

APPENDIX 1. METHODOLOGY FOR CORPORATE SENSITIVITY ANALYSIS¹⁹

A. Estimating the share of corporate external debt

As the breakdown of firm-by-firm foreign currency borrowing is not available through Orbis and other in-house databases, such debts are approximated, at the aggregate level, by external debt statistics and other sources as follows:

Sources of Corporate Borrowing	Data
Foreign currency debt	IMF's Vulnerability Exercise Securities database
Domestic banks	Banking system data from "Financial Soundness Indicators"
Domestic capital markets	Bloomberg

The share of aggregate corporate external debt to total corporate debt is estimated as:

$$\frac{\text{Foreign Currency Debt}}{\text{Foreign Currency Debt} + \text{Loans from Domestic Banks} + \text{Borrowings from Domestic Capital Markets}}$$

B. Estimating the impact of FX movements

FX movement impacts firms through two channels:

Interest payments due in the current year

Exchange rate depreciation would increase the interest burden from FX debts. This is estimated as:

$$\text{Share of External Debt} \times \text{Borrowing Cost} \times \text{Total Debt} \times \left[\left(\frac{\text{Share of USD Debt} \times \text{Nominal Exch. Rate}}{\text{Depreciation vs. USD}} \right) + (\text{Share of EUR Debt} \times \text{Nominal Exch. Rate Depreciation vs. EUR}) \right]$$

The proportion of debts denominated in USD and EUR is approximated by the share of USD and EUR bonds from Dealogic.

Revaluation of loan and bond principal²⁰

In the absence of information on the maturity structure of bank loans, we cannot compute realized FX loss from principal revaluation for the current period; instead, we present the impact on the total stock of debt including loss to be materialized in the future periods.

¹⁹ This follows the methodology used in the analysis of emerging market corporate vulnerability in the April 2014 Global Financial Stability Report (IMF, 2014).

²⁰ In line with IFRS 13 (fair valuation of liabilities).

FX loss on foreign currency debt principal is computed as:

$$\text{Share of External Debt} \times \text{Total Debt} \times [(\text{Share of USD Debt} \times \text{Nominal Exch. Rate Depreciation vs. USD}) + (\text{Share of EUR Debt} \times \text{Nominal Exch. Rate Depreciation vs. EUR})]$$

We compare FX debt to total income ratio before and after an FX shock. First, we compute ratios at the firm level and then we aggregate to the country level by weighting the ratios by the size of assets to account for the relative importance of large firms.

C. Accounting for Natural Hedges

FX losses from interest expense and revaluation of foreign currency debt principal are offset by FX gains from overseas earnings, computed as:

$$\text{Share of Foreign Sales} \times \text{EBIT} \times [(\text{Share of USD Revenue} \times \text{Nominal Exch. Rate Depreciation vs. USD}) + (\text{Share of EUR Revenue} \times \text{Nominal Exch. Rate Depreciation vs. EUR})]$$

Assumptions underlying this estimation are:

- Foreign sales are assumed to be in foreign currencies.
- The share of FX revenues is derived from the country trade weights. USD share of income refers to share of income earned through trade with the United States and China; EUR share refers to trade proceeds with euro area, and the remaining FX proceeds are assumed to be denominated in other currencies. This approach to account for natural hedges has several caveats. First, trade with countries other than the United States, China, and euro area maybe invoiced in USD (e.g., Turkey's trade with the Middle East [one-fifth of total trade]); and second, we fail to account for dollarization transactions which should be considered natural hedge even though revenues are from domestic sources.
- The multiplication by EBIT (operating profit) effectively takes into account foreign currency costs as it assumes that the share of these costs are in proportion to foreign currency incomes.

It is worth noting that the effectiveness of natural hedges is an approximation as it may fall short of expectations. Past episodes have demonstrated that overseas revenues declined in tandem with the depreciating currencies during turbulent periods.

D. Accounting for Financial Hedges

Currency hedging of foreign currency debts could also mitigate potential FX losses. Offset from financial hedging of foreign currency debt service is computed as:

Hedge Ratio x FX losses from FX debt interest

As information on financial hedging is sparse, this analysis assumes that at least 50 percent of foreign currency debts are hedged, on aggregate basis.

E. Estimating Nonperforming Loans and Banks' Buffers

The corporate nonperforming loans were projected from the aftershock corporate debt at risk owed to banks as follows:

$$\text{Corporate Nonperforming Loan After Shock} = \text{Probability of Default} \times \text{Corporate Loan at Risk} \times \text{Loss Given Default}$$

- *Probability of default:* With debt at risk defined as those with ICR below 1.5, the probability of default can be approximated as 15 percent.²¹
- *Corporate loan at risk:* This is derived from the scaling of the sample total debt and aftershock debt at risk by the amount of total lending to the nonfinancial corporate sector.
- *Loss given default:* This is derived from an average of the World Bank's loss given default rate for each country²² and 45 percent.²³

The aftershock loss absorbing buffers can be computed as:

$$(\text{Tier 1 Capital} + \text{Loan Loss Reserves} - \text{Existing Stock of Nonperforming Loans} - \text{Projected Increase in Nonperforming Loans}) / \text{Risk-Weighted Assets}$$

²¹ Based on Moody's default probability for corporate debts with ICR of 1.5 for a three-year horizon from 1970–2012.

²² See <http://www.doingbusiness.org/data/exploretopics/resolving-insolvency>. Loss given default is computed as 1-Recovery Rate.

²³ Based on the Bank for International Settlements' loss given default for senior claims on firms, sovereigns, and banks not secured by recognized collateral.

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