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# **IMF Working Paper**

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## **Stress Testing Corporate Balance Sheets in Emerging Economies**

by Julian T.S. Chow

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**I N T E R N A T I O N A L M O N E T A R Y F U N D**

**IMF Working Paper**

Monetary and Capital Markets Department

**Stress testing Corporate Balance Sheets in Emerging Economies**

**Prepared by Julian T.S. Chow<sup>1</sup>**

Authorized for distribution by James Morsink

September 2015

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**Abstract**

In recent years, firms in emerging market countries have increased borrowing, particularly in foreign currency, owing to easy access to global capital markets, prolonged low interest rates and good investment opportunities. This paper discusses the trends in emerging market corporate debt and leverage, and illustrates how those firms are vulnerable to interest rate, exchange rate and earnings shocks. The results of a stress test show that while corporate sector risk remains moderate in most emerging economies, a combination of macroeconomic and financial shocks could significantly erode firms' ability to service debt and lead to higher debt at risk, especially in countries with high shares of foreign currency debt and low natural hedges.

JEL Classification Numbers: G3

Keywords: Emerging market corporate debt, leverage, debt at risk

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## I. INTRODUCTION

Global debt is on the rise again. Since 2007, debt has expanded by \$57 trillion, outpacing the growth in global GDP.<sup>2</sup> Emerging markets accounted for half of this new debt, of which one quarter came from nonfinancial corporations. While some of the increase in debt undoubtedly reflects progress in financial deepening and greater access to global capital markets, history has shown that high levels of debt relative to equity in corporate balance sheets could accentuate losses, exacerbate cash flow stress, and heighten debt service obligations. This, in turn, could lead to deteriorating creditworthiness, debt-rollover risks, and higher corporate defaults that could spillover to the financial system.

This paper presents a cross-country analysis of corporate debt in emerging economies in recent years. The analysis is a useful complement to individual country studies, as well as to other analyses of corporate vulnerabilities, for example the contingent claims approach in estimating default risk (Gray et al., 2004), and the construction and applications of corporate vulnerability index (National University of Singapore, 2014). This paper builds on the analysis of emerging market corporate vulnerability presented in the IMF's [April 2014 Global Financial Stability Report](#). It uses a balance sheet approach to analyze and stress test the resilience of the corporate sector in a sample of emerging market countries to shocks from exchange rate depreciation, earnings decline, and increase in borrowing cost.

## II. RISING CORPORATE DEBT

Bond issuance by nonfinancial corporates in major emerging market countries has risen sharply in recent years, against the backdrop of ample global liquidity and prolonged low global interest rates. In 2014, corporate bond issuance rose by 10 percent (\$77 billion), with Asia leading other regions (Figure 1).<sup>3</sup> Foreign currency issuances amounted to one fifth of total issuance over the last five years, growing at a compounded annual rate of 15 percent. According to a recent paper, a large fraction of these foreign currency debts were issued through corporates' overseas subsidiaries (Chui et al., 2014). The paper also estimated that the rollover needs of corporates from major emerging market countries and their overseas subsidiaries are projected to rise from around \$90 billion in 2015, to \$130 billion in 2017–18. Sectors such as manufacturing, utilities and energy accounted for three-quarters of the new debt in 2014. In Latin America (Latam) and Europe, Middle East and Africa (EMEA), the energy sector comprised the largest share of issuance, while in Asia, the lion share came from manufacturing.

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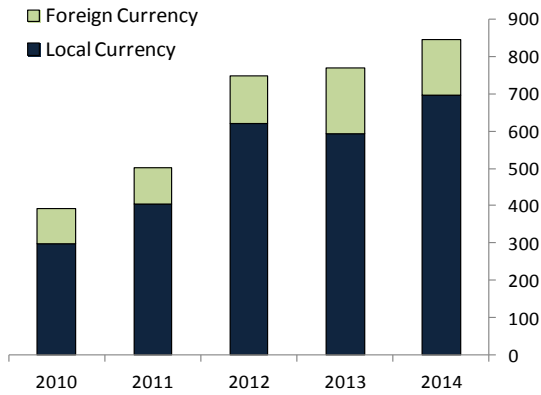
<sup>2</sup> By the second quarter of 2014, global debt stood at 286 percent of global GDP, compared to 269 percent of GDP in 2007. See [McKinsey Global Institute \(2015\)](#).

<sup>3</sup> Corporate bond data are available only for a few emerging economies. The estimates cited in this paper came from a sample of the following 17 countries: Argentina, Brazil, Bulgaria, Chile, China, Hungary, India, Indonesia, Malaysia, Mexico, Peru, the Philippines, Poland, Russia, South Africa, Thailand and Turkey. These are the ones included in the benchmark J.P. Morgan corporate debt indices (Corporate Emerging Market Bond Index (CEMBI) and regional indices – Asia (JACI), Latin America (LEBI) and Russia (RUBI)).

**Figure 1. Nonfinancial Corporate Debt Issuance and Rising Leverage, 2010-2014**

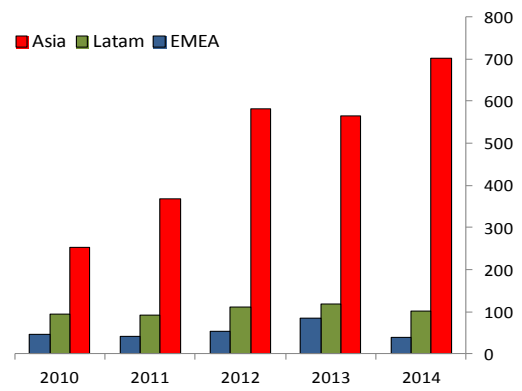
Corporate bond issuance has risen sharply since 2008...

**1. Bond Issuance by Currency (in US\$ billion)**



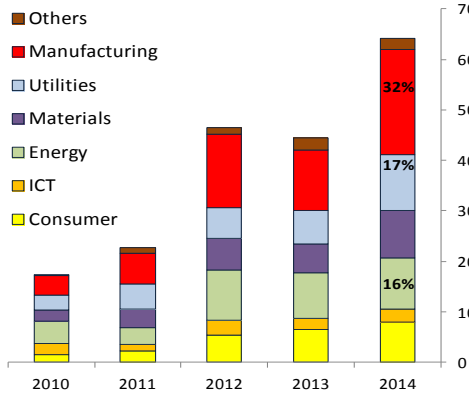
... with Asia leading the rise.

**2. Bond Issuance by Regions (in US\$ billion)**



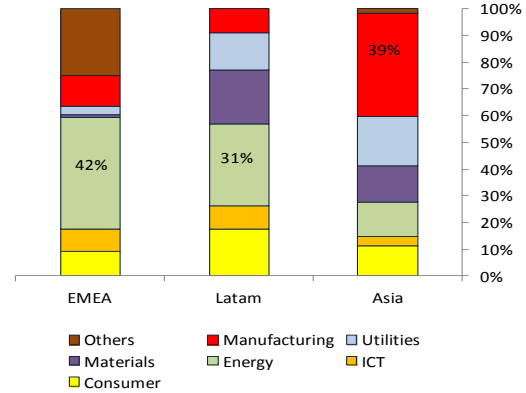
Manufacturing, utilities and energy sectors are the largest borrowers...

**3. Bond Issuance by Sector (in US\$ billion)**



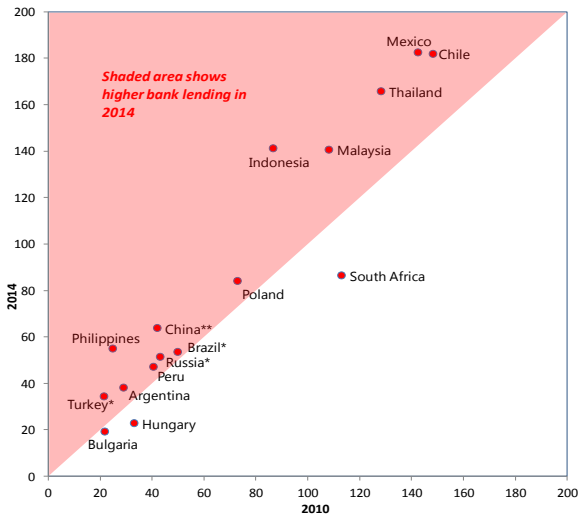
... with energy being the most important in Latin America and EMEA, and manufacturing in Asia.

**4. Bond Issuance by Sector in 2014**



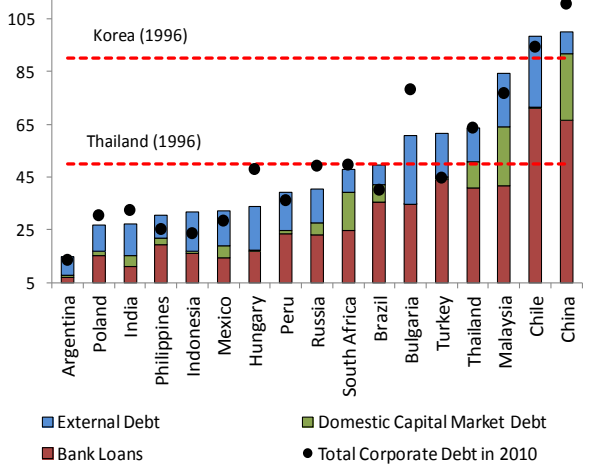
Bank lending has also increased...

**5. Bank lending to Nonfinancial Corporates (in US\$ billion)**



... leading to high levels of corporate leverage in several countries.

**6. Nonfinancial Corporate Debt to GDP, 2010 and 2014 (in percent) 1/**



\* scaled by 10 billion; \*\*scaled by 100 billion.

1/ Black dots indicate total corporate debt in 2010.

Sources: IMF, Bloomberg, National Authorities, Standard Chartered Bank, Orbis.

Note: The sample is determined by data availability and comprises major emerging market countries in the J.P. Morgan corporate debt indices.

Along with the rise in bond issuance, corporate borrowing from banks also increased. The ratio of total nonfinancial corporate debt to GDP rose in about one-half of our seventeen-country sample (Figure 1)<sup>4</sup>. In four countries, the ratio of corporate debt to GDP was broadly unchanged, while in another four countries it declined. As of 2014, the ratio of total nonfinancial corporate debt to GDP were above levels seen in vulnerable countries during the Asian financial crisis in six of the seventeen countries (Bulgaria, Chile, China, Malaysia, Thailand, and Turkey).<sup>5</sup> In China, Malaysia, and Thailand, corporate debt has been funded primarily by domestic banks and domestic capital markets. In contrast, corporates in Chile, Turkey and Bulgaria have borrowed primarily from international capital markets.

### III. RISING VULNERABILITIES

Economic growth in emerging markets slowed from 7.4 percent in 2010, to 4.6 percent in 2014. The IMF's [April 2015 World Economic Outlook](#) noted that negative growth surprises had lowered medium-term growth prospects in emerging markets, and warned that the distribution of global risks remained tilted to the downside.

Slowing growth in emerging markets has put pressure on firms' profitability. Firm-level data suggests that corporate profitability declined in 2014 across most emerging market countries relative to their five-year averages, with broad-based weaknesses across sectors (Figure 2). The data also shows that debt has grown faster than earnings in most countries, which led to an increase in the ratio of net debt to earnings before interest and taxation (EBIT), and that interest expense grew faster than earnings in all regions.

How vulnerable were emerging market firms in 2014? One way to answer this question is to examine debt service capacity and the share of debt at risk (Appendix 2). Using firm-level data for around 43,000 companies from the Orbis database, we computed the interest coverage ratio (ICR) of each firm and aggregated their debts according to the distribution of their ICRs. Basic statistics are presented in Appendix 3.

Figure 2 presents the results of the exercise. Panel 6 of this figure shows that, in the sample, the average debt at risk rose 22 percent in 2014 from levels in 2010<sup>6</sup>. The figure also shows that the highest levels of debt at risk were in EMEA, and that the pace of increase has been most rapid in Latin America.

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<sup>4</sup> Appendix 1 describes the methodology used to estimate total corporate debt.

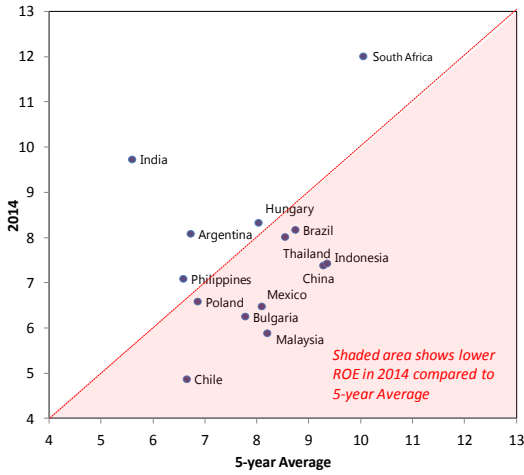
<sup>5</sup> It should be noted that the economic structure, and macroeconomic and regulatory framework have improved significantly in most emerging economies since the Asian financial crisis. On the whole, these changes have increased resilience.

<sup>6</sup> Turkey and Peru are excluded in this exercise due to data gaps and the lack of a good representative sample of firms.

## Figure 2. Emerging Market Corporates: Weakening Credit Metrics

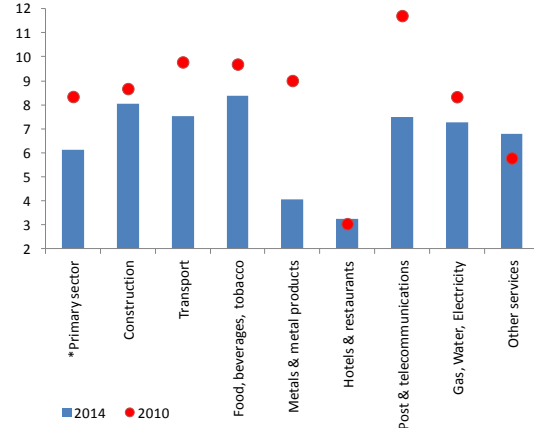
Slowing economic growth is putting pressure on profitability...

### 1. Returns on Equity (in percent, median)



... with broad-based weaknesses across sectors.

### 2. Returns on Equity by Sector (in percent, median)

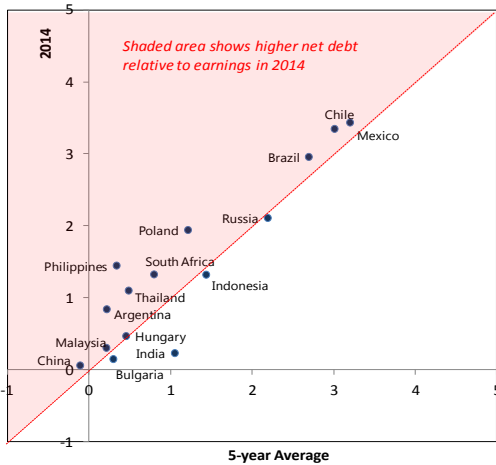


\*Primary sector includes oil and gas, mining, agriculture. The sectoral ROEs are computed as the average of median ROEs for each country.

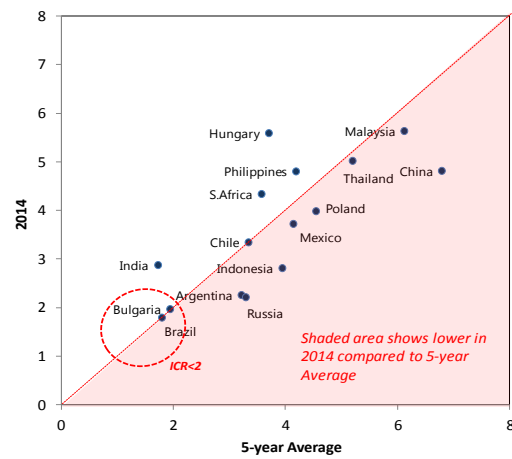
...leading to weaker debt service capacity.

Debt has grown faster than earnings in most countries...

### 3. Net Debt to EBIT (in multiples, median)

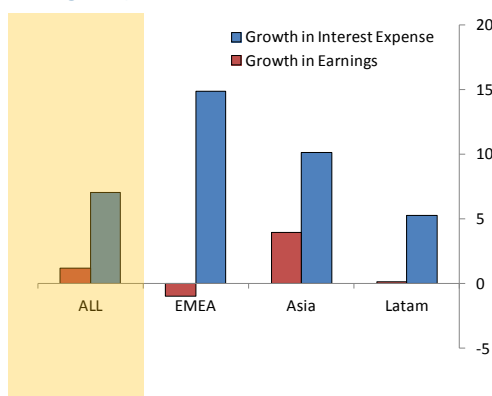


### 4. Interest Coverage Ratio (EBIT/Interest Expense, median)



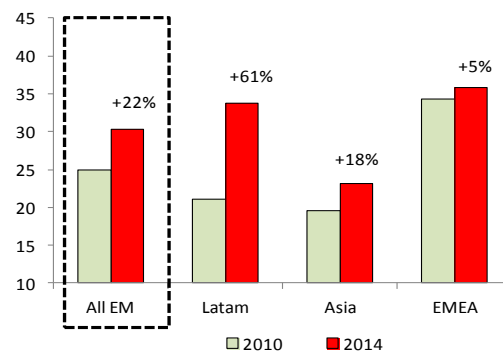
Interest expense has grown faster than earnings...

### 5. Average Annual Growth in Interest Expense and Earnings (in percent, 2010-2014)



...as a result, Debt at Risk is on the rise.

### 6. Debt at Risk (in percent of total debt, average)



Note: The vertical-axis shows the average share of debt at risk to total debt. The percentages above the bars show the increase in 2014 vis-à-vis 2010.

It should be kept in mind that the estimate of total debt used for these calculations may be a lower bound. Some corporates in emerging markets are able to borrow abroad through special purpose vehicles (SPVs) or through affiliates, and do not consolidate these exposures on their balance sheets.

#### IV. STRESS TESTING THE CORPORATE SECTOR

While the estimates of debt at risk give an indication of corporate vulnerability at a given point in time, they do not show how sensitive firms may be to macroeconomic and financial shocks. In particular, exchange rate depreciation exposes firms to losses from the higher nominal value of foreign currency debt service; tighter external financing conditions could lead to a rise in borrowing costs; and a slowdown in economic growth could reduce earnings. During the recent Global Financial Crisis (GFC), the three shocks unfolded simultaneously.

To examine the sensitivity of emerging market corporates to those types of shocks, we apply a “stress tests” to the firms’ balance sheets<sup>7</sup> using the following shocks:

- A 30 percent increase in borrowing costs (similar to the average of median changes in corporate borrowing costs across countries during the GFC).
- A 20 percent decline in earnings (similar to the average of median changes in firms’ EBIT observed across countries during the GFC).
- A currency depreciation against the U.S. dollar of 30 percent (similar to trends observed in late 1990s).<sup>8</sup>

We also tried to control for “natural” and financial hedges that could mitigate the corporates’ exposures to exchange rate risk. As data on hedges are extremely limited, we made the following assumptions:

- “Natural” hedges from foreign currency earnings were proxied by the share of foreign sales to total sales.<sup>9</sup> The currency breakdown for these “natural” hedges was derived from the trade weights.

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<sup>7</sup> The relationship between corporate vulnerability and key balance sheet ratios has been analyzed in several studies, usually using regression analysis. For example, Claessens et al. (2000) found that firm specific characteristics, both financial and nonfinancial, were most significant in explaining post crisis performance. Gray et al. (2004) uses contingent claims approach to identify corporate sector vulnerabilities. Our corporate balance sheet stress test exercise complements these analyses.

<sup>8</sup> We recognize that some currencies are pegged, or are in heavily managed exchange rate regimes. This sensitivity analysis examines what could potentially happen in an adverse scenario.

<sup>9</sup> As Orbis does not provide balance sheet information of foreign sales, we used Worldscope’s median foreign sales to total sales ratios for each country as a proxy for “natural” hedges.



- Financial hedges through derivatives—we adopted the (admittedly simple) assumption that 50 percent of the foreign currency debt interest expenses of the corporates are effectively hedged through derivative contracts.<sup>10</sup>

Figure 3 presents the results of the stress tests. Panel 2 of this figure shows that the joint occurrence of the three shocks would weaken the ICR of emerging markets corporates; in most cases, however, the median ICRs would remain above 1.5. The figure also shows that the largest impact on ICR occurs in countries where corporates borrow more in foreign currency and have lower natural hedges. This is especially worrisome for countries that have high levels of debt at risk to begin with. In fact, the exercise shows that debt at risk could exceed 50 percent of total corporate debt in Brazil, Bulgaria, Hungary, and Indonesia. For the sample as a whole, the exercise shows that debt at risk could increase from 30 percent of total debt to 45 percent of total debt. Large firms would account for the bulk of the new debt at risk in Asia and Latam. In contrast, in EMEA, one third of the new debt at risk would come from small-and-medium sized firms. The debt at risk analysis also reveals relatively high corporate leverage risk in some countries that are not flagged based on aggregate data.<sup>11</sup>

The stress tests also show that shocks to earnings, interest rate, and exchange rates could affect commodities-related firms and state-owned enterprises (SOE). In particular, the post-shock debt at risk from the commodities sector could increase sharply in Hungary, the Philippines, Indonesia, and Thailand, though they remain at low levels in these countries.<sup>12</sup> In Brazil, the debt at risk from commodities-related companies is high, amounting to around one third of total debt. Our sensitivity analysis suggests that SOE debt at risk could exceed 3 percent of GDP in Brazil, China, Hungary, and Malaysia if these shocks materialize.

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<sup>10</sup> While foreign exchange hedging instruments and markets are more developed now than during the late-1990 crises, it is important to note that some of these instruments are complex. For example, some currency hedges would terminate when the exchange rate depreciates beyond a certain “knock-out” threshold, thus rendering the hedge worthless. Moreover, firms are exposed to liquidity and rollover risks when these contracts expire.

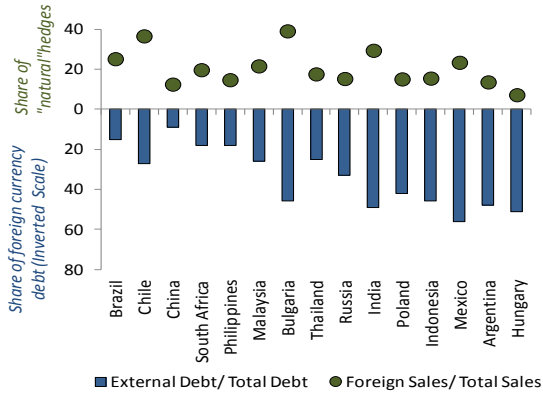
<sup>11</sup> This is supported by findings in the [May 2015 Regional Economic Issues \(Central, Eastern, and Southeastern Europe\)](#) which shows that Bulgaria and Russia, among others, have relatively larger shares of debt concentrated in firms with elevated liquidity risk compared to other countries in the region.

<sup>12</sup> This is in line with the findings in the [April 2015 Global Financial Stability Report](#) which suggest that the balance sheet deterioration for many oil and gas firms preceded the energy price decline of 2014. The *Global Financial Stability Report* also highlighted that the returns on assets, leverage and debt-servicing capacity of these firms are now at their worst levels since 2003.

**Figure 3. Stress Tests**

Some countries have relatively more foreign sales that provide "natural" hedges...

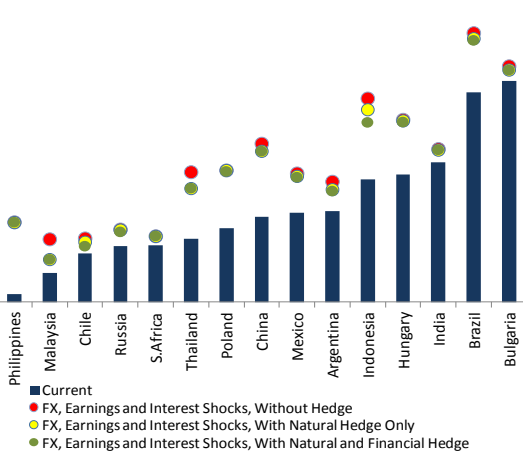
**1. Share of Foreign Sales and FX Debt** (in percent of Total Sales and Total Debt, respectively)



Note: The share of foreign sales is based on median, from Worldscope's data. The share of external debt is derived from QEDS.

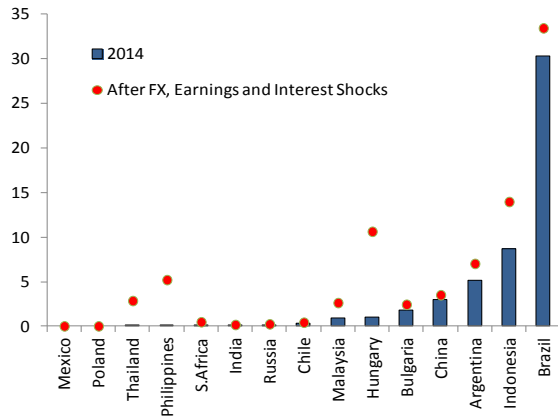
...leading to higher debt at risk

**3. Debt at Risk** (in percent of Total Corporate Debt)



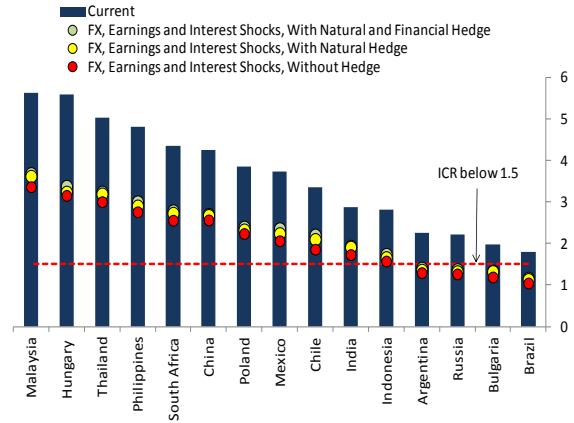
Commodities-related firms are weak in some countries...

**5. Debt at Risk in Commodities Sector** (in percent of total debt)



...shocks to exchange rates, earnings and interest expense could weaken debt servicing capacity ...

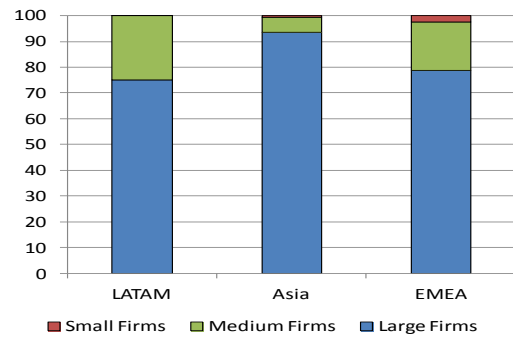
**2. Interest Coverage Ratio (EBIT/Interest Expense, median)**



Note: Natural hedge is derived from foreign sales; financial hedge assumes 50 percent hedge on FX debt principal and interest.

...large firms would account for the bulk of the debt at risk

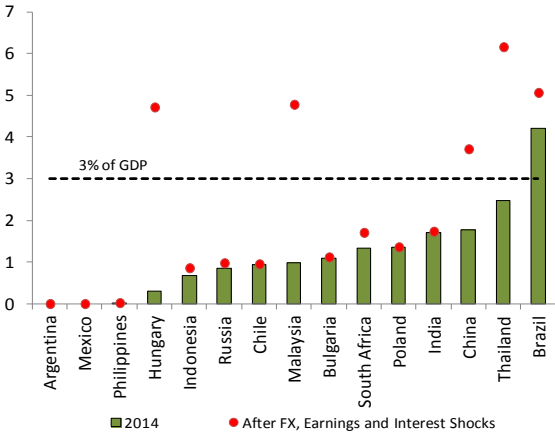
**4. Distribution of Debt at Risk by Firm Size** (in percent of total debt at risk)



Note: Firm size is derived from the country's sample firms by asset size: Large=Top 25th percentile; Small=Last 25th percentile; Medium=In between.

...while some state-owned companies are also at risk ...

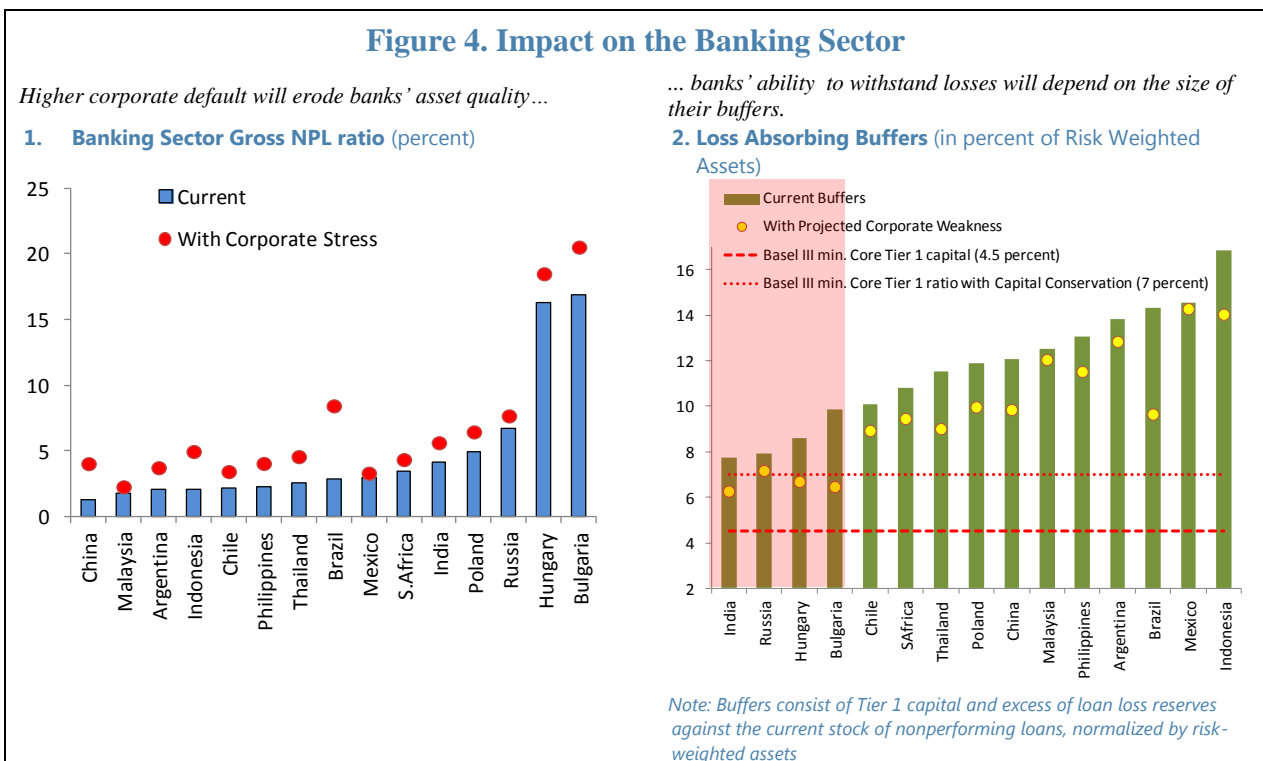
**6. SOE Debt at Risk** (in percent of GDP)



## V. IMPACT ON BANKS

Weaknesses in the corporate sector could put pressure on banks' asset quality through increases in nonperforming loans (Figure 4). The ability of banks to withstand those shocks will depend on the size of their buffers, comprising Tier 1 capital and loan loss reserves (Appendix 4). Assuming that in the stress scenario, corporate debt at risk owed to banks were to default with a probability of 15 percent, our sensitivity analysis suggests that buffers comprising Tier 1 capital and provisioning would be stretched in Bulgaria, India, Hungary, and Russia, when benchmarked against Basel III's minimum capital requirement.<sup>13</sup>

It is important to recognize that in some countries, bank buffers may be over-stated due to the lax recognition of doubtful assets and loan forbearance. In such instances, higher-than-expected corporate default in a downturn, and loan losses could erode what were thought to be adequate levels of equity capital.



<sup>13</sup> This is also in line with findings in the April 2015 Global Financial Stability Report.

## VI. POLICY RESPONSES

Rising vulnerabilities in the corporate sector should elicit a policy response from the authorities. The response should include:

- Strengthening the monitoring of corporate liabilities structure. In particular, the authorities could mandate better disclosure of firms' liabilities, especially those in foreign currency, and improve the collection and analysis of financial data. Timely and more granular data are needed on off- and on-balance sheet derivatives obligations and the extent of foreign currency hedging.
- Tightening microprudential policies. Where feasible, countries should consider imposing limits on firm's foreign currency borrowing as well as more stringent bank lending and underwriting standards. Countries whose banking sector has low loss absorbing buffers should consider measures to bolster banks' resilience through the buildup of more equity capital and provisioning.
- Improving macroprudential policy tools. Policymakers should identify macroprudential tools to mitigate rollover risk, debt service burden, and balance sheet sensitivity to interest rate changes and exchange rate risk. The [IMF Staff Guidance Note on Macroprudential Policy—Detailed Guidance on Instruments](#) provides details on these tools, including a discussion of the benefits and costs, and the need for recalibration.

## VII. SUMMARY AND CONCLUSIONS

Emerging market corporate debt has risen sharply in recent years, supported by low interest rates and easy access to global capital markets. While this reflects, in part, welcome progress in financial deepening, high levels of leverage could render firms vulnerable to shocks, especially in an environment of weak economic growth.

This paper uses country-level corporate balance sheet information to investigate this issue. The analysis suggests that corporates in emerging economies are indeed vulnerable to shocks on exchange rates, weaker-than-expected economic growth, and higher borrowing costs. Based on 2014 corporate balance sheet information in a sample of emerging market countries, the stress test exercise shows that a combination of these shocks could significantly erode firms' interest coverage ratios, though the overall corporate sector risk remains moderate in most countries. The adverse impact on debt-service ability is accentuated where corporates borrow more in foreign currency but have low natural hedges.

Corporate sector stress will affect the banking sector through increases in nonperforming loans. Banking systems where Tier 1 capital and provisioning are low would be most vulnerable.

Keeping emerging markets resilient calls for the need to focus on these vulnerabilities. Policymakers should carefully monitor and contain the rapid growth of corporate leverage through a combination of macro- and microprudential policies. In particular, there is a need to guard against the accumulation of unhedged foreign currency liabilities. Otherwise, the build-up of leverage could, once again, adversely affect financial stability.

## APPENDIX 1. EMERGING MARKETS CORPORATE DEBT DATA

Corporate debt, in aggregate, comprises borrowing from banks and bonds issued in the domestic and overseas capital markets, denominated in local and foreign currencies. Despite the increase in exposure to foreign currency debts, data on foreign currency liabilities, their currency breakdown and maturity structure remain sparse.<sup>14</sup> To navigate around these data gaps, we construct a proxy for the total corporate debt drawing on external debt statistics and other sources as follows:

Sources of Corporate Borrowing	Data
<b>Foreign currency-denominated debt from banks and capital markets</b> ( <i>approximated by external debt</i> )	Quarterly External Debt Statistics (QEDS) ( <a href="http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/EXTDECOE/DS/0,contentMDK:20721958~menuPK:4704607~pagePK:64168445~piPK:64168309~theSitePK:1805415,00.html">http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/EXTDECOE/DS/0,contentMDK:20721958~menuPK:4704607~pagePK:64168445~piPK:64168309~theSitePK:1805415,00.html</a> )
<b>Domestic banks</b>	Banking system data from “Financial Soundness Indicators”
<b>Domestic capital markets</b>	Bloomberg

- Total corporate debt is estimated as:

External Debt + Loans from Domestic Banks + Borrowings from Domestic Capital Markets

Note: These are adjusted using year-end exchange rates.

- Foreign currency-denominated debt is approximated by external debt<sup>15</sup> based on the following reasons:
  - (i) Most external corporate bonds funds prefer to invest in bonds that are denominated in foreign currencies to reduce liquidity and exchange rate risks. Funds that are driven by carry trade prefer local currency government bonds as they are more liquid and easier to unwind.
  - (ii) Debt covenants in some local currency corporate bonds are weak and credit assessments by international rating agencies are rare. This compounds the weak corporate governance and financial disclosures in several emerging economies.
- The share of foreign currency-denominated corporate debt is given by:

$$\frac{\text{External Debt}}{\text{Total Corporate Debt}}$$

<sup>14</sup> Debt maturity data is incomplete. While Bloomberg provides data on the maturity of corporate bonds, the maturity profiles of corporate borrowing from banks are not readily available through public sources. It is also worth noting that a firm will be classified as being in default if any interim interest or coupon payment is missed even though the principal amount of debt is not due.

<sup>15</sup> Based on residency, could be in foreign or local currency.

## APPENDIX 2. INTEREST COVERAGE RATIO AND DEBT AT RISK

### *Interest Coverage Ratio*

A firm's capacity to service its debt is often captured by its interest coverage ratio (ICR), computed as Earnings/Interest Expense, where Earnings is measured by earnings before interest and taxation (EBIT).<sup>16</sup> The lower the ratio, the more the company is burdened by debt expense relative to earnings. An ICR of less than 1 implies that the firm is not generating sufficient revenues to pay interest on its debt without making adjustments, such as reducing operating costs, drawing down its cash reserves, or borrowing more.

### *Debt at Risk*

By the time a firm's ICR dips below 1, it may have already been in distress. As an early warning signal of potential corporate difficulties, analysts often use an ICR of 1.5 as a threshold. An ICR lower than 1.5 also flags potential vulnerability to funding risks, particularly when market liquidity is scarce. During the Asian Financial Crisis, countries whose corporate sector with median ICR below 1.5 were more vulnerable.<sup>17</sup> Accordingly, we define *debt at risk* as the debts of firms with ICR below 1.5. The debt at risk for each country is computed as:

$$\frac{\sum \text{Debt of Firms with ICR} < 1.5}{\sum \text{Debt of All Firms}}$$

The share of *debt at risk* shows how much of these outstanding debts are vulnerable due to the weak debt servicing capacity. A relatively high share of debt at risk shows that the country may be more susceptible to corporate distress from macroeconomic and financial shocks.

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<sup>16</sup> Also known as operating profit/loss. This analysis uses EBIT as a measure of earnings instead of EBITDA (earnings before interest, taxation, depreciation and amortization) to account for the need to replace assets and reinvest to ensure going-concern.

<sup>17</sup> The median interest coverage ratio in Indonesia, Korea, and Thailand were below 1.5.

### APPENDIX 3. DESCRIPTIVE STATISTICS OF CORPORATE BALANCE SHEET DATA AND RATIOS

The table below shows the total assets, total liabilities, and key ratios of data used in the analysis.

**Appendix Table 1. Assets, Liabilities and Key Ratios in 2014**

	Number of Firms	Total Assets (in percent of GDP)	Total Liabilities (in percent of GDP)	Total Debt/Total Equity (percent)		Returns on Equity (percent)		Interest Coverage Ratio (percent)	
				Median	Standard Deviation	Median	Standard Deviation	Median	Standard Deviation
<b>Argentina</b>	4,994	18	6	48.6	16.7	8.1	4.1	2.3	1.1
<b>Brazil</b>	573	52	24	95.9	18.8	8.2	3.5	1.8	1.0
<b>Chile</b>	367	170	71	62.3	17.9	4.9	2.6	3.3	1.3
<b>Mexico</b>	123	52	28	62.8	12.2	6.5	1.9	3.7	0.8
<b>China</b>	3,720	48	16	29.8	36.9	7.0	8.6	4.3	4.1
<b>India</b>	4,818	16	5	37.7	20.7	9.7	4.9	2.9	1.5
<b>Indonesia</b>	436	28	10	44.6	20.3	7.4	4.3	2.8	1.6
<b>Malaysia</b>	2,986	130	42	26.4	20.6	5.9	5.3	5.6	2.8
<b>Philippines</b>	4,982	87	33	35.6	14.3	7.1	2.8	4.8	1.3
<b>Thailand</b>	4,920	91	36	44.7	24.1	8.0	5.0	5.0	2.2
<b>Bulgaria</b>	4,741	226	67	23.1	39.7	6.3	12.1	2.0	4.5
<b>Hungary</b>	4,587	185	45	31.2	40.5	8.3	12.4	5.6	4.6
<b>Poland</b>	4,902	31	9	40.8	38.3	6.5	12.1	3.9	5.5
<b>Russia</b>	195	51	18	74.4	16.2	3.1	3.6	2.2	1.1
<b>South Africa</b>	289	45	14	40.9	10.6	12.0	3.4	4.3	1.2

Source: Orbis

### APPENDIX 4. NONPERFORMING LOANS AND BANKS' LOSS ABSORBING BUFFERS

In the stress scenario, the increase in corporate nonperforming loan is estimated as follows:

$$\text{Increase Corporate NPL} = \text{Increase in Corporate Loan at Risk} \times \text{Probability of Default} \times \text{Loss Given Default}$$

- *Increase in Corporate Loan at Risk:* This is derived from the scaling of the sample total debt and increase in debt at risk by the amount of total bank lending to the nonfinancial corporate sector.
- *Probability of default:* This can be approximated as 15 percent based on Moody's default probability for corporate debts with interest coverage ratio of 1.5 for a three-year horizon, from 1970-2012.
- *Loss Given Default:* This is computed as an average of 45 percent (Basel II Foundation Approach for senior claims on corporates, sovereigns and banks not secured by recognized



collateral<sup>18</sup>) and country-specific LGDs from The World Bank’s data on “Resolving Insolvency”.<sup>19</sup> (Appendix 1).

The ability of banks to withstand losses will depend on their loss absorbing buffers, which comprise Tier 1 capital and the excess of provisioning over the stock of NPL. The after-shock loss absorbing buffers can be computed as:

$$\frac{\text{Tier 1 capital} + \text{Loan Loss Reserves} - \text{Existing Stock of NPL} - \text{Projected Increase in NPL}}{\text{Risk-Weighted Assets}}$$

### Computing Loss Given Default

Loss given default (LGD) can be calculated from The World Bank’s data on country-specific recovery rates as:  $1 - \text{Recovery Rate}$

The table below shows the imputed LGDs for the sample of countries used in this analysis:

**Appendix Table 2. Recovery Rates and Imputed LGDs by Region and Country**

Country	Recovery rate (cents on the dollar)	Loss Given Default (LGD, in percent)
Argentina	28.6	71.4
Brazil	25.8	74.2
Bulgaria	33.2	66.8
Chile	30	70
China	36	64
Hungary	40.2	59.8
India	25.7	74.3
Indonesia	31.7	68.3
Malaysia	81.3	18.7
Mexico	68.1	31.9
Philippines	21.2	78.8
Poland	57	43
Russian Federation	43	57
South Africa	35.7	64.3
Thailand	42.3	57.7

Source: The World Bank

<sup>18</sup> See section 287-288 of Basel II Accord (<http://www.bis.org/publ/bcbs128.pdf>).

<sup>19</sup> See <http://www.doingbusiness.org/data/exploretopics/resolving-insolvency>

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