Firm Dollar Debt and Central Bank Dollar Reserves: A Case of Moral Hazard?

Presented by
Rajeswari Sengupta

March 10, 2010
Corporate firms in emerging market economies (EMEs) borrow largely in foreign currency (or dollars).

Interest rates on dollar debt are lower than on local currency (peso) debt.

While liabilities are denominated in dollars, assets are mostly in pesos - especially for firms in non-tradable sectors.

Resultant currency mismatch on firms’ balance sheets is a source of financial vulnerability.

An exchange rate depreciation increases peso value of dollar debt.

This in turn increases likelihood of debt default and bankruptcy.

Cause of concern for EMEs in Latin America, East Asia and Eastern Europe.
During fixed exchange rate regime, firms have higher incentive to borrow in dollars.

As an economy shifts to flexible regime, ideally share of dollar debt should decrease.

However, an EME central bank (CB) may exhibit a lower credibility of maintaining a regime of float (‘float with a lifejacket’).

CB may intervene in forex market to stabilize exchange rate using its stock of international reserves (IR).

IR are accumulated as means of self-insurance against future financial instability *(precautionary motive; see Aizenman and Lee, 2007)*

- Moral Hazard: Firms may consider themselves insulated against currency risk.

**Objective**

Understand whether act of holding reserves may act as potential signal of currency stabilization, inducing firms to continue borrowing in dollar.

- Firm-level database: close to 1000 firms in 4 LATAM countries.
LHS axis: Avg. International Reserves to GDP ratio of Brazil, Mexico, Chile and Argentina (1995-2007).

RHS axis: Avg. Firm-Level Dollar Liabilities to Total Liabilities ratio of non-financial sector firms of 4 countries.
Main Topic
  - Context in Literature

Objective & Contribution

Data

Empirical Model

Results (work in progress)

Summary & Next Steps
Financial liberalization has led to widespread cross-border capital flows as well as capital flow reversals.


- Crises of 1990s reflected fragilities in balance sheets of firms, banks and governments (Dornbusch, 2001; Krugman, 1999).

- One source of balance-sheet fragility often emphasized is, foreign currency debt.

  - Krugman(1999); Aghion, Bacchetta and Banerjee(2001); Schneider and Tornell (2001); Cespedes, Chang and Velasco(2004).

    - Theoretically explored role played by currency mismatch in corporate balance sheets.
    - This reflects a shift of emphasis from government/macro variables to firm level financial variables.

- Pvt. sector dollar debt arises due to moral hazard created by bailout guarantees of CB (mostly bank bailouts).

Dooley (1997); Burnside, Eichenbaum and Rebelo (2001): Stabilizing exchange rate may lead to more foreign currency debt.

‘Fear of Floating’: (Calvo and Reinhart, 2002; Hausmann, Panizza and Stein, 2001).

- EMEs formally float their currency, but tend to limit exchange rate movement.
- Aggressively intervene in forex markets, using large stock of reserves.
Over past twenty years, CBs in EMEs (including LATAM) have accumulated large amounts of dollar reserves.

**Question**

*Does accumulation of reserves result in moral hazard by encouraging firms to borrow in dollars?*

**Contributions:**

- Association between CB’s reserves and firms’ dollar debt has not been empirically explored before.
  - Dearth of data on firm level dollar assets and liabilities.
- Use of a novel firm-level balance-sheet database covering close to 1000 firms in 4 major LATAM countries, to explore this association.
- Looking into this question will also throw light on possible determinants of LATAM firm level dollar debt.

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1 Moral hazard occurs when the party with more information about its intentions has an incentive to behave inappropriately from the perspective of the party with less information.
New database from Inter-American Development Bank (IDB): Annual balance sheet information of non-financial sector firms.

4 major LATAM countries (Argentina, Brazil, Chile & Mexico), over the period, 1995-2007.

Annual reports, audited corporate filings from country specific sources, regulatory agencies.

1. Sector a firm belongs to (1, 2,3 digit ISIC classification),
2. Total assets and liabilities,
3. Total dollar assets and liabilities,
4. Maturities of assets and liabilities,
5. Exports and sales,
6. Dummies indicating:
   - Whether firm owned by a foreign company,
   - Whether it has issued ADR-GDR in foreign stock exchanges,
   - Whether the firm belongs to a tradable sector.
Other studies that have used this IDB database: Cowan, Hansen and Herrera (2004); Cowan and Bleakley (2008); Galindo, Panizza and Schiantarelli (2003) etc.

Mostly explored the impact of dollar debt in balance sheets on firms’ investment.

Country level data from:

1. **Global Financial Database** *(Exchange rates, Lending rates & LIBOR)*
2. **World Development Indicators (WDI)** *(Reserves, GDP)*
3. **Datastream** *(Sovereign bond yields)*
4. **World Bank Financial Structure Database** *(Beck, Demirguc-Kunt and Levine, 2007)* *(Stock market cap. and private credit by banks to GDP ratio)*
To ensure that estimation is done with sufficient and consistent observations:

- Drop firms with less than three years of data.
- Drop firms with embedded gaps in duration/spell.
- Checking for inconsistent accounting data (e.g. dollar liabilities > total liabilities.)

All data converted to US dollars using contemporaneous exchange rates, to facilitate pooling of data.

For Argentina: most debt contracts were rewritten through *pesification* in 2002 (crisis).

- Exclude post-2001 years as contractual changes may distort estimations.
Empirical Model

Regression Equation


\[ D_{ijt} = \beta_0 + \beta_1 R_{jt-1} + \alpha_i + X'_{ijt-1} \beta_2 + Z'_{jt-1} \beta_3 + \epsilon_{ijt}, \]  

\( i = 1..N \) (firm) ; \( j = 1..K \) (country); \( t = 1..T \) (time)

- \( D_{ijt} \) = ratio of dollar liabilities and total liabilities of firm \( i \) in country \( j \) at time \( t \).
- \( R_{jt-1} \) = ratio of international reserves and gdp of country \( j \) at time \( t-1 \).
- \( X'_{ijt-1} \) = Firm level control variables.
- \( Z'_{jt-1} \) = Country level control variables.

Implicit guarantee provided by ex-ante reserves accumulation in period (t-1) may induce firms to increase ratio of dollar debt to total debt in period t.

- Expected \( \beta_1 > 0 \).
Empirical Model

Explanatory Variables: Firm Level

- Ratio of exports to sales:
  - Firms with higher exports to sales ratio are likely to be able to hedge their currency exposure using dollar denominated export earnings (Caballero and Krishnamurthy, 2003).
  - Likely to have better access to international credit markets as can pledge export receivables as collateral (Jeanne, 2003).
- Firm size measured by log of total assets.
  - Larger firms likely to have more assets to pledge as collateral and hence will be able to issue more dollar debt (Allayanis, 2003)
- Dummy $adr_{gdr} = 1$ from year when a firm starts trading in a foreign equity market.
  - Foreign stock market listing enables a firm to signal its superior quality to creditors (Allayanis, 2003) .
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Empirical Model

Explanatory Variables: Country Level

- Volatility in exchange rate:
  - A highly volatile exchange rate should lower the ratio of dollar debt to total debt.

- Differential Borrowing cost \((r-r^*)\): difference in domestic lending rate and LIBOR of same duration.
  - Positively associated with use of dollar debt (Graham and Harvey, 2001).
Table 1: Descriptive Statistics for Full Sample (1995-2007)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Brazil</th>
<th>Mexico</th>
<th>Chile</th>
<th>Argentina*</th>
<th>All</th>
</tr>
</thead>
<tbody>
<tr>
<td>dollar debt/total debt</td>
<td>0.20</td>
<td>0.36</td>
<td>0.20</td>
<td>0.57</td>
<td>0.27</td>
</tr>
<tr>
<td>(std. dev.)</td>
<td>(0.20)</td>
<td>(0.30)</td>
<td>(0.29)</td>
<td>(0.29)</td>
<td>(0.30)</td>
</tr>
<tr>
<td>exports/sales</td>
<td>0.12</td>
<td>0.17</td>
<td>0.07</td>
<td>0.07</td>
<td>0.10</td>
</tr>
<tr>
<td>(std. dev.)</td>
<td>(0.22)</td>
<td>(0.23)</td>
<td>(0.19)</td>
<td>(0.16)</td>
<td>(0.21)</td>
</tr>
<tr>
<td>total assets (billions USD)</td>
<td>2.09</td>
<td>1.58</td>
<td>0.32</td>
<td>0.51</td>
<td>1.21</td>
</tr>
<tr>
<td>(std. dev.)</td>
<td>(7.51)</td>
<td>(3.83)</td>
<td>(0.82)</td>
<td>(1.16)</td>
<td>(4.99)</td>
</tr>
<tr>
<td>total no. of firms</td>
<td>370</td>
<td>196</td>
<td>263</td>
<td>196</td>
<td>1025</td>
</tr>
<tr>
<td>reserves/gdp</td>
<td>0.07</td>
<td>0.07</td>
<td>0.19</td>
<td>0.07</td>
<td>0.11</td>
</tr>
<tr>
<td>(std. dev.)</td>
<td>(0.02)</td>
<td>(0.02)</td>
<td>(0.04)</td>
<td>(0.02)</td>
<td>(0.06)</td>
</tr>
<tr>
<td>reserves/m2</td>
<td>0.27</td>
<td>0.16</td>
<td>0.40</td>
<td>0.28</td>
<td>0.29</td>
</tr>
<tr>
<td>(std. dev.)</td>
<td>(0.06)</td>
<td>(0.03)</td>
<td>(0.12)</td>
<td>(0.03)</td>
<td>(0.10)</td>
</tr>
</tbody>
</table>

Source: Author’s own calculations.
First four columns report average values across all firms in each country. Last column reports average values across all firms in the pooled sample.

*Argentina sample truncated in 2001 due to large scale pesification post crisis.
## Results

### Table 2: Firm Dollar-Debt and CB Dollar-Reserves

<table>
<thead>
<tr>
<th>Indep. Vars.</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>res_gdp</td>
<td>0.259***</td>
<td>0.300***</td>
<td>0.304***</td>
<td>0.213**</td>
<td>0.166*</td>
<td>0.187**</td>
</tr>
<tr>
<td></td>
<td>(0.075)</td>
<td>(0.081)</td>
<td>(0.082)</td>
<td>(0.091)</td>
<td>(0.090)</td>
<td>(0.090)</td>
</tr>
<tr>
<td>export_sales</td>
<td>0.060***</td>
<td>0.059***</td>
<td>0.047**</td>
<td>0.045**</td>
<td>0.049**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.021)</td>
<td>(0.020)</td>
<td>(0.021)</td>
<td></td>
</tr>
<tr>
<td>firm_size</td>
<td>0.001</td>
<td>0.004</td>
<td>0.003</td>
<td>0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>adr_gdr</td>
<td>-0.048***</td>
<td>-0.042***</td>
<td>-0.028**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.014)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ex_vol</td>
<td>-0.002***</td>
<td>-0.002***</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>r-r*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.002***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>(0.000)</td>
<td></td>
</tr>
</tbody>
</table>

| Firm Fixed Effects | Y | Y | Y | Y | Y | Y |
| Observations      | 8588 | 7114 | 7112 | 6917 | 6917 | 6556 |
| Adj. $R^2$        | 0.002 | 0.004 | 0.004 | 0.004 | 0.024 | 0.043 |

Robust Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1

Res_gdp is ratio of international reserves to GDP.
A constant is included but not reported.
All explanatory variables are lagged by 1 period.
Lagged reserves to gdp ratio: Positive in line with hypothesis and statistically significant.

- A unit increase in reserves-gdp ratio induces an estimated increase of 0.19 unit in the dollar debt ratio of a firm, on average.

Exports to sales ratio of firms: Significant predictor of firms’ dollar debt.

- Result consistent with studies of firms’ financing choices (Caballero and Krishnamurthy, 2003; Jeanne, 2003; and Allayanis at al, 2003)

Exchange rate volatility: Expected negative sign.

Differential borrowing cost: Expected positive sign.
Table 3: With Alternative Measure of Reserves

<table>
<thead>
<tr>
<th>Indep. Vars.</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>res_m2</td>
<td>0.177***</td>
<td>0.213***</td>
<td>0.219***</td>
<td>0.200***</td>
<td>0.084**</td>
<td>0.077**</td>
</tr>
<tr>
<td></td>
<td>(0.027)</td>
<td>(0.029)</td>
<td>(0.030)</td>
<td>(0.032)</td>
<td>(0.034)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>export_sales</td>
<td>0.055***</td>
<td>0.054***</td>
<td>0.044**</td>
<td>0.044**</td>
<td>0.048**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.021)</td>
<td>(0.020)</td>
<td>(0.021)</td>
<td></td>
</tr>
<tr>
<td>firm_size</td>
<td>0.005</td>
<td>0.007</td>
<td>0.004</td>
<td>0.004</td>
<td>0.006</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
<td>(0.004)</td>
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<td></td>
</tr>
<tr>
<td>adr_gdr</td>
<td>-0.048***</td>
<td>-0.041***</td>
<td>-0.028**</td>
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</tr>
<tr>
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<td>(0.013)</td>
<td>(0.012)</td>
<td>(0.014)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>ex_vol</td>
<td></td>
<td>-0.002***</td>
<td>-0.002***</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
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</tr>
<tr>
<td>r-r*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.002***</td>
</tr>
<tr>
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<td></td>
<td></td>
<td></td>
<td>(0.000)</td>
</tr>
</tbody>
</table>

Firm Fixed Effects: Y Y Y Y Y Y
Observations: 8588 7114 7112 6917 6917 6556
Adj. R²: 0.006 0.010 0.010 0.009 0.024 0.043

Robust Standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
Res_m2 is ratio of international reserves to M2.
A constant is included but not reported.
All explanatory variables are lagged by 1 period.
One concern with baseline specification: large fraction of firms have zero dollar debt every year (roughly 23% in total).

Observations for dollar debt are left censored at 0.

- Estimate equation (1) using a Panel Tobit (censored) model for limited dependent variable (LDV).

Structural equation of Panel Tobit model with random effects:

$$D_{ijt}^* = \beta_0 + \beta_1 R_{jt-1} + \alpha_i + X'_{ijt-1} \beta_2 + Z'_{jt-1} \beta_3 + \epsilon_{ijt}$$  \hspace{1cm} (2)

where $D_{ijt}^*$ is a latent variable observed for values greater than 0.

- Observed $D_{ijt}$ is defined by the following equations:

$$D_{ijt} = D_{ijt}^* \text{ if } D_{ijt}^* > 0$$  \hspace{1cm} (3)

$$D_{ijt} = 0 \text{ if } D_{ijt}^* \leq 0$$  \hspace{1cm} (4)

$i = \text{firm}; j = \text{country}; t = \text{time}.$

- $\alpha_i = \text{Unobserved firm-specific effects}$

- Assume $\epsilon_{ijt}$ is normally distributed with mean 0 and variance $\sigma^2$.

- Also incorporate country, sector and year specific dummy variables.
### Table 4: Panel Tobit Model Estimates

<table>
<thead>
<tr>
<th>Indep. Vars.</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dep.Var: dollar debt/total debt</td>
<td></td>
</tr>
<tr>
<td>res.gdp</td>
<td>0.077 (0.055)</td>
<td>0.156* (0.091)</td>
</tr>
<tr>
<td>export_sales</td>
<td>0.060*** (0.012)</td>
<td>0.076*** (0.012)</td>
</tr>
<tr>
<td>firm.size</td>
<td>0.018*** (0.002)</td>
<td>0.030*** (0.002)</td>
</tr>
<tr>
<td>adr.gdr</td>
<td>-0.011 (0.008)</td>
<td>0.018** (0.008)</td>
</tr>
<tr>
<td>ex.vol</td>
<td>-0.002*** (0.000)</td>
<td>-0.001*** (0.000)</td>
</tr>
<tr>
<td>r-r*</td>
<td>0.001*** (0.000)</td>
<td>0.000** (0.000)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Firm Specific Effects</th>
<th>Y</th>
<th>Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Country Dummies</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Sector Dummies</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Year Dummies</td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

Observations 6556 6556
Uncensored Obs. (%) 77.03 77.03

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1
All explanatory variables are as in Table 2.
Coeff. estimates denote marginal effects on dep.var.
For dummies, it is the effect of discrete changes from 0 to 1.
**Objective:** Use firm level balance sheet data for LATAM (4) to explore possibility of moral hazard from implicit guarantee provided by ex-ante reserve-accumulation.

**Evidence:** Increase in reserves may lead to an increase in dollar borrowing of non-financial sector firms.

**Robustness:** Results hold when controlled for:

1. firm-level and country-level determinants of dollar debt;
2. firm-specific effects & sector, time and country dummies;
3. accounted for corner solutions in firms’ financing choices

**Next Steps**

1. Country specific analysis of potential moral hazard.
2. Policy implications with regard to responses of leveraged firms in LATAM to the current global financial crisis of 2008-09.
Thank You
Table 5: Panel Tobit: With Reserves/M2

<table>
<thead>
<tr>
<th>Indep. Vars.</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>res_m2</td>
<td>0.060***</td>
<td>0.058*</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.035)</td>
</tr>
<tr>
<td>export_sales</td>
<td>0.059***</td>
<td>0.076***</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>firm_size</td>
<td>0.019***</td>
<td>0.030***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>adr_gdr</td>
<td>-0.012</td>
<td>0.018**</td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.008)</td>
</tr>
<tr>
<td>ex_vol</td>
<td>-0.002***</td>
<td>-0.001***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>r-r*</td>
<td>0.001***</td>
<td>0.000**</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
</tbody>
</table>

Firm Specific Effects: Y
Country Dummies: Y
Sector Dummies: Y
Year Dummies: Y

Observations: 6556
Uncensored Obs. (%): 77.03

Standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1
All explanatory variables are as in Table 2.
Coeff. estimates denote marginal effects on dep.var.
For dummies, it is the effect of discrete changes from 0 to 1.

RHS axis: Avg. Firm-Level Dollar Liabilities to Total Liabilities ratio of non-financial sector firms.

RHS axis: Avg. Firm-Level Dollar Liabilities to Total Liabilities ratio of non-financial sector firms.
LHS axis: International Reserves to GDP ratio of Chile (1995-2007).

RHS axis: Avg. Firm-Level Dollar Liabilities to Total Liabilities ratio of non-financial sector firms.

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