Does the Balance of Payments Constraint Explain the Slowdown in Mexican Economic Growth after Trade Liberalization?

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Abstract

This paper investigates why the average growth rate of the Mexican economy has been so disappointing since the trade liberalization of the late 1980s. Some previous work has argued that the growth slowdown can be attributed to a tightening of the balance of payments constraint on Mexico’s growth, due to a rise in the income elasticity of import demand that outweighed the increase in export growth after trade liberalization. However, such an aggregative approach ignores the distinction between imports of final goods and intermediate goods, which is important in Mexico due to the high intermediate import content of manufactures—especially those produced for export. To address this issue, this paper presents a disaggregated model of the balance of payments constraint with two types of exports (manufactured and primary commodities) and two types of imports (intermediate and final goods). The empirical results show that the balance of payments constrained (equilibrium) growth rate did not fall, but instead rose slightly post-liberalization, so this model cannot account for the actual growth slowdown. Instead, the analysis points to an important role for the real exchange rate, which is overlooked in the balance of payments constrained growth model, as well as internal obstacles and policies.

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1. Introduction

By the early 1980s, the conventional wisdom in discussions of economic development in Mexico and other major Latin American nations was that the import substitution model had become exhausted and the continent needed to move toward the promotion of manufactured exports, following the model of the East Asian four tigers (South Korea, Taiwan, Hong Kong, and Singapore).¹ After the debt crisis of the early 1980s, Mexico did abandon import substitution policies, but instead of embracing East Asian-style export promotion via activist government industrial policy, Mexico instead adopted a series of market-oriented reforms of which the centerpiece was the liberalization of international trade and foreign investment (Lustig, 1998). Mexico succeeded in becoming a highly open economy, but one that was wide open to imports and foreign investment as well as more concentrated in exports of manufactures.

Nearly three decades after this dramatic opening of the Mexican economy, economists of all persuasions agree that the results in terms of growth have been disappointing. Since the trade liberalization of the late 1980s, the growth rate of Mexico’s real gross domestic product (GDP) has averaged about 3% per year, barely half of what the country achieved between the 1940s and the 1970s. Similarly, the average growth rate of per capita income fell from about 3% to 1% per year between the same two periods (the smaller gap is due to a reduction in population growth). There are numerous explanations for this disappointing growth performance (for critical surveys, see Moreno-Brid and Ros, 2009, pp. 222–51; Hanson, 2010), but broadly they fall into two camps. One side, informed by the neoclassical emphasis on productive efficiency and supply-

¹ See, for example, the discussion in Moreno-Brid and Ros (2009, pp. 140–45) and the citations given there to the previous literature. Earlier discussions in the 1970s had focused more on a perceived need to deepen import substitution by promoting greater domestic production of capital and intermediate goods (for example, Solís, 1977), although some authors also noted the lack of incentives for exports (for example, Ibarra, 1978).
side factors in the growth process, emphasizes that reform of the domestic economy has lagged behind the liberalization of the external sector. In this view, the absence (or poor design) of reforms in areas such as fiscal policy, energy (especially the state oil monopoly), telecommunications, and the financial sector has put a severe drag on the country’s growth, in spite of significant achievements in exports (e.g., Arias et al., 2010; Hanson, 2010; Kehoe and Ruhl, 2010). The other side, informed more by a Keynesian emphasis on demand-side constraints, generally believes that the slow growth in the post-liberalization era can be attributed to some combination of inadequate investment spending (especially deficient public spending on infrastructure), restrictive monetary and fiscal policies, and various external constraints (including, among other things, repeated episodes of overvaluation of the peso) (e.g., Ibarra, 2008; Blecker, 2009; Moreno-Brid and Ros, 2009).

Within the latter perspective, it has been argued specifically that the opening of the Mexican economy may actually have tightened, rather than relieved, the balance of payments (BP) constraint on the country’s growth, because the opening to imports has outweighed the benefits of increased export growth. Applying the theory of “balance-of-payments-constrained growth” (BPCG), originally due to Thirlwall (1979),2 several authors including Moreno-Brid (1999, 2002), López and Cruz (2000), Guerrero de Lizardi (2003), Pacheco-López and Thirlwall (2004), Pacheco-López (2005), and Cardero and Galindo (2005) found that trade liberalization had significantly increased Mexico’s income elasticity of import demand without generating a compensating acceleration of the country’s export growth, thereby reducing the growth rate consistent with balance of payments equilibrium (i.e., the growth rate just low enough to prevent increasing trade deficits due to imports rising faster than exports). This analysis has received a

2 See McCombie and Thirlwall, eds. (2004) for later extensions and applications of the model, and Razmi (2011) for a skeptical view of the model’s underpinnings.
challenge in the work of Ibarra (2011a, 2011b), who shows econometrically that the finding of a statistically significant increase in the income elasticity of import demand is not robust for imports of intermediate goods, which are the largest part of Mexico’s imports, when one controls for the fact that the demand for such imports is also a function of manufactured exports (because the latter are highly intensive in intermediate imports). However, Ibarra’s work leaves open the question of whether the BP constraint on Mexico’s growth was not tightened in another way, by the increasing share of manufactured exports in Mexico’s total exports, given the high intermediate import intensity of Mexican manufacturing production.

The present paper addresses this question by constructing a more complete BPCG model that explicitly incorporates two different kinds of imports (intermediate and final goods) and two different kinds of exports (manufactures and primary products). In this extended model, the solution for the equilibrium growth rate of GDP that satisfies the BP constraint (hereafter, the “BP-equilibrium growth rate”) takes account of the composition of imports and exports as well as the income elasticities and other estimated coefficients (especially, the elasticity of intermediate imports with respect to manufactured exports). Somewhat surprisingly, we find that, according to new econometric estimates of this model provided below, and taking into account the changes in the composition of exports and imports as well as the relevant estimated elasticities, the BP-equilibrium growth rate did not actually decrease after Mexico liberalized its trade in the late 1980s, but instead increased slightly. Neither the income elasticity of intermediate import demand nor the elasticity of this demand with respect to manufacturing exports increased significantly post-liberalization, in a statistically adequate model. Furthermore, our estimates imply that Mexico grew faster than the rate predicted by our augmented BPCG model in the 1960s and 1970s, and has grown notably more slowly than the BPCG rate
since the late 1980s. These results suggest that other factors, rather than the changes in the income elasticity of import demand claimed by proponents of the BPCG model, have accounted for the post-liberalization slowdown in Mexican growth. Nevertheless, these other factors do include other indicators of external constraints more broadly defined (especially, the real exchange rate as an indicator of external competitiveness, which is ignored in the standard BPCG model), as well as various internal policies and obstacles—all of which are beyond the scope of the present paper.

Before proceeding to the analysis, a few caveats are in order. First, the two perspectives on Mexican growth are not necessarily mutually exclusive. Many economists from various perspectives have agreed on certain issues, such as the need for fiscal reform, increased infrastructure investment, better competition policies, and financial sector reforms (even if there is no agreement on how to achieve these goals). Also, many economists with different viewpoints (e.g., Gallagher et al. 2008; Blecker and Esquivel, 2010; Hanson, 2010; Kehoe and Ruhl, 2010) have acknowledged that increased competition from China may have been a factor in lessening Mexico’s gains from increased exports, especially after China joined the World Trade Organization (WTO) in 2001.

Second, due to data limitations, the econometric analysis in this paper is conducted using export and import statistics that exclude the maquiladora industries, which acquired an increasing role in Mexico’s trade during the period under study. In order to obtain a data set that goes back significantly into the pre-liberalization era, it was necessary to use trade statistics that do not include maquiladora trade (for more recent periods, it was possible to subtract maquiladora trade from total trade, but only up to 2006 after which separate maquiladora data were no longer reported). The results in this paper therefore need to be taken with some caution, as they could
be sensitive to the exclusion of maquiladora data. In future work, we intend to produce a similar analysis using total trade data, including maquiladora trade, for the longest time period in which such data can be obtained.

The rest of the paper is organized as follows. Section 2 surveys the relevant literature. Section 3 presents the modified BPCG theoretical model. Section 4 discusses the data set and econometric analysis, while section 5 analyzes the implications of the estimates for the equilibrium growth rate as predicted by our modified BPCG model. Section 6 concludes with some thoughts on explaining the results and directions for future research.

2. Literature survey

Many economists have sought to explain the causes of the slow growth of the Mexican economy over the past few decades through a wide variety of theoretical and ideological lenses. For neoclassical economists, the fact that a country that was once the “poster child” for liberalizing reforms has grown so slowly poses a special challenge. Why did the liberalization of international trade and foreign investment, along with domestic deregulation and privatization, not bring the promised gains in terms of growth? The neoclassical response has generally been that reforms did not go far enough, and especially that large components of the domestic economy remain overregulated, monopolized, or inefficient. For example, Kehoe and Ruhl (2010, p. 1024) conclude as follows:

what sorts of reforms does Mexico need to enact to resume rapid catch-up growth? We hypothesize that these are reforms that eliminate the barriers to growth of an inefficient financial system, lack of rule of law, and rigidities in the labor market. In terms of more specific reforms, promoting competition in non-manufacturing sectors like petroleum extraction, electricity, telecommunications, and transportation could spur productivity growth.
Analytically, many studies have applied variants of neoclassical growth models to estimate the causes of slow growth in Mexico. In neoclassical growth theory, long-run growth is driven entirely by supply-side factors, on the assumption that demand deficiencies can occur only in the “short run.” Hence the focus is on identifying which supply-side factors have been the dominant constraints on overall growth. For example, Kehoe and Ruhl (2010) decompose per capita output into the capital-output ratio, the employment rate (ratio of employment to labor force), and the residual which is known as “total factor productivity” (TFP). Because the capital-output ratio and employment rate tend to be relatively constant over long periods of time (indeed, they must be constant in a theoretical “steady state”), it is not surprising that most of the fluctuations in output appear to be “explained” by changes in TFP in countries as diverse as Mexico and China. On this basis, Kehoe and Ruhl claim that most of the rising income gap between Mexico and China is accounted for by much faster growth of TFP in the latter. However, this usage of a statistical residual as a causal factor is methodologically suspect, and many critics have argued that such “growth accounting” exercises are flawed and TFP is not an independent causal factor in the growth process.3

Also within a neoclassical paradigm, other analysts have focused on problems of availability, quality, or cost of productive inputs. Arias et al. (2010) emphasize an alleged lack of qualitative improvements in labor inputs due to stress on families and inadequate early childhood education. The “capture of its educational system by powerful labor unions” has also been cited as a cause of Mexico’s weak educational performance (Hanson, 2010, p. 998). However, Moreno-Brid and Ros (2009, pp. 235-38) note the rising levels of educational attainment in

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3 For various skeptical views, see Rosenberg (1976), McCombie (2000–1), Felipe and McCombie (2006), and Aghion and Howitt (2009), among many others. Although Kehoe and Ruhl’s methodology for computing TFP is a bit unusual, qualitatively similar results for TFP growth in Mexico have been found using more conventional approaches by Bergoeing, et al. (2009) and others cited in Moreno-Brid and Ros (2009, pp. 231–32).
Mexico and argue that these make it implausible that educational deficiencies are the source of slow growth. In fact, they argue that slow employment growth has failed to absorb the rising cohorts of more educated workers, and similarly it could be argued that “stress on families” is a consequence and not a cause of slow growth and stagnant incomes.

Both Arias et al. (2010) and Hanson (2010) also focus on the informalization of the Mexican economy, i.e., the relegation of a large component of the Mexican labor force to informal sector activities that have lower productivity (and slower productivity growth) compared with formal sector activities. These authors argue that various social policies, tax policies, and other sources of labor-market “rigidities” give incentives for workers to seek employment in (or for jobs to be created in) the informal sector. However, Moreno-Brid and Ros (2009, pp. 231-35) counter that this argument has the causality backwards. In their view, workers end up in low-productivity, informal employment (largely in services) due to a lack of job creation in the more productive formal sector; hence, informalization is an effect of slow growth and not its cause. Hanson effectively admits that informalization is not an independent cause of slow growth when he writes,

> Mexico’s social protection programs may be raising the incentive for informality, possibly hindering growth. However, the newness of major financing for these programs suggests they cannot account for Mexico’s poor growth performance prior to the late 1990s. Social protection programs for the poor in Mexico have accommodated informality, thereby contributing to its persistence, but cannot explain the origins of informality in Mexico or why the growth effects of informality in the country would be worse than elsewhere in Latin America. (Hanson, 2010, p. 997)

Another line of research has focused on “imperfections” or “distortions” in Mexico’s financial markets (Beck et al., 2005; McKenzie and Woodruff, 2008; Haber, 2009). Mexico has an unusually low level of domestic credit flowing to the private sector, from banks and other financial institutions, for a country at its level of development (Hanson, 2010). This lack of
credit provision has been blamed on various legal and institutional impediments that allegedly don’t provide enough protection for creditors, such as inadequate bankruptcy laws as emphasized by Bergoeing et al. (2002). More broadly, many analysts have stressed the continued lack of competition in many key sectors of the economy, including energy, telecommunications, and other utilities, which create excessive costs for consumers and other producers alike (Chiquiar and Ramos Francia, 2009; Levy and Walton, 2009; Castañeda Sabido, 2010). While the energy sector’s problems are generally attributed to the inefficiencies of the state monopoly oil company Pemex (Petróleos Mexicanos), the monopolization of private sector activity in sectors like telecommunications is generally blamed on poorly implemented privatizations and a lack of adequate regulation or competition policy (and the capture of those regulatory bodies that do exist by the entities that are supposed to be regulated).

In contrast, economists using a Keynesian analytical framework have tended to emphasize demand-side constraints on Mexican growth, either internal or external. On the internal side, Máttar et al. (2003) and Moreno-Brid and Ros (2009, pp. 238-43) have focused on the lack of adequate investment spending since the debt crisis and liberalizing reforms of the 1980s. They argue that weak public investment in infrastructure as well as private sector accumulation of capital have caused the slow growth of formal sector employment, which in turn accounts for the increasing informalization of the labor force. They also criticize fiscal policies that have been targeted on the fiscal balance itself, rather than on growth and employment objectives (see also Esquivel, 2010; Ros, 2010).

On the international side, Blecker (2009) revived an older approach from the 1970s and 1980s by analyzing the role of external constraints on Mexican growth. He found that four

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4 These authors tend to view weak investment expenditures, both public and private, mainly as imposing demand-side constraints, but one could also argue that these have negative supply-side effects as well, and that the lack of adequate public infrastructure can itself be an obstacle to greater private investment.
external factors (the US growth rate, net financial inflows, real oil prices, and the one-year lagged real exchange rate) explain most of the annual fluctuations in Mexico’s growth, while there were structural breaks in the effects of some of these variables around the time of Mexico’s initial trade liberalization (1987) or the enactment of NAFTA (1994). However, Blecker’s analysis is ad hoc, as it employs variables that do not emerge from a clearly specified theoretical model, and his econometric approach only explains short-term fluctuations in growth rates rather than their long-run averages.

Keynesian economists who have used a more theoretically grounded approach have more typically relied on applying the BPCG model to the Mexican case, starting with Moreno-Brid (1998). According to the simplest and most basic version of this model, which assumes that the real exchange rate is constant (i.e., relative purchasing power parity holds) in the long run, the BP-equilibrium growth rate equals the ratio of the growth rate of exports to the income elasticity of import demand. In this model, trade liberalization would increase (decrease) the BP-equilibrium growth rate if it raises the growth rate of exports proportionately more (less) than it increases the income elasticity of import demand. Econometric studies by Moreno-Brid (1999, 2002), López and Cruz (2000), Guerrero de Lizardi (2003), Pacheco-López and Thirlwall (2004), Pacheco-López (2005), and Cardero and Galindo (2005) have generally found that a rise in the income elasticity of import demand outweighed the increase in export growth post-liberalization (or post-NAFTA), leading to a decrease rather than an increase in the BP-equilibrium growth rate.

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5 In particular, the impact of US growth only becomes significant post-NAFTA, while the effects of oil prices diminished and the effects of the real exchange rate increased post-liberalization.

6 In defense of Blecker’s econometric model, it can be seen as the reduced form of an (implicit) structural model, in which variables such as net exports, investment, and government spending depend on these four exogenous or pre-determined variables. However, such a structural model is not explicitly presented in Blecker (2009).
Given that Mexico has maintained only small current account imbalances since the late 1990s, after the repeated economic crises that resulted from large external deficits (and correspondingly large international debts) between the 1975 and 1995, the reduced BP-equilibrium growth rate becomes a plausible explanation of slower actual, average growth. However, an alternative interpretation could be that the Mexican economy is growing slowly because of reasons unrelated to the external constraint, that the current account deficit is small precisely because investment is low and economic growth is slow, and that because of the slow pace of economic growth the external (BPCG) constraint actually is not binding. This idea has been developed by Ibarra (2011c), who argues that there are no signs of foreign exchange pressure in the Mexican economy when growth accelerates and that investment does not respond strongly to variations in the level of foreign capital inflows—which shouldn’t be the case under a binding external constraint.

In addition, Ibarra (2011a, 2011b) argues that the standard BPCG model ignores an important feature of Mexico’s economic structure, which is the heavy dependence of its manufacturing sector (including export industries) on imports of intermediate inputs.7 In this respect, there is a direct connection between exports of manufactures and imports of intermediate goods that is missed in the standard analysis. Ibarra (2011b) shows that omitting the role of manufactured exports leads to an upward bias in estimates of the output elasticity of Mexico’s intermediate imports for the post-liberalization period, using trade data that includes

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7 The extreme dependence of Mexican manufacturing on imported intermediate goods and the consequent low ratio of value added to the gross value of manufacturing output have been emphasized previously by other authors, including Ruiz-Nápoles (2004) and Moreno-Brid et al. (2005), among others, but these authors focused on other issues (such as employment generation) and did not incorporate intermediate imports into a BPCG modeling framework. Interestingly, a concern over the country’s dependence on imports of productive inputs (capital and intermediate goods) dates back to the era of import substitution; see, for example, Solis (1977, pp. 217–48).
Ibarra (2011b) also shows that a model for intermediate imports that excludes manufactured exports as a dependent variable is econometrically mis-specified and that omitting this variable leads to a downward bias in estimates of the price (real exchange rate) elasticity of intermediate imports. Ibarra (2011a) demonstrates that there is no statistically significant increase in the latter elasticity post-liberalization (defined as 1987) compared with the pre-liberalization period, using a demand function for intermediate imports that controls for manufactured exports (in a longer sample that runs from 1960 to 2006, using an annual data set that excludes maquiladora trade, for the reasons explained earlier). A model excluding manufactured exports from the intermediate import equation is also shown to be mis-specified using this data set.

However, these findings do not necessarily imply that there was no change in Mexico’s BP-equilibrium growth rate after trade liberalization, since the increase in the share of manufactured exports (which are highly intensive in imported intermediate goods) in total exports could raise the overall demand for imports in the Mexican growth process. Once one distinguishes different types of imports (intermediate versus final goods) and exports (manufactures versus primary products), one clearly needs a more complete BPCG model than the standard version in which there are no distinctions between different types of imports or exports. Thus, Ibarra’s results suggest the need to construct a more complete BPCG model that can take these differences into account, which is critical for applying this model to the unique structural characteristics of the Mexican economy.

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8 In order to increase his sample size, Ibarra (2011b) used monthly data, and since GDP is not available on a monthly basis, he used an industrial production index as the output variable instead of GDP. Hence, we use the term “output” here instead of the more conventional “income” (which usually refers to GDP in the context of an import demand function). Ibarra (2011b) also finds that the output elasticity of intermediate import demand did not change significantly after Mexico joined the North American Free Trade Agreement (NAFTA) in 1994, while the elasticity of such demand with respect to the real exchange rate did diminish significantly (in absolute value) post-NAFTA.
Before turning to such a model in the next section, it is also relevant to mention the studies of the role of China in affecting Mexico’s exports and growth. It has been widely noted that, while South American nations produce many primary commodities for which Chinese demand is strong, Mexico is unique among the major Latin American nations in producing a mix of exports (primarily manufactures) that competes directly with Chinese exports (Ledermann et al., eds., 2009). Using a variety of models and methodologies, Gallagher et al. (2008), Hanson and Robertson (2009), and Feenstra and Kee (2009) (among others) have found evidence that Chinese exports have significantly reduced or displaced Mexican exports, particularly in the U.S. market. The more difficult analytical question is how this export displacement has affected Mexico’s growth. Such an effect does not square easily with a neoclassical approach, with its emphasis on supply-side factors and TFP. Kehoe and Ruhl (2010) are therefore forced to view the China effect as a “transitional” factor, but one operating over several decades, as China has greater opportunities for “catch-up” productivity increases given that it started out much further behind Mexico when both countries opened their economies in the 1980s and 1990s. A China effect on Mexico’s exports fits more naturally into a Keynesian or BPCG approach, with a focus on demand-side constraints in general and exports in particular. However, it remains to be seen how the China effect operates, e.g., more via a price channel (real currency undervaluation in China compared with overvaluation in Mexico) or quantity channels. While this paper will not directly address the role of China, the results are relevant to how trade affects Mexico’s growth, and can therefore help to provide an analytical framework in which the impact of Chinese competition can be understood.
3. Theoretical model

This section will present a simple extension of the BPCG model to incorporate two different kinds of exports (manufactured and non-manufactured goods) and two different kinds of imports (intermediate goods and final goods). In this theoretical model, all variables will be measured in growth rates (logarithmic differences) so that the coefficients can be interpreted as elasticities. However, all the equations in log differences can be derived from the corresponding, underlying equations that are multiplicative in levels (the so-called “Cobb Douglas” form, in which the parameters are exponents) or linear in log levels (in which the exponents are converted to coefficients), and it will be important to keep this in mind in regard to the econometric specification in the next section.

Let the growth rate of demand for manufactured exports in units of domestic output \((x_n)\) be determined by the function,

\[
(1) \quad x_n = \varepsilon (e + p^* - p) + \eta y^* 
\]

where \(e\) is the rate of nominal depreciation of the currency, \(p^*\) is the foreign inflation rate for industrial goods, \(p\) is the home inflation rate for industrial goods, and \(y^*\) is the growth rate of foreign real GDP. Thus, \(e + p^* - p\) is the rate of change in the real exchange rate (RER) or rate of real depreciation in terms of industrial goods. For simplicity, we assume that the growth rate of other exports (primary commodities, chiefly oil and agricultural products in the case of Mexico) in units of foreign output is exogenously given at the rate \(x_o\) and their prices change at the exogenously given rate \(p^*_o\) (denominated in foreign currency, i.e., U.S. dollars), on the assumption that their quantities and prices are determined by conditions in global commodity markets.
The demand function for intermediate goods (in growth rate form) is given by,

\[ m_i = -\varepsilon_i (e + p^* - p) + \eta_i y + \alpha n, \]

where the coefficient \( \alpha \) reflects the elasticity of demand for imports of intermediate inputs with respect to the production of manufactured exports.9 The demand function for imports of final (consumption and capital) goods (also in growth rate form) is

\[ m_c = -\varepsilon_c (e + p^* - p) + \eta_c y, \]

where it is assumed that these are not a function of manufactured exports (as will be verified in the econometric estimates below), and where imports are measured in units of foreign output. Here we also assume, admittedly somewhat artificially, that all imports have the same prices and all import-competing domestic goods have the same prices, regardless of whether they are intermediate or final goods. This assumption is perhaps easier to swallow give that the prices are expressed in rate of change form, so what is required is only that the inflation rates of these different types of goods (intermediate and final) are equal.

Ignoring capital flows (these also could be introduced later), the balance of payments equilibrium condition (also in growth rate form) expressed in terms of foreign currency (U.S. dollars) is

\[ \mu (p - e + x_n) + (1 - \mu) (p_{*o} + x_o) = \theta (p^* + m_i) + (1 - \theta) (p^* + m_c), \]

where \( \mu \) is the share of manufactures in total exports and \( \theta \) is the share of intermediate goods in

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9 Note that the value of \( \alpha \) depends on two factors, which are not modeled here explicitly. On the one hand, it depends on the underlying elasticity of imports of intermediate goods with respect to the production of manufactured exports. On the other hand, it depends on the proportion of intermediate goods imports that are devoted to export production (as opposed to domestic production). In principle, it would be desirable to model these two factors explicitly, which would require specifying the supply side of the model for production of exported and domestic manufactured goods, and this can be done in future extensions of this research. However, the available Mexican data do not distinguish intermediate goods imports according to whether they are used in the production of exported or domestic goods (except for the maquiladora industries, where it can be presumed that all imports are used in export production). Thus, the model as specified here is congruent with the data available for econometric estimation (excluding the maquiladora sector, which will be omitted for reasons discussed below).
total imports. This simply says that the total value of exports must grow at the same rate as the total value of imports, both measured in foreign currency.

Substituting (1), (2), and (3) into (4)—after first substituting (1) into (2)—and solving for the home country growth rate $y$, we obtain (after much manipulation):

$$y_B = \left[ \theta \eta_i + (1- \theta) \eta_c \right]^{-1} \{ (\mu - \alpha \theta) \eta_c y^* + (1 - \mu)(p_o^* - p^* + x_o) \}
+ [ (\mu - \alpha \theta) e_c + \theta e_i + (1- \theta) e_c - \mu ] (e + p^* - p) \}
$$

which is the most general expression (under the above assumptions) for the BP-equilibrium growth rate $y_B$. Note that the term in brackets $[\cdot]$ would have to be positive, i.e., $(\mu - \alpha \theta) e_c + \theta e_i + (1- \theta) e_c - \mu > 0$, for a higher rate of real depreciation $(e + p^* - p)$ to be expansionary (increase the growth rate).

If we also assume that the RER is constant in the long run, i.e., long-run purchasing power parity (PPP) prevails for manufactured goods, then $e + p^* - p = 0$ in the long run, and the solution (5) simplifies to:

$$y_B = \frac{ (\mu - \alpha \theta) x_o + (1 - \mu)(p_o^* - p^* + x_o) }{ \theta \eta_i + (1- \theta) \eta_c }$$

where we use the fact that (from equation 1) $x_o = \eta_c y^*$ when $e + p^* - p = 0$. Under this assumption, changes in the real exchange rate (i.e., the relative competitiveness of domestic goods) are eliminated as a factor affecting the BP-equilibrium growth rate, but this rate does depend on:

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10 This condition can be thought of as an extended Marshall-Lerner condition in the context of the present model. Note that this condition is stronger (i.e., more difficult to satisfy) than the standard Marshall-Lerner condition, to the extent that the weight $(\mu - \alpha \theta)$ on $e_c$ is less than unity, although it is weaker (i.e., easier to satisfy) to the extent that $\mu < 1$.

11 Perraton (2003) refers to solutions to the BPCG model under this assumption as the “weak” form of the model. He refers to solutions assuming that the Marshall-Lerner condition is not satisfied as the “strong” form of the model. In the present model, the latter would require that $(\mu - \alpha \theta) e_c + \theta e_i + (1- \theta) e_c - \mu \approx 0$. 

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- $x_n$ and $x_o$, the growth rates of the volumes of manufactured and other exports, respectively;
- $p^*_o - p^*$, the rate of increase in the terms of trade for other (primary commodity) exports, relative to imports from industrialized countries;
- $\mu$, the share of manufactures in total exports;
- $\theta$, the share of intermediate goods in total imports;
- $\alpha$, the elasticity of intermediate imports with respect to exports of manufactures; and
- $\eta_i$ and $\eta_c$, the income elasticities of import demand for intermediate goods and final (capital and consumption) goods, respectively.

In order to calculate $y_B$ in equation (6), then, we only need econometric estimates of equations (2) and (3) for imports of intermediate and final goods, respectively, in order to obtain estimates of the parameters $\alpha$, $\eta_i$, and $\eta_c$. On the assumption of PPP, none of the coefficients in the manufactured export equation (1) are included in (6), and therefore the latter equation does not need to be estimated. All the other parameters that go into the calculation of (6) can be obtained from the descriptive statistics. In the following sections, we produce calculations of the BP-equilibrium growth rate based on this assumption, but in future work we intend to explore the possibility that long-term trends in the RER have affected Mexico’s BP-equilibrium growth rate by estimating (1) and using the more general solution (5) to calculate $y_B$. In the latter case, the estimated price (RER) elasticities, as well as the income and manufactured-export elasticities, would become relevant to the calculation of $y_B$.

For Mexico, we are also interested in how all of these elasticities or parameters changed after trade liberalization in the late 1980s. Ibarra (2011a) showed that $\eta_m$ did not significantly increase post-liberalization (contrary to what some previous studies found), once the term $\alpha x_n$ is
included in the import function, but he did not consider how the other determinants of $y_B$
changed. Therefore, it is also important to estimate whether there was a statistically significant
increase in $\alpha$ in the post-liberalization period, as well as whether $\mu$ increased, how $p^{*o} - p^*$
changed, and how $x_n$ compared with $x_o$ after trade was liberalized. The next section presents
estimates of equations (2) and (3), including tests for structural breaks, while the following
section reports the implications for the BP-equilibrium growth rate per equation (6).

4. Import elasticities and trade liberalization in Mexico

In this section we present estimation results for import demand equations in Mexico.$^{12}$ As
specified in equations (2) and (3), two separate sets of equations are presented: one for imports
of final (consumption and capital) goods, and another for intermediate goods. The purpose is not
only to estimate the values of the elasticities contained in those equations, but also to test for the
possibility of significant changes in the elasticities after the liberalization of the trade regime
starting in the late 1980s in Mexico.$^{13}$

In standard fashion, imports are estimated as a function of real GDP and the bilateral
peso/dollar real exchange rate, with an increase in the latter representing a real depreciation of
the peso. In addition, it is explored whether manufactured exports are a statistically significant
determinant of each type of imports. Although our expectation is that manufactured exports only

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$^{12}$ By estimating only import demand, we effectively assume that import supply curves are horizontal, i.e., Mexico
can purchase any desired quantity of imports (of each type, intermediate or final goods) at a given relative price
(proxied by the RER). Fortunately, the econometric procedure used here helps to control for possible endogeneity
of the real exchange rate and other right-hand-side variables, as discussed below. Also, the use of the RER as our
relative price variable can also be considered as using an exogenous instrument for the relative prices of imports and
domestic goods, which would be more likely to be endogenous.

$^{13}$ As described in the definitive study by Lustig (1998), the policy shift toward trade liberalization began in 1985–
86, but the reductions in trade barriers went into effect starting around 1987. In our econometric work below, we
will use 1987 as the break point for the post-liberalization era.
have a significant effect on intermediate imports, as a reflection of the so-called vertical specialization of export production (that is, the import of intermediate goods for some assembly, little value added, and re-sale as exports), the estimations also test for whether manufactured exports are a significant direct determinant of imports of final goods.

To ensure the longest possible series for the period prior to trade liberalization, the trade data used here do not include maquiladora exports or imports. Also for reasons of data availability, the real exchange rate was calculated with consumer price indices, rather than industrial prices as in the theoretical equations (2) and (3). In addition, to detect “long-run” effects, which are the relevant ones for the growth analysis in this paper, the variables in the estimated equations appear in levels (rather than growth rates as in the theoretical equations). All variables are expressed in levels of natural logarithms, so that their estimated coefficients can be interpreted as elasticities as required by the theoretical model. As is well known, using variables in differenced form loses information about long-run relationships, so we prefer to express the variables in (log) levels while using an econometric procedure (described below) that controls for possible unit roots in the variables. Also, as observed earlier, although the theoretical model was presented with the variables measured in log differences (growth rates), it can be derived from underlying equations that are multiplicative with exponents in levels or linear in log levels, so we can use the latter specification for the econometric estimation here.

The estimation period runs from 1960 to 2006, for a total of 47 annual observations. It is not possible to have a more updated sample, because the official statistics have not distinguished maquiladora and non-maquiladora trade flows since 2006, so the more recent trade data cannot be made consistent with the earlier series. The estimations were carried out using the bounds

14 We could not find consistent data on maquiladora trade prior to 1980, which would not give us a long enough sample period for the pre-liberalization era in Mexico.
testing approach of Pesaran et al. (2001), and the tables report only the estimated long-run (or level) coefficients plus the error-correction (or speed of adjustment) coefficient. The estimated short-run coefficients for the variables in first-difference are not reported here for reasons of space, but are available on request.

As is well known, the bounds testing approach has several attractive features. In contrast to alternative estimation procedures, it can combine variables with different orders of integration in the same equation—in particular, variables may be integrated of order one or zero. As shown in Table 1, in our case this is a critical advantage, given that our data include both types of series. In addition, none of the series is integrated of order two or more, as required by our estimation technique.

[Table 1. Unit root tests]

A second critical advantage is that, thanks to the use of lags in the estimation, the bounds testing approach yields unbiased estimates of the long-run coefficients even when some of the regressors are endogenous (Pesaran and Shin 1998)—a condition that presumably affects all macroeconomic series, including the ones used in this paper, to some extent. Finally, compared to data-intensive, multi-equation techniques such as Johansen’s cointegrated VAR (vector autoregression) model, the bounds testing approach has good small-sample properties, given that it relies on the estimation of a single equation. However, if more than one long-run relationship exists between the variables, the present approach cannot uncover the other ones. Another drawback is that the critical values calculated by Pesaran et al. (2001) for the $t$ and $F$ bounds tests are valid only asymptotically. Narayan (2005), however, has calculated small-sample critical values specifically for the $F$-test, and we will use these below.

The purpose of the estimation is to obtain equations of the form,
where $M_{LR}$ is the “long-run” level of real imports of either final or intermediate goods, there are $k$ potential determinants $Z_i$, and to capture the long-run effects all the variables are measured in log levels as mentioned previously.

To obtain equations like (7), we proceeded in three steps. In the first step, we estimated an autoregressive distributed lag (ARDL) model in error-correction form, such as

$$
\Delta M_t = \sum_{j=1}^{n} a_j \Delta M_{t-j} + \sum_{i=1}^{k} \sum_{j=0}^{n} b_{i,j} \Delta Z_{i,t-j} + \sigma M_{t-1} + \sum_{i=1}^{k} d_i Z_{i,t-1} + d_0
$$

where $\Delta$ indicates the first difference of the variable, and $-\sigma$ measures the speed of adjustment of imports toward the long-run equilibrium defined by equation (7).

The variable $M$ can be imports of either final ($IMPC$) or intermediate ($IMPI$) goods. As already mentioned, the $Z$ set consists of three potential determinants: real gross domestic product (GDP); real manufactured exports ($EXPM$); and the bilateral real exchange rate between the U.S. and Mexico ($BRER$). The trade series, originally expressed in current dollars, were deflated with the general U.S. producer price index to obtain real quantities of imports, while GDP corresponds to Mexican output in constant 1993 pesos. $BRER$ is based on consumer prices, and an increase represents a real depreciation of the peso. All the variables were transformed to natural logs (see the appendix for details on data sources and definitions).

In the first step, we tested the statistical adequacy of the model. This involved determining the number of lags to be included, and confirming that the standard diagnostic tests were satisfied. Following results of applying the Schwarz and Akaike criteria, the models were estimated with one lag in the variables in first difference. The inclusion of one lag was sufficient to pass the standard battery of diagnostic tests, including absence of serial correlation. In some cases the Akaike criterion suggested the inclusion of two lags, but in those cases Schwarz was
followed, given the satisfactory diagnostic test results and the small number of observations in our sample. We verified that adding more lags did not result in stronger results for the bounds tests or a larger size of the speed of adjustment coefficient.

With the statistical adequacy of the model ensured, in a second step we tested for the existence of a level or long-run relationship, using two alternative tests. The first is a $t$-test on the speed of adjustment coefficient, $\sigma$. For a long-run relationship to be established without ambiguity, the absolute value of the $t$-statistic must lie above the (asymptotic) upper critical value calculated by Pesaran et al. (2001). In that case, the existence of a relationship can be accepted even if all the variables in the estimated equation were integrated of order one. The second is an $F$-test for the significance of the level coefficients, under the null that $\sigma$ and the $d_i$ coefficients in equation (8) are jointly equal to zero. Again, the existence of a relationship is accepted when the $F$-statistic lies above the upper critical bound. For this particular test, we are able to use the small-sample critical values calculated by Narayan (2005), but for the sake of comparison we also report the results using the asymptotic critical values of Pesaran et al.

After establishing the existence of a long-run relationship, in a final step we simplified the short-run segment of the model. This was done by deleting, for each variable, the longest statistically insignificant lags (provided the diagnostic tests were not compromised). The simplification of the lag structure generally results in larger and more significant long-run coefficients.\textsuperscript{15} At the end of this step, we retrieved the long-run coefficients as $\delta_i = -d_i/\sigma$.

\textsuperscript{15} This elimination of insignificant lags was not done in Ibarra (2011a). Hence, even though some of the estimates presented here are qualitatively similar to some of those in Ibarra (2011a), the present estimates are quantitatively different and have greater statistical precision. In addition, Ibarra (2011a) did not present equations for total imports of final goods, which are necessary for the application of equation (6) in the present paper.
4.1 Imports of final goods

We begin by presenting the results for imports of final (consumption and capital) goods—“final imports,” for short. In an initial specification we include only GDP and the real exchange rate as possible determinants of final imports, without allowing for a shift in coefficients after trade liberalization, and exclude a possible role for manufactured exports. The estimated coefficients have the expected signs, indicating that an increase in GDP tends to raise final imports, while a real depreciation of the peso (that is, an increase in BRER) tends to reduce them. The estimated equation is not entirely satisfactory, however: the real exchange rate coefficient is not statistically significant, the speed of adjustment is very slow, and both bounds tests reject the existence of a long-run relationship (see Table 2, column 1).

[Table 2. Estimated demand functions for imports of final goods]

Allowing for a permanent shift in the estimated coefficients on GDP and BRER after the beginning of trade liberalization dramatically improves the estimation results. Given that Mexico joined GATT in 1986, and that an important reduction in tariffs and in the share of import permits came afterwards, we examine whether a significant shift in the estimated coefficients took place beginning in 1987. For that purpose we defined a dummy that permanently increases from 0 to 1 in 1987, and included interactions of the dummy in the import equations. The dummy was interacted with both the level and the first difference of the import determinants, thus allowing for shifts in both the long- and short-run coefficients of the model; in the tables, though, only the long-run coefficients are reported.16

As just mentioned, introducing the trade liberalization dummy led to a much better model

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16 In Ibarra (2011a), the structural break dummies were only interacted with the levels. This is another reason why the estimates in the present paper may differ from those earlier estimates of import demand equations.
for final imports, particularly in the bounds test results, which now support the existence of a long-run relationship at 1% of significance (see Table 2, columns 2 and 3). In this improved model, there are two main results. First, the real exchange rate coefficient appears to have become statistically significant mainly in the post-liberalization period. This is intuitive if we think that the composition of final demand may become more responsive to changes in the relative price of local versus imported goods, after restrictions on the free international flow of goods are removed. And second, there is an increase in the income-elasticity of final imports, which moved from 1.1 during 1960–1986, to 1.56 (=1.1+0.46) during 1987–2006.

According to equation (6), the increase in the income elasticity of final imports reduces the BP-equilibrium growth rate of GDP. The intuition is straightforward: since now a given GDP growth rate produces faster import growth, the GDP growth rate must fall to maintain external equilibrium. On the other hand, the increase in the elasticity of final imports with respect to the real exchange rate means that a depreciated currency may have become more effective in loosening the external constraint on growth. This would be the case because of the real exchange rate’s negative effect on imports—in addition to the possible positive effect on exports, which is not estimated in the present paper. The theoretical model from section 3, however, implies that such an effect would be transitory, since the model makes the equilibrium GDP growth rate depend not on the level of the real exchange rate (as in some of the recent literature on the effects of the real exchange rate on economic growth—see, for example, Hausmann et al., 2005; Berg et al., 2008; Blecker and Razmi, 2008) but on the rate of change of the real exchange rate.

Finally, in the next sub-section we will see that manufactured exports play an important role in the determination of the level of intermediate imports, which is consistent with the idea

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17 It should be noted, however, that we have not explicitly controlled for trade barriers such as tariff rates in any of the estimates in this paper. We intend to investigate obtaining measures of such barriers in future extensions of this research.
that vertical specialization of export production is important in Mexico. Here, mainly for comparative purposes, we add manufactured exports as a possible additional determinant of final imports (see Table 2, columns 4 and 5). We can see that manufactured exports have a coefficient that is very far from being economically or statistically significant; unsurprisingly, given that lack of significance, their introduction in the import equation leaves the previous results practically unchanged. Specifically, the real exchange rate coefficient still appears to have become statistically significant only after the liberalization of trade, while the GDP coefficient keeps showing a large increase after liberalization—in fact, slightly larger than in the model without manufactured exports.

4.2 Imports of intermediate goods

We now present the estimated equations for imports of intermediate goods, and begin again by showing a simple specification in which intermediate imports depend only on GDP and the real exchange rate (see Table 3, column 1). As in the case of final imports, in this initial specification the GDP and BRER coefficients have the expected signs, but again the results are not entirely satisfactory: the \( p \)-value on the BRER coefficient is (slightly) above 10\%, the speed of adjustment is slow, both bounds tests reject the existence of long-run relationship, and now in addition the RESET test for equation misspecification fails at the 5\% significance level.

[Table 3. Estimated demand functions for imports of intermediate goods]

Based on previous results showing the importance of vertical specialization in export production in Mexico (see Ibarra 2011a, 2011b), we then add manufactured exports as a possible determinant of intermediate imports (see Table 3, column 2). The new estimation results show a
significant improvement over the initial specification: the speed of adjustment more than doubles, the two bounds tests (including the small-sample $F$-test) now support the existence of a long-run relationship at the 5% level, and all the coefficients are statistically significant and signed as expected. While there is a reduction in the absolute value of the GDP and real exchange rate coefficients, now both are statistically significant, and they are estimated with greater precision.

Compared to the estimated coefficient on GDP (1.01), the export coefficient is not small (0.51). How should we interpret the positive export coefficient? As mentioned in the theoretical section, the dependent variable corresponds to the economy’s total intermediate imports, and not specifically to those used in the export sector. In addition, the equation controls for GDP. Thus, the export coefficient measures the effect of an increase in manufactured exports holding GDP constant, which implies a shift in the composition of total output toward the export sector. Thus, the positive coefficient on exports means that export production is more intensive in intermediate imports than the rest of the economy. Thus, a pattern of GDP growth biased toward manufactured exports will automatically result in strong import growth in Mexico.

Starting from this last specification, we now examine whether import elasticities changed after the liberalization of trade. Similarly to the case of final imports, we proceed by including short- and long-run interactions of GDP and the real exchange rate with a 0–1 dummy for the 1987–2006 post-liberalization period (Table 3, column 3). In contrast to what happened with imports of final goods, once manufactured exports are included in the equation, the GDP and BRER coefficients do not shift in the expected way in the post-liberalization period.

In particular, rather than increasing, the estimated GDP coefficient seems to have decreased, while the opposite change happened with the real exchange rate coefficient. The shifts
in the estimated coefficients do not seem robust, however: if the only remaining statistically significant interaction between the post-liberalization dummy and the real exchange rate in the short-run segment of the model is removed, the shifts in the long-run coefficients on GDP and BRER become insignificant, with \( p \)-values of 0.5 or more (results not shown in the table, but available upon request). In addition, in the new specification the bounds tests reject the existence of a long-run relationship.

Thus, once we control for the direct effect of manufactured exports, there is no evidence of an increase in the income-elasticity of intermediate imports after trade liberalization, and thus no tightening of the external constraint on growth through this specific channel, in contrast to what was observed for imports of final goods. Rather than reflecting a tightening of the external constraint, the rapid growth of intermediate imports after liberalization largely reflected a pattern of growth that was biased toward (led by) manufactured exports.

On the other hand, the automatic increase in intermediate imports due to vertical specialization means that the high growth of manufactured exports has a smaller positive effect on the BP-equilibrium GDP growth rate than what otherwise would the case—that is, the BP-equilibrium growth rate in equation (6) is reduced by \( \alpha \) being positive. In other words, trade liberalization, by facilitating access to intermediate imports, supported a faster rate of growth of manufactured exports, but at the same time, the intensive use of imports implies that export growth has a reduced impact on GDP growth. What has been the net effect is an empirical question, the answer to which will be considered in the next section where we will calculate the BP-equilibrium growth rate before and after liberalization.

For such calculations, it is necessary to examine not only whether the income elasticity of imports increased after trade liberalization, but also whether the manufactured-export elasticity
increased. Such an increase could be expected, for example, from a deepening over time in the degree of vertical specialization of export production. To examine this issue, we again include interactions of the relevant variable with the post-liberalization dummy. Somewhat unexpectedly, however, there is no statistically reliable evidence of an increase in the manufactured exports coefficient after trade liberalization. The coefficient on the interaction between manufactured exports and the post-liberalization dummy is very small and negative (-0.04) (see Table 3, column 4). Moreover, including the interaction with the post-liberalization dummy reduces the significance of the bounds tests to the 10% level, using the asymptotic critical values from Pesaran et al. (2001), while the $F$-test rejects the existence of a long-run relationship using the small-sample critical values calculated by Narayan (2005). Thus, the $p$-value of 0.03 for the estimated coefficient of -0.04 is not a reliable indicator of statistical significance, because the entire equation is not statistically adequate.

Basically the same results are obtained if manufactured exports are interacted with a dummy for the 1994–2006 NAFTA period (see Table 3, column 5). Finally, if interactions with both the 1987–2006 and 1994–2006 dummies are included, the estimated coefficients on the interactions remain very small, the value of the bounds test statistics fall even more, and now the GDP coefficient becomes insignificant (results not shown in the table, but available upon request).

Some of the results in this section are unexpected, especially the lack of a statistically significant increase in the elasticity of import demand with respect to manufactured exports. However, we should recall that the data used here do not include maquiladora trade, and hence the estimated coefficients cannot capture the influence of the rise in the share of maquiladora industries in total manufactured exports especially during the post-liberalization period.
Moreover, estimations with quarterly data specifically for the liberalization period suggest that
an increase in the export-elasticity of intermediate imports may have occurred in the post-
NAFTA years, especially when maquiladora data are included (see Ibarra 2011b). Thus, the
results from the structural break tests in this section should be interpreted with caution.

5. Determination of the BP-equilibrium growth rate

In this section we calculate the BP-equilibrium growth rate $y_B$ for the Mexican economy,
using the estimated elasticities from Table 2 (columns 1 and 3) for final imports and Table 3
(column 2) for intermediate imports, along with the requisite descriptive statistics from the
underlying data set, in equation (6). We calculate $y_B$ for the entire 1960–2006 period, and then
We could not find a complete series for the terms of trade of Mexico’s primary exports for the
entire sample period. Thus, we carry out the analysis for the full sample period leaving this
variable aside. However, for the post-liberalization period, we are able to perform some
calculations using the international price of oil, deflated by the U.S. producer price index (PPI)
for industrial commodities less fuel, as a proxy for the country’s primary terms of trade. This
seems warranted since during that period the main non-manufactured export item was oil.

For the entire sample period 1960–2006, the BP-equilibrium growth rate of 4.01% per
year closely approximates the actual average GDP growth rate of 4.28% per year (see Table 4,
first column). This conforms with previous studies that have found that the BPCG model closely
replicates actual average growth over very long periods of time on the order of a half century
(see, e.g., Razmi, 2005, on India). The BP-equilibrium growth rate is, of course, the outcome of
various elasticities and parameters that operate in opposite directions, per equation (6). For the entire period 1960–2006, this rate was boosted, for example, by rapid growth of Mexico’s manufactured exports ($x_n = 11.24\%$ per year) and more modest growth of other exports ($x_o = 5.81\%$), but held down, for example, by a relatively high income-elasticity of final goods imports ($\eta_c = 1.58$) and a high manufacturing export-elasticity of intermediate imports ($\alpha = 0.51$).

However, the question that most concerns us here is whether the BPCG model can explain the slowdown in Mexico’s growth since the trade liberalization of the late 1980s. Much to our surprise, the answer provided by our estimates is no. According to our calculations, Mexico’s BP-equilibrium growth rate actually increased slightly in the post-liberalization period (1987–2006) compared with the earlier years (1960-1986), whereas the actual average growth rate decreased notably, as shown in Table 4 (compare the second and third columns). The small increase in $y_B$ was the net effect of several different influences that operated in opposite directions after the liberalization of trade. On the one hand, there was an increase in the income-elasticity of final imports ($\eta_c$), which according to equation (6) tended to reduce the equilibrium growth rate. On the other hand, once we control for the direct influence of manufactured exports, the income-elasticity of intermediate imports ($\eta_i$) remained stable. Moreover, the income-elasticity of imports is smaller for intermediate goods than for final goods, particularly in the post-liberalization period (1.01 versus 1.56). As a consequence, the increase in the share of intermediate goods in total imports ($\theta$), from 49\% in 1960–1986 to 65\% in 1987–2006, somewhat paradoxically tended to increase the equilibrium growth rate by reducing the denominator in equation (6).

Because the growth rate of manufactured exports ($x_n$) was much higher than the growth
rate of other exports \((x_o)\), the increase in the share of manufactures in total exports \((\mu)\) in the post-liberalization years had a positive effect on the BP-equilibrium growth rate of GDP. Note, however, that this positive effects was somewhat offset by the automatic “leakage” of foreign exchange through imports of intermediate imports, as captured by the \(a\theta\) term. Holding other factors constant, the intensive use of intermediate imports in the production of manufactured export production tends to reduce the positive effect of manufactured export growth on the BP-equilibrium growth rate—although, of course, the intensive use of intermediate imports presumably contributed to the rapid growth of manufactured exports. Finally, one surprising element is the fact that the growth rate of manufactured exports \(x_n\) did not increase in the post-liberalization period, but rather fell slightly from 11.82% per year in 1960–86 to 10.45% per year in 1987–2006. Of course, 10.45% still represents very rapid growth, but the growth rate of manufactured exports was even higher in the earlier period due to the very low base of such exports in the early 1960s.

Thus, there were as mentioned various effects acting in different directions on the BP-equilibrium growth rate. The net effect was that the equilibrium GDP growth rate experienced little change after the liberalization trade, rising from 4.2% during 1960–1986 to 4.7% during 1987–2006. Thus, factors such as the rise in the share of rapidly growing manufactured exports and the increase in the income-elasticity of final goods imports tended to cancel each other out. These calculations leave aside the possible influence not only of the real exchange rate and capital flows, which are not considered in equation (6), but also of changes in the terms of trade of non-manufactured exports.

Although, as noted earlier, the actual and the equilibrium GDP growth rates were similar over the entire period (4.3 versus 4.0%), they differ notably within each of the two sub-periods.
separated by trade liberalization. Specifically, during the pre-liberalization period the actual (average annual) GDP growth rate was above the BP-equilibrium rate (5.2 versus 4.2%), while the opposite was true during the post-liberalization period (3.0 versus 4.7%). Thus, during the post-liberalization period the Mexican economy has under-performed and the external constraint appears not to have been binding. Note that the same qualitative results are found if we leave out the years of the oil boom of the late 1970s and the debt crisis of the early-mid-1980s, and define the pre- and post-liberalization periods as 1960–77 and 1989–2006, respectively (see the last two columns in Table 4).

The evidence that the Mexican economy was underperforming relative to the BP-equilibrium growth rate is even stronger if we take changes in the prices of other exports into account. Here, we focus on oil prices because oil has been the leading non-manufactured export product of Mexico since the late 1970s. During the post-liberalization period, there were two stages in the evolution of the real price of oil in international markets. Initially, during the 1990s, the oil price tended to fall. Beginning in 1999, however, a strong recovery began, which eventually more than reversed the initial fall. As a result, for the entire 1987–2006 post-liberalization period, the real price of oil increased on average by 5.4% annually. Equation (6) indicates that this increase tended to raise the BP-equilibrium growth rate of the Mexican economy. After adding the effect from the increasing oil price, the equilibrium GDP growth rate rises from the previously mentioned 4.7 to 6.1% per year (or from 4.6 to 6.2% if the shorter 1989–2006 period is considered; see Table 4). Thus, the gap between the BP-equilibrium growth rate and the actual average GDP growth rate during the post-liberalization period was even greater if we take prices of oil exports into account.
6. Conclusions and directions for future research

This paper has developed an extended BPCG model, which incorporates two kinds of exports (manufactured and other) and two kinds of imports (intermediate and final goods). According to our estimates and calculations here, the BP-equilibrium growth rate “predicted” by this model closely fits the actual, average growth of Mexico’s GDP during the 46-year period from 1960 to 2006. As in many previous studies, the model explains actual growth well in very long-run samples, on the order of a half century. Also according to these estimates, Mexico outperformed its BP-equilibrium growth during the pre-liberalization years 1960–86, and even more strongly if we omit the oil boom and debt crisis and consider only 1960–77. This finding is consistent with the fact that, by the end of the pre-liberalization period, by either definition, Mexico was facing a series of repeated balance of payments crises that resulted in the sharp peso devaluations of 1975–76, 1982–83, and 1985–86.18

However, the estimates in this paper do not support the hypothesis that a tightening of the balance of payments constraint could account for the slowdown of Mexico’s economic growth in the post-liberalization years (1987–2006). On the contrary, our estimates show that the BP-equilibrium growth rate actually rose slightly in the post-liberalization period, suggesting that liberalization was modestly successful in relieving the country’s previous balance-of-payments constraints. The relaxing of the BP constraint was probably less than what policy makers hoped for, however, as the increase in the BP-equilibrium growth rate was only about 0.5 percentage points, and this disappointing improvement can be attributed in part to the high elasticity of imported intermediate goods with respect to manufactured exports—the most dynamic part of

18 On the tendency of Mexico to run increasing current account deficits as far back as the 1960s, see Ibarra (1978).
Mexico’s exports. But we do not find any evidence here that the BP constraint tightened after trade liberalization.

Since the actual average growth of the Mexican economy fell substantially in the post-liberalization period, by either definition (from about 5% including the oil boom and debt crisis, or 6% omitting them, to about 3% in both cases), our estimates imply that the Mexican economy has been underperforming relative to its BP-equilibrium growth rate—and the more so, if we include the terms of trade for oil, which is Mexico’s chief non-manufactured export product, in which case the BP-equilibrium growth rate is around 6% for the post-liberalization period compared with actual average growth of about 3%. There are several possible explanations for this underperformance.

First, it is possible that an alternative specification of our extended BPCG model might yield a decrease rather than an increase in the BP-equilibrium growth rate in the post-liberalization period. This is especially true because, due to data limitations, we were not able to include maquiladora trade in our export and import series. Because the maquiladoras are highly intensive in intermediate imports and increased their weight in overall exports during the sample period, it is possible that including them could alter the findings of this paper. In future work, we intend to investigate further the possibilities for finding or at least extrapolating the maquiladora trade data for the pre-liberalization period (1960s and 1970s). Alternatively, or additionally, we can investigate changes in Mexico’s BP-equilibrium growth rate during the post-liberalization period using complete trade data including maquiladoras, following the earlier work of Ibarra (2011b). We could, for example, test for differences between the pre-NAFTA years (1987–93), the early NAFTA years (1994–2000), and the years since China joined the WTO (2001–present), but we would not be able to test for structural breaks between the pre- and post-liberalization periods...
using those data.

Second, it is worth noting that, as in most previous studies in the BPCG framework, we have ignored changes in the RER and focused only on income elasticities (in this paper, these are augmented by the elasticity of intermediate imports with respect to manufactured exports and weighted by the shares of the different types of exports and imports). Similar to some earlier work in this framework (e.g., Perraton, 2003), we have allowed for terms-of-trade effects in regard to primary commodity exports, but not RER effects for manufactured exports and imports. Mexico’s RER was relatively constant in the very long run, in the sense that there is no pronounced trend over the entire sample period 1960–2006 (in spite of massive fluctuations associated with the BP crises mentioned earlier and the later one in 1994–95). Specifically, the average levels of our RER index were similar during the split sample periods, pre- and post-liberalization, and the average rate of change over the whole period 1960–1006 was very small (-0.25% per year).

[Figure 1. Bilateral Mexican-U.S. real exchange rate index, 1960–2006]

The trajectories of the RER were very different, however, within the pre- and post-liberalization periods considered separately (see Table 4 and Figure 1). During the 1960s, the RER index (which is based on 100 in 1996, and reflects the value of the peso inversely) was relatively stable, with an index value of about 84, and then it decreased (i.e., the peso appreciated in real terms) in two episodes during the 1970s—both of which were followed by currency crises and sharp devaluations. After the debt crisis of the early 1980s, the RER soared to 127 in 1986, so that the overall trend during the pre-liberalization period 1960–86 was toward a real depreciation. After liberalization, there was a reversal of this trend, with a tendency for the real exchange rate to appreciate (in spite of one more maxi-devaluation in 1994–95), as the index fell to 78 in
The average rates of change were +1.36% per year (depreciation) in 1960–86 and -2.42% per year (appreciation) in 1987–2006. The tendency of the peso to appreciate in real terms in the post-liberalization period may be an important factor in the underperformance of the Mexican economy during that time, especially given the economy’s greater openness in this period.

This suggests that further modification of the BPCG model to take account of RER fluctuations may be important for explaining the post-liberalization slowdown in Mexico’s growth. Whether incorporating the RER improves the predictive power of the model could be tested in future research by estimating equation (1) for Mexico’s manufactured exports, and then using equation (5), which includes the price (RER) elasticities, instead of (6), which excludes them, to calculate \( y_B \). Of course, any explanation that focuses on RER changes would require that the price (RER) elasticities of export and import demand were sufficiently large (in absolute value) to satisfy the (modified) Marshall-Lerner condition embedded in the model.\(^{19}\) Although an explanation of the growth slowdown that relies upon relative price (RER) changes would be consistent with a BP constraint in a broader sense, it would be different from the traditional BPCG model in which relative prices are assumed to have no impact (see, e.g., Alonso and Garcimartín, 1998–99).

Finally, it is of course possible that no extension of the BPCG model or improvements in the data set will suffice to enable this framework to explain the post-liberalization growth slowdown in Mexico. In this case, it would be important to identify the other factors that could account for that slowdown. For example, the financial and fiscal constraints referred to earlier, which have depressed the nation’s investment rate (both private and public), could be prime suspects. The real exchange rate could also play an additional role, as the real appreciation may

\(^{19}\) See footnotes 10 and 11, above. See also Ibarra (2011a, 2011b) for new estimates of the relative price (RER) elasticities of import demand and how they compare with earlier estimates.
squeeze profit margins in the tradables sector and discourage private investment (see Ibarra 2008, 2011c). Supply-side factors, such as financial sector rigidities, rule of law, and deficiencies in human capital formation, also discussed earlier, could possibly also play a role. One important hypothesis to consider is that the changes in macroeconomic policy since the 1990s—especially, the strict inflation-targeting monetary policy and balanced-budget targets for fiscal policy (see Esquivel, 2010)—may have led to a situation in which the country’s actual growth is chronically held below its potential rate (in a neoclassical sense) or its BP-equilibrium rate (in a Keynesian sense). Such possibilities will have to be explored in future research.

Appendix. Data sources and definitions

**Bilateral real exchange rate (BRER):** Calculated as the consumer price ratio between the U.S. and Mexico, multiplied by the nominal peso–dollar exchange rate. Sources: BLS for the U.S. consumer price index, and Bank of Mexico (BOM) and the IMF’s *International Financial Statistics* for Mexico’s consumer price index and nominal exchange rate.

**Gross domestic product (GDP):** In constant prices of 1993. Source: National Accounts data from Mexico’s National Institute of Statistics (INEGI). Pre-1980 data are based on the historical series in constant prices of 1980 calculated by INEGI.

**Imports of final goods (IMPO) and intermediate goods (IMPI):** Final goods are the sum of consumption and capital goods. Intermediate goods exclude maquiladoras. The original balance-of-payments data, in nominal dollars, were deflated with the general U.S. producer price index for finished goods. Source: BOM for trade data, and BLS for price index.

**Manufactured exports (EXPM):** Excluding maquiladoras. The original balance-of-payments data, in nominal dollars, were deflated with the general U.S. producer price index for finished goods. Source: BOM for trade data, and BLS for price index.

**Oil price (OIL):** Average of U.K. Brent, Dubai, and West Texas Intermediate. The original series in dollars per barrel was deflated with the U.S. producer price for industrial commodities less fuel. Source: IMF for nominal oil price, and BLS for price index.
References


Table 1. Unit root tests
Period: 1960-2006, 47 observations

<table>
<thead>
<tr>
<th></th>
<th>Augmented Dickey-Fuller (ADF)</th>
<th>Phillips-Perron (PP)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>level</td>
<td>level with trend</td>
</tr>
<tr>
<td>Bilateral real exchange rate, BRER</td>
<td>-3.64 ***</td>
<td>-3.59 **</td>
</tr>
<tr>
<td>Gross domestic product, GDP</td>
<td>-3.53 **</td>
<td>-1.55</td>
</tr>
<tr>
<td>Imports of final goods, IMPO</td>
<td>-0.48</td>
<td>-2.87</td>
</tr>
<tr>
<td>Imports of intermediate goods, IMPI</td>
<td>-0.31</td>
<td>-3.47 *</td>
</tr>
<tr>
<td>Manufactured exports, EXPM</td>
<td>-1.11</td>
<td>-2.50</td>
</tr>
</tbody>
</table>

***, **, *: The unit root hypothesis is rejected at 1%, 5%, 10% of significance.

ADF test with intercept and lag length determined by Schwarz, with max lag equal to 4. PP test with intercept, Bartlett kernel, and Newey-West bandwidth. Both sets of tests use MacKinnon one-sided p-values.

Source: Authors' calculations. See the appendix for data sources and definitions.
Table 2. Estimated demand functions for imports of final goods

Dependent variable: Final goods imports, IMPO.
Sample: 1960-2006, 47 observations

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-run coefficients:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed of adjustment, $\sigma$</td>
<td>-0.102</td>
<td>-0.161</td>
<td>-0.231</td>
<td>-0.244</td>
<td>-0.243</td>
</tr>
<tr>
<td>Gross domestic product, GDP</td>
<td>1.58 (0.02)</td>
<td>1.24 (0.00)</td>
<td>1.10 (0.00)</td>
<td>1.16 (0.00)</td>
<td>1.19 (0.00)</td>
</tr>
<tr>
<td>Real exchange rate, BRER</td>
<td>-1.24 (0.19)</td>
<td>-0.54 (0.19)</td>
<td></td>
<td>0.05 (0.88)</td>
<td></td>
</tr>
<tr>
<td>Manufactured exports, EXPM</td>
<td></td>
<td></td>
<td></td>
<td>-0.07 (0.61)</td>
<td>-0.09 (0.46)</td>
</tr>
<tr>
<td>GDP*DU87</td>
<td>0.15 (0.00)</td>
<td>0.46 (0.00)</td>
<td>0.55 (0.01)</td>
<td>0.54 (0.01)</td>
<td></td>
</tr>
<tr>
<td>BRER*DU87</td>
<td>-1.17 (0.02)</td>
<td>-1.42 (0.03)</td>
<td>-1.39 (0.02)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Diagnostics:** |        |        |        |        |        |
| Adj R-sq | 0.831 | 0.934 | 0.962 | 0.960 | 0.961 |
| Jarque-Bera | 0.34 (0.84) | 1.61 (0.45) | 0.27 (0.87) | 0.10 (0.95) | 0.11 (0.95) |
| Breusch-Godfrey | 0.35 (0.56) | 0.33 (0.57) | 0.13 (0.72) | 0.08 (0.78) | 0.09 (0.76) |
| ARCH | 0.08 (0.77) | 0.74 (0.39) | 0.00 (0.99) | 0.01 (0.91) | 0.03 (0.85) |
| RESET | 0.00 (0.98) | 2.83 (0.10) | 0.09 (0.76) | 0.34 (0.56) | 0.24 (0.63) |

| **Bounds testing:** |        |        |        |        |        |
| $t$-stat | -2.62 | -5.24 *** | -6.28 *** | -5.09 *** | -5.57 *** |
| $F$-stat | 3.06 | 13.62 *** (++) | 16.88 *** (++) | 9.41 *** (++) | 11.70 *** (++) |

Notes:
1) Trade data exclude maquila.
2) For illustrative purposes, the $p$-values of the $d_{t}$ coefficients (see equation 8 in the text) are shown in parenthesis next to the long-run coefficients.
3) The intercept was removed from all equations due to lack of significance. The ARDL models initially were estimated with one lag for the variables in first differences. The estimation results shown in the table correspond to the models after the longest non-statistically significant coefficients were removed - except the results of bounds testing, which was performed with the full lag structure.
4) To pass the normality test, equation (1) includes a 0-1 dummy for the year 1975, while the rest of equations also include dummies for 1986, 1987, and 1993.
5) Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), with no serial correlation of first order (Breusch-Godfrey) and no ARCH errors, and that the equation passes Ramsey’s mis-specification test using the squares of the fitted values (RESET). $F$-statistics (except $\chi^{2}$ for J-B) with $p$-values in parenthesis.
6) Bounds testing: ***, **, *: Rejects the null of no level relationship at 1%, 5%, 10% of significance, using the asymptotic upper critical values from Pesaran et al. (2001), tables CI(i) and CII(i): no intercept and no trend. +++, ++, +: Rejects the null of no level relationship at 1%, 5%, 10% of significance, using the small-sample upper critical values from Narayan (2005), appendix case II: restricted intercept and no trend, for $n=45$ observations. Critical values available only for the $F$-test.
Source: Authors' calculations.
Table 3. Estimated demand functions for imports of intermediate goods

<table>
<thead>
<tr>
<th>Long-run coefficients:</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed of adjustment, $\sigma$</td>
<td>-0.109</td>
<td>-0.260</td>
<td>-0.244</td>
<td>-0.272</td>
<td>-0.274</td>
</tr>
<tr>
<td>Gross domestic product, GDP</td>
<td>1.90 (0.05)</td>
<td>1.01 (0.00)</td>
<td>0.79 (0.05)</td>
<td>0.68 (0.06)</td>
<td>0.90 (0.01)</td>
</tr>
<tr>
<td>Real exchange rate, BRER</td>
<td>-2.05 (0.11)</td>
<td>-1.36 (0.00)</td>
<td>-1.35 (0.02)</td>
<td>-1.09 (0.01)</td>
<td>-1.33 (0.00)</td>
</tr>
<tr>
<td>Manufactured exports, EXPM</td>
<td>0.51 (0.01)</td>
<td>0.73 (0.00)</td>
<td>0.75 (0.00)</td>
<td>0.61 (0.00)</td>
<td></td>
</tr>
<tr>
<td>GDP*DU87</td>
<td>-0.37 (0.05)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BRER*DU87</td>
<td>1.06 (0.06)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPM(-1)*DU87</td>
<td>-0.04 (0.03)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EXPM(-1)*DU94</td>
<td>-0.02 (0.09)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Diagnostics:**

| Adj R-sq                                      | 0.676   | 0.802   | 0.830   | 0.821   | 0.812   |
| Jarque-Bera                                   | 0.34 (0.84) | 1.01 (0.60) | 1.15 (0.56) | 1.32 (0.52) | 1.19 (0.55) |
| Breusch-Godfrey                               | 0.37 (0.55) | 0.22 (0.64) | 0.57 (0.45) | 0.06 (0.81) | 0.38 (0.54) |
| ARCH                                          | 0.38 (0.54) | 1.03 (0.31) | 0.03 (0.86) | 0.02 (0.90) | 0.13 (0.72) |
| RESET                                         | 4.79 (0.03) | 0.10 (0.76) | 0.22 (0.64) | 0.07 (0.79) | 0.06 (0.81) |

**Bounds testing:**

| $t$-stat                                       | -2.16   | -3.49 ** | -3.18 a/ | -3.40 * | -3.32 * |
| $F$-stat                                       | 2.25    | 4.65 ** (++) | 2.67 b/ | 3.28 * c/ | 3.06 * c/ |

Notes:

a/ 10% upper critical value for k=5 regressors is -3.49 in Pesaran et al. (2001).
b/ 10% upper critical value for k=5 regressors is 2.93 in Pesaran et al. (2001) and 3.30 in Narayan (2005).
c/ 10% upper critical value for k=4 regressors is 3.34 in Narayan (2005).

1) Trade data exclude maquila.
2) For illustrative purposes, the $p$-values of the $d_i$ coefficients (see equation 8 in the text) are shown in parenthesis next to the long-run coefficients.
3) The intercept was removed from all equations due to lack of significance. The ARDL models initially were estimated with one lag for the variables in first differences. The estimation results shown in the table correspond to the models after the longest non-statistically significant coefficients were removed - except the results of bounds testing, which was performed with the full lag structure.
4) Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), with no serial correlation of first order (Breusch-Godfrey) and no ARCH errors, and that the equation passes Ramsey’s mis-specification test using the squares of the fitted values (RESET). $F$-statistics (except $\chi^2$ for J-B) with $p$-values in parenthesis.
5) Bounds testing: ***, **, *: Rejects the null of no level relationship at 1%, 5%, 10% of significance, using the asymptotic upper critical values from Pesaran et al. (2001), tables CI(i) and CII(i); no intercept and no trend.
   ++++, ++, +: Rejects the null of no level relationship at 1%, 5%, 10% of significance, using the small-sample upper critical values from Narayan (2005), appendix case II: restricted intercept and no trend, for n=45 observations. Critical values available only for the $F$-test.

Source: Authors' calculations.
Table 4. Actual GDP growth compared with BP-equilibrium growth and its determinants

<table>
<thead>
<tr>
<th>Period</th>
<th>Whole sample</th>
<th>Pre-liberalization</th>
<th>Post-liberalization</th>
<th>Excluding oil boom and 1980s crisis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual GDP growth rate</td>
<td>4.28</td>
<td>5.24</td>
<td>2.98</td>
<td>6.02</td>
</tr>
<tr>
<td>BP-equilibrium growth rate (without oil price)</td>
<td>4.01</td>
<td>4.16</td>
<td>4.65</td>
<td>4.10</td>
</tr>
<tr>
<td>BP-equilibrium growth rate (with oil price)</td>
<td>6.11</td>
<td>6.11</td>
<td>6.11</td>
<td>6.11</td>
</tr>
</tbody>
</table>

Average annual growth rates:
- Total exports (in PPI-deflated U.S. dollars): 7.79, 7.25, 8.53, 6.62, 8.39
- Manufactured exports: 11.24, 11.82, 10.45, 12.90, 9.29
- Non-manufactured exports: 5.81, 5.57, 6.13, 4.52, 6.98
- Total imports (in PPI-deflated U.S. dollars): 6.54, 2.36, 12.18, 2.19, 11.29
- Final goods imports: 4.99, 10.83, 5.87, 9.57
- Intermediate imports: 8.47, 7.25, 10.10, 9.13, 8.66
- Real international price of oil: n.a., n.a., 5.40, n.a., 6.20

- Share of manufactures in total exports: 45.0%, 28.5%, 67.3%, 30.1%, 69.1%
- Share of intermediate goods in total imports: 55.6%, 49.1%, 64.5%, 40.7%, 63.6%
- GDP-elasticity of final goods imports: 1.58, 1.10, 1.56, 1.10, 1.56
- GDP-elasticity of intermediate imports: 1.01, 1.01, 1.01, 1.01, 1.01
- Manufactured-export elasticity of intermediate imports: 0.51, 0.51, 0.51, 0.51, 0.51
- Bilateral real exchange rate index (average): 86.3, 85.6, 87.3, 82.0, 84.1
- Bilateral real exchange rate index (rate of change): -0.25, 1.36, -2.42, 0.20, -1.54

Note: All growth rates are expressed as average annual percentage rates.
Source: Authors' calculations. See appendix for variable definitions and sources.
Figure 1. Bilateral Mexican-U.S. real exchange rate index, 1960–2006.

Note: This index measures the relative price of foreign (U.S.) goods, so a higher index number indicates a real depreciation of the peso. The nominal exchange rate in pesos per dollar was adjusted using consumer price indexes.