Information Asymmetry and Foreign Currency Borrowing by Small Firms

Brown, M.; Ongena, S.; Yesin, P.

Publication date:
2011

CentER

Discussion paper

INFORMATION ASYMMETRY AND FOREIGN CURRENCY BORROWING BY SMALL FIRMS

By
Martin Brown, Steven Ongena, Pinar Yesin

September 1, 2011

European Banking Center Discussion Paper
No. 2011-026

This is also a CentER Discussion Paper
No. 2011-099

ISSN 0924-7815

Information Asymmetry and Foreign Currency Borrowing by Small Firms

Martin Brown*, Steven Ongena**, Pinar Yeşin***

September 1, 2011

* University of St Gallen and CentER – Tilburg University, email: martin.brown@unisg.ch, ** CentER – Tilburg University and CEPR, email: steven.ongena@tilburguniversity.nl, *** Swiss National Bank, email: pinar.yesin@snb.ch. We thank an anonymous referee for the Swiss National Bank Working Paper Series, Raphael Auer, Söhnke Bartram, Henrique Basso, Katalin Bodnar, Geraldo Cerqueiro, Andreas Fischer, Davide Furceri, Luigi Guiso, Werner Hermann, Herman Kamil, Anton Korinek, Marcel Peter, Alexander Popov, Maria Rueda Mauer, Philip Sauré, Linus Siming, Clas Wihlborg and seminar participants at the University of Amsterdam, the Federal Reserve Bank of Boston, the University of Zurich, the Swiss National Bank, as well as participants at the European Finance Association Meeting (Bergen), the SNB-CEPR conference on "Foreign Currency Risk Taking by Financial Institutions, Firms and Households" (Zürich), the Financial Intermediation Research Society Meeting (Prague), the CEPR/Studienzentrum Gerzensee European Summer Symposium in Financial Markets (Gerzensee), the European Economic Association Meetings (Milano), the CREDIT Conference (Venice), ESCE Meetings (Paris), the NBP-SNB Joint Seminar on "Challenges for Central Banks during the Current Global Crisis" and the Tor Vergata Banking and Finance Conference (Rome) for useful comments and discussions. We also thank Simon Wehrmueller for valuable research assistance. Ongena gratefully acknowledges the hospitality of the Swiss National Bank. Any views expressed are those of the authors and do not necessarily reflect those of the Swiss National Bank.

Information Asymmetry and Foreign Currency Borrowing by Small Firms

Abstract

We model the choice of loan currency in a framework which features a trade-off between lower cost of debt and the risk of firm-level distress costs. Under perfect information foreign currency funds come at a lower interest rate, all foreign currency earners as well as those local currency earners with high revenues and/or low distress costs choose foreign currency loans. When the banks have imperfect information on the currency and level of firm revenues, even more local earners switch to foreign currency loans, as they do not bear the full cost of the corresponding credit risk.

Keywords: foreign currency borrowing, competition, banking sector, market structure.

JEL: G21, G30, F34, F37.

I. Introduction

A large proportion of corporations in many countries have been traditionally borrowing in a foreign currency.[1] More recently and prior to the financial crisis also many retail clients, i.e., households and small firms, have taken out foreign currency loans. In countries such as Latvia, Lithuania, Hungary, and Bulgaria, for example, retail clients still hold a similar or larger share of their loans in foreign currency than corporations (European Central Bank (2010)).

These retail loans in foreign currency are popularly believed to be "small men's carry trades",[2] i.e., loans in which households and entrepreneurs seek lower interest rates and take unhedged exchange rate risk upon themselves (Sorsa, Bakker, Duenwald, Maechler and Tiffin (2007)). Yet in an empirical study Brown, Ongena and Yeşin (2011) document that foreign currency borrowing by small firms in transition countries is much stronger related to (firm-level) foreign currency revenues than it is to (country-level) interest rate differentials.[3] Thus "carry-trade behavior" may in fact not be the key driver of foreign currency borrowing (see also Brown and De Haas (2012)).

---

[1] In East Asia, corporate debt is split about equally between foreign and domestic currencies (Allayannis, Brown and Klapper (2003)) while in several Latin American countries the share of foreign currency debt exceeds 20 percent (Galindo, Panizza and Schiantarelli (2003)). Between 20 and 75 percent of all corporate loans in Eastern European countries are denominated in a foreign currency (European Central Bank (2006), p. 39).

[2] *Wall Street Journal*, May 29th, 2007. Carry trades, in which investors borrow in a low-yielding currency and invest in a high-yielding one, are a widespread phenomenon. At the beginning of 2007 it was estimated that that as much as US$1 trillion was involved in the yen carry trade for example (*The Economist*, February 1st, 2007). Traditionally, carry trades have been made by large financial institutions and leveraged institutions, such as hedge funds. Low exchange rate volatility and persistent interest rate differentials have fueled the growth in cross-currency positions in recent years (Galati, Heath and McGuire (2007)).

[3] They investigate the currency denomination of individual bank loans granted to 3,101 small firms in 25 transition countries between 2002 and 2005. Brown, Kirschenmann and Ongena (2010) examine the requested and granted loan currency of small business loans granted by one retail bank in Bulgaria. Other studies have examined foreign currency borrowing by analyzing aggregate cross-country data (e.g., Basso, Calvo-Gonzalez and Jurgilas (2011), Rosenberg and Tirpák (2008), Luca and Petrova (2008)) or the currency denomination of debt of large firms within a single country (Kedia and Mozumdar (2003), Keloharju and

Though a number of recent theoretical papers have started to model the choice of loan currency in a way that may also be relevant for small firms (Allayannis, Brown and Klapper (2003)), a theoretical framework to understand foreign currency borrowing in retail credit markets where informational asymmetries are acute is still lacking (see also the review in Nagy, Jeffrey and Zettelmeyer (2011)).

In this paper we aim to fill this gap in the literature by introducing an information asymmetry between banks and firms in a framework that also features a trade-off between the cost and risk of debt. We conjecture that banks do not necessarily know the currency in which (small) firms have contracted their sales, and/or the firms' actual revenue levels, an issue that may be particularly relevant in transition and developing countries.

Information asymmetries between banks and firms underpin our modern understanding of financial intermediation (Freixas and Rochet (2008)) and the asymmetries may be aggravated in transition and developing countries. The currency denomination of a firm's current and future sales contracts is often negotiated (and a closely guarded secret).[4] Depending on bank type, size or ownership and the degree of competition in the banking sector, banks may have difficulties or lack incentives to collect detailed information about firm revenues.

The costs of information acquisition are particularly high when dealing with small firms, which are less likely to have audited financial accounts,[5] and when dealing with

---

Niskanen (2001), Benavente, Johnson and Morande (2003), Cowan, Hansen and Herrera (2005), Gelos (2003)) or across countries (Rajan and Zingales (1995), Booth, Aivazian, Demirgüç-Kunt and Maksimovic (2001), Allayannis, Brown and Klapper (2003), Cowan (2006), Esho, Sharpe and Webster (2007), Kamil (2009), and Kamil and Sutton (2008)). Clark and Judge (2008) provides a review of the relevant empirical literature.

[4] See Friberg and Wilander (2008). Firm risk aversion (Viaene and de Vries (1992)), currency variability (Engel (2006)) and medium of exchange considerations (Rey (2001)) may determine currency choice.

[5] Firms in transition and developing countries often borrow without having any audited statements (e.g., Dollar and Hallward-Driemeier (2000)). In addition, banks often cannot verify firm sales information through advanced cash management services which are yet to be introduced there, either because banks do not offer

firms that are located in transition and developing countries, where due to the weak corporate legal system it is hard for banks to assess the credibility of available firm-level financial information (Pistor, Raiser and Gelfer (2000), Brown, Jappelli and Pagano (2009)). Firms therefore often borrow without having audited statements. Banks also can not verify firm sales information through advanced cash management services, which are yet to be introduced in many firms. Consequently, "soft" information may be the only type of information that is available, but foreign banks – which are widely present in transition and developing countries – may struggle to collect and use it (Stein (2002), Detragiache, Tressel and Gupta (2008)).

Our model clarifies how the choice of loan currency is affected by the bank's lack of information about the currency denomination and level of the firm's revenues, an acute issue for many banks when dealing with small firms in transition and developing countries.[6] Existing models demonstrate that firms' choice of loan denomination is affected by the structure of firm revenues,[7] interest rate differentials between local and foreign currency

---

these services (e.g., Tsamenyi and Skliarova (2005)) or firms do not demand them (for example, in the survey analyzed in Brown, Ongena and Yeşin (2011), one third of the firms report receiving less than one third of their income through their banks). Banks may also lack information on firm quality, project choice, or managerial effort, for example, incurring monitoring costs (Diamond (1984), Diamond (1991)) or forming relationships with the firms (Sharpe (1990), Rajan (1992), von Thadden (2004), Hauswald and Marquez (2006), or Egli, Ongena and Smith (2006), among others).

[6] Consequently, we do not discuss: (1) International taxation issues such as tax loss carry forwards and limitations on foreign tax credits; (2) The possibilities for international income shifting; (3) The differential costs across countries of derivatives to create synthetic local debt; and (4) Clientele effects in issuing public bonds. These issues are clearly important when analyzing the debt structure of large corporations.

[7] If the firm's cash flows are in foreign currency, borrowing in the same foreign currency will provide a straightforward natural hedge (Goswami and Shrikhande (2001)). Mian (1996), Bodnar, Hayt and Marston (1998), Brown (2001) and Allayannis and Ofek (2001), among others, analyze the hedging of foreign currency exposure, using forward contracts and derivatives for example. But many developing country currencies have no forward markets; and even in those that do, there are substantial costs to hedging (Frankel (2004)). And even in developed countries small firms rarely use derivatives to hedge their net currency exposure (Briggs (2004), Børsum and Ødegaard (2005), and O'Connell (2005), among others). As expected therefore, small firms in developing countries not uncommonly default on loans in foreign currency following a deep depreciation of the local currency (Ziaul Hoque (2003)).

funds,[8] and the distress costs of firms facing potential default (see Allayannis, Brown and Klapper (2003) for an overview).

Our theoretical model augments extant work, by featuring not only the trade-off between the risk and the cost of debt, but also a relevant information asymmetry between banks and firms that can have either domestic or foreign currency earnings.[9] Our model first confirms that under perfect information if there is an interest rate differential in favor of foreign currency funds, all foreign currency earners will prefer foreign currency loans. In addition, all local currency earners with low distress costs and high revenues will also choose foreign currency loans. In contrast, local currency earning firms with high distress costs and low revenues will prefer local currency loans. Then our model shows that if banks cannot identify either the currency or the level of the revenues of the firm, more local earners will borrow in foreign currency as the firms do not bear the full cost of the corresponding default risk.

Consequently, our model identifies the information asymmetry between lending banks and borrowing firms as a so far overlooked potential driver of "dollarization" in the credit markets. We also find the conditions under which all firms will be borrowing in foreign currency (full pooling equilibria), as well as no foreign currency loans will be

[8] Static capital structure trade-off theory suggests firms opt for the lowest cost debt, making the interest rate differential, i.e., the deviations from the uncovered interest rate parity (UIP), the second main determinant of the firm's choice of loan currency denomination (Graham and Harvey (2001)).

[9] In Jeanne (2000) financiers face an information asymmetry concerning the effort level of the exporting entrepreneurs. Exporters borrow locally in domestic or foreign currency. But borrowing in a foreign currency serves as a commitment device: The entrepreneurs have a stronger incentive for effort if they have foreign currency debt, because failure to achieve high returns is automatically sanctioned by termination. In Cowan (2006) firms with more foreign income and firms in countries with a higher interest differential (where foreign currency funds are cheaper) will have more foreign debt. Firms that are more financially constrained, i.e., firms that experience a higher risk premium when borrowing from a bank, are more likely to match the denomination of debt to their income streams. These firms would have to borrow at higher costs if they become financially distressed due to the accumulated currency mismatches. If a bank knows a firm is mismatched, it may pass on the corresponding expected default costs. In contrast to Jeanne (2000), in which firms only have foreign revenues, firms in our model have domestic or foreign currency earnings. In Jeanne (2000) entrepreneurial effort is unobservable to the financiers; in our model, the currency in which sales are contracted and sales revenues are collected cannot be observed by the bank.

offered by banks to firms who cannot prove they have either high or foreign currency income (market failure). The key predictions of our model are consistent with for example recent evidence by Degryse, Havrylchyk, Jurzyk and Kozak (2012) who find that foreign banks that enter via greenfield investment, and that may face more information asymmetry than those foreign banks that enter via domestic take-overs, lend more in foreign currency. We leave the more comprehensive testing of our model hypotheses to future empirical research.

The rest of the paper is organized as follows. Our model assumptions are introduced in Section II, followed in Section III by the analysis of the model with perfect information. In Section IV imperfect information is introduced. Section V concludes and summarizes all key firm- and country-level empirical predictions.

II. Model Assumptions

Define e_t, the exchange rate at time t, to equal the amount of local currency per unit of foreign currency, normalized at $t=0$ to $e_0=1$. At $t=1$, the local currency either appreciates to $e_A<1$, with probability p, or it depreciates to $e_D>1$, with probability $1-p$. We assume that $pe_A+(1-p)e_D=1$, so that the expected exchange rate at $t=1$ equals $e_1^*=1$ and the expected depreciation of the local currency is $\Delta e=\frac{e_1^*-e_0}{e_0}=0$.[10]

There is a continuum of firms and each firm needs to invest $I=1$ in local currency at $t=0$ to receive any revenues at $t=1$. Firms differ in their revenue structure. There are three types of firms, foreign (F), good local (LG) and bad local (LB) currency earners.

[10] As we assume that the level of firm revenues does not change with the exchange rate, the changes in the exchange rate in our model are assumed to be real.

Foreign currency earners have revenue R^F in foreign currency, which equals the expected revenue in local currency as the expected exchange rate equals one ($e_1^* = 1$, hence $R^F e_1^* = R^F$). The other two types of firms have local currency earnings. The good local currency earners have high earnings R^{LG} in local currency, while the bad local currency earners have low earnings in local currency, $R^{LB} < R^{LG}$. We abstract from the possibility that foreign currency earners may differ in their income levels and from exchange rate pass-through considerations, as neither issue alters the main insights of our model.[11]

Let all firm types be physically located in the domestic country. Their owners will spend their profits locally, so firms care about their expected payoff in local currency. Firms maximize their expected income and have no other wealth (and are thus limited liable).[12]

There are at least two identical banks that offer loans in both local and foreign currency and that are engaged in Bertrand competition setting prices simultaneously. When they can identify firm type, they charge a net interest rate r_k^j on a loan in foreign or local currency k, $k \in \{f; l\}$, to a firm of type $j \in \{F; LB; LG\}$.[13] Banks have no capacity limits on foreign or local currency funds. We normalize the cost of foreign currency funds to $i_f = 0$ and set the unit cost of local currency funds to i_l. We assume that the uncovered interest rate parity (UIP) is not fulfilled, and that there is an interest rate advantage to foreign

[11] Under perfect information, all foreign currency earners would take foreign currency loans at the same interest rate independent of their revenue level. With asymmetric information about firm revenues this result also holds for reasonable assumptions on firm-level distress costs, as we show in an earlier version of our model (Brown, Ongena, Popov and Yeşin (2011)). See Goldberg and Knetter (1997), for example, on exchange rate pass-through.

[12] While we assume that firms maximize expected income, their payoff is not linear in expected income when we assume distress costs. The assumption of distress costs implies that firms care about income variance, as would be the case if we assumed firms were risk-averse.

[13] Firms in our model receive both their expected income and their loan in a single – though not necessarily the same – currency. Without qualitatively affecting the main hypotheses, our model is readily extendable to include firms that receive their expected income and loans in varying proportions in multiple currencies.

currency funding for the bank, i.e., $i_l > i_f + \Delta e = 0$. Extensive empirical research, using a variety of methods, finds that the UIP rarely holds. Furthermore, the literature finds that the deviation from the UIP in emerging markets is systematic in nature and that a significant part of the excess return can be attributed to a risk premium.[14]

For simplicity we assume that interest payments are made upfront at $t = 0$, and the loan repayment is made at $t = 1$.[15] Firms' earnings are verifiable *ex post*, so that payments are enforceable if a firm has sufficient earnings.

We assume that the exchange rate volatility is such that bad local currency earners will always default if they take a loan in foreign currency and the local currency depreciates, i.e., $R^{LB} < e_D$. We also assume that all good local currency earners have sufficient revenues to pay back their loan regardless of the exchange rate movements, i.e., $R^{LG} > e_D$. Moreover, we assume that foreign currency earners have revenues that will enable them to fully repay a local currency loan even if the local currency appreciates, i.e., $R^F > \frac{1}{e_A}$.

If firms default on a loan, they face costs of financial distress. For example, defaulters can henceforth find external financing only at penalty costs. In this case, the distress costs C may be proportional to or convex in the default amount (though still homogenous across firms). Alternatively, these costs may involve the private value to its owner of a firm that is lost in bankruptcy (for example, in the case of small and family-owned firms (Froot, Scharfstein and Stein (1993))).[16] In this case, C will be independent of the default amount,

[14] General reviews by Hodrick (1987), Froot and Thaler (1990), Lewis (1995), Engel (1996), for example. For emerging markets, see Francis, Hasan and Hunter (2002) and Alper, Ardic and Fendoglu (2009).

[15] Given our focus, we do not derive the optimality of this debt contract (see Townsend (1979) for example).

[16] For example, this corresponds to the risk aversion of managers, as in Stulz (1984), or of firms, as in Calvo (2001).

but will be heterogeneous among firms. As the focus of our analysis is the information asymmetry between banks and *small* firms, we assume that distress costs (in local currency units) differ across firms in each type. Among each type of firm $j \in \{F; LB; LG\}$ there is a share ϕ with low costs $\underline{C}$ costs and a share $1-\phi$ with high distress costs $\overline{C}$.[17]

Given the above assumptions, the expected payoff v_k^j in local currency to a firm of type j taking a loan of type k equals:

$$[1] \qquad v_k^j = \begin{cases} R^j - (1+r_k^j) & \text{if } j \in \{F; LG\} \text{ or } (j,k) = (LB,l) \\ p\left[R^{LB} - e_A\right] - (1-p)C_i - r_f^{LB} & \text{if } (j,k) = (LB, f) \end{cases} .$$

III. Perfect Information Case

When banks are perfectly informed about the type of each firm, each bank sets six interest rates. For each of the three firm types, $j \in \{LG; LB; F\}$, they set two interest rates, depending on whether a foreign or local currency loan is offered.

Proposition 1: Under perfect information, all F and LG firms take foreign currency loans. The equilibrium share of LB firms that choose foreign currency loans is given as:

$$[2] \qquad \delta_{\text{perfect info}}^{LB} = \begin{cases} 0 & \text{if} \quad i_l < (1-p)\underline{C} \\ \phi & \text{if} \quad (1-p)\underline{C} \le i_l \le (1-p)\overline{C} \\ 1 & \text{if} \quad i_l > (1-p)\overline{C} \end{cases} .$$

Proof:

[17] See Brown, Ongena and Yeşin (2009) for a version of the model with a continuous distribution of firms' distress costs. A discrete distribution makes the analysis more elegant, yet does not alter the main intuition that asymmetric information leads to more foreign currency borrowing.

The expected profits of banks in local currency from each loan type are:

$$[3] \qquad \Pi_k^j = \begin{cases} r_k^j - i_k & \text{if } j \in \{F;\, LG\} \text{ or } (j,k) = (LB; l) \\ pe_A + (1-p)R^{LB} - (1+i_f) + r_f^{LB} & \text{if } (j,k) = (LB;\, f) \end{cases} .$$

Assuming perfect price competition, the expected profit on each loan type will be zero. Given our assumption that $i_f = 0$, this leads to the following equilibrium interest rates:

$$[4] \qquad r_k^j = \begin{cases} i_l & \text{if } k = l \\ 0 & \text{if } j \in \{F; LG\} \text{ and } k = f \\ (1-p)\left(e_D - R^{LB}\right) & \text{if } (j,k) = (LB\,,\, f) \end{cases} .$$

Inserting the equilibrium interest rates from [4] into [1], we obtain the following two results. Foreign currency earners (F types) as well as good local currency earning firms (LG types) always choose foreign currency loans. And the condition for LB firms to choose a local currency loan is:

$$[5] \qquad (1-p)C_i \geq i_l .$$

As a result we obtain the equilibrium share of LB firms that choose foreign currency loans as:

$$\delta^{LB}_{\text{perfect info}} = \begin{cases} 0 & \text{if} \quad \dfrac{i_l}{1-p} < \underline{C} \\ \phi & \text{if} \quad \underline{C} \leq \dfrac{i_l}{1-p} \leq \bar{C} \\ 1 & \text{if} \quad \dfrac{i_l}{1-p} > \bar{C} \end{cases}$$

■

Proposition 1 shows that under perfect information foreign currency earners (F types) always choose foreign currency loans. They do so because there is an interest rate advantage to foreign currency loans and they do not run the risk of incurring distress costs when taking such a loan. For the same reason, all good local currency earning firms (LG types) also choose foreign currency loans. Bad local currency earning firms (LB types) face a trade-off: If they choose a foreign currency loan they benefit from an interest rate advantage, but they may incur distress costs if the local currency depreciates. As a consequence, if the interest rate differential is low, compared to the minimum distress costs of firms, i.e., when $(1-p)\underline{C} > i_l$, we have a "separating" equilibrium in which all LB types take local currency loans. If the interest rate differential is high, i.e., when $(1-p)\overline{C} < i_l$, we have a "pooling" equilibrium in which all firms take foreign currency loans. For intermediate values of interest rate differentials we have a "partial pooling" equilibrium in which LB firms with low distress costs take foreign currency loans.

IV. Imperfect Information Case

We now introduce an information asymmetry between banks and firms about the revenues of the firms. Assume that banks can neither verify the currency denomination nor the level of revenues of a firm, i.e., banks cannot distinguish between the three types of firms: *F*, *LG*, and *LB* firms. Banks, however, know that a proportion $\lambda \in [0,1]$ of the total firm population are LB firms, and that the remaining proportion $1-\lambda$ are either F or LG

firms.[18] Banks can no longer condition their interest rates on firm types, and thus only offer two rates: r_l for local currency loans and r_f for foreign currency loans.[19]

In this case, the expected profits of banks in local currency from the two loan types are:

$$\Pi_k = \begin{cases} r_l - i_l & \text{if } k = l \\ \dfrac{\delta\lambda\left[pe_A + (1-p)R^{LB}\right] + (1-\lambda)}{\delta\lambda + (1-\lambda)} - (1+i_f) + r_f & \text{if } k = f \end{cases}, \quad [7]$$

where $\delta \in [0,1]$ is the equilibrium share of LB firms taking foreign currency loans. In equilibrium, and with zero expected profit, interest rates must equal:

$$r_k = \begin{cases} i_l & \text{if } k = l \\ \dfrac{\delta\lambda}{\delta\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right) > 0 & \text{if } k = f \end{cases}. \quad [8]$$

The interest rate charged on foreign currency loans covers the expected losses due to default on such loans. Under imperfect information, this depends on the share of LB firms taking such loans relative to F and LG firms.

Note that the interest rate that banks charge on foreign currency loans under asymmetric information lies between the rate it charges for such loans under perfect

[18] The bank does not need to separate *F* from *LG* firms, as from the previous section we know that these two types never default on any loan, and thus should both receive the same (risk-free) interest rate on either a local or foreign currency loan.

[19] In our model all banks are equally affected by the information asymmetry regardless of the currency in which they lend. Most domestic and foreign banks in Eastern Europe for example offer loans in both local and foreign currency to local firms (see Brown, Kirschenmann and Ongena (2010) and Brown, Ongena and Yeşin (2011)). If financiers lend only in their own currency, existing models predict that: (1) Firms may borrow first in the local and then in the foreign currency, after having exhausted internal funds, if local financiers have better information about the firm than foreign financiers (pecking order hypothesis); (2) Firms with high monitoring costs may borrow more locally in the local currency (Diamond (1984)); and (3) Better firms may borrow in the foreign currency to signal their quality, if foreign currency debt is more expensive (Jeanne (1999)) or entails more regulatory scrutiny hence higher distress costs (Ross (1977)).

information to F and LG firms, i.e., 0, and the rate it charges to LB firms, i.e., $r_f^{LB} = (1-p)(e_D - R^{LB})$. In other words, $r_f \epsilon [0, r_f^{LB}]$.

Bad local currency earners for which $v_f^{LB}(r_f, C_i) \geq v_l^{LB}(i_l, C_i)$ will choose foreign currency loans. From [1] we see that the share of LB firms which will take foreign currency loans will be:

$$[9]\ \delta = \begin{cases} 0 \quad \text{if} & i_l < r_f + (1-p)(\underline{C} - e_D + R^{LB}) \\ \phi \quad \text{if} & r_f + (1-p)(\underline{C} - e_D + R^{LB}) \leq i_l < r_f + (1-p)(\bar{C} - e_D + R^{LB}) \\ 1 \quad \text{if} & i_l \geq r_f + (1-p)(\bar{C} - e_D + R^{LB}) \end{cases}$$

From [9], we can establish that the lowest interest rate i_l at which LB firms start opting for foreign currency loans is $i_l = (1-p)(\underline{C} + R^{LB} - e_D)$. We assume from now on that:

$$[10] \qquad \underline{C} \geq e_D - R^{LB} > 0.$$

Assumption [10] ensures that unless there is a positive interest rate differential to the advantage of foreign currency funds, all LB firms will choose local currency loans. This assumption prevents that some LB firms choose foreign currency loans due to their limited liability even in the absence of an interest rate differential.

Propositions 2, 3 and 4 summarize how imperfect information changes the feasibility of separating, partial-pooling and full-pooling equilibria in our model. These propositions show that compared to the perfect information case a separating equilibrium exists only for lower interest rate differentials between local and foreign currency. Partial pooling and full pooling equilibria, by contrast, are feasible at lower interest rate differentials than under perfect information.

Proposition 2 (Separating Equilibrium): If $i_l < (1-p)(\underline{C} - e_D + R^{LB})$ a separating equilibrium will emerge.

Proof:

In a separating equilibrium we have by definition $\delta = 0$. From [8] the equilibrium interest rate for foreign currency loans is $r_f = 0$. From [9] it follows that a separating equilibrium exists if $i_l < (1-p)(\underline{C} - e_D + R^{LB})$ ■

Proposition 3 (Partial Pooling Equilibrium):

If $i_l \geq (1-p)\underline{C} - \frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$ and

$i_l \leq (1-p)\bar{C} - \frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$ a partial pooling equilibrium exists in which only LB firms with low distress costs $\underline{C}$ take foreign currency loans while LB firms with high distress costs $\bar{C}$ take local currency loans.

Proof:

In a partial pooling equilibrium we have by definition $\delta = \phi$. From [8] the equilibrium interest rate for foreign currency loans is $r_f = \frac{\phi\lambda}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$. From [9] it follows that only LB firms with low distress costs will chose a foreign currency loan if:

$i_l \geq (1-p)\underline{C} - \frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$, and

$i_l < (1-p)\bar{C} - \frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$ ■

Proposition 4 shows that full pooling equilibria is feasible under imperfect information starting at a lower interest rate differential than under perfect information.

Proposition 4 (Full Pooling Equilibrium):

If $i_l \geq (1-p)\bar{C} - (1-\lambda)(1-p)\left(e_D + R^{LB}\right)$ a full pooling equilibrium exists in which all LB firms take foreign currency loans.

Proof:

In a full pooling equilibrium we have by definition $\delta = 1$. From [8] the equilibrium interest rate for foreign currency loans is $r_f = \lambda(1-p)\left(e_D - R^{LB}\right)$. From [9] it follows that a separating equilibrium exists if $i_l \geq (1-p)\bar{C} - (1-\lambda)(1-p)\left(e_D - R^{LB}\right)$ ■

Note that in the partial-pooling and full-pooling equilibria described above we have assumed that LG and F firms chose foreign currency loans, which will be the case as long as $r_f(\delta) \leq i_l$. Assumption [10] ensures that in any equilibrium where $\delta > 0$ we have $r_f(\delta) \leq i_l$.

Figure 1 depicts the equilibria in our model under perfect and imperfect information. The figure shows that under perfect information there always exists either a separating, partial-pooling or full-pooling equilibrium. Under imperfect information two main things change: First, as mentioned above partial or fully-pooling equilibria exist at a larger range of interest rate differentials than under perfect information. This is due to the fact that foreign currency loans to LB firms are not fully pricing the credit risk of these loans due to expected exchange rate depreciations.

The second main difference under imperfect information is that the market for foreign currency loans may collapse. Proposition 5 summarizes the range of parameters for which an equilibrium with lending in foreign currency does not exist.

Proposition 5 (Market Failure Asymmetric Information): Under asymmetric information, there is no equilibrium in which foreign currency loans are extended if one of the following two conditions are met:

$$[i] \quad (1-p)\underline{C} - (1-p)(e_D - R^{LB}) < i_l < (1-p)\underline{C} - \frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$$

or

$$[ii] \quad (1-p)\bar{C} - \frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right) < i_l < (1-p)\bar{C} - (1-\lambda)(1-p)\left(e_D - R^{LB}\right)$$

Proof:

Follows directly from Propositions 2, 3 and 4. ■

Proposition 5 and Figure 1 show that there are two constellations under which the market for foreign currency loans may collapse with imperfect information. The first constellation is a range of interest rate differentials [i] at which LB firms with low distress consider switching from local currency to foreign currency loans if banks charge zero interest rates on foreign currency loans. However, if the $\phi\lambda$ LB firms with low distress costs would switch to foreign currency loans, the zero-profit interest rate on these loans would rise to $\frac{(1-\lambda)}{\phi\lambda + (1-\lambda)}(1-p)\left(e_D - R^{LB}\right)$. At that interest rate for foreign currency loans all LB firms will prefer to take local currency loans, and thus there is no equilibrium in which foreign currency loans are offered.

A similar effect lead to market collapse at interest rates in the range [ii], to the extent that these firms would be deterred from taking foreign currency loans. $(1-\phi)\lambda$ LB firms with high distress costs consider switching from local currency to foreign currency loans. In both of these regions the only credit market equilibrium is characterized by all firms taking local currency loans.

V. Conclusion and Testable Hypotheses

Motivated by policy concerns about the credit risks resulting from unhedged foreign currency loans, especially in opaque financial environments, we investigate how an information asymmetry between banks and firms in a theoretical framework – that also features the trade-off between the cost and the risk of debt – may determine the currency denomination of bank loans to firms. Banks may not know the currency in which firms have contracted their sales or the level of firm revenues.

Our model shows that foreign currency earners and local currency earners with distress costs that are small vis-à-vis the interest rate differential choose foreign currency loans if the foreign interest rate is lower. With imperfect information for the banks concerning the currency and level of firm revenues, we show that more local currency earners switch to foreign currency loans.

Our model yields several testable hypotheses regarding the firm-level choice of loan denomination. We predict that the likelihood of choosing a foreign currency loan is positively related to the share of income a firm earns in foreign currency. Under the assumptions of our model, all foreign currency earners choose foreign currency loans, so the proportion of foreign currency earners taking foreign currency loans is always at least as high as that of local currency earners.

However, our model shows that not only the currency denomination of a firm's cash flow is important, but also the magnitude of its cash flows compared to its potential loan repayments. Among firms with local currency earnings, firms with large revenues compared to their credit obligations are more likely to take foreign currency loans.

As predicted by the extant literature, the choice of a foreign currency loan should further be negatively related to the firm-level distress costs. The impact of distress costs on loan denomination should be stronger the lower the share of income a firm receives in foreign currency and the lower the revenue.

A key prediction of our model is that the choice of a foreign currency loan by local currency earners may be positively related to the opaqueness of the firm's revenue structure. More local currency earners choose foreign currency loans under imperfect information than under perfect information. The impact of information opaqueness is stronger for firms with higher shares of revenue in local currency (our model suggests that imperfect information does not alter the currency choice for firms with foreign currency earnings only). Worsening information opaqueness results in more levered firms (i.e., those with lower cash flow-to-loan ratios) to take foreign currency loans.

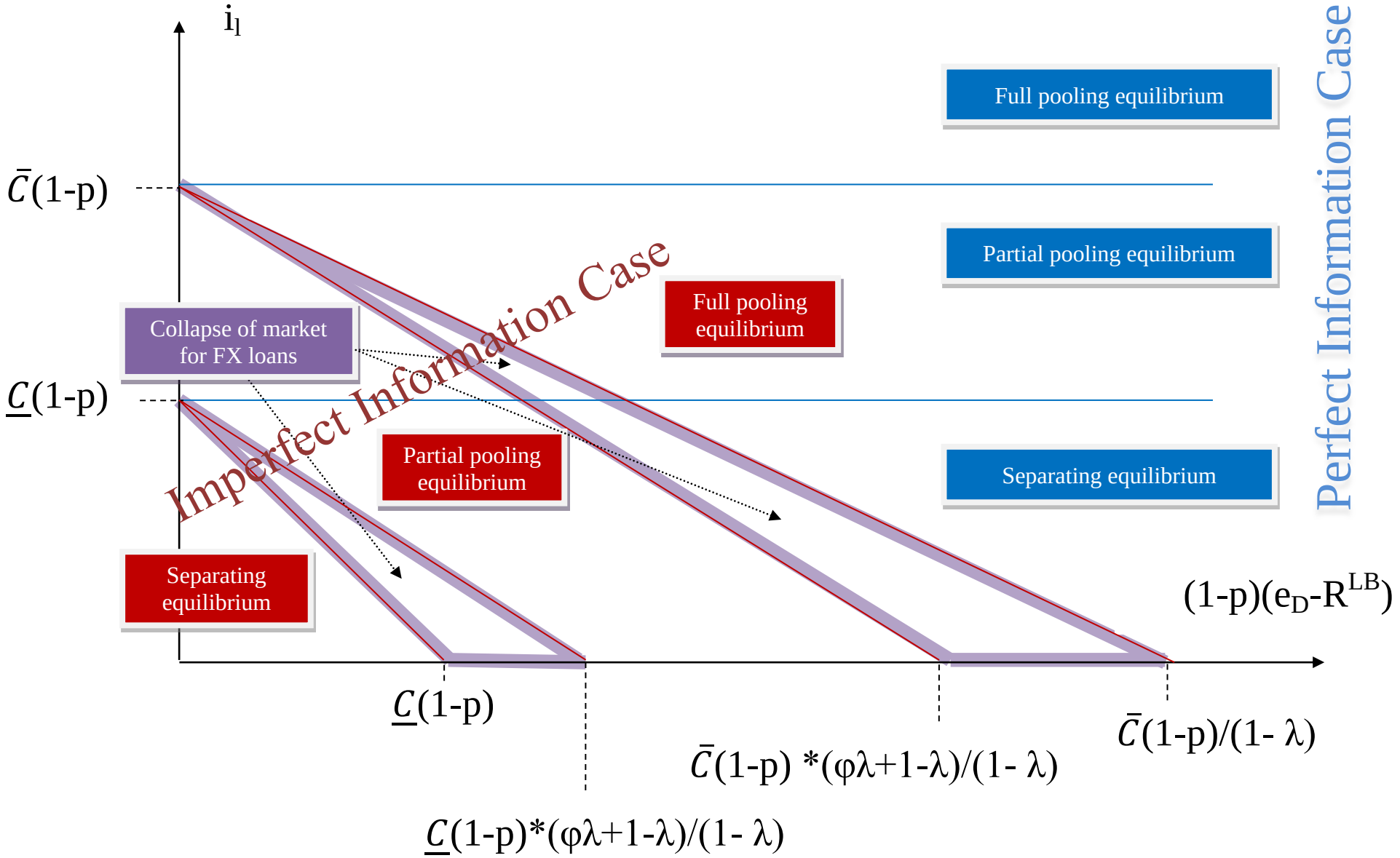
At the macroeconomic level, our model predicts that the choice of a foreign currency loan will be positively related to the interest rate advantage on foreign currency funds which is given by nominal interest rate differential between local and foreign currencies minus the expected depreciation of the local currency (which is implicit and equals zero in our model). The impact of the interest rate differential, however, does depend on firm characteristics. The reaction to an increase in the interest rate differential should be stronger for firms with less income in foreign currency.

The choice of a foreign currency loan will further be negatively related to exchange rate volatility. If the local currency is more likely to depreciate and also the larger the

depreciation, local currency earners (with low revenues) will be less likely to take a foreign currency loan. Moreover the impact of exchange rate volatility should be stronger for those firms with lower distress costs.

Finally, our model suggests that characteristics of the banking sector or of the legal environment that exacerbate information asymmetries between banks and firms may foster unhedged foreign currency borrowing.

Figure 1


i_l
$\bar{C}(1\text{-}p)$
$\underline{C}(1\text{-}p)$
Full pooling equilibrium
Partial pooling equilibrium
Separating equilibrium
Perfect Information Case
Collapse of market for FX loans
Full pooling equilibrium
Partial pooling equilibrium
Separating equilibrium
Imperfect Information Case
$(1\text{-}p)(e_D\text{-}R^{LB})$
$\underline{C}(1\text{-}p)$
$\bar{C}(1\text{-}p)/(1\text{-}\lambda)$
$\bar{C}(1\text{-}p)*(\varphi\lambda+1\text{-}\lambda)/(1\text{-}\lambda)$
$\underline{C}(1\text{-}p)*(\varphi\lambda+1\text{-}\lambda)/(1\text{-}\lambda)$

References

Allayannis, G., Brown, G. W. and Klapper, L. F., 2003. Capital Structure and Financial Risk: Evidence from Foreign Debt Use in East Asia. Journal of Finance 58, 2667-2709.

Allayannis, G. and Ofek, E., 2001. Exchange Rate Exposure, Hedging, and the Use of Foreign Currency Derivatives. Journal of International Money and Finance 20, 273-296.

Alper, E., Ardic, O. P. and Fendoglu, S., 2009. The Economics of the Uncovered Interest Parity Condition for Emerging Markets. Journal of Economic Surveys 23, 115-138.

Basso, H. S., Calvo-Gonzalez, O. and Jurgilas, M., 2011. Financial Dollarization: The Role of Foreign-Owned Banks and Interest Rates. Journal of Banking and Finance 35, 794-806.

Benavente, J. M., Johnson, C. A. and Morande, F. G., 2003. Debt Composition and Balance Sheet Effects of Exchange Rate Depreciations: A Firm-Level Analysis for Chile. Emerging Markets Review 4, 397-416.

Bodnar, G. M., Hayt, G. S. and Marston, R. C., 1998. Wharton Survey of Financial Risk Management by US Nonfinancial Firms. Financial Management 27, 70-91.

Booth, L. V., Aivazian, A., Demirgüç-Kunt, A. and Maksimovic, V., 2001. Capital Structures in Developing Countries. Journal of Finance 56, 87-130.

Børsum, Ø. G. and Ødegaard, B. A., 2005. Currency Hedging in Norwegian Non-Financial Firms. Norges Bank Economic Bulletin 133-144.

Briggs, P., 2004. Currency Hedging by Exporters and Importers. Reserve Bank of New Zealand Bulletin 67, 17-27.

Brown, G. W., 2001. Managing Foreign Exchange Risk with Derivatives. Journal of Financial Economics 60, 401-448.

Brown, M. and De Haas, R., 2012. Foreign Banks and Foreign Currency Lending in Emerging Europe. Economic Policy Forthcoming.

Brown, M., Jappelli, T. and Pagano, M., 2009. Information Sharing and Credit: Firm-Level Evidence from Transition Countries. Journal of Financial Intermediation 18, 151-172.

Brown, M., Kirschenmann, K. and Ongena, S., 2010. Foreign Currency Loans - Demand or Supply Driven? Mimeo, Swiss National Bank.

Brown, M., Ongena, S., Popov, A. and Yeşin, P., 2011. Who Needs Credit and Who Gets Credit in Eastern Europe? Economic Policy 65, 93-130.

Brown, M., Ongena, S. and Yeşin, P., 2009. Foreign Currency Borrowing by Small Firms. Working Paper, Swiss National Bank.

Brown, M., Ongena, S. and Yeşin, P., 2011. Foreign Currency Borrowing by Small Firms in the Transition Economies. Journal of Financial Intermediation 20, 285-302.

Calvo, G. A., 2001. Capital Markets and the Exchange Rate with Special Reference to the Dollarization Debate in Latin America. Journal of Money. Credit, and Banking 33, 312-334.

Clark, E. and Judge, A., 2008. The Determinants of Foreign Currency Hedging: Does Foreign Currency Debt Induce a Bias? European Financial Management 14, 445-469.

Cowan, K., 2006. Firm Level Determinants of Dollar Debt? Mimeo, Central Bank of Chile.

Cowan, K., Hansen, E. and Herrera, L. Ó., 2005. Currency Mismatches in Non-Financial Firms in Chile. Journal Economía Chilena - Chilean Economy 8, 57-82.

Degryse, H., Havrylchyk, O., Jurzyk, E. and Kozak, S., 2012. Foreign Bank Entry, Credit Allocation and Lending Rates in Emerging Markets: Empirical Evidence from Poland. Journal of Banking and Finance Forthcoming.

Detragiache, E., Tressel, T. and Gupta, P., 2008. Foreign Banks in Poor Countries: Theory and Evidence. Journal of Finance 63, 2123-2160.

Diamond, D. W., 1984. Financial Intermediation and Delegated Monitoring. Review of Economic Studies 51, 393-414.

Diamond, D. W., 1991. Monitoring and Reputation: the Choice between Bank Loans and Privately Placed Debt. Journal of Political Economy 99, 689-721.

Dollar, D. and Hallward-Driemeier, M., 2000. Crisis, Adjustment, and Reform in Thailand's Industrial Firms. World Bank Research Observer 15, 1-22.

Egli, D., Ongena, S. and Smith, D. C., 2006. On the Sequencing of Projects, Reputation Building, and Relationship Finance. Finance Research Letters 3, 23-39.

Engel, C., 1996. The Forward Discount Anomaly and the Risk Premium: A Survey of Recent Evidence. Journal of Empirical Finance 3, 123-192.

Engel, C., 2006. Equivalence Results for Optimal Pass-Through, Optimal Indexing to Exchange Rates, and Optimal Choice of Currency for Export Pricing. Journal of the European Economic Association 4, 1249-1260.

Esho, N., Sharpe, I. G. and Webster, K. H., 2007. Hedging and Choice of Currency Denomination in International Syndicated Loan Markets. Pacific-Basin Finance Journal 15, 195–212.

European Central Bank, 2006. EU Banking Sector Stability. Frankfurt.

European Central Bank, 2010. European Stability Review. Frankfurt.

Francis, B. B., Hasan, I. and Hunter, D. M., 2002. Emerging Market Liberalization and the Impact on Uncovered Interest Rate Parity. Journal of International Money and Finance 21, 931-956.

Frankel, J. A., 2004. Experience of and Lessons from Exchange Rate Regimes in Emerging Economies. In: Asian Development Bank (Eds.), Monetary and Financial Integration in East Asia: The Way Ahead. Palgrave Macmillan Press: New York NY.

Freixas, X. and Rochet, J. C., 2008. Microeconomics of Banking. MIT Press: Cambridge MA.

Friberg, R. and Wilander, F., 2008. The Currency Denomination of Exports - A Questionnaire Study. Journal of International Economics 75, 54-69.

Froot, K. A., Scharfstein, D. S. and Stein, J. C., 1993. Risk Management: Coordinating Corporate Investment and Financing Policies. Journal of Finance 48, 1629-1658.

Froot, K. A. and Thaler, R. H., 1990. Anomalies: Foreign Exchange. Journal of Economic Perspectives 4, 179-192.

Galati, G., Heath, A. and McGuire, P., 2007. Evidence of Carry Trade Activity. Bank for International Settlements Quarterly Review 33, 27-41.

Galindo, A., Panizza, U. and Schiantarelli, F., 2003. Debt Composition and Balance Sheet Effects of Currency Depreciation: A Summary of the Micro Evidence. Emerging Markets Review 4, 330–339.

Gelos, G. R., 2003. Foreign Currency Debt in Emerging Markets: Firm-Level Evidence from Mexico. Economics Letters 78, 323–327.

Goldberg, P. K. and Knetter, M. M., 1997. Goods Prices and Exchange Rates: What Have We Learned? Journal of Economic Literature 35, 1243-1272.

Goswami, G. and Shrikhande, M. M., 2001. Economic Exposure and Debt Financing Choice. Journal of Multinational Financial Management 11, 39-58.

Graham, J. R. and Harvey, C. R., 2001. The Theory and Practice of Corporate Finance: Evidence from the Field. Journal of Financial Economics 60, 187-243.

Hauswald, R. and Marquez, R., 2006. Competition and Strategic Information Acquisition in Credit Markets. Review of Financial Studies 19, 967-1000.

Hodrick, R. J., 1987. The Empirical Evidence on the Efficiency of Forward and Futures Foreign Exchange Markets. Harwood Academic Publishers: Chur.

Jeanne, O., 1999. Foreign Currency Debt and Signaling. Mimeo, International Monetary Fund.

Jeanne, O., 2000. Foreign Currency Debt and the Global Financial Architecture. European Economic Review 44, 719-727.

Kamil, H., 2009. How Do Exchange Rate Regimes Affect Firms' Incentives to Hedge Currency Risk in Emerging Markets? Mimeo, International Monetary Fund.

Kamil, H. and Sutton, B., 2008. Corporate Vulnerability: Have Firms Reduced Their Exposure to Currency Risk. In: International Monetary Fund (Eds.), Regional Economic Outlook: Western Hemisphere. International Monetary Fund: Washington DC.

Kedia, S. and Mozumdar, A., 2003. Foreign Currency-Denominated Debt: An Empirical Examination. Journal of Business 76, 521-546.

Keloharju, M. and Niskanen, M., 2001. Why Do Firms Raise Foreign Currency Denominated Debt? European Financial Management 7, 481-496.

Lewis, K., 1995. Chapter 37: Puzzles in International Financial Markets. In: Gene Grossman and Kenneth Rogoff (Eds.), Handbook of International Economics, Vol. III. Elsevier: North-Holland.

Luca, A. and Petrova, I., 2008. What Drives Credit Dollarization in Transition Economies? Journal of Banking and Finance 32, 858–869.

Mian, S. L., 1996. Evidence on Corporate Hedging Policy. Journal of Financial and Quantitative Analysis 31, 419-439.

Nagy, P. M., Jeffrey, S. and Zettelmeyer, J., 2011. Addressing Private Sector Currency Mismatches in Emerging Europe. In: Eswar Prasad and Masahiro Kawai (Eds.), Financial Market Regulation and Reforms in Emerging Markets. Brookings Institution Press: Washington DC.

O'Connell, S., 2005. Currency Game Is Risky for the Smaller Players. Sunday Times, February 5.

Pistor, K., Raiser, M. and Gelfer, S., 2000. Law and Finance in Transition Economies. Economics of Transition 8, 325-368.

Rajan, R. G., 1992. Insiders and Outsiders: the Choice between Informed and Arm's-Length Debt. Journal of Finance 47, 1367-1400.

Rajan, R. G. and Zingales, L., 1995. What Do We Know about Capital Structure? Some Evidence from International Data. Journal of Finance 50, 1421-1460.

Rey, H., 2001. International Trade and Currency Exchange. Review of Economic Studies 68, 443-464.

Rosenberg, C. B. and Tirpák, M., 2008. Determinants of Foreign Currency Borrowing in the New Member States of the EU. Working Paper, International Monetary Fund.

Ross, S. A., 1977. The Determination of Financial Structure: the Incentive-Signaling Approach. Bell Journal of Economics 8, 1-30.

Sharpe, S. A., 1990. Asymmetric Information, Bank Lending and Implicit Contracts: a Stylized Model of Customer Relationships. Journal of Finance 45, 1069-1087.

Sorsa, P., Bakker, B. B., Duenwald, C., Maechler, A. M. and Tiffin, A., 2007. Vulnerabilities in Emerging Southeastern Europe—How Much Cause for Concern? Working Paper, International Monetary Fund.

Stein, J., 2002. Information Production and Capital Allocation: Decentralized versus Hierarchical Firms. Journal of Finance 57, 1891-1922.

Stulz, R. M., 1984. Optimal Hedging Policies. Journal of Financial and Quantitative Analysis 19, 127-140.

Townsend, R. M., 1979. Optimal Contracts and Competitive Markets with Costly State Verification. Journal of Economic Theory 21, 265-293.

Tsamenyi, M. and Skliarova, D., 2005. International Cash Management Practices in a Russian Multinational. Managerial Finance 31, 48-64.

Viaene, J.-M. and de Vries, C. G., 1992. On the Design of Invoicing Practises in International Trade. Open Economies Review 3, 133-142.

von Thadden, E.-L., 2004. Asymmetric Information, Bank Lending, and Implicit Contracts: the Winner's Curse. Finance Research Letters 1, 11-23.

Ziaul Hoque, M., 2003. Flawed Public Policies and Industrial Loan Defaults: The Case of Bangladesh. Managerial Finance 29, 98-121.