Structural Change, the Real Exchange Rate, and the Balance of Payments Constraint in Mexico

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ABSTRACT

This paper provides complete estimates of a model of balance-of-payments-constrained growth for Mexico, with disaggregated exports (manufactured and non-manufactured) and imports (final and intermediate goods), in which manufactured exports are treated as endogenous. Alternative estimations with and without real exchange rate effects included are provided, but most of the qualitative results do not depend on this distinction. Obtaining statistically adequate estimates of the import and export functions required us to take into account a variety of structural breaks, implying a division of our overall sample period (1960–2012) into four subperiods. Generally, our results imply that a tightening of the balance-of-payments constraint cannot account for the slowdown in Mexico's actual growth during the early phase of trade liberalization and macro stabilization policies (1987–2000), but a tightening of this constraint is consistent with the further slowdown in actual growth in the 2001–12 period.

Keywords: Mexican economy; balance-of-payments constraint; trade liberalization; real exchange rate

JEL classifications: F43, F14, E12, O24

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1. Introduction

The Mexican economy has certain unique features, including its close regional integration with Canada and the United States through the North American Free Trade Agreement (NAFTA), as well as its unusual combination of exports of relatively advanced manufactured goods along with crude oil and other primary commodities. Nevertheless, Mexico has also gone through a series of economic transformations that have, in many respects, paralleled those of other emerging market nations over the past several decades.[1] Mexico had a long period of rapid and stable growth under an import substitution regime from the 1950s through the early 1970s, followed by chronic balance of payments (BOP) deficits and repeated currency crises from the mid-1970s through the mid-1990s. The country began its opening to the global economy by establishing the maquiladora export processing industries in the late 1960s, later went through a boom-and-bust cycle based on exporting oil and borrowing recycled petrodollars in the late 1970s and 1980s, and finally embraced trade liberalization by joining the General Agreement on Tariffs and Trade (GATT) in 1986 followed by NAFTA in 1994. After the debt crisis of 1982-86 and the peso ("tequila") crisis of 1994-95, the government adopted a series of macroeconomic stabilization measures intended to avert future crises, and radically altered its monetary, fiscal, and exchange rate policies.

Throughout all of these transformations, one recurrent theme has been the extent to which Mexico's economic growth remains constrained (or driven) by external forces, shocks, and conditions. In the aftermath of the 1980s debt crisis, many studies evaluated the extent to which these could be attributed to external shocks as opposed to domestic policies (e.g., Zedillo, 1986;

[1] For more detail on these transformations, their causes, and their consequences, see Lustig (1998) and Moreno-Brid and Ros (2009).

Lustig and Ros, 1993). After trade liberalization and macro stabilization were adopted, many studies commented on the emerging conflict between these two policies, as the latter frequently led to an overvaluation of the peso which inhibited the export-led growth that the former was intended to promote, as well as to current account deficits that culminated in currency crises (e.g., Dornbusch and Werner, 1994; Blecker, 1996; Nadal, 2003; Ramírez de la O, 2004; Ros, 1995; Galindo and Ros, 2008). More recently, Blecker (2009) found that Mexico's short-run growth remained highly sensitive to fluctuations in four external variables (U.S. growth rates, net financial inflows, real oil prices, and the lagged real exchange rate) during its period of economic opening, with the first of these variables becoming statistically significant only post-NAFTA.

This paper follows in a stream of literature on external constraints that has employed the model of balance-of-payments-constrained growth (BPCG), originally developed by Thirlwall (1979) and first applied to Mexico by Moreno-Brid (1998).[2] In the most basic version of this model, the growth rate that is consistent with balanced trade in the long run (defined as a period in which relative price effects can be neglected, for reasons to be discussed later) equals the ratio of the growth rate of a country's exports to the income elasticity of its imports. Numerous empirical studies have found evidence that Mexico's BOP-equilibrium growth rate had actually decreased in the aftermath of the nation's trade liberalization (GATT or NAFTA), as a rise in the income elasticity of imports more than outweighed the gains in export growth (see Moreno-Brid, 1999, 2002; Guerrero de Lizardi (2003), López and Cruz, 2000; Pacheco-López and Thirlwall, 2004; Pacheco-López, 2005; Cardero and Galindo, 2005). This was a stunning result, given that the intention of the trade liberalization policies was precisely to overcome the external limitations of the import substitution era, in which a lack of export dynamism was widely seen as

[2] See McCombie and Thirlwall, eds. (2004) for later extensions and developments of the BPCG model.

making rapid growth unsustainable, and to promote a process of export-led growth in the aftermath of the "lost decade" of the debt crisis (Lustig, 1998).

More recently, several papers have (explicitly or implicitly) challenged this previous finding. Gouvea and Lima (2010) found evidence more consistent with a rise rather than a fall in Mexico's BOP-equilibrium growth rate in the 1990s and early 2000s, as Mexico's exports exhibited a shift toward more dynamic, high-technology industries similar to what was observed in the East Asian countries in that time period. Ibarra (2011a) and Blecker and Ibarra (2013) undermined the previous finding of a significant rise in the income elasticity of Mexico's import demand in the post-liberalization period by showing that this result does not hold for imports of intermediate goods (which constitute the vast majority of Mexico's imports) when manufactured exports are controlled for in a demand function for those imports.

Blecker and Ibarra (2013) also constructed an extended BPCG model that distinguishes four types of goods (exports of manufactured and non-manufactured goods; imports of intermediate and final goods), and found that the BOP-equilibrium growth rate for Mexico actually increased rather than decreased in the post-liberalization period (defined as 1987-2006). Blecker and Ibarra's analysis implied that a tightening of the BOP constraint could not be blamed for the post-liberalization slowdown in Mexican economic growth, which instead had to be attributed to other factors (such as internal constraints either on the demand side or the supply side, or both) that presumably held the actual average growth rate below the BOP-equilibrium rate.[3]

The present paper is intended to overcome certain limitations in Blecker and Ibarra (2013) and to push the analysis in several new directions. First, this paper uses an updated data

[3] A vast literature has debated the role of domestic supply- or demand-side factors and policies in explaining the slowdown in Mexico's economy growth since the liberalization of trade and the adoption of macro stabilization policies in the late 1980s. For a variety of perspectives see, among many others, Williamson (1997), Máttar, et al. (2003), Galindo and Ros (2008), Ibarra (2008, 2010), Walton and Levy, eds. (2009), Moreno-Brid and Ros (2009), Esquivel (2010), Hanson (2010), Kehoe and Ruhl (2010), Arias, et al. (2010), and Ros (2010, 2013a).

set including data up to 2012 (our previous paper used a sample period that ended in 2006 for reasons explained below). Second, and more importantly, this paper estimates a version of the BPCG model in which manufactured exports are treated as endogenous and the effects of changes in the real exchange rate (RER) are incorporated into the calculation of the BOP-equilibrium growth rate. Third, and most significantly, this paper finds that a simple division of the past six decades into pre- and post-liberalization periods (with a single structural break in 1987) is too simple, and that a statistically adequate analysis of the BOP constraint for Mexico requires us to identify four distinct subperiods that were structurally different in terms of how exports and imports were determined.

The four subperiods or phases and our preliminary results for each of them are as follows:

I. **Stabilizing and shared development**, import substitution (1960-74): Actual growth exceeded BOP-equilibrium growth, creating pressures toward current account deficits and peso devaluation that eventually made the import substitution regime unsustainable.

II. **Recurrent crises and oil boom-bust** (1975-86): As the short-term oil boom gave way to a multiyear debt crisis in the early 1980s, on average BOP-equilibrium growth in this period exceeded actual growth. Mexico was forced to suppress domestic demand in order to effect debt service payments to the creditor nations, while continued trade barriers inhibited the country's export potential from being realized even after the peso was devalued.

III. **Trade liberalization and macro stabilization** (1987-2000): Excluding RER effects, BOP-equilibrium growth increased and again exceed actual growth (which fell further), as the country failed to take full advantage of its export success during the liberalization era (this result parallels the previous finding of Blecker and Ibarra, 2013, for the "post-liberalization" period defined as 1987-2006). If RER effects are taken into account, BOP-equilibrium growth actually fell, but remained above actual growth.

IV. **China-WTO and "stabilizing stagnation"**[4] (2000-12): BOP-equilibrium growth almost exactly coincided with the (very slow) actual growth rate (both were around 2%), as the U.S. growth slowdown and rising Chinese competition took their toll on Mexican exports; this finding implies that Mexico could not have grown faster during this period without incurring rising current account deficits unless it found a way either to make its exports grow faster or else to reduce its appetite for imports.

It is important to note that the same qualitative results are found for each period regardless of whether RER effects are or are not taken into account in calculating the BOP-equilibrium growth rate, or, put another way, none of our main findings are sensitive to whether manufactured exports are treated as endogenous or exogenous, and whether the RER elasticities of the various types of imports and exports are or are not included in the calculation of the BOP-equilibrium growth rate. What does matter is taking into account as much as possible the profound structural changes that occurred in Mexico between these four periods, so as to be able to consistently estimate the changing relationship between BOP-equilibrium growth and actual growth during our entire sample period of 1960-2012. It should also be emphasized that the differences between the four subperiods do not result entirely from changes in the estimated coefficients (elasticities) in the functions for export or import demand, but also from the changes in the share of intermediate goods in total imports and manufactured goods in total exports reflecting the structural transformations of the Mexican economy and its international orientation alluded to earlier.

[4] This expression is from Esquivel (2010), who used it as an ironic twist on the "stabilizing development" label associated with the 1960s. Esquivel argued that the strict form of inflation targeting practiced by the Bank of Mexico during Phase IV contributed to the sluggish growth recorded during this period.

Before proceeding to the analysis, several caveats are in order. First, our interest in doing a long-term analysis of structural change in this paper has unfortunately meant that some of the data series we would like to be able to use are not available for our entire sample period of 1960-2012. For example, thus far we have only been able to find tariff rates for manufactured goods back to about 1989 for both Mexico and its leading trading partner, the United States. This means that we have had to rely on dummy variables to represent policy episodes or shifts (e.g., the relaxation of trade barriers) more than would ideally be desirable. Second, the econometric results in this paper are still preliminary. We have done extensive specification testing, but only using ordinary least squares (OLS) estimation. As described in Section 4, we have used a methodology called "bounds testing" to try to identify long-run relationships in the presence of variables with unit roots. Both this method and the use of lags helps to address concerns about endogeneity of some of the regressors, but we need to try instrumental variables and other procedures as sensitivity tests to make sure we have confidence in the results.

Third, 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 many recent studies have continued to use the model in this spirit (e.g., Razmi, 2005; Jeon, 2009; Gouvea and Lima, 2010; Halicioglu, 2012). Some recent articles 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. We do not expect our estimated BOP-equilibrium growth rates to match or "predict" actual growth during our four time periods, especially because one of the key assumptions of the BPCG framework (constancy of the RER) does not hold during most of these periods, and also because the model does not specify the mechanisms by which the actual GDP growth rate will adjust toward the BOP-equilibrium growth rate, particularly when other constraints, in addition to the balance of payments, may restrict actual growth. Instead, we use our estimates of BOP-equilibrium growth rates as benchmarks to determine whether the Mexican economy was operating above or below its BOP constraint in each time period. However, this means that a key test of the accuracy of our estimates will be whether the country was 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, and this analysis in turn can shed light on possible adjustment mechanisms for the Mexican case.[5]

The rest of the paper is organized as follows. Section 2 covers the recent literature in more depth and motivates the four time periods in greater detail. Section 3 presents the theoretical model. Section 4 discusses the data set and econometric methodology. Section 5 presents the econometric results, while section 6 analyzes the implications of these results for the BOP-equilibrium growth rate with and without RER effects included. Section 7 concludes. Appendix A (included below) details data sources and definitions, while Appendix B (available in a separate document from the authors) presents additional econometric estimates.

2. Key recent studies and time periods for the present analysis

Using a multisectoral version of the BPCG model developed earlier by Araujo and Lima (2007), Gouvea and Lima (2010) found results consistent with an increase rather than a decrease

[5] We are indebted to Kirk Elwood of James Madison University for suggesting this point.

in Mexico's balance-of-payments (BOP) equilibrium growth rate in the 1990s and early 2000s. Specifically, they found that Mexico's ratio of the weighted income elasticities of exports to the weighted income elasticities of imports increased after its trade liberalization, implying a relaxing rather than a tightening 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 the country's strong demand for imports of intermediate goods for assembly had lessened the growth benefits of the export growth. The drawbacks of Mexico's heavy reliance on imports of intermediate goods for the country's development and employment objectives had been noted by many earlier analysts (for example, Ruiz-Nápoles, 2004; Moreno-Brid, et al., 2005), but none of these authors had explicitly incorporated those imports into a BPCG model.

Ibarra (2011a) addressed the links between exports of manufactures and imports of intermediate goods in an econometric study. He found that manufactured exports were a significant variable in explaining intermediate imports, and that once the former were controlled for in a function for the latter, 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 period of 1960-2006). This result was confirmed by Blecker and Ibarra (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. Blecker and Ibarra (2013) found that there was a statistically significant increase in the income elasticity of demand for final imports (i.e., consumption and capital goods), but not for imports of intermediate goods which comprise the vast majority of Mexico's imports. In effect, Ibarra (2011a) and Blecker and Ibarra (2013) showed that previous estimates of a rise in the income elasticity for imports were based on improper aggregation of two different types of imports that behave very differently into a single import equation, as well as biased by the exclusion of manufactured exports as an explanatory variable.

Blecker and Ibarra (2013) then constructed an extended BPCG model that included two different types of exports (manufactured and primary products) as well as the two types of imports (intermediate and final goods). They solved for a BOP-equilibrium growth rate that was a function of the shares of the various types of exports and imports in their respective totals, as well as the estimated elasticities from the two import demand functions and the growth rates of the two types of exports (including terms-of-trade effects for the primary commodity exports). Their estimates showed that Mexico's BOP-equilibrium growth rate had actually increased after trade liberalization (defined again as beginning in 1987), even taking the role of intermediate imports into account. According to these estimates, although the high elasticity of intermediate imports with respect to manufactured exports did diminish the growth benefits of the rapid growth in the latter, it was not enough to eliminate the gains from the increase in the share of manufactures in total exports at a time when manufactured exports were growing more rapidly than other exports.[6] Similarly, the rising share of intermediate imports in total imports also diminished, but did not completely offset, the gains from the higher weight on the more rapidly growing manufactured exports—and, paradoxically, the higher share of intermediate imports helped to lower the weighted average of the income elasticities of import demand, given that the domestic income elasticity is much lower for intermediate imports than for final imports.

The analysis in Blecker and Ibarra (2013) was subject to certain limitations. First, they

[6] Note that, in the data set of Blecker and Ibarra (2013), the growth rate of manufactured exports was not actually higher in the post-liberalization period (1987-2006) compared with the pre-liberalization period (1960-86)—in fact this growth rate fell slightly in the later period—but in both periods this growth rate far exceeded the growth rate of non-manufactured exports, so the rising share of manufactures in total exports tended to boost the BOP-equilibrium growth rate (as will become clear from the model presented in section 3, below).

estimated a version of the BPCG model which assumes long-run relative purchasing power parity (PPP), i.e., a constant real exchange rate (RER) in the long run, so that export growth could be treated as exogenous and only the import demand functions had to be estimated. Nevertheless, their own data showed that Mexico's RER varied notably during their two subperiods (pre-liberalization 1960-86 and post-liberalization 1987-2006), which raises the question of whether their results would be modified or even overturned if they incorporated RER effects into the analysis (which in turn would require treating manufactured exports as endogenous).[7] Second, they used a data set that ended in 2006, thus omitting information from the most recent years. This was motivated by the fact that separate data for the maquiladora sector are not available after 2006, so using a sample period that ended in that year allowed the authors to compare their results both including and excluding maquiladoras in the aggregate trade data as a sensitivity test. However, using information from the period since 2007, when Mexico was faced with the continuing challenge of Chinese competition in the U.S. market and the new challenge of a financial crisis and sharp recession in its leading trading partner, can result in better estimates of the extended BPCG model for the entire post-liberalization period.

When we began our work for this paper, we intended simply to extend our data set to 2012 and estimate a demand function for manufactured exports so that we could estimate BOP-equilibrium growth rates with RER effects included for the pre- and post-liberalization periods. However, both the inclusion of the newer data and our work on the manufactured export function, as well as further consideration of the import functions, led us to reexamine the subperiods

[7] RER was not absent from the analysis, in the sense that the estimated demand functions for imports of final and intermediate goods included RER as one of the explanatory variables. Including RER was necessary to correctly estimate the income and manufactured-export elasticities of imports that went into the BOP-equilibrium growth formula. Rather, what is meant is that elasticities of the two types of imports with respect to the RER were not included in that formula on the assumption of relative purchasing power parity (PPP), which implies that the RER does not change. See section 3 below for this formula with and without RER elasticities included.

used in our analysis. We began to realize that dividing all the data for 1960-2012 into only two subperiods, before and after trade liberalization (dated at 1987), was too simple, and in some cases did not yield statistically adequate econometric estimates (as detailed further below). We found it necessary instead to distinguish two additional major break points in our data, so that we ended up with the following four subperiods or phases:

I. *Stabilizing and shared development* (1960-74).[8] These were among the most successful years of import substitution policies and growth oriented toward the domestic market. Mexico had a fixed nominal peg of 12.50 pesos per U.S. dollar, which remained in effect during this entire period (in fact, it lasted from 1954 to 1975). The gross domestic product (GDP) grew rapidly (averaging 6.3% per year—see Figure 1) 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 increase toward the end of this period, leading into the next phase.

II. *Recurrent crises and oil boom-bust* (1975-1986). BOP and currency crises with maxi-devaluations 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 the U.S. interest rate hikes and oil price volatility also played a key role. This was still pre-liberalization, but the Mexican economy began to open up in other ways—via oil exports, international borrowing, and further expansion of the maquiladoras. The chronic crises combined with the success of the export-led growth strategy in East Asia increased awareness in Mexico of the need to improve export performance, and some incentives were given for manufactured exports (Moreno-Brid and Ros, 2009, p. 126). Average growth slowed down (to 3.9%), however, as the repeated crises more than outweighed the brief (and unsustainable) oil boom and borrowing binge of 1978-81 (Figure 1).

III. *Trade liberalization and macro stabilization* (1987-2000). GATT tariff reductions were phased in and other trade barriers (e.g., license requirements) were removed beginning in 1987, and these measures were followed by the liberalization of FDI (around 1990), the privatization of state enterprises (various years), the formation of NAFTA (1994), and the creation of the World Trade Organization (WTO) as the successor to the GATT (1995). We did not find evidence for structural breaks in our import and export equations in 1994, so we do not treat NAFTA as initiating a separate time period.[9] This period was punctuated by one

[8] Of course, import substitution policies predated 1960—they originated in the 1940s—but they were explicitly pursued as a development strategy during our Phase I. The term "stabilizing development" was used during the administrations of Presidents Adolfo López-Mateos (1958-64) and Gustavo Díaz-Ordaz (1964-70) to characterize the economic strategy of the 1960s. President Luis Echeverría Álvarez (1970-76) called his new strategy "shared development" to emphasize his redistributive objectives, but he ended up creating the instability that led to the next phase.

[9] In fact, the regional integration of Mexico with the U.S. economy predated NAFTA and began to intensify during the early liberalization years. The U.S. share of Mexican exports rose from 69% in 1987 to 83% in 1993, and then increased further to 89% in 2000 (Blecker, 2010). Now it is back down to approximately 80% (Blecker and Esquivel, 2013). But the fastest increase in this share occurred in 1987-93, *not* 1994-2000.

major financial/currency crisis in 1994-95, which marked the failure of the first set of macro stabilization policies based on using the exchange rate as a nominal anchor for the price level. In the aftermath of this crisis, Mexico adopted a new approach to macro stabilization based on a floating exchange rate regime and disinflationary monetary and fiscal policies that would eventually lead to the formal adoption of inflation targeting by the Bank of Mexico in 2001 and a balanced budget law in 2006. In spite of the rapid growth of exports during this period (discussed in section 4 below), GDP growth fell further to an average annual rate of 3.3% in this phase (Figure 1).

IV. *China-WTO and stabilizing stagnation* (2001-2012). This period begins when China joined the WTO and received permanent normal trade relations (PNTR, or most-favored-nation) status in the United States. China surpassed Mexico as the largest source of U.S. non-petroleum imports in 2003, and many studies have confirmed that Chinese exports displaced Mexican exports in the U.S. market during this period (e.g., Gallagher et al., 2008; Hanson and Robertson, 2009; Feenstra and Kee, 2009). Mexico was also buffeted by the financial crisis and Great Recession that originated in the United States in 2008-9.[10] While during this period inflation finally became stationary and kept close to the Bank of Mexico's 3% target, Figure 2 shows that Mexico's average growth rate of only 2.0% was the lowest for a sample of 26 major emerging market nations. 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. market toward the end of this period, but it is still too soon to tell whether a new phase has begun.

3. Theoretical model

The model presented in this section is very similar to the one developed in Blecker and Ibarra (2013), so our discussion here can be brief. Like the previous version, this model incorporates two types of exports (manufactured and other goods) and two types of imports (intermediate goods and final goods). In this paper, we also include a time trend in the export equation, designed to reflect the relaxation of supply-side constraints and foreign protectionist barriers that are not otherwise captured in the model. All variables are expressed in growth rates

[10] Although all observers agree that the 2008-9 crisis in Mexico was completely external in origin, some analysts have argued that the severity of the domestic impact can be attributed at least partly to an inadequate countercyclical response of domestic fiscal and monetary policies. See Blecker (2011) and Ros (2011) on the severity of the crisis in Mexico and Ibarra (2013a) on its subsequent recovery.

(differences in natural logarithms) so that the coefficients can be interpreted as elasticities.[11] The implicit assumption of constant elasticities is made for convenience of econometric estimation, but we will test for structural breaks in the elasticities in the econometric estimates in section 4.

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

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

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 demand for manufactured exports, and λ is an exponential time trend (which becomes a constant term in an equation expressed in differences of natural logs).[12] The time trend is included to represent the effects of foreign trade barriers, global competitive conditions, and domestic supply constraints, which we were unable to measure directly in the econometric analysis.[13] Note that $e + p^* - p$ is the rate of change in the real exchange rate (RER) or rate of real depreciation of the home country currency. For simplicity, we assume that the real quantity of other exports (primary commodities, chiefly oil and agricultural products) grows at the exogenously given rate

[11] The equations in log differences can be derived from underlying equations that are multiplicative in levels (the so-called "Cobb-Douglas" functional form, in which the parameters are exponents) or linear in log levels (in which case the exponents are converted to coefficients). This correspondence will be used in some of the econometric estimates, as discussed below.

[12] This equation in log differences can be derived from an underlying demand function of the form $X_n = A\left(\frac{EP^*}{P}\right)^{\varepsilon_n} Y^{*\eta_n} e^{\lambda t}$, where the upper-case variables represent the levels, A is a constant, and t is time (time subscripts on the other variables are suppressed for simplicity). Note that exports are assumed to consist of the same goods as domestic output and hence sell at the same price. The demand functions for final and intermediate imports in growth rate form, given as equations (2) and (3) below, can be derived from analogous underlying equations in levels.

[13] See section 5.3 and Appendix B for discussions of the additional variables we have tried (or intend to try in future work) in the manufactured export functions.

x_o, while their price (denominated in foreign currency, i.e., US 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.

The demand function for intermediate goods (in growth rate form) is given by

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

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.[14] The inclusion of manufactured exports as a determinant of intermediate imports follows from the analysis in Ibarra (2011a) and Blecker and Ibarra (2013). The demand function for imports of final (consumption and capital) goods (also in growth rate form) is

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

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. This equation assumes that imports of final goods are not a function of manufactured exports, as shown previously by 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

[14] Note that the value of ϕ depends on two factors, which are not modeled here explicitly. On the one hand, it depends on the underlying elasticity of imports of intermediate goods for use in export industries with respect to the production of manufactured exports. On the other hand, it depends on the proportion of intermediate goods imports that are devoted to export production (as opposed to domestic production). In principle, it would be desirable to model these two factors explicitly, which would require specifying the supply side of the model for production of exported and domestic manufactured goods. However, the available data do not distinguish intermediate goods imports according to whether they are used in the production of exported or domestic goods (except for the maquiladora industries, where it can be presumed that all imports are used in export production). Thus, the model as specified here is congruent with the data available for econometric estimation for the Mexican case.

goods have the same prices, regardless of whether they are intermediate or final goods.

Assuming no capital flows or transfers for simplicity, the balance of payments equilibrium condition expressed in terms of foreign currency (US dollars) can be written (also in growth rate form) as

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

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:

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

$$+[(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1-\theta)\varepsilon_c - \mu](e + p^* - p)\}$$

which is the most general expression (under the above assumptions) for the BOP-equilibrium growth rate y_B. Note that the term in brackets [·] multiplying the rate of RER depreciation ($e + p^* - p$) has to be positive, i.e., $(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu > 0$, for a faster rate of real depreciation to increase the BOP-equilibrium growth rate y_B. This condition can be thought of as an extended Marshall-Lerner (EML) condition.[15]

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 $x_n = \eta_x y^* + \lambda$ when $e + p^* - p = 0$. Note that, if we are willing to assume long-run relative PPP, none of the coefficients in the manufactured

[15] Note that this condition is stronger (i.e., more difficult to satisfy) than the standard Marshall-Lerner condition, to the extent that the weight $(\mu - \phi\theta)$ on ε_n is less than unity, although it is weaker (i.e., easier to satisfy) to the extent that $\mu < 1$.

export function (1) are included in the solution BOP-equilibrium growth rate per equation (6). To calculate y_B in (6), we only need econometric estimates of equations (2) and (3) for imports of intermediate and final goods, respectively, in order to obtain estimates of the parameters ϕ, η_i, and η_c. All the other variables and parameters needed for the calculation of (6) can be obtained from the descriptive statistics. However, if we do not assume PPP and we allow for RER effects as discussed earlier, then we must use equation (5) to determine y_B and this requires econometric estimation of equation (1) for manufactured exports as well as equations (2) and (3) for the two types of imports in order to obtain estimates of all the necessary parameters (elasticities).

4. Data set and descriptive statistics

We begin by plotting our four main trade aggregates (manufactured and non-manufactured exports, final and intermediate imports) in Figure 3, which uses a logarithmic scale so that the slopes can be interpreted as growth rates. This figure will help to provide the rationale for the four phases of Mexico's transformation described earlier. Manufactured exports started from a very low base in 1960, when exports consisted principally of primary products, but grew rapidly until 2000 (except for a brief slowdown in the late 1970s and early 1980s), and then grew much more slowly from 2001 to 2012 (Phase IV). The slowdown in the late 1970s and early 1980s (during Phase II) corresponded to the period of recurrent BOP and currency crises, and included the oil boom of 1978-81 during which the peso became severely overvalued (see Figure 4) and presumably manufactured exports were crowded out to some extent by "Dutch Disease." The slowdown in Phase IV coincides with the time when China joined the WTO and achieved PNTR status in the United States; it also coincides with a period of generally slower growth in the U.S.

economy and globally, including the Great Recession of 2008-9 and the subsequent sluggish U.S. and global recovery (aptly dubbed the “Lesser Depression” by Krugman, 2011).

Exports of non-manufactured goods (primary products) constituted a majority of Mexico’s exports during the 1960s, but grew very slowly at that time and were briefly surpassed by manufactured exports in the early 1970s until the former surged ahead during the oil boom of the late 1970s. Note that we measure non-manufactured exports by taking their nominal value in U.S. dollars and deflating it by the U.S. PPI for industrial commodities, so this measure incorporates a terms-of-trade effect (essentially, it reflects the purchasing power of these exports over imports of industrial goods). Thus, their boom-and-bust cycle in the late 1970s and early 1980s includes the effects of the rise and subsequent fall in oil prices, as well as fluctuations in the quantity of oil exports. Non-manufactured exports were then sluggish in the late 1980s and 1990s (Phase III), but grew notably faster in 2001-2012 (Phase IV) as world prices of oil, food, and other primary commodities rose sharply until the 2008-9 crisis (and have partly recovered since then).

Imports of final goods have grown more slowly along a relatively constant long-run trend, but also exhibit much more cyclical volatility than either exports of manufactures or intermediate imports. Imports of final goods declined notably during the various crisis episodes, including 1975–76, 1982–83, and 1994–95, before resuming their upward track. The rapid growth of final imports in most of Phase III, except during the peso crisis of 1994–95, appears as a “catching-up” process from their fall in the previous decade, and can also be seen as a response to the initial phase of trade liberalization when import restrictions were dramatically reduced. Intermediate imports, in contrast, grew slowly during the 1960s but then accelerated their growth in the 1970s, except for cyclical downturns in 1975–76 and 1982–83. Starting in the late1980s, however, the behavior of intermediate imports changed dramatically, as they started to track manufactured *exports* very closely from about 1987 on. Of course, not all intermediate imports are used in export production, but a very substantial proportion are, and the two series follow each other remarkably closely from 1987 to 2012 (Phases III and IV).

In addition to the trade variables shown in Figure 3, the following other variables were used in the empirical analysis (see Appendix A for more details on sources and definitions). We used the bilateral Mexican-U.S. RER, with nominal exchange rates adjusted by relative consumer price indexes. This was the only measure of the RER that we could construct on a consistent basis back to 1960. However, sensitivity tests using the multilateral RER published by the Banco de México (which is only available since 1968) showed that very similar results were obtained using either RER measure in samples covering 1975-2012. For some of the manufactured export regressions, we tried additional RER measures that are described when they are introduced into the equations in section 4.3. We used Mexican and U.S. real GDP (referred to as GDPMEX and GDPUS in the tables below) for home and foreign income, respectively. The U.S. share of Mexico's exports ranged from about 70 to 90% during most of our sample period (Blecker, 2010), so there is no question that U.S. GDP captures the lion's share of Mexico's export markets. Nevertheless, in future revisions to this paper we plan to test broader measures of foreign income, such as export-weighted GDPs of major trading partners, as a sensitivity test.

Because our data are aggregate time series, we begin our statistical analysis by reporting the results of the unit root tests in Table 1. To ensure the robustness of the results, we use two alternative methods: the Phillips-Perron (PP) and Kwiatkowski-Phillips-Schmidt-Shinn (KPSS) tests. Note that the null hypothesis for PP is that the variable has a unit root, but the null for KPSS is stationarity, and all variables are measured in natural logarithms. The Mexican-U.S.

bilateral real exchange rate (RER) is stationary according to almost all tests, except the PP test in levels with a trend. The U.S. multilateral real exchange rate (RERUS), used in one regression below, has a unit root according to PP but is stationary in levels according to KPSS. Both Mexican and U.S. real GDP are anomalously stationary in levels according to PP (GDPMEX at 1% and GDPUS at 10%), but (more in line with expectations) they both have unit roots according to KPSS. All three trade variables (final imports IMPF, intermediate imports IMPI, and manufactured exports EXPM) have unit roots according to both tests (although there is evidence that they are trend stationary using KPSS). In general, there is enough evidence that most of the variables have unit roots that we cannot estimate ordinary regressions in levels. However, given that RER is clearly stationary in levels, the variables are not all integrated of the same order as would be required for most cointegration methods (e.g., Johansen tests).

Because in principle we would prefer to identify permanent, level effects (rather than transitory ones), our preferred method of estimation is the bounds testing approach proposed by Pesaran et al. (2001). This approach has several advantages over alternative methods such as Johansen's vector error correction model (VECM), including its good small-sample properties, the possibility of including variables with different orders of integration (one or zero), and the implicit solution to the potential problem of regressor endogeneity by carrying out the estimation within an autoregressive, distributed lag (ARDL) framework. On the other hand, the bounds testing approach can uncover only one long-run relationship between the variables, even if more than one could exist.

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

$$\Delta Trade_t = \sum_{j=1}^{q} a_j \Delta Trade_{t-j} + \sum_{i=1}^{k}\sum_{j=0}^{q} b_{i,j} \Delta Z_{i,t-j} + \sigma Trade_{t-1} + \sum_{i=1}^{k} d_i Z_{i,t-1} + d_0 \qquad (7)$$

where *Trade* stands for imports of either final or intermediate goods, or exports of manufactured goods, and there are k potential determinants Z (note that this includes the constant and any intercept dummies, if those are included in an equation). 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. The choice of number of lags for the variables in first difference is based on the Akaike criterion, but also depends on the need to pass a standard battery of diagnostic sets. Following these criteria, all the equations were estimated with one lag ($q = 1$).[16]

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 joint significance of σ and all the d_i coefficients. These test statistics do not have the usual t- or F-distributions, so we use the critical values provided by Pesaran et al. (2001). Each test has an upper and lower bound for each significance level, with critical values depending on the number of regressors. If either statistic (t or F) is above the upper bound for a given significance level, the null 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.[17] We use the asymptotic critical values from Pesaran et al. (2001) for both tests; Narayan (2005) calculated small-sample critical values for the F-test, so we use those also as a sensitivity test, but none of our main conclusions are sensitive to which critical values are used for the F-tests.

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[16] 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).

[17] Because σ must be negative, 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.

After an equation "passes" the *F* and *t* bounds tests (in the sense that these statistics are each above their respective upper-bound critical values at the 1, 5, or 10% level), thus allowing us to reject the null hypothesis of no long-run levels relationship, the lag structure of equation (7) can be simplified by removing the longest statistically insignificant lags of the first differences for each variable. Then, the long-run coefficients δ_i can be calculated from the estimated d_i coefficients on the lagged levels of the independent variables, after removal of the longest insignificant lagged differences, as $\delta_i = -d_i/\sigma$, leading to the long-run equation,

$$Trade_{LR} = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + ... + \delta_k Z_k \qquad (8)$$

Finally, we compared the estimated long-run values from (8) with the actual series (in log levels) for each dependent variable,[18] and when the long-run fits were poor we made adjustments to the underlying specification (for example, by introducing additional slope or intercept dummies for our various subperiods) and then re-did the entire procedure for the alternative equation.

In the event that some equations did not pass the bounds tests (i.e., the *t*- and/or *F*-statistics were consistently below the lower bounds at standard significance levels in various alternative specifications), given that most of our variables have unit roots, we proceeded to estimate the equations in first differences. Although differencing potentially loses information about long-run relationships, if the bounds tests fail to confirm the existence of a long-run relationship then effectively no information is lost, and estimation in first differences is clearly the correct procedure in that situation. Moreover, even for the equations that passed the bounds tests, we also estimated parallel equations in first differences as sensitivity tests to confirm the

[18] Note that the long-run estimated value is not the same as the fitted value from a regression of the form of equation (7), in which the dependent variable is expressed in (log) differences. Rather, the long-run estimated value is the predicted value of the (log) level of the dependent variable based on the long-run coefficients using equation (8).

robustness of our results.[19]

5. Regression results

5.1 Final imports

Following the bounds testing approach as explained above, we estimated demand functions for imports of final goods (hereafter referred to as "final imports") starting from the following specification:

$$\ln M_{c,t} = \alpha_c + \varepsilon_c \ln (E_t P_t^*/P_t) + \eta_c \ln Y_t + u_t \qquad (3')$$

where the upper-case letters represent the levels of the variables corresponding to the growth rates with the same letters in lower-case in equation (3), t indicates time (year), and u_t is a random error. In addition to estimating the value of the elasticities contained in (3´), we want to explore the possibility of shifts in the intercept and/or elasticities, by introducing appropriate dummy variables, either alone or interacted with output and the RER.

Column (2.1)[20] in Table 2 presents estimates of an import demand function for final goods for the full sample period 1960–2012, where the explanatory variables are the bilateral Mexican-U.S. RER and GDPMEX. In this initial specification, where we allow for no shift in either the intercept or elasticities, the estimation yields mixed results. The equation passes the diagnostic tests (after including an outlier dummy for 1975), while the size of the estimated elasticities seems reasonable and their signs are as expected. Thus, we obtain estimates of the elasticity of final imports of 1.45 with respect to income, and of –1.30 with respect to the real

[19] These additional estimates are contained in Appendix B, which is available from the authors on request.

[20] Hereafter, the numbers of the columns in the tables with regression results will also be referred to as the numbers of the estimated "equations."

exchange rate. On the other hand, however, the RER coefficient is not statistically significant, and the two bounds tests are in the intermediate range, that is, they reject the null of no long-run relationship only under the condition that all variables are integrated of order zero—which according to the unit root tests is unlikely to hold.

In view of these shortcomings, in a next step we allowed for shifts in both intercept and elasticities. Based on the approach in Blecker and Ibarra (2013) and Ibarra (2011a), we began by testing for possible shifts in the coefficients of the import functions by interacting a post-liberalization dummy that takes a value of one starting in 1987 with the coefficients on the RER and GDPMEX. The expected result was to find an increase in both elasticities post-liberalization, in the case of the RER because a freer trade environment suggests that firms and consumers can react more strongly to variations in relative prices, and in the case of GDPMEX because trade liberalization can be expected to increase the import intensity of domestic activity.

The results are shown in column (2.2) in Table 2. To pass the diagnostic tests, the equation includes year outlier dummies for 1975, 1986, 1987 and 1993.[21] The estimation yields seemingly satisfactory results. Both bounds tests amply support the existence of a long-run relationship, the speed of adjustment coefficient is relatively large and negatively signed (–0.30), and the estimated coefficients on GDPMEX and RER are signed as expected. Moreover, the equation shows the expected shifts in the elasticities of imports. In particular, the income elasticity (the coefficient on GDPMEX) increased from 1.21 before liberalization to 1.73 post-liberalization, while the RER elasticity (the coefficient on RER) was not statistically significant (and thus was removed from the equation) before liberalization but became significant, with an

[21] Coefficients on the year outlier dummies are not shown in the table for reasons of space. In addition, intercept shift dummies for 1960–1974 and 1975–1981, which as can be seen are not particularly significant in this equation, are included mainly to facilitate comparison with the following equations, as will be explained.

estimated value of –1.53, after liberalization.

A closer look at some of the properties of the estimated equation, however, raises doubts about whether the equation is actually well specified. Comparing the estimated level of final imports using the long-run coefficients from equation (2.1) with the actual level of imports, we found that the long-run fit of the equation presents serious shortcomings.[22] A look at the original series suggests some of these shortcomings stem from failing to find a significant RER coefficient in the early part of the sample. For this reason, the final import equation was reestimated without including a shift in the RER coefficient (see column 2.3 in Table 2). In this new specification it was found that the RER coefficient was large and could be estimated with great precision. Also, it was found that a significant shift in the GDPMEX coefficient took place in 1975, well before the liberalization of trade in the mid-1980s.

As can be seen in Figure 3, imports of final goods appear to have been abnormally low from the mid-1970s until the mid-1980s, except for a temporary surge during the oil boom of the late 1970s and early 1980s. After some exploration, it was found that the fit of the equation was improved greatly by introducing intercept shift dummies for 1960–1974 and 1975–1981 (the latter of which includes the spike during the oil boom). Given the introduction of these various intercept dummies into the equation, the constant, which has a large negative value, corresponds to the autonomous part of imports in the depressed period from 1982 to 1986.

Equation (2.3) amply passes the bounds tests for the existence of a long-run relationship and, compared with the previous equation, there is large increase in the absolute value of the

[22] The graphs showing the long-run estimated values are not included in this paper for reasons of space, but are available from the authors on request. There is a persistent, and relatively large, underprediction of imports in the early part of the sample, and in addition the estimated series shows spikes in the years corresponding to the outlier dummies. On the other hand, if the year outlier dummies are withdrawn, then the equation fails the tests for normally distributed residuals and absence of serial correlation. Also, equation (2.2) captures very imperfectly the wide swings in final imports observed from the mid-1970s to the early 1980s.

speed of adjustment coefficient, from –0.30 to –0.70. Equation (2.3) shows a significant RER coefficient for the entire estimation period, and a very large increase in the GDPMEX coefficient (more than doubling) starting in 1975. In this specification, the post-liberalization dummy is statistically significant, but as an intercept shift rather than as a shift in any of the slopes.

However, equation (2.3) fails the normality test for residuals, and there is a problem also with the RESET test when this includes squared and cubed fitted values. Some exploration showed that those problems were linked to abnormally large residuals in 1986 and 1987. Thus, in a final specification outlier dummies for those two years were included, leading to the results presented in column (2.4) of Table 2. The introduction of the outlier dummies greatly improves the results of all the diagnostic tests, while the bounds tests keep supporting the existence of a long-run relationship and the speed of adjustment coefficient increases (in absolute value) to –0.78. It can be verified that the equation has a very good fit in the long run.[23]

For our purposes, the main results from equation (2.4) are: a statistically significant elasticity of final imports with respect to the real exchange rate, with an estimated value of –1.41 for the entire estimation period; an increase in the elasticity of imports with respect to GDP, from 0.94 during Phase I (1960–1974) to 2.40 after that; and a permanent, one-time increase in the level of imports (but not their elasticity) after the liberalization of trade in the mid-1980s.

Although equation (2.4) provides results that can be considered satisfactory, it still underpredicts the level of imports in the early part of the sample period (Phase I). Thus, as a robustness test, we estimated similar equations for a reduced sample, starting in 1975 and ending, as in the previous estimations, in 2012. Basically the same specification that we last

[23] Equation (2.4) well captures the wide swings in the level of final imports from the mid-1970s to the mid-1980s. Also, in this case the introduction of the year outlier dummies does not result in spikes in the long-run predicted series, in contrast to the equation with shifts in the elasticities in 1987. Detailed graphs are available on request.

described was used, except of course excluding the intercept dummy for 1960–1974 and the interaction of that dummy with GDPMEX. The initial results are presented in equation (2.5), and after detecting possible equation misspecification according to the RESET test with squared and cubed fitted values, we included year outlier dummies for 1986 and 1987 (years of major policy shifts) resulting in equation (2.6), which passes all the diagnostic and bounds tests. Reassuringly, the estimated value for the elasticities of imports in this estimation for the reduced sample are very similar to those obtained in the original sample, with respect to both GDPMEX (2.42 in the reduced sample against 2.40 in the original one) and RER (−1.35 in the reduced sample against the original −1.41).[24]

5.2 Intermediate imports

In previous work (Blecker and Ibarra 2013, Ibarra 2011a) we have shown that, once we control for the level of manufactured exports in the demand function for intermediate imports, there is no increase in the "income" (GDPMEX) elasticity after the liberalization of trade in the mid-1980s. Thus, what an equation that does not control for exports detects as an increase in the income elasticity is, in fact, a reflection of the intensive use of intermediate imports in the production of manufactured exports in Mexico and the rising share of manufactured exports in the country's GDP in recent decades. In what follows we show that an equation for intermediate imports with no shifts in elasticities is able to track closely the actual evolution of intermediate imports for both sample periods, 1960–2012 and 1975–2012.

[24] As mentioned above, as a robustness test we estimated equations for final imports in first differences, with results that are broadly consistent with those obtained in the bounds testing regressions. The main differences, as can be seen in Appendix Table B.3, are that the equations in first difference show a larger RER elasticity (in absolute value) for 1960–2012 and a smaller income elasticity for 1975–2012, compared with the bounds testing estimates.

Table 3 shows the main results. Equation (3.1) begins with a specification in which imports of intermediate goods are a function of GDPMEX, RER, and Mexico's manufactured exports (EXPM), all in natural logs. This simple specification produces very good results, with bounds testing supporting the existence of a long-run relationship, and a negatively-signed speed of adjustment coefficient (although with a relatively small value of –0.30). The equation makes evident the close link of intermediate imports and manufactured exports in Mexico, with an export elasticity of imports of 0.71, which is larger than the income elasticity (0.49). The RER elasticity (estimated at –0.56) is statistically significant (at 10%), although notably smaller in absolute value than the corresponding elasticity for final imports.

A problem with the previous equation is that the Jarque-Bera test for normally distributed residuals has a low *p*-value of 0.07. A look at the original series, and at the level of imports predicted by the estimated long-run coefficients, showed two possible sources of problem: first, the equation underpredicted the actual level of imports from 1975 to 1981 (a period that includes the oil boom); and second, the RER was very stable during the 1960s (see Figure 4). This lack of variation could reduce the precision with which the RER coefficient in the import function can be estimated. To deal with these problems, we introduced two changes in the equation: first, we included an intercept shift dummy for the period 1975–1981; and second, we also included an interaction of RER with a dummy for the first decade of the estimation sample, 1960–1969.

The new results are presented in column (3.2) of Table 3. This equation shows some improvements over the original specification. There is an increase in the speed of adjustment coefficient (from –0.30 to –0.53), and the statistics for the bounds tests also show increases (all in absolute values). The existence of a long-run relationship is accepted now at 1% by the two bounds tests, while the long-run fit of the equation is now better. The elasticity of imports with respect to GDPMEX is estimated at 0.39, while the elasticity with respect to manufactured exports is 0.77; moreover, the RER elasticity is now –0.46 and is significant at the 5% level.

However, the long-run fit of the estimated equation is less satisfactory in the early part of the sample than afterwards (in this case, including an intercept dummy for 1960–1974 did not improve the long-run fit, unlike in the equation for final imports). Thus, as a robustness check we estimated the equation for intermediate imports for a reduced sample starting in 1975, similarly to what we did for final imports, and the results are presented in columns (3.3) and (3.4) of Table 3. As expected, the fit of the equation is slightly better for the reduced sample, in the sense of obtaining a larger speed of adjustment coefficient (in absolute value), as well as for the elasticities with respect to GDPMEX and RER, estimated at 0.52 and –0.66, respectively, in the final equation (3.4), which also includes a (statistically significant) intercept dummy for 1975–1981. Again, no shift related to trade liberalization is needed in the estimated elasticities to account in a satisfactory way for the evolution of imports of intermediate goods, once manufactured exports are included as a determinant of the level of imports.[25]

5.3 Manufactured exports

Estimating the demand function for manufactured exports (1), hereafter referred to as "the export function,"[26] proved to be much more difficult than estimating the demand functions for imports of either intermediate or final goods. We began by testing for the existence of a long-run relationship between the variables in the export function, as we did for the two types of

[25] Appendix Table B.4 presents results for intermediate import equations estimated in first differences. The results are again broadly consistent with those obtained with the bounds testing methodology, but the estimated RER elasticity for 1960–2012 (in absolute value) and the income elasticity for 1975–2012 are larger in the first-difference estimations.

[26] Recall that non-manufactured exports will be treated as exogenous, for the reasons explained earlier (section 3).

imports. For this purpose, we assumed a long-run relationship in log levels as follows:

$$\ln X_{n,t} = \alpha_n + \varepsilon_n \ln (E_t P_t^*/P_t) + \eta_n \ln Y_t^* + \lambda t + u_t \qquad (1')$$

where the upper-case letters represent the levels of the variables corresponding to the growth rates with the same letters in lower-case in equation (1), t indicates time (year), α_n is a constant, and u_t is a random error. Following the bounds testing methodology, we estimated equations of the general form of equation (7), where the time trend was included as one of the independent variables (Z) when it was significant.[27] In these estimates, we used U.S. GDP (GDPUS) for foreign income and the same bilateral RER index that we used for imports.

We tested a wide variety of alternative specifications of equation (1′), including various combinations of intercept and slope dummies to control for possible structural breaks at various times (such as liberalization in 1987, NAFTA in 1994, and the entry of China into the WTO in 2001), as well as inserting year outlier dummies where necessary to eliminate extremely large residuals and to try to pass various diagnostic tests. As discussed in more detail in Appendix B, we were unable to find any statistically reliable evidence for the existence of a long-run relationship of the general form (1′) in any of the specifications we tried. For the entire sample period 1960–2012, no equation we tried passed the bounds t-test, and no equation passed the bounds F-test (asymptotic or small sample) except for one equation that failed other diagnostic tests (serial correlation and RESET).[28] After noting that the equations showed particularly poor fits in Phase I (1960–74), when the residuals were very large and followed no evident pattern, we applied the bounds testing method to equations for the more limited sample period 1975–2012.

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[27] Unlike in a regression in which all the variables are differenced, in this model a time trend has to be included separately and is not represented by the intercept. However, note that a differenced time trend vanishes here so it is not included in the difference terms ΔZ_i; if a time trend is included in this model, it appears only in level form.

[28] In addition, all the equations we tried for 1960–2012 showed serious problems in the residuals (serial correlation or ARCH) or the equation specifications (significant RESET statistics), making statistical inference unreliable.

This eliminated the ARCH (suggesting that it arose from the large residuals for 1960–74) and generally made the residuals less problematic. However, the equations still failed to pass both bounds tests in the regressions for 1975–2012, and the long-run estimated values failed to give good fits to the actual data even for this shorter sample period.[29]

Given that both manufactured exports and U.S. GDP have unit roots and that we could not find statistically reliable evidence for the existence of a long-run relationship between these two variables and RER, we instead estimated the export function in first differences. Thus, we estimated the econometric counterpart of the export function (1) in growth rate form:

$$x_{n,t} = \varepsilon_n(e_t + p_t{}^* - p_t) + \eta_n y_t{}^* + \lambda + v_t \qquad (1'')$$

where v_t is a random error term, and the results are shown in Table 4. Column (4.1) shows our initial estimates for the full sample period, 1960–2012, with all variables in first differences and no structural breaks. The constant (time trend) was dropped because it was not significant when included. The estimated RER elasticity (with the RER lagged one year) is relatively low (0.36), while the estimated GDPUS elasticity is relatively high (3.53).[30] Although these estimated coefficients appear to be statistically significant, the hypothesis tests are not valid due to the failure of at least one diagnostic test (the RESET statistic is significant at the 5% level, indicating likely misspecification). Also, we are only able to reject the null hypothesis of no ARCH in the residuals at the 14% level, which is marginal. However, this is the best estimate we could come up with for the entire sample period without structural breaks.

Table 4 also shows an effort to estimate equation (1″) for the full sample period, 1960–

[29] For this period, some of the specifications we tried passed the *F*-test (both asymptotic and small sample) at the 5% or 1% level in statistically adequate models, but none of them passed the *t*-test (with one apparent exception, in which the *t*-test is invalidated by a RESET statistic with a *p*-value of 0.04 for squared fitted values).

[30] Most likely, the high GDPUS elasticity is picking up some of the effects of a time trend (i.e., long-term supply-side shifts and the relaxation of trade barriers); in later estimates discussed below, when a constant is included (because it is significant, once structural breaks are controlled for), the GDPUS elasticities are about half as large.

2012, with structural breaks, in column (4.2). In this equation, there is a positive constant of 0.09, and a negative intercept dummy of the same absolute value and opposite sign (–0.09) for Phase IV (2001–12), and both are significant at the 5% level. Because this equation is estimated in log differences, the intercept (estimated constant) represents an exponential time trend, and the intercept dummy represents a shift in that trend, so the implication is that manufactured exports grew by approximately 9% per year faster than can be explained by the other included variables in the model from 1960–2000, and then this underlying trend completely disappeared in 2001–12. The time trend up to 2000 probably reflects a combination of the relaxation of domestic supply constraints, the liberalization of foreign trade barriers (e.g., U.S. policies that facilitated the creation of the maquiladora sector), and Mexico's own liberalization policies (joining GATT and NAFTA, etc.), which permitted more FDI and greater access of domestic producers to imported intermediate and capital goods and up-to-date technology. In addition, this equation implies a modest RER elasticity of 0.37 (significant at the 5% level), with a one-year lag on the RER (the current value and longer lags were not significant), and a substantial foreign income elasticity of 1.65 (this is the sum of the coefficients on current and one-year lagged GDPUS, and is significant at the 10% level). However, this equation does not pass various diagnostic tests: the RESET statistic is significant at the 5% level indicating likely misspecification, and there is also significant ARCH in the residuals at the 5% level.

We tried many alternative specifications similar to (4.2) with dummies to test for other structural breaks (e.g., at the time of liberalization in 1987 or the inauguration of NAFTA in 1994), both separately (i.e., as intercept dummies) or interacted with the other variables (RER and GDPUS), but none of them were statistically significant, and none of them were able to eliminate the problematic aspects of the equation specification and residuals. We also tried additional lags of the independent variables, but these were generally insignificant.[31] Looking at the plots of the fitted values from equations (4.1) and (4.2) versus the actual data for Δ ln EXPM as well as plots of the residuals, it seems likely that the misspecification and ARCH may result from the inclusion of data for the 1960s and early 1970s. In those years, the fitted values (even in log differences) look almost like a trend drawn through the actual (log differenced) series, while the residuals are large and jagged, indicating that there is virtually no fit during that period. In contrast, starting around 1975 the fitted values tend to move up and down more in synchronization with the actual values of Δ ln EXPM, and the residuals are notably smaller.

To test whether 1975 would mark a structural break in the relationship, we first ran the regression shown in column (4.3) of Table 4, where we included a dummy variable for 1975–2012 both separately (as an intercept dummy) and interacted with GDPUS (as a slope dummy)—it was not significant when interacted with RER, so that interactive term was omitted. Furthermore, we found that GDPUS was not significant except when interacted with the 1975–2012 dummy, so plain GDPUS was omitted (essentially, GDPUS is not significant in 1960–74). There were no statistically significant breaks in the slope coefficients for later events (e.g. liberalization in 1987, NAFTA in 1994, or China-WTO in 2001) in this equation, so all such other interactions were omitted. Taken at face value, the estimated coefficients in equation (4.3) show a similar RER elasticity to equation (4.2) (0.33 vs. 0.37) and a slightly higher GDPUS elasticity (2.35 vs. 1.65). There is a positive constant, representing an upward time trend in 1960–74 (Phase I), a negative shift in the intercept at 1975 (indicating a slowdown in manufacturing export growth during Phase II), a positive shift at l987 (Phase III), and a negative shift in 2001 (Phase IV); a

[31] Also, the sums of the coefficients generally did not change much when additional lags of each variable were included, indicating that the additional lags added no explanatory power. The fact that additional lags are not helpful was confirmed by the Akaike and Schwartz information criteria (AIC and SIC).

NAFTA intercept dummy was not significant and was not included. Including these additional structural breaks improves the fit of equation (4.3) compared with equation (4.2) by standard criteria, such as adjusted R^2 and the regression standard error. However, the equation fails several diagnostic tests and hence all the hypothesis tests are invalid.[32] Again, inspection of the residuals shows them to be relatively large in the 1960–1974 period, and this appears to be the likely cause of these diagnostic failures.

Based on the evidence that the model does not fit well during the period 1960–1974 but has a tighter fit starting in 1975, we re-ran the model for the sample period 1975–2012, and the results of the best equation thus obtained are shown in column (4.4) of Table 4. In this equation, the constant is no longer significant and so was dropped, but there were statistically significant intercept shifts starting in 1987 and again in 2001. The former shift is positive (+0.094, rounded to 0.09 in the table) and significant at the 1% level, while the latter is negative (–0.95, rounded to –0.10) and significant also at the 1% level, indicating that the upward time trend in Phase III (1987–2000) was essentially eliminated in the following period (Phase IV).

Also in equation (4.4) in Table 4, the income (GDPUS) elasticity of demand for manufactured exports is estimated to be about 1.84 and is significant at the 1% level (in this regression, only the current level of GDPUS was significant and is included). The RER elasticity (with RER lagged one year, as before) is estimated to be 0.54 (significant at the 1% level) for the period 1975–86, but declines significantly after liberalization: the interactive dummy for 1987–2012 multiplied by RER has a coefficient of –0.31 (significant at the 5% level), which lowers the RER

[32] The null hypothesis of no ARCH in the residuals with 2 lags is rejected at the 10%, while the *p*-value for the Jarque-Bera test for normality is 0.15, indicating that the residuals are likely to be non-normally distributed. The RESET test with squared fitted values is significant at the 5% level, indicating likely equation misspecification.

elasticity post-liberalization to 0.23 (significant at the 2% level).[33] The reduction in this elasticity may reflect the close integration of industrial supply chains in the U.S. and Mexican economies after liberalization, as well as the upgrading of Mexican exports from labor-intensive manufactures to more technologically sophisticated ones. This equation passes all the diagnostic tests, indicating that the model is statistically adequate and that the hypothesis tests are valid.[34] Furthermore, although this equation was estimated in first differences, we found that it predicts the long-run trend of manufactured exports in log levels quite well in a dynamic simulation.[35]

A variety of other similar models were tried for the sample period 1975–2012, with additional lags and structural breaks (in either the intercept or the slopes), but none of the other structural breaks or additional lags in these experiments were statistically significant, and none of them improved on the results shown in column (4.4) of Table 4. In particular, a structural break for NAFTA (1994–2012) was never significant either as a slope or intercept dummy. However, some experiments with including additional independent variables showed some promise.

First, the increasingly tight integration of Mexican industries into North American supply chains (Robertson, 2007) suggests that, in addition to tracking U.S. GDP (since the U.S. is Mexico's main export market), Mexico's manufactured exports should also be influenced by the U.S. RER, because the value of the U.S. dollar affects the competitiveness of North American industry as a whole. Accordingly, we tested including a measure of the U.S. multilateral, trade-

[33] A NAFTA dummy (for 1994–2012) was also tried in this equation, both as an intercept dummy and as a slope dummy (interacted with RER and GDPUS), and was never significant.

[34] It was necessary to include a year outlier dummy for the crisis year of 1986 (with a coefficient not shown in the table) in order to achieve these diagnostic results.

[35] The long-run estimated level of manufactured exports (in natural logs) was calculated by adding the fitted value of Δ ln EXPM to the lagged estimated value of ln EXPM, using actual ln EXPM for the year preceding the sample period (1974) as the base for this dynamic simulation. The model slightly overpredicts the long-run level of ln EXPM during the period 2001–2011 (and misses the severity of the 2008–2009 downturn), but comes back very close to the actual level of EXPM in 2012. A graph comparing the long-run estimated value with the actual series for ln EXPM is available from the authors on request.

weighted RER[36] (RERUS) in the export function, and the results are reported in column (4.5) of Table 4. RERUS has a positive (+0.47) and significant (10% level) coefficient when interacted with a post-1987 liberalization dummy. This suggests that when the U.S. economy becomes more (less) competitive because the U.S. dollar has depreciated (appreciated) vis-à-vis other currencies, Mexican manufactured exports benefit (suffer). This may help to explain the dip in Mexico's export growth in the early 2000s, when the U.S. dollar was overvalued. All the other variables retain the same orders of magnitude and significance levels as in equation (4.4), thus giving us more confidence in the results, and simple measures of goodness of fit (adjusted R^2, standard error) show improvement. The equation also passes most of the diagnostic tests, but there is some evidence of misspecification according to the RESET test using squared and cubed fitted values (the F-statistic has a p-value of 0.13; the χ^2 has a p-value of 0.06).

Second, we tested the hypothesis of intensified Mexican-Chinese competition in the U.S. market in Phase IV by interacting our dummy variable for 2001–12 with a measure of the Mexican-Chinese real exchange rate (MEXCHNRER, defined so that a higher value represents a real depreciation of the peso relative to the renminbi—see Appendix A for details). We found that this variable has a positive coefficient and is statistically significant, but only with a longer lag than the other variables. The best results, which are shown in column (4.6) in Table 4, were obtained using the 3rd lag of MEXCHNRER, but similar results were obtained using the sum of 1-3 or 1-4 lags.[37] We presume that the longer lag on this variable is accounted for by the time needed to relocate industries between Mexico and China and to establish the necessary supply

[36] We defined RERUS the same way as we expressed RER for Mexico, so that an increase indicates a real depreciation (see Appendix A for details). The Mexican peso is included in RERUS, but it represents a relatively small share, and because Mexico's bilateral RER with the U.S. dollar is also included in the regression, only the effects of the dollar's exchange rate with other currencies should be reflected in the coefficient on RERUS.

[37] The highest AIC and SIC, in absolute values, were obtained using the 3rd lag instead of longer distributed lags.

chains for the relocated production in response to changes in relative costs between these two countries. Thus, the low value of the renminbi in the late 1990s and early 2000s helped to account for the sharp rise in Chinese exports (and slowdown in Mexican exports) to the U.S. market in the period from about 2001 to 2007, while the appreciation of the renminbi (due to both nominal revaluation and increasing wages in China) starting in 2005 began to have an impact in reviving Mexican exports (holding other factors constant) beginning around 2008. The other coefficient values do not change much when MEXCHNRER is included, all diagnostic tests are passed, and the indicators of equation fit are good.

Interestingly, we still get a negative and significant coefficient on the 2001–12 intercept dummy (representing a downward shift in the time trend), and with about the same magnitude, even when the RER with China and slower U.S. GDP growth are controlled for. This suggests that Mexican exports may have slowed down in Phase IV for reasons beyond the rise of Chinese competition or the slowdown in U.S. growth; perhaps by 2001 Mexico had essentially completed its adjustment to the elimination of most trade barriers with its major trading partners, and hence no additional gains in export growth from market opening per se could be expected.

6. The BOP-equilibrium growth rate with and without RER effects

In this section, we calculate the BOP-equilibrium growth rate for the Mexican economy, using the best estimates of the elasticities for each type of imports and exports from the previous section,[38] as well as the indicators of trade growth and composition discussed in section 4. We calculate the BOP-equilibrium growth rate for both the entire period 1960–2012 and the Phases I

[38] The specific regression equations from which the elasticities were taken for each set of calculations are indicated in note c to Table 5.

to IV identified earlier, and link the changes in this rate to indicators of structural change (that is, changes in trade composition and elasticities) and the possible influence of the RER. Our main interest lies in contrasting the evolution of the BOP-equilibrium growth rate with the actual growth of the Mexican economy, and in that way determining whether the observed deceleration of growth can be explained by a tightening of the external constraint.

The results are presented in Table 5, which shows (in the first few rows) the actual growth rate of Mexico's GDP compared with the calculated BOP-equilibrium growth rates—the latter calculated both including RER effects (using equation 5) and excluding them (equation 6). Beginning with the first column, we see that, over the entire period 1960–2012, the actual growth rate (3.99%) is similar to, although somewhat smaller than, the BOP-equilibrium growth rate; the difference is larger when the latter excludes RER effects (4.44%) than when it includes them (4.25%). However, because the estimated equations for imports of final goods and manufactured exports for the entire period have statistical shortcomings (as noted earlier), the precise calculated values of the BOP-equilibrium rate for 1960–2012 must be taken with caution. Nevertheless, it is interesting that our estimates are higher than the actual, long-period growth rate, consistent with what most studies in the BPCG tradition have found (according to Razmi, 2011), and that we get closer to the actual average rate when RER effects are included even though, according to the canonical versions of this theory, RER effects should be negligible in the long run.

The remaining columns of Table 5 show the actual and equilibrium growth rates as we move through the four phases of the evolution of the Mexican economy since 1960. A first observation is that, during Phase I, actual growth (at 6.34%) was much higher than the rate consistent with BOP equilibrium, whether this excludes RER effects (3.76%) or includes them (2.02%). Consistent with this result, Figure 5 shows that, toward the end of this phase and moving into the next one, there was a rapid increase in the trade and current account deficits.

A second result is that the growth deceleration during Phases II and III (1975–86 and 1987–2000) cannot be explained by a tightening of the external constraint. This is because, while the Mexican economy was decelerating over these two periods, there was no parallel fall in the BOP-equilibrium growth rates, which in fact tended to increase, most clearly so if we focus on the calculations that exclude RER effects. Thus, as actual growth fell from 6.3% per year during Phase I to 3.3% in Phase III, the BOP-equilibrium growth rate rose from 3.8% to 4.9% (if we exclude RER effects), or from 2.0% to 4.5% (if we include them)—the latter after having reached a high value of 6.2% during Phase II. Moreover, note that while actual growth at 6.3% was at least 2.5 percentage points above the BOP-equilibrium growth rate during Phase I, signaling as we just saw a build-up of pressure in the external sector, the situation reversed during the next two phases, with actual growth being below the BOP-equilibrium rate in both periods II and III. This is consistent with the observation that the trade and current account deficits were smaller by the end of Phase III than at the beginning of Phase II, as shown in Figure 5. Thus, the falling average growth rates observed in Mexico from 1975 to 2000 cannot be explained by the evolution of the BOP-equilibrium growth rate.

Phase IV (2001–12) is qualitatively different from the previous ones. One reason is the behavior of the BOP-equilibrium growth rate. There were two negative shocks affecting it: first, the sharp fall in average U.S. GDP growth, to 1.6% from 3.3% in the previous phase, and second, the China effect, which at least in part is captured by the downward shift in the time trend in the manufactured export equation. In a context of stable trade elasticities and no major changes in the broad composition of exports and imports, these two are the main factors in the reduction of the BOP-equilibrium growth rate, from more than 4% to about 2%. The other reason why this phase is different from the previous ones is that actual growth behaved similarly to the BOP-equilibrium growth rate, and in fact the actual GDP growth rate fell, from 3.3 to 2.0%—a rate basically equal to the BOP-equilibrium rate. As expected, Figure 5 shows that the trade and current account deficits were relatively small and stable during this phase. This suggests that there may be an asymmetry in the application of the BPCG model to the determination of an economy's actual growth rate during specific sub-periods: an increase in the BOP-equilibrium rate may not lead to an increase in actual growth to the extent that other factors or restrictions on growth may be binding; a sufficiently strong fall in the BOP-equilibrium growth rate, in contrast, may indeed cause a decline in actual growth, because the external constraint may become binding. This asymmetry is similar to the idea presented in the recent literature on "growth diagnostics" and the older one on "gap models."[39]

6.1 Structural change and real exchange rate effects

In the relatively long period covered by the four phases we have identified in the development of the Mexican economy, there are several indicators of structural change (mainly, changes in the composition of trade and in trade elasticities); some of these had an effect on the BOP-equilibrium growth rate, while others did not. Moreover, our results lead us to reconsider some previous findings in the literature, including the frequent finding of a rise in the income elasticity of imports after trade liberalization in the late 1980s, as well as some of our own findings in Blecker and Ibarra (2013) about the timing of various structural breaks. In addition to elements of structural change, there were wide swings in the RER, which during some phases had a large effect on the BOP-equilibrium growth rate with RER effects included. We now

[39] See Ibarra (2011b) for further development of this idea and references to the literature.

consider some of the more notable indicators of structural change together with movements in RER, and link them to the evolution of the BOP-equilibrium growth rate, with reference to the data shown in Table 5.

As we move from Phase I to Phase II, we see a sharp increase, from 0.9 to 2.4, in the income (GDP) elasticity of imports of final goods, which according to equations (5) and (6) had a negative impact on the BOP-equilibrium growth rate. Interestingly, this change occurred notably earlier than the late 1980s or early 1990s, when many previous studies have found increases in the income elasticity for total imports. This was reinforced by the disappearance of the positive time trend in the manufactured export equation, which perhaps reflected negative side effects of the oil boom and macroeconomic instability that characterized the latter phase. Somewhat unexpectedly, however, the BOP-equilibrium growth rate, rather than falling, increased, especially if we include RER effects (in which case the BOP-equilibrium growth rate increased to 6.2% from 2.0%). This increase reflected the positive influence of several other factors in the transition from Phase I to II. First, the elasticity of manufactured exports with respect to U.S. GDP increased from 1.65 to 1.84. Second, the share of intermediate goods in total imports almost doubled (from 37.8% to 70.5%), and this put a greater weight on the much lower income (GDPMEX) elasticity of intermediate imports relative to final imports in the denominators of equations (5) and (6).[40] In addition, the RER depreciated at an annual rate of 4.9% in phase II, after appreciating by an average of 1.5% in Phase I. These three factors more than offset the negative impact of the increase in the income elasticity of final imports and the disappearance of the positive time trend in the manufactured exports equation, and resulted in the

[40] Equation (5) shows that changes in the share of intermediate goods in total imports have a net effect on the BOP-equilibrium growth rate whose sign depends on the specific values of several parameters and elasticities. For the values of these parameters and elasticities observed during Phase II, an increase in the share of intermediate imports tended to increase the BOP-equilibrium growth rate.

estimated increase in the BOP-equilibrium growth rate.[41] Of course, as we already saw, this increase did not prevent a large fall in the actual GDP growth rate as the Mexican economy moved into the crisis-ridden Phase II.

Somewhat unexpectedly, we did not find significant changes in most of the income (GDP) or RER elasticities in Phases III and IV in the most statistically adequate models, with the sole exception of a significant reduction in the RER elasticity of manufactured exports starting in 1987. There were, however, big changes in the growth rates of Mexico's trade aggregates and U.S. GDP, as well as in the time trends representing effects of unmeasured variables on manufactured exports. Between Phases II and III, there was a notable acceleration in import growth, from 5.5 to 14.5% for intermediate goods, and from –5.4 to 14.8% for final goods. There was also a reduction, from 8.7 to 4.1%, in the average growth of non-manufactured exports, already taking into account changes in the terms of trade. And yet, as just mentioned, there is no reduction in the BOP-equilibrium growth rate excluding RER effects, which in fact (slightly) increased. The reason is the positive effect that trade liberalization had on exports of manufactures, whose annual growth almost doubled from 8.2 to 15.1%. Since the peso tended to appreciate in real terms (at an annual rate of 3.6%) during this phase, while U.S. GDP growth increased only marginally from 3.1 to 3.3%, the acceleration in export growth probably reflects the direct, positive effect from a more liberal trade regime, an effect that in our export equations is represented by an increase in the time trend. The acceleration in export growth offset the same behavior observed in imports, so that the net effect on the equilibrium growth rate was minimal

[41] If we use the estimates from the import equations in first difference (Appendix Tables B.3 and B.4), the BOP-equilibrium growth rate without RER effects actually fell during Phase II and basically was equal to the actual GDP growth rate (see Appendix Table B.5). The conclusion about the importance of RER effects, however, is unaffected: the BOP-equilibrium growth rate with RER effects included increased by more than four percentage points in Phase II and remained well above the actual GDP growth rate, thus stressing the positive influence that RER depreciation had on the growth potential of the Mexican economy consistent with BOP equilibrium.

(less than one point) but positive. Of course, an alternative way to put this result is that the acceleration in export growth brought about by trade liberalization failed to increase in a significant way both the actual and the equilibrium growth rates of the Mexican economy.

However, the evolution of the RER appears to have reduced the potential benefits from trade liberalization during Phase III. Although the BOP-equilibrium growth rate increased from 4.1 to 4.9% when no RER effects are incorporated into the calculations, the equilibrium rate actually fell, from 6.2 to 4.5%, when such effects are included. The reason seems to be the real appreciation of the peso at an average rate of 3.6% per year in Phase III (in spite of a temporary sharp devaluation during the 1994-95 peso crisis). This may explain the large fall in the equilibrium growth rate when RER effects are incorporated, even though, as the last row of Table 5 shows, on average during this period the size of the “extended Marshall-Lerner” effect was quite small at 0.12 (more on this below).[42] In any event, whether the BOP-equilibrium growth rate during this phase is calculated with or without RER effects, the economy continued to underperform in relation to the rate consistent with its external constraint.

Finally, in Phase IV, there were additional changes that cut the BOP-equilibrium growth rate by more than half by either measure. The growth rate of manufactured exports slowed down severely, from 15.1% per year in Phase III to 2.8% in Phase IV, which brought down the equilibrium growth rate excluding RER effects. Meanwhile, the positive time trend in the manufactured export function disappeared (going from 9.4% per year to –0.2%) and U.S. growth tumbled from an average of 3.3% to only 1.6% between these same two phases, which brought

[42] The negative impact of RER appreciation on the growth potential of the Mexican economy during Phase III is reinforced when the estimated elasticities from the import equations in first difference (rather than those from the bounds testing regressions) are used in the calculations, since in that case the EML effect is almost twice as large (see Appendix Table B.5).

down the equilibrium growth rate including RER effects.[43] Indeed, the BOP-equilibrium growth rate would have fallen even further in Phase IV if it were not for the recuperation in real non-manufactured exports, which (largely as a result of favorable terms-of-trade effects) grew at a 6.4% annual clip in Phase IV compared to 4.1% in Phase III.

6.2 The extended Marshall-Lerner effect

Table 5 shows that an increase in RER (a real depreciation) has a net positive effect on BOP-equilibrium growth, as evidenced by the positive value of the extended Marshall-Lerner (EML) effect.[44] For the entire period 1960–2012, an increase of one percentage point in the peso's real depreciation rate tended to increase the BOP-equilibrium growth rate by 0.30 percentage points. Although this is not a marginal effect, the relative stability of the RER over the entire period 1960–2012 means that there is only a small gap between the BOP-equilibrium growth rates with RER effects (4.25%) and without them (4.44%).

Note, however, that there were notable changes in the size of the EML effect over time, with a steady decline from the relatively high values of 0.78 in Phase I and 0.42 in Phase II, to about only 0.10 points after the liberalization of trade (Phases III and IV). The decline in the EML effect minimized the impact of RER variations on BOP-equilibrium growth over time, particularly after the liberalization of the trade regime. Ironically, variations in the RER had a larger impact on the BOP-equilibrium growth rate before trade liberalization.

What were the sources of the decline in the EML effect, and therefore of the influence of

[43] The bilateral RER had only modest effects during this period, as discussed in the next subsection, but it is worth recalling that the appreciation of the U.S. dollar and the undervaluation of the Chinese renminbi had additional negative effects on Mexico's manufactured exports during the early part of Phase IV, based on some of the estimations in Table 4 (columns 4.5 and 4.6).

[44] Recall that the EML effect is measured by the term $[(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1 - \theta)\varepsilon_c - \mu]$ in equation (5) for the BOP-equilibrium growth rate including RER effects.

RER on the BOP-equilibrium growth rate? As noted above, the size of the EML effect depends on several parameters: the elasticities of manufactured exports, intermediate imports, and final imports with respect to the RER (ε_n, ε_i, and ε_c, respectively); the elasticity of intermediate imports with respect to manufactured exports (ϕ); and the shares of manufactures in total exports and of intermediates in total imports (μ and θ, respectively). If we focus on the strong decline in the EML effect that took place after liberalization (from 0.42 during Phase II to about 0.10 in Phases III and IV), we see that most of the elasticities just mentioned (namely, the elasticities of imports of intermediate and final goods with respect to RER, and the elasticity of intermediate imports with respect to manufactured exports) were constant; moreover, there was only a marginal increase in the share of intermediate goods in total imports (from about 0.71 to 0.76).[45]

In contrast, there was a sharp rise in the share of manufactures in total exports (from little more than 0.4 before liberalization to about 0.8 afterwards), and a reduction in the RER elasticity of manufactured exports (from 0.54 to 0.23). Although the change in the RER elasticity of manufactured exports was large, both the direction and the magnitude of its impact on the EML effect are uncertain in principle, because the RER elasticity is weighted by the term ($\mu-\phi\theta$). This weighting factor may be positive if the share of manufactures in exports (μ) is large, but it is diminished, and may even turn negative, if the effect of manufactured exports on total imports ($\phi\theta$) is sufficiently large. If we use the average values of these parameters during Phase II, the net effect was negative but very small (–0.07). If instead we use the average values from Phase III, the net effect is positive and relatively large (0.25), mainly because of the rise in the share of manufactures in total exports.

Interestingly, the impact of a change in the share of manufactures in exports on the size

[45] The bulk of the increase in the share of intermediates in total imports took place before liberalization during the Phase II, when it increased from less than 0.4 to 0.7.

of the EML effect is, in absolute terms, amplified by a decrease in the RER elasticity of manufactured exports: the smaller the RER elasticity of manufactured exports, the larger the reduction in the EML effect after a rise in the share of manufactured exports. It turns out that the fall in the size of the EML after liberalization is almost totally explained by the rise in the share of manufactures in total exports. Indeed, it can be calculated that if this share had remained at its pre-liberalization value, the EML effect would have remained at a value of about 0.4 after liberalization, instead of the approximately 0.10 actually observed.[46]

Thus, the diminishing benefit of real depreciation for Mexico's BOP-equilibrium growth rate is, paradoxically, largely an effect of the greater integration of the nation's manufacturing industries into North American supply chains and the increasing technological sophistication of Mexico's manufactured exports, both of which have made those exports less sensitive to the bilateral RER with the country's main trading partner, the United States. As noted previously, we did find some evidence that Mexico's manufactured exports became sensitive to the U.S. RER (after liberalization) and the bilateral Mexican-Chinese RER (after China joined the WTO), so in this broader sense RERs continue to play an important role in Mexico's export performance, although those factors were not incorporated in our calculations of BOP-equilibrium exchange rates in Table 5. Unfortunately for Mexico, some of the exchange rates that now affect its exports most strongly are beyond the country's control, but our results imply that Mexico has a strong interest in keeping the U.S. dollar low and letting the Chinese renminbi appreciate more.

[46] The size of the EML effect calculated in this way is only marginally reduced if we assume that the RER elasticity of manufactured exports also remained at its pre-liberalization value.

7. Conclusions

This paper has produced the first estimates of a complete BPCG model for Mexico, with disaggregated exports (manufactured and non-manufactured) and imports (of final and intermediate goods), including estimation of the manufactured export function and incorporating RER effects into the calculations of the BOP-equilibrium growth rate (along with more traditional calculations excluding those effects). In order to obtain statistically adequate estimates of the various equations in this model, we found that we had to identify structural breaks in the various relationships that occurred between four different time periods (our Phases I-IV) within our overall sample period of 1960–2012.

Contrary to many previous studies, but similar to Gouvea and Lima (2010) and Blecker and Ibarra (2013), we find that a fall in the BOP-equilibrium growth rate cannot account for the actual slowdown in Mexico’s growth in the immediate aftermath of trade liberalization, i.e., between 1987 and 2000. This result holds even though we control for the effects of the country’s heavy reliance on imported intermediate goods for the production of manufactured exports. Excluding RER effects, the BOP-equilibrium growth rate actually increased in that period (our Phase III), and remained above the actual growth rate. Moreover, the results underline the importance of changes in the RER. Thus, while the BOP-equilibrium growth rate increased when RER were excluded, including those effects makes the equilibrium growth rate decrease by several percentage points (although still remaining above the actual growth rate), reflecting the negative impact of RER appreciation on the growth potential of the Mexican economy.

Our new results also show that the BOP-equilibrium growth rate did decline notably in our Phase IV (2001–12). In this period, regardless of whether RER effects are included or not, the BOP-equilibrium growth rate fell and was approximately equal to the actual average growth rate of about 2%. The decrease was not, however, caused by an increase in the income elasticity of demand for either final or intermediate imports at that time, as claimed in some previous studies (cited earlier) for the early post-liberalization years.[47] Rather, this tightening of the BOP constraint appears to have been caused by increasing Chinese competition in North American markets, the slowdown in the growth of the U.S. economy, and the end of the "easy" gains in manufactured exports from the removal of trade barriers. Some evidence indicates that these factors were exacerbated by the high value of the U.S. dollar and the low value of the Chinese renminbi in the early 2000s, although both of these factors started to reverse after about 2005 (with long lags in the gains from Chinese appreciation). It is possible that, because the Mexican economy was more fully opened to global competition and shocks after 2001 than ever before, the BOP constraint finally became binding in the most recent period. However, it still remains to be seen whether the fall in the BOP-equilibrium growth rate caused the decrease in actual growth in this period, given the continued existence of other potential constraints on both the supply and demand sides.

In terms of policy implications, our results suggest caution in the advocacy of peso depreciation as a strategy for relieving BOP constraints. Our estimates show that the "extended Marshall-Lerner" condition is barely satisfied in the post-liberalization years, especially because manufactured exports have become relatively insensitive to the bilateral RER with the U.S. dollar. Strikingly, it appears that Mexico can gain more from continued depreciation of the U.S. dollar and appreciation of the Chinese renminbi, rather than from further depreciation of the peso

[47] According to our regression results from section 5, we found some evidence of an increase in the GDPMEX elasticity for final imports in either 1975 or 1987 (depending on the specification, using structural break tests), and for intermediate imports in 1975 (based on a comparison of the results using the sample periods 1960–2012 and 1975–2012). But neither of these income elasticities exhibited a statistically significant change in 2001.

vis-à-vis the U.S. dollar. However, this does not imply that peso depreciation could not have a positive impact on growth through other channels, such as by increasing profit margins in the tradables sector and thereby stimulating business investment as suggested by Ibarra (2008, 2011b, 2013b). Somewhat surprisingly, we find that peso depreciation would do more to reduce final imports than to stimulate manufactured exports. Moreover, our analysis indicates that structural policies, such as industrial promotion efforts that would encourage "backward linkages" of export production, could be essential for changing the structural parameters that currently limit the domestic benefits Mexico receives from its export success.

The estimates in this paper are still preliminary in some respects. We need to do more to make sure that our econometric procedures have adequately controlled for the endogeneity of manufactured exports by using alternative procedures (such as SUR, 3SLS, or GMM) as sensitivity tests. We will continue our efforts to find additional explanatory variables and to test alternative measures of the variables we are using, although as noted earlier there are severe limitations on the variables that are available for the long-run analysis in our entire sample period. We need to test whether including other components of the BOP, such as net financial inflows and remittances, would alter our results for the BOP-equilibrium growth rate. Most importantly, we need to work on identifying the most important other constraints, aside from the BOP, that have held Mexico's growth so far below its true potential during the nearly three decades since the country liberalized its trade in the late 1980s.

Appendix A. Data sources and definitions

Bilateral Mexican-U.S. real exchange rate (RER): Calculated as the ratio of the US consumer price index (CPI) to the Mexican CPI, multiplied by the nominal peso-dollar exchange rate. Sources: US Bureau of Labor Statistics (BLS) for the US consumer price index, the *IMF's International Financial Statistics* (IFS) for Mexico's CPI and nominal exchange rate from 1960 to 1967, and Bank of Mexico (BOM) for the same variables since 1968.

Multilateral Mexican real exchange rate (MRER): The BOM's Índice de Tipo de Cambio Real (ITCR) con precios consumidor y con respecto a 111 países (real exchange rate using consumer prices and with respect to 111 countries), rebased to equal 100 in 1996.

Multilateral, trade-weighted U.S. real exchange rate (RERUS): The reciprocal of the broad index of the real value of the U.S. dollar, from Federal Reserve Board of Governors. This is a trade-weighted index of the real value of the dollar, adjusted by consumer price indexes with 26 countries that account for the vast majority of U.S. trade (including both "major" currencies and currencies of "other important trading partners," i.e., developing and transition economies). The reciprocal was used in the regressions so that an increase indicates a real depreciation of the U.S. dollar.

Mexican-Chinese real exchange rate (MEXCHNRER): Defined as the nominal peso-renminbi exchange rate multiplied by the Chinese CPI and divided by the Mexican CPI (data from IFS). The nominal exchange rate was calculated by taking the ratio of pesos per U.S. dollar to renminbi per U.S. dollar (period averages). The Chinese CPI had to be constructed by creating an index in levels out of the annual percentage changes in consumer prices given in the IFS.

Mexican gross domestic product (GDPMEX): 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 (GDPUS): In chained 2005 dollars. Source: US Bureau of Economic Analysis.

Imports of final goods (IMPF): Total imports of final consumption and capital goods. The original BOP data, in nominal US dollars, were deflated with the general US PPI for industrial commodities. Source: BOM for trade data and BLS for price index.

Imports of intermediate goods (IMPI): Total imports of intermediate goods including imports of the maquiladora sector (see below). The original data, in nominal US dollars, were deflated with the general US PPI for industrial commodities. Source: BOM for trade data, and BLS for price index; see below regarding maquiladora data.

Manufactured exports (EXPM): Total exports of manufactured goods including exports of the maquiladora sector (see below). The original data, in nominal US dollars, were deflated with the general US PPI for industrial commodities. Source: BOM for trade data, and BLS for price index; see below regarding maquiladora data.

Non-manufactured exports: Calculated as the difference between total exports of goods and manufactured exports. The original BOP data, in nominal US dollars, were deflated with the general US PPI for industrial commodities Source: BOM for trade data and BLS for 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 US 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 US PPI for industrial commodities.

Appendix B. Supplementary econometric estimates (sensitivity tests)

Available from the authors in a separate file.

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Table 1
Unit root tests (sample period: 1960–2012, 53 annual observations).

	Phillips-Perron (PP) Null: unit root $I(1)$[a]			Kwiatkowski, Phillips, Schmidt, and Shinn (KPSS) Null: stationary $I(0)$[b]		
	level	level with trend	first difference	level	level with trend	first difference
Mexico-U.S. bilateral real exchange rate, RER	–3.15 **	–3.12	–9.10 ***	0.113 †	0.114 †	0.158 †
U.S. multilateral real exchange rate, RERUS	–1.98	–1.96	–3.85 ***	0.102 †	0.064 †	0.089 †
Mexican gross domestic product, GDPMEX	–3.89 ***	–1.65	–5.16 ***	0.954	0.234 †††	0.687 †††
U.S. gross domestic product, GDPUS	–2.66 *	–1.16	–5.36 ***	0.987	0.156	0.560 †††
Imports of final goods, IMPF	–0.46	–2.35	–6.77 ***	0.904	0.162 †††	0.112 †
Imports of intermediate goods, IMPI	–0.89	–1.88	–5.57 ***	0.846	0.120 ††	0.115 †
Manufactured exports, EXPM	–2.28	–1.17	–6.82 ***	0.851	0.153 †††	0.376 ††

Notes: All variables are measured in natural logarithms (GDP, imports, and exports in real terms). See Appendix A for data sources and variable definitions. All tests assume an intercept and use the Bartlett kernel and Newey-West bandwidth selection. Significance levels are as follows: ***, **, *: The null hypothesis of a unit root is rejected at the 1%, 5%, 10% significance levels, using MacKinnon one-sided *p*-values for PP. †††,††, †: The null hypothesis of stationarity is accepted at the 1%, 5%, 10% significance level. Critical values from Kwiatkowski, Phillips, Schmidt, and Shinn (1992, Table 1): For level or first difference, 10% = 0.347; 5% = 0.463; 1% = 0.739. For level with trend, 10% = 0.119; 5% = 0.146; 1% = 0.216.

Table 2. Bounds-testing regressions for imports of final goods, dependent variable: IMPF

Equation	(2.1)[a]	(2.2)[b]	(2.3)	(2.4)[e]	(2.5)	(2.6)[e]
Sample period	1960-2012	1960-2012	1960-2012	1960-2012	1975-2012	1975-2012
Speed of adjustment [c]	-0.087	-0.303	-0.699	-0.782	-0.708	-0.783
Mexico's GDP (GDPMEX)	1.45 **	1.21 ***	2.61***	2.40***	2.61***	2.42***
	(0.04)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Bilateral real exchange rate, RER	-1.30		-1.19 ***	-1.41 ***	-1.18 **	-1.35 ***
	(0.26)		(0.007)	(0.00)	(0.02)	(0.00)
GDPMEX*dummy for 1960-1974			-1.63 ***	-1.46 ***		
			(0.00)	(0.00)		
GDPMEX*dummy for 1987-2012		0.52 ***				
		(0.00)				
RER*dummy for 1987-2012		-1.53 ***				
		(0.00)				
Dummy for 1960-1974		0.51 **	25.52 ***	22.90 ***		
		(0.046)	(0.00)	(0.00)		
Dummy for 1975-1981		0.18	0.46 ***	0.40 ***	0.46 ***	0.41 ***
		(0.29)	(0.00)	(0.00)	(0.00)	(0.00)
Liberalization dummy, 1987-2012			0.52 ***	0.66 ***	0.53 ***	0.67 ***
			(0.00)	(0.00)	(0.00)	(0.00)
Constant		-3.41	-19.50 ***	-15.39 ***	-19.59 ***	-15.85 ***
		(0.13)	(0.00)	(0.00)	(0.00)	(0.00)
Adjusted R^2	0.823	0.962	0.873	0.915	0.877	0.926
SEE	0.104	0.048	0.088	0.072	0.100	0.077
Bounds tests						
t-test[c]	-2.47 &	-5.85 ***	-6.43 ***	-8.63 ***	-5.97 ***	-8.12 ***
F-test	2.84 #	19.37 ***, +++	22.87 ***, +++	36.27 ***, +++	23.37 ***, +++	40.43 ***, +++
Diagnostics (*p*-values, for *F*-statistics where relevant)						
Serial correlation (B-G, 2 lags)	0.793	0.411	0.295	0.816	0.351	0.480
Normality (Jarque-Bera)	0.555	0.472	0.042 **	0.874	0.338	0.937
RESET (squared fitted values)	0.591	0.260	0.407[d]	0.963	0.43 [f]	0.804
ARCH (2 lags)	0.822	0.748	0.659	0.987	0.759	0.865

Notes to Table 2 are on page 59, following Table 4.

Table 3. Bounds-testing regressions for imports of intermediate goods, dependent variable: IMPI

Equation [a]	(3.1)	(3.2)	(3.3)	(3.4)
Sample period	1960-2012	1960-2012	1975-2012	1975-2012
Speed of adjustment [b]	-0.300	-0.527	-0.824	-0.664
Mexico's GDP, GDPMEX	0.49 **	0.39 ***	0.63 ***	0.52 ***
	(0.011)	(0.00)	(0.00)	(0.00)
Bilateral real exchange rate, RER	-0.56 *	-0.46 **	-0.78 ***	-0.66 ***
	(0.098)	(0.012)	(0.00)	(0.00)
Mexico's manufactured exports, EXPM	0.71 ***	0.77 ***	0.64 ***	0.70 ***
	(0.00)	(0.00)	(0.00)	(0.00)
RER*dummy for 1960-1969		0.06 ***		
		(0.00)		
Dummy for 1975-1981		0.35 ***		0.21 ***
		(0.00)		(0.00)
Adjusted R^2	0.763	0.847	0.864	0.883
SEE	0.071	0.057	0.058	0.054
Bounds tests				
t-test [b]	-3.84 **	-5.93 ***	-4.97 ***	-4.62 ***
F-test	4.42 ***,+++	7.38 ***, +++	6.72 ***, +++	6.83 ***, +++
Diagnostics (*p*-values, for *F*-statistics where relevant)				
Serial correlation (B-G, 2 lags)	0.338	0.350	0.509	0.263
Normality (Jarque-Bera)	0.067 *	0.669	0.747	0.902
RESET (squared fitted values)	0.851	0.178	0.255 c	0.429
ARCH (2 lags)	0.590	0.334	0.492	0.338

Notes: Long-run coefficients are shown for all variables; numbers in parentheses are *p*-values. Significance levels: * 10%, ** 5%, *** 1%, except for finite sample bounds tests using critical values from Narayan (2005), + 10%, ++ 5%, +++ 1%. B-G is the Breusch-Godfrey test for serial correlation of the residuals.

[a] The constant was removed from all equations due to a lack of statistical significance.

[b] The bounds *t*-test is the test for the significance of the speed of adjustment coefficient, using the critical values from Pesaran et al. (2001).

[c] The RESET for squared and cubed fitted values has a *p*-value of 0.03 for the *F*-statistic and 0.01 for the chi-square statistic.

Table 4. Regressions for manufactured exports, all variables in first differences, dependent variable: Δ EXPM (in logs)

Equation	(4.1)[g]	(4.2)	(4.3)	(4.4)[c]	(4.5)[d]	(4.6)[c]
Sample period	1960-2012	1960-2012	1960-2012	1975-2012	1975-2012	1975-2012
Constant[a]		0.09**	0.19***			
		(0.02)	(0.00)			
Bilateral real exchange rate, ΔRER(t-1)	0.36**	0.37**	0.33**	0.54***	0.45***	0.55***
	(0.02)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Liberalization*ΔRER(t-1)				-0.31**	-0.37**	-0.31**
				(0.04)	(0.01)	(0.03)
Δ GDPUS (t, except as indicated)	3.53*** [b]	1.65* [b]		1.84***	1.88***	1.83***
	(0.00)	(0.09)		(0.00)	(0.00)	(0.00)
Dummy for 1975-2012*Δ GDPUS (t)			2.35***			
			(0.01)			
Liberalization*ΔRERUS(t)					0.47*	
					(0.09)	
China-WTO (2001-12)*ΔMex-China RER (t-3)[f]						0.46**
						(0.02)
Dummy for 1975-2012			-0.18***			
			(0.00)			
Liberalization (1987-2012)			0.08*	0.09***	0.09***	0.09***
			(0.05)	(0.00)	(0.00)	(0.00)
China-WTO (2001-2012)		-0.09**	-0.09**	-0.10***	-0.09***	-0.10***
		(0.03)	(0.04)	(0.00)	(0.00)	(0.00)
Adjusted R^2	0.193	0.259	0.406	0.749	0.786	0.786
SEE	0.112	0.107	0.096	0.055	0.051	0.051
Durbin-Watson	1.651	1.891	2.070	1.909	1.981	2.297
Diagnostics (*p*-values, for *F*-statistics where relevant)						
Serial correlation (B-G, 2 lags)	0.502	0.995	0.671	0.981	0.868	0.511
Normality (Jarque-Bera)	0.727	0.764	0.150	0.652	0.507	0.478
RESET (squared fitted values)	0.0103**	0.045**	0.077*	0.366	0.578 [e]	0.388
ARCH (2 lags)	0.139	0.039**	0.021**	0.607	0.441	0.452

Notes to Table 4 are on the next page.

Notes to Table 4

Notes: Numbers in parentheses are *p*-values. Significance levels: * 10%, ** 5%, *** 1%. B-G is the Breusch-Godfrey test for serial correlation of the residuals.
[a] Represents a time trend (exponential growth rate) since all variables are in first differences (of logs). Intercept dummies represent shifts in the time trend (growth rate).
[b] Sum of 0 and 1 lag.
[c] Includes a year outlier dummy for 1986; the constant and NAFTA dummy were insignificant when included so they were omitted.
[d] Includes year outlier dummies for 1986 and 2003; the constant and NAFTA dummy were insignificant when included so they were omitted.
[e] The RESET for squared and cubed fitted values has a *p*-value of 0.127 for the *F*-statistic and 0.061 for the chi-square statistic.
[f] Similar results were obtained using the sum of lags 1 to 3 or 1 to 4, but by the AIC and SIC criteria the best results were judged to be those using lag 3 only.
[g] The constant was insignificant when included so it was omitted. RESET is also significant at the 5% level using squared and cubed fitted values.

Notes to Table 2

Notes: Long-run coefficients are shown for all variables; numbers in parentheses are *p*-values. Significance levels: * 10%, ** 5%, *** 1%, except for finite sample bounds tests using critical values from Narayan (2005), + 10%, ++ 5%, +++ 1%. B-G is the Breusch-Godfrey test for serial correlation of the residuals.
[a] Includes a year outlier dummy for 1975.
[b] Includes year outlier dummies for 1975, 1986, 1987 and 1993.
[c] The bounds *t*-test is the test for the significance of the speed of adjustment coefficient, using the critical values from Pesaran et al. (2001).
[d] The RESET for squared and cubed fitted values has a p-value of 0.03 for the *F*-statistic.
[e] Includes year outlier dummies for 1986 and 1987.
[f] The RESET for squared and cubed fitted values has a p-value of 0.09 for the *F*-statistic and 0.03 for the chi-square statistic.
& Rejects the null of no long run relationship only under the condition that all variables are I(0), at 5% using the asymptotical critical values from Pesaran et al. (2001).
# Rejects the null of no long-run relationship only under the condition that all variables are I(0), at 5% using the asymptotical critical values from Pesaran et al. (2001) and at 10% using the small-sample (n = 50) critical values from Narayan (2005).

Table 5. Actual GDP growth compared with BOP-equilibrium growth and its determinants

Period	Whole sample	I. Stabilizing and shared development	II. Recurrent crises, oil boom-bust	III. Trade liberalization and macro stabilization	IV. China-WTO, stabilizing stagnation
Years	1960–2012	1960–1974	1975–1986	1987–2000	2001–2012
Actual GDP growth rate	**3.99**	**6.34**	**3.87**	**3.31**	**1.97**
BOP-equilibrium growth rate (y_B):[a]					
Excluding RER effects (manufactured exports exogenous)	**4.44**	**3.76**	**4.13**	**4.86**	**1.94**
Including RER effects (manufactured exports endogenous)	**4.25**	**2.02**	**6.21**	**4.51**	**2.01**
Trade aggregates (growth rates):					
Manufactured exports x_n	11.64	18.24	8.17	15.14	2.75
Non-manufactured exports $x_o + p_o* - p*$ [b]	5.27	2.72	8.69	4.11	6.38
Intermediate imports m_i	8.82	11.08	5.45	14.52	2.73
Final goods imports m_c	5.81	8.24	-5.41	14.82	3.47
U.S. GDP $y*$	3.01	3.81	3.09	3.29	1.60
Time trend in export equation λ	0.00	8.62	0.00	9.39	-0.16
Shares					
Share of manufactures in total exports (μ)	0.583	0.326	0.422	0.785	0.829
Share of intermediate goods in total imports (θ)	0.635	0.378	0.705	0.758	0.744
Elasticities [c]					
GDPMEX elasticity of final goods imports (η_c)	1.45	0.94	2.40	2.40	2.40
RER elasticity of final goods imports ($-\varepsilon_c$) [d]	-1.30	-1.41	-1.41	-1.41	-1.41
GDPMEX elasticity of intermediate imports (η_i)	0.49	0.49	0.52	0.52	0.52
RER elasticity of intermediate imports ($-\varepsilon_i$) [d]	-0.56	-0.56	-0.66	-0.66	-0.66
Manufactured export elasticity of intermediate imports (ϕ)	0.71	0.71	0.70	0.70	0.70
GDPUS elasticity of manufactured exports (η_n)	3.53	1.65	1.84	1.84	1.84
RER elasticity of manufactured exports (ε_n)	0.36	0.37	0.54	0.23	0.23

Table 5 continues on the next page

Table 5, continued

Period Years	Whole sample 1960-2012	I. Stabilizing and shared development 1960-1974	II. Recurrent crises, oil boom-bust 1975-1986	III. Trade liberalization and macro stabilization 1987-2000	IV. China-WTO and stabilizing stagnation 2001–2012
Memoranda:					
Bilateral real exchange rate index (RER)					
Average level	85.8	82.8	89.1	91.5	79.7
Average rate of change	-0.10	-1.46	4.89	-3.63	0.73
Extended Marshall-Lerner (EML) effect [e]	0.29	0.78	0.42	0.12	0.09

Source: Authors' calculations. See Appendix A for data sources and variable definitions, and the text for explanation.

Notes: All growth rates are annual averages of log differences, expressed as percentage rates.

[a] The BOP-equilibrium growth rate is calculated using equation (5) including RER effects and (6) excluding them.

[b] Includes terms-of-trade effects.

[c] Elasticities were taken from the following equations in Tables 2-4: for final imports, (2.1) for the whole sample and (2.4) for all other periods; for intermediate imports, (3.1) for the whole sample and 1960-74, (3.4) for all other periods; for manufactured exports, (4.1) for the whole sample, (4.2) for 1960-74, and (4.4) for all other periods.

[d] Note that the RER elasticities for imports are used in absolute values in the calculations because that is how they are expressed in the theoretical model.

[e] This is the net effect of a real depreciation of the peso (rise in RER) on y_B, $(\mu - \phi\theta)\varepsilon_n + \theta\varepsilon_i + (1-\theta)\varepsilon_c - \mu$.

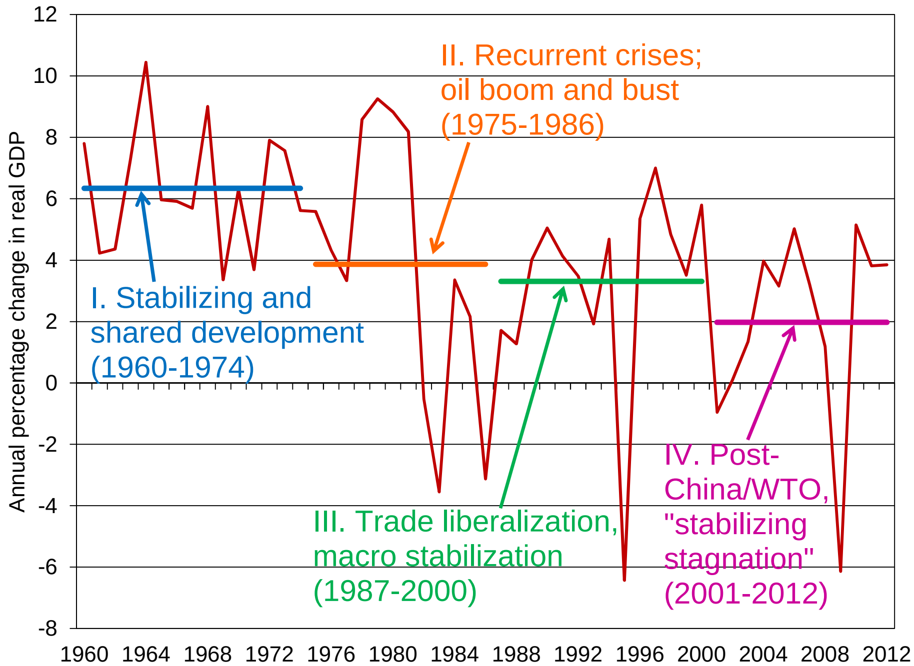

Figure 1. Growth rates of Mexico's real GDP, annually and averages for selected periods, 1960–2012

Source: Authors' calculations; see Appendix A for details.

Note: The growth rate is measured by the difference in natural logarithms.

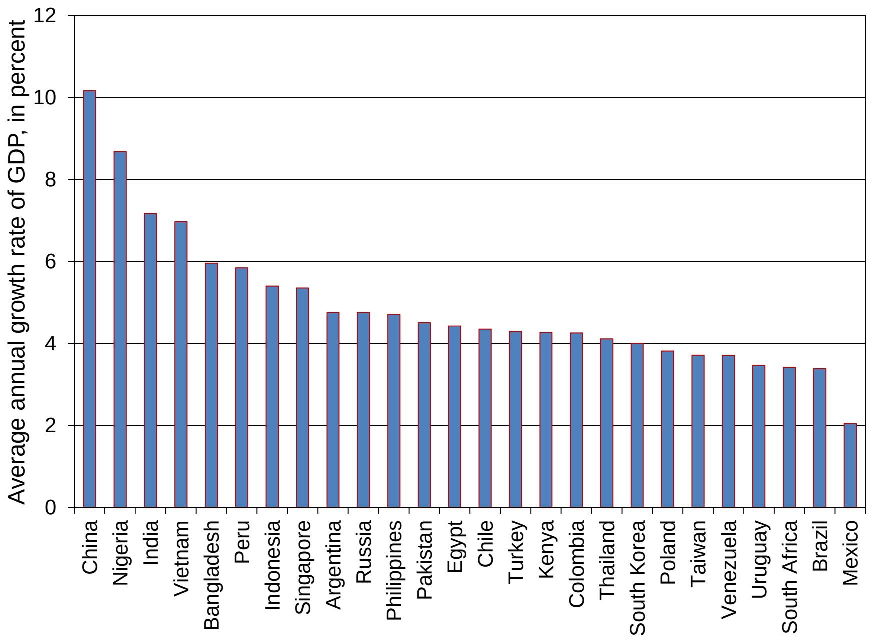

Figure 2. Average annual growth rates of real GDP, Mexico and other leading emerging market nations, 2001–2012

Source: International Monetary Fund, *World Economic Outlook Database*, October 2012 (downloaded April 1, 2013).

Note: Data for 2012 are estimated for all countries, and data for some earlier years are estimated for a few countries.

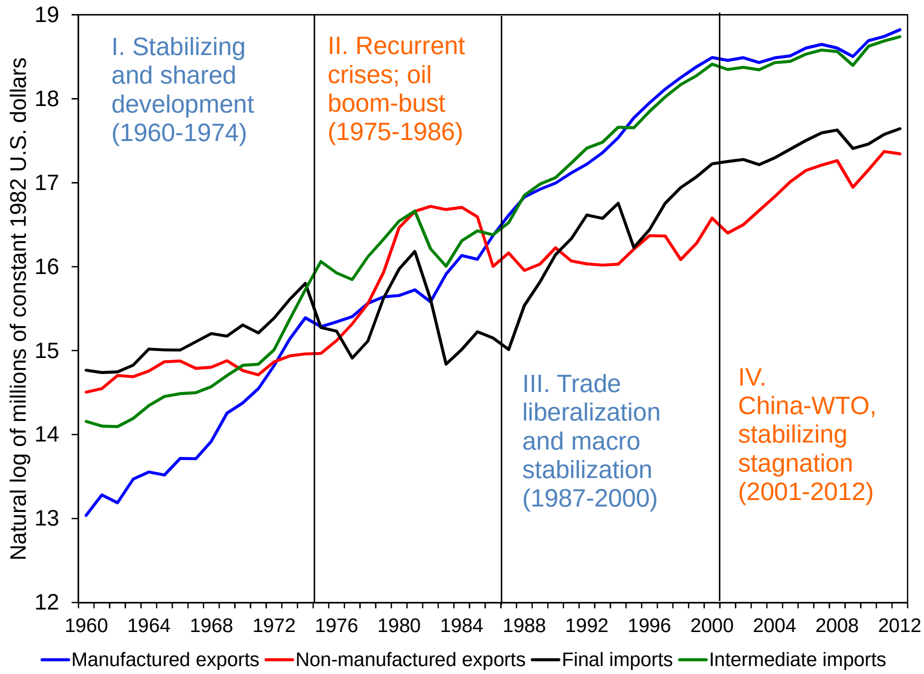

Figure 3. Mexican exports and imports by type, 1960-2012, in natural logs of millions of constant 1982 U.S. dollars
Sources: Authors' calculations; see Appendix A for details.
Note: Non-manufactured imports include a terms-of-trade effect.

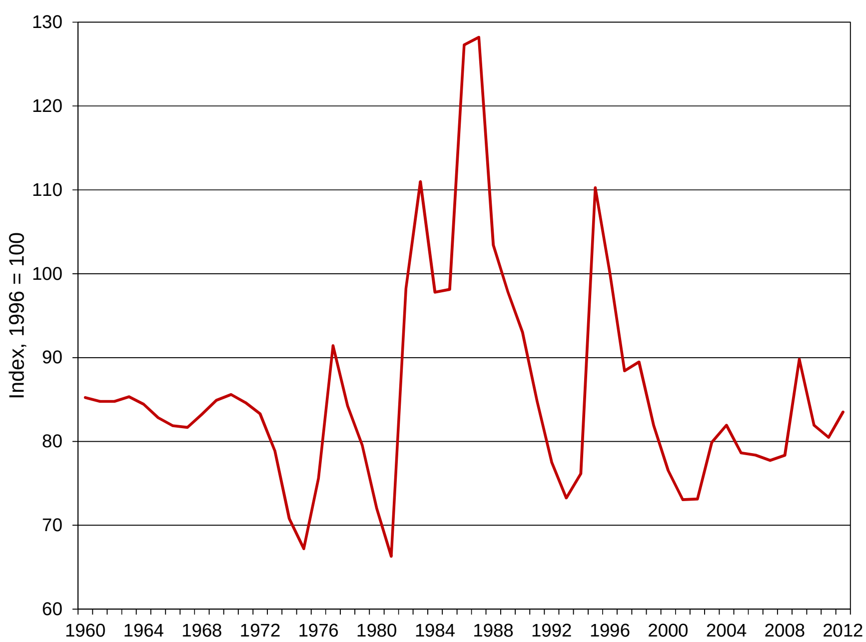

Figure 4. Bilateral Mexican-U.S. real exchange rate index (RER), annually 1960–2012
Source: Authors' calculations; see Appendix A for details.
Note: This index measures the relative price of foreign (U.S.) goods, so a higher number indicates a real depreciation of the peso.

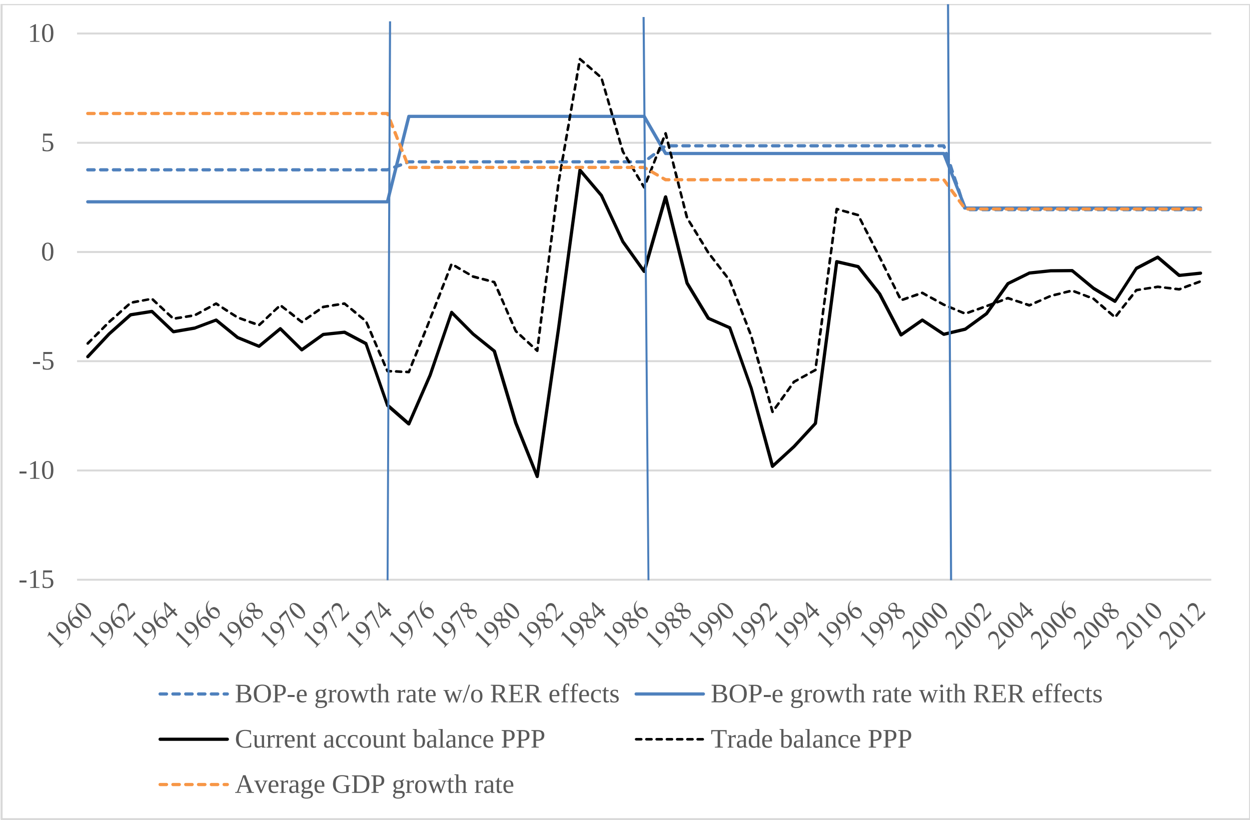

Figure 5. Trade balance, current account balance, as percentages of GDP, and actual and BOP-equilibrium GDP growth rates (in percent), 1960–2012.
Source: Authors' calculations.
Note: GDP is calculated at purchasing power parity (PPP) exchange rates.