\ PX_{IND,t}$)**
CointEq1	0.037 [0.22]	0.251 [5.55]	0.000	0.000	0.000
D($LN\ X_{Real,t-1}$)	-0.174 [-0.70]	-0.128 [-1.80]	-0.010 [-0.04]	0.145 [0.72]	-0.009 [-0.08]
D($LN\ X_{t-1}^{POT}$)	-0.420 [-0.56]	-0.354 [-1.63]	-0.204 [-0.29]	0.432 [0.71]	0.421 [1.23]
D($LNPX_{t-1}$)	0.368 [1.49]	-0.145 [-2.04]	-0.063 [-0.27]	0.033 [0.17]	0.009 [0.08]
D($LN\ PX_{LDC,t-1}$)	-1.258 [-2.44]	0.112 [0.76]	0.366 [0.37]	-0.478 [-1.14]	-0.136 [-0.58]
D($LN\ PX_{IND,t-1}$)	1.619 [2.46]	-0.001 [-0.01]	-0.242 [-0.39]	1.240 [2.32]	0.816 [2.74]
C	0.011 [0.24]	0.082 [5.71]	0.076 [0.08]	-0.021 [-0.52]	-0.012 [-0.55]
R-squared	0.426	0.505	0.109	0.341	0.534
Adj. R-squared	0.270	0.370	-0.133	0.162	0.407
Sum sq. resids	0.297	0.024	0.259	0.196	0.061
S.E. equation	0.116	0.033	0.108	0.094	0.052

Note: t-stats in parenthesis.

Table 6. Export Equation (1970-99): VECM Estimation with Restrictions on the Price Elasticities and Loading Coefficients

Cointegration Restrictions:

β_{11} =1, α_{21} 0, α_{41} =0, B_{21} =1, β_{22}=0, α_{22} =0, α_{42} =0, α_{52} =0

Restrictions identify all cointegrating vectors

LR test for binding restrictions (rank = 2)

χ^2 (4)	1.999	Probability	0.736

Cointegrating Eq:	**CointEq1**	**CointEq2**
$LN\ X_{Real,t-1}$	1.000	1.000
$LN\ X^{POT}_{t-1}$	-1.849 [-17.12]	0.000
$LN\ PX_{t-1}$	0.131 [-2.33]	1.731 [3.62]
$LN\ PX_{LDC,t-1}$	-0.111 [-0.52]	26.925 [7.60]
$LN\ PX_{IND,t-1}$	-0.099 [-0.76]	-18.821 [-8.00]
C	5.526	-62.775

Error Correction:	**D($LN\ X_{Real,t}$)**	**D($LN\ X_t^{POT}$)**	**D($LN\ PX_t$)**	**D($LN\ PX_{LDC,t}$)**	**D($LN\ PX_{IND,t}$)**
CointEq1	-1.918 [-8.37]	0.000	0.6598 [3.75]	0.000	-0.508 [-2.33]
CointEq2	0.060 [5.75]	0.000	-0.062 [-10.76]	0.000	0.000
D($LN\ X_{Real,t-1}$)	0.527 [3.17]	0.097 [1.61]	-0.198 [-2.55]	0.180 [3.33]	0.085 [0.75]
D($LN\ X_{t-1}^{POT}$)	1.238 [1.42]	0.321 [1.02]	0.776 [1.91]	0.103 [0.36]	0.138 [0.25]
D($LNPX_{t-1}$)	-0.800 [-0.97]	-0.081 [-0.27]	-0.0711 [-0.19]	0.2131 [0.80]	-0.691 [-1.31]
D($LN\ PX_{LDC,t-1}$)	-0.977 [-1.42]	-0.139 [-0.56]	0.272 [0.85]	-0.371 [-1.66]	0.321 [0.73]
D($LN\ PX_{IND,t-1}$)	1.690 [2.02]	0.112 [0.37]	-1.333 [-3.42]	0.268 [0.98]	-0.111 [-0.21]
C	0.036 [0.52]	0.034 [1.35]	0.098 [3.05]	-0.040 [-1.79]	0.056 [1.26]
R-squared	0.840	0.559	0.789	0.742	0.404
Adj. R-squared	0.738	0.279	0.655	0.578	0.025
Sum sq. resids	0.099	0.012	0.021	0.010	0.040
S.E. equation	0.095	0.034	0.044	0.030	0.060

Note: t-stats in parenthesis.

Table 7. Average Growth Rates of Key Variables: 1950-99 and Sub-Periods

Variable / Period	1951-60	61-70	71-80	81-90	91-99	56-85	70-99	51-99
1. $\Delta M_{REAL\_AVERAGE}$	0.73	3.48	4.87	6.37	14.48	5.17	9.18	6.40
2. $\Delta PM_{\_AVERAGE}$	-5.91	4.72	15.11	7.63	6.98	7.54	9.52	6.21
3. $\Delta WPI_{\_AVERAGE}$	0.98	6.30	9.98	7.12	7.76	7.58	8.27	6.60
4. λ	0.68	0.72	0.72	0.79	0.67	0.71	0.73	0.72
5. $\Delta X_{Real\_AVERAGE}$	-2.94	4.16	7.04	4.69	17.56	2.78	9.24	5.76
6. $\Delta X^{POT}_{\_AVERAGE}$	6.12	7.60	5.77	3.47	6.69	6.57	5.27	6.01
7. $\Delta PX_{IND\_AVERAGE}$	0.44	1.60	12.00	2.63	-0.64	5.53	1.08	3.61
8. $\Delta PX_{LDC\_AVERAGE}$	-1.47	1.60	14.22	-0.59	0.84	6.03	0.09	3.47
9. $\Delta PX_{\_AVERAGE}$	2.19	0.54	8.08	2.99	-1.66	3.89	0.79	2.55
10. $\Delta \mathbf{Y}_{\mathbf{REAL\_}AVERAGE}$	**5.04***	**4.11**	**3.06**	**5.80**	**5.50**	**3.97**	**4.83**	**4.51**
11. $\Delta \mathbf{Y}_{\mathbf{WEAK}}$	**-3.39**	**2.52**	**5.84**	**3.30**	**11.82**	**1.89**	**6.55**	**3.85**
12. $\Delta Y_{\_CONTRIBUTION}$	-2.00	2.84	4.80	3.20	11.97	1.90	6.30	3.93
13. $\Delta Price_{\_CONTRIBUTION}$	-1.39	-0.32	1.04	0.10	-0.16	-0.01	0.25	-0.08
14. $\Delta \mathbf{Y}_{\mathbf{STRONG\_1956\text{-}99}}$	**1.70**	**5.02**	**6.65**	**0.82**	**4.75**	**4.99**	**2.92**	**4.11**
15. $\Delta \mathbf{Y}_{\mathbf{STRONG\_1956\text{-}85}}$	**3.48**	**5.34**	**15.02**			**6.06**		
16. $\Delta X^{POT}_{\_CONTRIBUTION}$	3.25	4.04	3.07			3.49		
17. $\Delta PX_{IND\_CONTRIBUTION}$	0.14	0.46	3.42			2.80		
18. $\Delta PX_{LDC\_CONTRIBUTION}$	-0.58	0.68	6.06			2.53		
19. $\Delta PX_{\_CONTRIBUTION}$	0.67	0.17	2.48			-2.76		
20. $\Delta \mathbf{Y}_{\mathbf{STRONG\_1970\text{-}99}}$				**4.64**	**8.48**		**7.80**	
21. $\Delta X^{POT}_{\_CONTRIBUTION}$				4.38	8.44		7.08	
22. $\Delta PX_{IND\_CONTRIBUTION}$				1.09	-0.32		2.20	
23. $\Delta PX_{LDC\_CONTRIBUTION}$				0.04	-0.12		-0.55	
24. $\Delta PX_{\_CONTRIBUTION}$				-0.87	0.48		-0.92	

* The average for 1956-1960 was 4.09 percent.

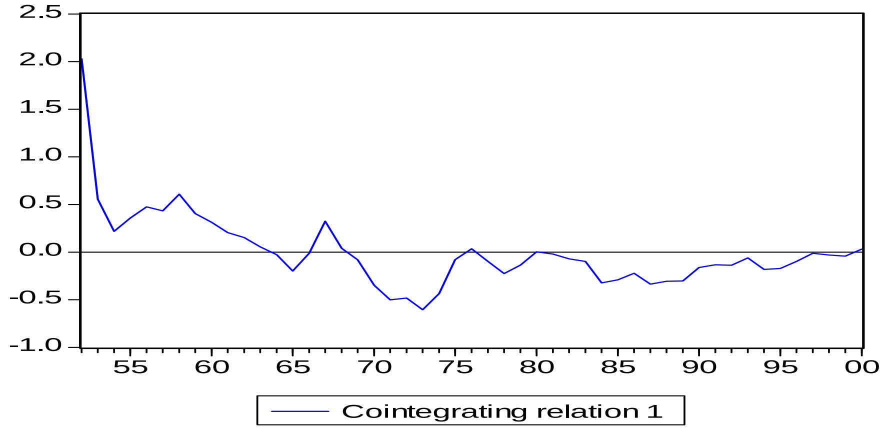

Figure 1. Import Equation: Residuals of the Cointegrating Vector

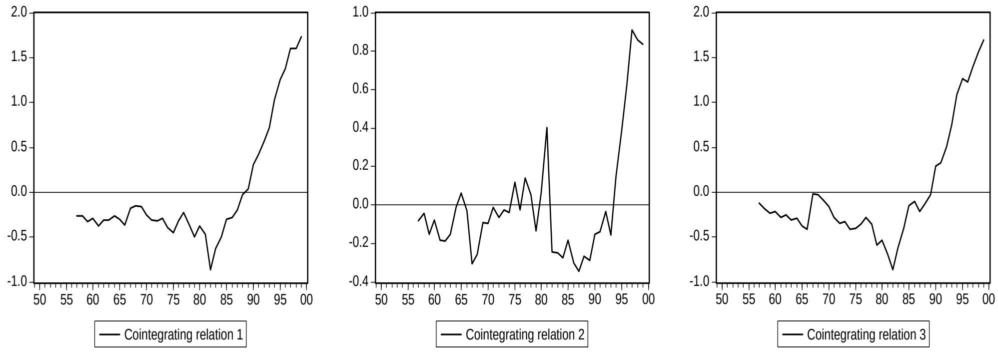

Figure 2. Export Equation: Residuals of the Cointegrating Vectors