Investment determinants and the real exchange rate's profitability channel: evidence and puzzles from the Mexican case

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Abstract
The paper explores whether the recently-studied positive effect of the peso's real exchange rate (RER) on private investment in Mexico reflects the operation of the RER's profitability channel. It shows that a RER index based on producer price indices from the manufacturing sector is positively correlated with the Mexican/US relative profit margin in that sector, and explains how that correlation may arise from the firms' currency pricing decisions. It proceeds to show econometrically that the Mexican profit margin or its components (labor productivity and the price/wage ratio) have the expected positive effect on private investment in Mexico; somewhat unexpectedly, though, the RER effect is "deeper" and its inclusion in the investment equation wipes out the effect from the Mexican profitability indicators. Moreover, the latter effect changes sign when the US profit margin or price/wage ratio are included in the estimation, while in contrast the US variables show a robust positive effect on investment in Mexico. Although the latter result can be motivated by Mexico's growing integration into US industrial production chains, it seems contrary to what could be expected from the operation of the RER's profitability channel.

Keywords: investment determinants; real exchange rate; relative unit labor cost; profit margins; profitability channel; currency pricing rules; Mexico.
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1. Introduction

Recent research has established the positive effect a competitive level of the real exchange rate (RER) can have on the rate of economic growth in developing countries.[1] While the research has focused on uncovering the empirical relationship between the two variables, not much work has been done to study its channels (Eichengreen 2008, Skott et al. 2012). The present paper contributes to this literature by analyzing the effect of the RER on private investment in Mexico, and exploring econometrically whether this effect can be explained by the so-called RER's profitability channel.

According to previous studies, the peso's RER (defined as the inverse of the real value of the peso) has a positive, highly significant effect on aggregate investment in Mexico. The effect —which seems to be most significant after the country liberalized its trade regime in the mid-1980s— is robust to using alternative RER measures and to controlling for the influence of a large number of investment determinants. It obtains in either a multiple-equation framework such as Johansen's vector error-correction model, or a single-equation setting like the autoregressive distributed lag (ARDL) bounds testing approach of Pesaran et al. (2001).[2]

The RER may affect investment through several conflicting channels (see e.g. Blecker 2007, and Bahmani-Oskooee and Hajilee 2010). Under liability dollarization, a real currency depreciation may reduce investment through a balance-sheet effect, a contractive effect that may be reinforced by the increase in the local currency price of imported capital and intermediate goods. On the other hand, a depreciation can make domestic firms more competitive internationally by reducing the foreign currency price of locally produced

[1] See e.g. Levy-Yeyati and Sturzenegger (2007), Prasad et al. (2007), Eichengreen (2008), Gala (2008), Rodrik (2008), Berg and Miao (2010), Rapetti et al. (2012), and Razmi et al. (2012); see also Magud and Sosa (2010) for a survey.

[2] See Ibarra (2010, 2011a, 2013). For an alternative result, see Blecker (2009), who studies the period 1980–2007 in Mexico and finds a real depreciation of the peso reduces the investment/GDP ratio —although the reduction is offset by the depreciation's positive impact on GDP growth. In contrast, in estimations for the period 1980–2006 López et al. (2011) present econometric evidence of a reduction in Mexico's GDP after a real peso depreciation.

tradable goods, which may increase net exports and production in the manufactures, and eventually —through an accelerator effect— investment.

In Mexico, however, the positive response of investment to the RER is observed after controlling for the influence of industrial production and manufactured exports. This suggests that the positive investment response could reflect the operation of the RER's profitability channel. While different theoretical approaches coexist, broadly speaking the channel refers to how a real depreciation of the currency improves profit margins in the capital-intensive, increasing-returns tradables sector, leading to faster accumulation of capital and economic growth in the medium run (see Kouri 1978, Ros and Skott 1998, Frenkel and Ros 2006, Gala 2008, Korinek and Serven 2010, and Ros 2012).

The purpose of this paper is to examine in more detail the profitability channel in the Mexican case. More specifically, the paper (a) calculates the evolution of the Mexican/US relative profit margin and its components in the manufacturing sector, (b) discusses how the link between the RER and the relative profit margin depends on the currency pricing decisions of firms, and (c) econometrically estimates the effect of the relative profit margin and its components on private investment in Mexico. The analysis focuses on the period following the liberalization of the country's trade regime, with an estimation sample running from 1988Q1 to 2010Q4.

To prepare the ground, the initial estimations show that private investment responds significantly to alternative measures of the RER, including those based on economy-wide consumer price indices; after that, however, the estimations use a RER measure based on manufacturing producer price indices. This choice allows for a simple identification of the link between RER and the relative profit margin. On the other hand, the dependent variable in the estimations is total private investment (rather than investment in the manufacturing sector alone). Besides issues of data availability, the use of total investment reflects an interest in exploring the effects of RER at the macroeconomic level, and in particular its likely effect on medium-run economic growth.

An analysis of the RER and relative profit margin's effect on investment is important for at least two reasons. First, on theoretical grounds, the investment function is central to the debate on profit-led versus wage-led demand growth (see Blecker 2011). Assume a real currency depreciation reduces the real wage and increases the domestic profit margin. There will be conflicting effects on aggregate demand. If workers have a relatively high propensity to consume, the depreciation will reduce domestic consumption. At the same time, the depreciation can increase aggregate demand by expanding net exports. The final effect on aggregate demand may depend on the strength of the investment response to the higher profit margin. The stronger the response, the more likely it is that aggregate demand, and thus capacity utilization, will increase, in which case aggregate demand will be profit-led. Moreover, irrespective of the effect on capacity utilization, demand growth may be profit-led under a sufficiently strong response of investment to profit margins. In any event, high levels of investment are necessary to expand production capacity, incorporate the fruits of technical progress, and achieve high rates of economic growth in a sustained way.

Second, the analysis is important by shedding light on the Mexican economy's slow growth syndrome, characterized among other elements by relatively low levels of investment and a tendency of the peso to appreciate in real terms (see Moreno-Brid and Ros 2009, and Ros 2013). If the RER has a significant effect on investment, then the peso appreciation becomes a factor in explaining the country's low rate of economic growth, beyond the often discussed negative effect of appreciations on export growth.

The rest of the paper is organized as follows. Section 2 presents the evolution of the RER and profit margins in the US and Mexican manufacturing sectors. Section 3 discusses theoretically the link between those variables and the pricing rules of firms. Sections 4 and 5 explain the econometric methodology and analyze the estimation results. After the conclusions in section 6, three appendices present data sources and definitions, and additional statistical material.

2. RER and profit margins

Assume local (Mexican) manufacturing firms set their prices by adding a profit margin to their unit variable cost,

(1) $$P = K(AW + BSP_i^*)$$

where $K>1$ is the gross profit margin (the ratio of price to unit cost), $K-1$ is the mark-up rate, and the expression in parenthesis is the unit variable cost. W is the nominal wage in pesos, A is the inverse of labor productivity (with respect to gross output), and therefore AW is the unit labor cost in pesos; S is the nominal exchange rate in pesos per dollar, P_i^* is the dollar price of intermediate inputs (assumed to be imported), B is the amount of intermediate inputs required per unit of gross output, and therefore BSP_i^* is the unit intermediate cost in pesos.

Equation (1) can be re-written as,

(1a) $$P = K\left(1 + \frac{BSP_i^*}{AW}\right)AW = K\left(\frac{1}{1-\sigma(S)}\right)AW$$

where σ, which depends positively on the nominal exchange rate, is the share of intermediate imports in the unit cost (see Hein and Vogel 2008 for a similar expression). Alternatively, equation (1) can be solved for the profit margin as,

(1b) $$K = (1-\sigma)\left(\frac{1}{A}\right)\left(\frac{P}{W}\right)$$

which shows the profit margin depends positively on labor productivity (1/A) and the price/wage ratio (P/W).

Assume foreign (US) firms set their prices in a similar way, and that foreign and local firms produce tradable but differentiated goods. In this case the ratio of foreign to

domestic prices must not necessarily remain constant, and variations in the price ratio will affect the firms' market share. The RER can then be written as,

$$\frac{SP^*}{P} = \left(\frac{K^*}{K}\right)\left(\frac{1-\sigma(S)}{1-\sigma^*}\right)\left(\frac{A^*W^*}{AW/S}\right) \tag{2}$$

where SP^*/P is the peso's RER (measured with price indices from the manufacturing sector), K/K^* is the relative profit margin, AW/S is the home unit labor cost in dollars, and therefore the last ratio on the right side of the equation corresponds to the relative unit labor cost (RULC) between the US and Mexico.

Finally, if we assume that profit margins are flexible, particularly in the open economy,[3] then equation (2) can be re-written more intuitively as,

$$\frac{K}{K^*} = \left(\frac{1-\sigma(S)}{1-\sigma^*}\right)\left(\frac{A^*W^*}{AW/S}\right)/\left(\frac{SP^*}{P}\right) = \left(\frac{1-\sigma(S)}{1-\sigma^*}\right)\left(\frac{RULC}{RER}\right) \tag{2a}$$

which shows the relative profit margin is related positively to RULC and negatively to RER —although as we will see in the next section, the sign of the correlation between the three variables depends on the source of variation and the pricing rules of firms. Note that equation (2a) can be simplified to,

$$\frac{K}{K^*} = \left(\frac{1-\sigma(S)}{1-\sigma^*}\right)\left(\frac{A^*}{A}\right)\left(\frac{P/W}{P^*/W^*}\right) \tag{2b}$$

showing a positive relationship between the relative profit margin and the relative price/wage ratio adjusted for relative labor productivity.

Figure 1 presents series for RER, RULC, and the Mexican/US relative profit margin in the manufacturing sector, all in index form. Profit margins were calculated according to

[3] For early discussions of this point, see e.g. Krugman and Taylor (1978), Blecker (1989), and Bhaduri and Marglin (1990).

equation (1b) but, due to limited data availability, the calculations did not consider the possible influence of changes in σ or σ^*.[4] The Mexican data on the unit labor cost and its components were taken from the industrial survey conducted by Mexico's National Institute of Statistics; the corresponding US source is the Bureau of Labor Statistics. In both countries the data on wages and productivity were retrieved from the unit labor cost series. The price indices correspond to the Producer Price Index (PPI) for total manufacturing industries in the US, and the PPI for manufactures of final use in Mexico. For consistency, RER corresponds to the ratio of those two price indices, multiplied by the peso/dollar nominal exchange rate, so that a rise in RER corresponds to a real depreciation of the peso.

Mexico's relative profit margin declined steadily during the country's first phase of disinflation and foreign capital surge, starting in the late 1980s and lasting until the currency crisis that broke out in December of 1994. This initial decline was rapidly reversed by the sharp peso depreciation that took place in the aftermath of the crisis. The relative profit margin fell again, although less strongly so, as the country entered a second phase of disinflation, renewed capital inflows, and real peso appreciation.[5] Broadly speaking, the relative profit margin appears to be positively correlated with both RULC and RER, although less markedly so in the post-crisis period. The major variations in RER seem to precede changes in the relative profit margin, which suggests causality runs from relative prices to the relative profit margin.[6] Moreover, RULC shows the widest swings throughout the period, whereas the relative profit margin shows a wider range of variation than RER before the currency crisis, but a narrower range after that and until the

[4] Within the restrictions imposed by the available data, Appendix C presents calculations of the share of intermediate goods in the variable cost in Mexico, and argues that changes in this variable are unlikely to have a major influence on the estimation results.

[5] See Galindo and Ros (2008) and Ibarra (2008, 2011b) for analyses of the influence of capital inflows and the Bank of Mexico's disinflationary policy stance on the evolution of the peso's real exchange rate, and Esquivel (2010) for a general assessment of the conduct of macroeconomic policy in Mexico.

[6] Note from equation (2) that if causality ran from exogenous changes in the relative profit margin K/K^* to RER, then the correlation between the two variables should be negative, in contrast to the positive one shown in Figure 1. More formally, López et al. (2000) present econometric evidence of a positive effect of RER on profit margins in the Mexican manufacturing sector and its major divisions in the period 1971–1992, while Onaran (2009) finds peso depreciations tended to reduce the labor share in the Mexican manufactures during the period 1970–2003.

stabilization of inflation in the early 2000s (more about the implications of this pattern below).

Figure 2 presents the series for the profit margin in each country. In the initial, pre-crisis stage, the Mexican/US relative profit margin fell mainly because of a reduction in Mexico's profit margin. In the second stage, however, Mexico's profit margin tended to increase, the net result of a steady rise in labor productivity and a stagnant own real wage in the manufactures. Despite the improvement in the Mexican profit margin, though, the relative margin tended to fall, because of an even faster increase in the US margin.

In closing, we may note an alternative interpretation of the profit margin. Consider an economy with two sectors, one producing tradable (manufactured) goods, and the other non-tradables. If the production of non-tradables is relatively intensive in labor so that their price is determined by the nominal wage in that sector (say, $P_N=W_N$), and if labor is sufficiently mobile to make the nominal wage homogeneous across sectors ($W=W_N$), then our measure of the profit margin, $K=(1/A)(P/W)$, can be interpreted as an indicator of the relative price of tradables to non-tradables, adjusted for labor productivity in the tradables sector. This interpretation may be relevant, as the relative price of tradables to non-tradables is commonly used as RER indicator in the theoretical literature on the profitability channel, and more generally on the RER effect on economic growth.[7]

Figure 3 shows the evolution of the two components of the profit margin in the US and Mexican manufactures. While in both countries the price/wage ratio follows a downward trend, we know that eventually this was more than offset by the steady rise in

[7] The empirical literature, on the other hand, tends to find that variations in aggregate price-based RERs are largely explained by variations in the relative price of local to foreign tradable goods, rather than by variations in the relative price of tradables to non-tradables (see e.g. Drozd and Nosal 2010, and the references therein). There is some disagreement on the Mexican case, though. Mendoza (2005) argues that the relative price of tradables to non-tradables was an important source of variations in a RER index based on US and Mexican CPIs during the initial part of our sample, 1988 to 1994, when Mexico had a managed exchange rate regime. Similarly, Urrutia and Meza (2010) argue that the appreciation trend of a RER index based on US and Mexican GDP deflators from 1988 to 2002 is mostly explained by a steady fall in the relative price of tradables to non-tradables.

labor productivity, resulting in an upward trend for the profit margin in both countries — although with transitory but relatively long periods of stagnation or fall in the Mexican case (recall Figure 2). A comparison with the series in Figure 1 reveals that the price/wage ratio in Mexico is positively correlated with the RER.

[Figures 1, 2, and 3]

3. Profit margins and pricing rules

What is the source of the positive correlation shown in the previous figures between the RER, the Mexican price/wage ratio, and the relative profit margin? The way these variables move together presumably depends on the type of shock that affects them. In this section we consider how the variables may adjust to variations in the nominal exchange rate (assumed to be determined exogenously in the assets markets), and how that adjustment depends on the currency pricing rules of firms. To stress the implications of the alternative pricing rules, the nominal wage is kept constant throughout the analysis.

Consider two types of local (Mexican) manufacturing firms: exporting and import-competing; and two types of pricing rules: local-currency pricing (LCP, or pricing to market), and producer-currency pricing (PCP). In the former case, firms set their price in the destination-market currency; for Mexican firms exporting to the US, this would mean setting their price in US dollars. Under PCP, in contrast, Mexican exporting firms would set their price in pesos.

Gopinath and Rigobon (2008) study import and export prices in the US (by far, Mexico's main trade partner) for the period 1994 to 2005, and find that "there is local currency pricing for US imports and producer currency pricing for US exports… Close to 90% of US imports and 97% of US exports are priced in dollars." (p. 532). These numbers strongly suggest that both US and Mexican exporters set their prices in dollars. Moreover, the authors conclude that "…prices are sticky in the currency in which they are reported as priced" (pp. 531–2), including in situations where the exchange rate changes; more

specifically, they show that (a) "…even if we restrict attention to periods of significant exchange rate movements, goods tend to exhibit fairly high price stickiness" (p. 555), and (b) "…even conditioning on a price change, exchange rate pass-through into imports prices is low at 22%" (p. 570).

We can use the equations from the previous section to calculate the proportional change in RER, RULC and the relative profit margin, for a given change in the nominal exchange rate, and conditional on the firms' pricing rules. For that purpose, in what follows a variable in lower-case letters will denote the proportional change of the corresponding variable shown in upper-case letters in the original equations. From equation (2a) the proportional change in the relative profit margin —equal to the proportional change in the Mexican profit margin under PCP by US firms— would be,

(3) $$k - k^* = -\sigma s + p$$

where $-\sigma s$ is the proportional change in $1-\sigma$ for a given proportional change s in the nominal exchange rate, and where the size of the change in prices p will depend on the pricing rules of firms. Similarly, the proportional change in RER and RULC would be,

(4) $$rer = s - p$$

(5) $$rulc = s.$$

Note that, in contrast to RULC, which will always change in the same proportion as the nominal exchange rate (under the assumption of a constant nominal wage), the proportional change in RER and the relative profit margin will depend on how prices adjust to variations in the nominal exchange rate. Consider the situation of local exporting firms and assume, according to the findings of Gopinath and Rigobon (2008), that they follow a pure LCP rule. In that case local firms would fully adjust their peso price to the variation in the nominal exchange rate $p=s$, and we would have,

(3a) $$k - k^* = -\sigma s + s = (1 - \sigma)s$$

(4a) $$rer = s - s = 0.$$

Equation (3a) shows the relative (and absolute) profit margin would increase after a nominal peso depreciation (although by less than the depreciation, because of the increase in the cost of imported intermediate goods), while according to equation (4a) RER would remain constant. This latter prediction, however, is at odds with the empirical evidence presented in the previous section. As an alternative, assume firms lean against the exchange rate and follow a rule of *partial* LCP, allowing a change in both profit margins and relative prices (and thus in market share) after the currency depreciates. Say firms allow a pass-through of exchange rate changes into peso prices equal to $\pi<1$, so that $p=\pi s$,[8] leading to,

(3b) $$k - k^* = -\sigma s + \pi s = (\pi - \sigma)s$$

(4b) $$rer = s - \pi s = (1 - \pi)s.$$

The predictions from the above equations fit the stylized facts of the Mexican economy well. First, they show a nominal currency depreciation will simultaneously raise both RER and the relative profit margin (except in the unlikely case that $\pi<\sigma$), which is consistent with the positive correlation between these two variables shown in Figure 1. Moreover, recalling that the proportional change in RULC would exactly match the nominal depreciation rate, whereas RER would change by a fraction $1-\pi$ of the depreciation, the equations imply that the proportional range of variation of RULC will be larger than that of RER, as actually seen in the mentioned figure. Finally, according to equations (3b) and (4b), the range of variation of the relative profit margin will be larger than that of RER under a sufficiently high exchange rate pass-through coefficient —more specifically, under $\pi>(1+\sigma)/2$. This suggests the range of variation of the relative profit margin in the Mexican case should be larger than that of RER during the early stages of disinflation, when the transmission of exchange rate changes into peso prices was relatively

[8] Under pure LCP, $\pi=1$. If local firms followed a pure PCP rule, then $\pi=0$. In that case, the real exchange rate would change by the full extent of nominal currency depreciation, while the relative profit margin would not rise (or more precisely, it would fall, because of the rise in the cost of intermediate imports), which again seems at odds with the stylized facts of the Mexican economy.

high, while it should be smaller after inflation became stationary in the early 2000s and the degree of pass-through fell (Banco de México 2011) —which is consistent with the ranges of variation shown in Figure 1.

The previous analysis considered the case of Mexican exporting firms. How would the conclusions change for import-competing firms selling in the domestic market? Keep assuming that US exporters follow a PCP rule and set their prices in dollars, irrespective of variations in the nominal exchange rate. The peso price of competing imports in the Mexican market is $P^*_{peso}=SP^*$, which implies that under a foreign PCP rule its proportional change will be equal to the nominal depreciation of the peso s. If local firms fully adjust to the change in the price of competing imports, we would have $p=s$, and obtain the same results as in the case of pure LCP by Mexican exporting firms. Alternatively, if local firms take advantage of the depreciation to increase their share in the local market, then they will increase their price but by less than the proportional change in the nominal exchange rate and their price will fall in relation to that of competing imports. In that case, $p=\pi s<s$ and we would have the same results as those obtained for exporting firms under partial LCP.

4. Econometric methodology

The previous sections showed that, in broad terms, there is a positive correlation between Mexico's RER, the Mexican price/wage ratio, and the Mexican/US relative profit margin in the manufactures, and argued that such correlation may arise from firms following a partial local-currency pricing rule. The impact on the profit margin is a possible explanation for the effect of the RER on private investment in Mexico. A real peso appreciation, for example, would imply a reduction in the price/wage ratio and relative profit margin and, through that channel, in private investment. The tendency of the peso to appreciate in real terms, as the country went through a protracted period of disinflation and repeated capital-inflow surges, becomes a potentially important factor in explaining the low levels of investment observed in Mexico in recent decades.

This section and the next one focus on the estimation of a private investment function for post-liberalization Mexico. The estimates are used to analyze the effects of the RER and profit margins on investment. There are three main effects to test. First, whether there is a positive effect of RER on investment, when the former is calculated with producer price indices from the manufacturing sector —to be consistent with the theoretical equations presented in the previous section— rather than with aggregate consumer price indices, as previously done in the literature. Second, whether there is a significant effect of profit margins (or their components) on investment. And third, whether the RER coefficient loses statistical significance after profit margins (and other macroeconomic controls) are included in the investment equation, as could be expected if profit margins are behind the observed effect of RER on investment.

In order to test for the existence of persistent, "level" effects (rather than purely transitory, "first-difference" ones), the estimations follow the bounds testing approach of Pesaran et al. (2001). This approach has several advantages over alternative methods such as Johansen's vector error correction model, including its good small-sample properties and the possibility of including variables with different (zero or one) orders of integration. In addition, the approach deals with the potential problem of regressor endogeneity by carrying out the estimation within an ARDL framework. On the other hand, the bounds testing approach can uncover only one long-run relationship, even if more than one existed.

The estimations use quarterly series from 1988 to 2010, for a total of 92 observations. To isolate the effect of RER and profit margins on investment, the estimations control for a set of standard determinants of investment, comprising the industrial production index (as an indicator of the level of economic activity, to control for the accelerator effect), government investment (to control for either complementary or substitution effects), and the real interest rate decomposed into the inflation and nominal interest rates. In addition, the equations include in their short run segment the broad money supply M2, in percentage of GDP, as a rough and ready indicator of credit levels.[9] While

[9] In general, when the M2 ratio was included in the long-run segment of the models, the estimated coefficient was wrongly signed and/or not statistically significant.

the latter three variables are measured in percentage, the remaining ones are expressed in natural logs, so all the estimated coefficients can be interpreted as elasticities (or semi-elasticities, in the case of M2 and the components of the real interest rate). This is the "core" set of determinants, to which we add other variables as we proceed. As shown in Appendix Table B1, our dataset consists of variables integrated of order zero *I*(0) and one *I*(1), making the bounds testing approach particularly attractive.

The equations include an intercept dummy for the period following the currency crisis of December 1994 (so the dummy shifts permanently from zero to one in the first quarter of 1995). The dummy coefficient is always very significant in statistical terms, and shows a negative sign that captures a persistent fall in private investment after the crisis. While the estimated value of the coefficient varies across the different specifications, it generally indicates a fall of at least one-third in the post-crisis level of investment, for given levels of all the other determinants.[10]

The estimations take the form of (error-correction) ARDL models such as,

$$(6) \qquad \Delta PI_t = \sum_{j=1}^{n} a_j \Delta PI_{t-j} + \sum_{i=1}^{k} \sum_{j=0}^{n} b_{i,j} \Delta Z_{i,t-j} + \alpha PI_{t-1} + \sum_{i=1}^{k} d_i Z_{i,t-1} + d_0$$

where Δ means the first difference of the variable, there are k potential determinants Z of private investment PI, and $\alpha<0$ is the error correction or speed of adjustment coefficient. Following Akaike's criterion, the equations were estimated with three lags. This was sufficient to pass a standard battery of diagnostic tests, although some equations required the introduction of quarter outlier dummies, as noted in the tables below.

Bounds testing estimation involves several steps. Initially, *F* and *t* tests are applied to the estimated ARDL model to determine whether the null of no long-run relationship can be rejected; this requires the *t* (in absolute value) and *F* statistics to lie above the upper

[10] Recent research has called attention to the large and very persistent fall in the investment/GDP ratio that may follow in the wake of severe financial crises, such as those in East Asia in the late 1990s and the ongoing crisis in the European periphery (see e.g. Reinhart and Tashiro 2013, and Chari and Henry 2014).

critical values (or upper bound) calculated by Pesaran et al. (2001).[11] In that case the null can be rejected irrespective of whether the variables are $I(0)$, $I(1)$, or a combination. If the null is rejected, in a second step the lag structure can be simplified by removing stepwise the longest, non-statistically-significant lags for each variable in first difference. Finally, the long-run coefficients can be retrieved as $\delta_i = -d_i/\alpha$ from the estimated coefficients of equation (6), leading to the long-run equation,

$$PI_{LR} = \delta_0 + \delta_1 Z_1 + \delta_2 Z_2 + \cdots + \delta_k Z_k. \quad (7)$$

5. Estimation results

5.1 RER and private investment

Before considering the role of profit margins, Table 1 presents estimates of the long-run effect of RER and RULC (which sometimes is used in the literature as a RER indicator) on private investment. Column (1.1) exemplifies the results to be obtained when the real exchange rate is calculated with aggregate consumer prices —in this case, the multilateral rate calculated by the Bank of Mexico. The equation passes all the diagnostic tests, the bounds tests support the existence of a long-run relationship at 1%, and the equation has a large (in absolute terms) speed of adjustment coefficient equal to 0.81.

The estimated coefficients indicate the existence of positive effects from industrial production and the inflation rate on investment, and a negative one from the nominal interest rate. The estimated (absolute) value of the inflation rate coefficient is smaller than that on the nominal interest rate (with the difference being statistically significant according to a Wald test), suggesting that, in addition to its positive effect via the real interest rate, inflation has other, partially-offsetting negative effects, which diminish its net effect on investment.[12] The coefficient on government investment has a negative sign, revealing the

[11] The null hypotheses are $\alpha=0$ (t test), and $\alpha=\delta_1=\delta_2=\ldots=\delta_k=0$ (F test) in equation (6).
[12] The difference between the inflation and nominal interest rate coefficients will not be statistically significant in some of the equations presented below, in which case the equations will be re-estimated using the real interest rate as a single regressor.

existence of substitution effects between public and private investment —perhaps reflecting the sale of public assets to the private sector in Mexico during the initial part of the estimation sample.

The RER coefficient is positively signed, with an estimated value of 0.42, and is statistically significant at 1%. Since RER is measured as a ratio of foreign to Mexican consumer prices, this means that a real depreciation of the peso increases private investment. Note that the result cannot be attributed to the effect of RER on industrial production, as the influence of the latter variable is already controlled for in the estimation.

To facilitate later comparisons, column (1.2) replaces the multilateral rate with the bilateral US/Mexico RER, still based on aggregate consumer prices. While the speed of adjustment coefficient is now smaller in absolute terms (0.59 against 0.81), the estimated value of the majority of long-run coefficients is larger than in the previous specification, including the RER coefficient (0.81 against 0.42). This suggests that the effect on investment is larger when the real exchange rate is measured specifically with US consumer prices rather than in multilateral fashion, perhaps because of the close integration of Mexico to the US economy.[13]

Next, column (1.3) replaces RER with RULC as a possible determinant of investment. The estimated value of the speed of adjustment coefficient is now smaller, and in addition the *t* bounds test supports the existence of a long-run relationship at 5% of significance, instead of the 1% found in the previous columns. Apart from those differences, however, we obtain results that are qualitatively similar to those presented in the preceding equations, including a positive effect on investment from a real depreciation of the peso, in this case meaning an increase in the US labor cost in relation to the Mexican one.

[13] See Ibarra (2013) for a detailed analysis of the robustness of the RER effect on private investment in Mexico, including to changes in the set of controls and the estimation sample.

To be consistent with the theoretical equations presented in the previous two sections, column (1.4) uses a RER indicator based on manufacturing prices. This indicator, which was initially shown in Figure 1, corresponds to the ratio of manufacturing producer price indices between the US and Mexico. The estimation results are very similar to those displayed in columns (1.1) and (1.2), including the positive effect of RER on investment. The estimated RER coefficient is similar to that on the bilateral, CPI-based real exchange rate (0.73 and 0.81, respectively), and larger than the coefficient on the multilateral rate (0.42).[14]

Finally, to discard the possibility that the RER coefficient is picking up an indirect effect via exports, column (1.5) adds real manufactured exports to the previous specification. The export coefficient is not very significant (with a *p*-value of 0.08) and relatively small at 0.18, which perhaps is not surprising since the estimation already controls for the effect of exports via industrial production (which has a much larger elasticity of 2.61). Moreover, the *t*-test for the null of no long-run relationship is not conclusive (it would reject the null hypothesis only on the condition that all the variables are *I*(0), an unlikely condition according to the results presented in Appendix Table B1). For our purposes, though, the important observation is that the RER coefficient remains large (larger, in fact, than in column 1.4) and highly significant in statistical terms —which means the manufacturing PPI-based RER indicator has a positive effect on private investment beyond its indirect effect via manufactured exports and industrial production.

[Table 1]

[14] As noted in the Introduction, while the new RER measure is based on prices in the manufacturing sector, private investment refers to total investment carried out in the Mexican economy, including outside the manufacturing sector. Thus, the significant effect of the manufacturing sector's RER on total investment could mean that the sector-specific RER measure is representative of the economy-wide relative price of tradable goods (assuming that investment is carried out mainly in the capital-intensive tradables sector) and/or that investment in the manufacturing sector acts as an engine, pulling with it investment in the rest of the economy.

5.2 Profit margins and private investment

The next tables explore the possible role of profit margins in the observed relationship between RER and private investment. Table 2 displays estimates of the effect of the Mexican profit margin or its components (labor productivity and the price/wage ratio) on private investment, excluding for the moment RER and the US profit margin. Column (2.1) shows that the Mexican profit margin has a statistically significant, positive effect on private investment, with an estimated elasticity of 0.66. The rest of the estimated coefficients remain statistically significant and keep their expected signs, while their estimated values are similar to those originally obtained in column (1.4). The equation is not totally satisfactory, however, in that the bounds tests can reject the null of no long-run relationship only under the unlikely condition that all the variables are $I(0)$.

Thus, in a next specification the profit margin was split into the price/wage ratio and labor productivity (see column 2.2). The estimated coefficients on the profit margin components are statistically significant and have the expected positive sign; interestingly, the estimated elasticity of investment with respect to labor productivity (1.21) is larger than the elasticity with respect to the price/wage ratio (0.43). Despite these good results, though, the bounds tests remain ambiguous, the ARCH test fails, and the coefficients on inflation and the nominal interest rate are no longer statistically significant.

Since the Wald test in column (2.2) does not support keeping inflation and the nominal interest rate as separate regressors, in a new specification these two variables were replaced with the real interest rate (see column 2.3). Notably, after this change the bounds test do support the existence of a long-run relationship, independently of the degree of integration of the variables, while the components of the profit margin keep showing a statistically significant, positive effect on investment.[15] The coefficient on the real interest

[15] It could be wondered whether the coefficient on labor productivity may not be picking up the effect of an exogenous time trend in investment (given that as we saw labor productivity is strongly upward trended). Similar estimates are obtained, however, after a time trend is included in the equation (in fact, the estimated elasticities with respect to both the price/wage ratio and labor productivity practically double), although the trend coefficient is not statistically significant. This,

rate remains non-significant, however, similarly to what happened in (2.2) with the individual coefficients on inflation and the nominal interest rate.

Column (2.4) shows that adding the ratio of the broad money supply M2 to GDP as a long-run determinant of investment makes the real interest rate coefficient statistically significant but with a wrong, positive sign, while in addition the coefficient on the M2 ratio has a counter-intuitive negative sign.[16] While not shown here to save space, including a time trend does not change the sign of the estimated M2 and real interest rate coefficients. Thus, in a final specification both the M2 ratio and real interest rate were omitted from the investment equation (see column 2.5). The equation shows a relatively high speed of adjustment coefficient (0.53), all the diagnostic tests are satisfactory, and the bounds tests support the existence of a long-run relationship at 1%. In this final specification, as was the case in the previous ones, the components of the Mexican profit margin show a statistically significant, positive effect on private investment.

[Table 2]

The significant effect of the Mexican profit margin (or its separate components) in the investment equation is a possible explanation for the positive effect of the RER on investment in Mexico. A real appreciation of the peso, for example, would imply a decrease in profit margins in the manufacturing sector and, through that channel, in investment. According to this reasoning, including simultaneously RER and the profit margin (or its components) in the investment equation can be expected to reduce the statistical and economic significance of the RER coefficient, since the RER's profitability effect would be directly captured by the coefficient on the profit margin (while the effect through industrial production would be already controlled for).

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and all the other estimation results mentioned in the paper as sensitivity tests but not included in the tables, are available from the author on request, in an unpublished estimations table.

[16] It may be recalled that the unexpected negative sign of the coefficient on the M2 ratio is the reason why this variable was restricted to enter only the short-run segment of the equations.

The next equations test this prediction (see Table 3). Column (3.1) presents estimates of an investment equation that includes simultaneously the RER and Mexican profit margin. The equation passes all the diagnostic tests and shows a high speed of adjustment (0.71), while the bounds tests support the existence of a long-run relationship at 1%. The estimated coefficients on all the controls are highly significant and correctly signed. Somewhat unexpectedly, however, the coefficient on the profit margin is no longer statistically significant, and in addition it shows a counter-intuitive negative sign. In contrast, the estimated RER coefficient remains large (larger, in fact, than in the original equation shown in column 1.4) and highly significant in statistical terms.

The remaining columns in Table 3 test the sensitivity of the previous results to alternative specifications. The results persist if the profit margin is split into the price/wage ratio and labor productivity (column 3.2); if the real interest rate, following the result of the Wald test in (3.2), is used instead of the inflation and nominal interest rates (column 3.3); if the M2 ratio is added to the long-run segment of the model (column 3.4), although its coefficient keeps showing a puzzling negative sign (and in the diagnostics, RESET fails); or if the equation includes an exogenous time trend (column 3.5). These results suggest that the RER has a "deeper" effect on private investment than that of the profit margin, in the sense that the latter's positive effect on investment is wiped out by the inclusion of RER in the equation, while the estimated RER effect remains unaffected, or even becomes larger.[17]

[Table 3]

The previous estimations focused on the effect of the Mexican profit margin on private investment in Mexico, and how this effect changes when RER is re-introduced in the equation. The analysis presented in sections 2 and 3, however, suggests that RER may matter for the determination of investment because of its impact on the *relative* profit margin between Mexico and the US, rather than on the Mexican margin alone. Thus, the following equations incorporate the influence of the US profit margin or its components

[17] While contrary to our initial expectations, we may note that a similar result was found by Blecker (2007) in his study of investment in the US manufacturing sector.

(see Table 4). Column (4.1) presents an equation that includes the Mexican/US relative profit margin as a possible determinant of investment. While the estimated coefficients on the controls are statistically significant and show the expected sign, the overall results are not satisfactory: the null of no long-run relationship can be rejected only under the implausible condition that all variables are *I*(0), there is serial correlation in the residuals, and the coefficient on the relative profit margin is wrongly signed and non-significant in statistical terms.

In view of these results, in a next step the relative profit margin was split into the Mexican and US profit margins (see column 4.2). This brings a notable improvement in the estimation results, including in the bounds tests, which now support the equation at 1%; the diagnostics are satisfactory (except for a relatively low *p*-value of 0.18 in the ARCH test), and the speed of adjustment increases from 0.41 to 0.79. Unexpectedly, though, the estimated coefficients on the individual profit margins have "switched" signs, with a large and highly significant *positive* effect from the US profit margin, and again a negative (although not statistically significant) effect from the Mexican one.[18] Moreover, if RER is added to the previous equation, the coefficient on the Mexican margin becomes statistically significant but the unexpected signs on the profit margin coefficients persist (see column 4.3).

Again, several alternative specifications were tried as sensitivity tests. Since the US profit margin is upward trended, its coefficient could be picking up the effect of an exogenous time trend in investment. Thus, equation (4.3) was re-estimated after including a linear time trend, either keeping or eliminating the post-currency crisis dummy (which we may recall shifts permanently to one in the first quarter of 1995). Additionally, the equation was re-estimated for the reduced samples 1988Q1–2007Q4 and 1990Q1–2007Q4, excluding in that way the global crisis period 2008–2010 and, in the second case, also the transition period from very high inflation rates to moderate ones in Mexico in the late

[18] Wald test results (not shown) support the inclusion of the real interest rate instead of the inflation and nominal interest rates, but in any case the results shown in columns (4.1) and (4.2) do not change qualitatively if the latter two variables are used to replace the real rate (results available on request).

1980s. In all the cases the estimations confirmed the unexpected signs of the coefficients on the Mexican and US profit margins, and the continuing significance of the RER coefficient (results available on request). Columns (4.4) to (4.6) show that similar results obtain if we use the price/wage ratios instead of the profit margins, alone or with a time trend.[19, 20]

Given the close integration of the Mexican manufacturing sector to the US industrial production chains, it is not surprising that US profitability appears to have a significant influence on Mexican investment. The sign of the effect, though, was in principle uncertain. An increase in US profitability may attract to the US investments that otherwise would have been carried out in Mexico, thus depressing investment in the latter country. On the other hand, the increase in the US profit margin may create expectations of a future expansion of the US economy and thus of the market for Mexican exports. The improvement in expectations could lead to higher investment levels in Mexico —which is one way to interpret the positive effect obtained in the estimations.

To test the robustness of the US profitability effect on investment in Mexico, the final columns in Table 4 replace the US profit margin with an index of the US real effective exchange rate based on manufacturing prices (where an increase indicates a real dollar depreciation). As shown by Blecker (2007), a real dollar depreciation increases profits and private investment in the US manufacturing sector. Thus, a dollar depreciation could create expectations of a future US expansion, and in that way encourage investment in Mexico. This effect seems confirmed by the results shown in columns (4.7) and (4.8). The estimated elasticity in the latter column, which controls for a time trend, is not small at 0.31, if for

[19] The time trend in an equation like (4.4) was not statistically significant (its coefficient had a *p*-value of 0.13). In any event, its inclusion did not change qualitatively the results.
[20] As noted above, profit margins were calculated using series for labor productivity and the price/wage ratio in the manufactures, as per equation (1b), but omitting the share of intermediate goods in the variable cost. While a series for this share which could be suitable for inclusion in the investment regressions is not available, it is possible to calculate some indicators for the reduced period 1994–2009 and use them to form an idea of whether the omission is likely to be an important factor. Appendix C presents these calculations, and argues that the relatively small changes in the share of intermediate goods, compared to the size of the observed changes in the RER and price/wage ratios, are unlikely to alter the qualitative results presented in Table 4.

comparison we consider that the elasticity of Mexican investment with respect to the peso's own real exchange rate is 0.54 in the same equation.[21]

[Table 4]

6. Conclusions

A salient feature of Mexico's slow economic growth syndrome is the mixture of relative low levels of investment and a tendency of the peso to appreciate in real terms. According to previous studies, the appreciation contributes to explaining the low levels of investment observed in the country. In different specifications and with different estimation methodologies, the same result obtains: a real appreciation of the peso tends to reduce the level of investment.

The above result could reflect the effect of the real exchange rate (RER) on profit margins in the tradable sector —the RER's profitability channel. The paper showed that, in broad terms, the peso's RER in the post-liberalization period has been positively correlated with the Mexican/US relative profit margin in the manufacturing sector, and with the Mexican price/wage ratio in the same sector. It argued that this correlation may arise from the Mexican firms leaning against currency depreciations and following a rule of partial local-currency pricing. In that case, exogenous variations in the nominal exchange rate would be reflected partly in the RER and partly in the relative profit margin, yielding a positive correlation between the two variables.

[21] If Mexican manufactured exports are added to equations (4.7) or (4.8), the value and statistical significance of the coefficient on the US real exchange rate are not diminished (in contrast to exports, which are not significant), which further suggests that the coefficient on the US real exchange rate is capturing an expectations effect rather than an effect from actual trade levels. Also, alternative versions of (4.7) were estimated with the US industrial production index or private investment in the manufacturing sector replacing the US real exchange rate, but neither variable was statistically or economically significant. Finally, the results shown in (4.7) and (4.8) do not change in any meaningful sense if the Mexican price/wage ratio is used instead of the Mexican profit margin (all of these results are available on request).

The paper tested for the operation of the RER's profitability channel in Mexico by estimating a private investment function for the post-liberalization period 1988Q1–2010Q4. It presented evidence of a statistically significant, positive effect of the Mexican manufacturing profit margin (or its components) on investment. It also presented some unexpected but robust results. First, the RER continues to have a large, statistically significant effect on private investment, after controlling not only for the industrial production index but also for the Mexican profit margin. Moreover, when both variables are included in the equation, the effect from the profit margin becomes non-significant and switches sign. Thus, the effect from the RER appears to be "deeper" than the effect from the profit margin, in the sense that the latter is wiped out by the inclusion of RER in the investment equation.

Second, the coefficient on the Mexican profit margin or alternatively the price/wage ratio also becomes negative (and in some specifications remains statistically significant) when the US profit margin or the US price/wage ratio are included in the investment equation. Moreover, the estimated coefficients on the US variables show a highly significant and robust positive sign. The positive effect of the US profit margin on investment in Mexico seems to come from the creation of optimistic expectations about a future expansion in the US economy (and hence in the market for Mexican manufactured exports) caused by an improvement in profit margins. This interpretation is supported by the observation that a real depreciation of the US dollar, measured on a multilateral basis, also has a positive effect on private investment in Mexico. The expectation of a future expansion in the US created by a real depreciation of the dollar —and the accompanying increase in the US profit margin— appears to pull with it investment in Mexico.

While it is not surprising (given the close integration of the Mexican manufacturing sector to the US industrial production chains) that good news for the US economy can create positive expectations in Mexico and induce higher investment levels, it is also the case that the positive sign of the estimated coefficient on the US profit margin (and the negative sign of the coefficient on the Mexican/US relative profit margin) seem contrary to what could be expected from the operation of the RER's profitability channel. All in all, it

appears that the channels for the RER effect on investment in Mexico deserve further analysis.

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Appendix A. Data sources and definitions

I) Mexican variables

Annual inflation rate: Annual variation of the consumer price index (CPI), in percentage. The quarterly CPI series corresponds to the average of the original monthly series. Source: Bank of Mexico (BOM).

Broad money supply, M2: Percentage ratio of nominal M2, BOM's definition, to the annualized nominal GDP. Nominal M2 corresponds to the quarterly average of the original end-of-month series. Source: BOM and Mexico's National Institute of Statistics (INEGI).

CPI-based, multilateral real exchange rate (RER): Natural log (times 100) of the multilateral, CPI-based real exchange rate index calculated by BOM. An increase in the index means a real depreciation of the peso.

Government investment: Natural log (times 100) of government investment (gross fixed capital formation), in real pesos. Source: National Accounts data from INEGI.

Industrial production index: Natural log (times 100) of the industrial production index. The quarterly series corresponds to the average of the original seasonally-adjusted monthly series. Source: INEGI.

Manufactured exports: Natural log (times 100) of Mexican manufactured exports, in US dollars deflated by the US producer price index (PPI) for industrial commodities. Source: Current account data from BOM, and BLS for the US PPI.

Manufacturing labor productivity and price/wage ratio: See "Mexican profit margin."

Mexican profit margin: Natural log (times 100) of the price/wage ratio in the Mexican manufacturing sector, multiplied by labor productivity. The price index is the PPI for manufactures of final use. The nominal wage and the labor productivity index (the latter, based on gross output) are the components of the unit labor cost in the manufactures calculated by INEGI with data from its industrial survey. The original series with base in 1980, 1993, and 2003 were spliced. Data exclude the maquiladora sector. Source: Author's calculations with data from BOM for the PPI and INEGI for the rest of variables.

Nominal interest rate: Quarterly average of the monthly series of the annualized nominal interest rate on 91-day Mexican Treasury bills (Cetes), in percentage. Source: BOM.

Private investment: Natural log (times 100) of private investment (gross fixed capital formation), in real pesos. Source: National Accounts data from INEGI.

Real interest rate: Difference between the nominal interest rate and the contemporaneous inflation rate.

II) Relative Mexican/US variables

CPI-based, US/MX RER: Natural log (times 100) of the CPI ratio between the US and Mexico, multiplied by the nominal peso/dollar exchange rate. Source: Author's calculations with data from BOM and the US Bureau of Labor Statistics (BLS).

Mexican/US relative profit margin: Natural log (times 100) of the ratio of the Mexican to the US profit margin in the manufactures. See the explanation for the calculation of each country's profit margin in this Appendix.

PPI-based, US/MX RER: Natural log (times 100) of the PPI ratio between the US and Mexico, multiplied by the nominal peso/dollar exchange rate. The US PPI is the index for total manufacturing industries, while the Mexican PPI is for manufactured goods of final use. Source: Author's calculations with data from US BLS and BOM.

Relative unit labor cost (RULC): Natural log (times 100) of the ratio of the unit labor cost in the manufactures between the US and Mexico, in dollars. Sources: US BLS and INEGI.

III) US variables

Manufacturing price/wage ratio: See "US profit margin."

Manufacturing real exchange rate: Natural log (times 100) of the US real effective exchange rate index based on manufacturing consumer price indices. The original index was inverted, so that an increase in the inverted index means a real depreciation of the dollar. Source: FRED database, Federal Reserve Bank of St. Louis, with data from the OECD Main Economic Indicators.

US profit margin: Natural log (times 100) of the price/wage ratio in the US manufacturing sector, multiplied by labor productivity. The price index is the PPI for total manufacturing industries. The nominal wage and the labor productivity index are the components of the unit labor cost in the manufactures calculated by the US BLS. Source: Author's calculations with data from US BLS.

Appendix B. Unit root tests

[Table B1]

Appendix C. The share of intermediate goods in the variable cost

The data for the calculations in this appendix were taken from the Annual Industrial Survey conducted by Mexico's National Institute of Statistics, INEGI (which is the same source for the data on the unit labor cost and its components used in the calculation of the Mexican profit margin, but in the latter case using the monthly survey). Data from two surveys are available: one comprising 205 industrial classes from 1994 to 2003, and an expanded one for 231 classes from 2003 to 2009. The data are reported in nominal pesos. Two indicators were calculated. The first is the ratio of total intermediate inputs (goods and services) to total variable cost, where intermediate inputs consist of home-produced and imported intermediate goods ("raw and auxiliary materials") plus different types of services (packaging, electricity consumption, marketing, shipping and handling, etc.), while the total variable cost consists of intermediate inputs plus labor payments. The second

indicator is the ratio of intermediate goods (i.e., without services) to variable cost, where the latter consists of intermediate goods plus labor payments. It turns out that both indicators behave in a similar way, so the following discussion considers only the second one (see Appendix Table C1).

Beginning with the data for 1994–2003, the share of intermediate goods in the variable cost changed over time, but the changes were relatively small and partly transitory. Thus, the share increased from 0.78 in 1994 to 0.86 in 1996, but then decreased steadily, reaching a minimum of 0.82 in 2002. The increase was driven by the higher share of imported intermediate goods, which rose from 0.28 in 1994 to 0.35 in 1996, and then fell back to 0.32. The timing and profile of these changes suggest that they were driven by the evolution of the peso's real exchange rate, which experienced a large depreciation in 1995, and was followed by a steady appreciation until the early 2000s.

During the 2000s the share of intermediate goods showed a slight upward trend, rising from 0.86 in 2003 to about 0.90 in 2008–09. Interestingly, this was the net result of an increase in the share of home-produced materials and this time a decrease in the share of imported ones (from about 0.27 to 0.24). In these years the peso tended to depreciate in real terms, so the decrease in the share of imported materials cannot be explained by the behavior of the real exchange rate —which in fact would have tended to increase their share in the variable cost, because of the depreciation.

The above changes in the share of intermediate goods —which amount to a slightly upward trend, within the years covered by each survey— seem too small, compared to the observed changes in variables like the RER and the price/wage ratio, to have an important effect on the Mexican profit margin, and hence on private investment. As a sensitivity test, however, the equation shown in column (4.5) in the main text was re-estimated after adding a linear time trend intended to capture —in an admittedly imperfect way— the possible influence of variables like the share of intermediates in the variable cost. As shown in column (4.6), the time trend is statistically significant and its inclusion improves the diagnostics of the original equation (4.5), in particular the normality test, and leads to an increase in the absolute value of the speed of adjustment coefficient (from 0.74 to 0.95). Despite this improvement, however, including a trend does not change qualitatively the estimation results regarding the effect of RER and the profit-margin components on private investment.

[Table C1]

Table 1. Real exchange rate and private investment					
Dependent variable: Private investment, *ln*					
Long-run coefficients from error-correction ARDL models, 1988Q1 2010Q4, n=92					
	(1.1) ^a	(1.2) ^b	(1.3) ^b	(1.4)	(1.5)
Speed of adjustment, α	-0.812	-0.594	-0.498	-0.767	-0.772
Post-crisis dummy, 1995-2010	-34.5 (0.00)	-47.2 (0.00)	-45.0 (0.00)	-39.6 (0.00)	-51.4 (0.00)
Industrial production index, *ln*	2.81 (0.00)	2.99 (0.00)	2.74 (0.00)	2.94 (0.00)	2.61 (0.00)
Government investment, *ln*	-0.28 (0.00)	-0.34 (0.00)	-0.24 (0.00)	-0.29 (0.00)	-0.33 (0.00)
Nominal interest rate, %	-0.54 (0.00)	-0.71 (0.00)	-0.54 (0.02)	-0.49 (0.00)	-0.46 (0.00)
Annual inflation rate, %	0.32 (0.00)	0.31 (0.00)	0.35 (0.01)	0.32 (0.00)	0.30 (0.00)
CPI-based, multilateral RER, *ln*	0.42 (0.00)				
CPI-based, bilateral US/MX RER, *ln*		0.81 (0.00)			
Relative unit labor cost RULC, *ln*			0.31 (0.04)		
PPI-based, manufacturing RER, *ln*				0.73 (0.00)	0.83 (0.00)
Manufactured exports, *ln*					0.18 (0.08)
Bounds t-statistic	-5.41 ***	-5.30 ***	-4.65 **	-4.95 ***	-3.94 ^c
Bounds F-statistic	7.05 ***	6.96 ***	5.01 ***	6.04 ***	3.77 **
Adjusted R-squared	0.901	0.926	0.909	0.896	0.899
Jarque-Bera	0.08 (0.96)	1.45 (0.48)	3.11 (0.21)	1.24 (0.54)	0.36 (0.84)
Breusch-Godfrey (4) F-test	0.92 (0.46)	0.48 (0.27)	1.11 (0.36)	1.45 (0.23)	1.02 (0.40)
ARCH F-test	0.03 (0.86)	0.58 (0.45)	0.12 (0.74)	1.39 (0.24)	1.03 (0.31)
RESET F-test	0.06 (0.81)	0.03 (0.87)	0.57 (0.45)	1.17 (0.28)	0.66 (0.42)
Wald F-test	10.2 (0.00)	14.4 (0.00)	2.27 (0.14)	5.70 (0.02)	5.31 (0.02)
Notes: 1) The underlying ARDL models were estimated with 3 lags and a long-run intercept (not shown).					
2) All the equations include the monetary aggregate M2/GDP in the short-run segment of the model.					
3) For illustrative purposes, p-values for the d_i coefficients from equation (6) (see main text) are shown in parenthesis next to the long-run coefficients.					
4) Diagnostics: The null hypotheses are that residuals are normally distributed (Jarque-Bera), and that there is no serial correlation of up to 4th order (Breusch-Godfrey), no ARCH errors, and no mis-specification error (RESET).					
χ^2 (Jarque-Bera) and F-statistics with p-values in brackets.					
5) Bounds testing: Rejects the null of no long-run relationship at ***1%, **5%, *10% according to the critical values calculated by Pesaran et al. (2001).					
6) Wald is an F-test for the null that the sum of coefficients on inflation and the nominal interest rate is zero.					
^a Includes a quarter outlier dummy for 2008Q3.					
^b Includes quarter outlier dummies for 1996Q4, 2008Q2, and 2008Q3.					
^c Rejects the null of no long-run relationship only under the assumption of purely I(0) variables.					

Table 2. Mexican profit margin and private investment					
Dependent variable: Private investment, *ln*					
Long-run coefficients from error-correction ARDL models, 1988Q1 2010Q4, n=92					
	(2.1)^a	(2.2)	(2.3)	(2.4)	(2.5)
Speed of adjustment, α	-0.502	-0.473	-0.504	-0.455	-0.529
Post-crisis dummy, 1995-2010	-55.0 (0.00)	-64.1 (0.00)	-65.4 (0.00)	-77.0 (0.00)	-60.6 (0.00)
Industrial production index, *ln*	2.30 (0.00)	1.75 (0.00)	1.74 (0.00)	1.41 (0.03)	1.94 (0.00)
Government investment, *ln*	-0.29 (0.00)	-0.37 (0.00)	-0.35 (0.00)	-0.22 (0.07)	-0.34 (0.00)
Nominal interest rate, %	-0.55 (0.00)	-0.07 (0.81)			
Annual inflation rate, %	0.30 (0.00)	0.10 (0.51)			
Real interest rate, %			0.10 (0.35)	0.25 (0.04)	
Broad money M2, *% of GDP*				-1.24 (0.048)	
MX profit margin, *ln*	0.66 (0.00)				
MX price/wage ratio, *ln*		0.43 (0.04)	0.53 (0.00)	0.78 (0.00)	0.42 (0.00)
MX labor productivity, *ln*		1.21 (0.00)	1.23 (0.00)	2.00 (0.00)	1.02 (0.00)
Bounds t-statistic	-3.32^b	-3.45^b	-4.14 *	-3.17^b	-4.75 ***
Bounds F-statistic	3.20^b	2.95^b	4.62 **	4.80 ***	7.38 ***
Adjusted R-squared	0.887	0.879	0.879	0.886	0.867
Jarque-Bera	0.11 (0.95)	0.13 (0.94)	0.25 (0.88)	0.25 (0.88)	1.64 (0.44)
Breusch-Godfrey (4) F-test	1.07 (0.38)	1.47 (0.22)	1.08 (0.37)	0.62 (0.65)	0.74 (0.57)
ARCH F-test	1.30 (0.26)	5.06 (0.03)	1.32 (0.25)	1.03 (0.31)	0.07 (0.79)
RESET F-test	0.32 (0.75)	1.85 (0.18)	1.62 (0.21)	0.33 (0.57)	1.51 (0.22)
Wald F-test	3.66 (0.06)	0.01 (0.90)			
For explanatory notes, see Table 1.					
The profit margin, price/wage ratio, and labor productivity are for the manufacturing sector.					
^a Includes a quarter outlier dummy for 1996Q4.					
^b Rejects the null of no long-run relationship only under the assumption of purely I(0) variables.					

Table 3. RER, Mexican profit margin, and private investment					
Dependent variable: Private investment, *ln*					
Long-run coefficients from error-correction ARDL models, 1988Q1 2010Q4, n=92					
	(3.1) ^a	(3.2)	(3.3)	(3.4)^b	(3.5)
Speed of adjustment, α	-0.708	-0.606	-0.648	-0.524	-0.572
Post-crisis dummy, 1995-2010	-37.3 (0.00)	-57.7 (0.00)	-49.6 (0.00)	-60.3 (0.00)	-56.5 (0.00)
Industrial production index, *ln*	3.25 (0.00)	2.96 (0.00)	3.03 (0.00)	2.88 (0.00)	3.21 (0.00)
Government investment, *ln*	-0.36 (0.00)	-0.53 (0.00)	-0.38 (0.00)	-0.40 (0.00)	-0.40 (0.00)
Nominal interest rate, %	-0.71 (0.00)	-0.46 (0.046)		-0.87 (0.00)	-0.54 (0.025)
Annual inflation rate, %	0.49 (0.00)	0.43 (0.00)		0.70 (0.00)	0.50 (0.00)
Real interest rate, %			-0.25 (0.01)		
Broad money M2, *% of GDP*				-2.06 (0.00)	
Time trend					-0.65 (0.048)
PPI-based, manufacturing RER, *ln*	1.03 (0.00)	1.21 (0.00)	0.90 (0.00)	1.82 (0.00)	1.34 (0.00)
MX profit margin, *ln*	-0.24 (0.21)				
MX price/wage ratio, *ln*		-0.27 (0.27)	-0.16 (0.34)	-0.35 (0.19)	-0.31 (0.23)
MX labor productivity, *ln*		0.44 (0.15)	0.19 (0.46)	1.18 (0.00)	0.79 (0.09)
Bounds t-statistic	-5.97 ***	-5.25 ***	-5.52 ***	-4.08^c	-4.49^c
Bounds F-statistic	6.11 ***	4.26 ***	5.68 ***	7.82 ***	5.01 ***
Adjusted R-squared	0.923	0.906	0.900	0.937	0.909
Jarque-Bera	0.05 (0.98)	0.01 (0.99)	2.37 (0.31)	1.29 (0.52)	0.15 (0.93)
Breusch-Godfrey (4) F-test	1.47 (0.22)	0.95 (0.44)	1.40 (0.24)	0.35 (0.84)	0.30 (0.88)
ARCH F-test	0.06 (0.80)	1.31 (0.26)	2.20 (0.14)	1.62 (0.21)	0.05 (0.83)
RESET F-test	0.09 (0.76)	0.08 (0.78)	0.00 (0.99)	3.99 (0.051)	0.07 (0.79)
Wald F-test	5.91 (0.02)	0.05 (0.83)		1.65 (0.20)	0.07 (0.80)^d
For explanatory notes, see Table 1.					
The profit margin, price/wage ratio, and labor productivity are for the manufacturing sector.					
^a Includes quarter outlier dummies for 2008Q2 and 2008Q3.					
^b Includes a quarter outlier dummy for 1997Q1.					
^c Rejects the null of no long-run relationship only under the assumption of purely I(0) variables.					
^d If the real interest rate is included as a single regressor, both the time trend and the components of the Mexican profit margin become statistically non-significant.					

Table 4. Profit margins, price/wage ratios, and private investment								
Dependent variable: Private investment, *ln*								
Long-run coefficients from error-correction ARDL models, 1988Q1 2010Q4, n=92								
	(4.1)	(4.2)	(4.3)	(4.4)^b	(4.5)	(4.6)	(4.7)	(4.8)
Speed of adjustment, α	-0.408	-0.792	-0.734	-0.749	-0.737	-0.945	-0.959	-0.990
Post-crisis dummy, 1995-2010	-29.3 (0.00)	-31.8 (0.00)	-35.1 (0.00)	-39.6 (0.00)	-40.1 (0.00)	-38.5 (0.00)	-30.9 (0.00)	-33.3 (0.00)
Industrial production index, *ln*	2.66 (0.00)	2.14 (0.00)	2.98 (0.00)	3.16 (0.00)	3.19 (0.00)	2.72 (0.00)	2.84 (0.00)	2.74 (0.00)
Government investment, *ln*	-0.24 (0.00)	-0.30 (0.00)	-0.34 (0.00)	-0.32 (0.00)	-0.31 (0.00)	-0.34 (0.00)	-0.24 (0.00)	-0.34 (0.00)
Real interest rate, %	-0.32 (0.04)	-0.14 (0.016)	-0.27 (0.00)	-0.40 (0.00)	-0.36 (0.00)	-0.25 (0.00)	-0.18 (0.012)	-0.22 (0.00)
PPI-based, manuf RER, *ln*			0.68 (0.00)	0.78 (0.00)	0.79 (0.00)	0.58 (0.00)	0.34 (0.09)	0.54 (0.009)
MX/US profit margin, *ln*	-0.17 (0.50)							
MX profit margin, *ln*		-0.17 (0.15)	-0.35 (0.013)				-0.04 (0.78)	-0.19 (0.16)
US profit margin, *ln*		1.04 (0.00)	0.55 (0.006)					
MX/US price/wage ratio, *ln*				-0.33 (0.00)				
MX price/wage ratio, *ln*					-0.29 (0.00)	-0.21 (0.013)		
US price/wage ratio, *ln*					0.35 (0.03)	0.37 (0.00)		
US manufacturing RER, *ln*							0.43 (0.00)	0.31 (0.03)
Time trend						0.31 (0.07)		0.30 (0.051)
Bounds t-statistic	-3.08^a	-5.61 ***	-6.39 ***	-6.07 ***	-5.60 ***	-5.64 ***	-5.96 ***	-6.23 ***
Bounds F-statistic	2.86^a	7.11 ***	7.01 ***	7.11 ***	5.97 ***	6.01 ***	6.21 ***	6.70 ***
Adjusted R-squared	0.852	0.898	0.904	0.897	0.906	0.906	0.906	0.912
Jarque-Bera	1.17 (0.56)	0.81 (0.67)	3.03 (0.22)	1.32 (0.52)	3.01 (0.22)	0.40 (0.82)	2.14 (0.34)	1.81 (0.40)
Breusch-Godfrey (4) F-test	4.38 (0.00)	0.71 (0.59)	1.04 (0.39)	0.31 (0.87)	0.67 (0.62)	0.43 (0.79)	0.43 (0.79)	0.15 (0.96)
ARCH F-test	1.23 (0.27)	1.86 (0.18)	1.02 (0.32)	0.05 (0.82)	0.39 (0.53)	0.01 (0.94)	0.01 (0.94)	0.01 (0.92)
RESET F-test	1.61 (0.21)	0.04 (0.83)	1.13 (0.29)	0.25 (0.62)	0.37 (0.55)	0.19 (0.66)	0.68 (0.42)	0.99 (0.32)
For explanatory notes, see Table 1.								
Profit margins and price/wage ratios correspond to the manufacturing sector.								
^a Rejects the null of no long-run relationship only under the assumption of purely I(0) variables.								
^b The relative Mexican/US labor productivity had a positively signed but not statistically significant coefficient, and thus was omitted from the equation.								

Table B1. Unit root tests					
1988Q1-2010Q4, 92 observations					
	Augmented Dickey-Fuller			Phillips-Perron	
	Level	First difference		Level	First difference
Annual inflation rate	-5.16 ***	-4.60 ***		-4.97 ***	-4.99 ***
Broad money supply, M2/GDP	-0.13	-6.21 ***		0.09	-20.81 ***
CPI-based, multilateral real exchange rate (RER)	-3.16 **	-4.12 ***		-2.90 **	-8.84 ***
CPI-based, bilateral US/MX RER	-3.60 ***	-4.12 ***		-3.49 **	-9.60 ***
Government investment	-0.43	-6.20 ***		-6.28 ***	-25.47 ***
Industrial production index	-1.83	-6.04 ***		-1.66	-5.04 ***
Labor productivity^a	-3.01 **	-4.86 ***		-4.56 ***	-11.92 ***
Manufactured exports	-1.54	-4.04 ***		-2.23	-12.60 ***
Mexican/US relative price/wage ratio^a	-3.56 ***	-7.04 ***		-2.76 *	-7.02 ***
Mexican/US relative profit margin^a	-2.71 *	-3.81 ***		-1.92	-8.67 ***
Nominal interest rate	-4.99 ***	-9.62 ***		-5.36 ***	-10.15 ***
PPI-based, bilateral US/MX RER	-3.04 **	-4.77 ***		-3.05 **	-10.42 ***
Price/wage ratio^a	-3.89 ***	-2.87 *		-2.97 **	-6.56 ***
Private investment	-1.66	-3.87 ***		-2.20	-15.91 ***
Profit margin^a	-1.23	-3.37 **		-0.73	-7.73 ***
Real interest rate	-5.21 ***	-7.95 ***		-3.07 **	-7.86 ***
Relative unit labor cost (RULC)^a	-3.34 **	-3.81 ***		-2.85 *	-9.41 ***
US manufacturing real exchange rate	1.18	-7.60 ***		1.24	-8.04 ***
US price/wage ratio^a	-1.07	-7.81 ***		-1.12	-7.99 ***
US profit margin^a	-0.01	-7.19 ***		-0.04	-7.87 ***
Notes: The unit root hypothesis is rejected at ***1%, **5%, *10%.					
The ADF tests include intercept, with lag length determined by Akaike (maximum lag of 4).					
The PP tests include intercept, with Bartlett kernel and Newey-West bandwidth.					
Both sets of tests use MacKinnon critical values.					
^a In the manufacturing sector.					

Table C1. Share of intermediate goods in the total variable cost

	(A) Share of intermediate goods and services	(B) Share of intermediate goods	(C) Share of home-produced intermediate goods	(D) Share of imported intermediate goods
Annual Industrial Survey for 205 industrial classes				
1994	0.832	0.778	0.499	0.279
1995	0.870	0.832	0.510	0.322
1996	0.887	0.857	0.503	0.354
1997	0.886	0.854	0.500	0.355
1998	0.882	0.849	0.491	0.359
1999	0.873	0.837	0.483	0.353
2000	0.870	0.832	0.480	0.352
2001	0.859	0.817	0.470	0.347
2002	0.860	0.816	0.479	0.337
2003	0.863	0.819	0.496	0.323
Annual Industrial Survey for 231 industrial classes				
2003	0.896	0.863	0.598	0.265
2004	0.904	0.874	0.609	0.265
2005	0.909	0.880	0.616	0.264
2006	0.915	0.889	0.629	0.260
2007	0.920	0.897	0.639	0.258
2008	0.926	0.905	0.659	0.246
2009	0.924	0.901	0.663	0.238

Notes: Intermediate goods correspond to "raw and auxiliary materials," while intermediate services include packaging, electricity consumption, marketing, shipping and handling, etc.
The variable cost in (A) corresponds to the cost of intermediate goods and services plus labor payments, while in (B) to (D) it corresponds to the cost of intermediate goods plus labor payments. (B) equals the sum of (C) and (D).
Source: Author's calculations with data in nominal pesos from INEGI's Annual Industrial Survey.

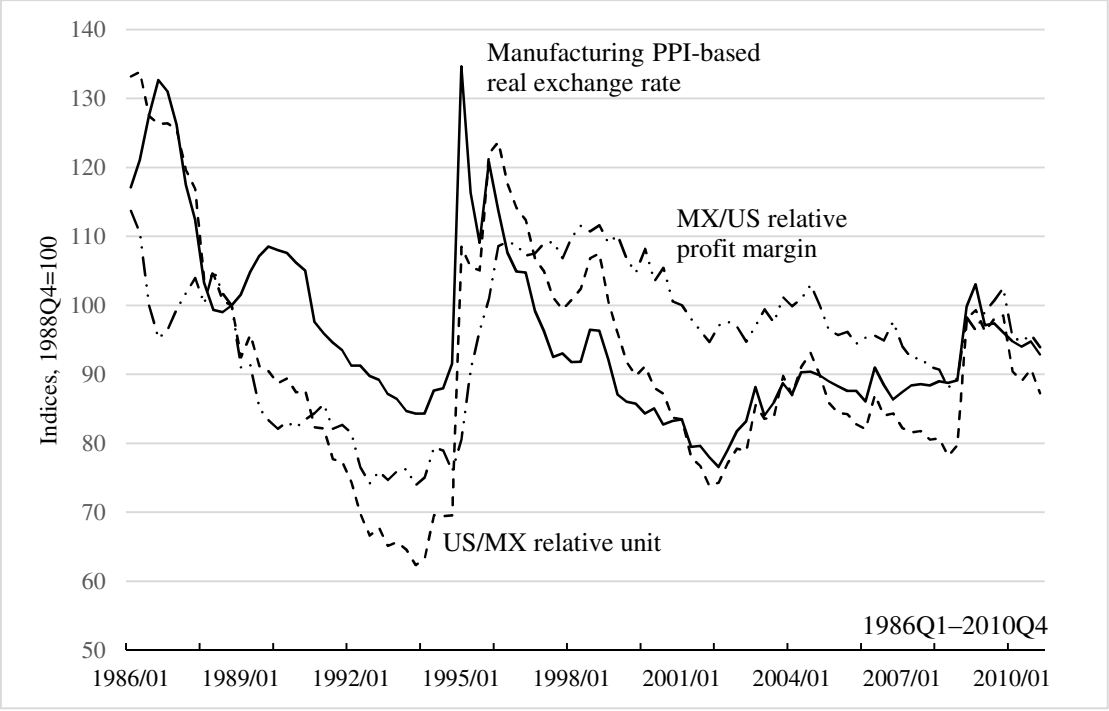

Figure 1. RER, RULC, and relative profit margin in the Mexican manufactures
Source: Author's calculations. See Appendix A for data sources and definitions.

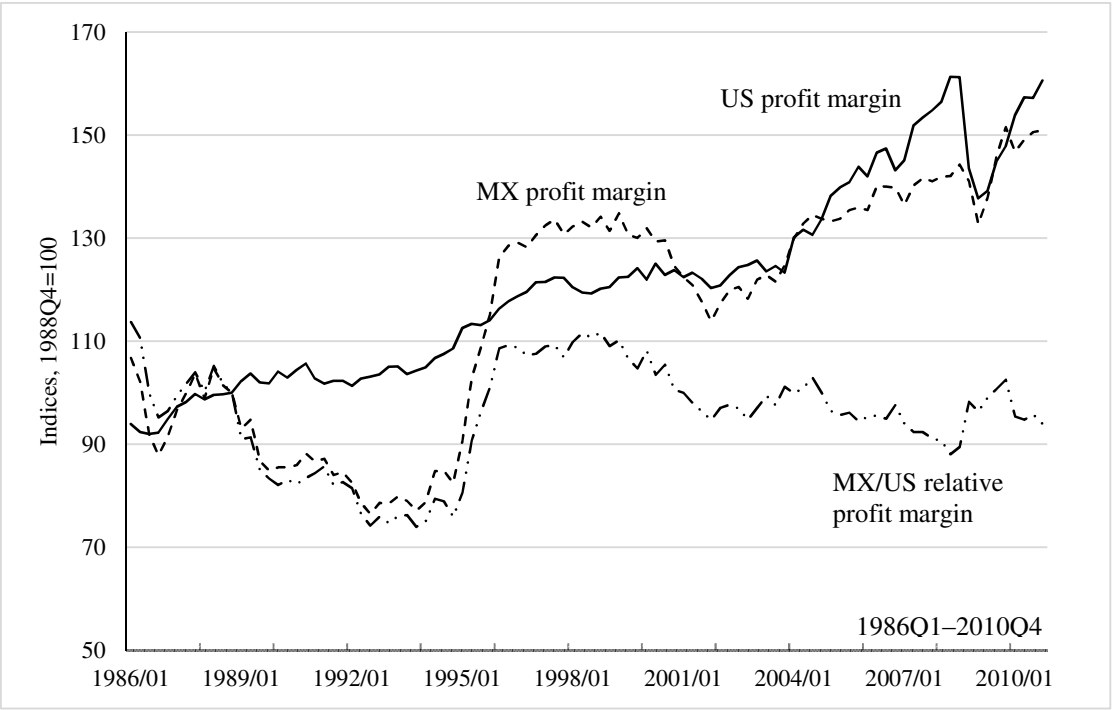

Figure 2. Profit margins in the US and Mexican manufactures
Source: Author's calculations. See Appendix A for data sources and definitions.

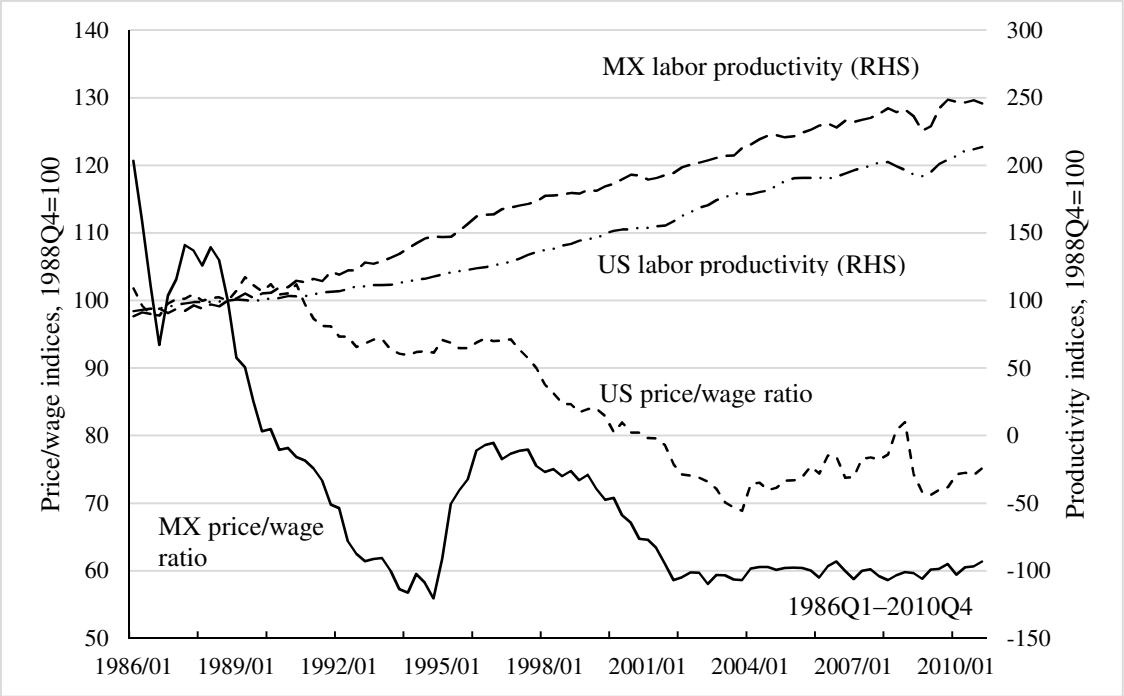

Figure 3. Price/wage ratio and labor productivity in the US and Mexican manufactures
Source: Author's calculations. See Appendix A for data sources and definitions.