DOCUMENTO CEDE 2003-24
ISSN 1657-791 (Edición Electrónica)
SEPTIEMBRE DE 2003

CEDE

DETERMINANTS AND CONSEQUENCES OF FOREIGN INDEBTEDNESS IN COLOMBIAN FIRMS†

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Abstract

During the nineties the performance of many emerging economies was linked to their access to foreign capital and its impact on the real exchange rate. Colombia was not an exception, as it experienced a sharp boom and bust cycle during the period. Although a number of studies have attempted to explain the recent underperformance of the Colombian economy, few attempts have been made at analyzing firm-level data. In this paper, we rely on information for a large sample of firms during 1995-2001 (nearly 8000 firms on average) and examine the determinants of foreign indebtedness as well as the effects on firm performance of holding dollar debt amid changes in the real exchange rate (i.e. the so called "balance sheet effect"). While size is the most robust determinant of dollar indebtedness, matching seems to take place, to the extent that firms in more open sectors and exporting firms have higher shares of dollar debt. In spite of the limited amount of dollar indebtedness of Colombian firms in general, our estimations suggest there is a negative balance sheet effect on firms' performance (i.e. on profitability). On the other hand, the interaction of dollar indebtedness with the real exchange rate is generally not significant in our investment regressions.

JEL Classification: E22, F31
Keywords: Colombia, investment, devaluation, balance sheet effects

† The authors work at the Department of Economics, Universidad de los Andes (*) and at the IMF's Executive Board of Directors (#). The views expressed in the paper do not implicate the IMF or its Board of Directors. We are indebted to Maurice Kugler for his valuable input during the initial stages of this project. Preliminary versions of this paper were presented at IDB seminars in Madrid and Boston College, at the IMF, Universidad de los Andes, and at the NBER Inter-American Seminar on Economics. We received useful comments from seminar participants, particularly Mark Aguiar, Adolfo Barajas, Stephen Bond, Arturo Galindo, Eduardo Levy-Yeyati, Marcela Melendez, Ugo Panizza, Roberto Rigobón, Fabio Sánchez, Fabio Schiantarelli, Hernán Vallejo, and Alejandro Werner. We are also indebted to Hoyt Bleakley for useful discussions on the empirical approach. The Superintendencia de Sociedades in Colombia generously provided us with access to its database, which was processed in collaboration with Francisco Mejia. Financial support from the IDB is gratefully acknowledged.

1 Introduction

The traditional expansionary effect of a devaluation predicted by the Mundell-Fleming model has been recurrently subjected to criticism (i.e. Krugman and Taylor, 1978), and challenged on new grounds (Calvo, 1999, 2000, Calvo and Reinhart, 2000, Dornbusch, 2001). The basic argument in this new strand of literature is that firms and governments that borrow in foreign currency and produce an output that is not entirely tradable face a currency mismatch which, following a devaluation, can produce a balance sheet effect that offsets any enhancement in competitiveness. Largely motivated by the failure of traditional models of balance of payments crisis to explain the financial turmoil in emerging markets during the late 1990's, a number of authors have appealed to the so called "open economy Bernanke-Gertler" argument (Krugman, 1999a). According to this view, in a context of financial market imperfections and constraints where net worth affects investment levels (Bernanke and Gertler, 1989), substantial levels of foreign currency denominated liabilities imply the possibility of self-fulfilling crises: a loss of confidence by foreign investors and the capital flight that results leads to a currency depreciation and a balance sheet effect that depresses investment.

The actual implications and policy prescriptions in this setting have not been settled on theoretical grounds. On the one hand, some argue that a loose monetary policy after a crisis is not a remedy, as it reinforces the currency depreciation and its balance sheet effect (Krugman, 1999b). Aghion, Bacchetta and Banerjee (2000, 2001) argue that the balance sheet effect of a devaluation might entail a decrease in economic activity which reduces money demand and weakens the currency even further. Thus, a currency crisis is a "bad" equilibrium, with low output and a weak exchange rate. They suggest that if credit supply does not react too strongly to changes in the interest rate, a tight monetary policy is the correct prescription to avoid a crisis.

On the other hand, in a series of papers Céspedes, Chang and Velasco support the Mundell-Fleming prediction and argue against dollarization. They point out that the offsetting effect of increased home output and returns to investment generally imply that the standard Mundell-Fleming expansionary effect of devaluations is still generated (Céspedes *et al*., 2000)[1]. Their model suggests that fluctuations in domestic output and investment are larger and more persistent under fixed exchange rates. Nonetheless, balance sheet effects do matter in that they magnify the effects of foreign disturbances and might lead to a situation of *financial fragility* –where devaluations increase the country risk premium.

If balance sheet effects matter, a puzzling question is why do domestic agents choose to hold foreign denominated liabilities in the first place. Explanations of the so called "original sin"—the fact that developing countries cannot borrow in their own currencies or at long maturities—range from models that point out moral hazard problems of fixed exchange rates and government policy (Burnside, Eichenbaum, and

[1] The overall impact of a devaluation might indeed be contractionary, but only if inherited dollar liabilities are (implausibly) large and international financial markets very imperfect (Céspedes *et al*., 2002).

Rebelo, 1999; Schneider and Tornell, 2001) to those which consider the role of financial underdevelopment (Caballero and Krishnamurthy, 2000).

In contrast to the theoretical discussion, empirical work on the determinants of liability dollarization and its "balance sheet effects" at the firm-level has been scarce and severely hindered by data availability. Exceptions include Bleakley and Cowan's (2002, BC henceforth) study for a sample of publicly traded Latin American firms. They report that the effect on performance of holding dollar debt during a devaluation is positive because the negative net worth effect is more than compensated by the effects of a devaluation on ex post earnings. Furthermore, they suggest that this results from firms' matching the currency composition of their liabilities and earnings in foreign exchange.

These conclusions are not supported by Aguiar (2002), who studies investment in post-crisis Mexican firms, finding an important negative "balance sheet effect" of devaluation on investment. Even though exporters outperform non-exporters in terms of profits and sales after a devaluation, their investment is constrained as a result of holding foreign currency denominated debt. Floating the currency also implies an increase in sales volatility, which further reduces investment. Aguiar does find that exporting and large firms tend to borrow more in dollars. These results are consistent with those presented in Gelos (2003), who uses a larger database of Mexican firms and finds that the share of dollar debt is positively correlated with imports, exports, and size.

An important issue for policy discussion that has received some attention is the role of the exchange rate regime on exchange risk hedging. Arteta (2002) uses a database on deposit and credit dollarization in developing and transition economies to examine whether flexible exchange rate regimes encourage *banks* to match dollar-denominated liabilities with assets. His results indicate that, if anything, floating regimes tend to exacerbate currency mismatches. According to Martínez and Werner (2002), the previous results are not supported in the case of firms in Mexico. These authors point out that the "original sin hypothesis" actually implies a sort of natural tendency for liability dollarization that goes beyond the choice of exchange rate regime. A model that incorporates these elements is presented and tested, and results indicate that firms have taken exchange rate risk more seriously after flotation in 1994. Indeed, during the fixed exchange rate regime the share of dollar debt was mainly determined by the size of the firm and unaffected by the composition of revenues, whereas during floating exports became the sole determinant of dollar indebtedness.

All in all, the available empirical evidence on the balance sheet effects of devaluations is not conclusive. The final verdict has to come form the data and the particular conditions of firms in specific countries. In this paper we study the firm-level effects of monetary and exchange rate developments in Colombia during 1995-2001. Like many other emerging economies, Colombia experienced positive and increasing levels of capital inflows during the first half of the 1990s that allowed for a respectable performance in terms of GDP growth. Nonetheless, a curtailment of foreign financing after 1997 has coincided with Colombia's worst growth performance on record. Ample foreign financing brought about an appreciation of the real exchange rate between 1990

and 1997, and a significant real depreciation was observed since (the effective real exchange rate index rose from 82 to 105 in 4 years).[2]

At the second half of 1997, the time the band came under attack, many observers argued that the lackluster performance of the economy was associated with an ill-conceived monetary and exchange rate policy that kept interest rates too high and the currency too strong. Under this interpretation, floating the currency should have reverted the trend of the key components of aggregate demand. The stylized facts indicate that during the period of floating the recovery of consumption and investment has been far from satisfactory, while non-traditional exports[3] have performed reasonably well. Whether this relatively poor performance is associated with a protracted effect of having instrumented a tight monetary policy to defend the currency when it came under attack and/or with the balance sheet effect associated with the depreciation following the floating of the currency is an empirical matter, better addressed at the level of the firm. In this paper, we rely on information for a large sample of firms during 1995-2001 and examine the impact of the exchange and interest rates on the performance of firms with varying degrees of foreign indebtedness, output tradability, and imported inputs.

Since the limited time dimension of our database makes the causal interpretation of macroeconomic effects on firm performance problematic, we focus on the effect of exchange and interest rate movements on the performance of firms with different characteristics. Our study does not allow us to pinpoint the overall expansionary or contractionary effect of devaluations, but rather the existence (or lack thereof) of particular channels whereby the exchange rate affects firm performance[4].

Our results suggest that matching does seem to take place in our sample, to the extent that firms in more open sectors and exporting firms are engaged more often in foreign indebtedness and have higher shares of dollar debt. Also, firm size is the most robust and significant determinant of dollar indebtedness. Although these results and the limited amount of dollar denominated indebtedness in Colombian firms tilt the balance *against* finding any balance sheet effect of devaluations, we find evidence of a negative balance sheet effect on firms' profitability. Results for investment, on the other hand, are rather mixed.

The paper proceeds as follows. Section 2 describes the data set that is used in section 4 to analyze the determinants and consequences of firm investment. In section 3, we briefly discuss BC's analytical framework for the effects of exchange rate devaluations on firm investment in the presence of dollar indebtedness. Section 4.1 presents some regressions for the currency composition of debt, whereas section 4.2 focuses on firm performance as measured by profitability and investment. The fifth section concludes.

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[2] These exchange rate developments occurred in the context of a number of distinct regimes: a standard crawling peg until 1991; an informal band in 1992 and 1993 that accompanied an active sterilization policy; a formal band that was put in place in 1994 but had to be shifted a number of times; and a floating regime introduced in late 1999.

[3] Those different from coffee, oil and coal.

[4] Moreover, much of the balance sheet effect of devaluations in Colombia at the macroeconomic level is likely to occur in the public sector, as the public deficit is largely financed with external debt and the government mainly produces non-tradable goods.

2 The Database

BC's empirical work is based on a sample of 2644 publicly traded firms in 5 countries, including Colombia. Their sample is biased to Brazil and Mexico and in that publicly traded firms, the source of their sample, are generally the largest and most financially sophisticated ones. We use a more representative database, which covers an average of 8,246 firms from 1995 through 2001. These firms belong to 66 sectors of economic activity (4-digit ISIC classification), and are under the supervision of the Superintendencia de Sociedades. Only commercial firms with assets of at least 20,000 legal minimum monthly wages[5] now *have* to report to the Superintendencia, but the sample also includes smaller firms[6].

Firms entering after 1995 or leaving before 2001 because they ceased to operate will allow us to work with an unbalanced panel. We modified the data set in several ways as explained in Appendix 1. Table 1 includes the number of firms per year and sector that survived our filtering criteria (1 to 4, see Appendix 1).

Table 1. Firms per Sector

	1995	1996	1997	1998	1999	2000	2001*
Agriculture	512	554	599	623	607	567	343
Mining	121	137	156	165	152	137	109
Manufacturing	1638	1735	1860	1915	1837	1749	1203
Electricity, gas and water	6	8	14	15	14	13	10
Construction	649	728	846	881	806	704	406
Commerce	1428	1534	1732	1842	1715	1621	1056
Transport and comunications	253	286	342	355	347	332	219
Services	1335	1466	1668	1771	1647	1538	873
TOTAL	**5942**	**6448**	**7217**	**7567**	**7125**	**6661**	**4219**

Source: Authors' calculations based on Superintendencia de Sociedades. Revised data set, see Appendix 1. (*) The reason for the decline in the sample is explained in footnote 6.

Table 2 shows that, on average, total liabilities (variables are defined in Appendix 1) are close to 48% of total assets at the beginning of the period, and nearly 42% by the end. The decrease in leverage occurs in the beginning of the period, from 1995 to 1998. The median value of leverage is close to the average. Apparently, firms have moved to more "conservative" indebtedness, although a few still have liabilities that are as large as their own assets.

[5] The current minimum monthly wage is US$110. Hence, only firms with assets above US$2 million are subject to mandatory reporting.

[6] Due to procedural changes—the Superintendencia now differentiates between inspected (inspeccionadas) and supervised (vigiladas) firms—there was a non-negligible decrease in the number of firms in 2001. Until 2000 all firms had to report their financial statements. Starting in 2001 only (larger) vigiladas have to do so.

Table 2. Firm Leverage, descriptive statistics

Total Debt to Total Assets (%)

Year	Mean	Median	Std. Dev.	Min	Max
1995	47.79	50.61	26.08	0.00	100
1996	45.35	46.92	25.72	0.00	100
1997	44.54	45.72	26.27	0.00	100
1998	43.02	43.39	26.43	0.00	100
1999	42.28	41.77	26.36	0.00	100
2000	41.89	41.38	26.24	0.00	100
2001	42.13	42.27	26.33	0.00	100

Source: Authors' calculations based on Superintendencia de Sociedades

The breakdown of liabilities by currency denomination, maturity, and financial vs. trade-related debt for the year 2000 is presented in Table 3[7]. Firms hold a large proportion of short-term debt (i.e. of less than one year). This is consistent with the available evidence on firms' financial opportunities in Colombia, where internal resources are often the source of funding for investment, whereas debt is a source of working capital. The share of foreign or "dollar" debt[8] is low on average and most firms hold no foreign currency denominated liabilities. Nonetheless, a few hold a high share. The median firm holds its entire domestic and dollar debt in the form of short-term debt for all years. Also, the proportion of short-term debt is higher on average for dollar debt. This has to do with the fact that a very important component of foreign debt is actually debt with foreign suppliers. If only financial dollar debt is considered (tables not shown), short-term dollar debt is actually close to 50% of total dollar debt on average.

About 26% of the firms in our sample hold a positive amount of dollar debt (Table 4) and those firms hold on average approximately 20% of their liabilities in dollars. The share of firms indebted abroad and, more surprisingly, their average indebtedness does not change much, despite the recent devaluation. The only exception is 2001 when, due to changes in the sample, the share of firms indebted abroad rises to nearly 33% of the entire sample. It seems that although larger firms that are *vigiladas* are more frequently indebted in dollars, they hold a smaller share of their debt in dollars.[9]

[7] Yearly information is available upon request. Ratios vary little through time.

[8] It should be noted that all foreign currency denominated debt is with overseas creditors, as Colombian domestic financial institutions are not allowed to denominate loans in dollars. Total dollar debt includes debt with foreign suppliers, whereas non-trade dollar debt refers to debt with banks and financial corporations overseas. We are not able to identify whether or not foreign debt is acquired with a parent firm abroad.

[9] The previous figures correspond to total dollar debt, which is largely composed of trade-related debt. When only financial dollar debt is considered (tables not shown) the average share of dollar debt in the entire sample is much smaller, close to 2%. Also, the proportion of firms holding dollar debt that is not trade-related is significantly lower, 8-10% of the sample.

Table 3. Debt Maturity, Denomination and Financial vs. Trade-related Debt

Descriptive statistics for 2000 (%)

Variable	Mean	Median	Std. Dev.	Min	Max
Balance sheet information (Total liabilities)					
Short Term Debt/Total Debt	76.66	93.40	30.42	0.00	100.00
Trade Debt/Total Debt	19.70	9.07	24.16	0.00	100.00
Financial Debt/Total Debt	24.82	15.21	26.95	0.00	100.00
Other Liabilities/Total Debt	55.48	52.91	33.06	0.00	100.00
Annex information (Financial liabilities and liabilities with foreign suppliers)					
Dollar Debt/Total Debt	5.47	0.00	14.79	0.00	99.98
Short Term Dollar Debt/Dollar Debt	92.19	100.00	24.82	0.00	100.00
Short Term Domestic Debt/Domestic Debt	78.88	100.00	32.36	0.00	100.00
Foreign Trade Debt/Foreign Debt	85.55	100.00	33.11	0.00	100.00
Foreign Trade Debt/Trade Debt	16.27	0.00	30.16	0.00	100.00
Domestic Trade Debt/Domestic Debt	39.83	27.97	37.44	0.00	100.00

Source: Authors' calculations based on Superintendencia de Sociedades

Table 4. Dollar Debt as % of Total Debt

For firms holding dollar debt

	Observations		Mean	Median	Std. Dev.
	Number of firms	As percent of sample			
1995	1679	26.06	18.93	9.50	22.34
1996	1820	26.53	18.47	9.50	21.80
1997	1991	26.03	19.07	10.44	22.13
1998	2021	25.59	18.77	9.71	21.89
1999	1977	26.05	18.77	10.13	21.89
2000	1931	26.85	20.35	11.14	22.60
2001	1492	32.97	17.45	8.92	20.77

Source: Authors' calculations based on Superintendencia de Sociedades

Turning to the revenue side, most firms do not export, although a few export their entire output (Table 5). The average share of income generated abroad, while still low, has increased through time. Regarding the currency composition of inputs, we rely on sectoral data on imported inputs for estimation purposes, using the most disaggregated information available from the economy's input-output matrix. For most sectors imported input shares do not change much through time, though there is significant heterogeneity in terms of import orientation and its evolution by sector. When examined by sector, exports are important for firms in agriculture, manufacturing, and mining, although most firms do not export at all, regardless of which sector they are in. On the other hand, several sectors seem to be affected by the cost of inputs channel (Figure 1). Foreign debt is also important for a number of sectors. In particular, the electricity, gas and

water sector (made up of a few and large firms) is highly indebted in dollars. This sector is also a net importer. Transportation and Commerce are in a similar situation (Figure 2).

Table 5. Composition of Output in Terms of Currencies

Ratio of exports to total revenue, in percent

	Mean	Median	Std. Dev.	Min	Max
1995	4.43	0.00	17.05	0.00	100.00
1996	4.52	0.00	17.25	0.00	100.00
1997	4.65	0.00	17.53	0.00	100.00
1998	4.79	0.00	17.35	0.00	100.00
1999	5.36	0.00	18.39	0.00	100.00
2000	5.83	0.00	18.88	0.00	100.00
2001	7.07	0.00	19.74	0.00	100.00

Source: Authors' calculations based on Superintendencia de Sociedades

The rate of investment in fixed capital- defined as net purchases of property, plant and equipment as percent of total assets-decreased sharply from 1996 to 1997 and slightly thereafter reaching its lowest level in 1999; a mild recovery is observed since.

We now turn to a description of the main correlates of firms' characteristics. In Figure 3 we identify each firm as belonging to one of three zones in the *foreign debt-exports* space: *hell, heaven, and hedge*. Firms are hedged when facing an exchange rate devaluation when the share of their output that is denominated in foreign currency is "similar" to their share of foreign denominated liabilities. Arbitrarily, we set the upper and lower bounds of the hedge area in the lines *share of foreign debt=(3/2)*share of exports* and *share of foreign debt=(2/3)*share of exports*, respectively[10]. Firms are in hell when their share of foreign debt is significantly larger than their share of exports. In the opposite extreme, firms in heaven have a larger proportion of their output in dollars as compared to their share of dollar debt[11]. The distribution of firms and the average value of assets for firms in each zone is presented for 2000 only, as it varies little through time. Only financial dollar debt is taken into account in Figure 3. Most of the firms in our sample belong to the hedge zone (78.77%), largely because many firms do not have foreign debt nor export. Firms in Heaven follow in importance (17.17%), whereas a smaller proportion of firms (4.05%) are in hell. In terms of size firms in hell are the largest on average, whereas those in hedge are the smallest.

[10] It must be pointed out that these bounds are chosen arbitrarily because of their geometrical appeal: they imply that the hell, heaven and hedge areas are of the same size. We experimented with alternative definitions of these areas, and results are very similar. Furthermore, we considered an alternative zone classification in the *net* exports-foreign debt space; a firm might actually find itself in "hell squared" during a devaluation if it has negative net exports besides from holding a large share of foreign debt.

[11] Obviously, firms in Heaven are actually in Hell as a result of a real exchange rate appreciation. Also, the definition of hedging considered here is quite limited in scope, as it has to do with the extent of mismatch between the currency composition of output and liabilities. In our data set we are unable to observe whether firms use financial instruments such as derivatives or forwards to hedge their foreign indebtedness.

Figure 1. Share of Imports, by sector
Purchases of goods and raw materials from abroad as percent of total purchase of goods and raw material, all years

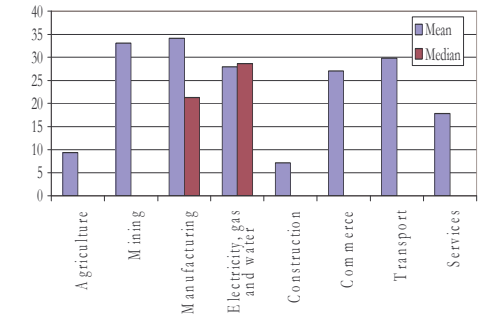
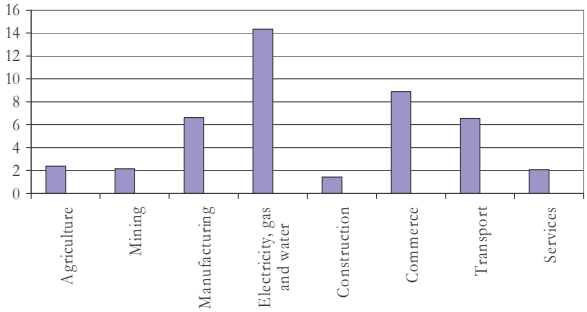
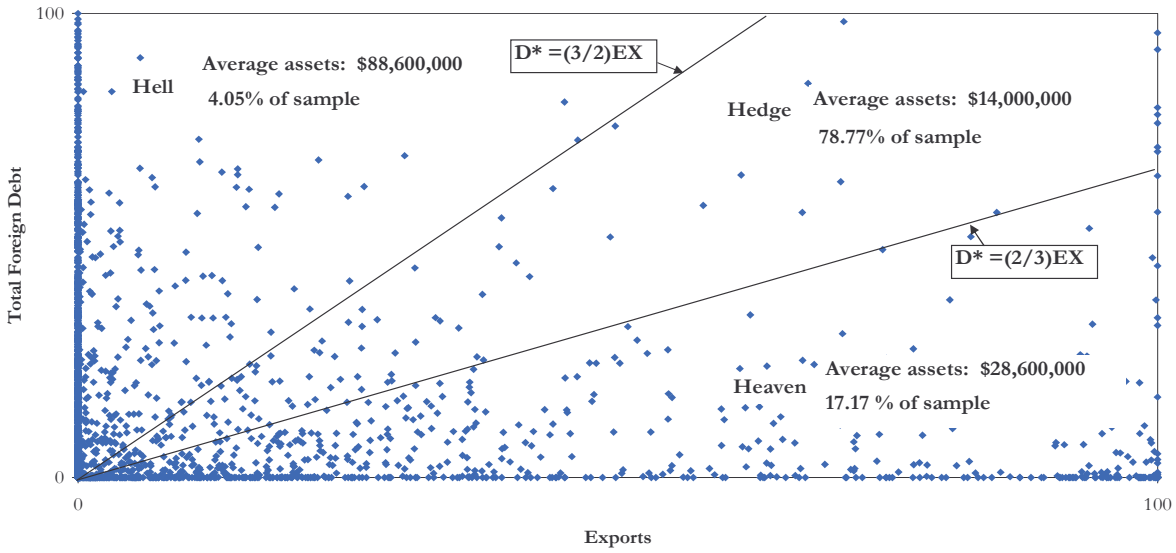


Figure 2. Share of Foreign debt, by sector
Total foreign debt as percent of total debt, all year median is zero for all sectors



Source: Authors' calculations based on Superintendencia de Sociedades

Figure 3. Share of Non-Trade Foreign Debt vs. Exports, 2000



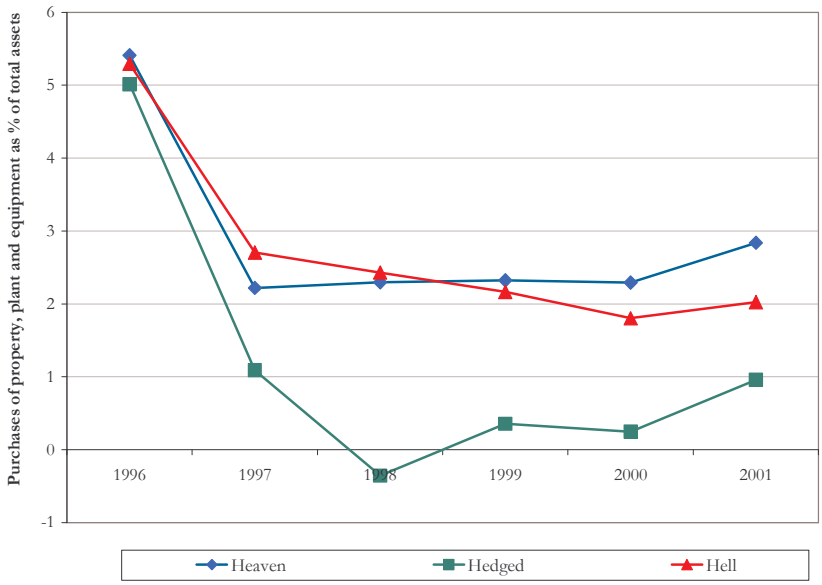
Source: Authors' calculations based on Superintendencia de Sociedades. Ratio of Foreign Debt to Total Debt and of Operational Income Generated Abroad to Total Operational Income, in percent *Average value of assets for firms in each zone in 2000 Colombian pesos (in thousands)*

Interestingly, fixed capital investment falls precipitously for firms in every zone at the beginning in 1997. The ones in hedge heavily decrease their rate of investment but with those in heaven are able to recover. Firms in hell, on the other hand, experience a steady decline in their average level (Figure 4).

Finally, a natural alternative to determine whether our sample of firms is sufficiently representative within the Colombian economy would be to compare the level of investment undertaken by our sample of firms with national accounts data for investment at the corporate level. Since our investment figures come from cash flow data (see Appendix 2), they are not directly comparable to national accounts data. Nonetheless, a suggestive figure refers to non-traditional exports. Once we exclude firms in the coffee, coal, and oil sectors, exports of firms in our sample amount to 74%

of total non-traditional exports in the national accounts. Likewise, total dollar debt of firms in our sample accounts for approximately three fourths of foreign debt acquired by the non-financial private sector, as reported by the Central Bank.

Figure 4. Average Fixed Capital Investment, by zone



Source: Authors' calculations based on Superintendencia de Sociedades

3 Analytical framework for the firm-level analysis

In section 4.2 we will closely follow BC's empirical strategy. Thus, before turning to the empirical analysis, it is useful to consider the basic intuition behind BC's model of the impact of exchange rate movements for firm level investment and its variation across firms with different levels of dollarization of liabilities (the model, with two simple extensions, is summarized in Appendix 3). In addition to the usual expansionary or "competitiveness" effect of devaluations, they consider the fact that for dollar-indebted firms devaluations might lead to a decrease in "net worth" due to a currency "mismatch" between liabilities and income. This deterioration in balance sheets makes firms appear as riskier investments. As a result, they face higher interest rates, which bring about a decline in investment.

BC's model can be easily extended in two directions, discussed by the authors but not incorporated in their model. First, firms might use imported inputs, challenging the fact that the "competitiveness" effect of a devaluation is necessarily positive. Second, firms pay an interest rate that depends not only on their own net worth, but also on the macroeconomic environment. In particular, quitting the "dogged" defense of the currency allows the domestic interest rate to decrease, fostering investment of firms indebted in pesos. Thus, in attempting to evaluate empirically the effect of a devaluation on firm investment across different levels of dollar indebtedness, it is important to take

into account both the extent to which firms tend to import their inputs and domestic credit conditions. For these reasons, in our empirical analysis we explicitly control for the tradability of firms output and inputs and their interaction with foreign exchange movements, as well as for the interaction of domestic debt with domestic credit conditions.

4 Estimation and results

4.1 Currency composition of debt

BC argue that firms holding dollar debt invest more than firms holding peso debt in the period following a devaluation because they match the currency composition of debt with the elasticity of their income to the real exchange rate. Under this interpretation, dollarization of liabilities should be higher in firms that could be expected to benefit from a devaluation. Lending support to this hypothesis, BC report the results of a set of simple regressions where the ratio of dollar debt to total liabilities is a (positive) function of several proxies for the sensitivity of profits to the real exchange rate. We start our empirical investigation examining whether this result holds in our data.

In Table 6 we consider a set of alternative specifications for the determinants of non-trade related dollar debt[12]. We are interested in knowing whether larger firms and with more tradable output have more access to external credit. Additionally, a number of authors have found that firms with international operations are more likely to hold foreign debt. In our data set the information on whether a firm is a parent or subsidiary is unreliable, so we include the share of foreign ownership in each firm[13].

The results presented in Table 6 show that foreign debt is positively correlated with firms´ size (i.e. the log of the value of its assets). In the first column, a simple random effects panel data estimation reveals that firms with foreign ownership have a (marginally significant) higher share of dollar debt to total debt, and the time dummies indicate a negative trend in the share of financial dollar debt. In this equation, belonging to a relatively open sector (agriculture, mining or manufacturing) is not a significant determinant of indebtedness in dollars.

[12] We also run regressions for the share of total dollar debt, to check the sensitivity of the results. There are only two significant changes. First, and not surprisingly, there is a positive correlation between imports and the total share of dollar debt. Second, the somewhat negative time trend that we report below for financial dollar debt does not hold for total dollar debt.

[13] Perhaps the most important determinant of the extent of dollar indebtedness is the interest rate differential that each firm faces when considering different financing options. Since we are working with low frequency data, it is difficult to find a reliable measure of such differential.

Table 6. Determinants of Debt Denomination

Dependent Variable: Non-trade Foreign Debt to Total Debt						
	Random effects					
	GLS	Tobit	Probit	Fixed Effects	Tobit	Probit
Independent variables						
Openness Dummy	-0.0069	9.072***	0.4170***			
	(0.17)	(1.27)	(0.06)			
Exports				0.00856**	0.132***	0.0071***
				(0.00)	(0.02)	(0.00)
Imports				-0.115	0.4204	0.0168
				(0.09)	(0.44)	(0.03)
Log (Assets)	0.996***	14.221***	0.628***	0.873***	12.31***	0.5665***
	(0.05)	(0.46)	(0.02)	(0.10)	(0.53)	(0.03)
Foreign participation	0.003**	0.0281**	0.00117**	0.0023	0.0385***	0.00176**
	(0.00)	(0.01)	(0.00)	(0.00)	(0.01)	(0.00)
1996	0.174*	2.386**	0.1544**	0.1755	2.267*	0.154**
	(0.10)	(1.05)	(0.05)	(0.13)	(1.18)	(0.06)
1997	-0.022	-0.724	0.02	-0.0862	-2.152*	-0.062
	(0.10)	(1.06)	(0.05)	(0.13)	(1.20)	(0.06)
1998	-0.0698	-2.043**	-0.054	-0.1356	-3.10**	-0.1158***
	(0.10)	(1.06)	(0.05)	(0.13)	(1.20)	(0.06)
1999	-0.241**	-4.839***	-0.194***	-0.4224	-5.93***	-0.221***
	(0.10)	(1.12)	(0.05)	(0.14)	(1.27)	(0.06)
2000	-0.515***	-8.147***	-0.327***	-0.758***	-9.898***	-0.399**
	(0.10)	(1.15)	(0.06)	(0.14)	(1.31)	(0.07)
2001	-0.890***	-9.076***	-0.3528***	-1.061***	-10.296***	-0.408***
	(0.12)	(1.23)	(0.06)	(0.16)	(1.38)	(0.07)
Constant	-12.838***	-284.32***	-12.567***	-10.952***	-245.13***	-11.285***
	(0.71)	(7.62)	(0.38)	(1.48)	(8.54)	(0.42)
No of observations	45179	45179	45179	27681	27681	27681
No of firms	7567	7567	7567	4567	4567	4567
Wald or F Joint sign Test	578.08 [0.00]			20.97 [0.00]		
R-square	0.0347			0.0497		
Likelihood Ratio test		1204.98 [0.00]	2409.91 [0.00]		818.1 [0.00]	1319.31 [0.00]
Pseudo R-square		0.03	0.08		0.03	0.07

Notes:
Asymptotic standard errors below coefficients in parenthesis.
p-values for regressions statistics in lower panel appear in [ ]
*, significant at the 90% level, ** at the 95%, *** at the 99%

This regression is nonetheless problematic since conventional estimators are biased and inconsistent in the context of limited dependent variables[14]. Thus, in the second column we report estimates of a Tobit model. Besides from the extent of dollar indebtedness, we are interested in the determinants of whether or not to acquire debt in dollars. Thus, a Probit model for the likelihood of holding dollar debt is presented in column 3. Results for size, foreign participation, and the time dummies are qualitatively

[14] In particular, since the dependent variable is truncated, the appropriate distribution of the error term must take this issue into account. Maximum likelihood procedures, whereby a log-likelihood function having a component for those observations that are "uncensored" and those that are "censored" is maximized, can be applied in this context to obtain consistent estimators.

unchanged. More importantly, there is a positive and significant coefficient attached to the openness dummy in the Tobit and Probit estimations[15]. These results provide evidence of matching of liabilities and income streams.[16] This negative trend implies that firms were able to reduce their share of foreign debt holdings at a rate that exceeded the devaluation rate. Notice that the time effects are negative from 1999 onwards, coinciding with the floating of the currency, probably suggesting that firms took exchange rate risk more seriously once the exchange rate band was abandoned.

In the three final columns, we drop the openness dummy and consider instead firms´ exports and imports as dependent variables. Initially, we run a regression where we control for firm specific effects and obtain a positive effect for exports and size. As before, this regression can be criticized on the grounds that the dependent variable lies between zero and one. Our Tobit and Probit[17] regressions show that exports, size *and* foreign participation are a significant and positive determinant of the existence and extent of foreign indebtedness.[18] The time dummies again show a downward trend.

In sum, our results suggest that matching does seem to take place to the extent that firms in more open sectors and exporting firms are engaged more often in foreign indebtedness and have higher shares of dollar debt. In this regard, it is also interesting that financial dollar debt has a downward trend during the devaluation period and that imports do no exert a significant effect on financial dollar debt. Finally, size is the most robust determinant of dollar indebtedness, whereas there is somewhat weaker evidence that the degree of foreign ownership increases dollar debt[19].

4.2 Firm performance

We begin by presenting some regressions for firm investment as a function of the "zone dummies" in Figure 3. The "zone dummy" is assigned a value of -1 for firms in heaven, 0 for firms in hedge, and 1 for firms in hell. A negative coefficient for this dummy would indicate that firms in heaven tend to perform better than hedged firms, which in turn perform better than those in hell. Indeed, this is the result we observe in the first column of Table 7, yet the coefficient is not significant. Sectoral GDP growth has a positive effect on firm performance, whereas lagged leverage is not significant[20]. Finally, the Wald Test for overall significance of the regressors shows that this regression has low explanatory power. Thus, in the second and third column we repeat the exercise for the periods before and after 1999 (with 1999 onwards being the period of floating and sharpest real depreciation). Interestingly, we obtain a large and significant negative

[15] A drawback from the previous estimations is that in our sample there is a substantial number of firms holding no dollar debt. Thus, in regressions, inference is drawn from the difference between a very small share of firms as compared to the majority of firms holding no dollar debt. There is no simple way to deal with this issue.
[16] Similar results are obtained if the degree of sectoral openness is defined as the ratio of sectoral exports plus imports to total sectoral production.
[17] Logistic regressions were also performed and results were very similar.
[18] For all estimations we report (and fail to accept) Likelihood Ratio and Wald tests for the joint lack of significance of the regressors.
[19] Indeed, besides from showing up with lower significance levels, the coefficient attached to this variable turns out not to be significant when outliers (in terms of investment) are dropped from the estimations in unreported results.
[20] The sign of this latter coefficient is undetermined a priori, as a high level of leverage could increase financial constraints and debt payments could reduce the amount of internal funds available for investment, yet a positive coefficient might arise from the fact that only firms that have access to credit are able to invest.

coefficient for the latter period[21]. Furthermore, the regression significantly improves its overall fit after 1999, indicating that the zone classification was a better predictor of performance during the strong depreciation period. Sectoral GDP growth is no longer significant in each sub-period and, quite interestingly, lagged leverage changes sign across sub-periods. Apparently, in the latter period the financial constraint effect dominated the overall sign attached to this variable.

Table 7. Zone-Performance Regressions

	Dependent Variable					
	Fixed capital investment			Profits		
Independent variables	whole sample	before 1999	from 1999	whole sample	before 1999	from 1999
Zone Dummy	-0.2104	-0.494	-0.6425***	-1.91**	-0.7438	-5.217**
	(0.780)	(1.182)	(0.284)	(0.804)	(1.031)	(1.040)
Sectoral GDP	0.0634***	0.084	0.0104	0.153**	0.024	0.2181**
	(0.038)	(0.094)	(0.011)	(0.036)	(0.075)	(0.041)
Leverage (-1)	0.017	0.0459***	-0.0316***	-0.01627	-0.0185	0.0324**
	(0.014)	(0.020)	(0.005)	(0.015)	(0.018)	(0.019)
Constant	0.4235	-0.4957	1.969***	4.776**	5.312**	2.847**
	(0.781)	(1.085)	(0.273)	(0.856)	(0.965)	(0.995)
Observations	37612	19607	18005	37612	19607	18005
Firms	7567	7217	7125	7567	7217	7125
R-square	0.0002	0.0004	0.0015	0.0002	0.0004	0.0015
Wald Test	4.27 [0.2339]	5.59 [0.1333]	42.52 [0]	24.92 [0]	1.8 [0.6143]	60.22 [0]

Notes:
Random effects GLS regressions; standard errors below coefficients in parenthesis
p-values for regressions statistics in lower panel appear in [ ]
*, significant at the 90% level, ** at the 95%, *** at the 99%

In the last three columns of Table 7, we present additional Zone-Performance regressions with profits (relative to total assets) as the performance variable[22]. The first column shows that there is on average a negative effect of the zone dummy on firm profitability throughout the whole period. More interestingly, there is no effect from the zone-dummy prior to the strong devaluation period and a negative effect from 1999 onwards, and the difference in the coefficients between the two periods is significant. In unreported regressions we interacted the zone dummy variable with a year specific dummy for the period following the 1999 depreciation, obtaining a negative and significant coefficient for the interaction. Regarding controls, sectoral GDP growth has a positive effect on firm performance and lagged leverage has a positive effect on firm performance as measured by profitability during the late period. A final point worth

[21] We also performed regressions in which we interacted the zone dummy variable with year specific dummies for the period following the 1999 depreciation obtaining negative coefficients for such interaction, thus confirming that firms in hell tended to perform worse during the devaluation period.

[22] Other left hand side variables considered in unreported regressions included sales to assets and cash flow to assets. We consistently find the same overall message: hedged firms and firms in heaven tend to perform better than firms in hell, and usually more so starting in 1999.

mentioning is the fact that, once again, these regressions significantly improve their overall fit after 1999.

We interpret these results as suggesting the presence of a negative balance sheet effect for firms that produce non-tradables and are indebted abroad. Below we control for a number of additional characteristics and employ more adequate estimation methods to analyze this issue more carefully. Before doing so, however, it is important to mention that the above results tend to contradict BC's finding of a *positive* effect on investment of holding dollar debt during devaluations. To confirm that these opposing results stem from differences in the data set employed rather than from the specification considered, we perform alternative versions of BC's regressions for our sample. We estimate[23] the following investment equation:

$$(1) \qquad I_{it} = \beta_1 + \mu_i + \beta_2\left(D^*_{i,t-1} \times \Delta e_{BSt}\right) + \beta_6 D^*_{i,t-1} + \beta_{10} \mathrm{X}_{i,t} + \varepsilon_{i,t}$$

where, I_{it} is the *rate* of fixed capital investment at time *t* for firm *i*, with investment in property, plant and equipment normalized by total assets. The main effect that we want to capture is the interaction between the inflation-adjusted devaluation of the bilateral exchange rate (with the U.S., e_{BSt}), and dollar debt at the beginning of *t*, $D^*_{i,t-1} \times \Delta e_{BSt}$. Two alternative definitions of $D^*_{i,t-1}$ are considered: the ratio of lagged dollar debt to total assets and to total debt for firm *i*. Since foreign debt is presumably denominated in dollars, to capture the "balance sheet effect" we define exchange rate, e_{BSt} as the nominal bilateral exchange rate with the U.S. adjusted by domestic inflation. By interacting the (log) percentage change in this real exchange rate index with the share of foreign debt, we capture the differential effect that real exchange rate devaluation has on investment for firms with varying degrees of foreign debt exposure[24]. The specifications consider firm fixed effects. In (1) we define $\beta_{1i} = \beta + \mu_{i_t}$ as the intercept for the ith firm with β as the mean intercept and μ_i the difference from this mean for the ith firm. An additional set of regressors, including firms' leverage and sectoral GDP growth, are summarized by $X_{i,t}$.

Alternative specifications are reported in Table 8.[25] The first point that should be highlighted is that the direct effect of the real exchange rate depreciation is consistently negative and significant (columns 1 and 3), whereas the interaction of the bilateral devaluation with dollar debt is negative but not significant[26]. In other words, the effect of the variation in the exchange rate is negative for all firms irrespective of the

[23] Estimations undertaken using DPD for OX developed by Manuel Arellano, Stephen Bond and Jurgen A. Doornik.

[24] We performed estimations for end of period and average percentage change of e_{BSt}. To ease reading, we shall present results with the latter measure, noting which results change when end-of-period depreciation is considered instead.

[25] Results presented in Table 8 and in tables below consider only non-trade dollar debt. Regressions including total dollar debt were also run, and some of the results are reported below.

[26] Whereas dollar debt is interacted with the bilateral real exchange rate (BRER) devaluation, when devaluation enters independently it is measured by the effective (multilateral) real exchange rate (RER) devaluation. When the BRER depreciation is included instead, the resulting direct effect is still negative and actually larger.

denomination of their debt, and dollar indebted firms do not fare any better (as they do in BC's sample).

If firms attempt to match their revenue and expense streams, the currency composition of debt might be correlated with a number of additional firm characteristics, such as the currency denomination of their revenue and inputs. Thus, in columns 2 and 4 we directly control for the degree of tradability of the firms' output and inputs[27]. In these regressions, the direct effect of the devaluation is still negative though not significant, and its interaction with the degree of foreign indebtedness remains insignificant. We do find evidence, however, that exports, when interacted with real exchange rate devaluation, have a positive impact on investment. Other controls, such as the non-interacted degree of dollar indebtedness, overall leverage, share of exports and share of imports, are generally not significant. The only exception refers to the share of dollar debt to total assets exerting a negative effect on investment when tradability terms are excluded. Likewise, sectoral GDP growth does not have a significant effect on investment in any of the specifications[28].

In short, these results, which replicate in our sample the estimation undertaken by BC for some publicly traded Latin American corporations, indicate that there is evidence of a negative effect on investment of devaluations and that foreign indebtedness (if anything) makes matters worse.

Although these estimations are suggestive, they have serious limitations. First, the only robust result refers to devaluations having a negative effect on investment[29]. Nonetheless, the interpretation of this coefficient is unclear. Actually, putting too much emphasis on any coefficient attached to macro variables is problematic because these variables only change through time, and are likely to be correlated with omitted macro variables that could be captured in a year-specific component of the error term. Thus, the coefficient attached to macro variables may be inconsistent. For instance, the negative coefficient of the devaluation term could actually proxy for a loss in consumer confidence. On more technical grounds, a major drawback of the estimations reported thus far is that, although the within estimator eliminates the inconsistency arising from the fact that firm-specific effects might be correlated with the set of independent variables, it does not account for the fact that most right hand side variables might be endogenous. Also, one might be interested in allowing the investment regressions to have a dynamic structure.

[27] There might be a chance for measurement error in the export and import variables if firms do not export/import directly but rather through an intermediary. As explained above, imported inputs data is imputed from sectoral data but we do rely on balance sheet data on exports for our baseline estimations. When these tradability terms are included, our sample is reduced substantially, as we cannot impute reasonable shares of imports to all of the firms in the sample.

[28] None of these results are sensitive to the definition of the bilateral exchange rate devaluation (end of period vs. average) nor to the inclusion of total dollar debt instead of non-trade dollar debt. Most importantly, the interaction of dollar debt with the devaluation term is rarely significant, and when it enters significantly it has a negative effect. Some results do change, however, when outliers are excluded. In that case, the negative effect of the devaluation term is much more robust to the specification and variable definition. Also, the interaction of the devaluation with exports is no longer significant, whereas its interaction with the share of imports is significantly negative, as expected.

[29] This result is not only robust under BC's specification, but under a number of additional specifications in which additional macro and firm-level variables (such as the interest rate, the maturity of indebtedness, the tradability of output and the import component of inputs) were considered, as well as in a number of regressions were different estimation methods were employed.

Table 8. Fixed Capital Investment Regressions (BC)

Non-Trade Dollar Debt

Dependent Variable: Fixed Capital Investment				
DIRECT EFFECTS	**dollar debt to total assets**		**dollar debt to total debt**	
Δ Log (exchange rate)	-0.229***	-0.418	-0.232***	-0.42
	(0.083)	(0.327)	(0.083)	(0.329)
INTERACTIONS				
Δ Log (bilateral US "RER") x Dollar Debt (-1)	-0.266	0.201	-0.065	0.1436
	(0.318)	(0.293)	(0.149)	(0.188)
Δ Log (real exchange rate) x Exports (-1)		0.0035**		0.0035**
		(0.002)		(0.002)
Δ Log (real exchange rate) x Imports (-1)		0.0046		0.0046
		(0.006)		(0.006)
CONTROLS				
Dollar Debt (-1)	-0.0919*	-0.0285	-0.034	0.005
	(0.051)	(0.045)	(0.024)	(0.026)
Leverage (-1)	-0.011	-0.0096	-0.0127	-0.0113
	(0.019)	(0.042)	(0.019)	(0.041)
Exports (-1)		-0.008		-0.0086
		(0.008)		(0.008)
Imports (-1)		-0.473		-0.472
		(0.417)		(0.417)
Sectoral gdp growth	-0.024	-0.0379	-0.025	-0.0378
	(0.039)	(0.077)	(0.039)	(0.077)
R^2	0.0008	0.0007	0.0007	0.0007
Observations	37512	17704	37512	17704
Firms	7567	3976	7567	3976
Wald Test	49.58 [0.000] **	106.9 [0.000] **	50.34 [0.000] **	102.8 [0.000] **

Notes:
Estimates using within estimator, robust standard errors in parenthesis
p-values for Wald Test of overall lack of significance of regressors appear in [ ]
*, significant at the 90% level, ** at the 95%, *** at the 99%

A Generalized Method of Moments (GMM) estimator based on the use of lagged observations of the dependent and explanatory variables allows us to deal with these problems (Arellano and Bover, 1995). To address the problem of possible omitted variable bias induced by firm specific effects, the regression equation is differenced. Also, to address the problem of joint endogeneity, suitably lagged values of the original (i.e. in levels) independent variables, including the lagged value of the dependent variable, are used as instruments for the right hand side variables (i.e. the differenced values of the original regressors) in the transformed equation. The validity of the moment conditions implicit in this "GMM difference estimator" are tested statistically. First, we present results for a Sargan test of over-identifying restrictions that checks the overall validity of these moment conditions. Under the maintained assumption that the

error term of the original dynamic levels equation is serially uncorrelated, the transformed error term for the difference equation is expected to have serial correlation of first order, but not of second order. Thus we report AR(1) and AR(2) tests on the lack of serial correlation for the transformed error term[30]. These test statistics are asymptotically normal under the null of no serial correlation.

A drawback of the first differenced GMM estimator is that the instruments available for the transformed regression equation are weak when the individual series have near unit root properties. Indeed, if the series are highly persistent, their differences are nearly innovations and there are no good instruments for near white noise series. Thus, the GMM difference estimator can be subject to finite sample biases. This potential bias can be reduced using the "GMM system estimator" proposed by Arellano and Bover. This estimator combines the regression expressed in first differences with the original equation expressed in levels. As before, suitably lagged values of the dependent variables in levels are used as instruments for the differenced equation, whereas the equation in levels is instrumented with lagged differences of the explanatory variables. Both the Sargan and serial correlation tests are examined in this case. A Difference Sargan Test is useful in this context, since the set of moment conditions specified under the simple difference estimator is a subset of the one considered in the system estimator. The difference between the Sargan statistic obtained under the system estimator and the one obtained under the difference estimator is asymptotically distributed χ^2 with degrees of freedom given by the difference between the number of degrees of freedom of the system estimator and that of the difference estimator. Failure to reject the null hypothesis of the validity of additional restrictions gives support to the system estimator[31].

Taking the former considerations into account, we estimate alternative specifications in which we drop the non-interacted macro variables and include year specific effects to capture the overall macroeconomic environment affecting our sample of firms. We concentrate our attention on the role of firm specific variables and, perhaps more importantly, their interaction with macroeconomic variables. In unreported regressions we considered a version of BC's specification for fixed capital investment where, besides from the key interaction term and time-specific effects, only lagged leverage and the lagged ratio of dollar indebtedness to assets are included as additional regressors. In sum, despite the suggestive evidence presented in Table 7 regarding the performance of firms in "hell" as opposed to hedged and in heaven, results from these regressions (as those from Table 8) indicate that it is difficult to find a significant degree of heterogeneity in firm response to exchange rate movements depending on their level

[30] One may allow for the error term of the original levels equation to follow an autoregressive process of finite order, as long as there are enough time series to estimate the parameters. For example, if the original error term is MA(1), the differenced error term is MA(2) and only lags of the dependent variables dated *t-2* are available as instruments for the differenced equation. See Bond (2002) for an intuitive review on this and other issues concerning GMM estimators for dynamic panel data models.

[31] The Difference Sargan Test is also useful in determining the lags available for instrumenting right hand side variables. Indeed, when right hand side variables are *endogenous*—correlated with present and past variables of the regression disturbance—lags dated *t-2* and onwards are available as valid instruments. If these variables are *predetermined*—correlated with past variables of the regression disturbance— then lags dated *t-1* also become available and if the variable is *strictly exogenous* then current values (dated *t*) are also available as valid instruments. In all specifications below, firm-specific characteristics are lagged one period, so we usually assumed that these variables are predetermined. Nonetheless, when more than one specification was valid according to Sargan tests, we relied on the Difference Sargan Test to choose the preferred specification.

of foreign indebtedness. This is probably not surprising considering the limited degree of foreign indebtedness of Colombian firms. These results are nonetheless important to the extent that they reveal that BC's result is unlikely to hold in our sample of firms (i.e. dollar indebted firms do NOT fare any better during devaluations)[32].

Moving away from BC's framework, in Tables 9 to 11 we consider an alternative set of regressions were we control for potentially relevant omitted factors and examine, together with the behavior of investment, the response of profits as an alternative performance measure. We include the interaction between dollar debt at the end of *t-1* and alternative channels for the real exchange rate[33], and interactions of exchange rate terms with lagged exports and imports. As noted in Section 3, we might see firms investing more after a devaluation not because individually they benefit from a "competitiveness effect" but because collectively this allowed for a looser monetary policy. Likewise, we could see them investing less not because of a balance sheet effect of dollar indebtedness but because they face higher interest rates under a dogged defense of the currency. Since this would most likely affect firms that are indebted domestically in the short run, we include interest rate terms interacted with different measures of indebtedness. In this set of regressions, time-specific effect are also included.

Although we present results for only one measure of dollar debt and exports, results do not change when alternative definitions are included[34]. We estimate static fixed effects specifications as well as dynamic GMM estimations[35]. Regarding the latter, Sargan and AR tests performed satisfactorily and the additional moment restrictions implied by the GMM System estimator were not rejected. Thus, we present both the GMM Difference and System estimations[36]. Our sample is significantly reduced as we are not able to impute reliable measures of imported inputs to all firms in our sample.

Table 9 presents a set of estimations for the case in which firm level variables are interacted with measures for the *changes* in the macro variables (i.e. dollar debt, exports, and imports are interacted with the real exchange rate *devaluation*, whereas

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[32] Since BC argue that their result is driven by the fact that dollar indebted firms see their sales and earnings rise after a devaluation, we also employed the same framework used for investment to examine the effects of a devaluation on earnings and sales. Results actually lent some evidence to the fact that dollar indebted firms experienced a decline rather than an upsurge in cash flow and sales during devaluation when compared to peso-indebted firms. Estimations are available from the authors upon request.

[33] In the case of fixed capital investment regressions, we interacted firm level variables both with the *changes* in macro variables and with their *levels*. The latter specification could be motivated by an *accelerationist* approach (see Bond et. al., 1997) whereby the desired level of capital depends, for instance, on the level of the exchange and interest rates so that the ratio of investment to total assets (a proxy for the rate of growth of capital) depends on the devaluations rate and the rate of change of the interest rate. On the other hand, interaction with levels captures to what extent investment (or profits) change as a result of shifts in, say, the real exchange rate.

[34] The exchange rate devaluation refers to average devaluation of the bilateral real exchange rate, short term debt is the share of short term domestic debt, and exports are obtained at the level of the firm. In the case of exports and imports, interactions of a multilateral real exchange rate is considered instead. Regressions were run for end of period depreciation, the overall share of short term indebtedness and for sectoral data on exports. Results were mostly unchanged.

[35] Estimating dynamic specifications with the OLS and within estimators is useful, since the former is usually biased upwards and the latter downwards. For all reported estimations, we run OLS and fixed effects regressions to check that our GMM estimators, presumably consistent, lied between the two. The difference in the estimators were often large, suggesting the presence of significant firm-specific effects

[36] Two step estimates with robust standard errors are presented. Second-step standard errors were computed using Windmeijer's (2000) finite-sample correction. It should also be noted that we instrument for the level of foreign debt, leverage, exports, and the maturity composition of debt. Also, although we run regressions using all available lags as instruments, we only report those in which three lags were used.

the degree of short term indebtedness is interacted with the (log) percentage change of the real interest lending rate). The most salient feature of these regressions is that we fail to find any significant heterogeneity in terms of the response of firms to exchange and interest rate movements. Actually, the terms included in our fixed effects regressions (besides from the time specific effects) are not jointly significant. In the case of the dynamic GMM regressions, there is clear evidence of persistence in the level of investment, but key interactions are once again insignificant. Only under the GMM System regression we find a significant effect of firm level characteristics, namely, a positive effect of short term debt, total leverage, and share of imports. In this case, sectoral GDP growth also exerts a significant positive effect on investment.

When macro variables are interacted in levels as in Table 10, we are able to capture somewhat more heterogeneity. In particular, the interaction of the real exchange rate index with exports is positive and significant in all fixed effects and GMM system specifications. On the other hand, although the interaction of dollar debt and the real exchange rate is negative, it is not significant. Regarding non-interacted firm level variables, the only important change refers to the level of exports having a negative effect on investment under the fixed effect and system GMM regressions. As before, time effects are significant, and there is evidence of persistence in investment[37].

Finally, in Table 11 we use profits (as % of total assets) as the dependent variable, while the macro variables in the interactions enter in levels[38]. Interestingly, we obtain a significant negative effect of the dollar debt interaction with the exchange rate. This result is somewhat puzzling since if (as we have assumed) net worth affects investment levels, decreased profits should imply lower investment[39]. There is also some evidence that exporting firms tend to have larger increases in their profits in times of devaluations, whereas the impact of having a higher share of imported inputs is not robust, though negative in the (preferred) System GMM regression. A noteworthy result is that there appears to be no persistence in firm profitability. Regarding the role of additional firm level variables, results are not robust to alternative specifications.

[37] Since a small share of firms hold non-trade related dollar debt, we also run the regressions of Tables 9 and 10 considering total dollar debt and its interaction with real exchange rate terms. When macroeconomic variables enter in changes, the interaction results hardly change, whereas in the case of level interactions the most important change refers to the interaction between dollar debt and the exchange rate having a negative and significant effect.

[38] Indeed, it is not straightforward to motivate, as in the case of investment, regressions that consider the rate of devaluation and the rate of change of the interest rate as right hand side variables resulting form an accelerationist approach. Rather, one would like to uncover the role of exchange rate shifts on the level of profits.

[39] When total dollar debt is considered instead of non-trade debt this result still holds.

Table 9. Detailed Fixed Capital Investment Regressions

Dependent variable: Fixed Capital Investment			
Independent Variables	**Fixed Effects**	**GMM Difference**	**GMM System**
Dependent Variable (-1)		0.054***	0.0596***
		(0.011)	(0.01058)
INTERACTIONS			
Bilateral US "RER" devaluation x Dollar Debt (-1)	0.0599	0.0394	0.0296
	(0.067)	(0.060)	(0.067)
Share of Exports (-1) x RER devaluation	0.0004	0.0003	0.0002
	(0.0004)	(0.0004)	(0.0004)
Share of Imports (-1) x RER devaluation	-0.0002	-0.0007	-0.0008
	(0.00027)	(0.0009)	(0.001)
Real interest lending rate % change x Short Term Domestic Debt (-1)	-0.017	0.024	-0.0026
	(0.019)	(0.026)	(0.0262)
CONTROLS			
Short Term Domestic Debt (-1)	0.0018	0.0035	0.0043**
	(0.001)	(0.0032)	(0.0019)
Leverage (-1)	-0.0004	0.038	0.0492***
	(0.0038)	(0.029)	(0.017)
Dollar Debt (-1)	-0.0016	-0.011	-0.0164
	(0.0127)	(0.0175)	(0.0178)
Exports (-1)	0.0038	-0.0006	0.0041
	(0.004)	(0.008)	(0.0048)
Imports (-1)	-0.0034	0.0009	0.0265*
	(0.0032)	(0.0124)	(0.015)
Sectorial Output Growth	-0.0012	0.0283	0.0567**
	(0.0087)	(0.0243)	(0.024)
TIME EFFECTS	YES	YES	YES
Observations	15900	15900	15900
Firms	3188	3188	3188
Wald Test (joint)	12.43 [0.257]	43.79 [0.000] **	83.21 [0.000] **
Wald Test (time)	206.6 [0.000] **	92.99 [0.000] **	120.4 [0.000] **
Sargan Test		47.49 [0.535]	72.31 [0.369]
Difference Sargan Test			24.82 [0.208]
AR(1)		-10.05 [0.000] **	-10.06 [0.000] **
AR(2)		0.9133 [0.361]	1.067 [0.286]

Notes: Robust standard errors in parenthesis; p-values for Wald Test of overall lack of significance of regressors and for joint significance of time dummies appear in [ ]; * denotes significance at the 90% level, ** at the 95%, *** at the 99%. Lags dated t-2 and t-3 for dollar debt, short term debt, leverage and exports were included as instruments for GMM difference estimations.

Table 10. Detailed Fixed Capital Investment Regressions

Dependent variable: Fixed Capital Investment			
Independent Variables	**Fixed Effects**	**GMM Difference**	**GMM System**
Dependent Variable (-1)		0.052***	0.059***
		(0.011)	(0.01)
INTERACTIONS			
Bilateral US "RER" x Dollar Debt (-1)	-0.001	-0.0008	-0.0001
	(0.0008)	(0.0007)	(0.0007)
Share of Exports (-1) x RER	0.0004**	0.0004	0.0005**
	-0.0002	(0.0003)	(0.00026)
Share of Imports (-1) x RER	-0.0004	-0.0005	-0.001
	(0.0003)	(0.0011)	(0.0011)
Real interest lending rate x Short Term Domestic Debt (-1)	-0.0003	0.000001	0.00003
	(0.0002)	(0.0004)	(0.0004)
CONTROLS			
Short Term Domestic Debt (-1)	0.040	0.0032	0.007
	(0.027)	(0.042)	(0.039)
Leverage (-1)	-0.0005	0.0478	0.049***
	(0.0038)	(0.030)	(0.016)
Dollar Debt (-1)	0.058	0.039	-0.0098
	(0.051)	(0.050)	(0.051)
Exports (-1)	-0.037*	-0.033	-0.054*
	(0.0225)	(0.032)	(0.028)
Imports (-1)	0.034	0.0547	0.142
	(0.029)	(0.109)	(0.113)
Sectorial Output Growth	-0.0015	0.0198	0.0598***
	(0.0085)	(0.020)	(0.022)
TIME EFFECTS	YES	YES	YES
Observations	15900	15900	15900
Firms	3188	3188	3188
Wald Test (joint)	20.74 [0.023] *	43.65 [0.000] **	89.62 [0.000] **
Wald Test (time)	183.8 [0.000] **	88.20 [0.000] **	115.5 [0.000] **
Sargan Test		45.05 [0.634]	70.36 [0.432]
Difference Sargan Test			25.31 [0.190]
AR(1)		-10.07 [0.000] **	-10.01 [0.000] **
AR(2)		0.8632 [0.388]	1.078 [0.281]

Notes: Robust standard errors in parenthesis; p-values for Wald Test of overall lack of significance of regressors and for joint significance of time dummies appear in [ ]; * denotes significance at the 90% level, ** at the 95%, *** at the 99%. Lags dated t-2 and t-3 for dollar debt, short term debt, leverage and exports were included as instruments for GMM difference estimations.

Table 11. Profits Regressions

Dependent variable: Profits			
Independent Variables	**Fixed Effects**	**GMM Difference**	**GMM System**
Dependent Variable (-1)		-0.296	0.026
		(0.27)	(0.031)
INTERACTIONS			
Bilateral US "RER" x Dollar Debt (-1)	-0.0189**	-0.0084*	-0.006*
	(0.087)	(0.005)	(0.003)
Share of Exports (-1) x RER	-0.0028	0.0035	0.0056**
	(0.0033)	(0.003)	(0.002)
Share of Imports (-1) x RER	0.0036*	-0.0073	-0.027***
	(0.0019)	(0.0079)	(0.01)
Real interest lending rate x Short Term Domestic Debt (-1)	-0.0015	0.0028	0.00004
	(0.002)	(0.0026)	(0.002)
CONTROLS			
Short Term Domestic Debt (-1)	0.268	-0.341	0.0024
	(0.203)	(0.291)	(0.213)
Leverage (-1)	0.172	0.35	0.296**
	(0.159)	(0.466)	(0.144)
Dollar Debt (-1)	1.209**	0.42	0.289
	(0.563)	(0.431)	(0.239)
Exports (-1)	0.418	-0.378	-0.617**
	(0.476)	(0.306)	(0.244)
Imports (-1)	-0.452**	0.742	3.106***
	(0.208)	(0.878)	(01.163)
Sectorial Output Growth	-0.216	0.0756	0.390
	(0.217)	(0.133)	(0.252)
TIME EFFECTS	YES	YES	YES
Observations	15900	15900	15900
Firms	3188	3188	3188
Wald Test (joint)	28.50 [0.001] **	14.06 [0.230]	16.05 [0.139]
Wald Test (time)	8.228 [0.144]	7.135 [0.211]	9.933 [0.128]
Sargan Test		54.5 [0.273]	79.43 [0.183]
Sargan Difference Test			24.93 [0.204]
AR(1)		-0.9876 [0.323]	-1.377 [0.168]
AR(2)		0.2931 [0.769]	0.8119 [0.417]

Notes: Robust standard errors in parenthesis; p-values for Wald Test of overall lack of significance of regressors and for joint significance of time dummies appear in [ ]; * denotes significance at the 90% level, ** at the 95%, *** at the 99%. Lags dated t-2 and t-3 for dollar debt, short term debt, leverage and exports were included as instruments for GMM difference estimations.

In sum, this section suggests that, while there is evidence of a negative balance sheet effect on firms' performance as measured by profitability, results for investment are mixed. On the one hand, firms that are not highly indebted in dollars and export part of their output tend to outperform dollar-indebted, non-exporting firms. Nonetheless, the interaction of dollar indebtedness with the exchange rate terms is generally not significant in the investment regressions. Finally, the real interest rate interaction is rarely significantly negative[40].

5 Conclusions

Recently, Colombia has experienced increased macroeconomic volatility. After a period of significant currency appreciation associated with large capital inflows and oil investments, the exchange rate experienced a strong real depreciation in response to capital outflows at the end of the decade (along with many emerging economies). While among policy makers the favorable view of exchange rate devaluation for firm investment has prevailed, there is a recent and increasing concern in the literature for the possible detrimental effects of devaluations in the presence of foreign indebtedness. Foreign denominated currency, it is argued, leads to a negative balance sheet effect that constraint firms' investment.

This paper contributes to this debate on empirical grounds. We examine the determinants of investment for a representative sample of Colombian firms in the period 1995-2001. Our results suggest that matching takes place, to the extent that exporting firms and those in more open sectors are more likely to have foreign indebtedness and hold higher shares of dollar debt. Firm size is the most robust and significant determinant of dollar indebtedness. Although the previous results and the limited amount of dollar denominated indebtedness in Colombia tilt the balance *against* finding any negative balance sheet effect of devaluations, we find evidence in favour of the latter on firms' performance as measured by profitability. Results for investment, on the other hand, are mixed. Although firms that are not highly indebted in dollars and export part of their output tended to outperform the rest during the devaluation period, the interaction of dollar indebtedness with the exchange rate is generally not significant in our investment regressions.

In sum, as it is shown in Table 12, there is evidence of matching in Colombian firms; yet, against BC, dollar indebted firms not necessarily fare better during devaluations. Answering our title's question, for a relevant group of firms "sins" are indeed punished. We find evidence that those firms in hell exhibit balance sheet effects during devaluations, both in investment and profitability. However, in our set of panel regressions these results are relatively less robust. We conclude that financial vulnerability related to foreign indebtedness cannot be ruled out.

[40] This finding is consistent with studies on the determinants of investment at the macro level in Colombia (see Ocampo *et. al.* , 1988 and Fainboim, 1990).

This paper opens the way for interesting further research. For instance, the difficulty in disentangling the effect of dollar indebtedness on firm performance is probably due to the fact that there is a small degree of dollarization of liabilities. Thus, it might be worthwhile to analyze the subset of firms that engaged in dollar indebtedness vis-à-vis other similar firms that did not. Sample selection models popularized by Heckman and others could help in this regard. Also, further research might concentrate on those firms that actually disappeared during this period of study, as a special case of vulnerability in our sample.[41]

Table 12. What can be concluded

	Mundell-Fleming	Balance sheet Effect	Not conclusive
Composition			
Table 6	Firms match their revenue and income streams: exporting firms and firms in more open sectors tend to have larger shares of "Dollar" debt and engage in in this type of indebtedness more often than firms selling in the domestic markets or firms belonging to closed sectors		
Performance			
Table 7		Exporting firms with low levels of dollarization of liabilities have better performance than dollar indebted firms producing non-tradables, both in terms of investment and profitability.	
Table 8	Exporting firms tend to benefit in the periods of devaluation.		Dollar indebted firms do not fare worse in terms of investment than peso-indebted firms.
Table 9-Table 10	Exporting firms tend to benefit in the periods of devaluation.		As in Table 8
Table 11		Dollar indebted firms experience a decline in profitability with shifts in the exchange rate	

[41] Mejía (2003) is a first approximation to this issue.

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Appendix 1. Variable definition

In this appendix, we list the main variables used in the analysis and explain how we modified the data set. The following were excluded:

1) Firms that do not appear in the sample for at least four consecutive years. This results in dropping 6700 firms, which account for roughly 44% of the sample
2) 65 firms that have no change at all in their level of assets or liabilities in consecutive years.
3) 6 firms reporting unrealistically low levels of assets. In particular, firms whose assets do not exceed $100,000 Colombian pesos (US$35 at current exchange rates), which is nearly a third of the legal minimum monthly wage.
4) 868 firms displaying inconsistent accounting information, including:
   - firms having liabilities that exceed the value of their assets (812 firms)
   - negative operational income (4 firms)
   - short-term assets larger than total assets (7 firms)
   - firms reporting negative values for their total liabilities, any of its components, or on interests on their financial liabilities (24 firms)
   - firms in which components of liabilities exceed the total (foreign, domestic, trade and financial, 21 firms)
5) For estimation purposes, we also check the sensitivity of our results to the exclusion of outliers (firms for which our measures of investment lie in the upper or lower 3% of the sample). In a number of estimations, we are also obliged to drop firms for which we do not have (or are unable to impute) denomination of output and inputs in terms of currencies. 1064 firms (964 belonging to the retail sector) are dropped because of these criteria.

Import input shares were imputed to each firm by mapping each firm's sector with the most disaggregated sector available in National Accounts Data. Sectoral imported input shares were computed as the ratio of imported intermediate purchases by each sector to total intermediate purchases, both domestic and imported. Such data is available from the economy-wide input-output matrix, with 60 sectors being the thinner disaggregation available. In constructing inventory investment, the real change in inventories was computed by deflating the original firm level data by the most disaggregated data available on sectoral producer price indices (PPI). In those cases were there was no satisfactory disaggregation of the PPI to match the firm's sector, total PPI was used. Further details on variables' construction are available form the authors upon request.

Debt Variables

1. Total Debt=Total liabilities. Balance sheet.
2. Short-term Debt=Total liabilities due in less than one year. Balance sheet.

3. Foreign or “Dollar” Debt= Liabilities with foreign banks, corporations and foreign suppliers (long and short-term). Balance sheet annex, no. 9.
4. Short-term Foreign Debt=Short-term liabilities with foreign banks, corporations and foreign suppliers. Balance sheet annex, no. 9.
5. Foreign Financial Debt= Liabilities with foreign banks and corporations (long and short-term). Balance sheet annex, no. 9.
6. Foreign Trade Debt= Liabilities with foreign suppliers. Balance sheet annex, no. 9.
7. Domestic Debt= Liabilities with domestic banks, corporations and national suppliers (long and short-term). Balance sheet annex, no. 9.
8. Short-term Domestic Debt=Current liabilities with domestic banks, corporations and suppliers. Balance sheet annex, no. 9.
9. Domestic Financial Debt= Liabilities with domestic banks and corporations (long and short-term). Balance sheet annex, no. 9.
10. Domestic Trade Debt= Liabilities with national suppliers. Balance sheet annex, no. 9.
11. Leverage=Total liabilities as a share of total assets in the balance sheet.

Investment Variables

1. Investment in fixed capital= Net purchase of properties, plant and equipment. Cash flow. For estimation, this variable is expressed as % of total assets.

Other Relevant Variables

1. Total assets. Balance sheet.
2. Exports= Operational income generated abroad. Balance sheet annex, no. 15.

Macroeconomic Variables

1. Real exchange rate index and bilateral exchange rate. Source: Banco de la República.
2. Real interest rate. Source: Superintendencia Bancaria.
3. Sectoral output and sectoral output growth. Source: DANE.

Appendix 2. Capital stock series at replacement costs

An ideal measure of fixed capital investment should consider the rate of change of the capital stock series at replacement costs. Nonetheless, a number of difficulties with balance sheet information led us to construct instead a measure of fixed capital investment from cash flow data. This Appendix describes some of the obstacles in constructing a satisfactory capital stock series at replacement costs based on balance sheet information. Our data set contains information on purchases, inflation adjustments, depreciation, valuation, and provisions, for 24 types of assets. While firms' asset valuation should in principle be a good approximation of the capital stock's "replacement value"—firms must declare such value on the basis of a "technical assessment"—in practice the series is probably correlated with firms' tax burden and access to credit.

A suitable alternative would therefore be to correct balance sheet data on fixed assets in order to get a good estimate of the replacement cost of capital. Reasonable assumptions on rates of investment, depreciation, and price of capital for different sectors and types of capital must be obtained in order to use the perpetual inventory formula for that purpose. For the Colombian case it is difficult to obtain satisfactory assumptions on these variables for the wide range of sectors and assets of our data set. For instance, although it is possible to gather information on average investment by sector and type of asset for the manufacturing sector from the yearly manufacturing survey, this is based on the book-value and not on the replacement value of assets. Regarding economically meaningful depreciation rates, the only source of information on depreciation rates by sector and type is Pombo (1999), available only for the manufacturing sector. Combining this rates with accounting data often implies a negative capital stock series. An alternative is to consider "reasonable rates" of depreciation for each type of asset following estimations by Harberger (1973). Yet, such estimations are definitely out of date and cover only the manufacturing sector. Accounting rates of depreciation from our data set are not satisfactory either, since they must be calculated from data on accumulated depreciation and often result in negative depreciation rates. Regarding the price of capital, there are implicit deflators of fixed capital formation by type of assets (4 broad categories), as well as a weighted average for the whole economy. For the period 1995-2001 we can find a thinner desegregation of categories, but for the "historical" rates of asset price inflation that enter the perpetual inventory formula there are but 4 categories and again no disaggregation by sector.

In short, there is no satisfactory measure of the capital stock at replacement costs from the balance sheet information in our data set, nor a convincing set of assumptions to correct the book value of fixed assets. The rate of investment from cash flow information provides a better measure of the evolution of capital stock for our sample of firms.

Appendix 3. The BC set-up: summary and extensions

A summary of the BC set-up

In a two-period world, a continuum of firms holding a fraction β of their total liabilities (normalized to 1) in dollars seek to maximize their profits in period t+1 as given by:

$$\pi_{t+1}(e_{t+1}, K_{t+1}; \beta) = g(e_{t+1}; \beta)F(K_{t+1}) - r(W_t)K_{t+1}. \quad (2)$$

The first term at the right hand side of (2) are earnings before interest payments. For each firm, the capital stock at period t, K_t, is predetermined, as is their fraction of dollar debt. Function *g* captures the response of profits to changes in the real exchange rate. Firms borrow capital at an interest rate that is decreasing in net worth (*W*):

$$W_t = \pi_t - (\beta e_t + (1-\beta)). \quad (3)$$

Devaluations reduce net worth because they increase the domestic currency value of foreign liabilities. Firms choose K_{t+1} so as to maximize (2) subject to (3) and to an exchange rate level in period t+1 that exhibits persistence, $e_{t+1} = \mu(e_t)$. The F.O.C. implicitly defines an optimal demand for capital, whose derivation with respect to the exchange rate leads to BC's competitiveness and net-worth channels on investment.[42]

$$\frac{dK_{t+1}}{de_t} = \theta_t g'(e_{t+1}; \beta)\mu'(e_t) + \sigma_t \left[g'(e_t; \beta)F(K_{t+1}) - \beta\right]. \quad (4)$$

The first term in (4) is the "competitiveness effect". BC consider the case in which $g'(e_{t+1;}\beta) \geq 0$. As long as the exchange rate exhibits persistence is such that $\mu'(e_t) \geq 0$, this implies a positive competitiveness effect of devaluations on investment. A more general case —for instance, if imported inputs are important in production— should consider that $g'(e_{t+1;}\beta)$ might be negative. The second term in (4), capturing the net worth channel, is ambiguous. If $g'(e_{t+1;}\beta)$ is negative, a devaluation reduces earnings and net worth, leading to a decline in investment. On the other hand, for a sufficiently strong matching of liabilities and income streams ($g'(e_{t+1;}\beta) >> 0$), earnings increase with a devaluation, leading to higher investment and compensating the rise in foreign denominated liabilities (as captured by –β).

[42] Where $\theta_t = \left[-\frac{F'(K_{t+1})}{g(e_{t+1};\beta)F''(K_{t+1})}\right] \geq 0$ and $\sigma_t = \left[g'(e_t;\beta)F(K_{t+1}) - \beta\right] \geq 0$.

Following BC, we consider a "neutral" exchange rate for which the peso value of debt is identical for all firms, so that $g'(\bar{e};\beta) = \bar{g}$ for all periods and all β and $\frac{d\theta_t}{d\beta} = \frac{d\sigma_t}{d\beta} = 0$. The differential effect on investment of a devaluation across firms with varying levels of "dollar" indebtedness is:

$$(5) \qquad \frac{d}{d\beta}\left[\frac{dK_{t+1}}{de_t}\right] = \frac{dg'(e_{t+1};\beta)}{d\beta}\left[\theta_t \mu'(e_t)\right] + \sigma_t\left[\frac{dg'(e_t;\beta)}{d\beta}F(K_{t+1}) - 1\right]$$

The effect of imported inputs

From (5) it is clear that the effect on investment of a devaluation can be either increasing or decreasing in β. BC consider the case of "weak" matching of liabilities, where $\frac{dg'(e_{t+1};\beta)}{d\beta} \geq 0$.[43] This assumption hinges on the fact that $g'(e_{t+1};\beta)$ has been assumed positive. What if imported inputs are so important that $g'(e_{t+1};\beta) < 0$? Then it might be that $\frac{dg'(e_{t+1};\beta)}{d\beta} \leq 0$; firms with more dollar debt face a sharper *decrease* in profits as the exchange rate depreciates. In this case, a devaluation unambiguously decreases investment, and investment falls more in firms with higher dollar debt.

The effect of lower domestic interest rates

Quitting the "dogged" defense of the exchange rate allows interest rates to decrease. Thus, in addition to the idiosyncratic decrease in net worth, a macroeconomic channel affects the rate at which firms rent capital. Firms maximize profits in period t+1, now given by:

$$(6) \qquad \pi_{t+1}(e_{t+1}, K_{t+1};\beta) = g(e_{t+1};\beta)F(K_{t+1}) - \left[r(W_t) + r^*(e_{t+1} - e_t;\beta)\right]K_{t+1}$$

In (6), the second term for the interest rate shows that higher devaluation expectations imply higher domestic interest rates. When the policymaker quits the "dogged" defense of the exchange rate, and a devaluation does occur, expectations for a devaluation disappear or decrease, and interest rates fall: $r'^*(e_{t+1} - e_t;\beta) \geq 0$. Firms with a higher fraction of peso debt will be favored more by a decrease in domestic interest rates[44]. F.O.C for firm's optimization implicitly defines an optimal demand for capital which, in addition to BC's competitiveness and net-worth channels, depends on a "macroeconomic channel":

[43] Presumably, risk averse firms will choose a composition of debt that will match the exchange rate sensibilities of their balance sheet and income stream. It could also be the case that creditors charge more to firm's without a proper currency matching. In equilibrium there would be a correlation between currency composition of liabilities and the "tradeability" of output.

[44] Where $\delta = -\left[\frac{1}{g(e_{t+1};\beta)F''(K_{t+1})}\right]r^{*\prime}(\mu(e_t) - e_t) \geq 0$.

$$\frac{dK_{t+1}}{de_t} = \theta_t g'(e_{t+1};\beta)\mu'(e_t) + \sigma_t\left[g'(e_t;\beta)F(K_{t+1}) - \beta\right] + \delta_t(\mu'(e_t) - 1). \tag{7}$$

The macro effect (third term on the RHS of (7)) has a simple interpretation. As long as $0 < \mu'(e_t) < 1$ —i.e. allowing the exchange rate to weaken today will not lead to a more than proportional weakening tomorrow— a devaluation has a positive impact on investment. The total effect on investment is still ambiguous; ultimately an empirical matter. The differential effect on investment of a devaluation across firms can be found by implicit differentiation of (7). This total effect is the sum of the competitiveness and net worth channels as well as an additional term capturing the "macroeconomic channel":

$$\begin{aligned}\frac{d}{d\beta}\left[\frac{dK_{t+1}}{de_t}\right] &= \frac{dg'(e_{t+1};\beta)}{d\beta}\left[\theta_t\mu'(e_t)\right] + \sigma_t\left[\frac{dg'(e_t;\beta)}{d\beta}F(K_{t+1}) - 1\right] \\ &+ \frac{1}{g(e_{t+1};\beta)F''(K_{t+1})}\frac{dr^{*}'(\mu(e_t) - e_t)}{d\beta}(\mu'(e_t) - 1)\end{aligned} \tag{8}$$

The way the macroeconomic effect on investment varies for firms with different proportions of dollar debt —the third term at the RHS of (8)— may be interpreted as follows. First, notice that under the assumption of moderate persistence of the exchange rate –-i.e. $(\mu'(e_t) - 1) < 0$— concavity of the production function implies that $\frac{1}{g(e_{t+1};\beta)F''(K_{t+1})}(\mu'(e_t) - 1) > 0$. Thus, the sign of the expression is determined by $\frac{dr'(\mu(e_t) - e_t)}{d\beta}$. Recall that $r^{*}'(\mu(e_t) - e_t) > 0$ and note that for highly "dollar indebted" firms interest rates might increase less if devaluation expectations are high, since such firms presumably depend less on domestic credit conditions. Thus, $\frac{dr'(\mu(e_t) - e_t)}{d\beta}$ is negative and so is the "macroeconomic" channel. In other words, *for firms with a high proportion of dollar debt a devaluation, by decreasing domestic interest rates, will result in a lower increase in investment.* The combined effect of changes in earnings, in liabilities, and in domestic interest rates on the demand for capital is theoretically ambiguous.