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Article

Information Asymmetry and Foreign Currency Borrowing by Small Firms

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We model how an information asymmetry between the lending bank and the applying firm about the currency structure of firm revenues may affect loan currency choice. Our framework features a trade-off between the lower cost of foreign currency debt and the costs of currency induced loan default. We show that under imperfect information about firm revenues more local earners choose foreign currency loans, as they do not bear the full cost of the corresponding credit risk. This result is consistent with recent evidence showing that information asymmetries may increase foreign currency borrowing by retail clients in the transition economies.
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INTRODUCTION

A large proportion of corporations in many countries have traditionally been borrowing in a foreign currency.[1] More recently and before the financial crisis also, many retail clients, that is, households and small firms, in transition countries have taken out foreign currency loans. In countries such as Latvia,

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

Lithuania, Hungary, and Bulgaria, for example, retail clients now hold a similar or larger share of their loans in foreign currency than do corporations (European Central Bank, 2010). These retail loans in foreign currency are popularly believed to be 'small men's carry trades', that is, loans in which households and entrepreneurs seek lower interest rates and take unhedged exchange rate risk upon themselves (see Sorsa *et al.*, 2007 and Beer *et al.*, 2010).[2]

Empirical work, due to a lack of micro data, has yet to investigate in detail the drivers for the rapid expansion of foreign currency mortgages and car loans to households in transition countries in the decade before the financial crisis. In Brown *et al.* (2011), we document, however, that foreign currency borrowing by small firms in transition countries is strongly related to their foreign currency revenues and age, an oft-used proxy for the availability of public information about the firm, than it is to between-country interest rate differentials. Degryse *et al.* (2012) show that foreign banks that enter *via* greenfield investment, and hence face an acute information asymmetry about potential borrowers, lend more in foreign currency than do foreign banks that take over existing local banks (that have established relationships with local firms).[3] Brown and De Haas (2012) confirm that foreign-owned banks lend more in foreign currency to corporate clients but not to households than do domestic banks. This evidence suggests that information asymmetries may actually limit the provision of foreign currency loans to the more financially opaque retail clients.

Hence, an information asymmetry between banks and firms may be a key determinant of the demand and supply of foreign currency loans. Our paper fills a gap in the theoretical literature by introducing information asymmetry in a framework that also features a trade-off between the cost and risk of firm debt. Assuming an interest rate differential in favor of foreign currency funds, we compare the currency structure of borrowing by small firms under two

[2] Foreign currency loans create serious challenges to policymakers. Countries with high volumes of foreign currency loans are more vulnerable to financial crises and more prone to spillover effects of country-specific shocks (see, eg, Cetorelli and Goldberg, 2011). Furthermore, foreign currency-denominated loans distort the transmission of monetary policy, influence the available credit in the economy, and therefore can impact the catching-up process of transition countries (see, eg, Gorodnichenko and Schnitzer, 2010).

[3] In contrast to these two studies, others have examined foreign currency borrowing by analyzing aggregate cross-country data (eg, Luca and Petrova, 2008; Rosenberg and Tirpák, 2009; Basso *et al.*, 2011) or the currency denomination of debt of large firms within a single country (Keloharju and Niskanen, 2001; Benavente *et al.*, 2003; Gelos, 2003; Kedia and Mozumdar, 2003; Cowan *et al.*, 2005) or across countries (Rajan and Zingales, 1995; Booth *et al.*, 2001; Allayannis *et al.*, 2003; Cowan, 2006; Esho *et al.*, 2007; Kamil and Sutton, 2008; and Kamil, 2009). Clark and Judge (2008) provide a review of the relevant empirical literature.

information conditions. Under perfect information, banks can verify the currency in which the firms contract their sales. Under imperfect information, the banks cannot verify the currency structure of firms' revenues.

Our model confirms that under perfect information all foreign currency earners and all local currency earners with low distress costs will choose foreign currency loans. By contrast, local currency earning firms with high distress costs will prefer local currency loans. Under imperfect information, more local earners will borrow in foreign currency, as these firms do not bear the full cost of the corresponding default risk. The intuition behind this result is the following: as the banks cannot distinguish the risky from the safe FX borrowers, they will charge a single interest rate to both types. This interest rate will be lower than the interest rate that prevails when the banks can identify the risky firms. Thus, it will be profitable for the risky firms to pool with safe firms and pay a lower risk premium for a foreign currency loan.

Consequently, our model identifies the information asymmetry between lending banks and borrowing firms as a so-far overlooked potential driver of dollarization or euroization in credit markets. We establish the conditions under which all firms will be borrowing in foreign currency (full pooling equilibria), as well as when no foreign currency loans will be offered by banks to firms that cannot prove they have either high or foreign currency income (market failure).

The key predictions of our model are consistent with suggestive evidence in Brown *et al.* (2011) in which we document that foreign currency borrowing by small firms in transition countries significantly decreases in their age (though not in two alternative yet crude proxies for the existing bank–firm information asymmetry, ie, whether the firm was audited or received income through a bank account). Our result is also consistent with the recent evidence in Degryse *et al.* (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 takeovers, lend more in foreign currency.

The rest of the paper is organized as follows. The literature is reviewed in the next section. Then our model assumptions are introduced, followed by the analysis of the model with perfect information. In the last-but-one section, imperfect information is introduced. The last section concludes.

LITERATURE REVIEW

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

et al., 2003),[4] 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 *et al.*, 2011). Yet, 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 where, due to the weak corporate legal system, it is hard for banks to assess the credibility of available firm-level financial information (Pistor *et al.*, 2000; Brown *et al.*, 2009a).

The costs of information acquisition by banks can be particularly high when dealing with small firms (eg, Berger and Udell, 1995; Berger and Udell, 2002; Degryse *et al.*, 2011), which are less likely to have audited financial accounts. 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 current and especially expected future sales revenues (Berger and Udell, 2006).[5] In particular, the currency denomination of firms' sales contracts is often negotiated and a closely guarded secret.[6] Consequently, soft information about sales revenues and its currency denomination may be the only type of information that is available, but foreign banks that are widely present in transition and developing countries may struggle to collect and use it (Stein, 2002; Detragiache *et al.*; 2008).

Existing models demonstrate that firms' choice of loan currency is affected by the structure of firm revenues, interest rate differentials between local and foreign currency funds, and the distress costs of firms facing

[4] We will 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.

[5] See, for example, 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 these services (eg, Tsamenyi and Skliarova, 2005) or firms do not demand them (eg, in the survey analyzed in Brown *et al.*, 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, eg, 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 *et al.*, 2006, among others). Also other financiers may face more information asymmetries in transition and developing countries (eg, Claessens *et al.*, 2000).

[6] 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.

potential default.[7] 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. This information asymmetry issue may be particularly relevant regarding small and young firms in transition and developing countries.

In Jeanne (2000), financiers also face an information asymmetry, but one 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, that is, 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) where firms only have foreign revenues, in our model firms have domestic or foreign currency earnings. In Jeanne (2000), entrepreneurial effort is unobservable to the financiers; in our model, the currency and level of sales revenues cannot be observed by the bank.

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

[7] If the firms' 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 *et al.* (1998), Allayannis and Ofek (2001), and Brown (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). Static capital structure trade-off theory suggests firms opt for the lowest cost debt, making the interest rate differential, that is, the deviations from the UIP, the second main determinant of the firm's choice of loan currency denomination (Graham and Harvey, 2001).

currency either appreciates to $e_A<1$, with probability p, or it depreciates to $e_D>1$, with probability $1-p$.

We assume that

$$pe_A + (1-p)e_D = 1, \tag{1}$$

so that the expected exchange rate at $t=1$ equals $e_1^*=1$ and the expected depreciation of the local currency is $\Delta e = e_1^* - e_0/e_0 = 0$.[8]

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 currency. There are two types of firms, foreign (F) and local (L) currency earners. Foreign currency earners have revenue R^F in foreign currency, which equals the expected revenue in local currency as the expected exchange rate equals 1 ($e_1^*=1$, hence $R^F e_1^* = R^F$). Local currency earners have earnings R^L in local currency. We assume that $R^L < R^F$ without loss of generality. We abstract from the possibility that local and/or foreign currency earners may differ in their debt-to-income levels because assuming more types of firms does not alter the main insights and results of our model.[9] Furthermore, we abstract from exchange rate pass-through considerations without loss of generality.[10]

Let both 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).

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 $j \in \{F; L\}$.[11] 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

[8] As we later 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.

[9] For a richer model in which firms also differ with respect to their debt-to-income levels, see the SNB Working Paper version of our paper (Brown *et al.*, 2009b).

[10] See Goldberg and Knetter (1997), for example, on exchange rate pass-through.

[11] 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.

(UIP) is not fulfilled,[12] and that there is an interest rate advantage to foreign currency funding for the bank, that is, $i_l > i_f + \Delta e = 0$. 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.[13]

For simplicity, we assume that interest payments are made upfront at $t = 0$, and the loan repayment is made at $t = 1$.[14] 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 local currency earners will default if they take a loan in foreign currency and the local currency depreciates, that is, $R^L < e_D$. We also assume that foreign currency earners have revenues that will enable them to fully repay a local currency loan even if the local currency appreciates, that is, $R^F > 1/e_A$.

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, eg, in the case of small and family-owned firms (Froot *et al.* 1993).[15] In this case, C will be independent of the default amount, but will be heterogeneous among firms.[16]

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. Among each type of firm $j \in \{F; L\}$, there is a share φ with low costs $\underline{C}$ and a share $1-\varphi$ with high distress costs $\overline{C}$. [17]

[12] This is a crucial assumption in our model. If the UIP holds then the local currency earners will not have any incentive to borrow in foreign currency, as they will only bear higher costs either in terms of higher interest rate and/or in terms of prevailing distress costs.

[13] General reviews by Hodrick (1987), Froot and Thaler (1990), Lewis (1995), Engel (1996), for example. For emerging markets, see Francis *et al.* (2002) and Alper *et al.* (2009).

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

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

[16] As financially distressed firm may lose customers, suppliers, and/or employees depending on the characteristics of their products and labor contracts for example, financial distress costs are also assumed to be heterogeneous across firms in Purnanandam (2008). Andrade and Kaplan (1998) estimate that financial distress costs vary between 10% and 20% of firm value (see also the review by Senbet and Seward, 1995). For small firms, both the level and dispersion of these costs are likely to be even higher (eg, Pindado *et al.*, 2006).

[17] See the SNB Working Paper version of our paper (Brown *et al.*, 2009b) for a model with a continuous distribution of firms' distress costs. A discrete distribution makes the analysis more

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.

Given the above assumptions, the expected payoff $v_k^{j,i}$ in local currency to a firm of type $j \in \{F; L\}$ with a distress cost $C_i \in \{\underline{C}; \overline{C}\}$ taking a loan of type $k \in \{l; f\}$ equals:

$$v_k^{j,i} = \begin{cases} R^j - \left(1 + r_k^j\right) & \text{if } j = F \text{ or } (j,k) = (L,l) \\ p[R^L - e_A] - (1-p)C_i - r_f^L & \text{if } (j,k) = (L,f) \end{cases} \tag{2}$$

PERFECT INFORMATION CASE

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

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

$$\pi_k^j = \begin{cases} r_k^j - i_k, & \text{if } j = F \text{ or } (j,k) = (L,l) \\ pe_A + (1-p)R^L - \left(1 + i_f\right) + r_f^L, & \text{if } (j,k) = (L,f) \end{cases} \tag{3}$$

Note that the term in equation 3 already uses two assumptions: (1) interest rate payments are made up front, thus the bank always receives them even in the case of a default, and (2) if an L firm, which took a foreign currency loan, defaults due to a depreciation of the local currency then the bank receives all of its R^L.

Assuming perfect price competition in the banking sector, the expected profit on each loan type will be 0. Given our assumptions that $i_f = 0$, and that (1) holds, this leads to the following equilibrium interest rates:

$$r_k^j = \begin{cases} i_l & \text{if } j \in \{F, L\} \text{ and } k = l \\ 0 & \text{if } j = F \text{ and } k = f \\ (1-p)(e_D - R^L) & \text{if } j = L \text{ and } k = f \end{cases} \tag{4}$$

elegant, yet does not alter the main intuition that imperfect information leads to more foreign currency borrowing.

Note that the term $(e_D - R^L)$ in equation 4 is the amount of the loan that a defaulting L firm does not pay back. Furthermore, the term $(1-p)$ is the probability of its default.

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

$$\delta^L_{\text{perfect info}} = \begin{cases} 0 & \text{if } i_l < (1-p)\underline{C} \\ \varphi & \text{if } (1-p)\underline{C} \leq i_l \leq (1-p)\overline{C} \\ 1 & \text{if } i_l > (1-p)\overline{C} \end{cases} \tag{5}$$

Proof. *In the Appendix.*

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. On the other hand, local currency earning firms (L 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 with the minimum distress costs of firms, that is, when $i_l < (1-p)\underline{C}$, we have a 'separating' equilibrium in which all L types, that is, firms with local currency revenue, take local currency loans. On the other hand, if the interest rate differential is high, that is, when $i_l > (1-p)\overline{C}$, 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 L firms with low distress costs take foreign currency loans, and L firms with high distress costs take local currency loans.

IMPERFECT INFORMATION CASE

We now introduce an information asymmetry between banks and firms about the revenues of the firms. Assume that banks cannot verify the currency denomination of a firm, that is, banks cannot distinguish between the two types of firms: F and L firms.

Banks, however, know that among each type of firm $j \in \{F;L\}$ there is a share φ with low costs $\underline{C}$ costs and a share $1-\varphi$ with high distress costs $\overline{C}$. Furthermore, banks know that a proportion $\lambda \in [0,1]$ of the total firm population is L firms, and that the remaining proportion $1-\lambda$ is F firms. 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.[18]

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

$$\pi_k = \begin{cases} r_l - i_l, & \text{if } k = l \\ \frac{\delta\lambda\left[pe_A + (1-p)R^L\right] + (1-\lambda)}{\delta\lambda + (1-\lambda)} - \left(1 + i_f\right) + r_f, & \text{if } k = f \end{cases} \tag{6}$$

where $\delta \in [0, 1]$ is the equilibrium share of L firms taking foreign currency loans. Given the assumption of equation 1, interest rates in equilibrium with 0 expected profit must equal:

$$r_k = \begin{cases} i_l, & \text{if } k = l \\ \frac{\delta\lambda}{\delta\lambda + (1-\lambda)}(1-p)(e_D - R^L) > 0, & \text{if } k = f \end{cases} \tag{7}$$

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 L firms taking such loans relative to F firms. This characterization of the interest rates implicitly uses a Nash equilibrium concept and is based on 0 profit conditions for the banks given the share of L firms taking a foreign currency loan.

Note that the expression $0 \leq \delta\lambda/\delta\lambda + (1-\lambda) \leq 1$ when $0 \leq \delta \leq 1$. Therefore, the interest rate that banks charge on foreign currency loans under imperfect information lies between the rate they charge for such loans under perfect information to F firms, that is, 0, and the rate they charge under perfect information to L firms, that is, $r_f^L = (1-p)(e_D - R^L)$. In other words, $r_f \in [0, r_f^L]$.

A local currency earning firm will choose to take a foreign currency loan if its expected payoff is higher when it takes a foreign currency loan than when it takes a local currency loan, that is, when $v_f^L(r_f, C_i) \geq v_l^L(r_l, C_i)$.

Substituting that $r_l = i_l$ in (2) and making use of equation 1, we see that a local currency earning firm will choose a foreign currency loan only if

$$(1-p)\left(C_i + R^L - e_D\right) \leq i_l - r_f. \tag{8}$$

[18] 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 *et al.*, 2011 and Brown *et al.*, 2012). 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).

In other words, a local currency earning firm will choose a foreign currency loan if its expected cost of default on the foreign currency loan is less than the interest rate advantage he will get over a local currency loan.

We assume from now on that:

$$\underline{C} \geq e_D - R^L > 0. \tag{9}$$

Assumption (9) ensures that, unless there is a positive interest rate differential to the advantage of foreign currency funds, all L firms will choose local currency loans. This assumption prevents some L firms opting for foreign currency loans due to their limited liability even in the absence of an interest rate differential. Note that assumption (9) states that the minimum distress costs is at least as large as the part of the foreign currency loan that a defaulting L firm does not pay back in the case of a default.

From (8), we see that under imperfect information the share of L firms, which will take foreign currency loans, will be:

$$\delta^L_{\text{imperfect info}} = \begin{cases} 0 & \text{if } i_l < (1-p)(\underline{C} + R^L - e_D) \\ \varphi & \text{if } r_f + (1-p)(\underline{C} + R^L - e_D) \leq i_l < r_f + (1-p)\left(\overline{C} + R^L - e_D\right) \\ 1 & \text{if } i_l \geq r_f + (1-p)\left(\overline{C} + R^L - e_D\right) \end{cases} \tag{10}$$

Note that the conditions under which firms choose to borrow in local or foreign currency involve the expected cost of default on a foreign currency loan. The expected cost of default would be the distress cost, C, minus the part of the foreign currency loan not paid back ($e_D - R^L$), in other words, a 'gain' for the firm as it does not pay back its full loan.

The following propositions show when different types of equilibria emerge under imperfect information given the values of the parameters in our model.

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

Proof. *In the Appendix.*

Above, we see that none of the local currency earners will choose to borrow in foreign currency if the interest rate disadvantage on local currency loans is smaller than the minimum expected cost of default when a foreign currency loan is taken.

Proposition 2 also shows that a separating equilibrium under imperfect information exists only for lower interest rate differential between local and

foreign currency loans compared with the minimum interest rate differential needed for a separating equilibrium under perfect information. In order to see that, compare the first lines of (5) and (10) and utilize assumption (9).

Proposition 3 (Partial Pooling Equilibrium): *If* $i_l \geq (1-p)\underline{C} - (1-\lambda)/\lambda\varphi + (1-\lambda)(1-p)(e_D - R^L)$ *and* $i_l \leq (1-p)\overline{C} - (1-\lambda)/\lambda\varphi + (1-\lambda)(1-p)(e_D - R^L)$ *a partial pooling equilibrium exists in which only L firms with low distress costs* $\underline{C}$ *take foreign currency loans while L firms with high distress costs* $\overline{C}$ *take local currency loans.*

Proof. *In the Appendix.*

Proposition 3 similarly shows that a partial pooling equilibrium is feasible under imperfect information starting at a lower interest rate differential between local and foreign currency loans than it is feasible under perfect information.

Proposition 4 (Full Pooling Equilibrium): *If* $i_l \geq (1-p)\overline{C} - (1-p)(1-\lambda)(e_D - R^L)$ *a full pooling equilibrium exists in which all L firms take foreign currency loans.*

Proof. *In the Appendix.*

Last but not the least, proposition 4 also shows that a fully pooling equilibrium under imperfect information is more feasible for a lower interest rate differential between local and foreign currency loans than it is under perfect information.

Note that in the partial-pooling and full-pooling equilibria described above we have assumed that all *F* firms chose foreign currency loans, which will be the case as long as $r_f(\delta) \leq i_l$. Assumption (9) ensures that in any equilibrium where $\delta > 0$ we have $r_f(\delta) \leq i_l$.

To summarize our findings, under perfect information there always exists either a separating, partial-pooling, or full-pooling equilibrium. Under imperfect information, two main things change. First, partial-pooling or full-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 *L* firms are not fully pricing the credit risk of these loans due to expected exchange rate depreciations. And second, the market for foreign currency loans may in fact collapse. Proposition 5 summarizes the range of parameters for which an equilibrium with lending in foreign currency does not exist.

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

$$\begin{aligned}(1-p)\underline{C}-(1-p)\left(e_D-R^L\right)<i_l<(1-p)\\ \underline{C}-\frac{(1-\lambda)}{\lambda\varphi+(1-\lambda)}(1-p)\left(e_D-R^L\right)\end{aligned} \tag{11}$$

or

$$\begin{aligned}(1-p)\overline{C}-\frac{(1-\lambda)}{\lambda\varphi+(1-\lambda)}(1-p)\left(e_D-R^L\right)<i_l<(1-p)\overline{C}\\ -(1-\lambda)(1-p)\left(e_D-R^L\right)\end{aligned} \tag{12}$$

Proof. *In the Appendix.*

Proposition 5 shows 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 (11) at which L firms with low distress consider switching from local currency to foreign currency loans if banks charge 0 interest rates on foreign currency loans. However, if a set of $\varphi\lambda$ of L firms with low distress costs would switch to foreign currency loans, the zero-profit interest rate on these loans would rise to $(1-\lambda)/\varphi\lambda+(1-\lambda)(1-p)(e_D-R^L)$. At that interest rate, for foreign currency loans, all L firms will prefer to take local currency loans, and thus there is no equilibrium in which foreign currency loans are offered.

A similar effect leads to market collapse at interest rates in the range (12), to the extent that these firms would be deterred from taking foreign currency loans, A set of $(1-\varphi)\lambda$ of L firms with high distress costs consider switching from local currency to foreign currency loans.

In both of these ranges of interest rate differentials the only credit market equilibrium is characterized by all firms taking local currency loans.

It should be noted that throughout the model we assume that there are no alternative financing options for foreign currency loans. Thus, foreign currency earners do not have any option other than subsidizing foreign currency loans for local currency earners. However, the more local currency earners borrow in foreign currency, the more expensive will a foreign currency loan be. In that case, a foreign currency earner can possibly opt out and find an alternative financing source, such as trade credit or capital market financing.

CONCLUSION AND TESTABLE HYPOTHESES

Motivated by policy concerns about the credit risks resulting from unhedged foreign currency loans, 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 in our model may not know the currency in which firms have contracted their sales.

Our model shows that under imperfect information concerning the currency of firm revenues more local currency earners choose foreign currency loans than when banks have perfect information about firms' revenues. The intuition behind this result is that when banks cannot distinguish the risky from the safe FX borrowers they will charge a single interest rate to both types. This interest rate will be lower than the interest rate for risky borrows (ie, local currency earners) that prevails when the banks can identify these firms.

In line with previous models (eg, Cowan, 2006), our model predicts that the currency structure of firm revenues as well as firm-level distress costs will affect loan currency choice. At the macroeconomic level, our model further confirms that the choice of a foreign currency loan will be positively related to the interest rate advantage on foreign currency funds and negatively related to exchange rate volatility.

The novel 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). 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. Finally, our model predicts that under information asymmetry the foreign currency loan market can collapse if too many local currency earners prefer to take foreign currency loans making them too expensive. Whether the market will collapse or not depends on the interest rate differential and the distribution of distress costs in the economy.

How do the novel predictions of our model square with recent firm-level and bank-level evidence? In Brown *et al.* (2011), we examine the determinants of foreign currency borrowing by small firms, using information on the most recent loan extended to 3,101 firms in 25 transition countries between 2002 and 2005. There we show that firms' revenue structure rather than the interest rate

differential between local currency and foreign currency funding is the key determinant of loan currency choice. That evidence confirms the fact that firm characteristics as opposed to monetary conditions seem to be the key drivers of foreign currency borrowing by small firms in Emerging Europe. With respect to the importance of information asymmetries as a driver of foreign currency loans, we find mixed evidence: Borrowing in foreign currency is unrelated to firm-level auditing procedures. At the same time, borrowing in foreign currency is negatively related to firm age suggesting that more opaque (younger) firms are more likely to borrow in foreign currency.

Degryse *et al.* (2012) as well as Brown and De Haas (2012) use bank-level data to study how the ownership structure of banks affects the currency denomination of their loan portfolio. Examining regulatory data for Polish banks during the period 1996–2006, Degryse *et al.* (2012) find that foreign banks that enter *via* greenfield investment, and hence face an acute information asymmetry about potential borrowers, are more likely to lend to larger, financially transparent firms than domestic-owned banks or foreign banks that take over existing local banks. They also find that greenfield banks are more likely to lend in foreign currency than domestic or takeover banks. These results suggest that information asymmetries play an important role in lending to small businesses in the region and may actually limit the provision of foreign currency loans to this segment of financially opaque borrowers. Brown and De Haas (2012) examine survey data covering 193 banks in 20 countries in 2001 and 2004. Their results confirm that foreign-owned banks lend more in foreign currency to corporate clients (but not to households) than domestic banks. Again, this evidence suggests that information asymmetries (that are arguably stronger for foreign-owned banks) may limit the provision of foreign currency loans to the more financially opaque retail clients.

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APPENDIX

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

$$\delta^{L}_{\text{perfect info}} = \begin{cases} 0 & \text{if } i_l < (1-p)\underline{C} \\ \varphi & \text{if } (1-p)\underline{C} \le i_l \le (1-p)\overline{C} \\ 1 & \text{if } i_l > (1-p)\overline{C} \end{cases} \tag{A.1}$$

Proof. *Recall that the equilibrium interest rates on loans under perfect information can be written as:*

$$r^{j}_{k} = \begin{cases} i_l & \text{if } j \in \{F, L\} \text{ and } k = l \\ 0 & \text{if } j = F \text{ and } k = f \\ (1-p)(e_D - R^L) & \text{if } j = L \text{ and } k = f \end{cases} \tag{A.2}$$

Recall also that the expected payoff of firms can be written as:

$$v_k^{j,i} = \begin{cases} R^j - \left(1 + r_k^j\right) & \text{if } j = F \text{ or } (j,k) = (L,l) \\ p[R^L - e_A] - (1-p)C_i - r_f^L & \text{if } (j,k) = (L,f) \end{cases} \tag{A.3}$$

and that the expected depreciation of the local currency is assumed to be 0:

$$pe_A + (1-p)e_D = 1. \tag{A.4}$$

Inserting the equilibrium interest rates from (A.2) into the expected payoff of firms (A.3), and using the equation (A.4), we obtain the following two results:

1. Foreign currency earners (F types) will always choose foreign currency loans, because their expected payoff will be higher when they take a foreign currency loan than when they take a local currency loan. Thus, all F firms will take foreign currency loans.
2. An L firm will choose a local currency loan when

$$(1-p)C_i \geq i_l. \tag{A.5}$$

The condition (A.5) tells us when it will be preferable for a local currency earner to borrow in foreign currency based on the values of the distress costs, the probability of depreciation, and the interest rate gap. In other words, a local currency earner will choose to take a local currency loan if its expected cost of default on a foreign currency loan is larger than the interest rate on local currency loans.

Recall that we assumed only two values for $C_i \in \{\underline{C}; \overline{C}\}$. Thus if $\overline{C} < i_l/(1-p)$, then all local currency earners will choose a foreign currency loan; and if $\underline{C} > i_l/(1-p)$, then no local currency earner will choose a foreign currency loan. For intermediate values of i_l, only local currency earners with low distress costs, $\underline{C}$, will choose a local currency loan. Thus, the equilibrium share of L firms that choose foreign currency loans can be written as:

$$\delta^L_{\text{perfect info}} = \begin{cases} 0 & \text{if } \frac{i_l}{(1-p)} < \underline{C} \\ \varphi & \text{if } \leq \frac{i_l}{(1-p)} \leq \overline{C} \\ 1 & \text{if } \frac{i_l}{(1-p)} > \overline{C} \end{cases}. \tag{A.6}$$

Note that (A.6) is equivalent to (A.1).

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

Proof. *In a separating equilibrium, all local currency earners will choose a local currency loan by definition. Thus, we have the share of L firms taking a foreign currency loan equal to 0, that is,* $\delta = 0$. *Recall that the equilibrium interest rate for foreign currency loans can be written as:*

$$r_k = \begin{cases} i_l, & \text{if } k = l \\ \frac{\delta\lambda}{\delta\lambda + (1-\lambda)}(1-p)(e_D - R^L) > 0, & \text{if } k = f \end{cases}. \tag{A.7}$$

Therefore, $r_f = 0$ *when* $\delta = 0$.

Also recall that

$$\delta = \begin{cases} 0 & \text{if } i_l < (1-p)(\underline{C} + R^L - e_D) \\ \varphi & \text{if } r_f + (1-p)(\underline{C} + R^L - e_D) \le i_l < r_f + (1-p)\left(\overline{C} + R^L - e_D\right) \\ 1 & \text{if } i_l \ge r_f + (1-p)\left(\overline{C} + R^L - e_D\right) \end{cases}. \tag{A.8}$$

From (A.8) it follows that a separating equilibrium exists, if $i_l < (1-p)(\underline{C} - e_D + R^L)$.

Proposition 3 (Partial Pooling Equilibrium): *If* $i_l \ge (1-p)\underline{C} - (1-\lambda)/\lambda\varphi + (1-\lambda)(1-p)(e_D - R^L)$ *and* $i_l \le (1-p)\overline{C} - (1-\lambda)/\lambda\varphi + (1-\lambda)(1-p)(e_D - R^L)$ *a partial pooling equilibrium exists in which only L firms with low distress costs* $\underline{C}$ *take foreign currency loans while L firms with high distress costs* $\overline{C}$ *take local currency loans.*

Proof. *In a partial pooling equilibrium, some local currency earners will choose a local currency loan, whereas others will choose a foreign currency loan. Recall that distress costs can take only two values,* $\underline{C}$ and $\overline{C}$. *Therefore, in a partial pooling equilibrium, the share of L firms that take a foreign currency loan should equal to the share of L firms that have low distress costs. Hence,* $\delta = \varphi$.

Recall that the equilibrium interest rate for foreign currency loans can be written as in (A.7). Therefore,

$$r_f = \frac{\varphi\lambda}{\varphi\lambda + (1-\lambda)}(1-p)\left(e_D - R^L\right). \tag{A.9}$$

Substituting (A.9) into (A.8), it follows that only *L* firms with low distress costs will chose a foreign currency loan if:

$$i_l \ge (1-p)\underline{C} - \frac{(1-\lambda)}{\varphi\lambda + (1-\lambda)}(1-p)\left(e_D - R^L\right)$$

and

$$i_l < (1-p)\overline{C} - \frac{(1-\lambda)}{\varphi\lambda + (1-\lambda)}(1-p)\left(e_D - R^L\right)$$

Proposition 4 (Full Pooling Equilibrium): *If* $i_l \geq (1-p)\overline{C} - (1-p)(1-\lambda)(e_D - R^L)$ *a full pooling equilibrium exists in which all L firms take foreign currency loans.*

Proof. *In a full-pooling equilibrium, all local currency earning firms take foreign currency loans, that is,* $\delta = 1$.

In this case, the expression (A.7) yields that the equilibrium interest rate for foreign currency loans is

$$r_f = \lambda(1-p)\left(e_D - R^L\right). \tag{A.10}$$

Substituting (A.10) into (A.8), it follows that a full-pooling equilibrium exists if $i_l \geq (1-p)\overline{C} - (1-\lambda)(1-p)(e_D - R^L)$.

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

$$\begin{aligned}(1-p)\underline{C} - (1-p)\left(e_D - R^L\right) < i_l < (1-p)\\ \underline{C} - \frac{(1-\lambda)}{\lambda\varphi + (1-\lambda)}(1-p)\left(e_D - R^L\right)\end{aligned}. \tag{A.11}$$

or

$$\begin{aligned}(1-p)\overline{C} - \frac{(1-\lambda)}{\lambda\varphi + (1-\lambda)}(1-p)\left(e_D - R^L\right) < i_l < (1-p)\overline{C}\\ - (1-\lambda)(1-p)\left(e_D - R^L\right)\end{aligned} \tag{A.12}$$

Proof. *Follows directly from propositions 2, 3, and 4.*