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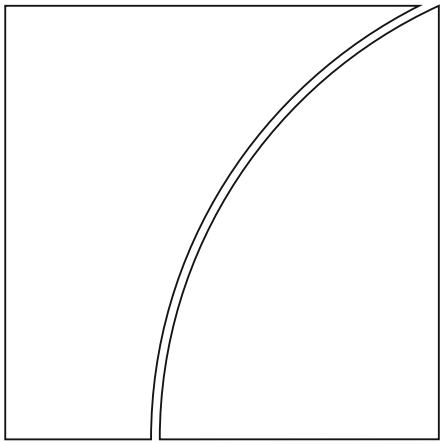

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Does exchange rate depreciation have contractionary effects on firm-level investment? The implications of alternative types of bond financing

Jose Maria Serena and Ricardo Sousa[#]

Abstract

We assess the conditions under which exchange rate fluctuations are contractionary for firm-level investment. To address this question, we match firm-level balance sheet data with a large dataset of firm-level bonds for about 1,000 firms from 36 emerging market economies over the period 1998–2014. We augment a standard firm-level investment model to control for (country-specific) macroeconomic variables, and interact the effect of an exchange rate depreciation with several dimensions of bond composition, namely: 1) currency of issuance; 2) maturity structure of bonds; and 3) market of issuance. We find that, conditional on the amount of debt issued in foreign currency, an exchange rate depreciation can have a contractionary impact on a firm's investment spending. We also find that the market of issuance and maturity structure, in particular, when coupled with foreign currency-denominated debt can influence this impact.

Keywords: investment, exchange rate, balance sheet, bonds, firm-level data, debt.

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[#] Bank for International Settlements

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"Now that the dollar has started to appreciate, the financial conditions of these firms [dollar debtors] have tightened, reducing investment..." (Caruana, 2016, p 10).

1. Introduction

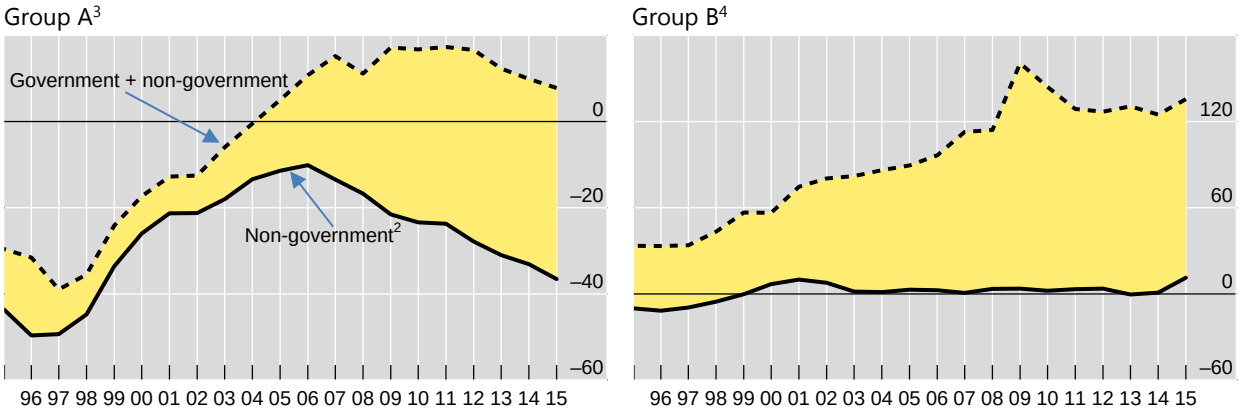
It has become conventional wisdom to assume that an exchange rate depreciation has a contractionary effect on the real economy through its negative impact on firms' investment spending.

In the aftermath of the Great Financial Crisis of 2008–2009, many firms in emerging market economies (EMEs) – including firms producing non-tradable goods – raised substantial amounts of foreign currency debt. This pattern of funding was accompanied by declining profitability and debt servicing capacity, and increasing leverage. Such developments translated into sharp rises in aggregate currency mismatches of the non-government sector and led to concerns about the potential impact of currency depreciation on the real economy (Chui et al (2016)).

Graph 1 shows that while being positive for the official sector, net foreign currency assets (NFCA) of the non-government sector have turned negative in many EMEs. Thus when the domestic currency depreciates the official sector with a positive NFCA, sees the value of its balance sheet rise and increased government spending has an expansionary effect. By contrast, a domestic currency depreciation implies that the value of the balance sheet of the non-government sector falls. This typically leads the private sector to reduce investment spending, and countries with larger foreign currency debts are likely to cut such spending the most. Hence the contractionary effect.

Net foreign currency assets as a percentage of exports[1]

In percentages — Graph 1



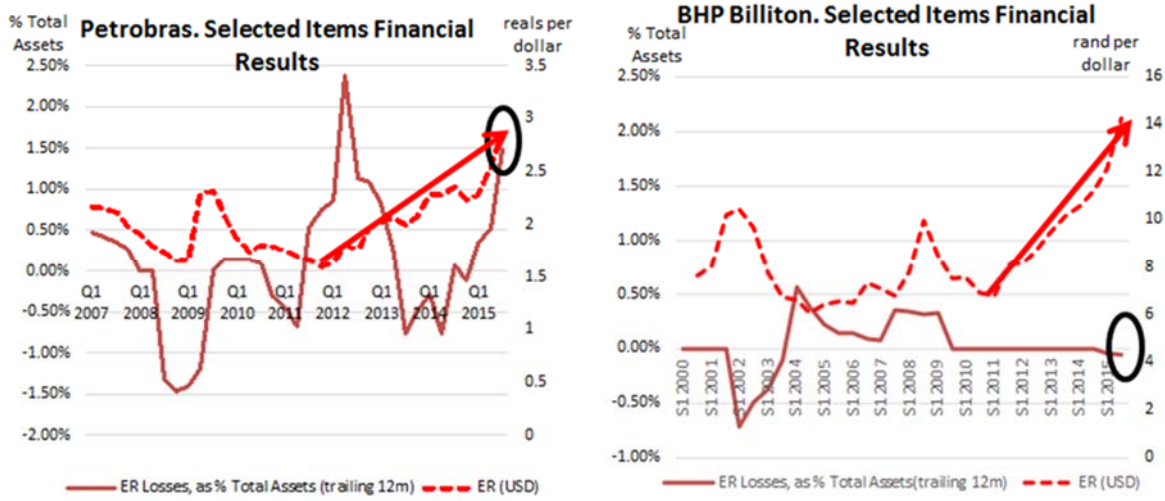
[1] For net foreign currency assets, outstanding positions at year-end. Calculated with aggregates of the economies listed in footnotes 3 to 4. [2] Excluding the central bank and general government assets/liabilities where these can be identified separately. [3] Brazil, Chile, Colombia, the Czech Republic, Hungary, Indonesia, Malaysia, Mexico, Peru, the Philippines, Poland, South Africa, Thailand and Turkey. [4] China, Chinese Taipei, India, Korea and Russia.

Source: M Chui, E Kuruc and P Turner (2016): "A new dimension to currency mismatches in the emerging markets - non-financial companies", *BIS Working Papers,* no 550, March.

In the specific case of non-financial firms, the expectation that currency depreciation can be contractionary is rooted in theoretical work highlighting its negative effect on firms' financial condition. In the presence of foreign currency debt, an exchange rate depreciation worsens firms' net worth. Firms' access to financial markets – in particular to foreign lenders – is impaired with the result that they could be forced to lower their investment (Céspedes et al (2004), Shin (2015) and Caruana (2016)).

Descriptive evidence relating to the link between firms' financial results, foreign currency debt and exchange rates is, at least, suggestive of contractionary depreciations. Graph 2 shows the exchange rate gains/losses of two firms: Petrobras, which is a Brazilian oil producer, and BHP Billiton South Africa, which is a commodity exporter. While these two firms have large stocks of outstanding debt, they differ in the composition of their liabilities: Petrobras has large foreign currency liabilities, while BHP Billiton South Africa has mostly domestic currency liabilities. In the case of Petrobras, the sharp depreciation of the Brazilian real in 2015, for which exchange rate losses represented 1.5% of total assets, exerted a drag on annual earnings. By contrast, a similar depreciation of the South African rand did not impair BHP Billiton South Africa's profits.

An illustration of the exchange rate balance-sheet effects Graph 2



Yet this drag on profits needs not translate into a contraction of investment. The negative effect on profitability could perfectly be counterbalanced – and eventually outweighed – by the positive impact of depreciation on competitiveness: a weaker currency can boost external demand (ie net exports) and lead to an expansion of investment and output. Whether the contractionary or the expansionary effect dominates is thus an empirical issue that deserves further analysis.

Despite the relevance of this question from a policy perspective, only a few papers conduct firm-level analysis and the available evidence does not provide a conclusive answer about the existence and the importance of the contractionary effects of depreciation on firm-level investment. This can be explained by limitations in data coverage, which is typically confined to the firms operating in a single country or region (Aguiar (2005), and Bleakley and Cowan (2008)) or the absence of granular information about firm-level debt composition (Galindo et al (2003) and IDB (2016)). This lack of conclusive evidence on the contractionary effect of depreciation on investment calls for a systematic assessment involving the use of firm-level information in a cross-country framework.

In this paper, we fill this gap and investigate whether exchange rate depreciation has a contractionary effect on corporate investment. To carry out the analysis, we use a comprehensive cross-country firm-level dataset. Overall, our dataset covers about 1,000 firms based in 36 EMEs over the period 1998–2014. The number of firms is balanced across countries and proportional to their GDPs, although small countries are somewhat overweighed to ensure a minimum number of firms for each country.

We address the severe data limitations on firms' foreign currency exposures. The breakdown required by most generally accepted accounting principles (GAAP) ignores some relevant details, such as currency composition, residual maturity and market of issuance. When this information is included in

financial statements, it is typically reported as notes in which firms disclose material financial risks in a discretionary way. Thus, using accounting information does not guarantee data comprehensiveness since whether the information is reported or not depends on the firm's willingness to provide the information. The same can be said about the maturity structure of liabilities.

For these reasons, we enrich the standard accounting information on the composition of liabilities with measures of outstanding debt constructed with bond-level data. This is a distinctive feature of our approach. By aggregating bond-level information at the firm-level, we are able to depict in detail the composition of liabilities in terms of currency, maturity and market of issuance.

Next, we estimate a standard firm-level investment model. As dependent variable, we use the ratio of capital expenditure to gross fixed assets. In the baseline equation, we include some key firm-specific variables as covariates, such as Tobin's Q ratio, the sales ratio and the cash flow ratio. Given the cross-country nature of our dataset, we are also able to add country-specific macroeconomic variables, such as real GDP growth and credit to GDP.

Since our interest lies in the impact of exchange rate fluctuations in the light of different dimensions of debt composition, we augment the baseline model to include domestic currency depreciation vis-à-vis the US dollar and its interaction with the three major dimensions of debt composition, namely: 1) currency (ie whether the debt is issued in foreign or domestic currency); 2) maturity (where we distinguish between residual maturity and long-term debt); and 3) market of issuance (ie whether the onshore or the offshore bond market is used for the issuance of debt).

Our main finding is that conditional on the amount of debt issued in foreign currency, exchange rate depreciation (appreciation) has a contractionary (expansionary) impact on firms' investment. In the absence of foreign currency debt, exchange rate movements do not translate into investment fluctuations. And these results hold while controlling for foreign currency assets.

In addition, we show that the maturity of bonds also plays a crucial role. In particular, an exchange rate depreciation associated with long-term debt issued in domestic currency boosts investment but can have a negative impact on capital expenditure by firms when coupled with long-term debt issued in foreign currency.

Finally, we evaluate the importance of the market of issuance. We find that an exchange rate depreciation has an expansionary (contractionary) effect on corporate investment when firms: (i) have issued a large amount of bonds in domestic (international) markets; (ii) hold a large amount of domestic currency-denominated bonds issued in domestic (international) markets; and (iii) have issued a large amount of long-term debt in domestic (foreign) currency regardless of the market of issuance.

We conduct an extensive number of sensitivity checks. Our results hold when we control for additional firm-level characteristics or country-level determinants. We also explore a dynamic model specification and conclude that the long-term impact of the main covariates is twice as large as their short-term impact but that the results are qualitatively similar. Finally, we do not find evidence of nonlinear effects in the relationship between firm-level investment and exchange rate depreciation.

All in all, our results highlight the importance of understanding the build-up of foreign currency liabilities and how it can affect the business cycles of EMEs via their impact on investment. They suggest that, at the very least, policymakers should maintain a vigilant posture vis-à-vis the composition of firms' liabilities across various dimensions.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature. Section 3 describes the dataset. Section 4 discusses the econometric framework. In section 5, the main empirical results are presented, while in section 6 several sensitivity checks are provided. Section 7 summarises the main conclusions.

2. Related literature

There is a well-established literature that highlights the importance of firms' net worth for investment decisions. For instance, Hubbard (1998) shows that it can have a stronger impact in the case of low net worth firms than for high net worth firms. And negative shocks to the net worth of firms that are financially-constrained raise the cost of external funding and reduce the incentives to invest, because imperfect information generates a premium between internal and external financing conditions via the credit channel effect (Bernanke and Gertler (1995)).[1]

As a firm's net worth may be affected if it has foreign currency debt and the exchange rate depreciates, these two factors can also matter for firm-level investment decisions. From a theoretical point of view, the exchange rate balance-sheet effect is best described in the work of Céspedes et al (2004, p 1183), who point out that:

> *"… In conventional textbook accounts, expansionary monetary policy and depreciation of the currency are optimal in response to an adverse foreign shock… But if an economy has a large debt denominated in foreign currency, then a weaker local currency can also exacerbate debt-service difficulties and wreck the balance sheets of domestic banks and firms… This channel may cause devaluations to be contractionary, not expansionary…"*

In addition, Caballero and Krishnamurthy (2003) argue that when financial constraints impact borrowing and lending between domestic agents, these tend to undervalue insurance against exchange rate depreciations. Then domestic agents opt for (excessive) US Dollar debt, because this type of insurance is more frequently available when external debt is denominated in domestic currency compared to US Dollars.

Our paper relies on cross-country firm-level data to investigate the role of exchange rate fluctuations for firm-level investment and to assess whether their impact depends on the composition of debt. Foreign currency debt can indeed be a major source of vulnerabilities and a cause of crisis episodes in EMEs (Gourinchas and Obstfeld (2012)).[2] Moreover, large and prolonged currency appreciations tend to go hand in hand with periods of rapid credit growth and the build-up of financial imbalances (Borio and Lowe (2003); Reinhart and Rogoff (2009)).[3]

Despite this, most of the research investigating the specific relationship between exchange rates, financial conditions and the real activity uses aggregate data.[4] For instance, Harvey and Hoper (1999) and

[1] Other authors emphasise the relevance of credit constraints (Whited (1991)) and financial restrictions (Stiglitz and Weiss (1981)), which can deter firms from investment because of credit rationing or due to the limited ability of banks to generate new loans. Banking sector inefficiency and financial markets' repression are also pointed out as factors shaping the behaviour of private investment (Shaw (1974) and Tybout (1983)).

[2] Cover and Mallick (2012) show that exchange rate shocks are also an important source of macroeconomic fluctuations, and Holtemöller and Mallick (2013) find that misalignments of the exchange rate from its equilibrium level are a predictor of currency crises.

[3] This impact that exchange rates have on the real economy through their effect on firms' financial conditions is referred to as the "risk-taking channel of currency appreciation". Here the US Dollar plays a pivotal role: a currency appreciation vis-à-vis the US Dollar is generally linked with permissive financial conditions (Hofmann et al (2016)). Goldberg and Tille (2008) also highlight the importance played by the US Dollar as a vehicle currency in international trade. Most importantly, the authors show that the choice of the invoice currency can be associated with the size of the demand elasticity that producers face in any given industry. More recently, Kohlscheen and Miyajima (2015) find that, in EMEs with a strong reliance on the banking sector, the volume of bank credit is a relevant determinant of fixed capital formation. Kohlscheen and Rungcharoenkitkul (2015) also uncover a relevant boost in credit expansion from exchange rate appreciations via the currency risk-taking channel.

[4] Peltonen et al (2011, 2012) investigate the determinants of country-level or aggregate private investment in EMEs. The authors highlight the role played by fundamentals (such as, the real GDP and the cost of capital) and financial factors (namely, credit, equity prices and lending rates). Using quarterly data for 31 EMEs for the period 1990:1–2008:3, they show that financial factors

Krugman (1999) rely on macroeconomic data to show that the exchange rate balance-sheet effect amplified the economic disruptions associated with the Asian Crisis. Other authors focus on the distributional impact of exchange rate fluctuations: Tille (2006) use a theoretical model to show that, in the presence of incomplete sector specialisation, a depreciation of the domestic currency generates adverse "beggar-thyself" effects - as in Tille (2001) - but with producers who compete against foreign producers ripping benefits that are disproportionally larger than those of producers who compete against domestic producers.

Acknowledging the problems of having data on the currency composition of firms' liabilities, some papers have opted for an alternative approach: compiling firm-level data at the country level as a way of making feasible the effort of gathering information about the currency composition of firms' liabilities.[5] For instance, Aguiar (2005) investigates the Mexican peso crisis of 1994. He shows that while the devaluation had a positive effect on profits and sales of exporting firms (when compared to non-exporting firms), it also reduced their investment because of the negative impact on their balance sheets. Galindo et al (2003) summarise the key findings of a joint project delving into the effect of exchange rate depreciations on investment for major Latin American economies. Using firm-level balance-sheet annual data for Brazilian firms from 1990 to 2002, Bonomo et al (2003) find that large firms change the composition of the currency of their debt more in response to a variation in the exchange rate risk than small firms. The authors also show that firms that operate in industries with a higher proportion of imported inputs tend to invest less when the domestic currency depreciates. Yet, no significant exchange rate balance-sheet effects on investment emerge in their analysis. The experience of other countries includes Argentina (Galiani et al (2002)), Chile (Benavente et al (2003)), Colombia (Echeverry et al (2003)), Mexico (Martinez and Werner (2002); Pratab et al (2003)) and Peru (Carranza et al (2003)). The results are not entirely homogenous across countries, but overall suggest that the contractionary effect dominates. Despite this, they are obtained separately for each country and can reflect methodological differences in the datasets or be driven by unobserved heterogeneity at the country-level.

Comparatively, there is much less research on the exchange rate balance-sheet effect using cross-country firm-level data.[6] A few studies show that firms' profitability after depreciations depends on the degree of indebtedness: the net income growth of highly-leveraged firms falls in the aftermath of a large depreciation of the domestic currency (Forbes (2002)). Other papers directly tackle the impact of exchange rates on investment. For instance, Bleakley and Cowan (2008) use accounting data for a sample of 450 firms over the period 1990-1999 and show that depreciations are expansionary: competitiveness

are especially important at explaining the dynamics of private investment albeit their role somewhat differs across regions: equity prices are a key driver of investment in emerging Asia; and credit and lending rates are more relevant in Latin America and emerging Europe, respectively.

[5] More generally, some authors analyse the determinants of corporate or firm-level investment using single-country data. In this regard, some firm-level characteristics have been put forward as particularly important. For instance, McConnell and Servaes (1995) rely on a large sample of non-financial US firms for the years of 1976, 1986 and 1988, and find that a firm's corporate value is negatively (positively) correlated with leverage for firms with a high (low) Tobin's Q. Lang et al (1996) use data for a sample of industrial firms in the U.S. over the period 1970–1989 and show that investment and leverage display a strong and negative relationship, but only in the case of firms with weak growth opportunities. Aivazian et al (2005) investigate the effect of financial leverage on firm-level investment using data for Canada. Again, a negative correlation is found between the two variables, especially for firms with low growth opportunities.

[6] Some studies explore different dimensions of corporate- or firm-level investment dynamics in emerging market economies using cross-country datasets. In this line of investigation, some authors emphasise the importance of capital market imperfections (Fazzari et al (1988); Gilchrist and Himmelberg (1995); Kaplan and Zingales (1997); Love and Zicchino (2006); Abel and Eberly (2011)). Others focus on the role played by foreign direct investment and capital flows (Gelos and Werner (2002); Harrison et al (2004); Forbes (2007); Magud and Sosa, 2015)). Additional work assesses the importance of cash flows (Fazzari et al (2000); Carpenter and Guariglia (2008)). Finally, there is also evidence on the relevance of external and future financing conditions for firm-level investment in emerging market economies (Almeida et al (2011); Li et al (2015)). For instance, Almeida et al (2011) argue that future financing constraints lead firms to prefer investments with shorter payback periods, less risky and which use more pledgeable assets. Magud and Sosa (2015) delve into the importance of country-specific commodity export prices and capital inflows as drivers of investment using a detailed firm-level dataset for emerging market economies. Li et al (2015) explore how variations in global interest rates and volatility affect firms' investment in emerging markets.

improvements dominate the balance-sheet effect. Despite this, some features of the data cast doubts about the generality of the results (Galindo et al (2003)): the bulk of the firms are Brazilian and only five Latin American countries are covered in the analysis. Besides, foreign currency debt is obtained from financial statements: this is not a compulsory balance-sheet item, but rather a discretionary note, which comments on prospective financial risks. Thus, this information is neither comprehensive, nor necessarily consistent across firms. More recently, IDB (2016) follows the model specification of Bleakley and Cowan (2008) and, using a large panel dataset of firms in Latin America and the Caribbean and Asia, it distinguishes between the competitiveness effect (ie the impact of the exchange rate on tradable goods prices) and the balance sheet effect (ie the interaction between foreign currency bond debt and an exchange rate depreciation) on investment. The analysis focuses exclusively on the currency dimension of bond financing, and does not take into account other dimensions of bond debt composition (such as, the maturity and the market of issuance) or their intersection with the currency in which debt has been denominated. Furthermore, even though it assembles information about a larger number of firms, it considers a smaller set of firm-level characteristics (namely, the interest coverage ratio, the leverage ratio and the operating profit margin) and covers a shorter sample period (ie 2005-2014) and a narrower country set (ie 15 EMEs).

We try to contribute to the existing literature in different directions. First, we match firm-level balance-sheet data with a large dataset of firm-level bonds. Thus, we cover about 1,000 firms from 36 EMEs over the period 1998-2014. Second, we collect data from firms' balance-sheets and financial statements to properly measure firm-level investment. Therefore, our dependent variable is the actual capital expenditures at the firm-level instead of a proxy for firm-level investment. Third, we augment a standard firm-level investment model to control for (country-specific) macroeconomic variables. Fourth, we study the direct effect of an exchange rate depreciation on firm-level investment. Fifth and most importantly, we interact the effect of exchange rate movements with three key dimensions of bond debt composition, namely: 1) *currency* (ie whether it is foreign or domestic currency-denominated debt); 2) *maturity* (ie whether it is short-term or long-term debt); and 3) *market of issuance* (ie whether the debt was issued in the onshore or the offshore market). Thus by using granular firm-level data about the composition of bond liabilities, we are able to make a very refined assessment of the balance-sheet effects of an exchange rate depreciation on firm-level investment.

3. Data

3.1. Main features

To estimate the impact of exchange rate movements on firms' investment and how it depends on debt composition, we construct a panel dataset covering 1,000 non-financial firms in 36 EMEs. The main source of information is Bloomberg and the period of the analysis is 1998-2014.

Our dataset is based on two distinct sets of information which we merge, namely: (i) firm-level information on balance-sheet and income statements; and (ii) measures of outstanding bonds guaranteed by these firms, which are computed using bond-level information. We follow this procedure to overcome the traditional problem of using the liability decomposition provided by financial statements, that is, standard balance-sheet items do not provide systematic detail on currency or maturity breakdowns. Firms might disclose this information merely as notes to their financial statements. Thus, it is a discretionary decision and firms may simply decide not to report it.

Moreover, the type of firms disclosing foreign currency exposures does not seem random. A bird's-eye-view suggests there are some regional differences: Latin American firms report more often their currency exposures than firms located in other regions. For instance, firms such as American Movil, Petrobras or PEMEX report this information. In contrast, firms with sizable foreign currency liabilities and

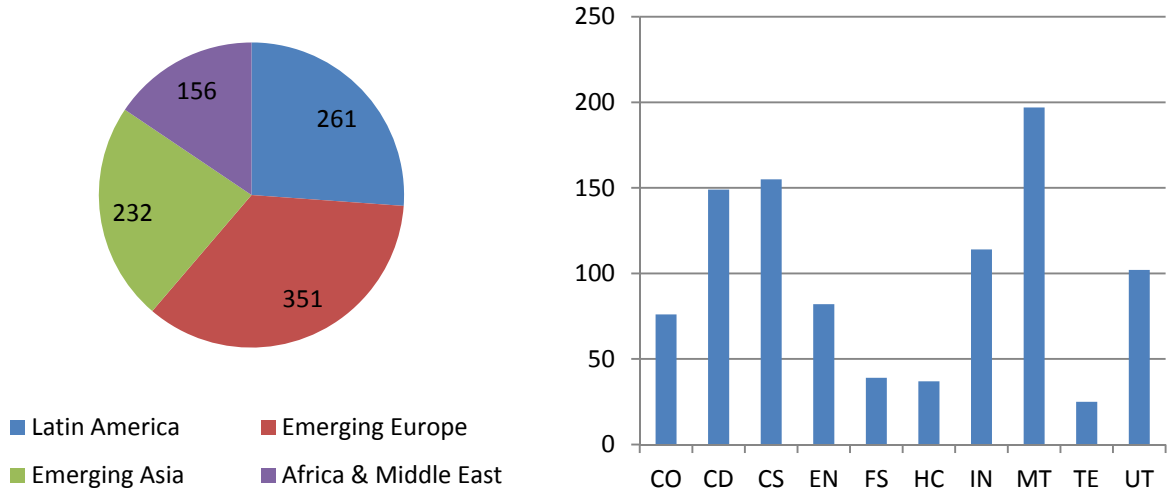
based in emerging Europe or Asia tend not to disclose it. This is the case of Gazprom – the largest Russian oil producer –, Bharti Airtel – the Indian telecommunication company –, or Samsung – the Korean multinational. In this context, using accounting information is not advisable.

The limits of standard sources of information have prevented the investigation of the impact of exchange rate depreciations on firms' investment on a systematic ground and on a cross-country setup. We overcome this problem by constructing measures of liability composition using bond-level information, and merging it with standard financial accounts measures. Besides, we enrich the dataset with relevant country-specific information. We detail the main features of the dataset in Graph 3.

The entities covered in the analysis are firms listed in the four regions of EMEs: Africa and the Middle East, emerging Asia, emerging Europe and Latin America.[7] In each country, we select the largest companies listed in the main stock exchange market. The number of companies differs across countries and is proportional to the GDP of the country in which they are located. Despite this, we somewhat overweight small countries by setting a minimum of, at least, 15 firms for each country. In our sample, all regions of EMEs are represented: emerging Europe is the region with more firms (351), followed by Latin America (261), emerging Asia (232), and Africa and the Middle East (156) - see right hand-side panel of Graph 3. The countries with the largest number of firms are: Brazil (77), India (69), Russia (64), South Korea (53) and Mexico (49).

Throughout the paper we use the Global Industry Classification Standard (GICS) of MSCI-Standard & Poors, which classifies firms into nine industry groups. We focus on non-financial companies, including real estate and insurance companies, but exclude financial services firms (such as banks, consumer finance and others). The sectors with greater representation are materials, consumer discretionary and consumer staples, followed by industrials and utilities – see left hand-side panel of Graph 3. There are fewer firms from health care, communications and technology in reflex of the fact that these sectors are narrower.

Composition of firms by region and by sector — Graph 3



Note: CO: communications; CD: consumer discretionary; CS: consumer staples; EN: energy; FS: real estate, property, and insurance; IN: industry; MT: materials; TE: technology; UT: utilities.

[7] Africa and the Middle East includes Egypt, Morocco, Nigeria, Saudi Arabia, South Africa, UAE; emerging Asia includes India, Indonesia, Malaysia, Philippines, Thailand, South Korea; emerging Europe includes Bulgaria, Belarus, Bosnia, Croatia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Turkey, Ukraine; and Latin America includes Argentina, Brazil, Chile, Colombia, Ecuador, Mexico, Peru, and Venezuela.

We focus on listed firms only. According to Bloomberg, the factors that determine if a firm is independent (ie can receive funds from related parties) are: 1) the management location; 2) the country of primary listing; 3) the country of revenue; and 4) the reporting currency of the issuer. Even if our dataset includes some foreign-owned entities, they are, from a financial point of view, legally independent from their parent companies. Firms are identified using the ticker of the stock exchange market in which they are listed.

For each firm we retrieve the financial statements, the income statements and key financial indicators. We also obtain non-financial information, such as the number of employees, reporting generally accepted accounting principles (GAAP), and whether the firm is an affiliate of a foreign company or not.

Separately, we collect data for all bonds issued and guaranteed by firms based in the jurisdictions under analysis. Following best practices, we treat firms as consolidated entities (Avdjiev et al (2016)). More specifically, for each bond issued over the period of the analysis we retrieve the ticker of the firm that has legal exposure to the corresponding liability. Hence, when firms issue bonds via financial vehicles, they are attached to the entity that guarantees them. Bond issuance by non-financial affiliates can be classified either as liabilities of the issuer or as liabilities of another related company (for instance, the parent company). This empirical issue depends on how the group manages the financial risks of its debt.

Table 1 summarises the dataset. Overall, aggregate gross issuances in the period under analysis amount for 2.8 USD trillion of bonds, of which 59% were issued in foreign currency and 41% in domestic currency. The proportion of issuances in international and domestic markets is very similar, and most of foreign currency issuances take place overseas. We cross-check the comprehensiveness of the bond-level information by comparing the portion of bonds issued in international markets with its natural benchmark - ie the newly published BIS data on debt securities, gross international bond issuances by non-financial corporations.[8] This is an important assessment since our firm-level measures constructed using this deal-level data capture the composition of firms' liabilities. The comparison shows that both sets of information are very similar, which implies that we cover the bulk of bonds issued by firms over the period. Typically, issuances in foreign currency have longer-term tenors, while firms in emerging Asia stand out as those issuing at longer maturities.

Bond-level data - Descriptive statistics

Table 1

	All EMEs	Emerging Asia	Latin America	Emerging Europe	Africa and the Middle East
Total amount (USD mn)	2,898,547	966,885	377,145	168,277	1,367,247
Number of bonds	38,579	5,238	3,104	717	29,430
Amount in local currency (USD mn)	1,678,658	342,662	194,254	74,649	1,064,654
Amount in foreign currency (USD mn)	1,219,890	624,223	182,891	93,628	302,593
Amount in international market (USD mn)	1,201,214	638,113	178,274	95,487	272,324
Amount in domestic market (USD mn)	1,697,333	328,772	198,871	72,790	1,094,923
Average bond issuance (USD mn)	75.15	184.63	121.62	234.70	46.47
Average maturity (years)	4.71	7.23	4.60	5.12	4.25
Maturity in international market (years)	6.71	8.76	6.41	7.75	5.19
Maturity in domestic market (years)	4.47	6.66	4.29	4.41	4.18

Source: Bloomberg; authors' calculations.

[8] We are not able to compare the total amount, since the BIS dataset on debt securities does not report gross bond issuances for domestic debt securities.

Using this granular deal-level dataset, we are able to construct firm-year measures of outstanding bonds. As a preliminary step, we compute measures of gross issuances and redemptions for each year. In the absence of early redemptions or exchange-offers, the difference between firm-level aggregate gross issuances and redemptions renders the outstanding stock of bonds for each firm. As discussed, we use the legal exposure to bonds as a systematic criterion to aggregate them. Besides computing the aggregate amount, we also break it down according to several dimensions, namely: currency, maturity and market of issuance. Since our raw data is at the deal-level, we are able to define even more granular decompositions. Among them, the most important ones are the residual maturity of currency composition and the market of issuance.

Next, we merge the firm-level dataset with our measures of outstanding bonds using the ticker of the firm. Following the previous examples, the ticker of Petrobras in IBOVESPA is PETR4 BZ Equity. It is straightforward to recover the corresponding balance-sheet, income statements and non-financial information. We identify bonds guaranteed by Petrobras using the same ticker. Then we merge both datasets. By using this procedure, we obtain a panel of firms that borrow in the bond market, and firms that do not do it. The total amount of issuances by firms covered in our sample is 1.6 USD trillion. This is equivalent to nearly 80% of all bonds issued in international markets, and 40% of all bonds issued in domestic markets. The remaining 1.2 USD trillion has been issued by firms not covered in our sample. These include unlisted (private) firms and issuances by small companies, which are typically very small.

3.2. Variables description

Firm-level data and measures of outstanding bonds are obtained from the Bloomberg Fundamental Database. We enlarge this dataset with country-specific and global variables from different sources. Table 2 provides a summary of the descriptive statistics.

Our dependent variable is the ratio of capital expenditure to the stock of gross fixed assets in the previous year. Capital expenditures correspond to the amount that a company spends on purchases of tangible fixed assets, and includes intangible assets when not disclosed separately. It is an item from the cash flow statement (code: RR014). Gross fixed assets is a balance-sheet item including depreciable and non-depreciable (tangible) fixed assets held for own use, capitalized fixed assets, and rental properties (code: BS030).

Most firm-specific variables are constructed from financial statements: 1) the Tobin's Q, which is the ratio of market value of a firm to the replacement cost of the firm's assets (code: RX242); 2) the sales ratio, that is, the amount of sales or revenues per dollar of assets (code: RR335); 3) the cash-flow ratio, which is the free cash-flow to total debt (code: RX281); 4) the cost of capital (WACC), which is a standard weighted measure of the cost of a firm's liabilities; 5) the leverage ratio, ie the ratio of average assets to average equity; and 6) the change in debt, which is the difference in total liabilities from the previous period scaled by lagged gross fixed assets.

We also include non-financial variables at the firm-level. The firms' industry is defined using the GICS classification. Firms' revenues are the most important indicator to classify firms, but earnings and market perceptions are also taken into account. Additionally, we define the nationality of a firm using the country of risk, which coincides with the country of primary listing as we focus on listed firms. Finally, we consider a measure of foreign ownership: instead of looking at the percentage of capital that is owned by a foreign investor, we focus on the informal managerial control. This can be important if groups influence their foreign-owned affiliates through informal links, or are deemed to support their affiliates for reputational issues. For this purpose, we examine the nationality of the parent company: when it is different from the nationality of the firm, the firm is a foreign-affiliate. We identify 146 foreign-affiliates.

Firm-level and country-level data - Descriptive statistics Table 2

	Mean	Stand. Dev.	p25	p50	p75
Investment	0.33	3.24	0.06	0.10	0.18
Total assets	5917	14733	812	2121	6121
Tobin Q	1.90	4.09	1.04	1.38	1.95
Sales ratio	3.42	14.30	0.51	1.15	2.71
Cash-flow ratio	0.87	3.46	0.43	0.59	0.79
Weighted average cost of debt (WACC)	4.89	3.63	2.39	4.21	6.07
Net leverage	0.20	22.38	–0.21	0.15	0.55
Change in debt	0.29	3.70	–0.02	0.02	0.12
Market capitalisation	5739	14345	707	2072	5271
EBITDA	0.75	4.82	0.14	0.24	0.42
Revenue	3.80	16.44	0.67	1.30	2.96
Gross profits	1.14	4.85	0.21	0.41	0.84
Number of employees	10339	18272	1034	3807	12123
Real GDP growth	4.30	3.13	2.96	4.89	6.26
Credit-to-GDP ratio	48.57	28.32	26.27	41.06	66.00
Bilateral exchange rate vis-à-vis the USD	–0.01	0.11	–0.06	–0.02	0.05
Nominal effective exchange rate (NEER)	–0.01	0.11	–0.06	0.00	0.05

Note: The sample includes 976 firms and 14,940 firm-year observations. Mean is the average; Stand. Dev. is the standard deviation; and p25 p50 and p75 are the quartiles. Most of the variables are firm-specific: Investment is the CAPEX to (lagged) gross fixed assets ratio; Assets is the total volume of assets in USD mn; Tobin's Q is the standard ratio of market to book value; Sales ratio is the ratio of trailed 12 month sales to (lagged) gross fixed assets; WACC is the weighted average cost of debt; Net leverage is the ratio of total debt net of cash and short-term receivables to (lagged) equity; Change in debt measures the change in debt from the previous period scaled by the (lagged) gross fixed assets; Number of employees is the number of employees of the firm; Market capitalisation is the stock market value of the firm; EBITDA, Revenue, and Gross profits are the ratio of EBITDA, revenues, and gross profits to the (lagged) gross fixed assets. Country-specific variables are the real GDP growth rate, the credit to GDP ratio and the change in the bilateral exchange rate vis-à-vis the US Dollar and the nominal effective exchange rate (NEER) (both in percentage).

As previously discussed, we use bond-level information to construct measures of outstanding amounts of bonds. We compute outstanding amounts as the difference between aggregate gross bond issuances and aggregate redemptions of a given firm.

Then, we exploit the granularity of the bond-level information and consider breakdowns by currency, maturity and market of issuance. Firstly, we compute outstanding amounts of bonds issued in foreign and domestic currency. The domestic currency is the functional currency – or currency of the primary economic environment in which the entity operates. Since firms are treated as consolidated entities, the relevant entity is the guarantor of the bond. For instance, the functional currency of the affiliates of Petrobras incorporated in the Netherlands or the Cayman Islands is the Brazilian real. Secondly, we break down outstanding amounts of bonds by maturity: short-term residual maturity is defined as debt to be paid back in less than one year and short-term issuances and maturing debt; and long-term debt consists of debt to be repaid in more than one year.

We also compute measures of outstanding amounts of debt issued in international markets (ie marketed outside the jurisdiction in which the firm is based) and in domestic markets. Again, whether the bond is international or local is defined by looking at the country of the incorporation of the firm guaranteeing the bond, including if those bonds have been issued by affiliates incorporated overseas.

The main explanatory variables are the exchange rate depreciation and its interaction with different measures of outstanding amounts of bonds (and their breakdowns). We focus on the bilateral US Dollar exchange rate. Exchange rate movements unrelated with the bilateral USD exchange rate have

been found poor predictors of sovereign yields (Hofmann et al (2016)). We also explore the sensitivity of the results when we consider the nominal effective exchange rate instead. The bilateral US Dollar exchange rate comes from national accounts, and the nominal effective exchange rate is obtained from the Bank for International Settlements (BIS).

Finally, we use the country code to retrieve country-specific variables. Real GDP growth is obtained from national accounts via Datastream. The credit to GDP ratio comes from the World Bank's Global Financial Development database.

4. Econometric framework

We start by estimating the following model of investment

$$I_{ijt}/K_{ijt-1} = \lambda_i + \delta_t + \beta X_{ijt} + \alpha \Delta lnUSD_{t-1} + \varepsilon_{ijt} \quad (1)$$

where I_{ijt} denotes capital expenditures of firm i in country j at time t, K_{ijt-1} stands for gross fixed assets at time $t-1$, $\boldsymbol{X}_{ijt}$ is a vector of control variables, $\Delta lnUSD_{t-1}$ represents the depreciation of the domestic currency vis-à-vis the US Dollar, λ_i are firm-level fixed-effects, δ_t are time-effects, $\boldsymbol{\beta}$ is a vector of parameters to be estimated, α is the parameter that captures the direct exchange rate effect, and ε_{it} is the error term.

Our empirical model is essentially a hybrid version of the Tobin's Q investment model (Tobin (1969)) and the neoclassical model of investment (Jorgenson (1963)). Thus, we follow other works in the literature (Lang et al (1996); Aivazian et al (2005); Love and Zicchino (2006); Hennessy et al (2007); Magud and Sosa (2015); Li et al (2015)) and, among the set of control variables included in $\boldsymbol{X}_{ijt}$, consider:

Firm-level factors:

- the Tobin's Q ratio, which is computed as the market capitalisation minus total equity plus total assets, scaled by total assets;
- the sales ratio, which is defined as total sales scaled by gross fixed assets at time *t-1*;
- the cash-flow ratio, ie net income plus assets' depreciation, scaled by scaled by gross fixed assets at time *t-1*;
- the weighted average cost of debt, ie the after-tax cost of debt for the security, calculated using government bond rates, a debt adjustment factor (average yield above government bonds for a given rating class), the proportions of short- and long-term debt to total debt, and the stock's effective tax rate;
- the net leverage ratio, which is computed as total debt minus cash items and cash equivalents, scaled by total equity at time *t-1*; and
- the change in debt from the previous period, scaled by gross fixed assets at time *t-1*.

Country-level factors:

- the real GDP growth; and
- the credit to GDP ratio.

In the Tobin's Q model of investment, firms' decisions are based on the ratio between the market value of the firm's capital stock and its replacement cost, ie the marginal Q, and Hayashi (1982) shows that the average Q is a good proxy for this variable. As the Tobin's Q model relies on the idea that investment is determined by the present discounted value of future dividends, we expect a positive relationship between the Tobin's Q ratio and firm-level investment. This reflects the fact that firms tend to invest more when they expect their profits to increase in the future.

The sales ratio and the cash-flow ratio essentially capture the financial constraints that firms face and proxy for the availability of internal funds. Thus, an increase in the internal funds of the firm is expected to have a positive effect on firms' investment. In contrast, the weighted average cost of debt tracks the cost of external funds. Therefore, a rise in this variable is expected be associated with lower investment.

Finally, the coefficients associated with net leverage ratio and the change in debt from the previous period are expected to be of opposite signs. Higher leverage should exert a negative effect on investment, but the flow of debt can boost capital expenditures because one of the main reasons why firms issue more debt is precisely to finance additional capital expenditures.

In what concerns the country-level variables, the real GDP growth captures the dynamics of real economic activity. Thus, economic growth should be linked with an acceleration of business investment. As for the credit-to-GDP ratio, it controls for changes in the credit access conditions (Fazzari et al (1988); Whited (1991)). Consequently, we expect a positive relationship between this control variable and the dependent variable.

The *direct exchange rate effect* (or "trade" channel) is the impact of a depreciation of the domestic currency vis-à-vis the US Dollar on business investment. It is captured by the parameter α and, at first glance, its sign is undetermined. The reason is that an exchange rate depreciation entails both a positive and a negative effect on investment (Bleakley and Cowan (2008)). On the one hand, a depreciation can generate a positive effect, because of higher exports profitability and/or wider export opportunities, especially when firms' exports are an important share of total output. In this case, the currency depreciation increases protection for domestic producers of tradable goods and boosts investment. On the other hand, the weakening of the domestic currency can have a negative effect when firms' imported inputs are a large fraction of total inputs. Under this alternative scenario, the currency depreciation can be contractionary for business investment. To the extent that the two effects are of the same order of magnitude, the direct exchange rate effect can be nil.

While the baseline model allows us to estimate the *direct exchange rate effect* of a depreciation of the domestic currency vis-à-vis the US Dollar, it neglects the potential *exchange rate balance-sheet effect* associated with such depreciation. Thus, we extend our model as follows:

$$I_{ijt}/K_{ijt-1} = \lambda_i + \delta_t + \boldsymbol{\beta X}_{ijt} + \alpha \Delta \ln USD_{t-1} + \xi \Delta \ln USD_{t-1} \cdot Bond_{ijt-1} + \varepsilon_{ijt}, \quad (2)$$

that is, we interact the exchange rate depreciation vis-à-vis the US Dollar with $Bond_{ijt-1}$, which is a variable that captures a specific dimension of bond composition (scaled by gross fixed assets at time *t-1*). This interaction term captures the *exchange rate balance-sheet effect*.

We consider three dimensions of bond composition: 1) currency; 2) maturity; and 3) market of issuance.

In the case of the *currency*, we look at: (i) the outstanding amount of bonds issued in domestic currency; and (ii) the outstanding amount of bonds issued in foreign currency. We expect a negative coefficient for the interaction between the exchange rate depreciation and the foreign currency debt and a positive coefficient for the interaction between the domestic currency depreciation and the domestic currency debt. The reason is that a weakening of the domestic currency when coupled with a large amount of debt issued in foreign currency should have a contractionary balance-sheet effect thus reducing business firm's investment. In contrast, firms with debt issued in domestic currency are immune to the exchange rate depreciation. In this case, an increase of the amount of debt issued in domestic currency can be used to boost capital expenditures, therefore having a positive effect on investment.

With regard to *maturity*, we distinguish between: (i) the short-term residual maturity ie the sum of the outstanding amount of bonds with maturity of up to one year and redemptions in a year; and (ii) the outstanding amount of bonds issued at maturities longer than a year. From a macroeconomic perspective, crisis episodes occur more frequently in economies that have a larger share of short-term debt vis-à-vis long-term debt. Similarly, at the micro level, firms are particularly exposed to shocks when

they hold a large fraction of debt of short duration. In this context, they become more vulnerable to capital flights, which can translate into sharp declines in investment (Bleakley and Cowan (2010)).

Finally, as for the *market of issuance*, we consider: (i) the outstanding amount of bonds issued in the local (onshore) market; and (ii) the outstanding amount of bonds issued in international (offshore) markets. Given that there is an important degree of overlapping between the composition of bond debt by market of issuance and the composition of bond debt by currency, we expect the coefficients associated with these two dimensions to be of the same sign.

5. Empirical results

5.1. Baseline model

Table 3 provides a summary of the results for our baseline model described by Equation (1). In Column 1, we only include firm-level characteristics among the set of explanatory variables. Column 2 adds country-level factors. Finally, in Column 3, we consider the exchange rate depreciation of the domestic currency vis-à-vis the US Dollar to account for the direct exchange rate effect.

Baseline model — Table 3

VARIABLES	investment	investment	investment
Tobin's Q	0.0002	0.0001	0.0001
	[0.002]	[0.002]	[0.002]
Sales ratio	0.0777***	0.0831***	0.0831***
	[0.003]	[0.003]	[0.003]
Cash-flow ratio	0.2149***	0.2244***	0.2243***
	[0.015]	[0.019]	[0.019]
Cost of debt	0.0002	–0.0289	–0.0294
	[0.014]	[0.020]	[0.020]
Leverage	–0.0010	–0.0017	–0.0017
	[0.002]	[0.003]	[0.003]
Change in debt	0.2073***	0.2183***	0.2184***
	[0.008]	[0.009]	[0.009]
GDP growth		–0.0071	–0.0053
		[0.015]	[0.018]
Credit-GDP ratio		0.0189**	0.0190**
		[0.008]	[0.008]
ΔlnUSD			0.1017
			[0.471]
Constant	–34.9940	13.6468	13.6681
	[24.310]	[39.929]	[40.600]
Observations	6,669	5,320	5,306
R-squared	0.296	0.299	0.299
Number of firms	743	633	633

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Firm-level characteristics play a significant role in shaping the dynamics of investment. In particular, variables like the sales ratio and the cash-flow ratio, which capture the fundamentals (and, to some extent, the financial constraints) of the firm, exert a positive and significant impact on investment.

Additionally, the change in debt from the previous period is also positively and significantly associated with investment, thus implying that firms raise debt to boost capital expenditures.

Among the country-level factors included in our baseline model, we find that an increase in the credit-to-GDP ratio has a positive and significant effect on firm-level investment in line with the idea that easing credit market conditions favour capital expenditures. In what concerns the exchange rate depreciation (see Column 3), we do not find a significant impact on investment, which suggests that the (positive) effect of depreciation on exports and the (negative) effect on imports cancel out. As a result, the trade channel appears to be, on net terms, muted for the firms included in the sample.

5.2. Investment and bond composition: Currency

We now turn to the extended version of the model, as described by Equation (2). We start by focusing on the currency dimension of bond debt composition. A summary of the findings is presented in Table 4. Column 1 adds the interaction between the exchange rate depreciation and the outstanding amount of bonds issued in domestic currency to the set of regressors, while Column 2 includes the interaction term between the depreciation and the outstanding amount of bonds issued in foreign currency. In both cases,

Investment and debt composition - Currency — Table 4

VARIABLES	investment	investment
Tobin's Q	0.0002	0.0002
	[0.002]	[0.002]
Sales ratio	0.0790***	0.0835***
	[0.003]	[0.003]
Cash-flow ratio	0.1749***	0.1614***
	[0.019]	[0.019]
Cost of debt	–0.0277	–0.0328*
	[0.019]	[0.019]
Leverage	–0.0012	–0.0014
	[0.003]	[0.003]
Change in debt	0.3311***	0.3213***
	[0.011]	[0.011]
GDP growth	–0.0114	–0.0099
	[0.017]	[0.017]
Credit-GDP ratio	0.0169**	0.0189**
	[0.008]	[0.008]
ΔlnUSD	–0.0119	0.2590
	[0.458]	[0.459]
ΔlnUSD * Bonds in domestic currency	0.7427***	
	[0.115]	
ΔlnUSD * Bonds in foreign currency		–1.6677***
		[0.397]
Constant	15.4558	15.8135
	[39.259]	[39.361]
Observations	5,263	5,263
R-squared	0.351	0.347
Number of firms	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

we interact the relevant variable capturing the bond debt composition with the exchange rate depreciation to capture the exchange rate balance-sheet effects.

Our results show that an increase in domestic debt, when coupled with the exchange rate depreciation, has an expansionary effect on investment (see Column 1). In contrast, conditioning the depreciation of the domestic currency vis-à-vis the US Dollar on the amount of debt denominated in foreign currency has a contractionary impact (see Column 2). In both cases, the exchange rate balance-sheet effects are significant at the 1% level. The effects are also large in magnitude: the coefficient associated with domestic debt is 0.7427, while the coefficient associated with foreign debt is -1.6677.

In line with the empirical findings for the baseline model, we do not uncover a significant direct exchange rate effect on investment. Moreover, firm-level factors (namely, the sales ratio, the cash-flow ratio and the change in debt from the previous period) remain significant and with the expected positive sign.

5.3. Investment and bond composition: Maturity

In this Section, we investigate the role played by the composition of bond debt in terms of its residual maturity. The empirical results are reported in Table 5. Column 1 includes, among the set of explanatory

Investment and debt composition - Maturity — Table 5

VARIABLES	investment	investment
Tobin's Q	0.0002	0.0002
	[0.002]	[0.002]
Sales ratio	0.0817***	0.0804***
	[0.004]	[0.003]
Cash-flow ratio	0.1643***	0.1707***
	[0.019]	[0.019]
Cost of debt	–0.0291	–0.0264
	[0.019]	[0.019]
Leverage	–0.0013	–0.0013
	[0.003]	[0.003]
Change in debt	0.3211***	0.3283***
	[0.011]	[0.011]
GDP growth	–0.0107	–0.0114
	[0.017]	[0.017]
Credit-GDP ratio	0.0184**	0.0172**
	[0.008]	[0.008]
ΔlnUSD	0.1059	–0.0227
	[0.459]	[0.459]
ΔlnUSD * Bonds at short maturity	2.0888	
	[1.340]	
ΔlnUSD * Bonds at long maturity		0.5870***
		[0.115]
Constant	16.6078	16.2400
	[39.425]	[39.325]
Observations	5,263	5,263
R-squared	0.345	0.349
Number of firms	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

variables, an interaction term between the exchange rate depreciation and the short-term residual maturity; and, in Column 2, we interact the exchange rate depreciation with the outstanding amount of bonds issued at maturities longer than one year. Both interaction terms capture the exchange rate balance-sheet effects by debt maturity.

We find that only the interaction term for long-term debt is statistically significant. Its coefficient is, as expected, positive (0.5870), implying that conditioning the exchange rate depreciation on outstanding bonds with long-term residual maturity has a positive effect on investment. This finding is in line with the idea that firms when firms have long-term debt, there is no immediate need to repay and the exchange rate depreciation may be expected to reverse. Thus, debt at long maturity helps to smooth the impact of exchange rate movements. In contrast, short-term debt coupled with a depreciation of the domestic currency can lower investment, because of the increase in the repayment burden. However, firms can also adjust payouts that have a quicker impact on profits and may find it easier to hedge against the exchange rate risk over the short-term, thus rendering the exchange rate balance-sheet effects associated with short-term debt insignificant.

Investment and debt composition - Maturity and currency

Table 6

VARIABLES	investment	investment	investment	investment
Tobin's Q	0.0002	0.0002	0.0002	0.0002
	[0.002]	[0.002]	[0.002]	[0.002]
Sales ratio	0.0817***	0.0834***	0.0792***	0.0835***
	[0.004]	[0.003]	[0.003]	[0.003]
Cash-flow ratio	0.1643***	0.1608***	0.1752***	0.1614***
	[0.019]	[0.019]	[0.019]	[0.019]
Cost of debt	–0.0291	–0.0288	–0.0274	–0.0328*
	[0.019]	[0.019]	[0.019]	[0.019]
Leverage	–0.0013	–0.0014	–0.0012	–0.0014
	[0.003]	[0.003]	[0.003]	[0.003]
Change in debt	0.3211***	0.3204***	0.3321***	0.3213***
	[0.011]	[0.011]	[0.011]	[0.011]
GDP growth	–0.0107	–0.0105	–0.0115	–0.0099
	[0.017]	[0.017]	[0.017]	[0.017]
Credit-GDP ratio	0.0184**	0.0187**	0.0167**	0.0189**
	[0.008]	[0.008]	[0.008]	[0.008]
ΔlnUSD	0.1075	0.1294	–0.0205	0.2577
	[0.459]	[0.460]	[0.458]	[0.459]
ΔlnUSD * Bonds at short maturity in local currency	2.0933			
	[1.341]			
ΔlnUSD * Bonds at short maturity in foreign currency		–2.1714		
		[34.809]		
ΔlnUSD * Bonds at long maturity in local currency			0.8315***	
			[0.123]	
ΔlnUSD * Bonds at long maturity in foreign currency				–1.6676***
				[0.397]
Constant	16.6113	16.9243	15.4034	15.8102
	[39.425]	[39.435]	[39.242]	[39.361]
Observations	5,263	5,263	5,263	5,263
R-squared	0.345	0.345	0.351	0.347
Number of firms	631	631	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

One potential caveat of this analysis is that it does not take the currency in which debt of different maturity is due. Thus, we merge the two dimensions of bond debt composition - ie currency and maturity - and distinguish between: (i) the short-term residual maturity in local currency; (ii) the short-term residual maturity in foreign currency; (iii) the outstanding amount of long-term bonds issued in local currency; and (iv) the outstanding amount of long-term bonds issued in foreign currency. Each of these terms is interacted with the exchange rate depreciation and then added to the set of regressors.

The empirical findings are summarised in Table 6. Again, the short-term residual maturity (regardless of whether it is in domestic currency or foreign currency) does not exert a statistically significant effect on investment. This may reflect the fact that short-term foreign currency debt has some natural hedges, such as the receivables in foreign currency or the trade credit. Therefore, the exchange rate balance-sheet effects associated with these maturity-currency pairs are not relevant.

In contrast, the interaction terms associated with long-term debt are both statistically significant. Interestingly, while long-term debt issued in domestic currency has a positive effect on investment, the coefficient associated with the interaction between the exchange rate depreciation and the long-term debt issued in foreign currency is negative (0.8315 versus -1.6676, respectively). This is consistent with the observation that hedging long-term debt against the exchange rate risk is more difficult or costly. Consequently, exchange rate balance-sheet effects emerge for these maturity-currency pairs. As before, our results do not provide support of a significant direct exchange rate effect and highlight the importance of firm-level characteristics in explaining the dynamics of investment.

5.4. Investment and bond composition: Market of issuance

Finally, the third dimension of bond composition that we look at is the market of issuance. Table 7 provides a summary of the results, where we distinguish between bonds issued in the local (onshore) market (Column 1) and bonds issued in the international (offshore) market (Column 2).

Consistent with the previous findings, we show that while the coefficient associated with the interaction between the exchange rate depreciation and the debt issued in the local market is positive and significant, the interaction term between the depreciation of the domestic currency vis-à-vis the US Dollar and the outstanding amount of bonds issued in the international market is negative and significant. Thus, exchange rate balance-sheet effects on investment are also important when we account for the market of issuance as a dimension of bond debt composition. We do not uncover a significant direct exchange rate effect on investment.

To have a more refined view of the exchange rate balance-sheet effects, we also investigate the intersection of two dimensions of debt composition: market of issuance and currency. Thus, we compute: (i) the outstanding amount of bonds issued in the local market in domestic currency; (ii) the outstanding amount of bonds issued in the local market in foreign currency; (iii) the outstanding amount of bonds issued in international markets in domestic currency; and (iv) the outstanding amount of bonds issued in international markets in foreign currency.

Table 8 shows that when we condition the exchange rate depreciation on bonds issued in domestic currency (regardless of the market of issuance) the effect on investment is positive and significant. This is particularly large in the case of bonds issued in the international market. In contrast, the interaction term between the exchange rate depreciation and the outstanding amount of debt issued in the international market and denominated in foreign currency is significant but negative. For debt issued in the domestic market in foreign currency, we also find a negative exchange rate balance-sheet effect, but this is not significant.

All in all, these results confirm that the currency in which debt is issued matters, and the depreciation of the domestic currency vis-à-vis the US Dollar can lead to a contraction of the balance-sheet of firms when these have a large fraction of debt issued in foreign currency. The reason behind this

result is that the depreciation of the domestic currency increases the value of liabilities, thus leading firms to cut their capital expenditures.

Investment and debt composition - Market of issuance Table 7

VARIABLES	investment	Investment
Tobin's Q	0.0002	0.0002
	[0.002]	[0.002]
Sales ratio	0.0789***	0.0840***
	[0.003]	[0.003]
Cash-flow ratio	0.1751***	0.1593***
	[0.019]	[0.019]
Cost of debt	–0.0276	–0.0318
	[0.019]	[0.019]
Leverage	–0.0012	–0.0014
	[0.003]	[0.003]
Change in debt	0.3320***	0.3207***
	[0.011]	[0.011]
GDP growth	–0.0118	–0.0105
	[0.017]	[0.017]
Credit-GDP ratio	0.0168**	0.0190**
	[0.008]	[0.008]
ΔlnUSD	–0.0413	0.2038
	[0.458]	[0.459]
ΔlnUSD * Bonds in domestic market	0.8232***	
	[0.123]	
ΔlnUSD * Bonds in international market		–1.2405***
		[0.379]
Constant	15.6292	16.5974
	[39.247]	[39.389]
Observations	5,263	5,263
R-squared	0.351	0.346
Number of firms	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

As a final assessment, we merge the three dimension of debt composition (market of issuance, currency and maturity) and construct: (i) the short-term residual maturity of bonds issued in the local market in domestic currency; (ii) the outstanding amount of long-term bonds issued in the local market in domestic currency; (iii) the short-term residual maturity of bonds issued in international markets in domestic currency; (iv) the outstanding amount of long-term bonds issued in international markets in domestic currency; (v) the short-term residual maturity of bonds issued in the local market in foreign currency; (vi) the outstanding amount of long-term bonds issued in the local market in foreign currency; (vii) the short-term residual maturity of bonds issued in international markets in foreign currency; and (viii) the outstanding amount of long-term bonds issued in international markets in foreign currency.

The results are displayed in Tables 9 and 10 and provide a fairly similar picture. More specifically, conditioning the exchange rate depreciation on bond issuance in domestic currency, especially at long maturity (and regardless of the market of issuance) has a positive effect on investment (see Columns 2 and 4 of Table 9). However, the impact of an exchange rate depreciation coupled with long-term bonds issued in foreign currency is contractionary for firm-level investment (see Column 4 of Table 10).

Investment and debt composition - Market of issuance versus currency

Table 8

VARIABLES	investment	investment	investment	investment
Tobin's Q	0.0002	0.0002	0.0002	0.0002
	[0.002]	[0.002]	[0.002]	[0.002]
Sales ratio	0.0789***	0.0817***	0.0834***	0.0835***
	[0.003]	[0.003]	[0.003]	[0.003]
Cash-flow ratio	0.1751***	0.1664***	0.1608***	0.1614***
	[0.019]	[0.019]	[0.019]	[0.019]
Cost of debt	–0.0276	–0.0286	–0.0288	–0.0327*
	[0.019]	[0.019]	[0.019]	[0.019]
Leverage	–0.0012	–0.0013	–0.0014	–0.0014
	[0.003]	[0.003]	[0.003]	[0.003]
Change in debt	0.3320***	0.3213***	0.3204***	0.3212***
	[0.011]	[0.011]	[0.011]	[0.011]
GDP growth	–0.0115	–0.0107	–0.0100	–0.0105
	[0.017]	[0.017]	[0.018]	[0.017]
Credit-GDP ratio	0.0167**	0.0183**	0.0185**	0.0190**
	[0.008]	[0.008]	[0.008]	[0.008]
ΔlnUSD	–0.0208	0.1001	0.1621	0.2171
	[0.458]	[0.459]	[0.506]	[0.459]
ΔlnUSD * Bonds in domestic market and local currency	0.8237***			
	[0.123]			
ΔlnUSD * Bonds in international market and local currency		3.5890***		
		[1.366]		
ΔlnUSD * Bonds in domestic market and foreign currency			–1.3743	
			[8.527]	
ΔlnUSD * Bonds in international market and foreign currency				–1.6649***
				[0.397]
Constant	15.4156	16.3990	16.5651	16.2453
	[39.247]	[39.406]	[39.496]	[39.360]
Observations	5,263	5,263	5,263	5,263
R-squared	0.351	0.346	0.345	0.347
Number of firms	631	631	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Investment and debt composition - Market of issuance versus currency versus maturity

Table 9

VARIABLES	investment	investment	investment	investment
Tobin's Q	0.0002	0.0002	0.0001	0.0002
	[0.002]	[0.002]	[0.002]	[0.002]
Sales ratio	0.0817***	0.0792***	0.0834***	0.0817***
	[0.004]	[0.003]	[0.003]	[0.003]
Cash-flow ratio	0.1643***	0.1753***	0.1608***	0.1664***
	[0.019]	[0.019]	[0.019]	[0.019]
Cost of debt	–0.0291	–0.0273	–0.0289	–0.0286
	[0.019]	[0.019]	[0.019]	[0.019]
Leverage	–0.0013	–0.0012	–0.0014	–0.0013
	[0.003]	[0.003]	[0.003]	[0.003]
Change in debt	0.3211***	0.3331***	0.3204***	0.3213***
	[0.011]	[0.011]	[0.011]	[0.011]
GDP growth	–0.0107	–0.0116	–0.0105	–0.0107
	[0.017]	[0.017]	[0.017]	[0.017]
Credit-GDP ratio	0.0184**	0.0166**	0.0187**	0.0183**
	[0.008]	[0.008]	[0.008]	[0.008]
ΔlnUSD	0.1076	–0.0301	0.1297	0.1003
	[0.459]	[0.457]	[0.459]	[0.459]
ΔlnUSD * Bonds in dom mkt, local currency and short maturity	2.0949			
	[1.341]			
ΔlnUSD * Bonds in dom mkt, local currency and long maturity		0.9249***		
		[0.132]		
ΔlnUSD * Bonds in int mkt, local currency and short maturity			–42.4798	
			[224.491]	
ΔlnUSD * Bonds in int mkt, local currency and long maturity				3.5904***
				[1.366]
Constant	16.6128	15.3664	16.9551	16.4018
	[39.425]	[39.228]	[39.435]	[39.406]
Observations	5,263	5,263	5,263	5,263
R-squared	0.345	0.352	0.345	0.346
Number of firms	631	631	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Investment and debt composition - Market of issuance versus currency versus maturity (cont.)

Table 10

VARIABLES	investment	investment	investment	investment
Tobin's Q	0.0002	0.0002	0.0002	0.0002
	[0.002]	[0.002]	[0.002]	[0.002]
Sales ratio	0.0834***	0.0834***	0.0834***	0.0835***
	[0.003]	[0.003]	[0.003]	[0.003]
Cash-flow ratio	0.1608***	0.1608***	0.1608***	0.1614***
	[0.019]	[0.019]	[0.019]	[0.019]
Cost of debt	–0.0288	–0.0288	–0.0288	–0.0327*
	[0.019]	[0.019]	[0.019]	[0.019]
Leverage	–0.0014	–0.0014	–0.0014	–0.0014
	[0.003]	[0.003]	[0.003]	[0.003]
Change in debt	0.3204***	0.3204***	0.3204***	0.3212***
	[0.011]	[0.011]	[0.011]	[0.011]
GDP growth	–0.0105	–0.0100	–0.0105	–0.0105
	[0.017]	[0.018]	[0.017]	[0.017]
Credit-GDP ratio	0.0187**	0.0185**	0.0187**	0.0190**
	[0.008]	[0.008]	[0.008]	[0.008]
ΔlnUSD	0.1275	0.1622	0.1294	0.2158
	[0.459]	[0.507]	[0.460]	[0.459]
ΔlnUSD * Bonds in dom mkt, foreign currency and short maturity	6.9080			
	[393.826]			
ΔlnUSD * Bonds in dom mkt, foreign currency and long maturity		–1.3814		
		[8.539]		
ΔlnUSD * Bonds in int mkt, foreign currency and short maturity			–2.2460	
			[34.969]	
ΔlnUSD * Bonds in int mkt, foreign currency and long maturity				–1.6648***
				[0.397]
Constant	16.9119	16.5617	16.9218	16.2440
	[39.438]	[39.497]	[39.435]	[39.360]
Observations	5,263	5,263	5,263	5,263
R-squared	0.345	0.345	0.345	0.347
Number of firms	631	631	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

6. Sensitivity analysis

6.1. Robustness checks

We analyse the robustness of our results in various directions. First, rather than including a single variable capturing a specific dimension of bond composition, we extend the baseline model to incorporate different variables of that specific dimension. The empirical results summarised in Table 11 are both qualitatively and quantitatively very similar to those reported in the previous Sections. However, in the case of the variables tracking the dynamics of the short-term residual maturity, they become statistically

Investment and debt composition - Multiple variables in the same specification

Table 11

VARIABLES	(1) investment	(2) investment	(3) investment	(4) investment	(5) investment	(6) investment
Tobin's Q	0.0001	0.0002	0.0002	0.0002	0.0001	0.0001
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Sales ratio	0.0789***	0.0832***	0.0837***	0.0789***	0.0796***	0.0828***
	[0.003]	[0.004]	[0.003]	[0.003]	[0.003]	[0.004]
Cash-flow ratio	0.1763***	0.1672***	0.1716***	0.1761***	0.1736***	0.1718***
	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]
Cost of debt	–0.0321*	–0.0242	–0.0292	–0.0324*	–0.0320*	–0.0300
	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]
Leverage	–0.0013	–0.0014	–0.0015	–0.0013	–0.0013	–0.0014
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Change in debt	0.3327***	0.3309***	0.3392***	0.3354***	0.3405***	0.3402***
	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]
GDP growth	–0.0107	–0.0116	–0.0109	–0.0120	–0.0105	–0.0103
	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]	[0.017]
Credit-GDP ratio	0.0170**	0.0171**	0.0165**	0.0170**	0.0161**	0.0163**
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
ΔlnUSD	0.1277	–0.0513	0.0938	0.0491	0.1168	0.1274
	[0.458]	[0.459]	[0.457]	[0.457]	[0.503]	[0.504]
ΔlnUSD * Bonds in domestic currency	0.7833***					
	[0.115]					
ΔlnUSD * Bonds in foreign currency	–1.8691***					
	[0.396]					
ΔlnUSD * Bonds at short maturity		–5.4476***				
		[1.890]				
ΔlnUSD * Bonds at long maturity		0.9198***				
		[0.163]				
ΔlnUSD * Bonds at short maturity in local currency			–9.3708***			
			[1.951]			
ΔlnUSD * Bonds at short maturity in foreign currency			–4.6003			
			[34.484]			
ΔlnUSD * Bonds at long maturity in local currency			1.5048***			
			[0.180]			
ΔlnUSD * Bonds at long maturity in foreign currency			–1.8010***			
			[0.395]			
ΔlnUSD * Bonds in domestic market				1.0264***		
				[0.128]		
ΔlnUSD * Bonds in international market				–2.1508***		
				[0.394]		
ΔlnUSD * Bonds in domestic market and local currency					1.5311***	
					[0.196]	
ΔlnUSD * Bonds in international market and local currency					–9.3665***	
					[2.152]	
ΔlnUSD * Bonds in domestic market and foreign currency					–3.4358	
					[8.455]	
ΔlnUSD * Bonds in international market and foreign currency					–1.9927***	
					[0.396]	
ΔlnUSD * Bonds in dom mkt, local currency and short maturity						–6.7178*
						[3.452]
ΔlnUSD * Bonds in dom mkt, local currency and long maturity						1.5791***
						[0.197]
ΔlnUSD * Bonds in int mkt, local currency and short maturity						–39.1296
						[222.486]
ΔlnUSD * Bonds in int mkt, local currency and long maturity						–1.9972
						[3.756]
ΔlnUSD * Bonds in dom mkt, foreign currency and short maturity						9.9796
						[390.823]
ΔlnUSD * Bonds in dom mkt, foreign currency and long maturity						–3.4300
						[8.482]
ΔlnUSD * Bonds in int mkt, foreign currency and short maturity						–4.7658
						[34.669]
ΔlnUSD * Bonds in int mkt, foreign currency and long maturity						–1.8565***
						[0.400]
Constant	14.1355	16.6686	14.3676	14.7510	13.7886	13.9217
	[39.170]	[39.294]	[39.064]	[39.125]	[39.145]	[39.143]
Observations	5,263	5,263	5,263	5,263	5,263	5,263
R-squared	0.354	0.350	0.358	0.355	0.357	0.358
Number of firms	631	631	631	631	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

significant (despite the fact that the coefficients keep the same sign). Thus, exchange rate balance effects accruing to short-term debt can also be contractionary for firm-level investment.

Second, we control for other firm-level characteristics, such as profitability (which is proxied by gross profits scaled by gross fixed assets) and size (as represented by the number of employees). We also condition our results on the inclusion of a wider range of country-level determinants of firm-level investment, namely: 1) the inflation rate; 2) the long-term government bond yield in the U.S.; 3) the short-term government bond yield in the U.S.; 4) the U.S. shadow federal funds rate (Lombardi and Zhu (2014)); 5) the U.S. term premium; 6) the international debt claims; and 7) the international bank claims. Variables 1)-5) are obtained from the BIS. International debt claims are gathered from the BIS International Debt Securities, which provides information about debt securities issued according to the borrowing sector. Finally, international bank claims are retrieved from the BIS Locational Banking Statistics, where the data are organized from the perspective of the borrowing country.

Our findings are reported in Table 12, which extends the baseline model to include other firm-level characteristics, and Table 13, which incorporates other country-level factors. For brevity, we only present the results associated with these extended versions of the baseline model represented by Equation (1). In the case of Table 12, it can be seen that neither the gross profits, nor the number of employees is statistically significant. As for Table 13, we find that U.S. monetary policy conditions do not seem to exert

Baseline model – Additional firm-level characteristics — Table 12

VARIABLES	(1) investment	(2) investment
Tobin's Q	0.0002 [0.002]	–0.0175 [0.021]
Sales ratio	0.0836*** [0.004]	0.1381*** [0.007]
Cash-flow ratio	0.2070*** [0.021]	0.3529*** [0.027]
Cost of debt	–0.0410* [0.022]	–0.0545* [0.030]
Leverage	–0.0015 [0.003]	–0.0004 [0.003]
Change in debt	0.3748*** [0.012]	0.2847*** [0.013]
GDP growth	–0.0127 [0.020]	–0.0322 [0.026]
Credit-GDP ratio	0.0224** [0.009]	0.0132 [0.012]
ΔlnUSD	0.1048 [0.521]	–0.0954 [0.696]
Gross Profits	–0.0027 [0.010]	
Number Employees		0.0000 [0.000]
Constant	20.6886 [45.466]	4.7045 [67.423]
Observations	4,393	3,205
R-squared	0.380	0.398
Number of firms	543	523

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

a statistically significant effect on firm-level investment (see Columns 1-5). However, international capital flows have a positive and statistically significant impact, albeit small, which corroborates the empirical findings of Magud and Sosa (2015). Finally, we highlight that the inclusion of additional firm-level characteristics and country-level factors does not change the statistical significance and the magnitude of the coefficients of the variables considered in our baseline model.

Baseline model - Additional country-level variables — Table 13

VARIABLES	(1) investment	(2) investment	(3) investment	(4) investment	(5) investment	(6) investment	(7) investment
Tobin's Q	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002
	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]	[0.002]
Sales ratio	0.0831***	0.0831***	0.0831***	0.0831***	0.0831***	0.0756***	0.0778***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Cash-flow ratio	0.2244***	0.2242***	0.2243***	0.2243***	0.2241***	0.1171***	0.1170***
	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]	[0.019]
Cost of debt	–0.0293	–0.0252	–0.0294	–0.0295	–0.0277	–0.0057	–0.0109
	[0.020]	[0.020]	[0.020]	[0.020]	[0.020]	[0.019]	[0.019]
Leverage	–0.0017	–0.0017	–0.0017	–0.0017	–0.0018	–0.0009	–0.0010
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
Change in debt	0.2184***	0.2183***	0.2183***	0.2185***	0.2187***	0.3544***	0.3449***
	[0.009]	[0.009]	[0.009]	[0.009]	[0.009]	[0.011]	[0.011]
GDP growth	–0.0051	–0.0057	–0.0049	–0.0072	–0.0104	–0.0119	–0.0134
	[0.018]	[0.018]	[0.018]	[0.018]	[0.018]	[0.017]	[0.017]
Credit-GDP ratio	0.0187**	0.0178**	0.0189**	0.0193**	0.0200**	0.0196**	0.0187**
	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]	[0.008]
ΔlnUSD	0.1449	0.0174	0.0984	0.1123	0.1034	0.2027	0.1932
	[0.490]	[0.475]	[0.472]	[0.472]	[0.471]	[0.452]	[0.454]
Inflation	–0.0048						
	[0.015]						
US long-term yields		–0.1216					
		[0.095]					
US short-term yields			–0.0034				
			[0.033]				
US shadow FFR				0.0087			
				[0.023]			
US term premium					–0.0636		
					[0.058]		
International debt claims						0.0002***	
						[0.000]	
International bank claims							0.0002***
							[0.000]
Constant	14.6247	80.0834	15.4223	5.7612	28.2881	16.0231	16.3278
	[40.717]	[65.872]	[44.032]	[45.442]	[42.714]	[39.157]	[39.370]
Observations	5,306	5,306	5,306	5,306	5,306	5,180	5,180
R-squared	0.299	0.299	0.299	0.299	0.299	0.376	0.369
Number of firms	633	633	633	633	633	613	613

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Third, we re-assess our results through the lens of potential endogeneity. Aivazian et al (2005) argue that previous studies that investigate the relationship between leverage and growth (McConnell and

Servaes (1995); Lang et al (1996)) ignore the relevance of unobservable firm-level characteristics. In our model, this does not pose any econometric issue, as our specifications are estimated using firm-level fixed effects. However, the authors also highlight that the relationship between leverage and growth is likely to be endogenous. More specifically and in line with the work of Myers (1977), the authors emphasize that debt overhang can reduce the incentives of shareholders to invest in projects with positive net present-value, because some of the benefits of such project will accrue to bondholders. As a consequence, highly-leveraged firms are less likely to take advantage of valuable growth opportunities and have a tendency to under-invest relative to firms with low leverage ratios. Alternatively, they face more severe liquidity constraints, in which case the negative link between leverage and growth emerges even when one controls for growth opportunities. The reason is that managers curb leverage ratios in anticipation of poor growth prospects, that is, leverage itself signals information about those future investment opportunities.

To account for the possibility that leverage may be an endogenous variable, we estimate our model using a fixed-effects instrumental variable (FE-IV) approach. As is standard in the literature, we use the first lag of the leverage ratio as an instrument for leverage. Following Aivazian et al (2005), we also consider the ratio between tangible assets and total assets as the instrumental variable for leverage. This is explained by the fact that: 1) tangible assets reduce the cost of bankruptcy, thus increasing the use of leverage; and 2) the correlation between tangible assets and future investment opportunities is low. Again, for brevity, we only report the results associated with our baseline model. These are summarised in Table 14, which show that endogeneity is not an important issue in our framework. In fact, the empirical findings are broadly in line with those of our baseline model.

Baseline model - Controlling for the endogeneity of leverage Table 14

VARIABLES	(1) investment	(2) investment
Tobin's Q	–0.0000 [0.003]	0.0000 [0.002]
Sales ratio	0.1414*** [0.006]	0.0783*** [0.006]
Cash-flow ratio	0.1367*** [0.022]	0.2354*** [0.024]
Cost of debt	–0.0364 [0.024]	–0.0393 [0.025]
Leverage	–0.0441 [0.104]	0.1032 [0.104]
Change in debt	0.2164*** [0.010]	0.2150*** [0.011]
GDP growth	–0.0035 [0.021]	–0.0129 [0.022]
Credit-GDP ratio	0.0216* [0.013]	0.0128 [0.011]
ΔlnUSD	0.1587 [0.539]	0.0387 [0.541]
Constant	40.3302 [52.086]	–3.4736 [49.325]
Observations	4,941	5,306
Number of firms	629	633

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Fourth, we account for the possibility that firms' investment decisions may display some inertia over time. As capital expenditures may not exhibit large swings from one year to another, firms' investment can be somewhat persistent. Thus, a dynamic panel model, where we include the lagged dependent

variable among the set of regressors, may be a better representation of firm-level investment than a static panel framework.

Table 15 provides a summary of the results. As can be seen, the statistical significance and the coefficients associated with the various explanatory variables are similar to those of the baseline model. Moreover, the coefficient associated with lagged investment is statistically significant and ranges between 0.2699 and 0.4906. This implies that the long-term impact of the various regressors on firm-level investment is between 1.37 and 1.96 times larger than the short-term impact.

Baseline model - dynamic panel framework — Table 15

VARIABLES	investment	investment	investment
Lagged investment	0.2699*** [0.010]	0.4905*** [0.020]	0.4906*** [0.020]
Tobin's Q	0.0001 [0.002]	0.0000 [0.002]	0.0000 [0.002]
Sales ratio	0.0782*** [0.002]	0.0953*** [0.003]	0.0953*** [0.003]
Cash-flow ratio	0.0668*** [0.014]	–0.0202 [0.019]	–0.0202 [0.019]
Cost of debt	–0.0201 [0.013]	–0.0332* [0.018]	–0.0335* [0.018]
Leverage	0.0002 [0.002]	–0.0005 [0.002]	–0.0005 [0.002]
Change in debt	0.3223*** [0.009]	0.3539*** [0.010]	0.3539*** [0.010]
GDP growth		–0.0221 [0.014]	–0.0229 [0.016]
Credit-GDP ratio		0.0079 [0.007]	0.0083 [0.007]
ΔlnUSD			–0.0364 [0.428]
Constant	–16.1649 [22.047]	10.0750 [35.933]	10.8757 [36.493]
Observations	6,581	5,244	5,231
R-squared	0.406	0.417	0.417
Number of firms	739	631	631

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Finally, we investigate the existence of potential nonlinear effects of the exchange rate depreciation on firm-level investment. We consider two experiments. In the first assessment, we distinguish between large and small exchange rate depreciations, that is, we create a dummy variable that takes the value of one if the domestic currency depreciates by more than 10% in a given year, and zero otherwise. Then we replace the exchange rate depreciation by this dummy variable when controlling for the direct exchange rate effect on investment. In the second exercise, we include, among the set of explanatory variables, not only the exchange rate depreciation but also its squared term. The empirical

results are displayed in Table 16. Again, we focus on the baseline model. We show that neither of the two econometric experiments gives support to a direct exchange rate effect on firm-level investment.

Baseline model - nonlinear direct exchange rate effects — Table 16

VARIABLES	(1) investment	(2) investment
Tobin's Q	0.0001	0.0001
	[0.002]	[0.002]
Sales ratio	0.0831***	0.0831***
	[0.003]	[0.003]
Cash-flow ratio	0.2243***	0.2243***
	[0.019]	[0.019]
Cost of debt	–0.0293	–0.0288
	[0.020]	[0.020]
Leverage	–0.0017	–0.0017
	[0.003]	[0.003]
Change in debt	0.2184***	0.2184***
	[0.009]	[0.009]
GDP growth	–0.0058	–0.0045
	[0.018]	[0.017]
Credit-GDP ratio	0.0190**	0.0184**
	[0.008]	[0.008]
ΔlnUSD	0.1381	
	[0.491]	
ΔlnUSD^2	–0.1522	
	[0.585]	
Large depreciation		0.0625
		[0.153]
Constant	14.7591	12.6735
	[40.819]	[40.003]
Observations	5,306	5,320
R-squared	0.299	0.299
Number of firms	633	633

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

6.2. Sub-sample analysis

In this Section, we consider other issues that could potentially affect the validity of our empirical results. The first one is that, in each year, a reasonably large number of firms may not have issued bonds. While this would imply that our framework is actually restrictive in the sense of providing a lower bound for the exchange rate balance-sheet effects on investment, it could nevertheless affect our assessment about the statistical significance of the different firm-level characteristics and country-level factors, as well as of the direct exchange rate effect. Thus, we re-estimate our baseline model excluding the firms that have not issued bonds in any given year covered by the sample period.

The second concern refers to the fact that we only account for debt issued in the form of bonds. Thus, we ignore other sources of financing at the firm-level, such as loans. If we exclude the possibility that firms use loans as a way of hedging against the exchange rate risk associated with the bonds that they issued in foreign currency, in which case the exchange rate balance-sheet effects that we uncover could

be upward biased, then again our results can be interpreted as a lower-bound for such effects. If anything, having loans issued in foreign currency would only amplify the exchange rate balance-sheet effects, thus leading to an even larger reduction in firm-level investment. While we do not have firm-level data on loans, we can infer that, for those firms included in the sample that have never issued bonds, loans may be an important source of financing for capital expenditures. Therefore, we exclude those firms from our sample and re-estimate our baseline model.

A third issue has to do with the fact that not only the exposure of firms to foreign currency debt can differ across sectors, but there are also some sectors, such as energy, that can be thought as natural hedgers (Stewart et al (2013); Kofanova et al (2015)). In one hand, this would again imply that our evidence about the exchange rate balance-sheet effects can be interpreted as conservative. On the other hand, it could potentially explain the lack of a significant direct exchange rate effect. From an econometric point of view, it is important to highlight that this "unobserved" sector heterogeneity is already taken into account, as we use firm-level fixed-effects which encompass sector-level fixed-effects.[9] Nevertheless, we also re-estimate our baseline model after dropping the firms that operate in the energy sector from our sample.

Sub-sample analysis

Table 17

	Only firms that *have not issued* bonds in a given year	Only firms that *have never issued* bonds	Excluding firms from the *Energy* sector	Excluding firms with *foreign ownership*
VARIABLES	(1) investment	(2) investment	(3) investment	(4) Investment
Tobin's Q	–0.0045	–0.0062	–0.0073	0.0001
	[0.028]	[0.032]	[0.018]	[0.002]
Sales ratio	0.0863***	0.0869***	0.0839***	0.0847***
	[0.005]	[0.005]	[0.004]	[0.004]
Cash-flow ratio	0.2410***	0.2419***	0.2127***	0.2443***
	[0.024]	[0.026]	[0.020]	[0.022]
Cost of debt	–0.0460	–0.0539	–0.0470**	–0.0307
	[0.030]	[0.035]	[0.022]	[0.023]
Leverage	–0.0021	–0.0023	–0.0021	–0.0019
	[0.003]	[0.004]	[0.003]	[0.003]
Change in debt	0.2388***	0.2435***	0.2384***	0.2202***
	[0.012]	[0.013]	[0.010]	[0.010]
GDP growth	–0.0009	–0.0036	–0.0039	–0.0068
	[0.024]	[0.028]	[0.019]	[0.021]
Credit-GDP ratio	0.0233**	0.0246*	0.0213**	0.0210**
	[0.011]	[0.013]	[0.009]	[0.009]
ΔlnUSD	0.2536	0.3933	0.1398	0.1727
	[0.732]	[0.881]	[0.509]	[0.556]
Constant	–4.7169	–8.2458	10.4260	9.6216
	[58.933]	[69.680]	[44.562]	[47.294]
Observations	3,815	3,128	4,801	4,499
R-squared	0.290	0.294	0.305	0.280
Number of firms	530	392	576	540

Note: Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

[9] We also consider measures of global industry opportunities, such as the earnings-per-share ratio, the price-earnings-ratio, the return on assets and the return on equity, of all listed firms of a given sector worldwide, instead of real GDP growth. These are

The fourth concern relates to foreign ownership. When firms are subsidiaries of parent companies located in a different country, one could argue that investment decisions at the firm-level are not solely determined by the firm but rather also by the parent company. For instance, if exchange rate developments have an effect on the balance-sheet of a subsidiary, this will not necessarily imply that the firm's investment will subsequently adjust because the parent company could counteract the impact of the depreciation. Or, differently, even if the firm is independent from the parent company but the latter is located in a different country, one could claim that the most relevant exchange rate developments are those of the currency of the country in which the parent company is located. To account for these issues, we re-estimate our baseline model by considering only the sub-sample of firms with domestic ownership.

The empirical results associated with these four sub-sample analyses are summarised in Columns 1-4 of Table 17, respectively. As can be seen, the findings are very similar to those associated with the baseline model. Therefore, we do not uncover a significant direct exchange rate effect on investment. In addition, firm-level characteristics, such as the cash-flow ratio, the sales ratio and the change in debt from the previous period remain statistically significant and with the expected positive sign. Similarly, the coefficient associated with the credit-to-GDP ratio is positive and significant.

7. Conclusion

In this paper, we match firm-level balance sheet data with a large dataset of firm-level bonds with the aim of investigating the existence of exchange rate balance sheet effects on firm-level investment spending. Using annual data for about 1,000 firms from 36 emerging market economies over the period 1998–2014, we find that such effects are important and can be mapped into three dimensions of outstanding bond composition: currency, maturity and market of issuance.

Our results show that an exchange rate depreciation has a positive effect on investment when conditioned on the outstanding amount of bonds issued in domestic currency, but is detrimental when associated with a higher outstanding amount of bonds issued in foreign currency.

Additionally, we find that an exchange rate depreciation has a contractionary impact on firm-level investment in the presence of outstanding long-maturity foreign currency debt. However, interacting exchange rate depreciation with bonds with long-term residual maturity and denominated in domestic currency has a positive effect on investment.

Finally, when considering the market for bond issuance, our empirical findings reveal that an exchange rate depreciation coupled with long-term debt issued in the form of foreign currency bonds has a negative effect on investment (regardless of the market of issuance). However, bonds denominated in domestic currency boost capital expenditure by firms, regardless of the market and the residual maturity.

Real business cycles typically occur when there are large swings in private investment. Moreover, it is well known that exchange rate fluctuations can be sharp, especially during periods of financial stress. From a policy perspective, our work implies that a vigilant posture vis-à-vis the composition of bond financing across various dimensions is warranted, particularly because it can provide valuable information about the likely (balance sheet) impact of exchange rate depreciation/appreciation on firm-level investment.

time-variant measures of exogenous growth opportunities that a given firm in a specific sector of activity might face. None of these measures emerged as statistically significant in the various regressions.

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