

Structural Change, the Real Exchange Rate, and the Balance of Payments in Mexico, 1960-2012

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ABSTRACT

This paper estimates a structural model of the balance of payments, with disaggregated exports (manufactures and other) and imports (final and intermediate), and a reduced form model of the trade balance for the Mexican economy. The analysis identifies structural changes in the composition of Mexico's trade and the parameters that affect it across five subperiods marked by statistical breakpoints. The results indicate that a tightening of the balance-of-payments constraint may account for the post-liberalization slowdown in Mexico's growth only during certain subperiods, and that the impact of real exchange rate changes on the trade balance has diminished, most likely as a result of the increasing integration of export industries into global supply chains. The results also suggest an asymmetry, whereby a country cannot sustain growth above the rate consistent with balance-of-payments equilibrium, as expected, but it can grow persistently below that rate when other constraints are more binding.

Keywords: Mexican economy; balance-of-payments constraint; trade liberalization; real exchange rate; structural change; Marshall-Lerner condition

JEL classifications: F43, F14, E12, O24

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1. Introduction

In a world economy characterized by an explosion in international trade and fast growth in most emerging-market economies over the past few decades (at least until the recent crisis), Mexico stands out for having fully embraced trade liberalization and undergoing deep structural reforms, yet failing to achieve high, sustained rates of economic growth. The country went through two major rounds of trade liberalization: first after joining the General Agreement on Tariffs and Trade (GATT) in 1986, and then after establishing the North American Free Trade Agreement (NAFTA) with Canada and the United States in 1994. This liberalization effort dramatically increased the ratio of trade to gross domestic product (GDP). Moreover, trade experienced a structural transformation, with manufactured exports and intermediate imports greatly increasing their shares in their respective totals. But despite the rapid expansion and re-composition of Mexico's trade, the average GDP growth rate has been disappointingly low, compared with both other emerging-market economies and the country's own historical record.¹

One branch of the literature has sought to explain this paradoxical outcome by employing the model of balance-of-payments-constrained growth (BPCG). In the most basic version of this model (Thirlwall, 1979), the growth rate consistent with balance of payments equilibrium (hereafter the "BOP-equilibrium growth rate") equals the ratio of the growth rate of exports to the income elasticity of import demand. Starting with the pioneering work of Moreno-Brid (1998, 1999), several studies concluded that Mexico's growth slowdown after trade liberalization could be explained by a tightening of the balance of payments constraint, which they attributed to an increase in the income elasticity of imports that more than outweighed the gains in export

¹ A vast literature has debated the causes of the slowdown in Mexico's growth since the liberalization of trade. See, for example, Ibarra (2008, 2011b), Hanson (2010), Kehoe and Ruhl (2010), Arias, et al. (2010), and Ros (2013a).

growth. More recently, however, several papers have (explicitly or implicitly) challenged this finding. Gouvea and Lima (2010) found evidence consistent with a rise in Mexico's BOP-equilibrium growth rate in the 1990s and early 2000s, as Mexico's exports shifted toward more dynamic, high-technology industries. Ibarra (2011a) and Blecker and Ibarra (2013) showed that, after controlling for the effect of manufactured exports, there was no post-liberalization increase in the income elasticity of intermediate imports, which have become the largest component of Mexican imports. Moreover, Blecker and Ibarra found there was an increase rather than a decrease in Mexico's BOP-equilibrium growth rate after trade liberalization.

A related literature has investigated how the real exchange rate (RER) affects the growth of the Mexican economy. These studies have produced conflicting results, with some finding positive effects of a real peso depreciation (e.g., Ibarra, 2008; Blecker, 2009) and others finding negative effects (e.g., Romero, 2009; López et al., 2011). All agree that the RER may affect GDP growth through several different channels, including the impact on income distribution and thereby on domestic consumption and investment, as well as the more direct impact on the trade balance. Given our focus on the balance of payments, we will restrict our attention to the latter impact in this paper.

This paper pushes the analysis of the BOP constraint and RER effects in Mexico in several new directions. First, building on the earlier work of Gouvea and Lima (2010) and Blecker and Ibarra (2013), it estimates a disaggregated version of the BPCG model, with two types of imports (final and intermediate goods) and two types of exports (manufactures and others), which incorporates the relationship between intermediate imports and manufactured exports and the effects of RER changes into alternative calculations of the BOP-equilibrium growth rate. Second, whereas many previous applications of the BPCG model to Mexico have

treated exports as exogenous, in which case it is only necessary to estimate an import function, we treat manufactured exports as endogenous and estimate a function for those exports. Third, as a sensitivity test, the BOP-equilibrium growth rate is calculated using the estimated coefficients from both a reduced-form trade balance equation and a structural model of imports and exports. Fourth, the paper provides estimates of an extended Marshall-Lerner (EML) effect, that is, the net impact of changes in the RER on the trade balance. Fifth, without incorporating them explicitly into the model, the paper analyzes how changes in other components of the BOP besides merchandise trade have affected the country's growth.

Finally, this paper finds that a simple division of the past five decades into pre- and post-liberalization periods, with a single structural break sometime in the 1980s (as in many previous studies of Mexico), is too simple. Our estimates identify four structural breaks, which correspond to known major changes in the Mexican policy regime and/or the global economic environment. These four breaks in turn imply five distinct subperiods for the analysis: I) Stabilizing and shared development, 1960-74; II) Recurrent crises and oil boom-bust, 1975-86; III) Initial trade liberalization and macro stabilization, 1987-93; IV) NAFTA, peso crisis, and recovery, 1994-2000; and V) China-World Trade Organization (WTO) and “stabilizing stagnation,” 2001-12. Following Araujo and Lima (2007) and Gouvea and Lima (2010), the structural change analyzed in this paper consists of changes in the composition of Mexico's trade (modelled here as the percentages of manufactures in total exports and of intermediate goods in total imports); in addition, following Tharnpanich and McCombie (2013) and Blecker and Ibarra (2013), we also add the dimension of changes in the estimated price and income elasticities.² The paper estimates how these structural changes have affected the BOP-equilibrium growth rate in Mexico across

² These changing shares and elasticities in turn are presumed to reflect deeper changes in the structure of Mexico's industries (especially the increasing role of assembly operations that rely heavily on imported inputs for export production) and the micro-level composition of its trade.

the five time periods, and compares this rate with the country's actual growth to determine whether the BOP constraint could be considered to be binding during each period.

The rest of the paper is organized as follows. Section 2 covers the literature in more depth and explains the way in which we use the BPCG model. Section 3 presents the theoretical model and discusses our alternative estimation strategies. Section 4 discusses the data set, explains the econometric methodology, and gives the rationale for the five time periods. Section 5 summarizes the econometric estimates, while section 6 analyzes their implications for the BOP-equilibrium growth rate and EML effect. Section 7 concludes.

2. Literature review and analytical approach

Using cointegration methods, Moreno-Brid (1999, p. 155) found that the income elasticity of Mexico's import demand increased between 1950-81 and 1982-96, and concluded that this increase "tightened the balance-of-payments constraint on Mexico's economic growth."³ Moreno-Brid (2002) estimated import demand functions for 1985-96 compared with 1970-84, and again found that the income elasticity increased while also finding that the RER elasticity diminished. Garcés (2008) found that the RER elasticities of imports of capital, consumption, and intermediate goods (excluding maquiladoras) all fell between 1980-89 and 1991-2000.

Some studies have also estimated equations for export demand or the trade balance. Using data for 1970-2000, Pacheco-López and Thirlwall (2004) found that the growth rates of Mexican exports and imports both accelerated after trade liberalization in Mexico (dated as 1985 or 1986), but there were no statistically significant changes in export or import growth after

³ Qualitatively similar results were obtained by Guerrero de Lizardi (2003), Cardero and Galindo (2005), and Romero (2012), although the exact years of the samples and structural breaks vary.

NAFTA (1994).⁴ They also estimated an equation for the growth rate of Mexico's trade balance and found that it was significantly reduced after liberalization but not after NAFTA. In addition, they found that Mexican trade barely satisfied the Marshall-Lerner condition, a result confirmed by Pacheco-López (2005). The latter also estimated import demand functions for various subperiods ranging from 1973-87 to 1985-99, and found that the income elasticity was generally higher in the later subperiods. Based on these estimates, she calculated that the BOP-equilibrium growth rate decreased after trade liberalization, dated as occurring in either 1985 or 1986.

More recently, attention has shifted to disaggregated versions of the BPCG model. Using a multisectoral BPCG model developed earlier by Araujo and Lima (2007), Gouvea and Lima (2010) found that Mexico's ratio of the weighted income elasticities of exports to the weighted income elasticities of imports increased after trade liberalization, implying a relaxation of the BOP constraint. Gouvea and Lima (2010, p. 188) cautioned that their analysis of Mexico did not take into account "the high import content of its manufactured exports," and argued that perhaps this had lessened the growth benefits of the export growth. The drawbacks of Mexico's heavy reliance on imports of intermediate goods had been noted by many earlier analysts (e.g., Ruiz-Nápoles, 2004; Moreno-Brid, et al., 2005), but none of these authors explicitly incorporated those imports into a BPCG model.

Ibarra (2011a) found that once he controlled for manufactured exports in a function for intermediate imports, there was no significant increase in the income elasticity of demand for those imports in the post-liberalization period (defined as 1987-2006, within an overall sample of 1960-2006), although he did find an increase in the income elasticity of demand for final imports (i.e., consumption and capital goods). These results were confirmed by Blecker and Ibarra

⁴ But see Bahmani-Oskooee and Hegerty (2009) and McDaniel and Agama (2003) for contrary results regarding NAFTA.

(2013), who also found (somewhat surprisingly) that the elasticity of intermediate imports with respect to manufactured exports did not increase significantly in the post-liberalization period.⁵ In effect, the estimates in Ibarra (2011a) and Blecker and Ibarra (2013) suggest that the appearance of a rise in the income elasticity of demand for aggregate imports in previous studies was largely picking up the increasing share of manufactured exports in GDP and the intensive use of intermediate imports in the production of those exports.

Blecker and Ibarra (2013) then constructed an extended BPCG model that included two different types of exports (manufactured and primary products) as well as two types of imports (intermediate and final goods). Their estimates showed that Mexico's BOP-equilibrium growth rate increased after trade liberalization (defined as beginning in 1987), even taking the increasing role of intermediate imports into account. However, Blecker and Ibarra estimated a version of the BPCG model that assumes long-run relative purchasing power parity (PPP), i.e., a constant RER in the long run, so that export growth could be treated as exogenous and only the import demand functions had to be estimated. Because Mexico's RER varied notably during their two subperiods (pre-liberalization 1960-86 and post-liberalization 1987-2006), their results could possibly be modified or even overturned if RER effects are incorporated into the analysis.

Before proceeding further, we should clarify the way in which we are employing the BPCG model in this paper. As originally developed by Thirlwall (1979), the model was intended to provide a causal explanation of long-run average growth rates in open economies, and most studies to date have used the model in this spirit. However, some recent studies have tested for changes in the BPCG relationship over shorter periods of time (e.g., Razmi, 2005; Tharnpanich

⁵ This result is not sensitive to the inclusion or exclusion of maquiladora trade, as Ibarra (2011a) used a data set that excluded maquiladoras while Blecker and Ibarra (2013) used one that included them. Garcés (2008) found an increase in the export elasticity of non-maquiladora intermediate imports between 1980-89 and 1991-2000, but he did not distinguish between manufactures and other exports.

and McCombie, 2013). Also, some theorists have argued that the model can only provide accurate predictions of long-run growth rates under special assumptions regarding non-tradable goods and the structure of the domestic economy (Razmi, 2011) or the relative size of the national economy (Ros, 2013b).

In this paper, we use the BPCG model in a more circumscribed manner. Consistent with the model's original assumptions, we do not expect our estimated BOP-equilibrium growth rates to match or "predict" actual growth during our five subperiods, especially because the BOP constraint (understood as balanced trade or a balanced current account) does not have to be binding in relatively short periods. In addition, one of the key assumptions of the standard BPCG framework (constancy of the RER) does not hold during most of these subperiods.⁶ Moreover, we found that we could not get statistically adequate estimates unless we allowed the slopes and intercepts to shift in various years corresponding to major structural breaks or policy changes. Our results do not support the view that a constant set of income elasticities of imports and exports have determined Mexico's average growth over our 53-year sample period, and our multiple structural breaks suggest the existence of supply-side shifts (especially for exports of manufactures) that cannot be attributed to changes in foreign income or the RER.

Our findings support the use of an extended BPCG model, incorporating RER effects and structural breaks, as a benchmark for understanding whether the growth process was or was not BOP-constrained during various subperiods defined by alternative policy regimes and external conditions. This means that a key test of the accuracy of our estimates is whether the country was

⁶ Following the suggestion of an anonymous referee, the subperiods analyzed in this paper could be considered short enough for the Kaldorian mechanism of export-led cumulative causation to operate. As discussed by Blecker (2013), this mechanism assumes feedbacks from export growth to output growth to productivity growth, which in turn affect the RER by making domestic goods more (or less) price-competitive. In the long run, relative purchasing power parity is more likely to hold, thus breaking the virtuous (or vicious) cycle of cumulative causation and imposing a balance of payments constraint. Unfortunately, the data set used in this paper does not permit the estimation of these dynamic feedbacks, but testing for such cumulative causation in Mexico is an important area for future research.

facing rising current account deficits and pressures to depreciate the currency at times when its actual growth exceeded the BOP-equilibrium rate, and conversely when actual growth was below the BOP-equilibrium rate. In addition, our modeling framework will also yield alternative estimates for the net effect of the RER on Mexico's trade balance (the EML effect), which will contribute to the debate over whether overvaluation of the peso has been a contributing factor to the country's slow growth via this channel.

3. Theoretical model

This section presents a model similar to the one developed in Blecker and Ibarra (2013), but extends it to permit alternative means of estimating both the BOP-equilibrium growth rate and the EML effect. The model is disaggregated into two types of exports (manufactured and other goods) and two types of imports (final and intermediate goods).⁷ All variables are expressed in growth rates (measured as differences in natural logarithms) so that the coefficients can be interpreted as elasticities.

The growth rate of demand for manufactured exports (x_n), measured in units of domestic output, is determined by the function,

$$x_n = \varepsilon_n(e + p^* - p) + \eta_n y^* + \lambda \quad (1)$$

where e is the rate of nominal depreciation of the home currency, p^* is the foreign inflation rate for industrial goods, p is the home inflation rate (also for industrial goods), y^* is the growth rate of foreign real GDP, ε_n and η_n are (respectively) the price (RER) and income elasticities of

⁷ Our disaggregation is limited to two types each of imports and exports, which is less than the number of sectors considered in Gouvea and Lima (2010), but was necessary due to data limitations for the whole period we wanted to analyze. Also, we follow Blecker and Ibarra (2013) here in explicitly modeling the relationship between manufactured export production and intermediate imports, which was not included in Gouvea and Lima's model.

demand for manufactured exports, and λ is a time trend. The time trend is included as a shift factor to control for the effects of changes in foreign trade barriers, global competitive conditions, and domestic supply constraints, which we could not measure directly in the econometric analysis due to data limitations. Note that $e + p^* - p$ is the rate of change in the RER or rate of real depreciation of the home country currency. We assume that the real quantity of other exports (primary commodities, chiefly oil and agricultural products) grows at the exogenously given rate x_o , while their price (denominated in foreign currency, i.e., U.S. dollars) increases at the exogenously given rate p_o^* . This specification assumes that the quantities and prices of primary commodity exports are determined by conditions in global commodity markets as well as domestic supply constraints, both of which are outside the scope of the present model.⁸

The demand function for intermediate goods is given by

$$m_i = -\varepsilon_i(e + p^* - p) + \eta_i y + \phi x_n \quad (2)$$

where m_i is the growth rate of intermediate imports, y is the growth rate of home real GDP, ε_i and η_i are (respectively) the price (RER) and income elasticities of demand for intermediate imports, and ϕ is the elasticity of demand for imports of intermediate inputs with respect to manufactured exports.⁹ The demand function for imports of final (consumption and capital) goods is

$$m_c = -\varepsilon_c(e + p^* - p) + \eta_c y \quad (3)$$

where m_c is the growth rate of final imports, and ε_c and η_c are (respectively) the price (RER) and income elasticities of demand for final imports. The inclusion of manufactured exports as a determinant of imports of intermediate goods, but not of those of final goods, follows from the

⁸ We estimated models similar to equation (1) for non-manufactured exports, and found (in results presented in an unpublished statistical appendix, available on request) that the models yield poor fits with insignificant coefficients; also, all these models fail the Jarque-Bera test for normality of the residuals.

⁹ For discussion of the interpretation of the ϕ coefficient, see Blecker and Ibarra (2013, p. 37n12), where it is referred to as α .

empirical results in Ibarra (2011a) and Blecker and Ibarra (2013). Imports are measured in units of foreign output. We thus assume, for analytical convenience (and to correspond with our use of aggregated price indexes in the empirical section), 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.

Assuming no capital flows, factor income payments, or transfers for simplicity,¹⁰ the BOP equilibrium condition expressed in terms of foreign currency (U.S. dollars) is

$$\mu(p - e + x_n) + (1 - \mu)(p_o^* + x_o) = \theta(p_i^* + m_i) + (1 - \theta)(p_c^* + m_c) \quad (4)$$

where μ is the share of manufactures in total exports and θ is the share of intermediate goods in total imports. Substituting (1), (2), and (3) into (4) and solving for the home country growth rate y , we obtain:

$$y_B = \frac{(\mu - \phi\theta)(\eta_n y^* + \lambda) + (1 - \mu)(p_o^* + x_o - p^*) + [(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu](e + p^* - p)}{\theta\eta_i + (1 - \theta)\eta_c} \quad (5)$$

which is the most general expression (under the above assumptions) for the BOP-equilibrium growth rate y_B . Note that $(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu > 0$ must hold in order for a faster rate of RER depreciation to increase the BOP-equilibrium growth rate y_B .

If we assume, as most BPCG theorists have, that relative PPP prevails in the long run, then $e + p^* - p = 0$ and (5) simplifies to:

$$y_B = \frac{(\mu - \phi\theta)x_n + (1 - \mu)(p_o^* + x_o - p^*)}{\theta\eta_i + (1 - \theta)\eta_c} \quad (6)$$

where we use the result (from equation (1)) that $x_n = \eta_n y^* + \lambda$ when $e + p^* - p = 0$. In this case, none of the coefficients in the manufactured export function (1) are included in the solution for

¹⁰ Most of our conclusions are not affected by the omission of these other components of the BOP, but it will be noted below where including them could make a difference.

the BOP-equilibrium growth rate. Equation (6) corresponds to what Perraton (2003) calls the “weak” version of BPCG, as it treats all export growth as exogenous.

As a sensitivity test, we will also present results obtained from estimating a reduced-form trade balance equation derived from this same model. Define the trade balance *ratio* as the value of exports divided by the value of imports, both measured in U.S. dollars.¹¹ Taking the natural logarithm of this ratio, we obtain the trade balance measured as the difference between the value of exports and the value of imports, both measured in natural logs. Then the rate of change in this ratio (i.e., the growth rate of the value of exports minus the growth rate of the value of imports) can be written as¹²

$$tb = \mu(p - e + x_n) + (1 - \mu)(p_o^* + x_o) - \theta(p^* + m_i) - (1 - \theta)(p^* + m_c) \quad (7)$$

Substituting (1), (2), and (3) into (7) and grouping terms, we obtain:

$$\begin{aligned} tb = & (\mu - \phi\theta)\lambda + [(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu](e + p^* - p) \\ & - [\theta\eta + (1 - \theta)\eta_c]y + (\mu - \phi\theta)\eta_n y^* + (1 - \mu)(p_o^* + x_o - p^*) \end{aligned} \quad (8a)$$

Here, the term $[(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu]$ measures the elasticity of the trade balance ratio with respect to the RER, and thus corresponds to what we have called the EML effect; this weighted sum of elasticities must be positive for a real depreciation to improve the trade balance as well as to increase the BOP-equilibrium growth rate.¹³

Equation (8a) can be estimated econometrically using the following specification:

$$tb = \beta_0 + \beta_1(e_t + p_t^* - p_t) + \beta_2 y_t + \beta_3 y_t^* + \beta_4(1 - \mu)(p_{o,t}^* + x_{o,t} - p_t^*) + v_t \quad (8b)$$

¹¹ We express the trade balance as a ratio because the trade balance as normally defined can be either positive or negative, and we cannot take logs of a negative number, but for econometric convenience in estimating elasticities we prefer to measure the variables in logs.

¹² Note this is simply a rearrangement of equation (4) for balanced trade equilibrium, which assumed that $tb = 0$.

¹³ To see the analogy to the standard Marshall-Lerner condition, note that the condition for the EML effect as defined here to be positive can also be expressed as stating that a weighted sum of the RER elasticities (all defined so as to be positive) must be greater than unity: $[1 - (\phi\theta/\mu)]\varepsilon_n + (\theta/\mu)\varepsilon_i + [(1 - \theta)/\mu]\varepsilon_c > 1$.

where $\beta_0 = (\mu - \phi\theta)\lambda$ is the constant in the regression; $\beta_1 = (\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu$ is the EML effect; $\beta_2 = -[\theta\eta_i + (1 - \theta)\eta_c]$ is the weighted average income elasticity of demand for imports; $\beta_3 = (\mu - \phi\theta)\eta_n$ is the weighted foreign income elasticity of demand for manufactured exports; β_4 (which we assume to equal unity in the econometric estimates, for consistency with equation 8a) is the impact of the change in non-manufactured exports (including terms-of-trade effects) weighted by their share in total exports; and v_t is a random error.

Setting $tb = 0$ in equation (8b) and solving for y , we can obtain alternative estimates of the BOP-equilibrium growth rate y_B including RER effects as defined in equation (5). However, estimation of (8b) does not permit us to identify all the parameters needed to calculate (6); instead, we can estimate an alternative version of the BOP-equilibrium growth rate (5) in which manufactured exports are treated as endogenous but RER effects are ignored (i.e., assuming $p^* + e - p = 0$):

$$y_B = \frac{(\mu - \phi\theta)(\eta_n y^* + \lambda) + (1 - \mu)(p_o^* + x_o - p^*)}{\theta\eta_i + (1 - \theta)\eta_c} \quad (9)$$

This corresponds to what Perraton (2003) calls the “strong” form of BPCG, in which PPP holds and manufactured export growth is explained entirely by foreign income growth plus a time trend. Equation (9) can be calculated using the results from estimating either the reduced form trade balance equation (8b) or the structural model consisting of equations (1) to (3). In any of the alternative solutions (5), (6), or (9), the BOP-equilibrium growth rate is affected by structural change—i.e., shifts in the composition of exports and imports as well as in the trade elasticities—both directly and through the EML effect.

4. Data set, estimation methods, and time periods

All data on Mexican exports and imports were taken from the balance of payments statistics of the Bank of Mexico (BOM); the nominal data in U.S. dollars were converted to real terms using a U.S. producer price index.¹⁴ We used the bilateral Mexican-U.S. RER, with the nominal exchange rate adjusted by the ratio of consumer price indexes. Of course, consumer prices may not be good indicators of the prices of tradable goods, but this was the only measure of the RER that we could construct on a consistent basis back to 1960—and it could be argued that consumer prices may be less likely to be endogenous than prices of exports and imports. Sensitivity tests using the BOM’s multilateral RER for 111 countries (which is only available since 1968)¹⁵ showed that very similar results were obtained using either RER measure in the sample period 1975-2012. We used Mexican and U.S. real GDP for home and foreign income, respectively. Because the U.S. share of Mexican exports ranged from about 70% to 90% during our sample period, U.S. GDP captures the lion’s share of Mexico’s export markets. Nevertheless, we also performed sensitivity tests by using two alternative measures of foreign income: the GDP of the high-income OECD countries and total world GDP excluding Mexico. These tests indicated that the main results of the paper are not sensitive to the use of U.S. GDP, and the diagnostics were mixed on whether the alternative measures yielded superior econometric estimates (these estimations are shown in the unpublished statistical appendix).

We tested our time-series data (all expressed in natural logarithms) for stationarity using two alternative methods: Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shinn (KPSS),

¹⁴ For the years prior to 1980, maquiladora trade had to be estimated. See the Appendix for more details on sources and definitions for all variables.

¹⁵ The IMF’s *International Financial Statistics* database has a (multilateral) real effective exchange rate index for Mexico, but it only starts in 1980.

and two sample periods: 1960-2012 and 1975-2012.¹⁶ The tests show a mixture of stationary and non-stationary variables in levels, but all the variables are stationary in first differences.¹⁷ The fact that our variables are not all integrated of the same order complicates our estimation strategy. Because in principle we would prefer to identify long-run, level effects (rather than short-run, transitory ones), our preferred method of estimation is the bounds testing approach developed by Pesaran et al. (2001). This approach is appropriate because of its good small-sample properties, the possibility of incorporating variables with different orders of integration, $I(0)$ or $I(1)$, and the implicit solution to potential endogeneity problems by carrying out the estimation within an autoregressive, distributed lag (ARDL) framework.

Bounds testing begins by estimating ARDL equations of the following error-correction form:

$$\Delta Trade_t = \sum_{j=1}^q a_j \Delta Trade_{t-j} + \sum_{i=1}^k \sum_{j=0}^q b_{i,j} \Delta Z_{i,t-j} + \sigma Trade_{t-1} + \sum_{i=1}^k d_i Z_{i,t-1} + d_0 + u_t \quad (10)$$

where $Trade$ stands for the level of imports (of either final or intermediate goods) or exports of manufactured goods, d_0 is an intercept, u_t is an error term, and there are k potential determinants Z (including any intercept dummies). The Δ symbol indicates the first difference of the variables, which are measured in natural logs so that all coefficients are elasticities, and σ is the speed of adjustment or error-correction coefficient.¹⁸

The next step is to perform the two bounds tests for the existence of a long-run relationship: a t -test for the significance of the speed of adjustment coefficient σ , and an F -test for the

¹⁶ The reasons for using two alternative sample periods are explained in section 5, below.

¹⁷ The RER is stationary in levels in all tests for both sample periods, whereas the trade variables have unit roots according to most tests. Most tests show that Mexican and U.S. GDP have unit roots, but a few tests imply (rather anomalously) that they are stationary in levels. Details of these tests are in the unpublished statistical appendix.

¹⁸ We also added year outlier dummies as needed to help the equations pass the various diagnostics; in general, only a few of these were needed (at most) for any given equation, and most of them corresponded to years of known economic events (such as major currency crises).

joint significance of σ and the d_i coefficients. Each test has upper and lower bounds for each significance level, where the critical values depend on the number of regressors. If either statistic (t or F) is above the upper bound for a given significance level, the null of no long-run relationship can be rejected even if all variables are $I(1)$; if the statistics are between the upper and lower bound, the null can be rejected only if all variables are $I(0)$; below the lower bound the null cannot be rejected regardless of the order of integration.¹⁹ We use the asymptotic critical values from Pesaran et al. (2001) for both tests; we also use the small-sample critical values calculated by Narayan (2005) for the F -test.

After conducting the bounds tests, the lag structure of equation (10) can be simplified by removing stepwise the longest statistically insignificant lags of the first differences for each variable. Then, the long-run coefficients can be calculated as $\hat{\delta}_i = -\hat{d}_i/\hat{\sigma}$, where \hat{d}_i and $\hat{\sigma}$ are estimated coefficients from (10), leading to the long-run equation

$$Trade_{LR} = \hat{\delta}_0 + \hat{\delta}_1 Z_1 + \hat{\delta}_2 Z_2 + \dots + \hat{\delta}_k Z_k \quad (11)$$

Finally, we compared the estimated long-run values from (11) with the actual series (in log levels) for each dependent variable, and when the long-run fits were poor we made adjustments to the underlying specification (for example, by introducing additional slope or intercept dummies) and then re-did the entire procedure for the alternative equation.

This method generally yields statistically adequate estimates (i.e., estimates that pass all diagnostic tests) for imports of both final and intermediate goods, especially when we allow for structural breaks. However, the equations for manufactured exports never pass all the bounds tests, thus indicating the failure of the method to uncover a long-run statistical relationship in

¹⁹ Because σ must be negative, and therefore the t -statistics and their critical values (bounds) are all negative, we use the words “upper” and “lower” (and “above” and “below”) with reference to the absolute values for the t -tests.

those equations. Therefore, we also estimated the equations of the structural model (i.e., equations 1-3) in first differences. This method is clearly proper, given that all variables are stationary in first differences. Nevertheless, differencing can potentially lose information and may result in estimates that only capture short-run effects. Therefore, even though not all of the bounds test results (especially for manufactured exports) are statistically adequate, we will present the results of both the bounds test and first difference estimates for the structural model as a check on the robustness of our findings. The reduced-form trade balance equation (8b), in contrast, can only be estimated in first differences, because we could not find a way to express it in levels in which the coefficients would exactly match those of one of the equations (5, 6 or 9) for the BOP-equilibrium growth rate y_B or the EML condition.

The estimation of the structural model in first differences is complicated by possible simultaneity bias in the three-equation system for final imports, intermediate imports, and manufactured exports. Specifically, equations (1) and (2) constitute a “triangular” or “recursive” system, because m_i is a function of x_n but x_n is not a function of m_i . For such a system, OLS estimates are unbiased and consistent only if the residuals from the two equations are uncorrelated (Greene, 1997, pp. 715-16, 732, 736-37). Moreover, there are obvious concerns about potential cross-equation correlation of the residuals for all three equations (1) to (3), because these three parts of Mexico’s trade may be affected by common shocks. Using the Breusch-Pagan Lagrange Multiplier test, we found significant correlations between the residuals from the equations for intermediate imports and manufactured exports in the estimates for 1960-2012, and also for final imports and intermediate imports for 1975-2012. However, these correlations were significant only at the 10% level, and we did not find significant correlations between the residuals from all three equations.

Although the results of the tests for cross-equation residual correlations were thus mixed, we also estimated the structural model in first differences using three-stage least squares (3SLS) as a sensitivity test.²⁰ We found that the estimated coefficients were quantitatively very close in the OLS and 3SLS estimates, thus indicating that any simultaneity bias is very slight. Because the OLS procedure allows us to perform a greater range of diagnostic tests, while none of our results are sensitive to the use of 3SLS vs. OLS, the OLS results will be presented below.²¹

In all of our estimates, we paid special attention to potential structural breaks in the estimates of equations (1) to (3) and (8b). As a first step, we examined the data for our disaggregated export and import series graphically, and noted that there appeared to be various distinct structural breaks in each of them.²² Table 1 shows that the growth rates of these trade variables changed notably over time, and also that the shares of manufactured exports and intermediate imports in their respective totals increased dramatically in Phases II through IV, representing important aspects of structural change as defined earlier. Second, we tested the export and import demand functions (equations 1-3) in first differences for structural breaks using a battery of tests (Chow tests for known break points, Quandt-Andrews unknown break point tests, and Bai-Perron multiple breakpoint tests). Third, we tested for intercept and slope shifts in all our regression equations, in both the structural model and the reduced form trade-balance model, and in the former case using both bounds testing and first differences (the latter with both OLS and 3SLS).

²⁰ Residual correlation by itself would indicate a need to use “seemingly unrelated regression” (SUR), but given the recursive nature of the system, residual correlation implies that one of the regressors may be correlated with the residuals thereby creating simultaneity bias. In this situation, 3SLS systems estimation—which combines SUR with two-stage least squares (2SLS) instrumental variables—is the appropriate estimation method.

²¹ Results of the Breusch-Pagan tests for cross-equation residual correlation and the 3SLS estimates of the structural model are available in the unpublished statistical appendix.

²² The original data and graphs are included in the unpublished statistical appendix.

[Table 1 about here]

In spite of some variation in the results, the tests generally coalesced in showing significant breaks in the various relationships at four crucial points during the sample period, which correspond to major changes in Mexico's economic conditions and trade policies.²³ Based on this evidence, we identified the following five subperiods or phases for our analysis:

[Figures 1 and 2 about here]

- I. *Stabilizing and shared development* (1960-1974). This was a period of import substitution policies and growth oriented toward the domestic market, during which Mexico maintained a fixed nominal peg of the peso to the U.S. dollar. GDP grew rapidly while inflation remained tame, leading to the idea of a “Mexican miracle” in the 1960s. However, inflation began to increase, the RER appreciated, and current account deficits began to rise toward the end of the period (see Figures 1 and 2).
- II. *Recurrent crises and oil boom-bust* (1975-1986). BOP and currency crises occurred in 1975-76, 1982-83, and 1985-86. Fiscal deficits and monetary expansion were often blamed for these crises, but external shocks such as U.S. interest rate hikes and oil price volatility also contributed. Although this was still pre-liberalization, Mexico began to open up in other ways: via oil exports, international borrowing, and expansion of the maquiladora assembly industries. Average growth slowed down as the repeated crises more than outweighed the unsustainable oil boom of 1978-81.
- III. *Initial trade liberalization and macro stabilization* (1987-1993). GATT tariff reductions were phased in and other trade barriers (e.g., licensing requirements) were removed beginning in 1987, followed by the liberalization of foreign direct investment and privatization of state enterprises. Average GDP growth continued to slow down, while the peso appreciated steadily in real terms and the trade deficit increased. Manufactured export growth accelerated and imports of intermediate goods began to closely track those exports.
- IV. *NAFTA, peso crisis, and recovery* (1994-2000). The inauguration of NAFTA was accompanied by the currency crisis of 1994-95, which marked the failure of stabilization policies focused on using a pegged exchange rate as a nominal anchor for the price level. Peso depreciation along with entry into NAFTA led to further acceleration in manufactured export growth and greater integration of Mexican industries into North American supply chains, but GDP growth increased only slightly.
- V. *China-WTO and stabilizing stagnation* (2001-2012). China joined the WTO and received

²³ These tests showed strong evidence for breaks around 1975, 1986-87, and 2001 for manufactured exports, and 1986-87 and 1994 for intermediate imports. The results for final imports were marred by non-normal residuals, but there was some evidence for structural breaks around 1975-76, 1986-87, and 1994. Detailed results of the structural break tests are included in the unpublished statistical appendix.

most-favored-nation status in the United States in 2001. China's share of the U.S. market surpassed Mexico's during this period, while U.S. growth decelerated notably. Mexico was buffeted by the global financial crisis and U.S. recession beginning in 2008-9. The country's average growth rate fell to only 2.0%, but the RER remained relatively stable and the current account deficit was small and decreasing.²⁴

5. Econometric results

5.1 Structural model of imports and exports

The estimates of the equations for final imports, intermediate imports, and manufactured exports using both bounds testing and first differences are reported in Tables 2-4, respectively. For each dependent variable, we begin with a specification that assumes no structural breaks in either the slopes or intercepts over the whole sample period, 1960-2012 (but outlier dummies for certain specific years were included in some equations to improve the fit and pass various diagnostic tests). We then proceed to test for structural breaks in either the slopes or intercepts between our various time periods. After noting certain econometric difficulties with the estimates (especially for manufactured exports) and also reflecting the results of the structural break tests, we then re-estimate all equations for the shorter sample period 1975-2012. What is reported in the tables for each dependent variable, time period, and econometric method is the best set of equations we could find, in terms of standard equation diagnostics (including the bounds tests, where relevant), for each such combination.²⁵

For imports of final goods (Table 2), the model without structural breaks for the whole sample period (column 2.1) does not clearly pass the bounds tests. However, when we include

²⁴ There is some evidence of a re-regionalization of trade and the beginnings of a Mexican catch-up with China in exports to the U.S. toward the end of this period (see Blecker, 2014).

²⁵ Lag lengths were determined by standard tests; given our use of annual data, in no case did more than one lag add explanatory power. Additional specifications and sensitivity tests are reported in the unpublished appendix.

structural breaks (column 2.2) and also when we start the sample period in 1975 (column 2.3), then the model passes both bounds tests at the 1% level. All the estimates in levels using bounds testing suggest an RER elasticity in the range of about -1.3 to -1.4, and the latter two estimates (including the structural break shown in column 2.2) suggest that the income (GDP) elasticity rose from about 0.9 in 1960-74 to about 2.4 in 1975-2012. The estimates in first differences (columns 2.3 to 2.6) show qualitatively similar results. Interestingly, the increase that we find in the income elasticity of final imports occurs notably earlier than the increases found in some previous studies.²⁶

[Table 2 about here]

Turning to imports of intermediate goods (Table 3), the specification with no structural breaks for 1960-2012 (column 3.1) passes both bounds tests at the 5% level. We were unable to identify any statistically significant structural breaks in the coefficients in the bounds test estimates. The results for 1975-2012 (column 3.2) are similar to the estimates for the entire sample period: the GDP elasticity is around 0.5, the RER elasticity is between -0.56 to -0.66, and the elasticity with respect to manufactured exports is around 0.7. The estimates in first differences (columns 3.3 to 3.5) find a similar order of magnitude for the elasticity with respect to manufactured exports.²⁷ Contrary to our expectations, we could not find any evidence that this elasticity increased significantly at any point in our sample period. The first difference estimates concur that the GDP elasticity was about 0.5 in the whole sample 1960-2012 (columns 3.3-3.4), but show that it was nearly 0.9 in the reduced sample 1975-2012 (column 3.5). The estimates in

²⁶ Blecker and Ibarra (2013) found that the income elasticity for final imports increased in 1987, while various studies cited in section 2 found that the income elasticity for total imports increased at some point in the 1980s.

²⁷ This elasticity—which is the coefficient for which we are most concerned about possible simultaneity bias—is very similar (about 0.6) in the OLS and 3SLS estimates in first differences when structural breaks are included in the full sample or if the sample starts in 1975 (see the unpublished statistical appendix for details). Thus, there is no evidence for any such bias being quantitatively important where we would most expect to find it.

first differences show a significant reduction in the absolute value of the RER elasticity starting in 1994, presumably as a result of the greater incorporation of Mexican export industries into North American and global supply chains after the formation of NAFTA.

[Table 3 about here]

Table 4 shows the estimates for manufactured exports. All of the estimates using bounds testing yielded very low estimates of the speed of adjustment coefficient σ , and no specification that we tried ever passed the bounds t -test. The basic equation with no structural breaks for the entire sample period (column 4.1) appears to pass the bounds F -test at the 5% level, but the hypothesis tests are not valid due to likely misspecification bias as shown by the significant RESET statistic. By allowing for a time trend and a shift in this trend in 2001-2012 in column 4.2, the model passes the RESET test, but fails both the t - and F -bounds tests, and there is evidence of ARCH with 2 lags ($p = 0.11$). When we estimate this equation for 1975-2012 (column 4.3), the F -statistic is significant at the 1% level but again the t -statistic is not.

[Table 4 about here]

Comparing columns 4.1 to 4.3 in Table 4, the estimated long-run elasticities with respect to the RER and U.S. GDP vary greatly depending on whether a time trend or structural break is included; this instability in the coefficients suggests the possible presence of multicollinearity. Furthermore, we found that we needed to include a large number of outlier dummies for various years prior to 1975 in order to get any sensible results for manufactured exports (including in the estimates in first differences); this was due to very large and volatile residuals in 1960-74, which indicate that the model simply does not fit the data for exports in those years.

Turning to the estimates for manufactured exports in first differences, they again have difficulty passing the RESET misspecification test for the whole sample period (columns 4.4-

4.5). However, it makes sense that Mexico's manufactured exports were not well explained by demand-side factors such as the RER or U.S. GDP during the 1960s and early 1970s, when those exports were very small and largely supply-constrained. These difficulties in estimating the manufactured export equation were the motivation for trying the alternative sample period of 1975-2012, which yields better fits and diagnostics for this equation in first differences.

Indeed, the only statistically adequate estimates for manufactured exports are the ones in first differences for 1975-2012 (column 4.6). This equation includes a significant time trend λ (indicated by an intercept dummy, given that the equation is estimated in log first differences) of 9.4% per year in 1987-2000, i.e., the initial years of trade liberalization and NAFTA, which is completely reversed in 2001-12 (after China joined the WTO). The U.S. GDP elasticity is about 1.8, while the RER elasticity is 0.55 for 1975-86 and then declines significantly to 0.23 in 1987-2012. The estimation in first differences including structural breaks for 1960-2012, shown in column 4.5, is less statistically adequate (it does not pass the RESET test), but does coincide in the main qualitative results: the RER elasticity is relatively low and decreases further after trade liberalization in 1987, and there are similar structural breaks in the time trend (with an extra upward trend in 1960-74). The shifting time trends likely reflect supply-side changes in Mexico's manufacturing export capacity and changing global market conditions, while the decreasing RER elasticity probably reflects the same phenomenon of integration into global supply chains that likely reduced the RER elasticity of intermediate imports.²⁸

²⁸ It is possible, as noted by an anonymous referee, that our estimates of RER elasticities could be biased downward (in absolute value) by potential measurement error in the construction of our RER series. However, it is not obvious why such measurement error should have increased at the times when these elasticities are found to have decreased. Alternatively, it is possible that the nominal exchange rate and/or domestic consumer prices could have become more endogenous after Mexico liberalized its trade and joined NAFTA, thereby worsening simultaneity bias. But we have tried to control for possible simultaneity with the use of lags and other procedures as described earlier.

5.2 Reduced form model of the trade balance

The results of estimating the reduced-form trade balance equation (8b) using OLS are shown in Table 5. The dependent variable is measured as $tb - (1-\mu)(p_{o,t}^* + x_{o,t} - p_t^*)$, i.e., the log difference of the ratio of total exports to total imports minus the log difference of non-manufactured exports, weighted by the share of non-manufactures in total exports, in order to impose the restriction $\beta_4 = 1$. Column (5.1) shows results for the full sample period with no structural breaks. Although the estimated coefficients have the expected signs and their magnitudes seem plausible, the coefficient on U.S. GDP is not statistically significant.

[Table 5 about here]

Columns 5.2 and 5.3 report the results of controlling for structural breaks in the two sample periods. The Mexican GDP elasticity is estimated to be -1.61 for 1960-2012 and -1.55 in 1975-2012; contrary to what we found for final imports, no structural break in this elasticity was significant.²⁹ In contrast, the results show a large and statistically significant reduction in the RER coefficient (EML effect) in the trade balance equation in 1994, when NAFTA went into effect. Using the full sample, the estimated RER coefficient decreases from 1.12 during 1960-1993 to 0.30 afterwards; the results using the reduced sample are similar. The reduction of the RER coefficient in the trade balance equation in 1994 is likely related to the reductions we found in the RER elasticities of intermediate imports in 1994 and manufactured exports in 1987.³⁰

There is some evidence of an increase in the U.S. GDP coefficient in the trade balance equation, again in 1994, although this appears only using the 1975-2012 sample (column 5.3).

²⁹ These contrasting results are probably explained by the decrease in the share of final goods in total imports between our various subperiods, which reduced the weight on the Mexican GDP elasticity for final imports η_c in the elasticity of the trade balance ratio with respect to domestic GDP in equation (8a).

³⁰ It should be noted that, in all of these equations, there was some evidence for a structural break in the RER elasticity in either 1987 or 1994 (but not both). The years reported for these breaks here are the ones for which the equations had the best diagnostics and were most statistically adequate for each equation.

This shift is significant only at the 10% level, but then U.S. GDP is only significant at this level (even apart from the shift). This result may appear surprising because we did not find evidence of a significant increase in the foreign income (U.S. GDP) elasticity of manufactured exports after trade liberalization or NAFTA. The increased U.S. GDP coefficient in the trade balance equation (in which the foreign income elasticity of exports is weighted by the share of manufactures in total exports adjusted for their indirect effect on intermediate imports) likely reflects the increase in the share of manufactures in total exports after the formation of NAFTA.

6. Estimates of the BOP-equilibrium growth rate and EML effect

Table 6 reports a range of estimates for the two primary variables of interest—the BOP-equilibrium growth rate and the EML effect—for the entire sample period 1960-2012 and the five subperiods identified earlier. The BOP-equilibrium growth rate is calculated in three different ways, corresponding to equations (5), (6), and (9),³¹ using our best estimates of the elasticities and time trend (if any) for each phase from Tables 2-5 as indicated in the notes to Table 6. These alternative calculations allow us to explore the sensitivity of the results to whether RER effects are included or excluded and whether manufactured exports are treated as exogenous or endogenous. Alternative results are also shown for the estimates of the structural model using both bounds testing and OLS with first differences. It should be recalled that the bounds testing estimates were not statistically valid for the manufactured export equation, and many of the estimates for the entire sample period were statistically weak, especially without structural breaks, so all of the calculations that use those estimates should be taken with caution.

³¹ Equation (6) was estimated previously in Blecker and Ibarra (2013), but only for two subperiods (pre- and post-liberalization). Equations (5) and (9) are estimated for the first time in this paper.

This wide range of estimates provides numerous tests for the sensitivity of the results, while enabling us to identify the impact of structural change on the deviations of actual growth from the BOP-equilibrium rate and the magnitude of the EML effect.

[Table 6 about here]

6.1 BOP-equilibrium growth

Although it is not our main emphasis, the estimated BOP-equilibrium growth rate was slightly greater than the actual average annual growth rate for the full sample period (1960-2012) according to all of the alternative calculations in the first column of Table 6. The differences are not large, however, ranging from about 0.1 to 1.1 percentage points. This finding is consistent with many previous studies in the BPCG tradition (Perraton, 2003; Razmi, 2011), while the small size of the differences between the estimated BOP-equilibrium growth rates including and excluding RER effects is consistent with the relatively constant long-run trend in the RER over the whole period 1960-2012 (see Table 1 and Figure 1). The nearly constant trend in the RER index and the fact that it is stationary in log levels are consistent with the assumption in the canonical version of the BPCG model that relative PPP holds in the long run.

However, our main focus here is on how the changes in the BOP-equilibrium growth rate compare with the changes in actual growth across the five phases we have identified. During Phase I (1960-1974), actual growth (at 6.34%) was much higher than the BOP-equilibrium rate in all of the estimates in Table 6. Given the observed appreciation of the peso during this phase (see Table 1), the differences are amplified when RER effects are included. Figure 1 shows that most of the appreciation occurred toward the end of the period (early-to-middle 1970s), and as

would be expected Figure 2 shows that Mexico's trade deficit worsened around the same time.³²

During Phase II (1975-86), actual average growth suffered a strong deceleration as a result of repeated crises. According to the estimates from the structural model with RER effects excluded, the Mexican economy grew close to its BOP equilibrium rate on average during this phase. However, the estimates using the reduced form trade balance equation show that actual growth was below the BOP-equilibrium rate, even with RER effects excluded (3.9% vs. 4.7%). The actual growth rate was much lower than the BOP-equilibrium rate when RER effects are included in all three sets of estimates (3.9% vs. 5.3 to 8.3%). Most likely, Mexican producers could not take advantage of the peso's depreciating trend during this period as a result of the macroeconomic and financial instability (including the temporary real appreciation during the oil boom), as well as the continued presence of high trade barriers outside the maquiladora enclave. Consistent with the negative gap between actual growth and the BOP-equilibrium rate with RER effects included, the trade deficit decreased and turned into a large surplus in the latter part of this phase (see Figure 2).³³

During the initial period of trade liberalization (Phase III, 1987-1993), actual average GDP growth fell further to about 3.1%, even though no crises occurred. The estimated BOP-equilibrium growth rate also decreased between Phases II and III, to about the same rate as (or

³² The econometric estimates in section 5 and the calculations of the BOP-equilibrium growth rate in this section focus on merchandise trade. As Figure 2 shows, the total trade (goods and services) and current account balances generally tend to move together with the merchandise trade balance. Therefore, other components of the current account, such as factor income payments and transfers (remittances), do not change most of our qualitative results (with a few qualifications to be noted below). Moreover, taking net capital inflows into account does not alter our main conclusions either, as the capital account balance (including errors and omissions) basically mirrors the evolution of the current account balance (see Table 1), again with a few qualifications as stated below.

³³ Of course, Mexico was essentially forced to run a trade surplus after the debt crisis, as it was cut off from international borrowing. The surplus was achieved through drastic reductions in imports (especially of final goods), rather than by accelerated export growth. However, the gap between the trade and the current account balances widened during the late 1970s and 1980s, when debt service payments became a significant share of GDP (see Table 1 and Figure 2). Thus, net outflows of factor income probably put an additional constraint on Mexico's growth, especially after 1982 when new capital inflows ceased. This may be an additional reason why actual growth was below the BOP-equilibrium rate during Phase II.

even slightly lower than) actual growth, according to the structural estimates without RER effects, and fell even more in the estimates based on the reduced form trade balance model without RER effects. As a result of the sharp appreciation of the peso during Phase III, the estimated BOP-equilibrium growth rates including RER effects are the lowest for this period. As would be expected given the wide gap between the actual growth rate and the BOP-equilibrium growth rates including RER effects, there was a dramatic deterioration in the trade balance during this period (see Figure 2), which became the prelude to the peso crisis of 1994-95.

The slow growth of the Mexican economy during the initial phase of liberalization was accompanied by a tightening of the external constraint, but not for the reason found in many earlier studies. According to all our estimates for final goods (Table 2) and the first difference estimates for intermediate goods (Table 3), the income elasticities of import demand increased in 1975, more than a decade before trade was liberalized. Rather, the reasons for the decline in the BOP-equilibrium growth rate in Phase III (post-1987) were the continued rise in the *proportion* of intermediate imports in total imports, which lessened the gains from the acceleration of export growth, coupled with the appreciation of the peso (when RER effects are included) and a strong deceleration of non-manufactured export growth. Given that a BOP and currency crisis ensued a year after this period ended, it seems likely that the country was in fact operating beyond its BOP constraint, especially when RER effects are taken into account.³⁴

Phase IV, which begins when NAFTA went into effect in 1994, shows an abrupt reversal in the relationship between actual growth and the BOP-equilibrium rate. While the latter jumped up to somewhere between 6.1% and 7.6% according to the structural estimates and nearly 5% according to the reduced-form estimates, actual growth remained sluggish at 3.5% per year. The

³⁴ It should also be noted that net capital inflows were larger (as a percentage of GDP) during this period than in any other phase (see Table 1), and these undoubtedly permitted relatively faster growth in the short run than would otherwise have occurred, while laying the foundations for the subsequent crisis in 1994-95.

increase in the BOP-equilibrium growth rate mainly reflected the accelerated growth of both non-manufactured exports and U.S. GDP in 1994-2000. Including RER effects makes practically no difference for the BOP-equilibrium growth rate in this phase, because of both the relatively small change in the RER over this whole period³⁵ and the significant reduction in the EML effect (to be discussed below). In this phase, there is no evidence of a possible tightening of the BOP constraint that could explain the slow growth of the Mexican economy.³⁶ Of course, it did not help that Mexico began the post-NAFTA period with a currency crisis that led to a 6% drop in GDP in 1995, but even after the recovery the country did not achieve the kind of rapid, sustained growth that had been widely anticipated during the euphoria in the lead-up to NAFTA.

Finally, in Phase V (2001-12), the actual average GDP growth rate fell to about 2.0% from 3.5% in the previous phase. In this last phase, the actual growth rate was close to the BOP-equilibrium rate, which decreased sharply in all of the estimates shown in Table 6. The fact that these estimates are all close to each other and to actual growth is consistent with the relative stability of the RER during this period. As expected, Figure 2 shows that the trade deficit was small and stable during this phase.³⁷ The decrease in the BOP-equilibrium growth rate during Phase V is explained mainly by two negative external shocks: first, a large fall in average U.S. GDP growth, and second, the China effect, which is captured by the downward shift in the time

³⁵ Of course, the peso depreciated sharply at the beginning of this period in 1994-95, but it subsequently rebounded until by 2000 it was nearly back to its 1994 value (see Figure 1).

³⁶ Our results for this period most resemble the finding in Blecker and Ibarra (2013) that Mexico grew below its BOP-constrained growth rate in the entire post-liberalization period (1987-2006 in that study), but in the present estimates it appears that this was only true in the immediate post-NAFTA years (1994-2000).

³⁷ Also, the gap between the trade and the current account balances shrank notably (and even reversed sign) during this phase. This reflects both a reduction in net factor income payments and a notable increase in remittances, which more than doubled as a percentage of GDP (from 1.01 to 2.13%) between Phases IV and V (see Table 1). Thus the BOP restriction on the economy's growth could have been even worse during Phase V, if it were not for the increased inflows of remittances.

trend in the manufactured export equation after 2001³⁸ (except when manufactured exports are treated as exogenous, both of these factors are captured by the slower growth of those exports).

6.2 The extended Marshall-Lerner effect

All the estimates of the EML effect, from all three models (as shown in the first column of Table 6), are similar in magnitude (about 0.7 to 0.9) for the entire sample period, thus indicating that the EML condition is easily satisfied. However, some of the underlying equations for the entire sample period were not statistically adequate or had some insignificant coefficients, and these estimates also ignore structural changes in the Mexican economy and policy regime that were found to be significant, so this full-sample result should be taken with great caution.

Indeed, all the estimates for Phases I-V show that the EML effect diminished notably at some point between 1975 and 1994,³⁹ although the calculations do not agree on exactly when the effect decreased or by how much. The differences, which can be seen in the bottom rows of Table 6, are partly a result of the different timing of the structural breaks in the underlying estimated equations from Tables 2-5, as well as the fact that the changes in the shares (of manufactured exports and intermediate imports in their respective totals) are entered explicitly into the calculations based on the structural model but are only implicit in the estimated elasticities derived from the reduced form trade balance model.

³⁸ Admittedly the use of a shift in the time trend to capture the China effect is not entirely satisfactory. However, our inference that the dummy for the 2001-12 period reflects the impact of China is supported by the literature (e.g., Gallagher et al., 2008; Hanson and Robertson, 2009; Feenstra and Kee, 2009) that has found micro-level evidence for Chinese exports displacing Mexican exports around that time. Our bilateral Mexican-U.S. RER does not include the Chinese exchange rate, and even the multilateral indexes we tried in sensitivity tests (see above) do not adequately capture the importance of China in the most recent period. It might be thought that the entry of China would change some of the other elasticities (RER or U.S. GDP) in the manufactured export equation, but we tested for this using slope dummies for 2001-12 and found no statistically significant results. See also note [45] below.

³⁹ This finding is broadly consistent with a number of previous studies that found diminished RER effects at some point after Mexico's liberalization process, as cited in section 2 above. However, the present study is the first to show that the RER elasticities decreased only for intermediate imports and manufactured exports, and that the overall Marshall-Lerner effect was influenced by the changing shares of these types of goods in total trade.

In the structural model estimated by bounds testing, the EML effect drops from 0.78 in Phase I to a lower but still positive level (between 0.29 and 0.37) in the later phases. In contrast, the structural model estimated in first differences shows that the EML effect started out higher and then diminished even further in a series of gradual steps, falling from 1.15 in Phase I to 0.64 in Phase II, 0.38 in Phase III, and eventually negative levels (-0.12 to -0.19) in Phases IV-V. If these last estimates are correct, Mexico has not satisfied the EML condition since 1994. However, in the reduced-form trade balance estimates the EML effect falls only after 1994, and only to 0.37 in the last two phases, thus indicating continued satisfaction of the EML condition.

All of these results, regardless of the exact dates or magnitudes found for the decrease in the EML effect, have the ironic implication that variations in the RER had a larger impact on the trade balance and the BOP-equilibrium growth rate before trade liberalization and NAFTA.⁴⁰ Most likely, the diminishing benefits of real peso depreciation for Mexico's trade balance and BOP-equilibrium growth rate stem from the greater integration of the nation's manufacturing industries into North American and global supply chains as well as the increasing technological sophistication of Mexico's manufactured exports (Blecker, 2014). In addition, the diminished EML effect also reflects the reduced share of final imports in total imports, given our finding that the RER elasticity is higher for final imports than for intermediate imports.

7. Conclusions

This paper has employed the BPCG model less as a means of predicting Mexico's long-

⁴⁰ We tested for the sensitivity of this result to the use of a multilateral RER index instead of the bilateral peso-dollar index, and the results for structural breaks were qualitatively similar. However, in estimates that are not presented here for reasons of space, we also found evidence that Mexico's manufactured exports became sensitive to the U.S. multilateral RER (after Mexico's trade liberalization) and the bilateral Mexican-Chinese RER (after China joined the WTO). Samples of all these results can be found in the unpublished statistical appendix.

run average growth rate and more as a vehicle for specifying an external constraint that may or may not be binding during specific phases in the evolution of the country's economy. This approach was adopted because of the strong empirical evidence for structural shifts that make it impossible to estimate a constant set of elasticities that are valid for the entire sample period 1960-2012. Indeed, our empirical analysis led to the identification of four clear moments of structural breaks in 1975, 1987, 1994, and 2001, and five correspondingly distinct phases. These phases are closely related to the presence of structural change—which is understood, similar to previous studies, as consisting of shifts in the composition of exports and imports, and also in the trade elasticities. Hopefully, by controlling for these breaks, we have been able to obtain more statistically valid estimates of the income and RER elasticities of import and export demand than are found in studies that ignore such breaks, or which allow them only in a single year.

A range of alternative estimates shows that the relationship between actual growth and BOP-equilibrium growth changed notably across the five phases. One important implication is that the BOP constraint cannot explain the slow growth of the Mexican economy during the entire period since trade liberalization in the late 1980s. Especially, the economy grew significantly below the BOP-equilibrium rate during the immediate post-NAFTA years (1994-2000), in spite of booming exports at that time. In periods when the BOP-equilibrium growth rate did decline and (at least according to some estimates) approximated the actual growth rate, the decreases in the equilibrium rate were caused by factors other than the rise in the income elasticity of import demand emphasized in some earlier studies. Rather, the declines in the BOP-equilibrium growth rate in those periods were caused by factors such as the rising share of intermediate imports in total imports, slower growth of non-manufactured exports, and real appreciation of the peso in 1987-93, and by slower growth of the U.S. economy and increasing

competition from Chinese exports (both of which resulted in slower growth of manufactured exports) in 2001-12.

In regard to the RER, our results (subject to the previously stated qualifications about possible estimation biases) suggest caution in the advocacy of peso depreciation as a strategy for improving the trade balance or relieving BOP constraints. Our estimates show that the EML effect fell sharply, and depending on the specific method and set of estimates may or may not be satisfied, in the post-NAFTA period. Even the estimates which show that the EML effect is still positive suggest that real depreciation would bring only modest gains in the trade balance. Although peso depreciation would significantly reduce demand for final imports, the gains for the trade balance are muted by the fact that manufactured exports are largely assembled using imported inputs. Our estimates show that for every 10% increase in exports of manufactures, intermediate imports rise by about 6-7%, thereby negating most of the potential gains in domestic value added and employment even if such exports increase.

Our finding that Mexico only barely (if at all) satisfies the EML condition in recent years is consistent with the assumption in the BPCG model that most of the adjustment to BOP equilibrium must come through changes in output growth rather than in the RER. Nevertheless, the analysis in this paper suggests an asymmetry in the application of the BOP constraint to the determination of the actual growth rate, depending on whether the BOP-equilibrium rate rises above or falls below actual growth. On the one hand, a sufficiently sharp fall in the BOP-equilibrium growth rate may lead to a decline in actual growth, as expected, because the external constraint may become more binding, as exemplified by the double shock of intensified Chinese competition and slower U.S. growth after 2001. On the other hand, an increase in the BOP-equilibrium growth rate may not lead to an increase in actual growth if other restrictions on

growth become more important, as seems to have characterized the situation in Mexico in the immediate post-NAFTA years. In other words, although it may not be sustainable for an economy to grow faster than its BOP-constrained rate, it may be quite possible for an economy to grow below its BOP-equilibrium rate for a sustained period of time.

Finally, it should be noted that our estimates of relatively low RER elasticities (and a relatively small EML effect) in recent decades are far from conclusive about the potential impact of RER depreciation on Mexico's long-run growth. By virtue of the way it is framed, the BPCG model implies that the BOP-equilibrium growth rate depends only on the rate of *change* of the RER, and not its level, which is why the theory discards the RER as a determinant of the long-run growth rate (because in the long run, the rate of change of the RER should be negligible if relative PPP holds, as is the case for our whole sample period). Another branch of literature, however, focuses more on the *level* of the RER and emphasizes that it is important for a low currency value to be maintained for a long period of time to yield significant growth benefits (see Gala, 2008; Rodrik, 2008; Berg et al. 2012; Rapetti et al. 2012). A sustained low level of the currency value (as opposed to a continuous depreciation) may yield growth benefits through other channels besides the trade balance, for example, by increasing profit margins in the tradable goods sector and thereby stimulating private investment (Ibarra 2008, 2011b, 2013). Thus, further research is still required to obtain a more complete perspective on how the RER affects the long-run growth of Mexico and other emerging market countries.

Appendix. Data sources and definitions

Bilateral Mexican-U.S. real exchange rate (RER): Calculated as the ratio of the U.S. consumer price index (CPI) to the Mexican CPI, multiplied by the nominal peso-dollar exchange rate. Sources: U.S. Bureau of Labor Statistics (BLS) for the U.S. consumer price index, the

IMF's International Financial Statistics for Mexico's CPI and nominal exchange rate from 1960 to 1967, and Bank of Mexico (BOM) for the same variables since 1968.

Mexican gross domestic product: In constant prices of 2003 for 1993-2012; pre-1993 data were based on constant prices of 1993 (for 1980-1992) and 1980 (for 1960-1979), and were spliced with the later data. Source: National accounts data from Mexico's Instituto Nacional de Estadística y Geografía (INEGI).

U.S. gross domestic product: In billions of chained 2005 dollars. Source: U.S. Bureau of Economic Analysis.

Mexican imports and exports: Imports of final goods are the sum of imports of consumption and capital goods; both imports of intermediate goods and exports of manufactures include the respective components from the maquiladora sector (see below); non-manufactured exports were calculated as the difference between total exports of goods and manufactured exports. The original BOP data, in current U.S. dollars, were deflated with the general U.S. PPI for industrial commodities. Source: BOM for trade data and BLS for the price index.

Maquiladora exports and imports: Since 2007, data are no longer reported separately for the maquiladora sector. For 1980-2006, Mexico reported export and import data including maquiladoras, although data for maquiladora exports and imports were also reported separately. For the years prior to 1980, we were not able to find data for the gross value of maquiladora exports or imports, but Mexico did include a line for services of transformation (i.e., maquiladora value added) as a credit item in the current account of the balance of payments (data from BOM). For 1969-1979, we used U.S. data for imports from Mexico under tariff sections 806.300 and 807.00 (from Grunwald, 1985, p. 148, Table 4-6) for maquiladora exports (assuming that virtually all maquiladora exports were sold in the United States in those years), and then subtracted maquiladora value added to get maquiladora imports (value added for 1979 was interpolated). For 1966-1968, we assumed that maquiladora exports were in the same ratio to value added as the average for 1969-1970 (2.76), and then subtracted value added from exports to get imports. We could not find any data on maquiladora value added for 1965, the year when the maquiladora program was enacted by the Mexican government, so we assumed that maquiladora exports and imports were zero in that year (if this is not accurate, the number for 1966 is so low that it must have been negligible in 1965). All these data were measured in US dollars and converted to real terms using the U.S. PPI for industrial commodities.

Mexican balance of payments: Other BOP data in current U.S. dollars (except for the exports and imports discussed above) were converted to percentages of GDP (as shown in Table 1 and Figure 2), where GDP in nominal Mexican pesos was converted to U.S. dollars using the market peso-dollar exchange rate. Sources: Original BOP data from BOM; GDP in current pesos from World Bank, *World Development Indicators*, for 1960-1979, and INEGI for 1980-2012; and exchange rates from the same sources reported above for the calculation of the bilateral RER.

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Table 1. Descriptive statistics by time period

Period (Phase) and Years	Whole sample 1960-2012	I. Stabilizing and shared development 1960-1974	II. Recurrent crises and oil boom-bust 1975-1986	III. Initial liberalization and macro stabilization 1987-1993	IV. NAFTA, peso crisis, and recovery 1994-2000	V. China- WTO and stabilizing stagnation 2001-2012
<u>Average annual growth rates (in percent):</u>						
<i>Real GDP</i>						
Mexico (y)	3.99	6.34	3.87	3.08	3.54	1.97
United States (y^*)	3.01	3.81	3.09	2.64	3.93	1.60
<i>Mexican trade aggregates</i>						
Manufactured exports (x_n)	11.64	18.24	8.17	14.08	16.20	2.75
Non-manufactured exports ^a ($x_o + p_o^* - p^*$)	5.27	2.72	8.69	0.23	7.99	6.38
Imports of intermediate goods (m_i)	8.82	11.08	5.45	15.76	13.28	2.73
Imports of final goods (m_c)	5.81	8.24	-5.41	20.35	9.30	3.47
<u>Shares of Mexican exports and imports (in percent):</u>						
Share of manufactures in total exports (μ)	58.3	32.6	42.2	71.5	85.5	82.9
Share of intermediate goods in total imports (θ)	63.5	37.8	70.5	74.2	77.3	74.4
<u>Bilateral real exchange rate (RER)</u>						
Average level (index, 1996 = 100)	85.8	82.8	89.1	94.0	89.0	79.7
Average rate of change ($e + p^* - p$) (in percent)	-0.10	-1.46	4.89	-7.89	0.62	0.73
<u>Balance of payments (in percent of GDP):</u>						
Current account balance	-2.02	-2.41	-1.77	-2.49	-2.44	-1.26
Trade balance (goods and services)	-0.90	-1.86	0.85	-0.71	-0.74	-1.64
Merchandise trade balance	-0.31	-1.15	1.33	-0.33	-0.50	-0.79
Net factor income	-2.15	-1.07	-3.18	-2.72	-2.79	-1.79
Transfers from remittances ^b	0.93	0.43	0.42	0.77	1.01	2.13
Capital account balance ^c	2.50	2.54	1.96	3.21	2.86	2.37

Sources: See text and Appendix for sources and definitions of all variables.

Notes:

^a Includes terms-of-trade effects.

^b Other net transfers were very small percentages of GDP in all periods shown.

^c Includes errors and omissions.

Table 2. Estimated equations for imports of final goods

Estimation method	<u>Bounds testing estimates in log levels</u>			<u>OLS estimates in log first differences</u>		
	(2.1) ^a 1960-2012	(2.2) ^{b,c} 1960-2012	(2.3) ^b 1975-2012	(2.4) ^d 1960-2012	(2.5) ^d 1960-2012	(2.6) ^d 1975-2012
Equation						
Sample period	1960-2012	1960-2012	1975-2012	1960-2012	1960-2012	1975-2012
Speed of adjustment	-0.087	-0.782	-0.783			
Bilateral real exchange rate (RER) ^e	-1.30 (0.26)	-1.41 *** (0.00)	-1.35 *** (0.00)	-1.80 *** (0.00)	-1.72 *** (0.000)	-1.74 *** (0.00)
Mexican GDP (GDPMEX)	1.45 ** (0.04)	0.94 *** (0.00)	2.42 *** (0.00)	1.65 *** (0.00)	1.17 *** (0.001)	2.13 *** (0.00)
Dummy for 1975-2012×GDPMEX		1.46 *** (0.00)			0.96 * (0.051)	
Dummy for 1987-2012		-22.24 *** (0.00)	0.67 *** (0.00)			
Adjusted R^2	0.823	0.915	0.926	0.863	0.871	0.891
SEE	0.104	0.072	0.077	0.091	0.088	0.094
Durbin-Watson	1.872	1.966	2.090	1.910	2.191	2.093
<u>Bounds tests</u>						
<i>t</i> -test	-2.47 ^f	-8.92 ***	-8.12 ***			
<i>F</i> -test	2.84 ^{fg}	25.64 ***, +++	35.54 ***, +++			
<u>Diagnostics (<i>p</i>-values, for <i>F</i>-statistics where relevant)</u>						
Serial correlation (Breusch-Godfrey, 2 lags)	0.793	0.816	0.480	0.926	0.457	0.813
Normality (Jarque-Bera)	0.555	0.874	0.937	0.458	0.771	0.758
RESET (squared fitted values)	0.591	0.963	0.804	0.157	0.210	0.218
ARCH (2 lags)	0.822	0.987	0.865	0.846	0.702	0.609

Notes: Numbers in parentheses are *p*-values. Coefficients for the bounds testing estimates are long-run coefficients after model simplification. The constant was omitted due to a lack of statistical significance except as noted. Significance levels are as follows:

***, **, * indicate the 1%, 5%, 10% level, using asymptotic upper critical values from Pesaran et al. (2001) for bounds tests (*t*- and *F*-tests).

++, +, + indicate the 1%, 5%, 10% level, using small-sample upper critical values from Narayan (2005), for bounds *F*-test only.

^a Includes a year outlier dummy for 1975.

^b Includes a constant and intercept dummies for 1975-81, 1986, and 1987.

^c Also includes an intercept dummy for 1982-86.

^d Includes year outlier dummies for 1975, 1983, and 1986.

^e Sum of coefficients on current and one-year lag in columns (2.4) to (2.6).

^f Rejects the null only under the condition that all variables are $I(0)$, at 5% using asymptotical critical values from Pesaran et al. (2001).

^g Rejects the null only under the condition that all variables are $I(0)$, at 10% using small-sample ($n = 50$) critical values from Narayan (2005).

Table 3. Estimated equations for imports of intermediate goods

Estimation method	<u>Bounds testing estimates in log levels</u>		<u>OLS estimates in log first differences</u>		
	(3.1)	(3.2) ^a	(3.3) ^b	(3.4) ^c	(3.5) ^d
Equation	1960-2012	1975-2012	1960-2012	1960-2012	1975-2012
Sample period					
Speed of adjustment	-0.300	-0.664			
Bilateral real exchange rate (RER)	-0.56 [*] (0.098)	-0.66 ^{***} (0.00)	-0.84 ^{***} (0.00)	-0.92 ^{***} (0.00)	-0.80 ^{***} (0.00)
Mexican GDP (GDPMEX)	0.49 ^{**} (0.011)	0.52 ^{***} (0.00)	0.48 [*] (0.06)	0.51 ^{**} (0.03)	0.87 ^{***} (0.00)
Manufactured exports ^e	0.71 ^{***} (0.00)	0.70 ^{***} (0.00)	0.59 ^{***} (0.00)	0.61 ^{***} (0.00)	0.64 ^{***} (0.00)
Dummy for 1994-2012×RER				0.59 ^{***} (0.00)	0.56 ^{***} (0.00)
Adjusted <i>R</i> ²	0.763	0.883	0.836	0.855	0.924
SEE	0.071	0.054	0.059	0.056	0.043
Durbin-Watson	1.613	1.693	1.649	1.696	2.063
<u>Bounds tests</u>					
<i>t</i> -test	-3.84 ^{**}	-4.62 ^{***}			
<i>F</i> -test	4.42 ^{**,++}	6.83 ^{***,+++}			
<u>Diagnostics (<i>p</i>-values, for <i>F</i>-statistics where relevant)</u>					
Serial correlation (Breusch-Godfrey, 2 lags)	0.338	0.263	0.523	0.802	0.966
Normality (Jarque-Bera)	0.067 [*]	0.902	0.642	0.974	0.347
RESET (squared fitted values)	0.851	0.429	0.699 ^f	0.815	0.740
ARCH (2 lags)	0.590	0.338	0.570	0.683	0.428

Notes: Same as for Table 2, except as noted.

^a Includes outlier dummy for 1975-81.

^b Includes year outlier dummies for 1961, 1975, 1983, and 1995.

^c Includes year outlier dummies for 1961, 1975, and 1983.

^d Includes year outlier dummies for 1975, 1982, and 1983.

^e Sum of coefficients on current and one-year lag in columns (3.3) to (3.5).

^f The RESET for squared and cubed fitted values has a *p*-value of 0.04 for the *F*-statistic and 0.02 for the χ^2 .

Table 4. Estimated equations for exports of manufactured goods

Estimation method	Bounds testing estimates in log levels			OLS estimates in log first differences		
	(4.1) ^a 1960-2012	(4.2) 1960-2012	(4.3) ^b 1975-2012	(4.4) ^c 1960-2012	(4.5) ^d 1960-2012	(4.6) ^e 1975-2012
Sample period						
Speed of adjustment	-0.08	-0.19	-0.21			
Bilateral real exchange rate (RER) ^f	4.17*** (0.00)	0.36 (0.66)	1.05*** (0.01)	0.32** (0.025)	0.55*** (0.00)	0.55*** (0.00)
U.S. GDP (GDPUS)	3.35	1.48	4.79*** (0.00)	1.99*** (0.008)	1.41*** (0.009)	1.84*** (0.00)
Dummy for 1987-2012×RER ^f					-0.32* (0.07)	-0.32** (0.04)
Time trend ^g		0.08** (0.02)		0.05* (0.052)	0.18*** (0.00)	
Dummy for 1975-2012 ^h					-0.17*** (0.00)	
Dummy for 1987-2012 ^h					0.10*** (0.00)	0.094*** (0.00)
Dummy for 2001-2012 ^h		-0.02** (0.03)	-0.03*** (0.00)		-0.10*** (0.00)	-0.095*** (0.00)
Adjusted <i>R</i> ²	0.631	0.313	0.793	0.280	0.724	0.749
SEE	0.076	0.103	0.050	0.106	0.066	0.055
Durbin-Watson	1.703	1.809	1.994	1.882	2.181	1.909
<u>Bounds tests</u>						
<i>t</i> -test	-1.51	-1.97	-2.90			
<i>F</i> -test	4.988**	2.68	11.47***,+++			
<u>Diagnostics (p-values, for F-statistics where relevant)</u>						
Serial correlation (Breusch-Godfrey, 2 lags)	0.347	0.91	0.81	0.357	0.728	0.981
Normality (Jarque-Bera)	0.883	0.95	0.96	0.987	0.737	0.652
RESET (squared fitted values)	0.049**	0.78	0.49	0.137	0.056*	0.366
ARCH (2 lags)	0.698	0.11	0.89	0.344	0.596	0.607

Notes: Same as for table 2, except as noted.

^a Includes a constant and year outlier dummies for 1960, 1962, 1965, 1974, and 1985.

^b Includes a constant and a year outlier dummy for 1985.

^c Includes a year outlier dummy for 1960.

^d Includes year outlier dummies for 1960, 1962, 1965, 1967, and 1986.

^e Includes a year outlier dummy for 1986.

<Notes to Table 4 continue on the next page>

<Notes to Table 4 continued>

^f The one-year lag of RER was used in the regressions in log first differences (columns 4.4 to 4.6); current RER was never significant in these equations.

^g The time trend is measured by the constant in the regressions in log first differences.

^h Shift in the time trend in the bounds testing regressions; shift in the constant in the regressions in log first differences.

Table 5. Estimated equations for the trade balance ratio^a using OLS in first differences

Equation:	(5.1) 1960-2012	(5.2) 1960-2012	(5.3) ^b 1975-2012
Sample period:			
Constant (time trend)		0.03** (0.03)	
Bilateral real exchange rate (RER)	0.90*** (0.00)	1.12*** (0.00)	1.16*** (0.00)
Mexican GDP (GDPMEX)	-0.97*** (0.00)	-1.61*** (0.00)	-1.55*** (0.00)
U.S. GDP (GDPUS)	0.66 (0.13)	0.67* (0.09)	0.71* (0.07)
Dummy for 1994-2012×RER		-0.82*** (0.00)	-0.79*** (0.00)
Dummy for 1994-2012×GDPUS			0.82* (0.06)
Adjusted <i>R</i> ²	0.793	0.868	0.942
SEE	0.066	0.053	0.040
Durbin-Watson	1.916	1.947	1.828
<u>Diagnostics (<i>p</i>-values, for <i>F</i>-tests where relevant):</u>			
Serial correlation (Breusch-Godfrey, 2 lags)	0.344	0.377	0.761
Normality (Jarque-Bera)	0.994	0.183	0.775
RESET (squared fitted values)	0.624	0.481	0.450
ARCH (2 lags)	0.903	0.742	0.717

Notes: All variables were measured in first differences of natural logarithms. Numbers in parentheses are *p*-values. ***, **, * indicate significant at the 1%, 5%, 10% level. The constant was omitted due to a lack of significance, except where shown. All equations include outlier year dummies for 1983, 1985, and 1986, plus other dummies as noted.

^a Defined as $tb - (1-\mu)(p_{o,t}^* + x_{o,t} - p_t^*)$, i.e., the log difference of the ratio of total exports to total imports minus the share-weighted log difference of non-manufactured exports, which constrains the coefficient on the latter variable to be unity. See the discussion of equations (8a) and (8b) in the text.

^b Also includes outlier dummies for 1975 and 1993.

Table 6. Alternative calculations of BOP-equilibrium growth rates and extended Marshall-Lerner effects by time period

Period (Phase) and Years	Whole sample 1960-2012	I. Stabilizing and shared development 1960-1974	II. Recur- rent crises and oil boom-bust 1975-1986	III. Initial liberalization and macro stabilization 1987-1993	IV. NAFTA, peso crisis, and recovery 1994-2000	V. China- WTO and stabilizing stagnation 2001-2012
Actual growth rate of Mexican GDP y (in percent per year)	3.99	6.34	3.87	3.08	3.54	1.97
<u>BOP-equilibrium growth rate y_B (in percent per year), from:^{a,b}</u>						
<i>Bounds testing estimates of structural model in levels</i>						
Equation (6)	4.44	3.76	4.11	2.80	6.57	1.93
Equation (9)	4.20	3.44	3.67	2.51	7.44	2.61
Equation (5)	4.10	1.95	5.32	-0.06	7.63	2.85
<i>OLS estimates of structural model in first differences</i>						
Equation (6)	5.10	3.88	3.86	2.89	6.06	1.73
Equation (9)	4.99	4.39	3.91	2.92	6.19	1.79
Equation (5)	4.91	2.58	6.44	0.39	6.09	1.71
<i>OLS estimates of reduced form model of trade balance in first differences</i>						
Equation (9)	4.31	4.59	4.66	1.25	4.63	2.28
Equation (5)	4.22	3.57	8.32	-4.66	4.78	2.46
<u>Extended Marshall-Lerner (EML) effect, from:^{b,c}</u>						
Bounds testing estimates of structural model in levels	0.80	0.78	0.37	0.33	0.29	0.33
OLS estimates of structural model in first differences	0.67	1.15	0.64	0.38	-0.19	-0.12
OLS estimates of reduced form model of trade balance in first differences	0.90	1.12	1.16	1.16	0.37	0.37

Source: Authors' calculations.

Notes: Non-manufactured exports are treated as exogenous in all calculations.

^a Equation numbers refer to equations in the text as follows:

Equation (6): weak form of BPCG, excluding RER effects, all exports exogenous.

Equation (9): strong form of BPCG, excluding RER effects, manufactured exports endogenous.

Equation (5): most general form of BPCG, including RER effects, manufactured exports endogenous.

^b Parameters (elasticities and time trends) for the calculations were taken from the following columns in Tables 2 to 5:

Bounds testing estimates of structural model in levels: 1960-2012: 2.1, 3.1, 4.1; phase I: 2.2, 3.1, 4.2; phases II to V: 2.3, 3.2, 4.3.

OLS estimates of structural model in first differences: 1960-2012: 2.4, 3.3, 4.4; phase I: 2.5, 3.4, 4.5; phases II to V: 2.6, 3.5, 4.6.

OLS estimates of reduced form model of trade balance in first differences: 1960-2012: 5.1; phase I: 5.2; phases II to V: 5.3.

^c The EML effect is given by $[(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu]$.

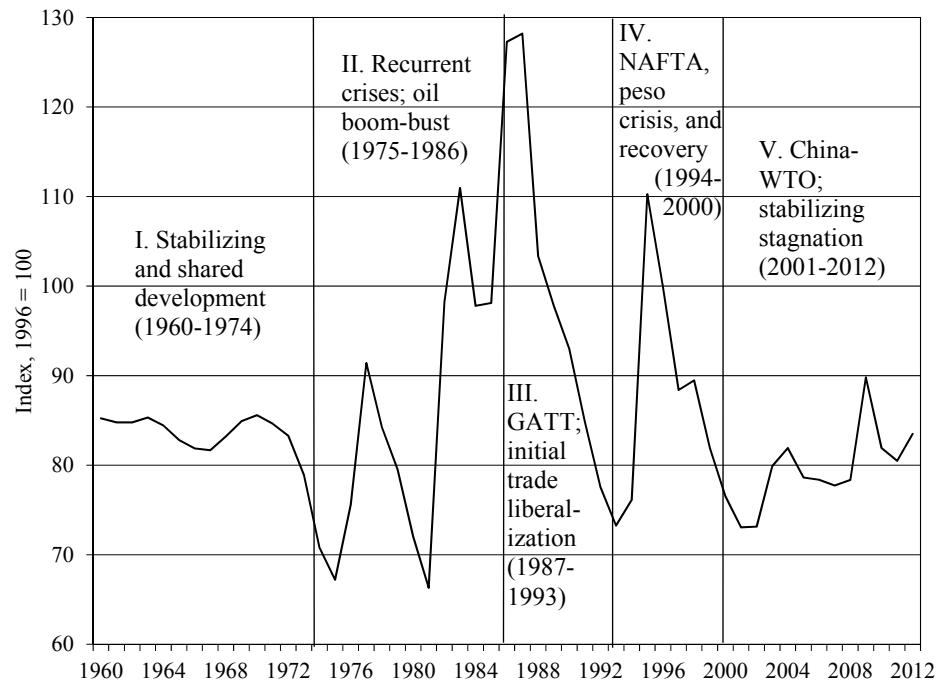


Figure 1. Bilateral Mexican-U.S. real exchange rate index (RER), 1960-2012

Source: Authors' calculations as specified in the Appendix.

Note: This index measures the relative price of foreign (U.S.) goods, so a higher number indicates a real depreciation of the peso.

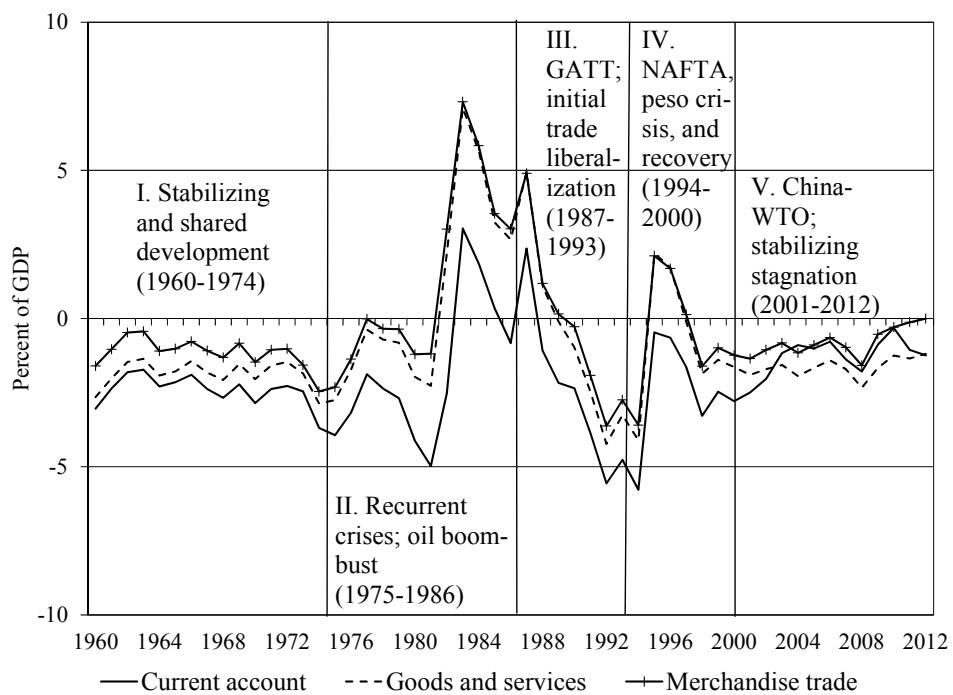


Figure 2. Current account, goods and services, and merchandise trade balances for Mexico, in percent of GDP, 1960-2012.

Sources: Authors' calculations as specified in the Appendix.