Assessing the financial role of the exchange rate

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Abstract. Our contribution aims at rethinking the role of the exchange rate as a tool to boost investment and structural change, by constructing an analytical macro model based on Frenkel and Ros (2006), Ros (2015) and Dvoskin and Feldman (2018). We consider, in particular, the financial cost of depreciation, which is generated by imbalances in the foreign exchange rate position in firms' balance sheet. The imbalance, as stylized facts for Mexico show, is due to the excess of imported capital goods and the issuance of foreign exchange debt. Results from the model shows that exchange rate policies work to promote capital accumulation and structural change, however, there are specific conditions under which they must operate.

Key Words: exchange rate; economic growth; structural change; exchange rate policy; foreign exchange debt; depreciation.

Evaluando el rol financiero del tipo de cambio

Resumen. Nuestro aporte apunta a repensar el papel del tipo de cambio como herramienta para impulsar la inversión y el cambio estructural, mediante la construcción de un modelo macro analítico basado en Frenkel y Ros (2006), Ros (2015) y Dvoskin y Feldman (2018). Consideramos, en particular, el costo financiero de la depreciación, que se genera por los desequilibrios en la posición del tipo de cambio en el balance de las empresas. El desequilibrio, como muestran hechos estilizados para México, se debe al exceso de bienes de capital importados y a la emisión de deuda en moneda extranjera. Los resultados del modelo muestran que las políticas cambiarias funcionan para promover la acumulación de capital y el cambio estructural, sin embargo, existen condiciones específicas bajo las cuales deben operar.

Palabras clave: tipo de cambio; crecimiento económico; cambio estructural; política cambiaria; deuda cambiaria; depreciación.

Clasificación JEL: D33; F31; F34; O23.

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1. INTRODUCTION[1]

The development literature in the last decade has rediscovered the role of exchange rate policy as an instrument to foster growth. This new attention owns to a great extent to the theoretical works of Jaime Ros (with Skott (1998) and Frenkel and Ros (2006)) and by its empirical assessment by Rodrik (2008). However, the debate generated by its work has shown that there is no consensus on this positive effect or on the ways in which exchange rate depreciation could be beneficial. Probably because this relationship is in continuous evolution and the patterns that dominate it turn out to be dynamic over time. On the one hand, conventional macroeconomic theory asserts that depreciating the currency in real terms benefits the competitiveness of domestic products against foreign ones, and this generates investment and employment. Also, it suggests maintaining a depreciated and stable Real Exchange Rate (RER) even if this leads to a reasonably higher price level. The non-conventional position, on the other hand, states that a country's exports are partly conditioned by relative prices between countries and mainly determined by the income level of the exporting country's trading partners. The effect of exchange rate depreciation would be negative as the consumer's purchasing power decreases and the input costs for companies increase.

As a matter of fact, there exist other factors that have been partially neglected by the literature, namely, the (re)emergence of the problem of foreign indebtedness, especially of the corporate sector (Chui *et al.*, 2016). In particular, macroprudential theories advocate avoiding exchange rate depreciation, especially for those sectors where firms suffer currency mismatches –that is, higher foreign exchange denominated liabilities than assets. For those firms, depreciation would cause a balance sheet effect (Gertler *et al.*, 2007; Céspedes *et al.*, 2004). Moreover, this exposition appears to have been facilitated by the increasing role of financial motives, financial markets, and financial actors in the economy that has taken place in the last 30 years –that is, under the so-called financial integration, or, *financialization*, as defined by Crotty (1990) and Epstein (2005). Specifically, capital account liberalizations eased the issuance of foreign-denominated liabilities, that have been growing exponentially in developing and emerging countries following the

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adoption of expansionary monetary policies in the US in the aftermath of the 2008 crisis (UNCTAD, 2017).

In this paper we advance the hypothesis that exists a financial cost of depreciation that negatively affects investment and the profit rate. We argue that, by adjusting firms' profit rate for the financial cost of depreciation, the incentive of the private sector to invest in capital formation decreases, assuming that the latter is a positive function of profitability. Our analysis is on the investment channel of depreciation, attempting to combine within our analytical framework the positive effect on the profit rate –as put forward by Ros and Skott (1998), Frenkel and Ros (2006) and Ros (2015)– and the negative effect on firms' balance sheet. We based our study on the Mexican case, as the relationship between the real exchange rate and capital accumulation in this country appears to have weakened. Since the fall in oil prices in September 2014, an event that marked the end of the global commodity price boom, the Mexican peso has depreciated by 30% in real terms, without benefiting private investment neither economic growth. An important element for Mexico is the negative net foreign exchange rate position of the non-financial sector, due to great issuance of foreign debt, which exponentially increased with the low interest rate environment promoted since 2010.

The contribution aims to rethink the role of the RER for growth and structural change in a context of high financial integration, by constructing a theoretical framework based on Dvoskin and Feldman (2018). Results from the model shows that exchange rate policies promote capital accumulation and structural change only under strict, specific conditions. The most important is that the financial cost of depreciation*, i.e.* the cost associated with exchange rate swings and the revaluation of debts denominated in foreign currency, should be tamed. Our results are in line with the idea of Guzmán *et al.* (2018) of promoting multiple RERs able to boost investment in those sectors that need a competitive currency, while not harming the others.

The paper is organized in the following way. Section 2 presents some stylized facts related to the financial costs of devaluation for the Mexican economy, at a macro and micro level. Section 3 examines the theoretical and empirical literature on the effect of the exchange rate on investment, as well as contributions on the financial costs of currency devaluation. In section 4, we introduce our formal model. Different scenario analyses based on this framework are then carried out in section 5. Finally, section 6 sums up and proposes some policy suggestions.

2. The worsening of the non-financial sector balance sheet from 2010: some stylized facts from Mexico

In the following subsections we try to analyse which are the elements that have prevented the RER from generating the expected positive effects on private investment. In this sense, two main factors are identified: *i)* the strong dependence on the import of foreign equipment and machinery; *ii)* the increase in the issuance of foreign currency debt. These two elements together lead to an adverse effect on the balance sheet of enterprises, due to the worsening of the net foreign currency position, as we will present shortly. The worsening of the companies' balance sheets causes depreciation to create a financial cost which, when considered, reduces the companies' investment.

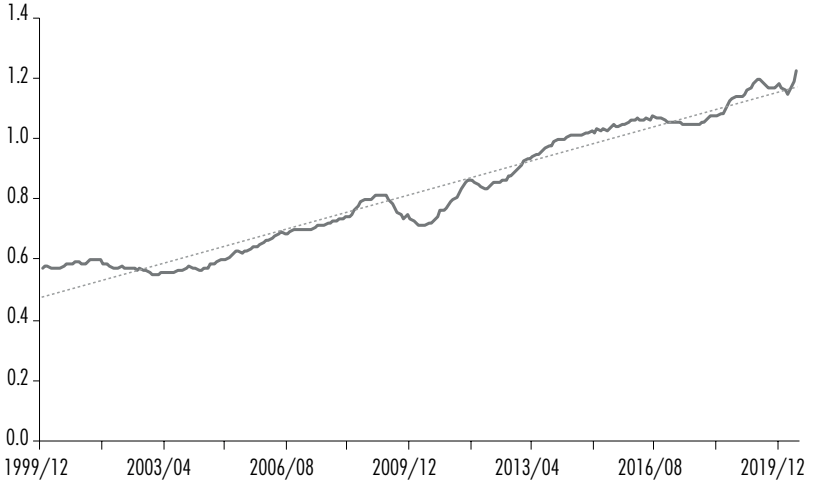
Imports of fixed capital have grown steadily

In principle, during periods of exchange undervaluation there should be a substitution effect from imported to domestic capital goods, that is, since imported capital goods become more expensive, companies should substitute them with domestically produced capital goods. However, in Mexico this did not occur and to date the import of foreign fixed capital represents a very important proportion of the gross fixed capital formation. The presence of a significant penetration in the Mexican productive system of fixed capital imports represents the first obstacle to the transfer of the positive externalities of the undervalued currency to the economy. Faced with depreciation, the cost of imported inputs increases, worsening the balance sheet of companies by increasing their liabilities denominated in foreign currency not yet amortized. Therefore, if part of the retained earnings is used to repay past debts, investment should decrease.

The result of the sustained growth in the import of fixed capital by the private sector is reflected in the stock of capital of the Mexican economy. Figures 1 and 2 report the stocks of imported and domestic machinery and equipment, both at the aggregate level and for the manufacturing sector, respectively. Today, the stock of foreign equipment and machinery is at an all-time high. Figure 1 reports the one-year moving average of the ratio between imported and domestic machinery and equipment (a ratio higher than one indicates that a higher proportion of imported machinery). Since the second half of the 2000's, the indicator has been located at levels very close to one, reaching the unit in 2013. The penetration of imported capital goods is particularly

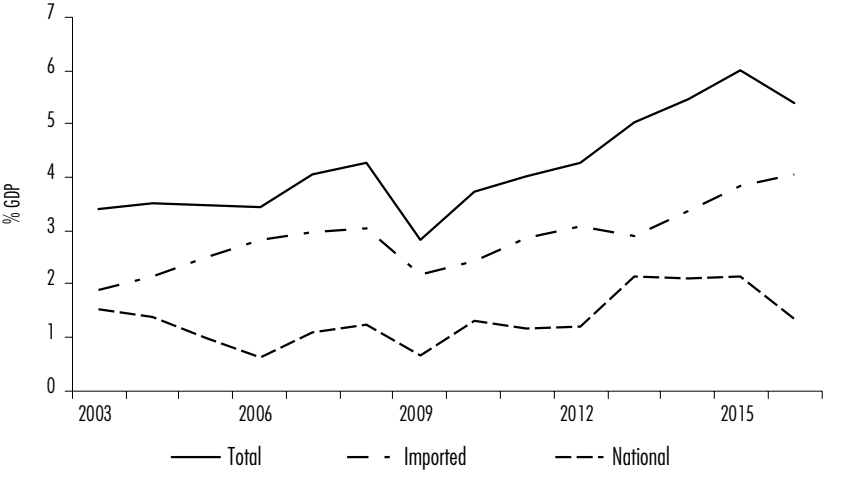
observed in the manufacturing sector where, today, fixed capital imports represent more than twice the national level. In terms of Gross Domestic Product (GDP), in 2016 gross capital formation in equipment and machinery imported by the manufacturing sector represents about 4 points, against 1.5 of the national (see figure 2).

Figure 1. Twelve-month moving average of the ratio between imported machinery and national machinery



Source: own elaboration with data from INEGI'S National Accounts System (http://www.inegi.gob.mx).

Figure 2. Gross capital formation in the manufacturing sector



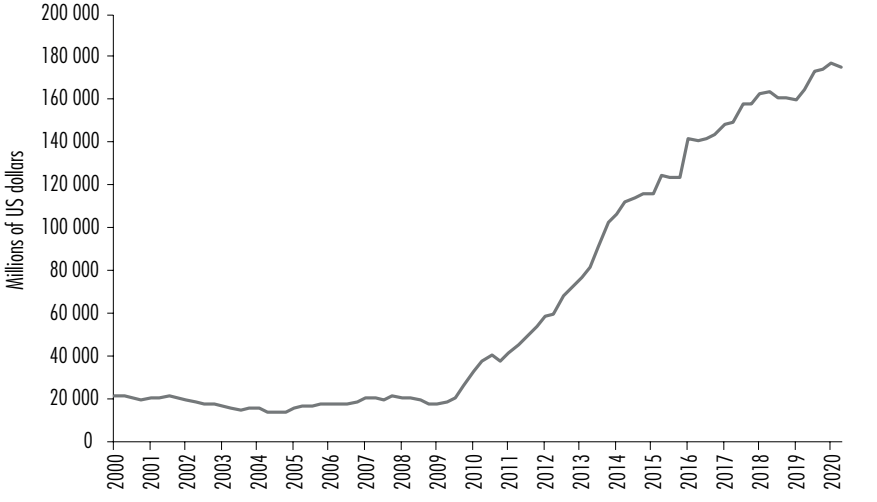
Source: own elaboration with data from INEGI'S National Accounts System (http://www.inegi.gob.mx).

The increase in non-financial sector debt issuance from 2010

A further element to consider when assessing the impact of exchange rate policy on promoting investment is the level of foreign currency debt issued by the non-financial sector. This element has also changed over time. Today, given the high levels of indebtedness of non-financial corporations, it needs to be considered. This channel contributes to the worsening of firms' balance sheet. As the currency depreciates, the cost of servicing debt issued in foreign currency will increase, which implies an increase in the liabilities on the balance sheet.

The level of international debt issued by Mexican companies in the non-financial sector is reported in figure 3. From 2000 to 2010 the average debt issued by these corporations has remained stable at around 20 billion of dollars. As of 2010, a structural change in the series is observed, coinciding with the adoption of expansive monetary policies by central banks worldwide that reduced international interest rates to historical low levels. Over the next few years, the cost of external financing remained low, creating a disincentive for firms to use internal resources to finance new projects and favoring the incentive to collect capital by selling bonds abroad.

Figure 3. Amount in circulation of international debt securities issued by Mexican non-financial corporations, all maturities



Source: Bank of Intenational Settlemenents, Security Debt Statistics (2020) (FRED), https://fred.stlouisfed.org/series/IDSNFAMRIAOMX

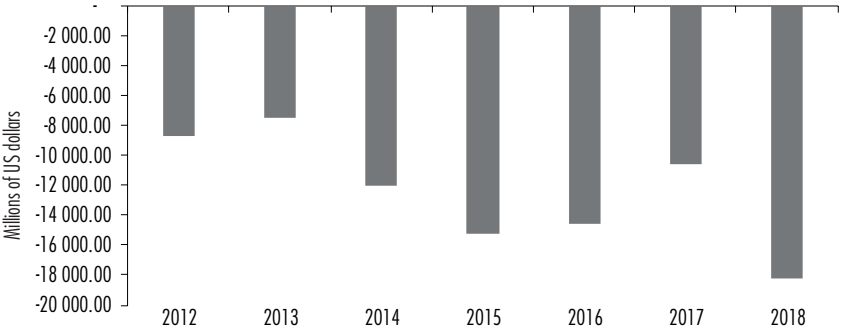
Worsening of the balance sheet: construction of series of the net foreign currency position

The previous sections discussed the presence of dollarized elements that would have worsened the balance sheet of Mexican non-financial corporations. In other words, companies would suffer a negative Net Foreign Exchange Position (NFXP),[2] which means that liabilities in foreign currency would be greater than assets. Therefore, when experiencing exchange rate depreciation, companies see their liabilities increase and their wealth decrease. The main consequences are the worsening of the company's credit condition and the difficulty in investing in new projects, since their profitability is reduced by the higher cost of financing.

In order to provide empirical evidence of the worsening of the net foreign currency position of Mexican companies we constructed a series using data available in the annual financial reports submitted to the Mexican Stock Exchange (*Bolsa Mexicana de Valores*). Those are data that listed corporations are requested to disclose to investors and are available on a quarterly basis. The task, however, presents some complications. Companies that are required by law to disclose information about their foreign currency positions are those listed on the stock exchange, which limits the study to a very limited number of corporations. Furthermore, some of the listed companies conduct their business in the domestic non-tradable sector; therefore, they are excluded from this study, as well as financial companies and banks. Finally, data availability is limited in time as it is only since 2011 that these companies report their monetary position in foreign currency. Provided the above mentioned restrictions, nine companies (Alfa, Alpek , Gruma, Bimbo, Grupos Cementos de Chihuahua, Nemak, Mexichem, Arca Continental, Kimber) with available data were selected, all of them engaged in tradable business. Thus, these companies are not representative of all the tradable-type firms, but they intend to explain how listed corporation that operate in the tradable sector might work when facing depreciation. Figure 4 reports the NFXP of these companies, while a full breakdown of each of their annual net positions in foreign currency in USD millions can be found in the Appendix.

[2] Aslan and Tunç (2017) and Chui *et al.* (2016) provide general guidelines for the calculation of the net foreign currency position of companies, which can be summarized as follows: on the assets side goes *Deposits*, both held in domestic banks and abroad; *Securities*, both from Government and from the private sector (*i.e.* Portfolio Investments Abroad); *Export Receivables;* and *Direct Investments Abroad.* On the liabilities side, in turn, go *Import Payables* and *Loans*, both Domestic and External.

Figure 4. Net Foreign Exchange Position (NFXP), nine selected companies



Source: own calculations using end-of-the year financial reports published by Bolsa Mexicana de Valores (2019).

The year 2011 is the first period with available data in the stock market database; we can appreciate already negative net foreign currency positions. However, the figure shows a certain degree of stability in the foreign currency positions of the companies under analysis between 2011 and 2013. In this period the RER is stable and around the 80 points on average. The balance sheet in foreign currency is also stable and, except for the company Bimbo, it does not show strong variations. On the contrary, during these years, five out of nine companies (Bimbo, Gruma, Alfa, Mexichem, Arca Continental) improve their position.

With the fall of the oil price in 2014 and the geopolitical events of 2016 (Brexit and the US elections), the Mexican peso depreciated. From these events, companies' balance sheets recorded the worsening of the foreign currency monetary position. From 2013 to 2018 the fall in the net position of the nine companies analysed is 60%. The cases of Nemark, Mexichem, Arca and Kimber stand out, with foreign currency liabilities increasing by 121, 87, 99 and 92%, respectively. Also, Alpek and Gruma had a substantial worsening of their balance sheet (61 and 53%), while Bimbo and Grupo de Cementos de Chihuahua had more conservative falls (39 and 32%).

Unlike previous episodes of strong exchange rate devaluation, such as the 1994 and 2007 crises, the depreciation that has occurred since 2014 has not been only an overshooting limited in time, on the contrary, to date the currency has not fully recovered to oil pre-crisis levels. It is difficult, therefore, to consider the financial cost of the depreciation as transitory element, given that the high levels of debt and capital goods imports have prolonged the effect of the balance sheet over time.

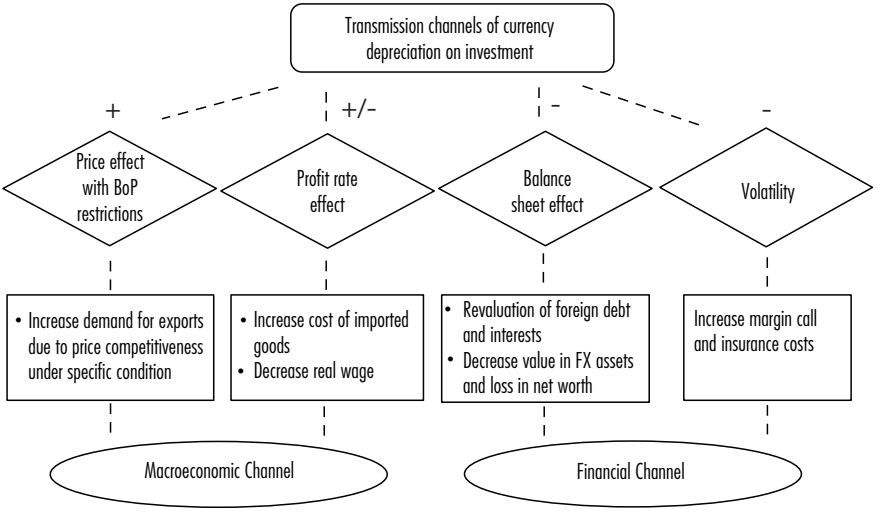
3. Literature review

The effect of RER on investment operates through different transmission channels, including exports, profit rates, input costs, and balance sheet effects. Channels, however, are not mutually exclusive and can operate simultaneously with contrasting effects on growth. It is difficult to consider *ex-ante* that all depreciations (appreciations) are positive (negative) for growth. The final impact may be ambiguous and vary from case to case, depending on the institutional and financial structure of the countries as well as its technology and productive structure. Only if negative effects do not predominate, the economy experiences an expansion in investment.

To better understand the result of undervaluation and its ambiguous effects on capital accumulation, we summarize in figure 5 the transmission channels through which depreciation operates. We distinguish between two main effects, namely, macroeconomic and financial channels, to underline the different origin of these transmission mechanisms.

Two elements compose the real macroeconomic effect of currency depreciation on firm's output. The first is the price effect, that is, the competitiveness of domestic tradable goods with respect to foreign peers, which ultimately might lead to the increase of the demand for exports. This channel finds its

Figure 5. Transmission channel of currency depreciation to firms



Source: own elaboration.

origin in the Mundell-Fleming model and the balance of payment restriction. That is, under certain specific conditions –such as increasing global demand and limited propensity to import of the domestic country– the undervalued currency can promote growth in the external sector and, consequently, a sustainable economic growth.

The second component of the macroeconomic channel is the effect of currency devaluation on profit rate, in accordance with Ros and Skott (1998), Frenkel and Ros (2006), Rapetti (2013), Rodrik (2008) and Bresser-Pereira (2008) –the authors commonly associated with the Neo-Developmentalist[3] school of thought. As real wages decrease, profit rate grows, stimulating capital accumulation. However, the latter also needs to account the firm's productive structure and the technology of production domestically available for different sectors of the economy, as mentioned by Bruno and Sussman (1979). Not all sectors can rely on domestic supply of those capital goods needed in their production lines. Thus, some manufacturers depend on imported inputs, a factor that might outweigh the benefit of lower real wages in case of currency depreciation.

In addition, there exists a financial side of the currency devaluation, which is composed by the loss in firm's net worth –the so-called balance sheet effect– and the cost of maintaining a stable exchange rate through derivatives.

The financial impact of RER depreciation is found in the works of Bernanke and Gertler (1986), Gertler *et al.* (2007) and Céspedes *et al.* (2004) and is related to the theory of the financial accelerator of Bernanke *et al.* (1994). According to these works, it is necessary to evaluate the effect of exchange rate depreciation on firm's balance sheet, since this effect –properly called the balance sheet effect– could negatively impact private investment. On the one hand, these authors, constructing general equilibrium models, recognize the positive influence of a depreciation of the real exchange rate on trade in the external sector. On the other hand, they consider the effect on firms with foreign exchange denominated liabilities. For these companies, exchange-rate depreciation would lead to a negative wealth effect. The result is an increase in the risk premium of these companies and less access to credit, with an inevitable decrease in private investment.

Céspedes *et al.* (2004) simulate two different models, one in which the economy is characterized by financial fragility –expressed by a high level of corporate indebtedness– and an economy with robust finances. The authors show analytically that the financial condition of the corporate sector –fragility

[3] For an in-dept analysis of Neo-Developmentalism, see Bresser-Pereira *et al.* (2017).

or resilience– affects the outcome of depreciation. There will be an expansionary effect via trade in the case of robust finance, while the balance sheet effect will predominate in the case of excessive indebtedness before depreciation.

Cavallo *et al*. (2005) provide a further explanation of the currency depreciation financial effect. They study, theoretically and empirically, the consequences of RER depreciation on the value of assets and liabilities in the balance sheet of companies in emerging countries. They focus on the implications for growth and investment in the presence of a financial crisis. The authors claim that during episodes of financial crisis there exists a financial constraint –a level of depreciation above which investors operate a domestic assets sell-off– which generates further exchange rate depreciation, an effect that authors define as *overshooting*. Exchange-rate depreciation due to overshooting causes a negative wealth effect that aggravates the fall in output and private investment generated by the crisis, especially in the case of firms with high foreign debt ratios.

The vision of the balance sheet is oriented towards the effect on firms' creditworthiness, that is, depreciation reduces the wealth of the company and increases the risk premium, which makes access to external financing for new projects difficult. Indeed, the study of the balance sheet effect is generally considered within the evaluation of macro-prudential practices to limit the transfer of international financial turbulence to developing domestic economies. On the contrary, the Neo-Developmental approach does not take into consideration the relationship between credit and depreciation since it considers the financial shock as a short-term element. Neo-Developmentalists, additionally, do not explicitly take into account the financial cost of depreciation, a cost that may be generated by the reduced accessibility to credit or by the insurance (derivative contract) necessary to counteract the currency mismatch.[4] It is true that these authors acknowledge that exists an "optimal" or "industrial equilibrium" RER (Bresser-Pereira *et al*., 2017; Bresser-Pereira, 2020), hence deviations from it either in one sense (*i.e*., excessive overvaluation) or another (*i.e*., excessive devaluation) can be unsustainable. However, to the best of our knowledge we are not aware of any work treating explicitly the balance sheet effect.

[4] Botta (2017) is a notable exception. He develops a macroeconomic model of the exchange rate determination with medium and long run dynamics for the exchange rate based, among others, on Bresser-Pereira (2008), where he explicitly take into account either the price, the profit margin and the balance sheet effects. However, in his model the share of manufacture on GDP is assumed to be a negative function of RER appreciations, something that not quite match the stylized facts for Mexico reviewed in the previous section.

It is necessary to emphasize that the balance sheet effect should not be associated only with the foreign currency debt of companies. The net position in foreign currency (currency mismatch) is given by the difference between assets and liabilities –or inflows and outflows– denominated in foreign currency. This difference can also be caused by an over-import of foreign capital goods, which makes the dollar-denominated liabilities exceed the assets on the balance sheet.

The mortgage crisis in the United States in 2008-2009 intensified the debate about the financial consequences of a real depreciation of the currency. In his famous article "Rethinking Macroeconomic Policy", Blanchard *et al*. (2010) underlines the importance for countries, especially those in the developing world, to maintain exchange rate stability and shows that in the presence of global financial integration there are strong limits for monetary authorities to intervene in the currency market to sterilize the exchange rate. In addition, the author stresses that those companies that hold a large number of contracts denominated in foreign currency will be affected by fluctuations (volatility) in the exchange rate, especially in the face of depreciation which will lead to the effect of the balance sheet with negative consequences for private investment. Nijathaworn (2010) also warns about the risks of financial globalization for those countries that are fully integrated into the global financial system and at the same time heavily dependent on the export sector. These countries have growth patterns that are often conditioned by international capital flows, which are constantly altering the exchange rate level. The author also suggests that these countries should gradually move away from the export growth model and develop a solid domestic demand in the face of financial turbulence and its implications for the exchange rate.

4. Theoretical model

Stylized facts in section 2 show the increase in imported fixed gross investment and foreign debt in the non-financial sector. As a result, assets and liabilities denominated in foreign currency have established a permanent role in emerging market firm's balance sheet, which implies that changes in the value of the currency may have a long-lasting effect on firm's balance sheet. The total effect of depreciation on profitability needs to adjust the positive benefit in the long run for the financial costs sustained by the company.

Secondly, we consider currency volatility, an element that often accompanies depreciation, especially if the former is due to financial turmoil. As

stated by Guzmán *et al*. (2018) exchange rate fluctuations are costly as they often increase procyclicality. If firms want to avoid it, then they need to pay an insurance (derivative), whose price (margin call) grows as volatility rises.

In the next subsection we start from Dvoskin and Feldman (2018) –hereafter, we use the acronym DFI– as their work explicitly considers imports of capital goods, addressing implicitly differences in the productive structure among sectors. Then, we include the financial channel of depreciation. We do so by focusing on two elements. The first element is NFXP –an attempt to model the *pure* balance sheet effect. The second element is volatility, defined as the standard deviation of the exchange rate. By introducing both elements, the model will differ from DFI, in the sense that firm's profit rate dramatically changes according to the level of *financialization*. In other words, the more a company presents currency mismatches, the less it will benefit from currency undervaluation.

Model description

Our small, open economy is composed by three sectors: a non-tradable, producing capital goods as in Ros and Skott (1998), and two tradables, one producing capital and the other consumption goods. Thus, the two tradable goods in our model modification are two types of exports with a different production process. We assume that the manufacturing sector I produces using only a fourth, imported commodity to emphasize that some sectors strongly rely on foreign capital goods due to technological gaps. It will serve as benchmark to track the effect of exchange rate depreciation on the profit rate of more imports-dependent sectors. On the other hand, sector C uses both domestic and foreign capital. We will show that for low level of dependence on imported capital goods, the effect of depreciation on profit rate could be significant.

In addition, we introduce a financial cost that further affects the profit rate, especially during time of financial distress and currency volatility. We assume that this financial cost is a function of two elements, namely, the NFXP –the difference between foreign assets and foreign liabilities– and the cost of insurance against currency volatility (σ_E). When companies have large imbalances in their NFXP, they need to hedge that position through an insurance. Insurance costs increases with higher foreign imbalances or higher currency volatility. We will explain further about the financial cost in few paragraphs. Supply prices functions showing production costs for the three goods are reported in equation (1)-(3):

$$P_H^S = wl_h\,(1+r) \tag{1}$$

$$P_C^S = (wl_C + k_C E p_K^*(1+\phi) + \alpha h_C p_H)(1+r) \tag{2}$$

$$P_I^S = (wl_I + k_I E p_K^*(1+\phi))(1+r) \tag{3}$$

$$\phi = f(NFXP, \sigma_E) \tag{4}$$

$$NFXP = \ FX\ asset - FX\ liabilities \tag{5}$$

Equation (1) shows that the supply price for the non-tradable good depends on unitary labor costs –nominal wage (*w*) multiplied for the quantity of non-specialized labor (l_h)– and the profit margin (*r*). The supply price of the tradable good *C* depends also on the unitary costs of two types of capital goods: one is imported ($k_C p_K^*$) and it is influenced by the Nominal Exchange Rate (NER) (*E*) and a financial cost (ϕ), associated with currency volatility (σ_E) and the Net Foreign Exchange Position (*NFXP)*, as expressed by equation (4); the other one is domestically produced by the non-tradable sector ($\alpha h_C p_H$).[5] The proportion of local inputs used in sector *C* is given by α. Notice that the rate of profit (*r*) is the same throughout the economy, meaning that sectors can continue to run their production provided than their unit costs allow doing so.[6]

Equation (2) describes how costs for tradable goods are closely related to the performance of the RER. If the latter is described as $e = E/w$, we observe that depreciation has two effects; on the one hand, it reduces the cost of labor, on the other hand, it increases the cost of the imported capital goods. A first consideration about the model implies that the technique adopted in the industry is crucial element when considering the final effect of the RER. Equation (4) focuses on the financial cost of depreciation, that is, the parameter ϕ. The first term represents the net foreign exchange position. According to Aslan and Tunç (2017), assets expressed in foreign currency are deposits abroad, foreign securities (portfolio investment abroad and foreign govern-

5 For sake of simplicity, we assume the capital good to be entirely circulating.

6 In this simple framework, the wage rate as well as foreign prices are assumed as exogenously given. Hence, no explicit role for domestic inflation is accounted for. This is the reason why equation (5) is reported in nominal terms, that is gross of domestic prices. Whenever this theoretical setting was to change, perhaps as a result of the endogenization of the wage rate, NFXP should be considered in real terms. Thus, through this channel, a rise in the general level of prices would help to tame the financial cost ϕ, although the final effect on profit rates should be assessed by considering other channels –for instances, the level of real wages.

ment debt), foreign direct investment and export receivables. On the other hand, liabilities are represented by foreign loans/debts and import payables. As mentioned in section 2, the NFXP is measure of currency risk. Every sector of the economy carries foreign exchange risk when it has either open position (liabilities > assets) or long position (assets > liabilities). Since importers must add this insurance to the price of the fourth input of production (Ep_K^*), measured in national currency, ϕ shall be intended as a margin, as stated in equation (2) and (3).

In case of open position, the currency depreciation would increase the payment of foreign liabilities open position; in case of long position, it would decrease the receipt of foreign assets. In both cases, it generates a currency loss, lowering the profitability and in some cases ending in liquidity problems. To tackle this risk, companies need to buy derivative contracts and hedge their FX position. But the greater the foreign open position is, the more expansive the insurance will be. And it gets more expansive if the company needs to cover its position during time of uncertainty and volatility, when liquidity dries and finding a counterpart for deals becomes difficult.

Equations (6) and (7) report the equilibrium conditions in the tradable market. Relationships are expressed in the form of equality between the demand and supply price for each sector, with the former representing the maximum amount of money that consumers are willing to pay for a certain commodity. Due to international competition, the domestic economy is price-taker, and then the demand price is originated internationally. To stay in the market, companies that produce tradable goods should have the following price relationship:

$$P_T^D = EP_T^* \tag{6}$$

$$P_T^D \leq P_T^S \tag{7}$$

In turn, the demand price for the non-tradable good depends upon its supply price, as this commodity is produced and exchanged only within local borders.

$$P_{NT}^D = P_{NT}^S \tag{8}$$

Assuming both a constant NER ($E = \bar{E}$) and a nominal wage rate ($w = \overline{w}$) and recalling that the price of imported capital goods is exogenously given ($P_K^* = 1$), we can solve for the rate of return of each tradable sector:

$$r_I = e\frac{1}{l_I + k_I e\phi} - 1 \tag{9}$$

$$r_C = \frac{\sqrt{[ek_C(1+\phi)]^2 + {l_C}^2 + 2ek_C(1+\phi)l_C + 4h_C\alpha l_c e} - (ek_C(1+\phi) + l_C + 2\alpha h_C l_h)}{2(l_h \alpha h_C)} \tag{10}$$

Equation (9) indicates that the profit rate for sector *I* positively depends on the exchange rate, a higher value in e (depreciation) is associated with a higher r_I. However, it is necessary to adjust this value by both the labour and the capital coefficient in sector $I\,(l_I + k_I)$, recalling that the latter has to be imported from abroad and thus sustain an external cost ($e\phi$). If, for example, a company increases its imports of capital goods or increase the issuance of foreign debt, this would deteriorate the NFXP as the value of the foreign liabilities will increase over assets.

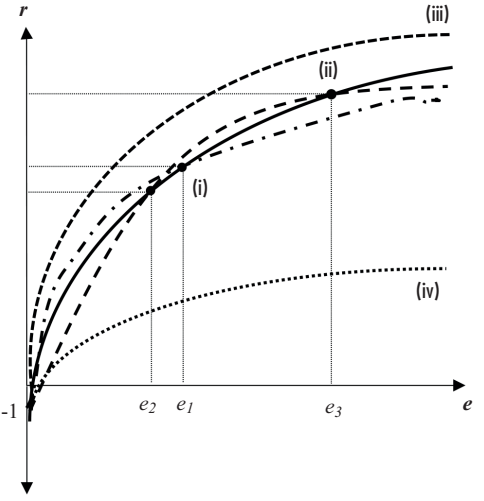
Equation (10) instead it is slightly more complicated due to the dependence of the profit rate of sector *C* upon both the foreign capital goods and local, non-tradable goods, and it requires a numerical simulation, that will be carried out in the next subsection. Notice, however, that in both cases the profit rate is a positive function of RER – as in Ros (2015). A devaluation, thus, is less (more) beneficial for those sector highly (lowly) dependent upon imported capital goods, and therefore favor a shift towards one or another sector.

As in DFI, we can draw a graph illustrating the possible shapes of these curves for any given level of the RER (hereafter, $e - r$ curve). In figure 6 we have reported four different cases, namely: *i)* the one assumed by Frenkel and Ros (2006), in which a devaluation aimed at achieving the equilibrium level e_1 does accomplishes the policy objective to maintain diversified the productive structure by avoiding a shift in relative prices and thus rents that can endanger either *C* or *I* (represented by the bold and thick line, respectively).

Nevertheless, this is only one possible outcome once we account for all the possible combination that the r_C curve can take on –for a given value of its technical coefficients k_C and l_C, the financial conditions captured by ϕ, and the parameters α and b_K. For instance, in case *ii)* there are two equilibrium levels (e_2, e_3) that ensure the coexistence of these sectors, hence depending on the position in the curve the policymaker could opt either to appreciate or depreciate local currency. Finally, in case *iii)* and *iv)* no solutions exist, that is, sector *C* (*I*) is always the most competitive one, and the country specializes itself in only one item.

In what follows, we will report a set of DFI's $e - r$ curve showing how different combination of φ affect the profit rate. In order to simulate the model,

Figure 6. Four possible outcome of the *e-r* curve



Note: the curve in bold stands for the r_I locus, while curves in thick are possible shapes of r_C.
Source: own elaboration.

we need to set up initial values. We accomplish this task by adopting DFI's initial values, we report them in the Appendix. It is important to notice that we model the two sectors with structural differential. We assume that the consumer good *C* is a less sophisticated good that has capital intensity (k_C) of 0.125. The capital intensity (k_I) for the industrial good *I* (the one with higher technological sophistication) is 0.20.

5. EXCHANGE RATE, PROFIT MARGIN, AND THE COST OF DEPRECIATION

In this section we study how functions behave according to different levels of financial cost in the productive processes.

The point of intersection between the two lines represents the level of RER that allows investing successfully in both sectors, promoting diversification in the productive system. Values outside the equilibrium show differential in returns between the two sectors. On the left of the equilibrium, sector *I* will be more profitable thanks to the devaluation of its debt generated by a relatively appreciated the currency. On the right, sector *C* has a higher profitability compared to the industrial good as does not rely on foreign debt.

The value of ϕ affects the slope of the $e - r$ curve. As it increases, the slope diminishes, reflecting a lower response of profit rates to currency depreciation. Indeed, the increase in profit margin dies out quickly as the financial cost of depreciation increases. That is:

$$if \uparrow \phi, \text{ then} \downarrow r_I, r_C$$

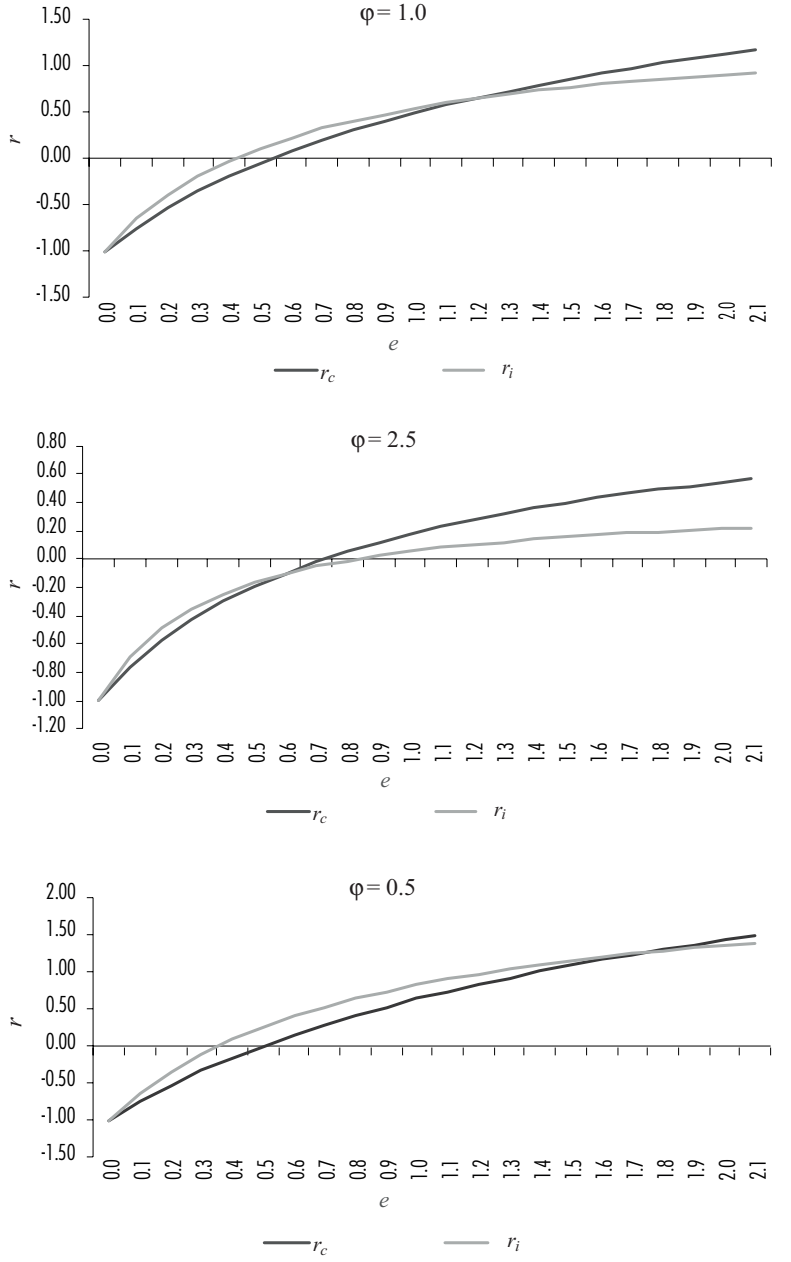
This implies a first important result, that is, the penetration of the financial cost in the productive system of a firm has a negative effect for firms' profit margin *per se*, independently of which sector is under scrutiny. We can appreciate this by looking at the different combination of $e - r$ curves in figure 7.

Higher level of ϕ shift the combination of $e - r$ curves lower, indicating lower profit margin for both sectors. For instance, when $\phi = 2.5$, both sectors will have always lower returns on their investment, other things being equal, than when $\phi = 0.5$. Those firms which ordinary operations require financial transactions will experience lower profit margins in the face of currency depreciation. However, it will affect sector *I* the most. The visual inspection of the graph shows the largest gap between the two sectors' returns.

Reducing the impact of finance on the productive structure ($\phi = 1$) leads to two effects in the model in comparison to the previous case: *i)* higher returns for both sectors; *ii)* lower gap in returns between sectors. The first effect follows the process: a lower ϕ implies a more resilient balance sheet as there is less exposure of firms to currency swings and derivative cost. The second element, the lower gap in returns between sectors, suggests that when financial cost plays a softer role in the production of the industrial good, sector *I* can exploit higher productivity in using capital goods and reduce the gap in returns with sector *C*. In other words, when financial balance sheet neutrality increases, so does the profit margin of sector *I*.

A third case is the neutral level of financial cost ($\phi = 0.5$). An important result of the simulation is the existence of a level of ϕ behind which the financial cost of depreciation does not prevent currency depreciation to be expansive. Figure 7 shows that when the financial cost is low, it does not affect the profit margin as in the previous examples. On the contrary, when $\phi = 0.5$, it is always more profitable to invest in sector *I* rather than *C*. Under this assumption, sector *I* always benefits higher returns due to the higher productivity of the industry, together with the limited transfer of the financial cost on profit margin.

Figure 7. *e-r* curve given different level of the financial cost (φ)



Note: for this simulation we assume that the consumer good C is produced by using $a = 0.5$.
Source: own elaboration.

Particular cases

It could be concluded that if financial cost reaches a deeper level, a lower technology dependence would be needed to maintain the profit rate, that is, companies should favor domestic capital goods over imported ones. The benefit would be a lower foreign liabilities position, which, in turn, decreases the foreign position to cover. The ultimate effect would be a lower ϕ in equation (4). However, this might find some pitfalls. In fact, emerging countries productive system are often constrained by a limited technological availability and the substitution of foreign inputs with local commodities would be unfeasible, to a certain extent.

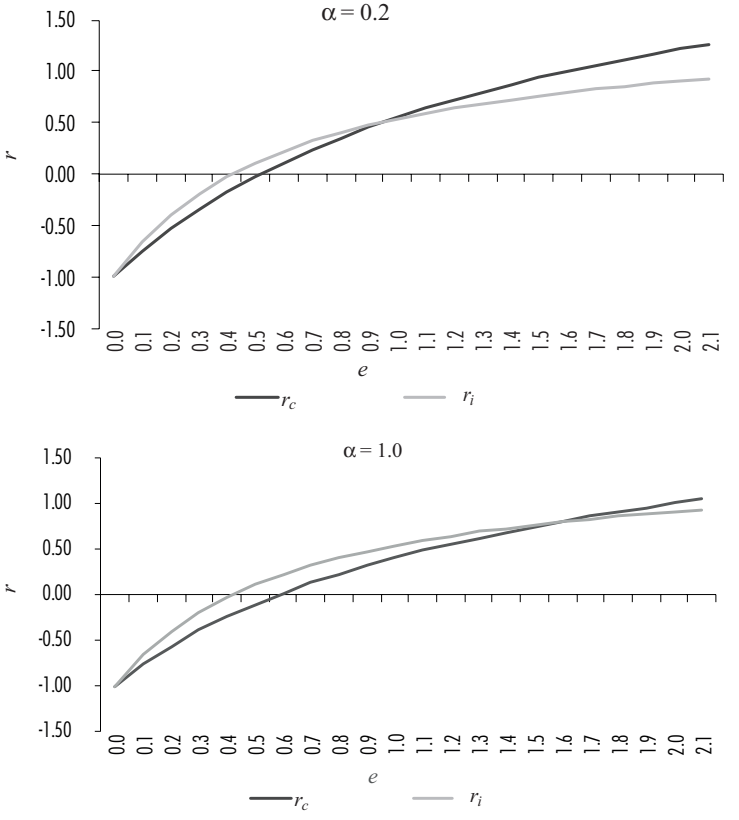
Yet, there could be some beneficial effects in increasing the backward linkage with the non-tradable sector. In figure 8 we report the $e - r$ curve according to the level of domestic capital good penetration in the production of the consumer good. We take the parameter for the financial cost as given, to an arbitrary value that we set equal to 1. In this case we study the problem of exchange rate policies and financial cost from another perspective. If firms cannot change the impact of finance of their balance sheet, for example, because they issued long-term bond, they could rely more on domestic inputs, if available. Hence, we study the cases of low and high backward linkages ($\alpha = 0.2; 1$).

When the sector relies less on domestic capital formation ($a = 0.2$), the profit rate that ensure the coexistence of both sector I and C is lower. This is shown by the diversification point –that is the intersection of r_I with r_C –which is the lowest combination in figure 8.

Conversely, when the consumer good production present the same linkages with respect the domestic and foreign sector ($a = 1$), the rate of profit that grants structural heterogeneity is higher compared to the scenario where $a = 0.2$. Hence, when studying the effect of RER depreciation on the investment channel, the penetration of imported capital goods plays a crucial role in defining the outcome in the determination of aggregate profitability.

However, the effectiveness of the developmental channel of the RER should not be taken for granted in the model. As a matter of fact, behind some level of depreciation there is an incentive (given by the higher profit rate) to invest in a less-productive and less-advanced sector, like sector C, rather that keep developing the more productive one, which in this case would be sector I. This is challenging for the use the exchange rate as policy tool to promote structural change and long-run development. The process that leads to shift investment from sector I to sector C could be interpreted as a form of *dein-*

Figure 8. Curve *e-r* given different values of α



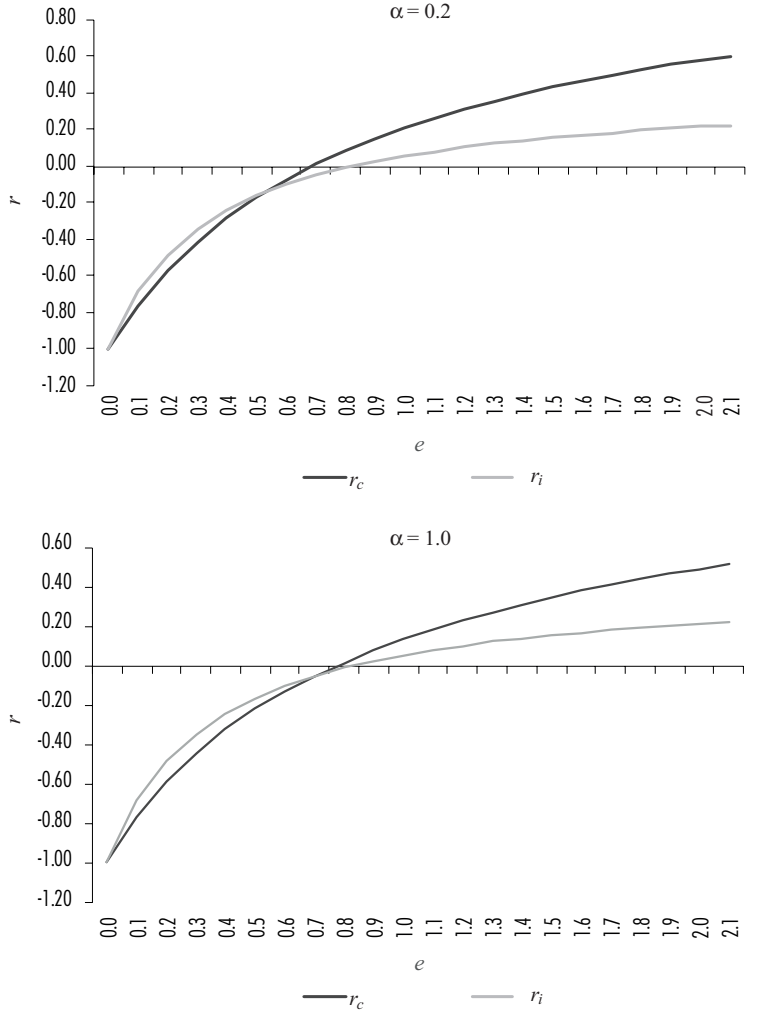
Note: ϕ = 1 for all sectors.
Source: own elaboration.

dustrialization due to excess depreciation, that is, a process that leads developing countries with export-led, financially-integrated growth models to specialized in labor-intensive sectors rather than capital-intensive ones due to their higher profit rates. Therefore, under specific conditions, maintaining an excess depreciated currency could lead to opposite effect than a structural change, namely, a shift toward less productive activities.

Additionally, one could be led to think that the reliance upon domestic capital goods production could help to tame the balance sheet effect, even in presence of over-indebtedness in foreign currency. However, that is not the case; in figure 9 the same experiment as in figure 8 has been carried out, but this time setting ϕ at 2.5 –an extremely high level of financial cost. Re-

sults show that even in the most extreme case, the slope of the profit rates is compressed. In practice, a scenario in which both sector *I* and *C* can coexists is unlikely attainable. In sum, the country ends up in a technical lock-in and being specialized in low value added commodities, as in the case of several developing countries.

Figure 9. Curve e - r given different values of α



Note: $\phi = 2.5$ for all sectors.

Source: own elaboration.

6. Final remarks and policy suggestions

In this paper we analyzed the role of exchange rate policies in promoting capital accumulation in a financial-integrated environment.

We started from some stylized fact for Mexico. Using data available in the stock exchange database, we built series for the net exchange rate position for some selected industrial corporations. Data showed that currently nonfinancial companies suffered from negative currency mismatch, a factor that created friction for spillovers of the undervalued exchange rate. We identified two main causes of the negative position, namely, foreign exchange rate denominated debt and imports of foreign capital goods. We showed that, while imports of foreign capital goods are a longstanding process in the Mexican economy, the negative position in the NFXP is particularly pronounced after 2010, when the nonfinancial sector started to finance its operation through the issuance of foreign debt. We argued that currency mismatch creates a negative balance sheet effect for firms, which limits the benefit of the undervalued currency on capital accumulation.

Based on these stylized facts, we built a theoretical model inspired on Frenkel and Ros (2006) and Dvoskin and Feldman (2018). Differently from them, we explicitly included two elements in our model, namely, difference in productive structure and financial cost of depreciation. Both elements were useful to expand their results on the limitation of using currency depreciation as an expansionary tool for capital accumulation and structural change.

Results from our model show that both technology and balance sheet effects (financial cost) are two important elements to consider when analyzing the effect of exchange rate policies on structural change and growth. These policies are more effective on those sectors whose production system is oriented towards domestic capital goods built by the domestic non-tradable sector. In other words, the development channel of the RER work better for those firms that are involved in the tradable activities, but they are currently using close-to-non-tradable technology (labor-intensive).

An important implication of the model concerns the role of finance. Profit rates for both sectors are higher under the assumption of less financial cost penetration in the structure of a firm. This implies that exchange rate policies cannot be always used as tool for long run growth; instead they need to be used as a temporal switch-off effect for certain sectors. Maintaining the currency depreciated for long period might end up to permanently reduce

returns of the most productive sectors and create distortion in the allocation of capital toward lower-productive sectors.[7]

The difficult question to answer is how to find and maintain the level of financial cost penetration that does not harm the effect of expansionary exchange rate policies. According to equation (4), the financial cost of depreciation is a function of net foreign currency position and the currency volatility. The latter is an exogenous factor that firms cannot control, as volatility finds its origin in adverse macroeconomic, geopolitical, and financial news. The second element in the equation, the balance sheet effect generated by currency mismatches, offers higher degree of flexibility. For instance, the decision to issue international debt to finance new projects is an endogenous decision of the company. Firms should avoid this practice due to the adverse effects that it might generate in case of currency depreciation –a common stylized facts for Latin American economies, and in particular Mexico. This is, however, difficult in absence of strong, regional development bank that can support strategic investment in the private sector. Indeed, too often firms need to recur to financial markets to satisfy their need for financing new projects, a factor that exposes them to financial cost, uncertainty and volatility.

We also advocate for the need of coordination between exchange rate authorities and private firms in order to allow authorities to plan long-run exchange rate policies that promote currency stability and higher profit margins. This suggests that exchange rate policy should go together with industrial policy. Indeed, exchange rate policies could be both promoting and hurting a specific sector depending on its technological structure. Thus, exchange rate policy and industrial policies should be coordinated, rather than considering the first a substitute of the latter. Moreover, technological catching-up should be enhanced by means of innovation policies aimed at changing the position of a country in global value chains –not necessarily to reduce its dependence from the latter.

Finally, a crucial aspect in promoting exchange rate policy is currency stability. When a country decides to pursue export-led growth, it needs to minimize currency swings to avoid additional financial costs for firms. This task turns out to be complicated under free capital mobility, low international interest rates, and financial market expansion –that is, in the macro-financial scenario observed in the aftermath the 2009 Great Recession.

[7] Guzmán *et al.* (2018) advocate for a system of effectively multiple exchange rates when spillovers across different tradable sectors differ. Optimality entails competitive, stable, and effectively multiple RER policies.

APPENDIX

Table A1. NFXP, selected listed Mexican companies
(In US$ millions)

Companies	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*
Alfa	-3 515.16	-2 954.31	-2 389.64	-4862.90	-6 086.33	-3 101.80	-3 778.95	-9 731.80
Alpek		-661.87	-773.11	-629.01	-179.67	-1 107.23	-1 384.60	-1 774.76
Gruma	-982.46	-1 471.01	-858.26	-756.21	-668.80	-503.22	-841.40	-560.93
Bimbo	-2 079.78	-1 865.28	-1 696.73	-3 329.76	-3 054.04	-3 498.87	-3 576.51	-2 800.77
Grupos Cementos de Chihuahua	-528.89	-411.47	-450.90	-484.40	-468.04	-719.88	-703.31	-664.83
Nemak	7 725.25	-720.64	-738.13	-716.24	-1 688.17	-1 542.29	3 597.89	3 472.84
Mexichem	-838.73	-594.96	-527.89	-957.21	-2 726.69	-2 441.18	-2 215.46	-4 128.89
Arca Continental	-14.30	-16.63	-7.52	-14.08	92.37	-1 012.90	-974.29	-1 299.83
Kimber	-43.69	-29.96	-54.24	-300.05	-470.34	-671.98	-715.50	-680.60
Total	**-2 77.75**	**-8 726.14**	**-7 496.41**	**-12 049.86**	**-15 249.70**	**-14 599.36**	**-10 592.12**	**-18 169.56**

Note: stock of assets and liabilities are considered at the end of commercial year, available in the consolidated financial statement of the companies. Data are for assets (liabilities) denominated in both US dollars and other currencies.

Sources: own calculations using end-of-the year financial reports published by Bolsa Mexicana de Valores (2019).

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