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Endogenous Corporate Leverage Response to a Safer Macro Environment: The Case of Foreign Exchange Reserve Accumulation

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ABSTRACT

A country may adopt policy measures such as raising its foreign exchange reserves to better prepare for foreign interest rate shocks or sudden reversal of international capital flows, which in principle should reduce financial vulnerability for its firms and the entire economy, but the beneficial effect of such policies may be partially offset by endogenous firms' decisions to take on more risks. We present a robust but previously undocumented relationship between corporate leverage and country-level foreign exchange reserve holdings. For 6610 non-financial firms in 23 emerging markets from 2000 to 2006, we show that more foreign reserve accumulation leads to higher corporate leverage. While the reserve accumulation can reduce macroeconomic uncertainty, the increase in corporate leverage is also significantly greater in sectors that are intrinsically more sensitive to policy uncertainty. We go from correlation to causality via a two-prong instrumental variable strategy: simultaneously (1) instrumenting FX reserves by global commodity price movement, and (2) examining leverage of firms outside the commodity-sensitive sectors.

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1. Introduction

Corporate leverage ratio is a source of corporate risk (e.g., Acharya, Amihud, and Litov 2011). The classical paper by Rajan and Zingales (1995) presents an international comparison of the determinants of leverage, although it does not study how country-level financial and trade openness themselves affect corporate leverage. Several papers have examined how stock market liberalization affects cost of financing for firms (e.g., Stulz 1999; Bekaert and Harvey 2000; Henry 2000; Mitton 2006; Doidge, Karolyi and Stulz 2013) or how credit market integration affects firm borrowing (Schmukler and Vesperoni 2006; Lucey and Zhang 2011).[1] However, the literature is still limited on how the international integration may affect the capital structure of firms such as the equity-debt tradeoff, potentially due to the challenges of identifying exogenous shocks to international integration and/or of documenting the specific channels for the integration to affect the capital structure.

The government often adopts policy measures that are designed to reduce the country's financial vulnerability. For example, currency crisis, debt crisis, and banking crisis in emerging market economies are often associated with interest rate shocks in advanced countries or a sudden reversal of international capital flows. If a country builds up its foreign exchange reserves, holding the private sector's actions constant, the stronger foreign reserves act as a buffer that can deter speculative attacks on the country's exchange rate system, and enhance its ability to fulfill the foreign currency debt obligation (Kaminsky and Reinhart 1999; Jeanne 2007). These

[1] On the equity side, Stulz (1999) argues that the integration of national stock markets with the global stock market can reduce the cost of capital. This has also been empirically confirmed by Bekaert and Harvey (2000), Henry (2000), and Mitton (2006). Doidge, Karolyi and Stulz (2013) show that financial globalization enables firms from countries with weak institutions to issue global IPOs. On the debt side, Schmukler and Vesperoni (2006) find that the access to global bond market increases the debt maturity, while Lucey and Zhang (2011) document that credit market integration increases firm borrowing.

enhancements would imply a lower probability of a currency crisis, banking crisis, or debt crisis. The corporate sector in such an economy would be as a result less likely to face a sudden tightening of financial conditions. One potential caveat of this argument is that the private sector actions cannot be held constant when the country takes measures to make the macro environment safer. In particular, the private sector firms may respond to a safer macro environment by taking on more risks, partially offsetting the effect of the public policy. One concrete area in which firms may load up more risks is corporate leverage ratio.

In this paper, we examine whether and how a change in a country's foreign exchange reserves affects corporate leverage in the economy. A search of the literature returns no paper that we can find on this particular linkage. Yet, foreign exchange reserves are often featured as something that matters for a country's vulnerability to financial crisis. For example, the ratio of foreign exchange reserves to short-term foreign debt has been found to be one of the very few variables that can predict the likelihood of a crisis (Eichengreen, Rose, and Wyplosz 1996; Frankel and Rose 1996, etc.).

Somewhat surprisingly, a higher level of foreign reserve holding during the 2008-2010 global financial crisis did not seem to help with the ultimate country experience with the financial crisis. In the years leading up to the global crisis, many countries had accumulated large foreign reserves (Figure 1), with the intent to build up a cushion against external negative shocks, such as a sudden reversal of international capital flows in Asia and Latin America during 1997-1999 (Obstfeld, Shambaugh, and Taylor 2009). To the extent that higher foreign reserves make a country less likely to suffer a balance-of-payments crisis, corporations should experience less negative impacts. But the empirical evidence on the effects of FX reserves is mixed. For example,

Blanchard, Faruqee and Klyuev (2009) find that the reserve holdings did not lessen the severity of the 2008 crisis for emerging countries.

While the lack of a negative relationship could potentially be explained by several possibilities, in this paper we investigate a particular hypothesis that is anchored to corporate financial behavior. In particular, we examine whether an increase in country-level insurance as measured by an increase in the reserves/GDP ratio could induce corporations to respond by raising their leverage, and hence increasing their vulnerability to a negative shock. As a result, when a large negative shock actually arrives (such as in 2008), the actual severity of the corporate financial difficulties in a country with a high pre-crisis reserves/GDP ratio is not necessarily significantly better than their counterparts in a country with a lower reserves/GDP ratio. In other words, for a given level of private-sector risks, foreign exchange reserves do help to reduce vulnerability to external shocks. However, the level of private sector risk exposure is endogenous, and in particular may increase in a non-crisis time precisely to take advantage of a rise in the country-level FX reserve holding.

We put this hypothesis into test by examining over 6,610 listed firms in 23 emerging economies from 2000 to 2006. A robust pattern in the data is that firms in countries (or years) with a higher ratio of foreign exchange reserves to GDP tend to have a higher leverage ratio. The correlation could reflect a mechanical association or even a reverse causality. In particular, massive capital inflows into an emerging economy (say due to low interest rates in the United States and Europe) could inflate the leverage ratios in all corporations while raising the reserve-to-GDP ratio. We hence control for macroeconomic variables that may directly affect firm leverage, such as international capital inflow (as proxied by foreign liabilities over GDP), country-level borrowing costs (as proxied by real interest rates), and the business cycles (as proxied by GDP growth rate).

Reassuringly, the main results still carry through: increases in a country's FX reserves tend to be associated with increases in the leverage ratios of the companies in the country.

We further investigate the channels through which FX reserves affect corporate leverage. In particular, we explore a specific channel relatively new to the literature: FX accumulation provides country insurance, reduces the uncertainty in economic policy, but this induces firms to leverage up by incurring more debt. According to the trade-off theory of capital structure, firms consider the probability of financial distress, which increases with the volatility of a firm's profits and assets values (Berk, DeMarzo and Harford 2014). Thus, firms whose value and cash flows are more subject to uncertainty are more likely to have lower levels of debt so as to avoid financial distress. As reserve accumulation reduces the likelihood of financial crises and economic policy uncertainty, corporate leverage is then likely to increase.[2] With this channel at play, the effect of FX reserves on leverage is expected to be larger for firms in sectors intrinsically more sensitive to policy uncertainty.

To examine this channel, we first construct an index, at the sector level, of intrinsic sensitivity to policy uncertainty based on US data. We take the following steps. First, for each US stock, from 2000 to 2006, we regress its daily stock return onto the daily MSCI US market return and the daily percentage change of the US policy uncertainty index from Baker, Bloom and Davis (2016).[3] Consistent with one's intuition, the slope coefficient for the uncertainty index is generally negative across stocks: greater policy uncertainty tends to depress stock returns. Second, we define the firm-level sensitivity to policy uncertainty as the negative value of the coefficient for the

[2] Policy uncertainty tends to rise sharply during crisis times, such as during the Asian Financial Crisis and the Global Financial Crisis in 2008-09 (Davis 2016). We will also show later that foreign reserve accumulation tends to be associated with lower policy uncertainty in our sample period from 1999 to 2007 as well.

[3] See also http://www.policyuncertainty.com/

uncertainty index in the above regressions, and, for each four-digit US SIC sector, we define the sector-level intrinsic sensitivity to uncertainty by the median value of the firm-level sensitivity to uncertainty among all firms in the sector. The greater the value, the more sensitive firms in that sector are to a given increase in uncertainty. This covers 697 four-digit sectors. Third, we interact this sector-level sensitivity-to-uncertainty index with the country-year-level FX reserves in a regression for our sample of firms in 23 emerging markets where the corporate leverage is the dependent variable. We find the coefficient on the interaction term is positive and statistically significant. In other words, the impact of FX reserves on leverage is indeed larger for the firms in those sectors that are more sensitive to uncertainty. (It is worth noting that, our regression sample on corporate leverage does not include US firms. In this sense, the sector level measure of sensitivity to uncertainty estimated from the US data is exogenous to the regression error term.)

To find out if the pattern reflects a causal relation from country insurance to corporate leverage, we adopt a two-prong strategy. The first prong is to isolate the changes in a country's FX reserves that are due to exogenous movement in global commodity prices. More precisely, we predict a country's current-year commodity exports by multiplying its one-year-lagged commodity export volume with the current-year commodity price. We then instrument a country's FX reserves by the interaction between the predicted commodity exports and a dummy for those countries that require a mandatory surrender of foreign exchange earnings.[4] The second prong is to examine leverage choices by those firms that neither export commodities nor use imported commodities as inputs. By construction, commodity exports do not directly affect the balance sheet of those firms.

[4] Those countries that require exporting firms to surrender their foreign exchange earnings directly convert export earnings to official foreign exchange reserves. In comparison, for other countries without this requirement of mandatory surrender, export earnings can remain in private sector's hand rather than showing up as the country's foreign reserve holdings.

In other words, we examine how the leverage of firms outside commodity sectors react to changes in the country-level foreign exchange reserves that are driven by commodity price changes. This two-prong strategy can help addressing concerns about possible endogeneity of the foreign reserve changes.

In the first-stage regression, we find that the above instrumental variable is an important and significant predictor of reserve accumulation; an increase in commodity exports by one million dollars leads to an increase in the FX reserves by 0.47 million dollars for those countries with surrender requirement. In the second-stage regression, we find that an increase in the foreign reserve accumulation significantly increases corporate leverage. To gain further insight, we explore cross-sector heterogeneity in terms of sensitivity to economic uncertainty. We find that the increase in leverage after an increase in FX reserves is particularly large for firms in sectors with a higher degree of sensitivity to uncertainty shocks. The economic effect is also large: for firms at the threshold of the top quartile of uncertainty-sensitivity, an increase in the FX reserves by one standard deviation is associated with an increase in leverage by 0.11, amounting to 55% of the standard deviation of leverage in the sample.

Throughout the analyses, we include control variables that the existing literature has regarded as robust explanatory variables for corporate risk-taking, including firm size, growth opportunity, asset tangibility, and profitability (e.g., Rajan and Zingales 1995; Bartram, Brown and Stulz 2012). We include firm fixed effects in the regressions, which subsume country fixed effects and therefore account for time-invariant country features in our sample, such as shareholder rights protection, creditor rights protection, bankruptcy laws and accounting regulations, and time-

invariant firm features, such as sector affiliation. Reassuringly, including these variables does not change our key results with regard to the effect of reserve accumulation.

It is worth mentioning that our paper does not regard corporate leverage as necessarily socially inefficient. Indeed, risk-taking could increase firm's growth and value during normal times (e.g., Obstfeld 1994; Acemoglu and Ziliboti 1997; John, Litov, and Yeung 2008). Instead, we argue that firm's leverage buildup may increase their vulnerability to unexpected liquidity shocks such as the 2008 global crisis. Based on the same sample in this paper, we find that one percentage point increase in firm's leverage ratio in year 2006 is significantly associated with an extra decline of firm's return on assets by 2.7 percentage points from 2006 to 2009.[5] Similarly, Tong and Wei (2011) find that during the 2008 crisis, firms with high leverage in 2006 experienced a more severe decline in the stock prices. Moreover, as illustrated in Jeanne and Korinek (2019), individual borrowers may not internalize the social welfare implication of their borrowing, causing excessively large booms and busts in aggregated credit flows.

The paper is related to three literatures. First, it is linked to a large literature on country characteristics and leverage, such as Rajan and Zingales (1995), Booth, Aivazian, Demirguc-Kunt and Maksimovic (2001), Korajczyk and Levy (2003), Hackbarth, Miao and Morellec (2006), Bates, Kahle and Stulz (2009), and Erel, Julio, Kim, and Weisbach (2012). Much of the research has focused on the relationship between leverage ratios and macroeconomic conditions (e.g., Erel *et al.* 2012). However, it is not clear from these papers whether foreign reserve accumulation as a means of country insurance affects the capital structure decisions of firms, especially in emerging markets which are more prone to crisis and related economic uncertainty. In this paper, we identify

[5] We regress the change of firm's return on assets from 2006 to 2009 onto the leverage in 2006, controlling for firm's growth opportunity, size, profitability and tangibility in 2006 as well as country fixed effects. The coefficient of leverage is -2.73, significantly different from zero at the 1% level (with a t-stat of -2.77).

the role of country insurance on leverage, with the leverage increasing relatively more in countries with faster FX reserve accumulation, particularly in sectors that are sensitive to economic uncertainty.

Second, our paper is linked to a subset of international finance/open economy macroeconomics literature on foreign reserve accumulation, such as Frankel and Rose (1996), Kaminsky and Reinhart (1999), Aizenman and Lee (2008), Obstfeld, Shambaugh, and Taylor (2009) and Jeanne (2016). While these papers examine the roles of foreign reserves in reducing the occurrence of financial crises, they do not examine the endogenous response by corporate finance variables to country insurance.

Third, our paper also relates to a growing literature examining the effects of policy uncertainty on market risk and firm behavior. For example, Brogaard and Detzel (2015) find that US policy uncertainty, as measured by Baker, Bloom and Davis (2016), increases the market risk for equities. US policy uncertainty is also found to reduce firm-level investment and mergers and acquisitions in the United States (e.g., Gulen and Ion 2016; Nguyen and Phan 2017; Bonaime, Gulen and Ion 2018). In this paper, we extend this line of research to firm-level leverage in emerging economies and examine how foreign reserve accumulation, by providing country insurance against policy uncertainty, affects leverage of firms according to their sector-level intrinsic sensitivity to policy uncertainty.

The rest of the paper is organized as follows. In Section 2, we explain the empirical methodology and definitions and the data sources of the key variables. In Section 3, we examine the impact of reserve accumulation on leverage and examine heterogeneity across sectors in terms of sensitivity to uncertainty shocks. In Section 4, we instrument FX reserves with commodity price movement and focus on firms with little exposure to commodities. Section 5 concludes.

2. Methodology and Data

We denote leverage by firm *i* in country *k* at year *t* by $Leverage_{ikt}$. The key empirical relationship that we examine relates firm-level leverage to the country-level ratio of foreign exchange reserves to GDP (denoted by $FXR_{k,t}$), conditional on firm fixed effects (which encompass country fixed effects), year fixed effects, and other control variables. More specifically,

$$Leverage_{ikt} = \gamma FXR_{k,t} + Controls_{ikt} + Firm\_Fixed\_Effects + Year\_Fixed\_Effects + e_{ikt} \quad (1)$$

The key parameter of interest is γ.

Leverage is measured as the ratio of total book debt over total book assets, following Welch (2004) and Coles, Daniel and Naveen (2006). When financial crises occur, firms with a higher leverage ratio are more likely to face financial distress. For example, Tong and Wei (2011) report that firms with higher leverage suffered more during the 2008-09 global crisis. Following Welch (2004), we use book leverage rather than market leverage as a proxy for financial risk, as market leverage may change passively due to stock price movement rather than due to an active firm choice.

On the right-hand side of the equation, we include traditional firm-level controls of corporate leverage guided by the existing literature (e.g., Rajan and Zingales, 1995) on empirical determinants of corporate leverage: firm growth opportunity (Tobin's Q), firm size (the log of total book assets normalized by GDP deflator (with year 2000=100)), tangibility (property, plant and equipment over assets) and profitability (earnings before interest and tax over total assets).

We also control for macroeconomic variables. Few theoretical models pay significant attention to the impact of macroeconomic conditions on corporate leverage; an exception is Hackbarth, Miao and Morellec (2006) who propose a theoretical model to examine the impact of business cycles on corporate leverage. One reason for the lack of attention is given by Booth,

Aivazian, Demirguc-Kunt and Maksimovic (2001): "Macroeconomic variables supposedly play no role in most capital structure models. These factors do not affect the personal versus corporate leverage decision that is at the heart of the Modigliani and Miller (1958) capital structure framework." Empirically, the literature has examined a set of macroeconomic factors. For example, Korajczyk and Levy (2003) examine the variation of leverage over economic cycles; Huang and Ritter (2009) explore the role of real interest rate on capital structure. Following the above literature, we include the following macroeconomic variables in the baseline: real GDP growth rate to capture business cycle influence, foreign liabilities over GDP, and real interest rate to proxy for county-level borrowing costs.

Time-invariant country features in our sample, such as legal origins, shareholder rights protection, creditor rights protection, bankruptcy laws and quality of the accounting system, and time-invariant firm features, such as sector affiliation, capital intensity, and political connections, are all absorbed in the firm fixed effects. Time-varying common global shocks, such as the global interest rate, the global risk appetite, and the global demand shocks, are absorbed in the year fixed effects.

Our sample consists of 6,610 listed non-financial firms in 23 emerging economies from 2000 to 2006.[6] Country coverage and summary statistics are provided in Tables 1 and 2.

[6] Following Bates et al. (2009), we require that firms have positive assets to be included in a given year. We exclude financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999) as their leverage can be subject to regulatory supervision.

3. The Impact of Foreign Reserves on Leverage

3.1 First Look at the Data

In Figure 2, we plot the average leverage ratio across firms within a country-year against the reserves/GDP ratio in that country-year for 23 emerging market economies during 2000-2006, conditional on country fixed effects and year fixed effects. From the 161 country-year observations, there is a clearly positive relationship between the two variables. The slope of the fitted line is 0.155, with a standard error of 0.055 (and a t-statistic of 2.79).

Instead of taking the average across firms in a given country and year, one can filter the data differently. First, we pool all firm leverage ratios in all countries and years together, and take out country means and year fixed effects. Second, we classify all residuals into 20 equal-sized bins based on the value of the reserves/GDP ratios, with each bin having 5% of the observations. Third, within each bin, we compute the average leverage ratio. In Figure 3, we plot the average leverage ratio in a bin against the lower bound of the reserves/GDP ratio for that bin. A positive slope is clearly visible in the graph, which is also about 0.18 with a standard error of 0.016. These two plots serve to illustrate that the positive correlation between country insurance and corporate leverage is not driven by one or two firms or by one or two countries.

In the rest of this section, we will show that the positive correlation is robust to including other control variables, and reflects at least in part a causal effect of a change in a country's foreign exchange reserves on corporate leverage.

3.2. Panel Analysis

We now examine whether the patterns in Figures 2 and 3 for leverage carry over when we perform panel analysis with control variables. The regressions are presented in Table 3. Column 1

includes firm-level control variables (growth opportunity, size, tangibility, and profitability), firm fixed effects and year fixed effects. The standard errors are clustered at the country-year level. The coefficient for reserves/GDP is 0.20, with a t-statistic of 4.76. Therefore, corporations tend to have a higher leverage ratio in country-years with a higher ratio of foreign reserves to GDP. This is consistent with the fitted line represented in Figure 2. Based on the point estimate, an increase in the reserves/GDP ratio by one standard deviation (0.18) is associated with a higher leverage ratio by 3.6 percentage points. This is a non-trivial effect since the standard deviation of the leverage ratio in the sample is only 20 percentage points.

One interpretation of this significant result is that firms determine the optimal leverage by trading off the tax benefit of additional debt and the costs of increased exposure to financial stress, with the tradeoff affected by the macroeconomic conditions. Because foreign reserve accumulation reduces the likelihood of policy uncertainty and hence the likelihood of firm financial stress, it induces firms to increase leverage.

It is worth noting that the average leverage ratio declines gradually over time in our sample, as suggested by the relative coefficients of year dummies. These results are consistent with the summary statistics as well. From 2000 to 2006 in our sample, the average leverage ratio declines from 0.27 in 2000 to 0.24 in 2006. This pattern of declining leverage is also documented in Bates, Kahle and Stulz (2009) for the sample of US non-financial firms. Here for our sample of 23 emerging markets, we identify not only the general time trend of declining leverage, but also the heterogeneity across these emerging markets due to their different level of FX reserve accumulation.

Firm-level control variables have sensible signs and are largely consistent with the existing literature. For example, larger firms and firms that have more tangible assets (which could be

pledged as collaterals) have a higher leverage ratio, probably because it is relatively easy for them to borrow. Firms that are more profitable have lower leverage ratios. Inclusion of these firm-level controls improves the fitness of the model. Interestingly, it has little effect on the coefficient of the reserves/GDP ratio. Firms continue to have a higher leverage ratio if they are in a country/year that has a higher reserves/GDP ratio.

In Column 2, we add macro variables including economic growth rate, real interest rates, and foreign liabilities over GDP. We do not find significant results for these macro control variables. Reassuringly, the results for FX reserves carry through with almost the same magnitude and statistical significance.

3.3 Heterogenous Effects along the Uncertainty Dimension

In this sub-section, we examine a potential channel for the corporate leverage to respond to FX reserves; that is, FX reserve accumulation provides stronger country insurance and reduces the macroeconomic uncertainty faced by the firms in the country. For example, a country with a bigger FX reserve buffer does not have the same kind of pressure as one with less FX reserves to raise tax revenue to deal with the rollover risk of debt, especially the foreign currency denominated debt, or fend off a run on its currency. A country with more abundant FX reserves also faces less need to use inflation to "monetize" its debt. These translate into a lower probability of fiscal, monetary, or regulatory shocks faced by firms.

In Figure 4, we first examine the link between FX reserves and country-level policy uncertainty. We collect the monthly macroeconomic uncertainty indexes from the Economic Policy Uncertainty database for countries in our sample, including Chile, China, Colombia, India,

Korea, Mexico, Russia, and Singapore from years 1999 to 2007.[7] We then construct the annual uncertainty index as the average of the monthly uncertainty index. In Figure 4, we plot the log change of the annual uncertainty index against the one-year-lagged log change of foreign reserves over GDP, controlling for year and country fixed effects. The coefficient for the log change of foreign reserves is -0.73, significantly different from zero at the 1% level. Hence, foreign reserve accumulation significantly reduces policy uncertainty.

One way to examine the importance of macroeconomic uncertainty is to explore cross-sector heterogeneity in terms of sensitivity to uncertainty. We now investigate whether the effect of FX reserves on leverage is larger for firms in sectors that are intrinsically more sensitive to policy uncertainty. To examine this channel, we first construct an index, at the sector level, of sensitivity to policy uncertainty based on US data. We take the following steps. First, for each US stock, from 2000 to 2006, we regress its daily stock return onto the daily MSCI US market return and the daily percentage change of the US policy uncertainty index from Baker, Bloom and Davis (2016). The slope coefficient for the uncertainty index is generally negative across stocks: more uncertainty tends to depress stock prices. Second, we define the firm-level sensitivity to uncertainty by the negative value of the coefficient for the uncertainty index in these regressions. For each four-digit US SIC sector, we define the sector-level intrinsic sensitivity to uncertainty by the median value of the firm-level sensitivity within the sector. This covers 697 four-digit sectors. (It is important to note that, while the sector level sensitivity to uncertainty is estimated with the US firm-level data, our regression sample on corporate leverage, FX reserves, and sector level

[7] Data is collected from the website http://www.policyuncertainty.com/.

sensitivity to uncertainty, does not include US firms. In this sense, the sector level measure of sensitivity to uncertainty is exogenous to the regression error term.)

The sector-level sensitivity-to-uncertainty index has a mean value of 0.09 and a median value of 0.08, with a standard deviation of 0.38. One example of a sector with a high sensitivity-to-uncertainty index is Machine Tools, Metal Forming Types (SIC 3542), and an example of a sector with a low sensitivity-to-uncertainty index is Forestry Services (SIC 0831).

The results on the effects of the sensitivity-to-uncertainty index are presented in Table 4. In Column 1, we include the sensitivity-to-uncertainty index itself and find that the sensitivity index has a coefficient of -0.009, significantly different from zero at the 5% level.[8] That is, consistent with our hypothesis, a higher value of the sensitivity index significantly reduces firm's leverage.

In Column 2, we include the interaction term of FX reserves with the sensitivity-to-uncertainty index. The interaction term has a coefficient of 0.10, significantly different from zero at the 1% level. Hence the impact of FX reserves on leverage is significantly larger for those firms in sectors with a higher degree of sensitivity to uncertainty.

The effect is economically significant. Across the 697 four-digit sectors, the one at the 90th percentile of sensitivity to uncertainty is "Household Refrigerators (SIC 3632)" (with sensitivity equal to 0.75), while the sector at the 10th percentile is "Storage Batteries (SIC 3691)" (with sensitivity equal to -0.5). The country-year at the 90th percentile of Reserves/GDP is Malaysia 2002 (with a FX reserves/GDP ratio of 0.3), while the country-year at the 10th percentile is Indonesia 2004 (with a FX reserves/GDP ratio of 0.06). Based on Column 1 of Table 4 (with a

[8] In Column 1, we drop firm fixed effects and add country-2-digit-sector fixed effects. Firm fixed effects are dropped because the sensitivity index, with a variation at the 4-digit sector level, can be fully projected by firm fixed effects.

coefficient of 0.10 for the interaction of uncertainty-sensitivity and FX reserves), the leverage of Household Refrigerators would be 0.03 (=0.1*(0.75+0.5)*(0.3-0.06)) higher than that of Storage Batteries in Malaysia 2002 as compared to in Indonesia 2004. The difference is not trivial compared to the standard deviation of leverage (0.2).

In Column 3 of Table 4, we include many macroeconomic control variables. These control variables are not significant. Reassuringly, the results on foreign reserves still carry through.

4. **Instrumental Variable Estimation**

4.1 A Two-pronged Strategy

In this section, we employ a two-pronged strategy to investigate if the positive association between corporate leverage and reserve holdings goes beyond a passive or a mechanical change in corporate leverage due to omitted variables or a reverse causality. Our idea is to examine how corporate leverage for firms outside the commodity sectors respond to changes in country-level FX reserves that are mostly driven by exogenous global commodity price movement.

More concretely, the first part of the two-pronged strategy is to find an instrumental variable for FX reserves based on a triple interaction among global commodity price movement, the volume of country's commodity exports, and the presence of mandatory surrender of firms' FX earnings (which is a type of capital controls that are common in many developing countries). The second prong is to restrict the sample to those firms that neither export commodities nor use imported commodities intensely.

The first prong

The instrument for foreign reserves is the predicted level of commodity exports interacted with the country's surrender requirement of exports receipts.

When constructing commodity exports, we use the export values predicted from the global commodity price movement. We include the following ten major commodities: Food & live animals (SITC 0), Beverages and tobacco (1), Natural rubber/latex (231), Iron ore/concentrates (281), Copper ores/concentrates (283), Coal/coke/briquettes (32), Petroleum and products (33), Gas natural/manufactured (34), Animal/veg oil/fat/wax (4), and Non-ferrous metals (68). We use each country-commodity's export volume at the previous year, and then multiply it by the global price of each commodity in the current year to derive the predicted export value for each commodity-country-year. We then sum over each commodity for each country-year to derive the country-year's predicted overall commodity export value. The change of FX reserves due to the commodity price movement is exogenous to the own behavior of the firms outside the commodity sectors in the country. The county-product-level data on commodity exports is from the United Nations International Trade Statistics Database (UN Comtrade), while the data on annual commodity price is from Datastream.

The rationale to include the mandatory surrender requirement is that if a country requires the surrender of export receipts (i.e., surrendering export earnings to a government agency, typically an agent of the central bank, in exchange for local currencies), then commodity export receipts are more likely to directly contribute to an increase in the FX reserves. (If the export receipts are not transferred to the central bank either voluntarily or by the surrender requirement, they will become part of the foreign assets held by the private sector, but not as a part of the country's FX reserves.) Moreover, as the surrender requirement is a capital control policy at the country-level, it is unlikely to be affected by individual firm's leverage behavior and hence will not be subject to the concern of reverse causality.

The data on surrender requirement is retrieved from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER). We construct a dummy variable that is equal to one when the country in a given year has a surrender requirement. The dummy is time-varying, as some countries changed the requirement during our sample period. Overall, 15 countries in our sample had the surrender requirement, while eight countries did not. This translates into 75% of firm-year observations with the surrender dummy equal to one.

The second prong

For corporate leverage behavior, we focus only on firms in those sectors with little direct exposure to commodities. First, we remove commodity sector exporters. This means that we remove 4-digit SIC sectors that product any of the ten commodity products mentioned above. Second, we remove sectors that use a large amount of commodity inputs. To construct a sector's reliance on commodity inputs, we use information from the United States, namely, the 1997 Supplementary Industry-by-Industry Total Requirements table at the detailed level (Table VIII), which is part of the 1997 US Benchmark Input-Output Data. The requirement table contains estimates of the inputs from each industry (industry i) that are directly and indirectly required to deliver a dollar of another industry's output (industry j) to final users. From there we construct the total usage of commodity inputs at the 3-digit SIC sector. We then regard a sector as using little commodity inputs if its usage of commodity is below the sample median, which is four cent usage of commodities per dollar industrial output. The assumption here is that the usage of commodities is a technical feature of a sector, and the US-based measures apply to the countries in our sample.

4.2 First-stage Estimation

The first-stage regressions of foreign reserves over GDP are presented in Table 5. In Column 1, the regression variables include predicted commodity exports interacted with surrender requirement of export receipts, country fixed effects and year fixed effects. The coefficient on the interaction of predicted commodity exports and surrender requirement is positive (0.47) and significant at the 1% level. This suggests that the interaction term is a strong predictor of foreign reserves. Economically speaking, it suggests that for a country with surrender requirement, one-million-dollar increase in commodity exports is associated with a 0.47 million dollar increase in foreign reserves.

In Column 2 of Table 5, we include all the macroeconomic control variables from the second stage, including growth rate, real interest rate and foreign liabilities over GDP. These macro control variables are not significantly associated with foreign reserves. Reassuringly, the instrumental variable remains a significant predictor of foreign reserves.

4.3. The Second-Stage Estimation

In Table 6, we report the second-stage estimation of the effects of reserves on leverage. For comparison, we first present in Columns 1 of Table 6 the OLS regression results (for the reduced sample of sectors with little direct exposure to commodities). The econometric model is the same as Table 3, but with only 17,681 firm-year observations instead of the original 35,092 firm-year observations in Table 3. In Column 1 of Table 6, foreign reserve holding has a coefficient of 0.13, slightly smaller than the estimate of 0.19 in Table 3.[9]

[9] For the sample of sectors with little exposure to commodities, we still find that the average leverage ratio declines gradually over time, as suggested by the coefficients on year dummies (unreported). In other words, besides a trend

(continued)

Column 2 of Table 6 presents the results for the uncertainty channel. The interaction term of FX reserves with sector-level sensitivity to uncertainty has a coefficient of 0.14, significant at the 1% level. This means that, subsequent to an increase in the FX reserves, the corporate leverage ratio rises more in sectors with a stronger sensitivity to economic uncertainty.

In Columns 3 and 4, we repeat the same exercise of Columns 1 and 2, but report the second stage estimation instead. In Column 3, the coefficient of instrumented FX reserves has a coefficient of 0.53, significantly different from zero at the 5% level. Comparing with the estimate in Column 1, we conclude that the OLS underestimates the corporate leverage response to higher FX reserves due to an endogeneity bias. Based on the IV estimate in Column 3, a one-standard deviation increase of fitted FX reserves/GDP (0.18) is associated with an increase of leverage by 0.09, which is 45% of the standard deviation of leverage (0.2). Therefore, the economic impact of FX reserves is large (and much larger than what is implied by the OLS estimate).

In Column 4, we examine the role of the uncertainty channel by including the interaction of instrumented FX reserves with the sensitivity-to-uncertainty index. This interaction term has a coefficient of 0.35, significantly different from zero at the 1% level. We can also gauge the economic magnitude of the uncertainty channel. The sector at the 90th percentile of sensitivity to uncertainty is "Household Refrigerators (SIC 3632)" (0.75), while the sector at the 10th percentile is "Storage Batteries (SIC 3691)" (-0.5). The country-year at the 90th percentile of predicted Reserves/GDP is Thailand 2004 (0.30), while the country-year at the 10th percentile of predicted Reserves/GDP is South Africa 2004 (0.07). Based on Column 4 of Table 6 (with a coefficient of 0.35 for the interaction of uncertainty-sensitivity with FX reserves), the leverage of Household

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of declining leverage, it is important to take notice of heterogeneity across emerging markets due to their different levels of country insurance.

Refrigerators should be 0.1 (=0.35*(0.75+0.5)*(0.3-0.07)) higher than that of Storage Batteries in Thailand 2004 as compared to in South Africa 2004. The difference is large compared to the standard deviation of leverage (0.2).

To summarize, these results show that corporations tend to undertake actions that increase their leverage in response to an increase in a country's reserves/GDP ratio. The pattern of the corporate responses is robust and is both economically and statistically significant.

5. Concluding Remarks

If one holds private sector actions constant, an increase in a country's reserves/GDP ratio should enhance a country's ability to defend against macroeconomic risks associated with a "sudden stop" in international capital flows. This should imply a reduced vulnerability in the corporate sector to a negative shock that is external in origin. Yet, one cannot hold private sector actions constant. In particular, as a country improves its self-insurance in the form of a higher reserves/GDP ratio, corporations may take actions that could make themselves more vulnerable to a negative shock.

In this paper, we provide the first documentation of a robust pattern in the data, namely corporate leverage tends to be systematically higher in country-years in which the reserves/GDP ratio is higher, particularly for firms in sectors that are more sensitive to policy uncertainty. We adopt several different approaches and conclude that at least a part of the strong, positive association reflects actions taken by the firms that expose themselves to more risks when they see improvement in their country's overall capacity of self-insurance (as exemplified by an increase in the FX reserves).

This research has useful implications for policy designs. In particular, macroeconomic policy designs and macro prudential frameworks need to take into account possible endogenous responses by the private sector that might partially offset the effects of the public policies.

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Table 1: List of Countries

Country	# of Firms
Argentina	58
Brazil	220
Chile	121
China	1,207
Colombia	22
Czech Republic	25
Egypt	37
Hungary	30
India	612
Indonesia	240
Israel	150
Korea (South)	962
Malaysia	845
Mexico	106
Pakistan	103
Peru	56
Philippines	125
Poland	176
Russian Federation	61
Singapore	548
South Africa	325
Thailand	405
Turkey	176
Total	6,610

Note: We use data on listed non-financial firms in 23 emerging economies over the period 2000-2006. Following Bates *et al.* (2009), we require that firms have positive assets to be included in a given year. We exclude financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999). Data sources: Worldscope.

Table 2. Summary Statistics

	# of obs	median	mean	st dev	min	max
Firm-year level						
Leverage	35092	0.23	0.25	0.20	0.00	1.00
Growth Opportunity	35092	0.85	1.13	0.97	0.11	7.34
Firm size (log)	35092	9.63	10.10	3.01	-0.13	20.37
Profitability	35092	0.07	0.06	0.13	-0.68	0.41
Tangibility	35092	0.37	0.38	0.22	0.00	0.92
Country-year level						
FX reserves/GDP	161	0.16	0.20	0.18	0.02	1.03
Real interest rate	161	6.25	9.21	11.72	-22.2	75.7
GDP growth rate	161	0.09	0.07	0.14	-0.96	0.41
Foreign liabilities/GDP	161	0.75	0.90	0.66	0.30	4.02
sector-level						
Sensitivity to Uncertainty	697	0.08	0.09	0.38	-0.59	0.75

Note: Firm leverage is the ratio of total book debt over total book assets. Firm growth opportunity is measured by Tobin's Q; Firm size is the log of total book assets normalized by GDP deflator (with year 2000=100); Tangibility is property, plant and equipment over assets; and Profitability is earnings before interest and tax normalized by total assets. Foreign Reserves/GDP is from the World Bank's World Development Indicators. Sensitivity to Uncertainty is constructed in Section 3.3. We use data on listed non-financial firms in 23 emerging economies from 2000 to 2006. Data sources: Worldscope, Datastream and World Development Indicators.

Table 3. The Impact of FX Reserves on Corporate Leverage

	(1)	(2)
FX reserves/GDP	0.20***	0.19***
	[0.042]	[0.042]
Growth opportunity	0.0030	0.0027
	[0.0025]	[0.0024]
Firm size	0.055***	0.055***
	[0.0046]	[0.0047]
Profit	-0.24***	-0.24***
	[0.017]	[0.017]
Tangibility	0.18***	0.18***
	[0.014]	[0.014]
Real interest rate		0.00071
		[0.0010]
GDP growth rate		0.0055
		[0.029]
Foreign Liabilities/GDP		0.016
		[0.016]
year==2001	0.00038	0.0026
	[0.0097]	[0.0092]
year==2002	-0.016*	-0.013
	[0.0095]	[0.0094]
year==2003	-0.023***	-0.020**
	[0.0086]	[0.0080]
year==2004	-0.034***	-0.031***
	[0.0092]	[0.0090]
year==2005	-0.044***	-0.040***
	[0.010]	[0.010]
year==2006	-0.045***	-0.041***
	[0.0097]	[0.010]
Firm fixed effects	Y	Y
Observations	35,092	35,092
R-squared	0.811	0.811

Note: The dependent variable is firm's leverage. Standard errors in brackets. Standard errors are clustered at the country-year-sector level. *** p<0.01, ** p<0.05, * p<0.1.

Table 4. The Effects of FX Reserves on Leverage
--the uncertainty dimension

	(1)	(2)	(3)
Sensitivity to Uncertainty	-0.0092**		
	[0.0042]		
FX reserves/GDP		0.19***	0.18***
		[0.042]	[0.042]
FX reserves/GDP*Sensitivity to Uncertainty		0.10***	0.098***
		[0.027]	[0.028]
Growth opportunity	-0.0038*	0.0030	0.0027
	[0.0022]	[0.0025]	[0.0024]
Firm size	0.024***	0.055***	0.055***
	[0.0018]	[0.0046]	[0.0047]
Profit	-0.38***	-0.24***	-0.24***
	[0.024]	[0.017]	[0.017]
Tangibility	0.19***	0.18***	0.18***
	[0.013]	[0.014]	[0.014]
Real interest rate			0.00071
			[0.0010]
GDP growth rate			0.0055
			[0.029]
Foreign Liabilities/GDP			0.016
			[0.016]
year==2001	-0.0077	0.00039	0.0026
	[0.011]	[0.0098]	[0.0092]
year==2002	-0.021**	-0.016*	-0.013
	[0.010]	[0.0095]	[0.0094]
year==2003	-0.025***	-0.023***	-0.020**
	[0.0088]	[0.0086]	[0.0080]
year==2004	-0.028***	-0.034***	-0.031***
	[0.0092]	[0.0093]	[0.0090]
year==2005	-0.030***	-0.044***	-0.040***
	[0.0099]	[0.010]	[0.010]
year==2006	-0.028***	-0.045***	-0.041***
	[0.010]	[0.0098]	[0.010]
Firm fixed effects	N	Y	Y
Observations	35,092	35,092	35,092
R-squared	0.294	0.811	0.811

Note: The dependent variable is firm's leverage. Sensitivity to Uncertainty is constructed in Section 3.3. Column1 includes country-2-digit-sector fixed effects. Standard errors in brackets. Standard errors are clustered at the country-year-sector level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5. First Stage Estimation of FX Reserves/GDP

	(1)	(2)
Predicted commodity exports*Surrender requirement	0.47***	0.45***
	[0.16]	[0.16]
Real interest rate		0.00035
		[0.00071]
GDP growth rate		-0.0067
		[0.027]
Foreign liabilities/GDP		0.0082
		[0.026]
year = 2001	0.010	0.011
	[0.011]	[0.011]
year = 2002	0.021*	0.022*
	[0.011]	[0.011]
year = 2003	0.039***	0.040***
	[0.011]	[0.011]
year = 2004	0.047***	0.048***
	[0.011]	[0.012]
year = 2005	0.040***	0.042***
	[0.011]	[0.012]
year = 2006	0.049***	0.052***
	[0.011]	[0.012]
Country fixed effects	Y	Y
Observations	161	161
R-squared	0.964	0.964

Note: The dependent variable is country's FX reserves over GDP. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. The Impact of FX Reserves on Leverage
--Second Stage Estimation

	(1) OLS	(2) OLS	(3) IV	(4) IV
FX Reserves/GDP	0.13***	0.12***		
	[0.042]	[0.041]		
FX Reserves/GDP* Sensitivity to uncertainty		0.14***		
		[0.034]		
FX Reserves/GDP (IV)			0.53**	0.51**
			[0.22]	[0.22]
FX Reserves/GDP (IV)* Sensitivity to uncertainty				0.35***
				[0.13]
Growth opportunity	0.00038	0.00029	-0.00035	-0.00040
	[0.0026]	[0.0026]	[0.0026]	[0.0026]
Firm size	0.043***	0.043***	0.043***	0.043***
	[0.0040]	[0.0040]	[0.0040]	[0.0040]
Profit	-0.20***	-0.20***	-0.21***	-0.20***
	[0.018]	[0.018]	[0.018]	[0.018]
Tangibility	0.21***	0.21***	0.21***	0.21***
	[0.015]	[0.015]	[0.015]	[0.015]
Real interest rate	0.00068	0.00067	0.00033	0.00033
	[0.00091]	[0.00091]	[0.00091]	[0.00090]
GDP growth rate	0.026	0.025	0.021	0.020
	[0.026]	[0.026]	[0.027]	[0.027]
Foreign Liabilities/GDP	0.018	0.017	0.030**	0.029**
	[0.015]	[0.016]	[0.015]	[0.015]
Year fixed effects	Y	Y	Y	Y
Firm fixed effects	Y	Y	Y	Y
Observations	17,681	17,681	17,681	17,681
R-squared	0.791	0.791	0.791	0.791

Note: The dependent variable is firm's leverage. Sensitivity to Uncertainty is constructed in Section 3.3. Standard errors in brackets. Standard errors are clustered at the country-year-sector level. *** p<0.01, ** p<0.05, * p<0.1.

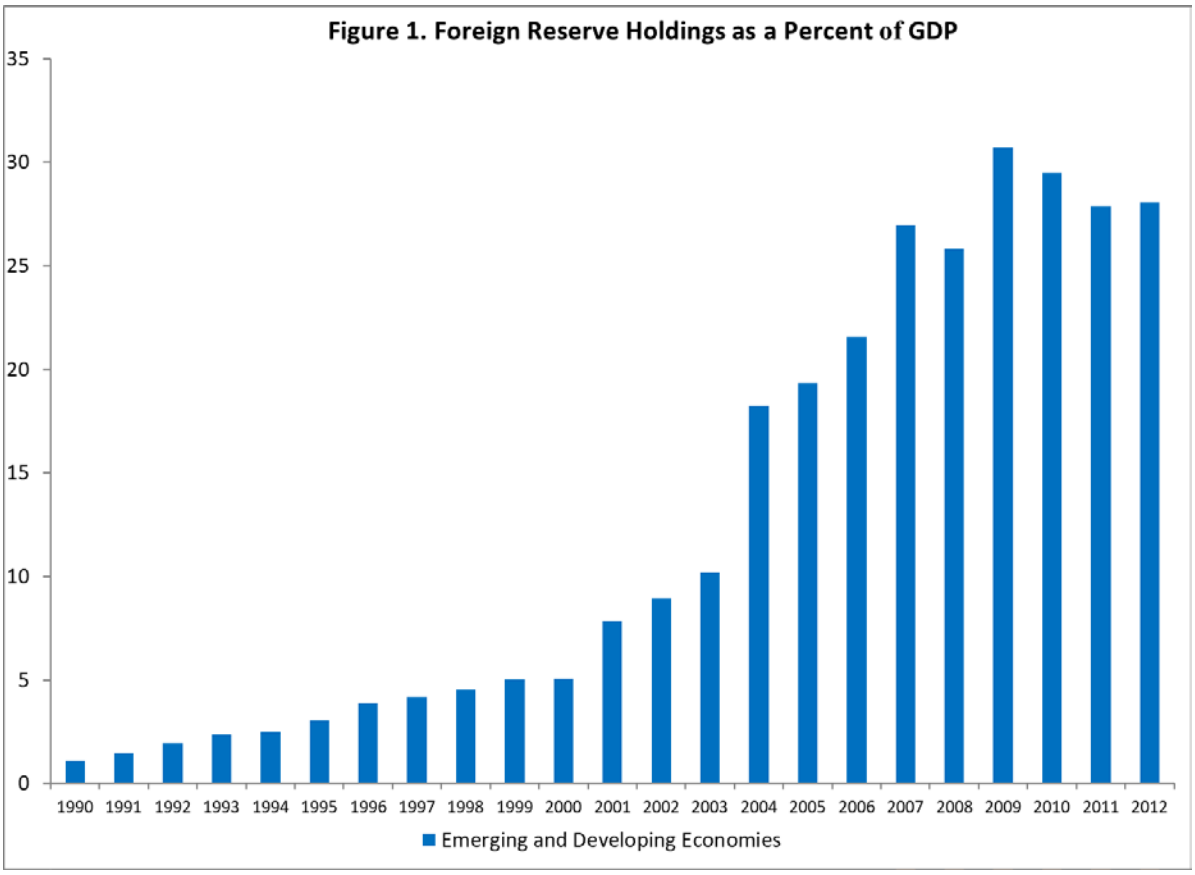


Figure 1. Foreign Reserve Holdings as a Percent of GDP
35
30
25
20
15
10
5
0
1990 1991 1992 1993 1994 1995 1996 1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012
Emerging and Developing Economies

Figure 2: Average Leverage (over Firms in a Country-Year) against Reserves/GDP, Conditional on Country and Year Fixed Effects

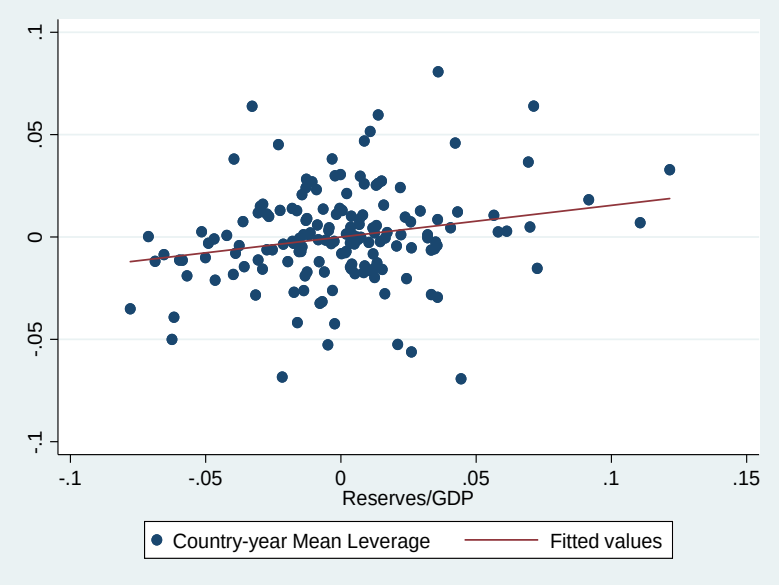
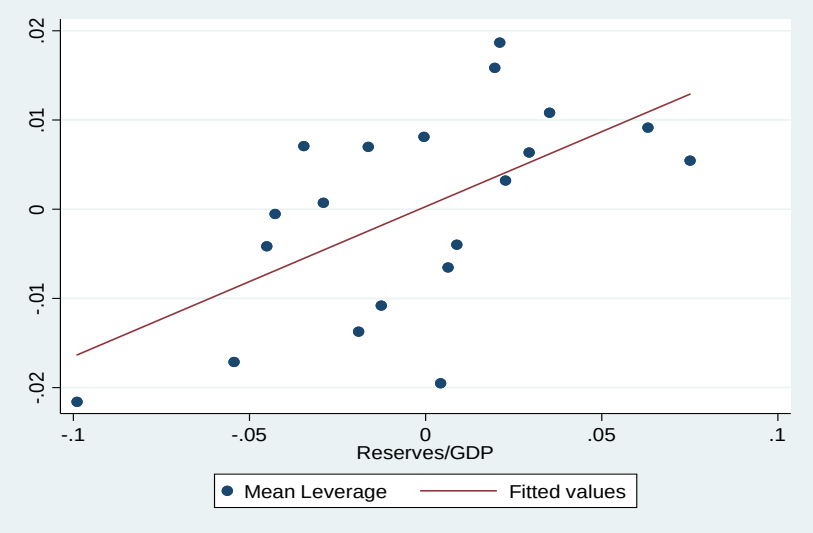
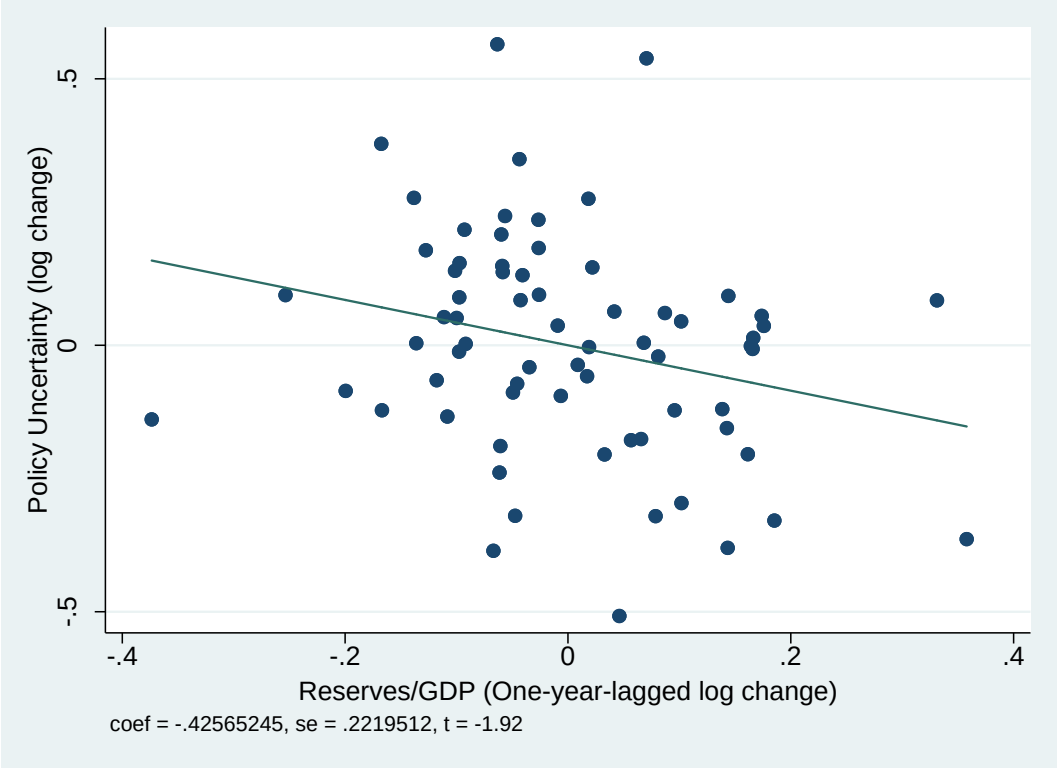


Figure 3: Average Leverage (for a Given Reserves/GDP Ratio) against Reserves/GDP, Conditional on Country and Year Fixed Effects



(Note: All observations, after taken out of country and year means, are first put into 20 equal-sized bins based on the value of Reserves/GDP ratio. The average value of all leverage ratios in a bin is then plotted against the lower bound of the Reserves/GDP bin.)

Figure 4. Log Change of Policy Uncertainty Against Log Change of Foreign Reserves



(Note: The x-axis is the one-year lagged log change of foreign reserves over GDP conditional on country and year fixed effects. The y-axis is the log change of the annual Policy Uncertainty Index conditional on country and year fixed effects. The sample covers Chile, China, Colombia, India, Korea, Mexico, Russia, and Singapore from years 1999 to 2007.)