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LESSONS UNLEARNED? CORPORATE DEBT IN EMERGING MARKETS

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ABSTRACT

This paper documents a set of new stylized facts about leverage and financial fragility for emerging market firms following the Global Financial Crisis (GFC). Corporate debt vulnerability indicators during the Asian Financial Crisis (AFC) attributed to corporate financial roots provide a benchmark for comparison. Firm-level data show that post-GFC, emerging market corporate balance sheet indicators have not deteriorated to AFC crisis-country levels. However, more countries are close to or in the "vulnerable" range of Altman's Z-score, and average leverage for the entire emerging market sample is higher in the post-GFC period than during the AFC. Regression estimates suggest that the relationship between leverage, exchange rate depreciations, and corporate financial distress is time varying. Also, a central finding is that firm size is correlated with corporate distress and, further, that currency depreciations amplify the impact of leverage on financial vulnerability for large firms during a crisis. Consistent with Gabaix (2011) the paper finds a granularity effect in that large firms are systemically important—idiosyncratic shocks to the sales growth of large firms significantly correlate with GDP growth in our emerging markets sample. Relatedly, the sales growth of large firms with higher leverage is more adversely impacted by exchange rate shocks. While this result holds for the average country in our sample, there is substantial cross-country heterogeneity.

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1. Introduction

There was a rapid credit expansion in emerging-market countries in the aftermath of the Global Financial Crisis (GFC). A surge in foreign borrowing and deterioration in net external debt positions accompanied the increase in domestic credit (BIS, 2014; IMF, 2015). The non-financial corporate sector accounts for the lion's share of this surge in leverage, which also accounts for large increases in international bond issuance (BIS, 2016). The total domestic and international debt of emerging market-based non-financial firms rose from $2.4 trillion to $3.7 trillion, and outstanding international bonds grew from $360 billion to $1.1 trillion between 2007 and 2015 (BIS, 2016).

The impact of monetary policy reversals in advanced economies on emerging-market sovereign debt premia, in conjunction with low corporate profitability and market valuations, have the potential to cause severe liquidity problems for emerging market firms.[1] Nearly $1 trillion flowed out of emerging markets in the first three-quarters of 2015, eclipsing the outflows during the GFC.[2] Understanding potential vulnerabilities require knowing more about the state of emerging market corporate balance sheets and their potential impact on the macroeconomy. Our paper fills this gap.

In this paper, we show that the relationships between leverage, exchange rate depreciations, and corporate financial distress are time varying—this result is new. In particular, controlling for firm characteristics, the relationship between (i) leverage and distress scores and (ii) leverage, currency depreciation and distress scores varies across the crisis and tranquil periods in our sample. A key finding is that firm size plays a critical role in the relationship between these three variables. Specifically, there is an inverse correlation between firm size and corporate distress scores and, further, currency depreciations amplify the impact of leverage on financial vulnerability for large firms during a crisis. Therefore we go on to investigate the role

[1] The growth in corporate profits has slowed considerably and the return on invested capital in emerging-market firms has significantly declined since the financial crisis. As evidence, emerging markets usually trade at a lower valuation than their advanced-economy counterparts, and while these relative valuations increased in the aftermath of the GFC, emerging markets are trading at a discount again.

[2] A number of direct and indirect channels can transmit shocks to highly leveraged non-financial corporates to the domestic economy. For example, a deterioration of credit quality of corporate borrowers or a sudden withdrawal of funds from the domestic financial system by firms that are unable to roll-over their international obligations can impair the domestic banking system (Acharya et. al., 2015).

of large firms and the amplification of macroeconomic vulnerabilities in emerging markets. To the best of our knowledge, this is the first paper to document these facts and implications.

The analysis proceeds in the following steps. First, we examine differences in leverage and other indicators of corporate vulnerability immediately prior and during the Asian Financial Crisis (AFC), the intervening tranquil period and the post-GFC period. Then, we present a formal regression analysis that highlights the importance of the interaction between leverage and exchange rate movements on corporate distress scores in the different sub-periods. This interaction provides indirect evidence for the relative importance of foreign currency debt in different periods, a variable that is not observable in balance sheet data. The regression analysis also brings to light the importance of firm size as it shows that, all else equal, it is the larger firms that are more vulnerable.

Next, we explore the role of large firms and their importance for the overall economic performance in emerging markets. We believe that this is the first paper to formally test the role of Gabaix (2011) and others' granularity idea using emerging market data. We find that while large firms are less leveraged than small firms, they may have a more risky type of leverage as large firms corporate distress scores deteriorate more significantly in response to exchange rate depreciations. In conjunction with the contributions that large firms make to the overall economic performance in emerging markets, the leverage vulnerabilities of these firms may, therefore, warrant particular attention from policy makers.

Note again that there is considerable concern about the recent increase in dollar borrowing by emerging market firms (BIS, 2015, Avdjiev et al., 2014, and Acharya et al., 2015). Our paper is the first to provide evidence of the macroeconomic consequences of the links between leverage, currency movements, and firm size. Given that disaggregate data on the liability composition (currency, maturity, type of lender) of non-financial firms are not available, our tests are a valuable and novel contribution to the literature. The details of the analysis follow below.

To reiterate, the first objective of this paper is to document a set of stylized facts about leverage and financial fragility in the non-financial corporate sector in emerging markets. We use detailed firm-level data to document stylized facts about the evolution of corporate leverage and its relationship to financial fragility in emerging markets over the last twenty years. With this data in hand, we compare corporate debt immediately before and during the Asian Financial

Crisis (AFC) with corporate debt in emerging markets in the aftermath of the GFC. The AFC serves as the benchmark that allows us to answer the following question: How do corporate debt vulnerability indicators in emerging markets today compare with these indicators on the eve of the AFC?[3] In particular, how is corporate financial fragility related to leverage and other pertinent firm characteristics? While research on the state of corporate balance sheets in emerging markets shows that leverage and foreign currency exposure of emerging-market-based corporates have increased, a lack of relevant benchmarks prevents prior studies from assessing the magnitude of the risks brought about by these trends (IMF 2015).

The second objective of our paper is to provide such a benchmark by comparing the current situation with the evolution of corporate balance sheets during the AFC. Why the AFC? Historically, emerging market crises arose from sovereign debt problems, and twin banking and currency crises (Reinhart and Rogoff, 2009). However, the underlying microeconomic roots attributed to the AFC include corporate debt vulnerabilities (Pomerleano,1998; Corsetti et al. 1999) as well as implicit guarantees and moral hazard (Krugman 1998, Craig, et al. 2003). The crisis was accompanied by widespread corporate failures due to adverse balance sheet effects via currency and maturity mismatches at the firm level. Corporate debt levels associated with the AFC, therefore, serve as a natural benchmark to assess corporate sector vulnerabilities in emerging markets today.

Third, we ask whether leverage poses a risk to the health of emerging market firms. To test this, we regress corporate fragility on leverage and other firm characteristics and macroeconomic control variables, focusing on different periods, sectors, and exchange rate regimes.

Fourth, as noted by Gabaix (2011), the largest firms dominate economic activity across many countries and shocks to the largest firms can affect total output as these shocks do not get diversified in the aggregate data.[4,5] The role of large firms is particularly critical in many emerging markets.

[3] Chari and Henry (2015) use this methodological approach to compare and contrast the fiscal policy response and its impact on the recovery of GDP growth in the aftermath of the AFC to examine Europe's pivot from stimulus to austerity and it's impact on European growth in the aftermath of its crisis.
[4] See also Acemoglu et al. (2016) and Acemoglu et al. (2017).
[5] Note that weak bank balance sheets and non-performing loans leading up to the AFC were arguably associated with corporate sector weaknesses (see Corsetti et al., 1999).

The final objective of the paper is to carefully examine whether the most levered and financially fragile firms are also the most systemically important. In particular, implicitly the vulnerabilities of systemically large firms are intimately linked to bailout guarantees and moral hazard issues in emerging market lending where widespread corporate debt vulnerabilities can turn into full-blown financial crises.

We compile extensive firm-level data between 1992 and 2014 from Worldscope and Osiris for 26 countries classified as emerging markets by the Bank of International Settlements (Argentina, Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, Slovakia, Slovenia, South Africa, South Korea, Taiwan, Thailand, Turkey, and Vietnam). We exclude financial firms from our analysis. The firm-level data provide different indicators from the balance sheets and income statements to analyze cash flows, leverage, liquidity, solvency, and profitability ratios—the returns on equity and invested capital.

To document the stylized facts, we split the sample into two subperiods: AFC (1996-1998) and post-GFC (2008-2014). We compare the post-GFC indicators to two benchmarks: (i) a within-country comparison relative to 1996-1998 values for a given indicator; and (ii) a crisis-country comparison to the 1996-1998 average of the five Asian countries involved in the AFC (Asian Crisis Five).[6,7] We find that the within-country cross-time benchmark and the Asian Crisis Five benchmark yield varying cross-country patterns of results.

In particular, the data reveal the following stylized facts. First, over half of the emerging markets in our sample display increased leverage in the post-GFC period. However, no emerging market country has leverage ratios that exceed the average of the Asian Crisis Five on the eve and during the Asian Financial crisis. Second, half our sample countries have higher short-term liquidity needs measured by current to total liabilities compared to the Asian Crisis Five. Third, about 91% of countries in the sample have stronger solvency positions, measured by coverage ratios, in the post-GFC period than the Asian Crisis Five during the AFC.[8] Fourth, a measure of corporate financial fragility (Altman's (2005) emerging-market Z-score) shows that post-GFC, a

[6] Indonesia, Malaysia, Philippines, South Korea and Thailand.
[7] In robustness analyses, we also exclude, obtaining similar results, the period 1999-2002 to avoid contaminating our tests with emerging market crises which were associated with sovereign debt episodes as the Russian, Brazilian, and Argentine crises of the late 1990s early 2000s were not clearly attributable to corporate leverage, (see Reinhart and Rogoff, 2009).
[8] This could be a result of higher liabilities, lower profitability or a combination of the two.

larger number of countries are in or close to the grey or "vulnerable zone" than in the AFC period. However, while South Korea was in the distress zone during the AFC, there are no countries in the distress zone in the post-GFC period. In summary, our data show that post-GFC, emerging market corporate balance sheet indicators have not deteriorated to AFC crisis-country levels. However, more countries are close to or in the "vulnerable" range of Altman's Z-score (in the "grey zone" or barely above the threshold) and average leverage for the entire emerging market sample is higher in the post-GFC sub period than during the AFC.

Next, we formally analyze the relationship between leverage and corporate financial fragility at the firm level controlling for a variety of firm, sector, and country-level (macroeconomic) factors. Regression estimates confirm that during the AFC and in the aftermath of the GFC, there is a negative and statistically significant correlation between leverage and firm financial fragility. In other words, firms with higher leverage have Z-scores that are closer to the financial distress range. The data also show that currency depreciation amplifies the negative impact of leverage Z-scores during the Asian Financial Crisis.

To examine whether the leverage and corporate financial fragility patterns can portend adverse macroeconomic consequences, we examine the role of large firms in the macroeconomy. Consistent with Gabaix (2011) we find that large firms are systemically important—idiosyncratic shocks to large firms significantly correlate with GDP growth in our sample of emerging markets. We also find that while large firms are, on average, less leveraged than smaller firms, the more-levered large firms are more vulnerable to exchange rate shocks than smaller firms with comparable levels of leverage. While this result holds for the average country in our sample, we also find that there is substantial cross-country heterogeneity.

Our paper is related to several strands of literature. First, the paper contributes to the literature on the recent evolution of corporate debt in the aftermath of the GFC. IMF (2015) documents the main trends and shows that global factors drive the increase in corporate leverage following the GFC. This finding is in line with Shin's (2013) view that the response to the crisis led to a sudden increase in global liquidity. Acharya et al. (2015) present several case studies and evaluate vulnerabilities and potential policy responses.

The paper is also related to the literature on the origins of the AFC. Several papers suggest that weak fundamentals and excessive risk-taking by corporates caused the crisis. The "crony capitalism" view suggests that the increase in corporate leverage was due to moral hazard

attributed to weak banking supervision and implicit guarantees for well-connected borrowers (Corsetti et al., 1998, Claessens and Glaessner, 1997, Krugman, 1998, Johnson et al., 2000; Burnside et al., 2001, 2003).[9] Pomerleano (1998) uses firm-level data and finds that excessive leverage and poor financial performance in the corporate sector caused the AFC.[10] More generally, this paper relates to the literature documenting the association between rapid credit growth and the building of corporate leverage and financial crises (Mendoza and Terrones 2008, and Schularick and Taylor, 2012).

The paper proceeds as follows. Section 2 presents trends in broad macro-indicators to motivate the analysis. Section 3 describes the firm-level data. Section 4 uses the AFC as a benchmark to detail stylized facts about leverage and corporate financial fragility, and Section 5 presents formal firm-level regression results. Section 6 analyzes the interplay between emerging-market corporate fragility and the macroeconomy. Section 7 concludes.

2. The Post-GFC Rise in Emerging Market Borrowing

In the aftermath of the GFC, advanced economies were characterized by increases in government borrowing and household and corporate deleveraging.[11] Emerging markets stand in stark contrast. Over 2001-2007 average credit to the non-financial sector in emerging market countries remained close to 120% of GDP. The GFC caused a sudden reduction in credit, which went from 122% of GDP in 2007 to 109% in 2008. Credit started expanding rapidly in 2009 and reached 175% of GDP in 2015, a 67-percentage point increase with respect to the 2008 trough

[9] An alternative view as in Furman and Stiglitz (1998), Radelet and Sachs (1998), and Stiglitz and Bhattacharya (2000) maintains that there was nothing particularly wrong with the pre-crisis fundamentals of most East Asian economies.

[10] Ghosh et al. (2002) also show that in 1995–96 several East Asian countries had debt ratios and share of short-term debt which were significantly higher than debt ratios and short-term debt shares in OECD countries. Claessens et al. (2000) suggest that corporate financial risk factors may have been an amplifying factor in the crisis.

[11] Low global interest rates notwithstanding, the higher leverage led to a rapid increase in the debt service ratios of emerging market borrowers. In a period when the average debt service ratio of Advanced Economies decreased from 21 to 18 percent, the average debt service ratio of emerging markets increased from 10 to 12.5 percent. In a subset of emerging economies characterized by rapid credit expansion, debt service ratios surpassed the advanced economy average (BIS credit statistics).

(Figure 1). Borrowing by non-financial corporations was a key driver of this surge in leverage—corporate debt went from 57% to 101% of GDP over 2008-15.[12]

There is, however, substantial heterogeneity across emerging market countries (Figure 2). By the end of 2015 total domestic credit to the non-financial sector was above 200 percent of GDP in China and South Korea and below 100 percent of GDP in Argentina, Indonesia, Mexico, and Russia. Borrowing by non-financial corporations is important in China, Korea, Hungary, Czech Republic, and Turkey.[13] According to BIS data, in the case of China the total credit-to-GDP ratio for the non-financial sector went from 150% in 2008 to nearly 250% in 2015, with borrowing by non-financial corporations increasing from 100% to 166% of GDP. If we exclude China from our sample of emerging market countries we find a more moderate credit expansion (solid line in Figure 1).

Non-financial corporations also played a key role in international bond issuances.[14] Over 2008-2015, outstanding international bonds issued by non-financial corporations grew from $360 billion (approximately 30% of total outstanding bonds) to $1.1 trillion (more than 40% of total outstanding bonds). Issuances by non-financial corporations were particularly important in Asia and Latin America, where they now represent nearly 50% of total outstanding bonds. In addition, by 2015, total claims of BIS reporting banks on emerging markets and outstanding international securities issued by emerging market nationals surpassed $5.8 trillion, representing an 80% increase over emerging-market liabilities in 2007. The largest increases, both in percentage and absolute terms, were in Emerging Asia and Latin America (148% and 93%, respectively).[15] The increase in leverage was particularly important in non-tradable cyclical sectors such as construction.

The figures for Asia and, to some extent, Latin America are however driven by two important outliers. As mentioned, liabilities by Chinese nationals increased by 500 percent and, if we remove China from the Asian total, we find a more modest increase in foreign liabilities (a 58% increase compared to 148%). In the case of Latin America, instead, removing Brazil from

[12] Over the same period, household debt increased by 12 percentage points and government debt increased by 9 percentage points.
[13] While borrowing by households is important in Malaysia and Thailand, public sector borrowing is relatively more important in Brazil, India, Indonesia, South Africa, Mexico, and Argentina. See Alfaro and Kanczuk (2013).
[14] In 2015, borrowing by non-financial corporation accounted for about 25 percent of EM cross-border borrowing from BIS reporting banks.
[15] Alfaro, Chari, and Kanczuk (2017) analyze the effects of Brazilian capital control policies regarding capital inflows.

the total brings down the increase in foreign liabilities from 93% to 76%. Brazil and China account for 48% of the increase in total claims of BIS reporting banks on EMs and outstanding international securities issued by EM nationals, and excluding Brazil and China from the EM total reduces the percentage increase of these liabilities from 80% to 45%.

As the introduction mentions, domestic credit expansion in emerging markets was accompanied by a surge in foreign borrowing.[16] In 2007 foreign currency bonds represented 16 percent of international debt by emerging market-based non-financial corporations and by 2014 the foreign currency share had grown to 22 percent (IMF, 2015).[17] However, the increase in leverage and foreign currency debt documented above took place in an environment of ample global liquidity and record low policy rates in advanced economies. Emerging market-based corporates have therefore borrowed at longer maturities and lower yields.[18] Recent fears are that, as monetary policy conditions in the US normalize, they could trigger a wave of corporate failures in a number of emerging economies.

3. Data

Firm-level data are from Worldscope (gathered through Datastream) and Osiris.[19] Both sources provide detailed historical information for listed and unlisted firms for a wide sample of countries. We compared Worldscope and Osiris' coverage for emerging markets and chose the data source with the most data availability for each country. Osiris had better coverage for China and India, while Worldscope dominated for all other countries. Column 1 in Table A1 shows total sales of firms in our database by country as a percentage of the country's total market capitalization, as computed by the World Bank. We find this a better measure of sample

[16] Total cross-border claims on EMs by BIS reporting banks increased from $2.4 trillion in 2008 to a peak of $3.7 trillion on 2014. Data for 2015 indicates a $200 billion retreat, with total cross-border claims standing just below $3.5 trillion (Table 1).

[17] The share of dollar-denominated bonds issued by non-financial corporations is higher than the overall share of dollar-denominated bonds.

[18] Maturity went from the pre-crisis average of 5 years to more than six years and average yields decreased from 8 to 6 percent (IMF, 2015).

[19] The Worldscope database provides detailed historical financial statement information for the world's leading public and private companies. Osiris, published by Bureau van Dijk, has information as well on listed, and major unlisted/delisted, companies around the world. All data for Tangible fixed assets is also from Osiris. When extracting data from Osiris, we restricted the sample to include sales information.

coverage than Sales/GDP because the large majority of the firms in our database are publicly listed, and the size of the listed market relative to GDP varies significantly by country, as Column 2 shows.

The sample consists of data on non-financial firms from 1992–2014 for the main countries classified as emerging markets by the Bank of International Settlements. These are Argentina, Brazil, Chile, China, Colombia, Czech Republic, Hungary, India, Indonesia, Jordan, Malaysia, Mexico, Morocco, Pakistan, Peru, Philippines, Poland, Russia, Slovakia, Slovenia, South Africa, South Korea, Taiwan, Thailand, Turkey, and Vietnam. Since coverage of Eastern European countries is extremely sparse, we group together firms from Czech Republic, Hungary, Poland, Slovakia, and Slovenia into 'Eastern Europe'.

Overall, the dataset covers primarily larger firms. While a lack of smaller firm coverage tends to pose problems in other settings, a focus on large corporations is to our advantage in this paper. As mentioned in the introduction, large firms have the propensity to contribute more to systemic risk, and thus they are precisely the firms whose financial health is of greatest concern to policy-makers.

Our final sample includes all companies that have data for each indicator of firm performance described below. [20] We exclude outliers and all noticeable errors in the data. The sample varies from a maximum of 8,286 firms with data on return on invested capital totaling (41,888 firm-year observations) to a minimum of 2,986 firms (14,393 observations) with enough data to compute Altman's Emerging Market Z-score. The countries with most firms in the database are China, India, and South Korea, and with the least Eastern Europe.

We use several indicators of corporate financial vulnerabilities and firm performance. For *leverage*, we use as a main indicator the debt to equity ratio (a firm's total debt divided by its common equity), which indicates how much debt a company is using to finance its assets relative to its common equity. As a proxy for *liquidity*, we use the current ratio (current to total liabilities). For *solvency*, we compute the coverage ratio, the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) over total liabilities to measure a company's ability to use their cash flow to pay back its outstanding liabilities.

[20] The number of companies with data for every variable and year of interest is too small to create a balanced sample. Nonetheless, we have performed the analysis maintaining a balanced sample during different periods, obtaining similar results (e.g. to analyze yearly debt/assets ratio for the 2008-2014 period, we select for our sample all companies that have data for each indicator of Total Debt, Total Assets, and Sales for each year in 2008-2014).

For firm performance, we analyze as well the increase in tangible fixed assets as a proxy for *investment.* *Profitability* is captured by the return on equity (ROE) and return on invested capital (ROIC). ROE is defined as the amount of net income returned as a percentage of shareholders' equity, and ROIC is the ratio of operating profit (earnings before interest and tax) to invested capital (sum of shareholders' equity and debt liabilities).

As a summary measure of *corporate fragility*, we calculate the Altman (2005) Emerging Market Z-score. The measure weighs four ratios constructed using the firms' financial statements (working capital to total assets, retained earnings to total assets, operating income to total assets, and book value of equity to total liabilities).[21] The measure is an enhanced version of the standard Z-score model, adjusted to incorporate the characteristics of emerging market firms and best suited to assess the relative vulnerability of the sample of countries we consider in this paper. Lower Z-scores are associated with greater vulnerability and likelihood of bankruptcy. Companies with EM Z-scores greater than 5.85 are considered to be in the "safe zone", scores between 5.85 and 3.75 indicate vulnerability, and scores below 3.75 indicate that the firm is in state of distress. The following table from Altman (2005) compares Z-scores with bond ratings.

Table A. Altman's EM Z-Score and Bond Rating

	Z' Score			Rating	Z' Score			Rating	
Safe Zone	>	8.15		AAA	5.65	-	5.85	BBB-	Grey Zone
	7.60	-	8.15	AA+	5.25	-	5.65	BB+	
	7.30	-	7.60	AA	4.95	-	5.25	BB	
	7.00	-	7.30	AA_	4.75	-	4.95	BB-	
	6.85	-	7.00	A+	4.50	-	4.75	B+	
	6.65	-	6.85	A	4.15	-	4.50	B	
	6.40	-	6.65	A-	3.75	-	4.15	B-	
	6.25	-	6.40	BBB+					
	5.85	-	6.25	BBB	3.20	-	3.75	CCC+	Distress Zone
					2.50	-	3.20	CCC	
					1.75	-	2.50	CCC-	
						<	1.75	D	

[21] EM score =6.56 (X_1) + 3.26 (X_2) + 6.72(X_3) + 1.05(X_4) + 3.25, where X_1= working capital/ total assets, X_2=retained earnings /total assets, X_3=operating income /total assets, X_4=book value of equity /total liabilities. The constant term (derived from the median Z`` score for bankrupt US entities) standardizes the analysis so "that a default equivalent (D) is consistent with a score below zero." The use of book value of equity, not market value, was motivated by a concern that equity markets may be less liquid than in developed markets. Altman (2005) adjusts the measure to consider currency devaluation vulnerability, industry adjustments (relative to U.S.): competitiveness position adjustment (dominant firms in the industry due to size, political influence, etc.); special debt issue figure (collateral or bona fide, high-quality guarantor); sovereign spread (comparison to US corporate bond of the same rating).

To further validate our use of Altman's EM Z-score as a proxy for (the inverse of) corporate financial fragility, we test its ability to predict exit from the sample. We find that firms with low Z-scores are more likely to exit the sample the next period. Specifically, a one standard deviation (corresponding to a 4.7%) decrease in the Z-score is associated with a 2% increase in the probability that the firm will not be in the sample in the following year. This outcome allows us to think of the Z-score as a rough proxy for distance to default.[22]

4. Corporate Fragility in Emerging Markets: Stylized Facts

We begin by comparing corporate financial fragility indicators during the AFC – which was deemed to have corporate financial roots – with the same indicators following the GFC, a period characterized by the rapid build-up in emerging market corporate debt. To do so, we divide the data into two periods: AFC (1996-1998) and post-GFC (2008-2014).[23] We use the indicators described in Section 3 to analyze corporate fragility and profitability using data from the balance sheet, income statements, and cash flows. For different indicators of corporate financial vulnerabilities and firm performance, Table 2 and Figures 3-6 present several stylized facts via weighted mean values using sales (as a proxy for size) as the weights. The weighted means are calculated for all firms in a country by year. The yearly weighted means are then averaged for each of the two sub-periods, also by country. We also analyze simple means and simple and weighted medians. The Asian Crisis Five include Indonesia, Malaysia, Philippines, South Korea and Thailand.

Leverage: Panel A of Table 2 presents the findings for changes in leverage levels (weighted means), measured as the debt to equity ratio for the firms in the sample.[24] It is

[22] Specifically, we run a regression where the dependent variable is an "exit" dummy, which takes a value of one if a firm that was in the sample in year t-1and year t-2 is not in the sample in year t and takes a value of zero if a firm that was in the sample in year t-1 and year t-2 is still in the sample in year t. The explanatory variables are the t-1 value of the Z-score and a set of firm fixed effects. We find that the coefficient is -0.005 with a standard error of 0.0019. We would like to thank an anonymous referee for suggesting to check whether the Z score predicts survival.

[23] We also compared results against an average of the period 1992-1997. The main results and implications are similar.

[24] The debt to equity is a leverage ratio that compares a company's total liabilities to its total shareholder's equity. The measure provides information about the magnitude of the commitments from lenders and creditors to a firm compared to the magnitude of shareholder commitments. The debt to equity ratio therefore provides an alternative lens from which to view a firm's leverage position by comparing total liabilities to shareholders' equity rather than to

important to note that the debt to equity ratio provides a more striking perspective on a firm's leverage position than the debt to assets ratio. For example, South Korea's AFC average debt to asset ratio of 68% for the firms in our sample seems less burdensome than its debt to equity ratio of more than 280%, which implies that debt obligations are more than twice as high as shareholder commitments.

We also documented the patterns for the simple means and medians, as well as the weighted median. Here a point about the relevance of the summary statistic used is worth noting. In general, the weighted median measure attenuates the distributional consequences of observations in the tails of a distribution. In many circumstances, this adjustment is warranted to ensure that outliers do not drive the results. In other words, if a few observations skew the weighted mean, the weighted median that adjusts for non-uniform statistical weights and gives the 50% weighted percentile measure is the more appropriate statistic. However, in the case of leverage and measuring the overall riskiness of corporate debt for the financial system in a country, we would like to assess the upper bound of the risk. If a few large firms are also the ones with the highest leverage, it is desirable to give a larger weight to these observations since arguably these firms have the greatest potential to generate systemic risk—we focus on these large firms in Section 6. We therefore present the main results using the (sales) weighted mean rather than the weighted median while recognizing that the weighted median provides a useful alternative benchmark.

Columns 1 and 2 present the firm level weighted mean leverage by country for our two periods: one year before and during the AFC (1996-98) and post-GFC (2008-14). Column 1 shows that the average debt to equity ratio in the Asian Crisis Five was close to 145% while the average for the full emerging market sample was 80%. Column 3 counts the number of countries with higher average leverage during the post-GFC than during the AFC, revealing that 56% of countries[25] (10 out of 18) have higher average leverage ratios in the post-GFC period. Column 4 tabulates how many countries have higher average leverage during the post-GFC years than the average of the Asian Crisis Five during the AFC. It shows that all countries have lower leverage post-GFC than the Asian Crisis Five did on the eve and in the midst of the crisis. Figure 3 confirms these patterns visually.

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assets. Similar to the debt to assets ratio, a lower percentage means that a company is using less leverage and has a stronger equity position.

[25] Data for Jordan following the Global Financial crises was patchy for leverage.

For purposes of illustration it is interesting to note the patterns we obtain when we use the (sales) weighted median instead of the weighted mean. First, in the AFC period the weighted median leverage ratios for the Asian Crisis Five and full emerging market sample are much lower than the weighted mean, close to 93% and 67%, respectively. Second, 14 out of 19 countries have a higher post-GFC weighted median. Third, three countries have a higher weighted median compared to the Asian Crisis Five.

Liquidity: Panel B of Table 2 provides the (sales) weighted mean of the current to total liabilities ratio by country to analyze the liquidity needs of the firms in our sample.[26] Column 3 suggests that six countries demonstrate a higher current to total liability ratio in the post-GFC sub-period. Column 4 shows that 11 out of the 22 countries have higher short-term liquidity needs compared to the Asian Crisis Five. Figure 4 presents a graphical representation of these patterns.

Solvency: The coverage ratio is a measure of a firm's ability to meet its obligations to lenders. Generally, the higher the coverage ratio, the better the ability of the firm to fulfill its debt obligations. Common coverage ratios include the interest coverage ratio, debt service coverage ratio and the asset coverage ratio. The interest payment and debt service ratio data are very sparse in our sample of emerging market firms. We therefore use a modified version of the coverage ratio – the ratio of EBITDA to total liabilities. By definition, this modified ratio will be biased downward as total liabilities exceed interest expenses or other debt obligations used to calculate more standard versions of the coverage ratio. Nevertheless it provides a useful snapshot of a firm's solvency position.

In Panel C of Table 2, we see that the pre-crisis coverage ratio average of the Asian Crisis Five has increased. The average for the full emerging markets sample on the other hand has remained unchanged. Column 3 shows that half of the countries have coverage ratios that are lower than their AFC levels, but 20 countries have coverage ratios that exceed that of the Asian Crisis Five. Figure 5 visually confirms these patterns.

Profitability: Next we examine the profitability of the firms in our sample (Panel D, Table 2). We use two measures: the return on invested capital (ROIC) and the return on equity

[26] Current liabilities measure a firm's debts and other obligations that are due within one year and include short-term debt, accounts payable, accrued liabilities and other debts. Note that current liabilities provide a more comprehensive measure of a firm's short-term liquidity needs compared to short-term debt since it includes accounts payable and accrued liabilities.

(ROE). A concern with increased leverage is that if it is accompanied by a slowdown in profitability, firms will find it more difficult to service their debt obligations. Unlike equity, debt is a non-contingent claim that needs to be met regardless of the state of firm profits. Firm-level liquidity and solvency ratios therefore feature some measure of earnings relative to debt service obligations to provide a measure of a firm's flexibility with respect to these obligations.

Panel D shows that while the ROIC for the Asian Crisis Five during the AFC was close to 7% the number for the overall emerging markets sample was approximately 10%. In the post-GFC period, the average ROIC across all emerging markets in our sample was similar to the AFC sample period. However, 77% of countries (17 out of 22) had higher profitability post-GFC than the Asian Crisis Five during the AFC. The fact that the Asian crisis five countries had significantly worse profitability during the Asian crisis and the emerging market averages for profitability are the same in the AFC and GFC periods suggests that profitability has fallen between the two periods for the countries not involved in the AFC. This pattern indicates that a broader sample of emerging markets have subpar profitability in the post-GFC period.

Interestingly, consistent with an increase in leverage, the return on equity (ROE) shows a much different pattern (not reported in Table D). Note that increased leverage (debt) increases the expected rate of return on the equity simply because leveraged investments are riskier than unlevered ones. The average ROE went from negative to 13% for the Asian Crisis Five across the two sample periods while the overall emerging market average increased from 9% to 14%. More than half the sample of countries has higher ROE values in the post-GFC period compared to the AFC period. Strikingly, post-GFC, most of the countries have higher ROE values compared to the Asian Crisis Five during the AFC.

Corporate Fragility: As mentioned in section 3, Altman's Emerging Market Z-score can be used as a composite summary statistic for corporate fragility. The measure is composed of various income statement and balance sheet items: the ratios of working capital, retained earnings, and operating income to total assets, as well as the book value of assets to total liabilities. By combining various aspects of firm operations, it paints an overall picture of corporate health. The advantage of the approach, as the data section shows, is that the different ranges of "safe", "grey" and "distress" can be correlated with corporate ratings letter grades used by credit rating agencies. Altman modifies the summary statistics to account for different structural characteristics of emerging market firms; e.g. he replaces the market value of assets to

the book value to adjust for the relative trading illiquidity in emerging markets compared to advanced economies. The Z-score statistics correspond to AAA to BBB for the safe zone, BBB- to B- for the grey zone and CCC+ and below for the distress zone.

Panel E of Table 2 and Figure 6 present the results. Companies with EM Z-scores greater than 5.85 are considered to be in the "safe zone", scores between 5.85 and 3.75 indicate vulnerability, and scores below 3.75 indicate that the firm is in state of distress. Figure 6 shows that among the Asian Crisis Five, South Korea was in the distress zone during the AFC period. Malaysia, Philippines and Thailand were in the grey area, as were China, India, and Pakistan. The only Asian country in the safe zone was Taiwan. In Latin America, while Argentina and Brazil were in the grey zone, Chile, Colombia, Mexico and Peru were in the safe zone. Note also that both Turkey and South Africa were in the safe zone. The average Z-score for the Asian Crisis Five was 5.2 (in the grey zone) and the AFC emerging market average was 6.1 (in the safe zone).

The picture changes in the post-GFC period. Countries with higher Z-scores in the post-GFC period are Colombia, Eastern Europe, Malaysia and Indonesia. South Korea moved from the distress zone into the safe zone. China, India and Turkey are in the grey zone as is Mexico. The picture suggests that the issues of corporate vulnerability apply to a broader set of emerging markets in the post-GFC period given the number of countries in or barely above the grey zone. It is worth pointing out that there are no countries in the distress zone post-GFC. Also, note that some of the countries in the safe zone show a fall in their Z-scores compared to their AFC scores and are now barely over the grey zone threshold. If the Altman Z-score provides a leading indicator of the potential for distress, the data suggest that corporate financial vulnerabilities are more widespread now than during the AFC period.

Summary: Thus far, we have contrasted a range of firm-level indicators related to corporate fragility and profitability prior to and during the AFC of 1998 and the aftermath of the GFC of 2008–2009. We compare the indicators using two benchmarks: (i) a within-country cross-time comparison to the 1996-1998 values for a given indicator; and (ii) a comparison relative to the 1996-1998 average of the Asian Crisis Five.

In the 1996-1998 period, East Asian corporates had greater leverage and financial vulnerabilities than corporates in other emerging markets. While there is substantial cross-country heterogeneity in the post-GFC period, our data suggest that more countries have higher

leverage and are in or close to the "grey zone" post-GFC than in the AFC period, implying a higher risk of financial distress. It is important to note that the analysis of the East Asian crisis is "ex-post" in that we examine the leverage of the Asian countries that were eventually hit by a crisis. The leverage levels in these countries therefore provide a useful "worst case scenario" benchmark against which to assess leverage-related vulnerabilities in the post-GFC period. Note also that while warning lights are flashing regarding these vulnerabilities, thus far no emerging market country is actually in crisis. Therefore, we do not have a single country with leverage akin to the Asian Crisis Five in the red "distress" zone.

The appendix includes a table that helps visualize some of our findings through heat maps for leverage and Altman's Z-score. The maps confirm our prior observations that East Asian corporates had greater leverage and financial fragility than corporates in other emerging markets during the AFC, that the AFC period displays the greatest heterogeneity across countries (both in leverage and Z-score), and that leverage and financial fragility have surged for several countries in the post-GFC period.

5. Corporate Fragility in Emerging Markets: Firm Level Evidence

In the previous section we found that in the post-GFC period more countries are in Altman's grey zone for corporate fragility or barely above the threshold. In this section we delve further into the firm-level data and run regressions to examine the link between corporate financial fragility and leverage as well as the role of firm-characteristics—in particular firm size. We also examine the impact of macroeconomic and institutional factors such as exchange rates, economic growth, and financial globalization interacted with leverage on the corporate distress scores.

As a first step, we examine whether the relationship between leverage and Z-score is different across time periods by estimating the following model:[27]

$$Z_{i,c,t} = \alpha_i + \delta_{c,t} + (\beta_1 D1 + \beta_2 D2 + \beta_3 D3) L_{i,c,t} + \varepsilon_{i,c,t} \qquad (1)$$

[27] In the regressions, the variables are Winsorized at 5%. The results are robust to using 1% Winsorization as well as no Winsorization.

where $Z_{i,c,t}$ is the Z-score for firm *i*, country *c*, year *t*; $L_{i,c,t}$ is leverage for firm *i*, country *c*, year *t*; α_i are firm fixed effects; $\delta_{c,t}$ are country-year fixed effects; D1 is a dummy that takes a value of 1 for years 1996-98 (the AFC period and its run-up); D2 is a dummy for years 2003-2007 (tranquil period); and D3 is a dummy for years 2008-14 (post-GFC period). In the baseline regression, we exclude 1992-1995 from the regressions because we have a small number of firms for this period. We also exclude 1999-2002 to avoid contaminating our tests with emerging market crises associated with sovereign – not corporate – debt episodes (i.e. Russian, Brazilian, and Argentinean crises). However, as a robustness check we include these years and more generally, find that the results remain robust to alternate specifications of the subsamples.

We begin by examining the unconditional correlation between leverage and the Altman's Z-score across the three sub-periods, i.e., with a specification that does not include compositional controls. In other words, we start by estimating specification (1), but without firm and country-year fixed effects. Column 1 of Table 3 examines the impact of leverage on the Altman's Z-score across three sub-periods. $\beta 1$, $\beta 2$, and $\beta 3$ measure the correlation between leverage ant the Z-score in the Asian Financial Crisis (AFC) period, the tranquil period (Tranquil), and the post-Global Financial Crisis (GFC) periods.

Column 1 shows that leverage is negatively correlated with the Z score, i.e., scores for firms with high leverage are closer to the distress range. The effect is statistically significant at the 1% level in all three periods. A potential concern with the econometric specification in Column 1, however, is that the ratio of Book-Value-of-Equity to Total Liabilities, a component of the Altman's Z-score, is by construction negatively correlated with our measure of leverage. Therefore, one might argue that the relationship between leverage and the Z-score is hard-wired and endogenous. This subtle point is worth emphasizing. On the one hand, at first pass it may appear that "leverage is regressed on leverage." However, note that this holds because leverage is part of the Z score, but not an entirely correct interpretation because the specification in Column 1 examines whether the relationship between leverage and the Z-score varies over time and hence is not limited to the automatic correlation between leverage and the Z-score. Although, in Column 1, we find that the coefficients are not statistically significantly different from each other, this pattern changes as we include controls for firm observables such as firm size and compositional controls in later specifications.

Nevertheless, to circumvent this concern, we construct a modified Z-score that does not include the leverage term and only includes the ratios of working capital, retained earnings and operating income to total assets. Higher values of these components drive up the Z-score and are a sign of improving corporate health. Column 2 examines the unconditional correlation between leverage and the modified Altman's Z-score across the three sub-periods. The coefficients on $\beta 1,\ \beta 2,$ and $\beta 3$, are negative and highly statistically significant. The pattern suggests that there is an inverse unconditional correlation between leverage and the modified Altman's Z-score as well. This suggests that firms with higher leverage also have a lower index of working capital, retained earnings and operating income relative to total assets.

In Column 3 we introduce firm observables such as investment and firm size. Size is inversely correlated with the modified Z-score, suggesting that, for a given level of leverage, larger firms are more financially fragile. Real investment is positively correlated with firm financial health. Note that the coefficient on 1 , which measures the impact of leverage on the modified Altman's Z-score during the AFC, loses significance, but the other two coefficients, $\beta 2,$ and $\beta 3$, remain significantly negative. The bottom panel of the table shows that the three coefficients are not significantly different from each other.

The inverse relationship between firm-size and financial health is of interest as the financial vulnerability of large firms is of particular concern to regulators. For example, Chapter 3 of the IMF's World Economic Outlook (October 2015) report explicitly states that it is "important to closely monitor sectors and systemically important firms most exposed to risks and the sectors and large firms closely connected to them, including across the financial system, and to prepare for contingencies."

Since the results in Columns 2 and 3 do not control for time-invariant unobservable heterogeneity at the firm level and time variant unobservable heterogeneity at the country level, we go on to include firm fixed effects, as well as country-year fixed effects to control for compositional effects at the country and year levels. The results, presented in Column 4, suggest that the correlation between leverage and other dimensions of firm resilience captured by the modified Z-score is positive and statistically significant during the tranquil period ($\beta_2 > 0$) and remain negative (albeit not statistically significant) in the other two sub-periods. In other words, once compositional controls are introduced, better firms, i.e., firms with higher working capital, retained earnings and operating income, borrow more during the tranquil sub-period. An

important pattern to also note in this regard is that the coefficients on leverage ($\beta 1$, $\beta 2$, and $\beta 3$), are time-varying and significantly lower during the AFC and post-GFC periods compared to the tranquil period ($\beta_1 - \beta_2 < 0$ and $\beta_3 - \beta_2 < 0$), suggesting that firms with high leverage experienced worsening liquidity, solvency and profitability during the AFC and post-GFC periods.

Column 4 also includes a control for firm size. We find that firm size continues to be negatively correlated with the modified Z score. This implies that, controlling for leverage, larger firms have significantly lower modified Z-scores, i.e., overall lower values of working capital, retained earnings and operating income as fractions of total assets.[28]

Turning to the sector-specific dimension, we use a linear regression with dummy variables to test whether the relationship between leverage and the Z-score differs across sectors. For instance, industries such as energy and mining are traded but exposed to commodity prices. Industries such as construction and utilities tend to be non-traded and therefore particularly exposed to currency risk when they access international capital markets. Currency mismatches associated with excessive foreign currency leverage were one of the root causes of the AFC. However, such mismatches may be less damaging for firms that, by operating in the tradable sector, may have natural hedges through foreign currency revenues.[29]

We observe two patterns. First, in the AFC period the negative correlation between leverage and the modified Z-score is not statistically significant in the tradable sector (Column 5, Table 3), positively correlated with the modified Z-score in the tranquil period and inversely correlated in the post-GFC period, mirroring the patterns observed in Column 4. Second, for the non-tradable sector none of the interacted leverage coefficients are statistically significantly related to the Z-score in any sub-period. Post-GFC, it appears that, conditional on leverage, the tradable sector is more financially vulnerable. Firm size continues to be inversely correlated with the Z-score for both tradable and non-tradable sectors.

[28] We also estimated a specification with a control for the return on assets. The coefficient on firm size remains inversely correlated with the modified Z-score while the return on assets, a measure of profitability, is positively correlated with the modified Z-score.

[29] We start by classifying as non-tradable all firms that have a SIC2 code above 39, but then we also classify as non-tradable firms with SIC2 codes 7 (Agricultural Services), 9 (Fishing, Hunting and Trapping), 15 (Construction - General Contractors & Operative Builders), 16 (Heavy Construction, Except Building Construction, Contractor), 17 (Construction - Special Trade Contractors), 25 (Furniture and Fixtures), 27 (Printing, Publishing and Allied Industries), and 32 (Stone, Clay, Glass, and Concrete Products). This classification yields 5,888 observations in the tradable sector and 4,000 in the non-tradable sector. Our results are robust to using the simpler above 39 and below split.

Next, we examine the impact of the interaction of leverage and three macroeconomic variables - exchange rates, interest rates and GDP growth - on financial fragility. We begin with the exchange rate. This variable stands to play an important role because, in the presence of foreign currency denominated debt, the relationship between leverage and the Z-scores may vary with currency movements. While we do not have data on the currency composition of firm-level debt, the finding that currency movements amplify the correlation between leverage and corporate financial fragility measured by the modified Z-score would be consistent with the presence of currency mismatches. We test this hypothesis by estimating the following equation:

$$Z_{i,c,t} = \alpha_i + \delta_{c,t} + (\beta_1 D1 + \beta_2 D2 + \beta_3 D3) L_{i,c,t} + \\ +(\gamma_1 D1 + \gamma_2 D2 + \gamma_3 D3) L_{i,c,t} \Delta EX_{c,t-1} + \varepsilon_{i,c,t} \quad (2)$$

Here, $\Delta EX_{c,t-1}$ is the percentage change in the nominal exchange rate, where $\Delta EX > 0$ represents a currency depreciation. Table 4 presents the results. Again, we start by estimating the model without including firms and country-year fixed effects. The first column's negative, statistically significant coefficient on γ_1(AFC×ΔEX×Leverage) suggests that, in the AFC period and conditional on a depreciating currency, leverage has a statistically adverse impact on the firm-fragility score. β_1 the unconditional effect of leverage on the modified Z-score during the AFC period is no longer statistically significant once we include the interaction of leverage and exchange rate changes.

At the same time, β_2 and β_3 , the unconditional effects of leverage on the modified Z-score remain negative and statistically significant and γ_3, the effect of leverage conditional on currency changes in the post-GFC period is not statistically significant. This result is consistent with the fact that in the AFC period firms with high leverage also had currency mismatches. However, currency mismatches do not seem to be important in the post-GFC period, possibly due to the lack of severe currency depreciations. Also, note that while Asian currencies experienced significant depreciations during the AFC, the post-GFC period was generally marked by an appreciation of emerging market currencies with the exception of the period after 2013.

Column 2 of Table 4 shows that the interaction effect between leverage and exchange rate change (γ_1) holds when we introduce firm-specific factors like investment in fixed assets

(investment) and firm size (log of total assets). Specifically, the modified Z-score continues to be inversely correlated with firm size, and the effect is statistically significant at the 1% level. Column 3 introduces firm and country-year fixed effects. It is interesting to note that once we include compositional controls, the only two coefficients that are statistically significant (and at the 1% level) are the interaction effect between leverage and exchange rate change (γ_1) and the negative coefficient on firm size.

Finally, we split the sample between firms in the tradable and non-tradable sectors. As before, we do not run separate regressions but interact the coefficients with tradable and non-tradable dummies. Column 4 shows that in the AFC period the differences between firms in the tradable and non-tradable sectors are not apparent. The point estimates on γ_1, i.e., the interaction effect of leverage during the AFC period conditional on changes in exchange rates are virtually identical across the two sectors, albeit the coefficient is more precisely estimated for the non-tradable sectors.[30] Taken together, the findings are consistent with the idea that in the AFC period (and immediately before it) the link between leverage and corporate financial fragility indicates the presence of currency mismatches. Further, while, γ_3, the interaction effect between leverage and exchange rate changes in the post-GFC period, is not statistically significant for either the tradable or the non-tradable sector, β_3, the unconditional relationship between leverage and the modified Z-score continues to be negative and significant in the post-GFC period only for the tradable section. This pattern is similar to that observed in Table 3. Post-GFC leverage vulnerabilities appear significant for the tradable sector independent of exchange rate changes as well. Also note that firm size is inversely related to the modified Z-score at the 1% level of statistical significance in all specifications.

One may argue that our results are driven by the fact that exchange rate movements were different in the two periods. In the period following the immediate aftermath of the post-GFC period when international capital flows began their surge towards emerging markets, many emerging markets experienced appreciating currencies (2010-2012) and/or relatively modest depreciations (2012-2014) in comparison to the massive currency depreciations in the AFC period. To examine whether this may be the case, we distinguish between periods of currency appreciation and depreciation. Specifically, we estimate the following model:

[30] As in Table 3, Columns 4a and 4b are estimated jointly. In robustness analysis (not shown) the results are robust to including the periods excluded from the table (the excluded periods are 1992-95 and 1999-2002).

$$Z_{i,c,t} = \alpha_i + \delta_{c,t} + (\beta_1 D1 + \beta_2 D2 + \beta_3 D3) L_{i,c,t} +$$
$$+(\gamma_1 D1 + \gamma_2 D2 + \beta\gamma_3 D3) L_{i,c,t} \Delta EX_{c,t-1} +$$
$$+A_{c,t-1}(\theta_1 D1 + \theta_2 D2 + \beta\theta_3 D3) L_{i,c,t} \Delta EX_{c,t-1} + \varepsilon_{i,c,t} \quad (3)$$

where $A_{c,t-1}$ is a dummy that takes a value of 1 if $\Delta EX_{c,t-1} < 0$ (i.e., if we observe a currency appreciation). The specification captures the differential effects of depreciations and appreciations interacted with leverage on corporate financial fragility. In this set up γ_i measures the joint effect of leverage and change in the exchange rate on Z-scores conditional on a currency depreciation, and $\gamma_i + \theta_i$ measures the effects conditional on an appreciation. We find γ_1 to be negative and statistically significant whereas $\gamma_i + \theta_i$ yields positive but statistically insignificant values (results unreported but available from the authors). This pattern corroborates the hypothesis that leverage interacted with currency depreciation has a statistically significant adverse impact on Z-scores, our measure of corporate financial fragility in emerging markets.

An important concern is whether survivorship bias drives the observed pattern of results. To address this, in Table 5 we re-estimate the specification in Column 3 of Table 4 with firms that survive or are present in the data for different lengths of time. We limit the sample to firms that are present for at least five years (column 2), for at least ten years (column 3) and for at least fifteen years (column 4). The finding that exchange rate depreciations amplify the negative correlation between leverage and the modified Z-score during the AFC period is robust to restricting the analysis to these subsamples. Interestingly, the correlation rises in magnitude as we proceed from a sample with a fewer number of years in Column 2 to a sample with firms with data for fifteen years in Column 4.

In emerging markets, currency depreciations are often accompanied by economic recessions and tighter financial conditions. The previous results could thus be driven by the fact that highly leveraged firms suffer more during recessions or, in the presence of maturity mismatches, are particularly affected by sudden increases in the interest rate. In Table 6, we take these underlying macro fundamentals into account by further interacting our three period dummies (AFC, tranquil, and GFC) with lagged GDP growth and the deposit rate (we would have preferred a lending rate but faced data constraints).

The main results from the tables 4 and 5 on the adverse impact of leverage conditional on currency depreciations (γ_1) on Z-scores during the AFC period remain unchanged. Column 1 includes lagged real GDP growth as a control and suggests that during the post-GFC period leverage conditional on higher real GDP growth rates is positively but not significantly correlated with Z-scores. It is interesting to point out that in specifications that use the regular Z-score as a dependent variable there is a positive and statistically significant correlation between leverage conditional on real GDP growth in the post-GFC period, suggesting that leverage in growing countries is correlated with less corporate financial vulnerability. Column 2 controls for leverage interacted with lagged values of the interest rate. The coefficient estimates on interest rates interacted with leverage are not statistically significant. Column 3 includes both interaction effects (lagged real GDP growth and lagged interest rates). The interaction effect on lagged real GDP growth continues as positive and that on lagged interest rates remains statistically insignificant. The findings that size is inversely correlated with the modified Z-score while real investment is positively correlated remain robust to the inclusion of these additional macro controls. Note that β_1, the unconditional effect of leverage on the modified Z-score during the AFC period, is positively and significant (Columns 1 and 3) suggesting that controlling for real GDP growth, firms with better prospects were able to borrow more during this period.

Many emerging market countries reacted to the crises of the late 1990s with reforms aimed at improving their institutional and macroeconomic framework. Fourteen of the twenty-five countries included in our sample moved to an inflation-targeting framework between 1997 and 2009. Many countries and also implemented reforms aimed at improving their domestic capital markets (the Asian Bond market Initiative was a specific outcome of the Asian Financial crisis) and promoting financial deepening. In our sample of countries average financial depth went from 50% in 1995 to 72% in 2014. The period we study was also characterized by different phases of financial globalization with an increase of cross-border capital flows over 2002-2007, a collapse over 2007-2009 and a rapid increase in flows to emerging markets after 2010 (Lane and Milesi-Ferretti, 2017).

In Table 7 we test whether our results are driven by these factors by examining the effects of leverage conditional on changes in the exchange rate are robust to the inclusion of an index of financial development, inflation targeting regimes, and the updated Lane and Milesi-Ferretti (2007) index of financial globalization. The adverse impact of leverage conditional on currency

depreciations (γ_1) on Z-scores during the AFC period remains unchanged to the inclusion of these additional controls. It is important to note that the inverse correlation between firm size and the modified Z-score is salient across all specifications.

6. Corporate Fragility in Emerging Markets and the Macroeconomy

A key question is whether the increase in corporate leverage documented above can have large negative macroeconomic consequences when central banks in advanced economies start raising their interest rates (a process already begun by the Federal Reserve). Acharya et al. (2015) suggest this could lead to capital outflows from emerging markets and potential problems associated with the presence of currency mismatches in firm balance sheets.

Note that in all the specifications in Tables 3-7 that included firm size, size was a significant predictor of financial vulnerability. Moreover the coefficient was highly statistically significant. The inverse correlation between firm size and the Altman's Z-score (both the standard and modified versions), suggest that in emerging markets firm size or the extent of granularity in the firm-level data may be a novel and powerful indicator of financial vulnerabilities.

We address this question by studying the behavior of large firms. Specifically, we proceed in two steps. First, we follow Gabaix (2011)[31] and show that idiosyncratic shocks to large firms are significantly correlated with GDP growth in our sample of emerging markets.[32] Second, we test whether large firms are particularly vulnerable to exchange rate movements. We find that large firms are, on average, less leveraged than smaller firms. However, we also find that the more-leveraged large firms are more vulnerable to exchange rate shocks compared to equally-leveraged smaller firms. This evidence is consistent with the idea that large firms make a

[31] Gabaix (2011) shows that idiosyncratic shocks to firms can generate aggregate fluctuations. An intuitive reason is that some firms are very large, and further that initial shocks can be intensified by a variety of generic amplification mechanisms. In the context of exchange rate or other shocks that can adversely impact highly levered firms, an additional concern is that shocks to systemically important firms in emerging markets could have feedback effects for the financial systems in these countries. The financial vulnerability of large firms is inextricably linked to the banking system in particular.

[32] Gabaix (2011) uses data for US listed firms. To the best of our knowledge, we are the first to apply his methodology to emerging market countries and show that the result also holds in this sample of countries.

greater use of foreign currency borrowing and that they are not fully hedged against exchange rate movements. While this result holds for the average country in our sample, we also find that there is substantial cross-country heterogeneity.

6.1 Granularity in emerging market countries

Gabaix (2011) shows that if the distribution of firm size can be approximated with a fat-tailed power law (formally $P(S > x) = ax^{-\xi}$ where S is firm size and $\xi \geq 1$) idiosyncratic firm-level shocks can play a key role in explaining aggregate fluctuations. He builds a "granularity" index that captures idiosyncratic shocks for the largest 100 US firms and shows that this index is closely correlated with overall US GDP growth.

According to Gabaix, granularity effects are likely to be even more important in countries that are less diversified than the United States. He mentions several emerging market countries and suggests that "It would be interesting to transpose the present analysis to those countries" (Gabaix, 2011 p. 737). We take this suggestion seriously and build a granularity index for our sample of 26 emerging market countries.

Gabaix (2011) measures granularity with the following index:

$$\Gamma_t = \sum_{i=1}^{K} \frac{S_{i,t-1}}{Y_{i,t-1}} \left(g_{i,t} - \bar{g}_t \right) \tag{4}$$

where $S_{i,t-1}$ measures sales of firm i, $Y_{i,t-1}$ is GDP, $g_{i,t}$ is the growth rate of firm i (defined as the growth rate of the sales to employees ratio) and $\bar{g}_t$ is the simple average of the growth rate of the largest Q firms in the economy (with $Q \geq K$, and where firm size is measured by sales). Gabaix sets K=100 and experiments with Q=100 and Q=1000. When Q=100, the index is equal to the weighted growth rate of the 100 largest firms minus the (simple) average growth rate of these same firms. When Q=1000, the index is equal to the weighted growth rate of the 100 largest firms minus the (simple) average growth rate of the largest 1000 firms. It should be noted that the weights ($\frac{S_{i,t-1}}{Y_{i,t-1}}$) do not add up to one because the weights are computed for a subset of firms and the numerator is sales and the denominator is GDP.

In order to build a granularity index for our sample of emerging markets we need to address two issues. The first issue relates to data limitations. As mentioned above, Gabaix measures firm growth as the growth rate of the sales-to-employees ratio. Unfortunately, we do not have a good coverage of firms with data on total employment. Therefore, we measure firm growth by focusing on the growth rate of total sales. Our measure is a good approximation of the sales to employees growth rate as long as most of the variance in the ratio used by Gabaix arises from variations in sales rather than in variations of employment.

The second issue relates to the definition of "large" firms in an emerging market context. While it is reasonable to assume that, in a large and diversified economy like the United States, the largest 100 firms are indeed very large, this assumption is problematic in smaller and less diversified emerging market countries.

One possible way to address this issue is to simply use a smaller number of firms for all countries in our sample. In choosing this number however the number of firms needs to be large enough to capture some variability in idiosyncratic shocks and cover a meaningful share of overall GDP. Among the various possible thresholds, the largest number that allows us to include all the countries in our sample is 25.[33]

An alternative strategy is to use a criterion based on the share of total sales over GDP. For instance, we can rank firms in descending order of size and impose a cumulative sales-to-GDP ratio threshold.[34] Formally, let $f_{1,c,t}$ be total sales of the largest firm (by sales) in country c, year, t, $f_{2,c,t}$, the sales of the second largest and $f_{n,c,t}$ the sales of the nth largest firm. Let *x* be a threshold in terms of cumulated sales of over GDP. Then firm are defined as large up to the point where:

$$\sum_{i=1}^{N} \frac{f_{i,c,t}}{GDP_{c,t}} < x \qquad (5)$$

We experimented, with different thresholds and found that most country-years in our sample reach the level of 20% of the cumulative sales-to-GDP ratio. One issue is that in

[33] Note that country heterogeneity poses a challenge. 25 firms are likely to capture a large share of the economy in a relatively small country like Peru, but twill capture a much smaller share of the economy in a larger country like Brazil or China.

[34] As before there are tradeoffs in the choice of the threshold, *x*. If the threshold is too low there will be too few "large" firms and if the threshold is too high there will be many countries in our sample with few listed firms that do not reach a higher threshold.

countries with high degrees of concentration, a very small number of firms are sufficient to breach the threshold.

In the end, we adopt an intermediate strategy: we define as large, the largest firms for whom cumulative sales are below 20 percent of GDP. However, if less than 25 firms are sufficient to reach this threshold, our definition of large is the largest 25 firms. As we do not want to include more firms than what Gabaix includes for the US, we limit the number of large firms to 100. Summing up, we rank firms by sales and we define as large a firm $f_{i,c,t}$ if $i \leq 25$ or $\sum_{i=1}^{N} \frac{f_{i,c,t}}{GDP_{c,t}} < 20$, and $i \leq 100$.[35] Table 8 replicates Gabaix's results and shows that granularity is positively correlated to GDP growth in our sample of emerging market countries.

6.2 Large Firms and Exchange Rate Vulnerabilities

Having established that idiosyncratic shocks to large firms are correlated with GDP growth, we now examine whether leveraged large firms are more vulnerable to currency depreciations. As a first step, we check if there are differences in leverage and other potential measures of fragility between large and smaller firms. Column 1 of Table 9 shows that compared to smaller firms, lower levels of leverage characterize the large firms in the sample. Columns 2-4 show that there are no statistically significant differences in other measures of corporate financial vulnerabilities such as solvency, liquidity, and the Z-score.

While large firms have lower leverage with respect to smaller firms, it is possible that they have an "unhealthier" type of leverage. Specifically, in the presence of fixed costs it is easier for large firms to borrow abroad and foreign borrowing tends to be in foreign currency. There is evidence that large firms issue international bonds not only to finance investment projects but also to engage into carry trade activities (Bruno and Shin, 2016, Caballero, Panizza, and Powell, 2015). Lack of data on the currency composition of firm liabilities prevents us from directly testing if this is the case for our full sample of countries, but there is some evidence that (i) large Brazilian firms are more likely to have foreign currency debt compared to smaller firms (Bonomo et al.2003); (ii) large firms in US use more foreign currency derivatives (Allayannis and Weston, 2001); (iii) large firms in Finland are more likely to borrow in foreign currencies

[35] The results are robust to defining as large the largest 25 firms without taking into consideration the cumulative sales-to-GDP ratio.

than small firms (Keloharju and Niskanen, 2001); and larger firms hold a higher fraction of dollar debt in a set of firms from Argentina, Brazil, Chile, Colombia, and Mexico (Bleakley and Cowan, 2005).

Given that we cannot test directly whether currency mismatches are potentially more problematic for larger firms, we test whether sales growth (associated with GDP growth in the granularity regressions of Table 8) responds more to exchange rate movements in large and leveraged firms than in equally leveraged smaller firms. As a first step we estimate the following model for our full sample of firms:

$$GR_{i,c,t} = LEV_{i,c,t}(\beta + \gamma DXR_{ct}) + \delta LARGE_{i,c,t} + \theta DXR_{ct} + \alpha_i + \varepsilon_{i,ct,t} \qquad (6)$$

where $GR_{i,c,t}$ is sales growth in firm i, country c, year t, $LEV_{i,c,t}$ is leverage, DXR_{ct} is the percentage change in the exchange rate in country c, year t (positive values are depreciations), $LARGE_{i,c,t}$ is a dummy variable that takes a value of one for large firms (defined as above), and α_i are firm fixed effects.

Column 1 of Table 10 shows that currency depreciations and leverage are negatively correlated with sales growth, but that the interaction between leverage and sales growth is not statistically significant. The lack of a significant effect on the interaction between leverage and currency depreciations may be due to the fact that for the average firm in our sample the negative effect of depreciation is not linked to the presence of negative balance sheet effects brought about by the presence of foreign currency debt. Alternatively, the lack of statistical significance may be due to the fact that firms that have currency mismatches are less leveraged on average. As we saw earlier, large firms are less leveraged and may have larger shares of foreign currency debt. When we augment the model with country-year fixed effects (a specification that does not allow us to separately estimate the effect of the exchange rate change, DXR), we find results that are essentially identical to those of the model without country-year fixed effects (compare the first two columns of Table 10).

Next, we estimate our model with country-year fixed effects separately for large and small firms. Columns 3 and 4 of Table 10 show that leverage and the interaction between leverage and exchange rate movements are statistically significant for large firms and are not statistically significant for smaller firms. There are also large differences in the coefficients. The

leverage coefficient is three times larger in the large firms subsample and the interaction between leverage and DXR is ten times larger in the large firms subsample. The point estimates imply that in large firms, a 30% depreciation of the exchange rate (DXR=0.3) yields correlations between leverage and sales growth ranging from -0.045 to -0.195.

In column 3 of Table 10, we find that the interactive coefficient takes a value of -0.5. This means that, all else equal, a 30% depreciation (the average in our sample) reduces sales for the large firm with average leverage (the average for large firms is 65% in our sample) by approximately (10% 65*0.3*0.5=9.75%). Assume that these large firms have sales that amount to 50% of GDP. The granularity regressions of Table 8 (column 1) say that if there is a 1% shock to sales of the largest firms with total sales accounting for 50% of GDP, GDP growth will decrease by 0.35 percentage points (0.698/2). These back-of-the-envelope calculations imply that the GDP growth effects of a 30% depreciation will be a decrease in growth of 3.5 percentage points.

In column 4, we pool all our observations but allow for the differential effect of firm size by estimating the following model:

$$GR_{i,c,t} = LEV_{i,c,t}\left(\beta + \gamma DXR_{ct} + \phi LARGE_{i,c,t} + \psi LARGE_{i,c,t}\times DXR_{ct}\right) + \\ +\delta LARGE_{i,c,t}(\delta + \lambda DXR_{ct}) + \alpha_i + \chi_{c,t} + \varepsilon_{i,ct,t} \quad (7)$$

Where $\chi_{c,t}$ is a country-year fixed effect and all other variables are defined as above. In this case our parameter of interest is ψ, which captures how firm size affects the impact on sales of the interaction between depreciation and leverage. The results are in Column 5 of Table 10. We find that ψ is negative, large in absolute value, and statistically significant. This confirms that the interaction between leverage and currency depreciations in absolute value is significantly larger for large firms. We also find that λ is negative and statistically significant, suggesting that large firms are negatively impacted by currency depreciations even in the absence of leverage.

Given that our panel is highly unbalanced with some countries in the sample with more than 400 listed firms while others with only 20 listed firms, we re-estimate our model by keeping a maximum of 150 firms per country-year. The results remain near identical to what we obtain for the full sample of firms (compare columns 5 and 6 of Table 10).

Our findings are consistent with the hypothesis that many large firms may have unhedged foreign currency liabilities and are thus vulnerable to sudden currency depreciations. Given our previous evidence that idiosyncratic shocks to large firms affect overall economic activity, one is tempted to conclude that a sudden capital flows reversal could lead to very adverse effects on real output in emerging markets.[36]

Such a pessimistic conclusion is however mitigated by the fact that, while the results of Table 10 are valid for the average emerging market country, there is substantial heterogeneity among the countries included in our sample. Figure 7 reports the point estimates of the parameter ψ obtained by estimating Equation 7 (without the country-year fixed effects) separately for 16 countries in our sample.[37] The point estimates range between -1 (Pakistan) and 2.5 (Russia). They are negative for 10 countries (statistically significant for 5 countries) and positive for 6 countries (statistically significant for one country). Thus, there is substantial cross-country heterogeneity and one challenge for future research will be to identify the drivers of this heterogeneity.

7. Conclusion

This paper addresses widespread concerns about and potential macroeconomic repercussions of the rapid increase in corporate leverage in emerging markets following the GFC. Stylized facts using firm-level data show that post-GFC, emerging market corporate balance sheet indicators have not deteriorated to AFC crisis-country levels. However, more countries are close to or in the "vulnerable" range of Altman's Z-score (in the "grey zone" or barely above the threshold) and average leverage for the entire emerging market sample is higher in the post-GFC sub period than during the AFC. Significantly, we find that the relationships between leverage, exchange rate depreciations, and corporate financial distress scores are time varying. Also, a central finding is that firm size is inversely correlated with corporate distress scores and, further,

[36] Please note that all the results are robust to interacting leverage and firm size with financial debt and a measure of financial globalization.

[37] For the remaining countries in our sample, there was not enough information in the data to estimate country-specific coefficients.

that currency depreciations amplify the impact of leverage on financial vulnerability for large firms during a crisis.

Therefore the question arises whether the corporate financial health of large firms is more important for the macroeconomy than others. Following Gabaix (2011), we find that at a granular level, the sales growth of large firms is a systemically important driver of economic growth. Large firms, therefore, have the potential to transmit corporate distress to other firms in emerging markets via network effects and other spillovers, warranting special attention from policymakers. Although large firms in our sample consistently have less leverage, the sales growth of these firms is more adversely impacted by exchange rate depreciations compared to similarly levered smaller firms, albeit with substantial cross-country heterogeneity in the observed impacts.

The AFC had corporate financial roots. In particular, increased leverage on firm balance sheets in conjunction with foreign exchange denominated debt made firms vulnerable to the currency devaluations that accompanied the crisis. Currency and maturity mismatches led to widespread firm failures, while implicit bailout guarantees created moral hazard issues related to the increased leverage. Credit to emerging market firms has witnessed an unprecedented and rapid growth since the GFC. Given the systemic importance of large and highly levered firms, our results suggest that policymakers closely monitor this subset of emerging market firms.

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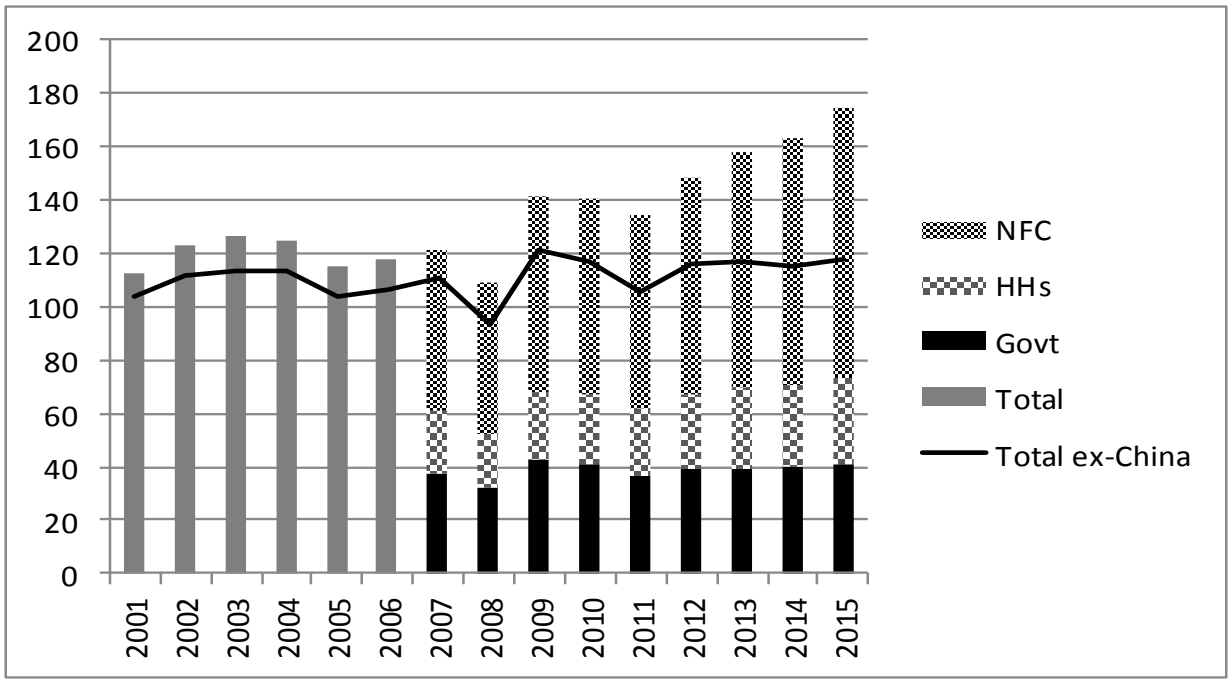
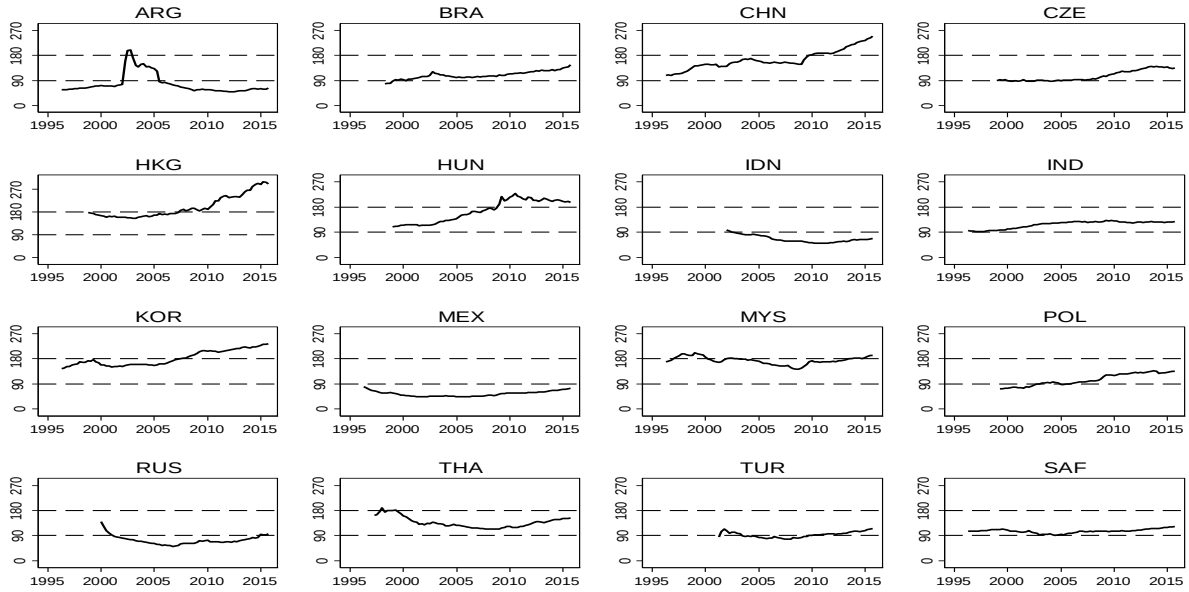
Figure 1: Total Credit to the Non-Financial Sector in Emerging Markets (% of GDP)



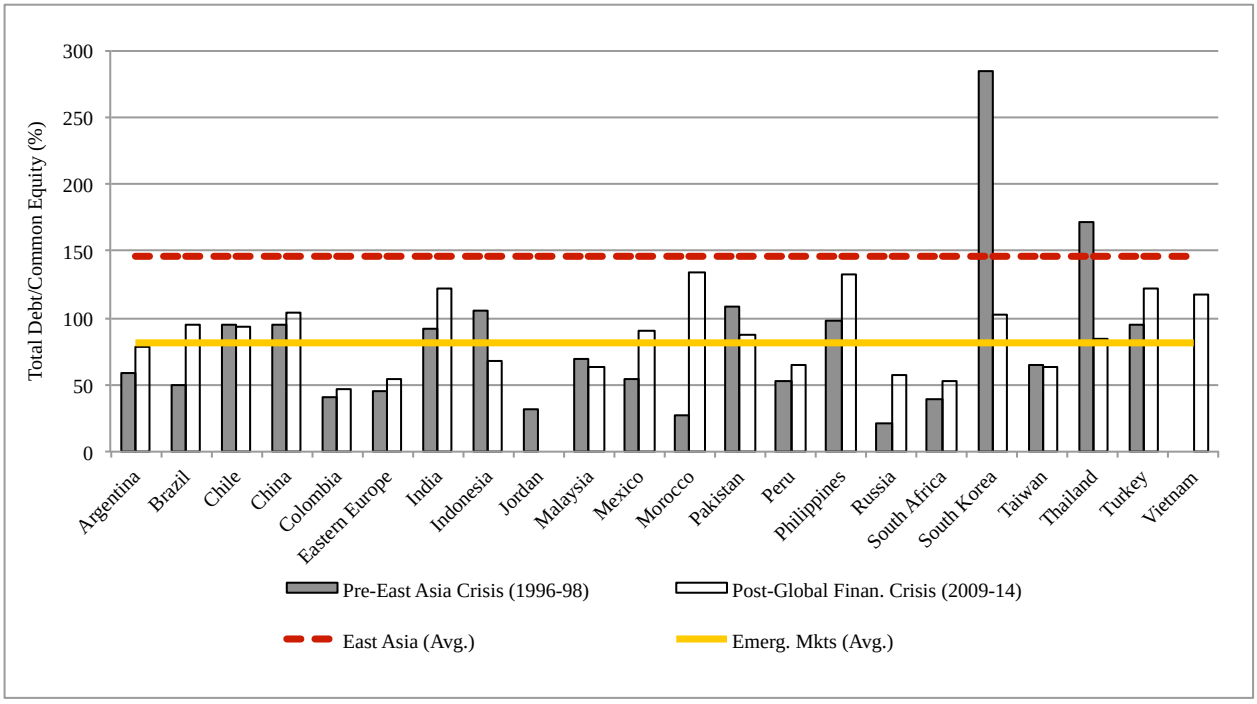
Source: authors calculations based on BIS total credit statistics. (Decomposition across sectors is only available after 2006)

Figure 2: Total Credit to the Non-Financial Sector in Emerging Markets (% of GDP)



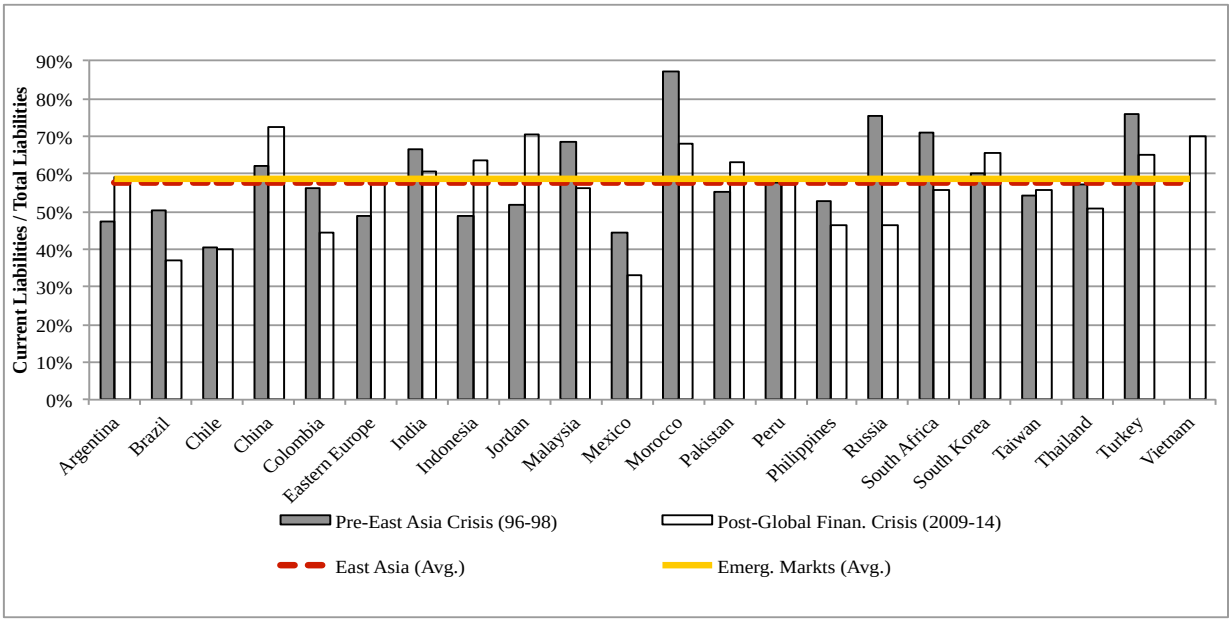
Source: authors calculations based on BIS total credit statistics

Figure 3: Leverage – Debt to Equity (Weighted Mean)



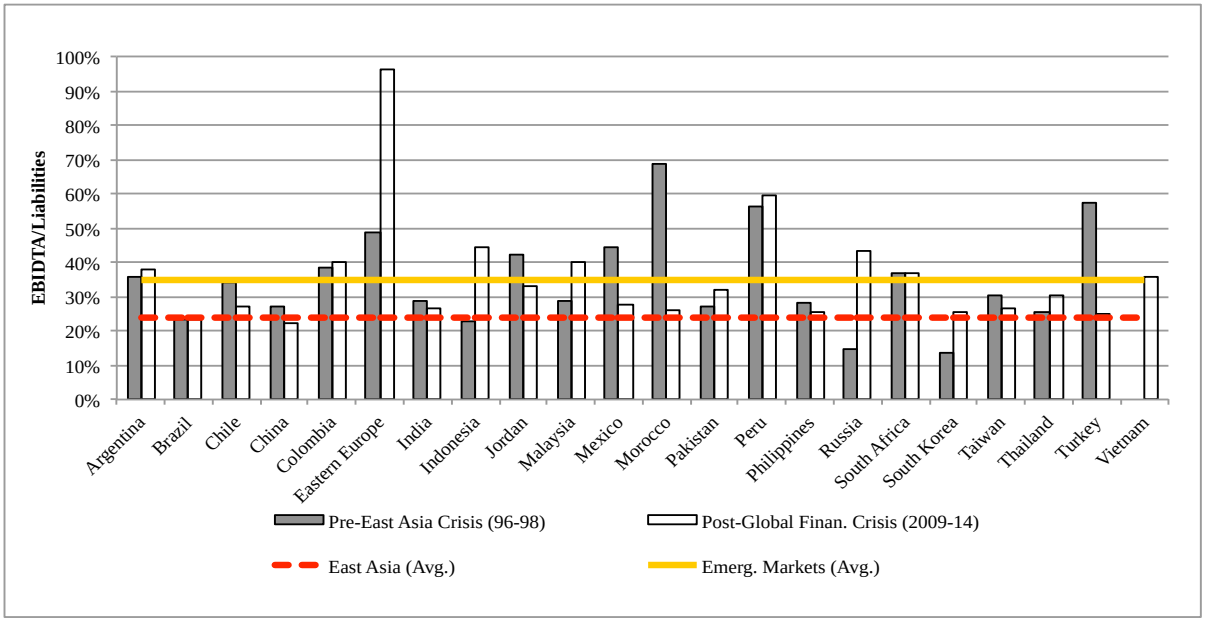
Source: authors calculations based on Worldscope data.

Figure 4: Liquidity – Current to Total Liabilities (Weighted Mean)



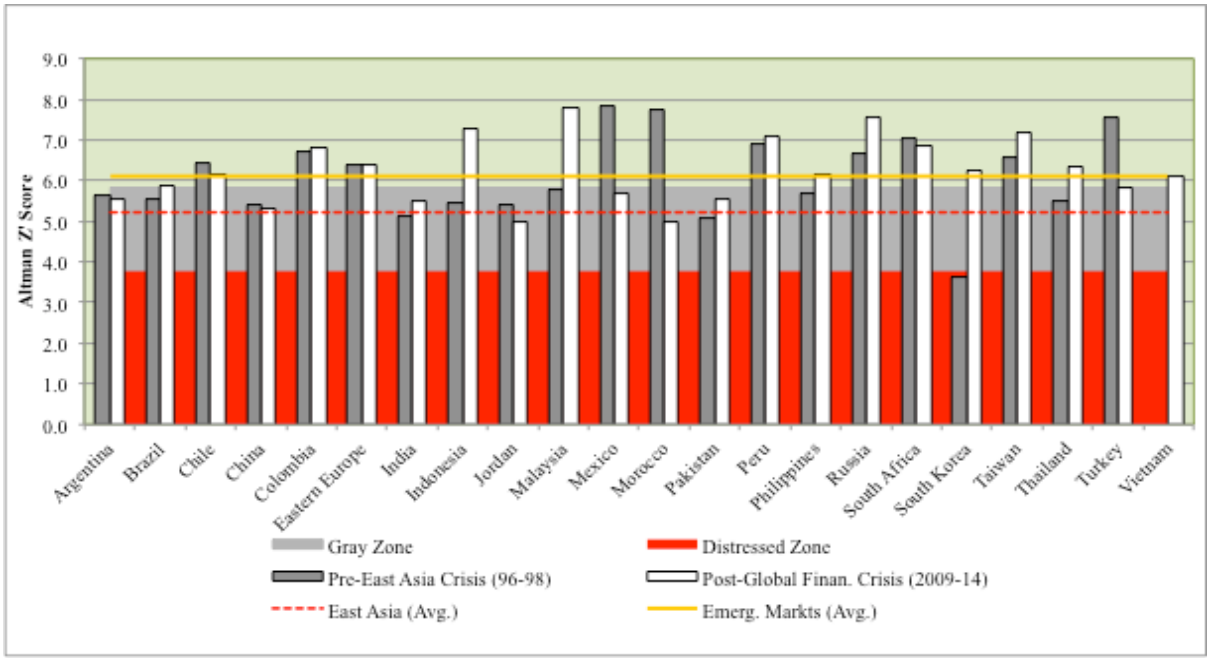
Source: authors calculations based on Worldscope data.

Figure 5: Solvency – EBITDA to Total Liabilities (Weighted Mean)



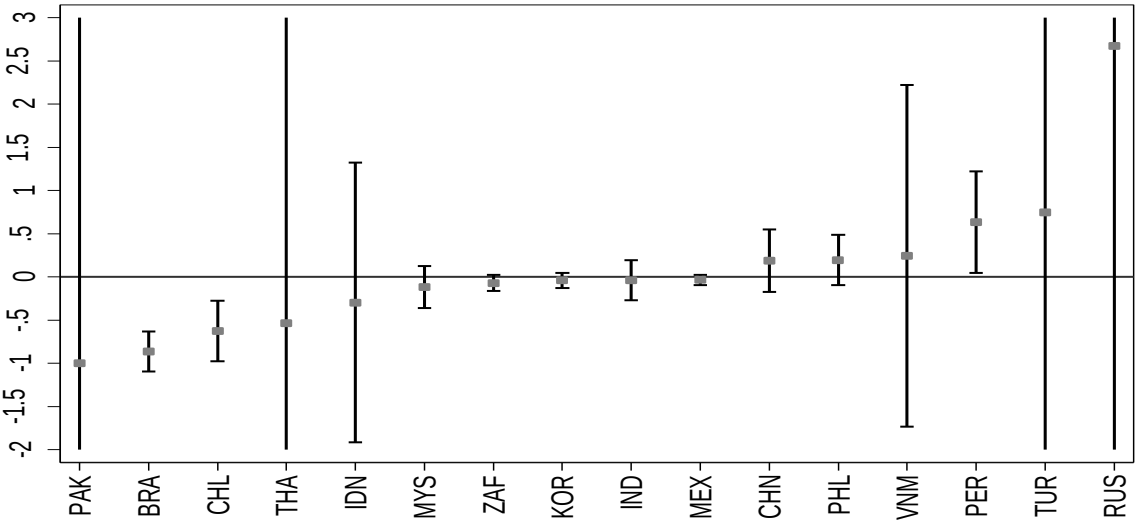
Source: authors calculations based on Worldscope data.

Figure 6: Altman Z''-Score EM (Weighted Mean)



Source: authors calculations based on Worldscope data.

Figure 7: Coefficient of the Parameter ψ



Notes: The figure plots the equation the coefficient (with a 95% Confidence Interval) of the Parameter ψ of X4 (Without the country-year fixed effects) estimate one country at a time.

Table 1: Total Claims on Emerging Market Countries, BIS reporting Banks (billion USD)

Source: Own elaborations based on BIS Locational Statistics. The data are for total claims (all instruments and all sectors) on residents of counterparty countries. Top five currencies are USD, euro, yen, British pound, and, Swiss franc.

	2007	2008	2009	2010	2011	2012	2013	2014	2015Q3
Emerging Markets									
Total	2,419	2,408	2,396	2,807	3,032	3,157	3,640	3,699	3,471
% top 5 curr.	81%	83%	81%	79%	79%	77%	77%	71%	74%
% USD	52%	53%	52%	53%	55%	53%	54%	55%	58%
Emerging Markets Ex-China									
Total	2,231	2,254	2,219	2,476	2,555	2,634	2,740	2,663	2,594
% top 5 curr.	82%	84%	81%	80%	81%	79%	81%	81%	82%
% USD	52%	53%	52%	53%	56%	55%	58%	61%	63%
Asia									
Total	830	738	783	1,064	1,258	1,349	1,801	1,945	1,752
% Total EM	34%	31%	33%	38%	41%	43%	49%	53%	50%
% top 5 curr.	78%	84%	80%	79%	79%	77%	74%	62%	65%
% USD	56%	58%	59%	59%	59%	56%	56%	53%	56%
Asia Ex-China									
Total	641	584	606	733	782	826	901	908	874
% Total EM	26%	24%	25%	26%	26%	26%	25%	25%	25%
% top 5 curr.	81%	86%	84%	82%	85%	83%	84%	82%	83%
% USD	57%	59%	60%	61%	66%	64%	67%	69%	71%
Latin America									
Total	403	410	413	533	602	626	647	633	627
% Total EM	17%	17%	17%	19%	20%	20%	18%	17%	18%
% top 5 curr.	83%	84%	76%	76%	78%	78%	79%	82%	85%
% USD	70%	74%	67%	67%	70%	70%	71%	75%	79%
Developing Europe									
Total	728	786	722	711	690	698	713	609	559
% Total EM	30%	33%	30%	25%	23%	22%	20%	16%	16%
% top 5 curr.	79%	81%	80%	76%	76%	73%	77%	77%	77%
% USD	35%	33%	29%	28%	29%	27%	31%	32%	31%
Africa and Middle East									
Total	459	474	478	499	481	484	479	513	533
% Total EM	19%	20%	20%	18%	16%	15%	13%	14%	15%
% top 5 curr.	87%	84%	85%	84%	86%	83%	84%	83%	84%
% USD	58%	60%	62%	61%	63%	61%	61%	63%	65%

Table 2: Asian Financial Crisis vs Post-Global Financial Crisis

Leverage is measured by the debt to equity ratio: a firm's total debt divided by its common equity. Liquidity is measured by current-to-total liabilities. Solvency is measured by the coverage ratio: earnings before interest, taxes, and depreciation divided by total liabilities. Profitability is measured by the return on invested capital (ROIC): the ratio of operating profit (earnings before interest and tax) to invested capital (sum of shareholders' equity and debt liabilities). Altman's (2005) Emerging Market Z-Score measures the inverse of firm fragility (computation described in the text). The first two columns present the average measure for each group of countries during our two fragile periods: The Asian Financial Crisis (1996-1998) and the post-Global Financial Crisis (2008-2014). The last three columns count the number of countries in our sample that meet ("Yes") and don't meet ("No") the conditions stated in the column headings. The data is weighted by sales by year and then averaged per period per country. Asian Crisis Five countries include Indonesia, Malaysia, Philippines, South Korea, and Thailand. Source: authors calculations based on Worldscope data.

	(1)	(2)		(3)	(4)	(5)
Countries	Asian Financial Crisis (1996-1998)	Post-Global Financial Crisis (2008-14)		Post-GFC > AFC (By country)	Post-GFC > Asian Five AFC avg.	Post-GFC > EM AFC avg.
	Panel A: Leverage (Debt to Equity)					
Asian Crisis Five	145.5%	73.9%	Yes	10	0	12
Emerging Markets	80.8%	87.3%	No	8	21	9
	Panel B: Liquidity (Current to Total Liabilities)					
Asian Crisis Five	57.6%	59.5%	Yes	6	11	11
Emerging Markets	58.7%	56.4%	No	12	11	11
	Panel C: Solvency (Coverage ratio: EBITDA to Total Liabilities)					
Asian Crisis Five	23.7%	48.3%	Yes	9	20	9
Emerging Markets	34.9%	35.7%	No	9	2	13
	Panel D: Profitability (Return on Invested Capital)					
Asian Crisis Five	7.3%	11.0%	Yes	9	17	9
Emerging Markets	10.9%	10.7%	No	9	5	13
	Panel E: Emerging-Markets Z-score (Distance to Default)					
Asian Crisis Five	5.2	6.6	Yes	9	20	13
Emerging Markets	6.1	6.2	No	9	2	9

Table 3: The Relationship Between Leverage and Distance to Default in Different Time Periods

This table shows the results of a set of firm-level regressions where the dependent variable is distance to default (the regular Z-score in column 1 and the modified Z-score in columns 2-5), and the explanatory variables are the interactions between leverage and each of three dummy variables taking a value of one for the Asian Financial Crisis (1996-1998), tranquil period (2003-2007), and post-Global Financial Crisis (2008-2014), respectively. In column 5 the variables are further interacted with a dummy taking a value of one for firms that operate in tradable sectors (column 5a) and non-tradable sectors (column 5b). In columns 3-5, the model is augmented with a set of firm-specific controls measuring investment and size proxied by the log of total assets. The last two rows display whether a specification includes country-year and firm fixed effects. Robust standard errors clustered at the firm-level in parenthesis.

	(1)	(2)	(3)	(4)	(5)	
	Dep Var: Altman Z-score	Dep Var: Modified Altman Z score				
					(5a) Tradable	(5b) Non-Tradable
β_1 (AFC×Leverage)	-2.666***	-0.389**	-0.225	-0.252	-0.233	-0.270
	(0.229)	(0.179)	(0.201)	(0.259)	(0.332)	(0.338)
β_2 (Tranquil×Leverage)	-3.024***	-0.711***	-0.512***	0.386*	0.495*	0.281
	(0.196)	(0.153)	(0.171)	(0.219)	(0.280)	(0.297)
β_3 (GFC×Leverage)	-2.908***	-0.573***	-0.522***	-0.236	-0.526**	0.177
	(0.183)	(0.143)	(0.157)	(0.201)	(0.249)	(0.289)
Investment			0.066	0.0432	0.769	0.0413
			(0.041)	(0.0392)	(0.623)	(0.0393)
Firm Size			-0.053***	-1.632***	-1.650***	-1.613***
			(0.012)	(0.0731)	(0.0973)	(0.111)
Constant	-2.666***	-0.389**	28.55***			
	(0.229)	(0.179)	(0.203)			
Observations	9,257	9,257	8,015	6,495	6,495	
$\beta_1 - \beta_2$	0.358	0.322	0.287	-0.638**		
P value	0.20	0.13	0.23	0.04		
$\beta_3 - \beta_2$	0.115	0.138	-0.01	-0.622**		
P value	0.62	0.44	0.96	0.02		
$\beta_1 - \beta_3$	0.242	0.185	0.297	-0.016		
P value	0.36	0.37	0.19	0.96		
Firm fixed effects	No	No	No	Yes	Yes	
Country-year fixed effects	No	No	No	Yes	Yes	

Table 4: Distance to Default, Leverage, and the Exchange Rate

This table shows the results of a set of firm-level regressions where the dependent variable is distance to default (the modified Z-score), and the explanatory variables are the interactions between leverage and each of three dummy variables taking a value of one for the Asian Financial Crisis (1996-1998), tranquil period (2003-2007), and post-Global Financial Crisis (2008-2014), respectively. These variables are then further interacted with the percentage change in the nominal exchange rate (lagged one period). In columns 2, 3 and 5, the model is augmented with a set of firm-specific controls measuring investment and size proxied by the log of total assets. The last two columns (5a and 5b) estimate separate effects for firms in the tradable and non-tradable sectors. The last two rows display whether a specification includes country-year and firm fixed effects. Robust standard errors clustered at the firm-level in parenthesis.

	(1)	(2)	(3)	(4)	(5)	
	Dep Var: Modified Altman Z score					
					(5a) Tradable	(5b) Non-Tradable
β_1 (AFC×Leverage)	-0.225	0.0239	0.245	-0.225	0.336	0.159
	(0.198)	(0.227)	(0.349)	(0.198)	(0.446)	(0.468)
β_2 (Tranquil×Leverage)	-0.731***	-0.550***	0.340	-0.731***	0.425	0.267
	(0.154)	(0.173)	(0.262)	(0.154)	(0.319)	(0.373)
β_3 (GFC×Leverage)	-0.596***	-0.522***	-0.234	-0.596***	-0.499*	0.134
	(0.146)	(0.160)	(0.237)	(0.146)	(0.296)	(0.348)
γ_1 (AFC×ΔEX×Leverage)	-1.747*	-2.333**	-4.800***	-1.747*	-4.881***	-4.822***
	(0.909)	(0.980)	(1.402)	(0.909)	(1.848)	(1.619)
γ_2 (Tranquil×ΔEX×Leverage)	-1.586	-2.699*	-3.131	-1.586	-2.440	0.263
	(1.529)	(1.632)	(1.907)	(1.529)	(2.031)	(2.509)
γ_3 (GFC×ΔEX×Leverage)	1.236	0.336	0.402	1.236	-0.523	1.880
	(1.468)	(1.604)	(2.683)	(1.468)	(3.099)	(3.907)
Investment		0.064	0.042		0.789	0.043
		(0.041)	(0.027)		(0.511)	(0.029)
Firm Size		-0.056***	-1.632***		-1.649***	-1.611***
		(0.012)	(0.089)		(0.120)	(0.134)
Constant	27.64***	28.59***		27.64***		
	(0.0475)	(0.204)		(0.0475)		
Observations	9,257	7,351	6,495	9,257	6,495	
Firm fixed effects	No	No	Yes	Yes	Yes	
Country-year fixed effects	No	No	Yes	Yes	Yes	

Table 5: Firms that Remain in the Sample

This table shows the specification in Table 4, column 3 on samples that include firms present for different number of years in the sample. Column 1 uses the entire sample, while columns 2-4 limit the sample to firms with at least 5, 10, and 15 years of data, respectively. The dependent variable is distance to default (the modified Z-score), and the explanatory variables are the interactions between leverage and each of three dummy variables taking a value of one for the Asian Financial Crisis (1996-1998), tranquil period (2003-2007), and post-Global Financial Crisis (2008-2014), respectively. These variables are then further interacted with the percentage change in the nominal exchange rate (lagged one period). The model is augmented with a set of firm-specific controls measuring investment and size proxied by the log of total assets. All specifications control for country-year and firm fixed effects. Robust standard errors clustered at the firm-level in parenthesis.

	(1)	(2)	(3)	(4)
	Dep Var: Modified Altman Z score			
β_1 (AFC×Leverage)	0.245	0.191	0.519	0.485
	(0.349)	(0.352)	(0.406)	(0.457)
β_2 (Tranquil×Leverage)	0.340	0.377	0.417	0.393
	(0.262)	(0.263)	(0.329)	(0.477)
β_3 (GFC×Leverage)	-0.234	-0.164	-0.286	0.146
	(0.237)	(0.239)	(0.296)	(0.439)
γ_1 (AF×ΔEX×Leverage)	-4.800***	-4.803***	-5.751***	-7.002**
	(1.402)	(1.395)	(1.750)	(2.696)
γ_2 (Tranquil×ΔEX×Leverage)	-3.131	-2.986	-4.153*	-4.870
	(1.907)	(1.925)	(2.230)	(3.596)
γ_3 (GF×ΔEX×Leverage)	0.402	0.604	0.830	-0.358
	(2.683)	(2.690)	(3.206)	(4.190)
Investment	0.042	0.0444*	-0.317*	0.431
	(0.027)	(0.0259)	(0.192)	(0.712)
Size	-1.632***	-1.597***	-1.665***	-1.941***
	(0.089)	(0.091)	(0.113)	(0.172)
Observations	6,495	6,473	3,940	1,929
Sample	All	At least 5 years	At least 10 years	At least 15 years
Firm fixed effects	Yes	Yes	Yes	Yes
Country-year fixed effects	Yes	Yes	Yes	Yes

Table 6: Leverage, Distance to Default, Interest Rate, and Growth

This table shows the results of a set of firm-level regressions where the dependent variable is distance to default (the modified Z-score), and the explanatory variables are the interactions between leverage and each of three dummy variables taking a value of one for the Asian Financial Crisis (1996-1998), tranquil period (2003-2007), and post-Global Financial Crisis (2008-2014), respectively. These variables are then further interacted with the percentage change in the nominal exchange rate (lagged one period), the local interest rate (IR is the deposit rate), and lagged GDP growth (GR). The model is augmented with a set of firm-specific controls measuring investment and size proxied by the log of total assets. All regressions control for country-year and firm fixed effects. Robust standard errors clustered at the firm-level in parenthesis.

	(1)	(2)	(3)
	Dep Var: Modified Altman Z score		
β_1 (AFC×Leverage)	1.566**	0.736	1.346**
	(0.611)	(0.580)	(0.590)
β_2 (Tranquil×Leverage)	0.163	0.288	0.108
	(0.499)	(0.382)	(0.530)
β_3 (GFC×Leverage)	-0.275	-0.260	-0.308
	(0.368)	(0.436)	(0.440)
γ_1 (AFC*ΔEX)	-3.521**	-4.181**	-4.472***
	(1.634)	(1.731)	(1.707)
γ_2 (Tranquil*ΔEX)	-3.407	-3.172	-3.522
	(3.002)	(3.070)	(3.081)
γ_3 (GFC*ΔEX)	-0.0931	-0.317	-0.145
	(2.738)	(2.764)	(2.797)
AFC*GR	21.33		32.46
	(19.887)		(28.34)
Tranquil*GR	4.287		3.779
	(7.940)		(8.198)
GFC*GR	2.144		1.999
	(5.431)		(6.941)
AFC*IR		-3.933	7.445
		(4.144)	(7.873)
Tranquil*IR		1.652	1.194
		(4.123)	(4.210)
GFC*IR		1.877	0.742
		(7.208)	(9.052)
Investment	0.0434*	0.0443*	0.0436*
	(0.0260)	(0.0259)	(0.0260)
Firm Size	-1.613***	-1.609***	-1.615***
	(0.0892)	(0.0892)	(0.0894)
Observations	6,334	6,334	6,334
Sample	All	All	All
Country-year FE	Yes	Yes	Yes
Firm-FE	Yes	Yes	Yes

Table 7: Leverage, Distance to Default, and Macro/Institutional Framework

This table shows the results of a set of firm-level regressions where the dependent variable is distance to default (the modified Z-score), and the explanatory variables are the interactions between leverage and each of three dummy variables taking a value of one for the Asian Financial Crisis (1996-1998), tranquil period (2003-2007), and post-Global Financial Crisis (2008-2014), respectively. These variables are then further interacted with an index of financial development, inflation targeting regimes, and the updated Lane and Milesi-Ferretti (2007) index of financial globalization. The model is augmented with a set of firm-specific controls measuring investment and size (proxied by the log of total assets). All regressions control for country-year and firm fixed effects. Robust standard errors clustered at the firm-level in parenthesis.

	(1)	(2)	(3)	(4)
	Dep Var: Modified Altman Z score			
β_1 (AFC×Leverage)	0.331	0.247	0.457	0.549
	(0.622)	(0.349)	(0.781)	(0.801)
β_2 (Tranquil×Leverage)	0.492	0.240	-0.239	-0.331
	(0.528)	(0.455)	(0.826)	(1.021)
β_3 (GFC×Leverage)	-0.505	-0.440	-1.517*	-1.287
	(0.475)	(0.393)	(0.773)	(0.788)
γ_1 (AFC*ΔEX)	-4.865***	-4.804***	-4.842***	-5.077***
	(1.481)	(1.403)	(1.361)	(1.473)
γ_2 (Tranquil*ΔEX)	-1.422	-3.082	-1.517	-2.083
	(1.994)	(1.902)	(2.064)	(2.221)
γ_3 (GFC*ΔEX)	0.604	0.377	-3.626	-3.486
	(2.679)	(2.689)	(2.917)	(2.920)
AFC*FINDEV	-0.001			-0.004
	(0.006)			(0.009)
TRANQ*FINDEV	-0.002			-0.005
	(0.006)			(0.007)
GFC*FINDEV	0.003			-0.004
	(0.005)			(0.008)
AFC*IT		-		-
		0.158		0.255
TRANQ*IT		(0.541)		(0.584)
		0.299		-0.338
GFC*IT		(0.465)		(0.584)
			-0.244	-0.0398
AFC*LMF			(0.769)	(0.963)
			0.426	0.677
TRANQ*LMF			(0.618)	(0.698)
			0.889*	1.109*
GFC*LMF			-0.489	-0.229
			(0.712)	(0.920)
Investment	0.042	0.042	0.082***	0.081***
	(0.02)	(0.027)	(0.011)	(0.01)
Firm Size	-1.630***	-1.630***	-1.619***	-1.618***
	(0.0890)	(0.0889)	(0.108)	(0.108)
Observations	6,473	6,473	4,971	4,971
Sample	All	All	All	All
Country-year FE	Yes	Yes	Yes	Yes
Firm-FE	Yes	Yes	Yes	Yes

Table 8: The Granularity Effect

This table reports a set of regression in which the dependent variable is per-capita GDP growth and the explanatory variables are granularity (G) and its first two lag (L.G and L2.G). All the regressions control for country and year fixed effects. Robust standard errors clustered at the country level in parenthesis.

	(1)	(2)	(3)
G	0.698**	0.819***	0.810**
	(0.262)	(0.293)	(0.310)
L.G		0.527**	0.509*
		(0.236)	(0.258)
L2.G			-0.0739
			(0.365)
Observations	486	486	486
Nr of countries	26	26	26
Country fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Sample	1994-2014	1994-2014	1994-2014

Table 9: Fragility and Firm Size

This table reports a set of regression in which the dependent variables are various measures of potential or realized fragility (leverage, solvency, liquidity, and distance to default) and the explanatory variable is a dummy variable taking the value of 1 for large firms (Large). All the regressions control for country and year fixed effects. Robust standard errors clustered at the country level in parenthesis.

	(1)	(2)	(3)	(4)
	Leverage	Solvency	Liquidity	Distance to default
Large	-25.15***	1.737	0.392	-68.66
	(7.849)	(1.648)	(0.944)	(42.46)
Observations	45,104	38,741	39,271	16,687
Sample	All	All	All	All
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes

Table 10: Leverage, Depreciation and Firm Size

This table reports a set of regression in which the dependent variable is sales growth and the explanatory variables are leverage, change in in the exchange rate, firm size and the interactions among these variables. All the regressions control for year fixed effects, and specifications 2-6 control also for country fixed effects. Robust standard errors clustered at the country level in parenthesis.

	(1)	(2)	(3)	(4)	(5)	(6)
LEV	-0.0115*	-0.0119*	-0.0350**	-0.0108	-0.00824	-0.0290
	(0.00674)	(0.00709)	(0.0139)	(0.00865)	(0.00776)	(0.0404)
DXR _LEV	-0.0553	-0.0593	-0.500**	-0.0448	-0.0474	-0.0520
	(0.0495)	(0.0510)	(0.198)	(0.0571)	(0.0501)	(0.0533)
Large	-209.0***	-284.5***			-285.0***	-316.5***
	(19.20)	(24.70)			(24.70)	(27.94)
DXR	0.543					
	(4.742)					
DXR _LARGE					-35.14**	-32.46*
					(17.73)	(17.89)
LARGE_LEV					-0.0316*	-0.0113
					(0.0182)	(0.0466)
LARGE_LEV_DXR					-0.417**	-0.416**
					(0.201)	(0.203)
Observations	42,542	42,542	9,959	32,583	42,542	22,228
Number of firms	7,441	7,441	2,956	6,046	7,441	4,990
Sample	All	All	Large Firms	Other	All	Largest 150
Firm FE	YES	YES	YES	YES	YES	YES
CY FE	NO	YES	YES	YES	YES	YES

Appendix Tables

Table A1: Sample Sales and Country Market Cap and GDP

This table shows what percentage of a country's economy is captured by firms in our sample. Column 1 reports – by country – the total sales in firms in our sample divided by the country's total market capitalization, as measured by the World Bank. Column 2 shows the ratio of total market capitalization and GDP in each country.

	(1)	(2)
Country	Sales to Market Cap	Market Cap to GDP
Argentina	52%	14%
Brazil	43%	49%
Chile	51%	111%
China	49%	51%
Colombia	30%	45%
Eastern Europe	100%	34%
India	36%	72%
Indonesia	34%	39%
Jordan*	27%	
Malaysia	46%	146%
Mexico	61%	35%
Morocco*	12%	
Pakistan	107%	16%
Peru	33%	45%
Philippines	32%	69%
Russia	116%	26%
South Africa	23%	225%
South Korea	119%	78%
Taiwan*	93%	
Thailand	59%	75%
Turkey	68%	31%
Vietnam	79%	13%

* No country-level market capitalization data. Value shows Sales / GDP instead.

Table A2: Altman's EM Z-score and Leverage Heat Maps

This table shows average Z-scores and leverage for each country over time. The color scale moves from red (for low Z-scores and high leverage) to green (for high Z-scores and low leverage), going through several shades of orange yellow.

	Altman's EM Z-score			Leverage		
Country	1996-98	2003-07	2008-14	1996-98	2003-07	2008-14
Argentina	5.64	7.38	5.62	59%	45%	74%
Brazil	5.52	6.13	5.88	50%	83%	94%
Chile	6.44	6.44	6.20	95%	82%	93%
China	5.39	5.58	5.28	95%	95%	103%
Colombia	6.71	6.58	6.77	40%	47%	44%
Eastern Europe	6.38	6.49	6.30	45%	48%	55%
India	5.14	5.62	5.55	92%	79%	118%
Indonesia	5.43	6.36	7.13	105%	81%	72%
Jordan	5.39	5.97	5.14	32%	81%	
Malaysia	5.76	6.95	7.77	69%	69%	63%
Mexico	7.83	6.26	5.53	54%	59%	89%
Morocco	7.73	7.47	5.04	28%	42%	128%
Pakistan	5.07	5.26	5.44	108%	56%	84%
Peru	6.88	7.23	6.99	53%	53%	68%
Philippines	5.70	6.02	6.11	98%	103%	131%
Russia	6.69	8.76	7.60	22%	42%	56%
South Africa	7.04	6.71	6.88	39%	50%	54%
South Korea	3.63	5.58	6.11	284%	140%	110%
Taiwan	6.58	6.80	7.03	65%	66%	66%
Thailand	5.51	6.21	6.32	172%	84%	83%
Turkey	7.57	6.30	5.80	95%	104%	124%
Vietnam		6.51	6.18		95%	116%