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## Corporate Investment in Emerging Markets: Financing vs. Real Options Channel

by Delong Li, Nicolas E. Magud, and Fabian Valencia

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# Corporate Investment in Emerging Markets: Financing vs. Real Options Channel

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**Abstract**

We examine how firm and country heterogeneity shape the response of corporate investment in emerging markets to changes in global interest rates and volatility. We test for the presence of (i) a financing channel originating from changes in the costs of external borrowing and (ii) a real options channel—reflecting firms' option values to delay investment. We find evidence of the coexistence of both channels. Financially weaker firms reduce investment by more in response to higher interest rates or volatility, while firms with stronger balance sheets become less willing to invest after volatility spikes. Furthermore, the intensity of the financing channel diminishes for firms in countries with lower public debt, higher foreign reserves, or deeper financial markets.

JEL Classification Numbers: F3, E2, E6

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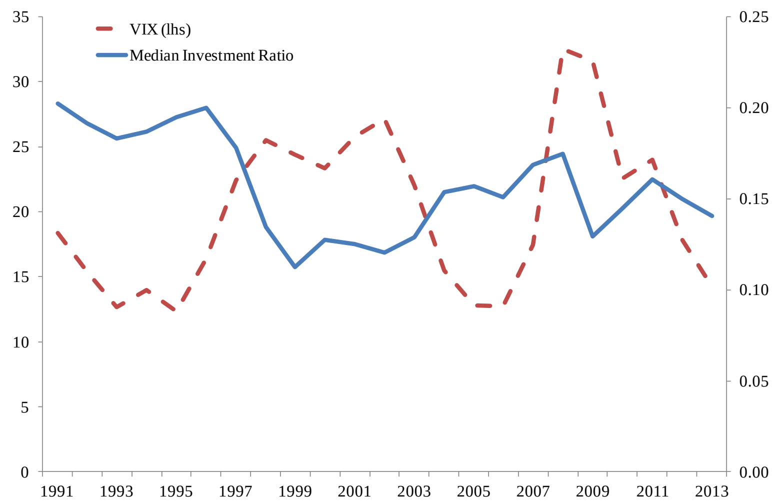
# I. Introduction

Periods of tighter global financial conditions are often followed by lower corporate investment in emerging markets (Figure 1). But beyond these aggregate effects, documented in the existing literature,[2] there can be a great deal of heterogeneity in the response of investment to external financial conditions across firms and countries. We explore this question by focusing on differential responses of corporate investment to changes in global interest rates and financial volatility depending on firms' financial strength. We test for the presence of a *financing* channel, derived from changes in the cost of external finance, as well as a *wait-and-see* or *real-options* channel resulting from non-convex adjustment costs to the capital stock.[3] Furthermore, we exploit country heterogeneity to gauge whether macroeconomic fundamentals influence the strength of the aforementioned channels.

**Figure 1. VIX and Investment in emerging markets**




*Sources*: World Scope, CBOE, Bloomberg, and authors' calculations.
*Notes*: Median investment rate across emerging-market firms and VIX.

Under the financing channel, firms with lower cash flows or more leverage reduce their investment more aggressively in response to higher interest rates or volatility given that their

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[2] See for example Bloom (2009), Carriere-Swallow and Cespedes (2013), Caldara and others (2014), and Gilchrist and others (2014) for experiments on aggregate investment. See Gilchrist and others (2014) and Magud and Sosa (2015) for discussions on average investment.

[3] See Bernanke and Gertler (1989), Bernanke, Gertler, and Gilchrist (1999), Gilchrist and Zakrajsek (2007), Arellano, Bai, and Kehoe (2012), Christiano, Motto, and Rostagno (2014), Caldara and others (2014), and Gilchrist and others (2014) for discussions of costly external financing; see McDonald and Siegel (1986), Dixit and Pindyck (1994), Abel and Eberly (1994), Bloom and others (2000, 2007, 2009, 2014) and Magud (2008) for discussions of the option value of wait-and-see. Gelos and Isgut (2001) document the impact of non-convex adjustment costs in emerging markets.

average costs of capital will be affected to a greater extent.[4] This higher sensitivity can be equivalently expressed as an increase in the marginal propensity to invest (MPI) out of cash flows in response to higher interest rates or volatility. The *real options* or *wait-and-see* channel, relevant for the case of volatility, can be thought of a "cautionary effect," as described by Bloom and others (2007), and corresponds to an increase in firms' option value of waiting when the future is riskier.[5] Because those firms with stronger cash flows are the ones who can afford to wait, this channel implies a lower MPI when uncertainty increases, the opposite of the financing channel.

We look for evidence of both channels in a dataset comprising 17,000 nonfinancial listed firms in 38 emerging markets over 1990–2013. The empirical framework is a standard *Q* model of investment augmented with financial strength variables and their corresponding interaction terms with changes in interest rates and volatility. Specifically, we focus on (i) changes in (10–year) U.S. government bond yields, and (ii) uncertainty (or volatility),[6] measured by the VIX. Focusing on these two measures of external financial conditions, common and exogenous to any emerging-market firm in our sample, allows us to mitigate reverse causality concerns. Furthermore, by concentrating on firm-differential behavior along the financial strength dimension, we are less concerned with results being driven by a standard neoclassical cost of capital channel, where a firm's financial structure plays no role.

We find evidence suggesting the co-existence of both financing and wait-and-see channels, with their intensity depending on the type of shock and the strength of firms' balance sheet.[7] In the case of higher interest rates, the evidence is consistent with the predictions of the financing channel. Firms with higher leverage reduce investment disproportionately more in response to an increase in interest rates, and the marginal propensity to invest (MPI) out of cash flows increases. When confronting higher volatility or uncertainty, we find on the one hand that more levered firms reduce investment disproportionately more, consistent also with the financing channel—especially when firms are closer to their default boundaries

[4] This can be the result of a wedge between the cost of internal and external finance that moves counter-cyclically with a firm's networth, which could arise from the interaction between default risk and some financial friction. In a setting where default risk is endogenous, it can be shown (for instance using Townsend, 1979's costly state verification) that this wedge can move in response to changes in risk-free interest rates (as in Bernanke, Gertler, and Gilchrist, 1999) and in response to increases in volatility (as in Sandri and Valencia, 2013; and Christiano, Motto, and Rostagno, 2014).

[5] For the real option of waiting, the canonical literature mostly focuses on an inaction region along the demand/productivity dimension. Decamps and Villeneuve (2006) provides a similar theoretical foundation along the liquidity dimension.

[6] Both terms, volatility and uncertainty, will be used interchangeably throughout the paper.

[7] It is worth clarifying that we loosely use "shock" and "change" in these variables interchangeably. Strictly speaking, a shock should be the unexpected component of the change. Because part of the change can be expected, our results likely underestimate the impact of the unexpected component.

(i.e., higher net leverage). On the other hand, we also find that the marginal propensity to invest out of cash flows decreases, consistent with the wait-and-see channel. Which of these channels dominates depends on firms' balance sheets. We show that the financing channel is more significant (and the wait-and-see channel less significant) the more leveraged firms are. This is consistent with a view in which credit market frictions are more relevant when firms are closer to default. In contrast, we find that firms with low leverage cut their investment voluntarily to wait and see and their marginal propensity to invest decreases when volatility spikes.

The above results are also quantitatively important, both in terms of average and differential effects. A one standard-deviation increase in interest rates or volatility leads to a median reduction in investment equivalent to 10–15 percent of the observed average reduction in investment during the Global Financial Crisis (GFC). And it leads to a differential response in investment by a firm at the top 5$^{th}$ percentile of net leverage that is 7 times larger than a firm at the bottom 5$^{th}$ percentile.

Finally, when exploring the role of country heterogeneity, we find that lower public debt, higher foreign reserves, and deeper financial markets weaken the contraction of investment in response to higher interest rates. These differential responses are also quantitatively important. For instance, following an increase in U.S. long-term interest rates, the contraction in investment by a firm with median level of net leverage is three times larger if the firm is located in a country with public debt of 75 percent of GDP than if it is located in a country with public debt of around 32 percent of GDP. One possible explanation is that firms in countries with weaker fundamentals face relatively higher downside risks, which can exacerbate the role of financial frictions, increasing the sensitivity of investment higher interest rates through the financing channel. And downside risks for firms in countries with stronger fundamentals could be reduced because (i) countries with deeper financial markets offer relatively better opportunities for firms to substitute domestic financing for external financing when global credit conditions tighten; or (ii) global investors rebalance portfolios toward firms in countries with stronger fundamentals; or (iii) higher government ability to conduct countercyclical macroeconomic policies.

In contrast, we do not find a statistically significant role for macroeconomic fundamentals in shaping the response of investment to higher uncertainty. This could be related to the fact as macroeconomic fundamentals strengthen, the financing channel weakens but in turn the real-option channel strengthens.[8]

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[8] The intuition is that the two channels wane-and-wax in a negatively-correlated way. This leaves aggregate effects of uncertainty on investment similar across countries. Specifically, in a country with stronger fundamentals, the financing channel of uncertainty will be weaker as downside risks are lower. In this case the wait-and-see channel will be observed as firms are more *capable* of waiting–as they do not need to rush investments to generate operating revenues or building capital to use as collateral, if confronted with tighter financial constraints.

Our paper contributes to different strands of the literature. First, existing papers relating global factors to investment in emerging markets mainly focus on average (Magud and Sosa, 2015) or aggregate responses (Carriere-Swallow and Cespedes, 2013). In contrast, we look into the differentiated impacts observed through firm balance-sheet heterogeneity. Second, there is a recent debate about the channels through which uncertainty shocks are transmitted. Bloom (2009) and Bloom and others (2007, 2014) follow the canonical theory of investment under uncertainty, arguing that higher volatility increases firms' option value of waiting and thus reduces voluntary investment (see also Magud, 2008). In contrast, Arellano, Bai, and Kehoe (2012), Christiano, Motto, and Rostagno (2014), Caldara and others (2014) and Gilchrist and others (2014) argue that under financial market imperfections, higher volatility leads to greater deadweight losses associated with agency costs or asymmetric information and thus depress economic activity by increasing firms' costs of funds. Our work reconciles the two sides of the debate by showing the coexistence of both channels and that the dominating channel depends on underlying firms' balance sheets. Moreover, our work also contributes to a strand of the literature on investment-to-cash sensitivity (Fazzari, Hubbard, and Petersen, 1988, 2000; Kaplan and Zingales, 1997, 2000; McLean and Zhao, 2014) by showing that such sensitivity is state-dependent and affected by changes in global interest rates or volatility.[9] Last but not least, this paper is, to the best of our knowledge, the first in quantifying the role of macroeconomic fundamentals in shaping the response of corporate investment to higher global interest rates or volatility.

The rest of the paper is organized as follows. The next section discusses briefly the channels we aim at identifying, graphically sketching the theoretical underpinnings of the econometric exercise that we undertake below. Section III presents the empirical strategy while Section IV describes the data. Section V shows the main results and robustness checks, and Section VI discusses their economic significance. Section VII incorporates the role of country fundamentals into the analysis. Section VII concludes.

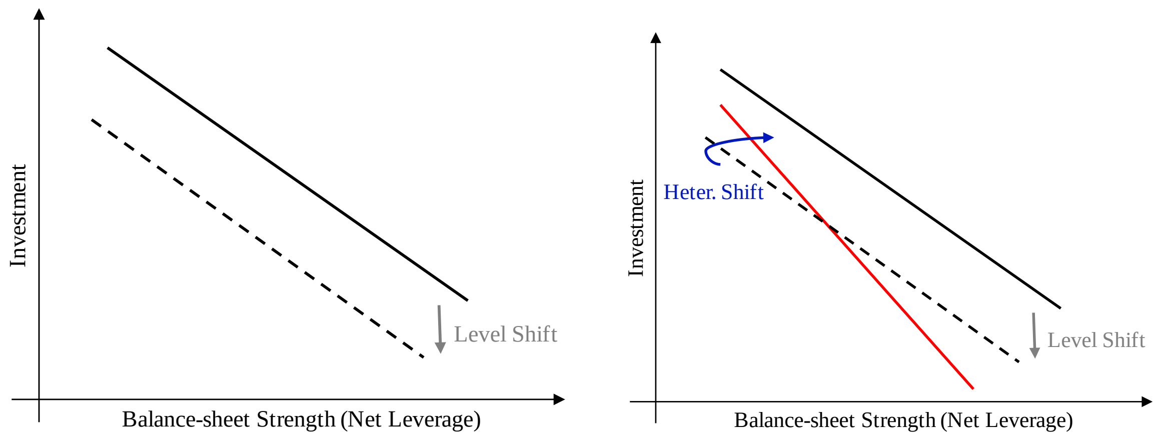
## II. THE FINANCING VS. WAIT-AND-SEE CHANNELS: AN ILLUSTRATION

To fix ideas, it is useful to start with a graphical illustration of the channels at work in our empirical investigation. To this end, Figure 2 (left panel) shows a downward-sloping relationship between investment and net leverage, consistent with the presence of financial market imperfections—a departure from the frictionless world in Modigliani and Miller (1958). Specifically, owing to agency costs from asymmetric information, firms with higher net leverage face more costly external financing, and invest less. In response to an external financing/volatility shock, the existing empirical literature has indicated that (on average and

[9] Before McLean and Zhao (2014), most of the literature treats this sensitivity to be time-invariant; they instead use U.S. data to show that such sensitivity varies over time with the business cycles. Our work further specifies that interest rates and uncertainty are two crucial determinants. Related work includes Baum and others (2009 and 2010) from which we depart by exploiting country heterogeneity among emerging market firms (as in Love and Zicchino, 2006; Love, 2003; and Magud and Sosa, 2015).

in the aggregate) firms cut their capital expenditures. This is depicted as a *parallel* downward shift in the investment schedule. We argue, however, that the shift is not necessarily parallel in that firms may respond differently depending on their existing leverage, as illustrated in Figure 2 (right panel). The latter results from the fact that increases in external financing costs in response to a shock are generally not homogeneous over the cross-section of firms. Firms that are more leveraged will incur a greater increase in the cost of external finance upon an increase in interest-rate/volatility and thus cut investment by relatively more. Moreover, we also explore the existence of differential responses along the dimension of country fundamentals.

**Figure 2. Cross-sectional responses of investment to higher interest rates**

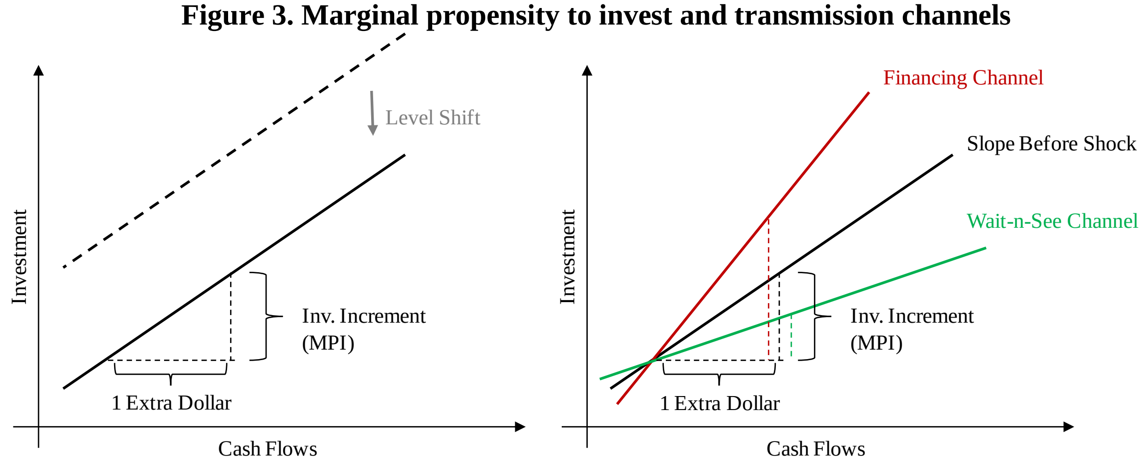



*Notes*: The left panel illustrates the average response of corporate investment to higher interest rates in the presence of financial frictions. The right panel adds the rotation of the investment schedule resulting from firms with heterogeneous leverage responding differently to the shock.

Figure 3 presents the investment schedule as a function of a firm's cash flow, where the positive slope can also result from the presence of financial market imperfections. We interpret this slope as the marginal propensity to invest (MPI). As before, the average response to a negative financial shock is represented by a parallel downward shift in the investment schedule, yet the direction of the rotation varies with the channel at work. For an interest-rate shock, the slope increases. Firms with more internal funds (cash flow) have their average costs of capital affected relatively less by this shock and firms' average marginal propensity to invest increases.

For an uncertainty shock, however, the response is more complex. As before, there is a financing channel through firms' external borrowing costs. Higher volatility can lead to higher default risk, which exacerbates the deadweight losses associated with financial frictions. Thus, those firms with more cash flow reduce capital expenditures less when facing an uncertainty shock. In other words, and as with interest-rate shocks, the financing channel of uncertainty increases firms' average marginal propensity to invest (the investment slope to cash flows increases). However, there is an additional channel through which uncertainty, despite having qualitatively similar effects on investment *levels*, has a totally different impact on the propensity to investment. The canonical investment theory under uncertainty, with non-convex adjustment costs to capital like fixed costs or irreversibility, implies that firms should be more cautious in making investment decisions during high-uncertainty periods. Bloom (2007), Dixit and Pindyck (1994), and Magud (2008) point out that 'caution' means a more limited response of investment to changes in the external environment given that firms have the option of waiting until uncertainty decreases to move on with capital expenditures. Thus, firms have a lower marginal propensity to invest—i.e., holding constant the level of financial imperfections, firms are more reluctant to invest out of any extra dollar from cash flows. We dub this channel the wait-and-see or real-options channel.

**Figure 3. Marginal propensity to invest and transmission channels**

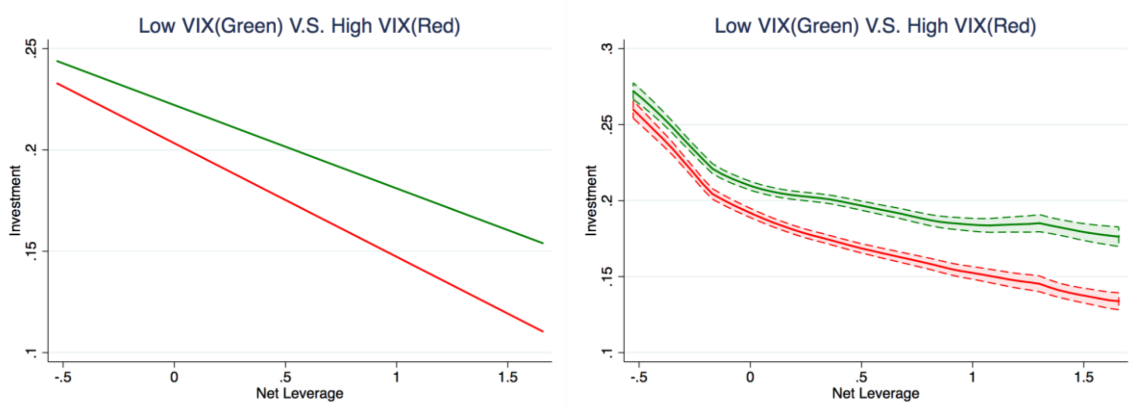



*Notes*: The left panel illustrates the average response of corporate investment to higher uncertainty or interest rates in the presence of financial frictions where the slope represents the marginal propensity to invest out of cash flows (MPI). The right panel illustrates the two channels at work: under the financing channel MPI increases (after higher uncertainty or interest rates) whereas under the wait-and-see channel (after uncertainty shocks), MPI decreases.

To support the statements above, we present both simple OLS and Nadaraya-Watson non-parametric fittings of investment on (lagged) net leverage during high vs. low uncertainty periods to illustrate graphically the role of heterogeneity in shaping the response of firm-level investment to changes in uncertainty. As Figure 4 shows, firms with higher net leverage reduce investment *more* than firms with lower net leverage when uncertainty increases.[10]

[10] Here high vs. low means whether in a particular year the VIX is above or below the median.

**Figure 4. Heterogeneous responses upon uncertainty shocks**




*Notes*: The left panel shows the uni-variate fitting of the investment ratio to (lagged) net leverage for periods of low (upper line) and high (lower line) volatility, respectively. We define low vs. high by whether the VIX is below or above the median. We observe that when uncertainty switches from low to high, the fitting line not only shifts downward but also rotates, becoming steeper, indicating that firms with weaker balance sheets cut investment more aggressively. Similar results are shown in the right panel, where we adopt the standard Nadaraya-Watson kernel fitting to incorporate possible nonlinearities (bands are 95-percent confident intervals).

We explore these channels more formally in the empirical framework discussed next.

## III. Empirical Strategy

The starting point is the neoclassical *Q*-model of investment, augmented by firm balance-sheet variables. In Hayashi (1982), marginal *Q* is a sufficient statistic for investment decisions and the forward-looking Tobin's average *Q* is a good proxy for unobserved marginal *Q* when profits are linear in capital and financing is frictionless. However, owing to financial frictions, a firm's financial structure becomes relevant for investment decisions. This translates into having capital expenditures also depending on a firm's balance-sheet and cash-flow strength. In essence, our starting point, is similar to regression specifications used in Hennessy, Levy, and Whited (2007) and Magud and Sosa (2015), given by

$$\iota_{i,j,t} = \alpha_i + \theta S_t + \beta q_{i,j,t-1} + \gamma_1 x_{i,j,t-1}^{NLev} + \gamma_2 x_{i,j,t}^{CF} + \varepsilon_{i,j,t} \qquad (1)$$

where $\iota_{i,j,t}$ denotes the investment-to-capital-stock rate of firm *i*, in country *j*, during year *t; q* stands for firm *i*'s average Tobin's *Q* (proxied by the market-to-book value of the firm), as of period *t-1*; $x^{NLev}$is a measure of net leverage (i.e., total debt net of cash stock, as a share of total common equity) for firm *i*, and $x^{CF}$ represents cash flows, again normalized by the capital stock. Finally, *S* denotes volatility or changes in U.S. benchmark interest rates, as described in the introduction. The construction of each variable is defined in more detail in Section IV below. As suggested by the existing empirical literature, we expect $\theta$ to be negative.

The logic behind the inclusion of net leverage is that it considers a firm's debt, past liquidity accumulations (cash stocks), and limited liabilities (equity) simultaneously. It is therefore a parsimonious proxy for the borrower's credit *quality* in the presence of financial-market imperfections, taking into account entrepreneurs' net stake in the firm and existing debt overhang.[11,12]Another crucial measure of financial strength is cash flow, as a proxy for internal funds availability. Cash flows enter the equation contemporaneously—as in existing studies (e.g., Magud and Sosa, 2015)—but leverage is lagged, for two reasons. The first one is to avoid a mechanical feedback between investment and net leverage given that borrowing to invest will affect the financial structure directly. The second reason is related to the timing of a firm's decisions. If investment in year *t* reflects the materialization of a plan—including financing—initiated in the previous period, then the relevant state variable is leverage as of the previous period.[13] It is also closer to what lenders observe at the moment of agreeing to finance a project.

Our main contribution focuses on understanding the heterogeneous responses of firms to common shocks, which we capture by adding the interaction terms ($x^{NLev} \times S$) and ($x^{CF} \times S$) to equation (1). The latter term would capture a change in the marginal propensity to invest out of cash flows, $\gamma_2$ , as a consequence of a shock. With these interactions, equation (1) becomes

$$\iota_{i,j,t} = \alpha_i + (\theta + \varsigma_1 x^{NLev}_{i,j,t-1})S_t + \beta q_{i,j,t-1} + \gamma_1 x^{NLev}_{i,j,t-1} + (\gamma_2 + \varsigma_1 S_t)x^{CF}_{i,j,t} + \varepsilon_{i,j,t} \qquad (2)$$

**Hypothesis 1:** Firms with relatively higher net leverage reduce investment more aggressively in response to higher interest rates or volatility:

$$\frac{\partial \iota}{\partial S} = \theta + \varsigma_1 x^{NLev}_{i,j,t-1} + \ \dots \qquad with\ \ \theta, \varsigma_1 < 0$$

Hypothesis 1 is consistent with a view that rising interest rates or uncertainty increase a firm's costs of external finance and more so for firms that are already financially weak

[11] One important consideration here is whether to use market or accounting leverage. We opt for accounting leverage as in Hennessy, Levy, and Whited (2007) because it is less affected by differing degrees of stock market liquidity among emerging markets.

[12] Adopting net debt (leverage) is closer to various theoretical setups like Hennessy, Levy, and Whited (2007) or Gilchrist and others (2014), where cash stocks are treated as negative debt. In reality, we observe ubiquitously that firms hold cash and external debt at the same time, partially owing to leverage adjustment costs. Also, Bates and others (2009) argue that a precautionary motive for future riskiness is the most crucial reason for firms to hold cash. Therefore, we treat cash flows, rather than cash stocks, as a more reliable source of internal funds for investment. This is also more widely used in the existing literature. Another reason is that the use of cash flow brings us closer to the theoretical definition of the marginal propensity to invest since cash flow can be more plausibly treated as an stochastic variable than cash stocks.

[13] Such a time-to-build effect of investment is also discussed in Bernanke, Gertler, and Gilchrist (1999).

(i.e., those relatively more leveraged), making them reduce investment proportionally more. The intuition is that higher volatility—ceteris paribus—increases the probability of bad states of nature occurring, increasing the deadweight losses associated with agency problems, but less so for borrowers with more "skin in the game" (i.e., lower leverage) as they would engage in less misbehavior (Tirole 2010) or would lead to lower expected bankruptcy costs.

**Hypothesis 2:** Higher interest rates increase the marginal propensity to invest (MPI) out of cash flows:

$$\frac{\partial \iota}{\partial x^{CF}} \equiv MPI = \gamma_2 + \varsigma_2 S_t \qquad \gamma_2, \varsigma_2 > 0$$

Following what we argued above, firms' investment propensity to invest out of any extra dollar of internal funds is higher on average when external financing becomes generally more expensive. A financing channel—affecting disproportionately more firms with weaker cash flows—would be consistent with $\varsigma_2$ being positive.

**Hypothesis 3:** Higher uncertainty could increase or decrease the marginal propensity to invest out of cash flows.

Under the financing channel, $\varsigma_2$ would be positive as in the case of higher interest rates. Under the *wait-and-see* or *real-options* channel, $\varsigma_2$ would be negative. The latter effect is expected to be more pronounced for firms with stronger cash flows because those firms are precisely the ones that can afford to *wait*. Instead, firms with weaker cash flows need to maintain investment levels to be able to generate enough cash flows to sustain their business operations or to accumulate enough physical capital that can be used as collateral for future borrowings (Hennessy, Levy, and Whited, 2007).

We estimate equations (1) and (2) by way of panel regressions (firm-year) with firm fixed-effects and standard errors clustered at the country level. In the robustness checks, we also show results of two-way (firm and year) fixed-effects and two-way (country and year) clustered standard errors.

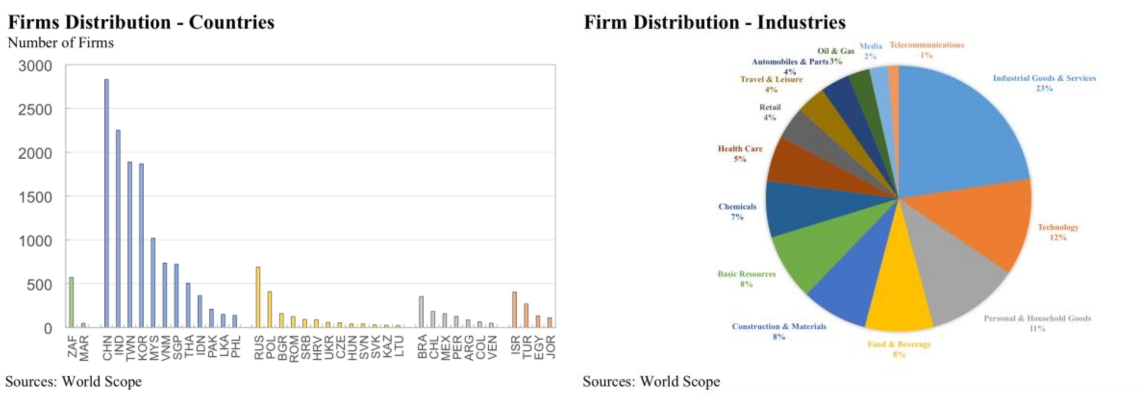
## IV. DATA

Firm-level balance-sheet data come from the World Scope database, and consists of 38 emerging markets from 1990 to 2013 (annual frequency), compiled in Magud and Sosa (2015). We drop firms whose core accounting variables are negative and firms in the financial, utility, and public sectors.[14] After these exclusions, our sample includes more than

[14] Core accounting variables include: total asset, total (net) property, plant, and equipment, total common equity, cash stock, and capital expenditures. Such criteria are common in the existing literature; see, for example, Bolton, Chen, and Wang (2013) or McLean and Zhao (2014).

17,000 listed firms (in 14 sectors) and around 130,000 firm-(country)-year observations. The distribution of firms by country and sector are shown in Figures 5.

**Figure 5. Sample distribution**




*Notes*: The left panel shows our sample distribution over different countries, where the y-axis displays the number of individual firms. The right panel shows our sample distribution over different sectors.

For each firm *i*, in country *j* and year *t*, we define firm-level variables following the literature (e.g., Kaplan and Zingales, 1997; McLean and Zhao, 2014):

- Investment ratio ($\iota$): capital expenditures (purchase of fix assets) within the year normalized by the capital stock (total net property, plant, and equipment) at the beginning of the year.

- Tobin's $Q$: market capitalization minus total common equity plus total assets, divided by (book value) total assets (i.e., market-to-book value of the firm).

- Net leverage ($x^{NLev}$): total debt net of cash stocks, divided by total common equity.

- Cash flow ratio ($x^{CF}$): net income plus depreciation and depletion within the year, normalized by total (net) property, plant, and equipment at the beginning of the year.

For financial/volatility variables ($S$), to which we will be loosely referring as shocks as noted in the introduction, we used the following variables:

- Interest-rate shocks: change in the annual average of the daily yield of the 10-year, constant-maturity U.S. Treasury bond taken from the Federal Reserve Bank of Saint Louis (FRED). In the robustness checks, we also use the change in zero-coupon, continuously compounding yields, taken from Gurkaynak, Sack, and Wright (2006, GSW).

- Uncertainty shocks are measured by the VIX (of the Chicago Board of Options Exchange) or by realized volatility using U.S. stock market prices. For the VIX, we use the annual average of daily values. For realized volatility, we calculate the annual standard deviation of daily returns of the total equity market portfolio of the Center for Research in Security Prices (CRSP). To put both measures in comparable scales,

> we divide the VIX by 100. We also use in robustness checks the measures of uncertainty presented in Jurado and others (2015), which come from extracting common factors from macro and firm-level series of forecast errors. In the regressions, we denote those series as JLN (macro), for the measure calculated from macroeconomic variables, and JLN (firm), for the measure from firm-level data. Both measures are obtained from U.S. data, which implies they are common to all our emerging market firms.

The macro-level data of individual countries come from the International Monetary Fund's World Economic Outlook and International Financial Statistics; we use World Bank's Financial Development database to get bank credit to GDP statistics as a measure of financial depth. In addition, to control for a country's financial account openness, we use the Chinn-Ito index, normalized between 0 and 1 (Chinn and Ito, 2006).

We winsorize accounting variables at the 5$^{th}$ and 95$^{th}$ percentiles, respectively, and trim our macroeconomic variables for each emerging country at the 1$^{st}$ and 99$^{th}$ percentile. Changes in U.S. interest rates, volatility, and U.S. real GDP growth enter the regression unaltered. Table 1 shows summary statistics of the main variables. Simple correlations show that firms' investment is positively associated with Tobin's *Q* and cash flows, while it is negatively correlated with net leverage.

**Table 1. Summary statistics and correlation matrix**

| | Obs. | Mean | SD | Min | Max | Correlation Matrix | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel-A: Corporate Variables (X)** | | | | | | | | | | | |
| (1) Investment Ratio | 92,901 | 0.206 | 0.179 | 0.018 | 0.66 | 1 | | | | | |
| (2) Tobin's Q | 109,085 | 1.293 | 0.61 | 0.606 | 2.888 | 0.241 | 1 | | | | |
| (3) Net Leverage | 92,119 | 0.336 | 0.583 | -0.526 | 1.657 | -0.084 | -0.229 | 1 | | | |
| (4) Cash Flow Ratio | 87,790 | 0.313 | 0.333 | -0.163 | 1.228 | 0.368 | 0.317 | -0.367 | 1 | | |
| **Panel-B: Shock Variables (S)** | | | | | | | | | | | |
| (1) Yield Shocks | 95,277 | -0.002 | 0.005 | -0.011 | 0.012 | 1 | | | | | |
| (2) Yield Shocks (GSW) | 95,277 | -0.003 | 0.005 | -0.012 | 0.01 | 0.963 | 1 | | | | |
| (3) VIX | 127,558 | 0.211 | 0.065 | 0.124 | 0.325 | -0.557 | -0.44 | 1 | | | |
| (4) U.S. Realized Volatility (RVOL) | 127,558 | 0.186 | 0.086 | 0.074 | 0.4 | -0.51 | -0.369 | 0.929 | 1 | | |
| (5) JLN Measure (Macro) | 127,558 | 0.978 | 0.06 | 0.899 | 1.115 | -0.315 | -0.169 | 0.733 | 0.812 | 1 | |
| (6) JLN Measure (Firm) | 108,330 | 0.921 | 0.084 | 0.768 | 1.086 | -0.394 | -0.354 | 0.817 | 0.656 | 0.617 | 1 |
| **Panel-C: Macro Variables (F)** | | | | | | | | | | | |
| (1) Foreign Reserves/ST External Debt | 104,890 | 4.52 | 4.333 | 0.464 | 74.92 | 1 | | | | | |
| (2) Public Debt/GDP | 120,827 | 0.452 | 0.206 | 0.082 | 1.032 | 0.19 | 1 | | | | |
| (3) Private Bank Credit/GDP | 89,098 | 0.739 | 0.341 | 0.135 | 1.394 | -0.101 | -0.212 | 1 | | | |
| (4) Chinn-Ito Index of Openness | 110,356 | 0.413 | 0.288 | 0 | 1 | -0.209 | 0.159 | 0.001 | 1 | | |

*Notes*: Correlations showed in the right panel are calculated in a pooled manner.

## V. EMPIRICAL RESULTS

We start by showing the estimation results of equation (1), presented in Table 2. We observe that, consistent with the simple by-variate correlations shown in the previous section, all firm fundamentals contribute to investment as expected—and predicted by theory. A higher

Tobin's *Q*, lower net leverage, or higher cash flows are all associated with statistically significant increases in investment. Columns (1), (3), and (5) show that increases in U.S. long-term yields and in the lagged VIX significantly reduce corporate investment *levels*. However, when the VIX enters the regression contemporaneously (columns (2) and (4)), it is no longer statistically significant. The stronger effect of the lagged VIX is not very surprising. A time-to-build/adjust argument for firms' investment could, in principle, explain the larger effects of the lagged VIX than the contemporaneous VIX. Another possible reason comes from the hypothetical timing of decisions mentioned before. If an important fraction of *realized* investment in any given year reflects the execution of an investment *plan* made, for instance, one year before, the lagged value of uncertainty should be the relevant variable to include in the regression. From here on we focus on the results from regressions where the lagged VIX enters the regressions. We also control for U.S. real GDP growth to reduce concerns related to simulteneity problems.

**Table 2. Average level effects: equation (1)**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| (Lag) Tobin's Q | 0.059*** | 0.060*** | 0.058*** | 0.060*** | 0.056*** |
| | (0.008) | (0.008) | (0.007) | (0.008) | (0.007) |
| (Lag) Net Leverage | -0.064*** | -0.064*** | -0.064*** | -0.064*** | -0.064*** |
| | (0.006) | (0.006) | (0.006) | (0.006) | (0.006) |
| Cash Flow Ratio | 0.133*** | 0.132*** | 0.132*** | 0.133*** | 0.134*** |
| | (0.010) | (0.010) | (0.010) | (0.010) | (0.010) |
| Δ U.S. Interest rates | -0.737*** | | | -0.889*** | -0.969*** |
| | (0.099) | | | (0.096) | (0.086) |
| VIX | | 0.007 | | -0.039 | |
| | | (0.024) | | (0.027) | |
| (Lag) VIX | | | -0.131*** | | -0.142*** |
| | | | (0.014) | | (0.013) |
| U.S. Real GDP Growth | 0.341** | 0.276* | 0.100 | 0.255* | 0.198 |
| | (0.130) | (0.140) | (0.136) | (0.139) | (0.138) |
| Observations | 61,320 | 61,320 | 61,320 | 61,320 | 61,320 |
| R-squared | 0.121 | 0.120 | 0.124 | 0.121 | 0.125 |
| Number of Firms | 11,282 | 11,282 | 11,282 | 11,282 | 11,282 |

*Notes*: Estimation results for equation (1) including firm-level fixed effects with standard errors (in parentheses) clustered at the country level (also robust to arbitrary form of heteros-kedasticity). *** p<0.01, ** p<0.05, * p<0.1.

Table 3 shows the results from estimating equation (2). The top panel shows the results for changes in U.S. interest rates; the bottom panel shows the results for uncertainty. We will show later on that our results are robust to including both changes in interest rates and volatility and interactions at the same time or including time or country-year fixed effects.

Our baseline results are presented in column (1) using the changes in U.S. 10-year bond yields and lagged VIX, denoted in the table as shocks. The coefficient on the interaction term between these and net leverage, $(x_{i,j,t-1}^{NLev} \times S)$, is negative, supporting Hypothesis 1. However, it is statistically significant only for the case of uncertainty. This implies that there is a statistically significant differential response of investment to higher uncertainty along the firm leverage dimension, but not in response to higher interest rates.

**Table 3. Adding interactions: equation (2)**

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Baseline | | Subsamples | |
| | | Net leverage below median | Net leverage above median | Net leverage above 75th pctile. |
| (Lag) Tobin Q | 0.059*** | 0.050*** | 0.067*** | 0.074*** |
| | (0.008) | (0.008) | (0.012) | (0.015) |
| **S: Interest rate shock** | -0.888*** | -0.725*** | -0.609* | -0.134 |
| | (0.100) | (0.188) | (0.303) | (0.574) |
| (Lag) Net Leverage | -0.064*** | -0.128*** | -0.057*** | -0.064*** |
| | (0.006) | (0.021) | (0.007) | (0.010) |
| (Lag) Net Leverage * S | -0.130 | 0.851 | -0.463 | -0.907*** |
| | (0.236) | (0.825) | (0.318) | (0.321) |
| Cash Flow Ratio | 0.135*** | 0.117*** | 0.166*** | 0.173*** |
| | (0.010) | (0.010) | (0.012) | (0.019) |
| Cash Flow * S | 0.698** | 0.575 | 1.042* | 2.000** |
| | (0.321) | (0.523) | (0.564) | (0.944) |
| US Real GDP Growth | 0.341** | 0.377** | 0.242* | 0.191 |
| | (0.130) | (0.142) | (0.141) | (0.187) |
| Observations | 61,320 | 30,749 | 30,570 | 15,241 |
| R-squared | 0.121 | 0.103 | 0.119 | 0.110 |
| Number of firms | 11,282 | 7,868 | 7,111 | 4,511 |
| (Lag) Tobin Q | 0.057*** | 0.048*** | 0.063*** | 0.069*** |
| | (0.007) | (0.007) | (0.009) | (0.012) |
| **S: Uncertainty Shock** | -0.056** | -0.042 | -0.081*** | -0.092 |
| | (0.024) | (0.036) | (0.024) | (0.077) |
| (Lag) Net Leverage | -0.042*** | -0.113*** | -0.038** | -0.044** |
| | (0.011) | (0.039) | (0.016) | (0.020) |
| (Lag) Net Leverage * S | -0.101*** | -0.083 | -0.080 | -0.079 |
| | (0.027) | (0.106) | (0.047) | (0.075) |
| Cash Flow Ratio | 0.162*** | 0.148*** | 0.186*** | 0.169*** |
| | (0.020) | (0.018) | (0.027) | (0.043) |
| Cash Flow * S | -0.136** | -0.149*** | -0.114 | -0.014 |
| | (0.055) | (0.054) | (0.078) | (0.139) |
| US RGDP Gr | 0.099 | 0.204 | -0.051 | -0.127 |
| | (0.135) | (0.134) | (0.150) | (0.178) |
| Observations | 61,320 | 30,749 | 30,570 | 15,241 |
| R-squared | 0.124 | 0.105 | 0.125 | 0.116 |
| Number of firms | 11,282 | 7,868 | 7,111 | 4,511 |

*Notes*: Alternative robustness checks for equation (2), where the top panel is for interest-rate shock and the bottom panel is for uncertainty shock. Column (1) to (3) is the subgroup experiment based on net leverage. In column (4) we let standard errors cluster in both country and year dimensions. Column (5) presents results for dropping all firms from China and India. Robust standard errors (to both heteroskedastisity and cluster) in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

With regards to Hypothesis 2, the coefficient on the interaction between shocks and cash-flows ($\varsigma_2$) are both statistically significant; however, they have opposite signs. Firms with *weaker* cash flows reduce investment relatively more in response to higher interest rates. In contrast, firms with *stronger* cash flows reduce investment relatively more in response to higher uncertainty. This means that higher interest rates increase the MPI—consistent with the financing channel—whereas higher uncertainty reduces the MPI, consistent with the wait-and-see channel.

The main take-away from the above results is that of the co-existence of the financing and wait-and-see channels. Two points from these results are worth further investigation. First, unlike uncertainty, changes in interest-rates do not show statistically significant heterogeneous effects on firms with different leverage. Second, on average firms' MPI tends to go down—the interaction between cash flows and uncertainty is negative—but we wonder how it can be reconciled with the evidence in support of the financing channel. To shed some extra light on these two points, we go to subsample experiments dividing observations according to firm net leverage, shown in columns (2)-(4) above. Column (2) presents the results for firms with net leverage below the median; column (3) displays the results for firms with net leverage above the median; and column (4) shows results for firms with net leverage above the $75^{th}$ percentile.

We observe for the subsample of firms in column (4) a clear sign of heterogeneous responses—in this subgroup, firms with higher leverage are more affected by an interest-rate shock. The bottom panel shows that the marginal propensity to invest decreases after an increase in uncertainty only for firms with below-median leverage. On the one hand, the financing channel should have a stronger impact on financially-weaker firms. On the other hand, as only "financially healthier" firms can afford to *wait*, the wait-and-see channel should be stronger for firms with a good-enough balance sheet. Putting these facts together, the dominating channel depends on a firms' financial position. In the whole sample, the wait-and-see channel dominates when net leverage is below the median whereas the two channels statistically cancel out when net leverage is above the median.

### A. Robustness

We now show a number of regressions to check the robustness of our results. Starting with Table 4, we replicate our baseline results in columns (1) and (7) to ease comparability. In columns (2) and (8) we change our measures of interest rate shocks to the zero-coupon continuouly compounding yield changes (Gurkaynak, Sack, and Wright, 2006) and our measure of uncertainty to the U.S. realized stock market volatility. The results are nearly identical to those under the baseline definition of interest rates and uncertainty. In addition, to mitigate concerns arising from an omitted variable bias, columns (3) and (9) report estimates using year fixed effects, while columns (4) and (10) report estimates using country-year fixed effects. In both cases, variables that vary only across time drop from the regression, but the

## Table 4. Robustness checks

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Changes in U.S. Interest Rates | | | | | | Uncertainty | | | | | |
| | Baseline | GSW | Year FE | Ctry-Yr FE | Two-way Clustering | Ex. China and India | Baseline | RVOLY | Year FE | Ctry-Yr FE | Two-way Clustering | Ex. China and India |
| (Lag) Tobin's Q | 0.059*** | 0.060*** | 0.051*** | 0.049*** | 0.059*** | 0.066*** | 0.057*** | 0.057*** | 0.051*** | 0.049*** | 0.057*** | 0.062*** |
| | (0.008) | (0.008) | (0.006) | (0.005) | (0.008) | (0.004) | (0.007) | (0.007) | (0.006) | (0.005) | (0.007) | (0.005) |
| Shocks | -0.888*** | -0.808*** | | | -0.888** | -0.917*** | -0.056** | -0.043** | | | -0.056 | -0.076*** |
| | (0.100) | (0.112) | | | (0.424) | (0.124) | (0.024) | (0.017) | | | (0.037) | (0.025) |
| (Lag) Net Leverage | -0.064*** | -0.064*** | -0.068*** | -0.070*** | -0.064*** | -0.058*** | -0.042*** | -0.052*** | -0.049*** | -0.056*** | -0.042*** | -0.034*** |
| | (0.006) | (0.006) | (0.004) | (0.003) | (0.006) | (0.004) | (0.011) | (0.009) | (0.007) | (0.005) | (0.011) | (0.010) |
| (Lag) Net Leverage * Shocks | -0.130 | 0.123 | -0.109 | -0.020 | -0.130 | 0.101 | -0.101*** | -0.065*** | -0.084*** | -0.064*** | -0.101*** | -0.108*** |
| | (0.236) | (0.188) | (0.198) | (0.191) | (0.259) | (0.210) | (0.027) | (0.022) | (0.020) | (0.018) | (0.034) | (0.033) |
| Cash Flow Ratio | 0.135*** | 0.135*** | 0.135*** | 0.134*** | 0.135*** | 0.121*** | 0.162*** | 0.154*** | 0.162*** | 0.159*** | 0.162*** | 0.136*** |
| | (0.010) | (0.011) | (0.011) | (0.011) | (0.010) | (0.006) | (0.020) | (0.015) | (0.020) | (0.019) | (0.021) | (0.011) |
| Cash Flow * Shocks | 0.698** | 0.975** | 0.741* | 0.935* | 0.698* | 0.368 | -0.136** | -0.111*** | -0.132** | -0.127** | -0.136** | -0.078* |
| | (0.321) | (0.379) | (0.376) | (0.494) | (0.382) | (0.312) | (0.055) | (0.032) | (0.054) | (0.051) | (0.064) | (0.044) |
| U.S. Real GDP Growth | 0.341** | 0.288** | | | 0.341** | 0.393*** | 0.099 | -0.032 | | | 0.099 | 0.144 |
| | (0.130) | (0.129) | | | (0.147) | (0.099) | (0.135) | (0.149) | | | (0.150) | (0.103) |
| Observations | 61,320 | 61,320 | 61,320 | 61,320 | 59,504 | 45,200 | 61,320 | 61,320 | 61,320 | 61,320 | 59,504 | 45,200 |
| R-squared | 0.121 | 0.121 | 0.135 | 0.155 | 0.121 | 0.120 | 0.124 | 0.123 | 0.136 | 0.155 | 0.124 | 0.124 |
| Number of firms | 11,282 | 11,282 | 11,282 | 11,282 | 9,466 | 7,817 | 11,282 | 11,282 | 11,282 | 11,282 | 9,466 | 7,817 |

*Notes*: Estimation results for equation (2) including firm-level fixed effects with standard errors (in parentheses) clustered at the country level (also robust to arbitrary forms of heteroskedasticity). Column (1) and (7) are baseline results where the interest-rate shock is measured by the yield change of the 10-year Treasury from FRED and the uncertainty shock is measured by VIX. Columns (2) and (8) adopt an additional definition of variables, as explained in Section IV. Column (3) and (9) use year fixed effects while columns (4) and (10) include country-year fixed effects. Columns (5) and (11) show results with standard errors clustered in both country and year dimensions. Columns (6) and (12) present results after dropping all Chinese and Indian firms. *** p<0.01, ** p<0.05, * p<0.1.

interactions of changes in interest rates and uncertainty with firm-level variables are kept. This particular experiment should deal with any possible ommitted time-varying variable that is common to all firms in the sample or that are common to all firms in a given country. The results shown in those columns reveal that our results are robust to these specifications.[15]

In columns (5) and (11) of Table 4 we use two-way clustering, allowing the error terms to be correlated within the same country *or* the same year and the statistical significance of the results does not change. Finally, given the large number of Chinese and Indian firms in our sample, as illustrated in Section IV, in column (5) we show results excluding Chinese and Indian firms. This experiment rules out the concern that results may be driven by their large representation in our data since the results are similar to those shown in columns (1) and (7).[16]

**Table 5. Measure of uncertainty in Jurado and others (2015)**

| | (1) | (2) |
|---|---|---|
| | JLN (macro) | JLN (firm) |
| (Lag) Tobin's Q | 0.059*** | 0.055*** |
| | (0.008) | (0.007) |
| Uncertainty | -0.03 | -0.073*** |
| | (0.028) | (0.021) |
| (Lag) Net Leverage | -0.001 | 0.03 |
| | (0.038) | (0.029) |
| (Lag) Net Leverage * Uncertainty | -0.065* | -0.106*** |
| | (0.035) | (0.028) |
| Cash Flow Ratio | 0.296*** | 0.232*** |
| | (0.039) | (0.042) |
| Cash Flow * Uncertainty | -0.165*** | -0.109*** |
| | (0.036) | (0.038) |
| US Real GDP Growth | 0.062 | 0.275** |
| | (0.133) | (0.128) |
| Observations | 61,320 | 55,595 |
| R-squared | 0.122 | 0.127 |
| Number of Firms | 11,282 | 10,728 |

*Notes*: Estimation results for equation (2), similar as before, but using the (lagged) measure of uncertainty in Jurado and others (2015). Column (1) is for uncertainty calculated from macroeconomic variables and column (2) is for uncertainty calculated from firm-level data. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

[15] It is important to note that our model specification (2) passes the Sargan-Hansen endogeneity test for all right-hand-side firm-level variables when firm fixed effects are included, which implies support to treating them as exogenous. Results are available from the authors upon request.

[16] Dropping also firms in the oil-&-gas sector does not affect our results; this is to rule out effects of changes in oil prices on investment.

We also show that our main results are robust to alternative measures of uncertainty in Table 5 above. It has been argued that changes in stock market volatility like VIX or RVOLY can happen without any change in underlying uncertainty, for instance if there is a change in risk aversion (Jurado and others, 2015). Since we aim at capturing changes in risk or uncertainty, we check if our results are robust to an alternative measure. To this end, we use the uncertainty measures presented in Jurado and others (2015), which are orthogonal to real-time forecasting power and are computed over a large number of macroeconomic and microeconomic series (described in Section IV). These measures are computed using U.S. Data and therefore satisfy a key property that they are common to emerging-market firms. Column (1) of Table 5 corresponds to uncertainty calculated from macroeconomic variables while column (2) to uncertainty calculated from firm-level data. One can see that the results are qualitatively the same as those shown in Table 4.

In previous regressions, we have included either changes in interest rates or uncertainty in the regressions to keep a parsimonious presentation of results. In Table 6 we show that our main results are also robust to including both interest rate and uncertainty shocks (and their interactions) simultaneously. As discussed before, results are stronger when the VIX is lagged.

**Table 6. Simultaneous inclusion of shocks**

| | (1)<br>Cont. VIX | (2)<br>Lagged VIX |
|---|---|---|
| (Lag) Tobin's Q | 0.06*** | 0.056*** |
| | (0.008) | (0.007) |
| (Lag) Net Leverage | -0.063*** | -0.042*** |
| | (0.011) | (0.01) |
| Cash Flow Ratio | 0.156*** | 0.163*** |
| | (0.014) | (0.02) |
| **S1: Interest rate shock** | -0.819*** | -0.944*** |
| | (0.187) | (0.119) |
| (Lag) Net Leverage * S1 | -0.167 | -0.354 |
| | (0.206) | (0.231) |
| Cash Flow * S1 | -0.049 | 0.391 |
| | (0.384) | (0.278) |
| **S2: Uncertainty Shock** | -0.005 | -0.069*** |
| | (0.038) | (0.024) |
| (Lag) Net Leverage * S2 | -0.006 | -0.104*** |
| | (0.034) | (0.029) |
| Cash Flow * S2 | -0.108** | -0.129** |
| | (0.052) | (0.053) |
| US Real GDP Growth | 0.258* | 0.195 |
| | (0.139) | (0.138) |
| Observations | 61,320 | 61,320 |
| R-squared | 0.121 | 0.126 |
| Number of firms | 11,282 | 11,282 |

*Notes*: Estimation results of equation (2) when both types of shocks are considered simultaneously including firm-level fixed effects letting standard errors (in parentheses) clustered at the country level (also robust to arbitrary form of heteroskedasticity). Column (1) is when VIX is measured contemporaneously and column (2) is when VIX is used in a one-year lag. *** p<0.01, ** p<0.05, * p<0.1

## VI. ECONOMIC SIGNIFICANCE

To gauge the economic significance of the estimated effects, we calculate in Table 7 the drop in investment resulting from a one standard deviation interest rate and uncertainty increase—measured with our baseline variables—for various levels of net leverage. As the table shows, there is significant heterogeneity in the reduction in investment. The difference in the response between firms at the extremes of the distribution (bottom and top 5 percentile in net leverage) could be as large as about 7 times. The economic significance of the response by a firm at the median level of leverage is also important. The investment-to-capital ratio by such firm would be reduced in around 0.5 or 0.7 percentage points after a one standard deviation interest rate or uncertainty increase, respectively. To put these numbers in perspective, the median reduction in investment in 2009, at the time of the global financial crisis (GFC), was around 4.6 percentage points. Therefore, our estimates suggest that a one-standard deviation shock could lead to a drop in investment of as much as 10–15 percent of the observed reduction around the GFC. Alternatively, if we plug into our estimated regression the observed increase in the VIX during the GFC, our estimated coefficients would explain 37 percent of the median reduction in investment observed during the GFC.

These results, while quantitatively important, would still underestimate the total effects of interest rate and uncertainty shocks on investment given that our sample comprises only listed firms. The average firm outside our sample is likely to face higher borrowing costs, as it would likely be smaller and more subject to informational frictions—given that non-listed firms are not subject to the same disclosure and regulatory requirements applicable to listed companies. In addition, the fact that our measures of shocks are not purely unexpected implies an additional source of potential underestimation of the impact of these shocks on investment.

**Table 7. Economic significance**

| Net Leverage | (1)<br>Interest Rates | (2)<br>VIX |
|---|---|---|
| p5 | -0.41 | -0.22 |
| p25 | -0.45 | -0.48 |
| p50 (median) | -0.47 | -0.67 |
| p75 | -0.50 | -0.92 |
| p95 | -0.58 | -1.46 |
| p75 / p25 | 1.13 | 1.93 |
| p95 / p5 | 1.40 | 6.67 |

*Notes*: percentage points reduction in investment rates in response to one standard deviation increase in U.S. interest rates or the VIX. p5-p95 represent percentiles. The last two rows show quotients between corresponding categories.

## VII. COUNTRY FUNDAMENTALS MATTER

Since our sample encompasses a wide coverage of emerging economies, we now turn to the question of how country fundamentals influence the response of corporate investment to higher global interest rates or volatility. In other words, we ask the question whether two firms with the same financial strength—measured by both net leverage and cash flows—would respond differently to a common shock only because they are in countries with different fundamentals. Our prior is that firms in countries with stronger fiscal or external indicators, or deeper financial markets, face lower aggregate (domestic) risk, which lessens the effects of the financing channel. In the context of the costly state verification example used earlier, both aggregate and idiosyncratic risk can increase expected bankruptcy costs, in absence of contingent debt instruments. Two firms with the same level of idiosyncratic risk but facing different degrees of aggregate domestic risk, because of differences in country fundamentals, would face different wedges in the cost of external finance. In turn, these wedges could diverge even more if the external shock increases aggregate risk for the weaker country, affecting investment by firms in that country more.

By the above reasoning, countries with strong fundamentals should buffer their firms better from external shocks. To this end, we augment our regression model further with country fundamental variables, *F*, focusing on three dimensions: external liquidity, fiscal space, and financial development. These indicators are proxied by the following variables:

1. F1: foreign reserves to short-term external debt ratio

2. F2: public debt to GDP ratio

3. F3: financial depth[17]

We estimate the following specification:

$$\begin{aligned} \iota_{i,j,t} &= \alpha_i + \beta q_{i,j,t-1} + \theta S_t + \gamma_1 x^{NLev}_{i,j,t-1} + \gamma_2 x^{CF}_{i,j,t} + \lambda_F F_t \\ &+ \varsigma_1 (x^{NLev}_{i,j,t-1} \times S_t) + \varsigma_2 (x^{CF}_{i,j,t} \times S_t) + \lambda_{SF} (S_t \times F_t) + \lambda^{NLev}_{xF} (x^{NLev}_{i,j,t-1} \times F_t) + \lambda^{CF}_{xF} (x^{CF}_{i,j,t} \times F_t) \\ &+ \zeta_1 (S_t \times x^{NLev}_{i,j,t-1} \times F_t) + \zeta_2 (S_t \times x^{CF}_{i,j,t} \times F_t) + \varepsilon_{i,j,t} \qquad (3) \end{aligned}$$

The above equation includes all possible interactions among shocks, firm- , and country-fundamentals. Different responses of firms in different countries upon a common shock are investigated using the following differential of equation (3):

[17] Specifically we use the ratio of total private credit by deposit banks to GDP as a measure of financial depth. Our results are robust to using private credit from all financial institutions.

$$\frac{\partial \iota}{\partial S} = \left(\theta + \varsigma_1 \hat{x}^{NLev}_{i,j,t-1} + \varsigma_2 \hat{x}^{CF}_{i,j,t}\right) + \left(\lambda_{SF} + \zeta_1 \hat{x}^{NLev}_{i,j,t-1} + \zeta_2 \hat{x}^{CF}_{i,j,t}\right) \times F \quad (4)$$

Equation (4) shows that responses of investment to increases in U.S. interest rates or volatility depend on firm- and country-fundamentals at the same time. If, for example, we substitute the *median* firm's net leverage and cash flow levels, $\hat{x}$, into (4), we obtain a linear combination of the estimated coefficients. We can further test the differential responses of firms in various countries to global interest rate/volatility shocks by looking at:

$$\frac{\partial}{\partial F}\left(\frac{\partial \iota}{\partial S}\right) = \lambda_{SF} + \zeta_1 \hat{x}^{NLev}_{i,j,t-1} + \zeta_2 \hat{x}^{CF}_{i,j,t} \gtreqless 0$$

where

$$\zeta_1 = \frac{\partial}{\partial F}\left(\frac{\partial}{\partial x^{NLev}}\left(\frac{\partial \iota}{\partial S}\right)\right) \qquad \zeta_2 = \frac{\partial}{\partial F}\left(\frac{\partial}{\partial S}\left(\frac{\partial \iota}{\partial x^{CF}}\right)\right)$$

Under the hypothesis that stronger fundamentals buffer corporate investment better, the above coefficient $\zeta_1$ would be positive ($\zeta_2$ being negative) for the case of interest rate shocks, consistent with the financing channel. For uncertainty shocks, we have argued that there exist two possible signs for $\frac{\partial}{\partial S}\left(\frac{\partial \iota}{\partial x^{CF}}\right)$, depending on whether the financing or the wait-and-see channel dominates. Therefore, $\zeta_2$ helps us shed some light on whether the dominant channel differs along the country-fundamentals dimension.

Results are shown in Table 8. As before, to keep a parsimonious presentation, we show results including one macroeconomic variable at a time, and either changes in interest rates or uncertainty, but we will show later—in a more compact way in Table 9—that the main results are robust to including all variables at the same time. At first glance, the statistical significance of the estimated coefficients is sparse. However, this is a natural consequence of colinearity, given the inclusion of the same variable several times through the interaction terms. Thus, it is more informative to look at the statistical significance of the linear combination of the estimated coefficients given in Equation (4) and its cross-derivatives. Figure 6 shows, graphically, the point estimate and 90-percent confidence bands of the linear combination (equation 4), evaluated at the median level of net leverage and cash flows, depending on country fundamentals.

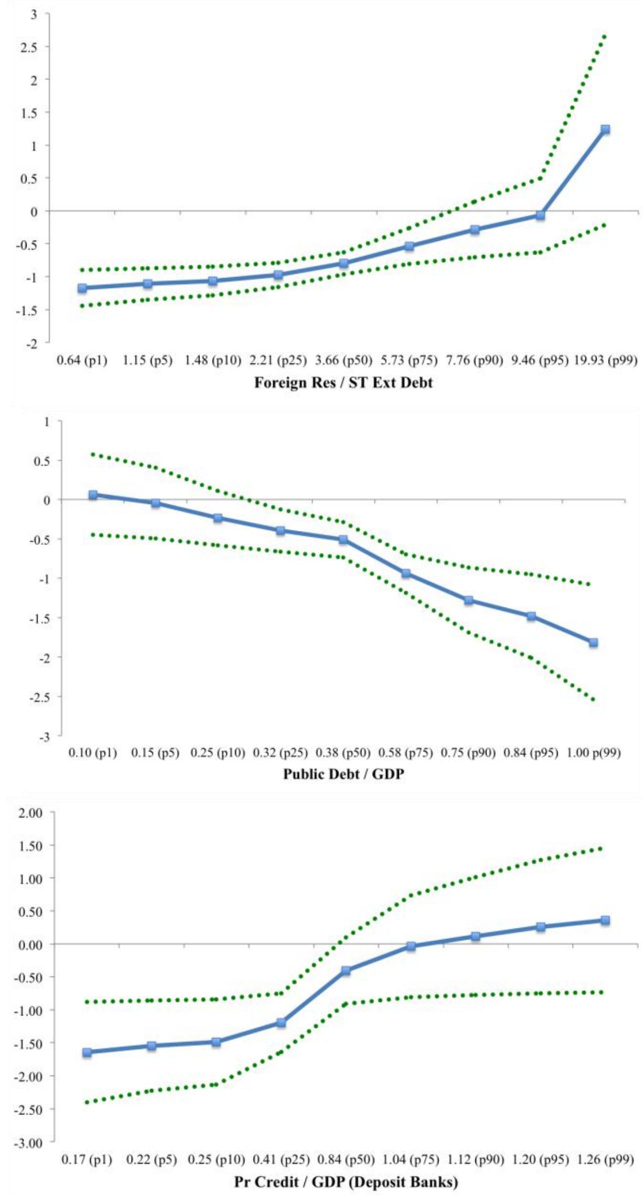
**Table 8. Adding country fundamentals: equation (3)**

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | Interest-rate shocks | | | Uncertainty shocks | | |
| (Lag) Q | 0.057*** | 0.056*** | 0.056*** | 0.055*** | 0.055*** | 0.051*** |
| | (0.009) | (0.008) | (0.011) | (0.007) | (0.007) | (0.009) |
| Shocks: S | -1.485*** | -0.056 | -2.292** | -0.070 | -0.098 | -0.012 |
| | (0.430) | (0.538) | (1.017) | (0.049) | (0.071) | (0.071) |
| F1: Foreign Reserves/ST External Debt | -0.002 | | | -0.003 | | |
| | (0.001) | | | (0.004) | | |
| F2: Public Debt/GDP | | -0.172*** | | | -0.181*** | |
| | | (0.044) | | | (0.053) | |
| F3: Private Bank Credit/GDP | | | -0.021 | | | 0.027 |
| | | | (0.038) | | | (0.061) |
| S*F | 0.139 | -1.706 | 2.698* | 0.005 | 0.155 | -0.086 |
| | (0.104) | (1.224) | (1.337) | (0.012) | (0.148) | (0.091) |
| (Lag) Net Leverage | -0.068*** | -0.062*** | -0.051** | -0.047*** | -0.033 | 0.017 |
| | (0.008) | (0.019) | (0.023) | (0.016) | (0.037) | (0.039) |
| (Lag) Net Leverage * S | -0.148 | 0.662 | 0.191 | -0.096** | -0.151 | -0.300*** |
| | (0.388) | (0.528) | (0.599) | (0.044) | (0.095) | (0.103) |
| (Lag) Net Leverage * F | -7.90e-05 | -0.009 | -0.023 | 3.69e-05 | -0.025 | -0.076 |
| | (0.001) | (0.034) | (0.026) | (0.002) | (0.069) | (0.045) |
| (Lag) Net Leverage * S * F | 0.007 | -1.736* | -1.174 | -0.001 | 0.114 | 0.243** |
| | (0.038) | (0.960) | (0.860) | (0.006) | (0.193) | (0.114) |
| Cash Flow Ratio | 0.132*** | 0.123*** | 0.179*** | 0.151*** | 0.125*** | 0.196*** |
| | (0.011) | (0.021) | (0.034) | (0.028) | (0.042) | (0.063) |
| Cash Flow Ratio * S | 1.191 | 0.755 | 1.315 | -0.105 | -0.019 | -0.161 |
| | (0.895) | (1.333) | (2.257) | (0.098) | (0.125) | (0.174) |
| Cash Flow Ratio * F | 0.001 | 0.027 | -0.054 | 0.005 | 0.084 | -0.042 |
| | (0.002) | (0.044) | (0.038) | (0.007) | (0.088) | (0.074) |
| Cash Flow Ratio * S * F | -0.072 | 0.201 | -2.555 | -0.014 | -0.265 | 0.056 |
| | (0.214) | (2.555) | (2.582) | (0.022) | (0.267) | (0.209) |
| US Real GDP Growth | 0.280** | 0.288** | 0.275* | 0.051 | 0.096 | 0.055 |
| | (0.130) | (0.139) | (0.145) | (0.139) | (0.153) | (0.137) |
| Observations | 52,315 | 58,959 | 39,129 | 52,315 | 58,959 | 39,129 |
| R-squared | 0.119 | 0.123 | 0.118 | 0.122 | 0.125 | 0.123 |
| Number of firms | 10,010 | 11,084 | 8,499 | 10,010 | 11,084 | 8,499 |

*Notes*: Estimation results of equation (3) including firm-level fixed effects letting standard errors (in parentheses) clustered at the country level (also robust to arbitrary form of heteroskedasticity). Columns (1)-(3) are for interest-rate shocks and columns (4)-(6) are for uncertainty shocks. *** p<0.01, ** p<0.05, * p<0.1

Figure 6 shows that firms in countries with stronger sovereign balance sheets or more developed financial markets are buffered to a greater exent when facing an increase in U.S. interest rates. For example, following an increase in U.S. long-term interest rates, the contraction in investment by a firm with the median level of net leverage is three times larger if the firm is located in a country with public debt of 75 percent of GDP than if it is located in a country with public debt of around 32 percent of GDP. Similarly, a firm with net leverage equal to the sample median would contract investment in response to higher interest rates by less if it is located in a country with higher foreign reserves or in deeper financial markets.

**Figure 6. Country heterogeneous investment responses**




*Sources*: authors' calculation
*Notes*: The y-axis is the partial derivative of the investment ratio with respect to interest-rate shock from equation (4). The x-axis marks the respective percentile (1 to 99) for each variable. Solid-blue lines draw the point estimates and dotted green lines indicate the 90% confident intervals.

Visual inspection of the figures above suggests that the slope is statistically different from zero. Nevertheless, we test this formally in Table 9 in column (1). We also show this test for regressions where—unlike in Table 8 where we include one shock or macroeconomic variable at a time—we include all macroeconomic variables and the corresponding interactions at once, which is shown in column (2) of Table 9. We also control for capital account openness and its interaction with the shocks to make sure the above results are not just driven by the fact that firms in a country with a more open capital account can be affected proportionally more by external financing shocks. Table 9 (column 3) shows that these results hold under this additional specification, using the expanded regression with all macroeconomic variables and interactions in the equation.[18] In fact, the effect of the size of public debt on investment triples when all fundamentals and the openness indicator are included, compared to what is shown in Table 8. Notewithstanding our results for increases in U.S. interest rates, we do not find a statistically significant heterogenoues response, along the country fundamental dimension, in response to higher uncertainty, as shown in the last column of Table 9.

**Table 9. Country heterogeneity: slope of equation (4)**

| | Interest rate shocks | | | Uncertainty |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| | From Table 8 | All at once | All + Openness | From Table 8 |
| Foreign Reserves | 0.125** | 0.268*** | 0.261*** | 0.002 |
| | (0.052) | (0.081) | (0.084) | (0.006) |
| Public Debt | -2.087*** | -7.307*** | -7.346*** | 0.123 |
| | (0.795) | (1.771) | (1.814) | (0.076) |
| Credit Deepening | 1.836* | 1.543* | 1.677** | -0.014 |
| | (0.967) | (0.800) | (0.757) | (0.068) |

*Notes*: Statistical significance of the slope term in equation (4), where the left panel is for interest-rate shocks and right panel is for uncertainty shocks. Column (1) and (4) are directly from Table 8, while column (2) are for specifications where all three macro variables are included; column (3) is when financial account openness and its intereaction term are further controlled. *** p<0.01, ** p<0.05, * p<0.1

## VIII. Concluding Remarks

We document the existence of significant heterogeneity in the response of corporate investment in emerging markets to changes in U.S. interest rates or volatility. Along the balance sheet dimension, we find that more levered firms reduce capital expenditures proportionally more when confronting higher uncertainty or interest rates. This supports the existence of a financing channel. Moreover, firms' marginal propensity to invest (out of cash flows) increases on average when faced with higher interest rates, consistent with the financing channel as well. But we also find evidence in support of a wait-and-see channel, reflected in a decrease in the marginal propensity to invest when uncertainty increases. We show that the relative strength of the two channels depends on firms' leverage. For highly leveraged firms, the financing channel gains potency, while the wait-and-see channel weakens, and vice versa.

Finally, we document the relevance of macroencomic fundamentals to improve the resilience of corporate investment to external financial shocks. Low public debt, high international reserves, and deeper financial markets mitigate the response of firms' investment to an increase in U.S. interest rates. Our interpretation of these results is that strong country

[18] The detailed regression results are not reported but are available from the authors upon request.

fundamentals reduce firms' aggregate risks and with them the intensity of financial frictions. From a policy perspective, these results highlight the importance of maintaining strong macroeconomic fundamentals to mitigate the effects of higher global interest rates on corporate investment through the financing channel. However, such heterogeneity upon a volatility shock is less siginificant.

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