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Foreign Currency–Denominated Debt: An Empirical Examination*

We examine the determinants of debt issuance in 10 major currencies by large U.S. firms. Using the fraction of foreign subsidiaries and tests exploiting the disaggregated nature of our data, we find strong evidence that firms issue foreign currency debt to hedge their exposure both at the aggregate and the individual currency levels. We also find some evidence that firms choose currencies in which information asymmetry between domestic and foreign investors is low. We find no evidence that tax arbitrage, liquidity of underlying debt markets, or legal regimes influence the decision to issue debt in foreign currency.

I. Introduction

In recent years, as the global economy has become increasingly integrated, there has been a dramatic increase in the number of firms that have some business activity outside their country of incorporation. Such foreign involvement ranges from simple import or export activity to more complicated decisions including integrated global sourcing, production, and competition. These multinationals face many different product and capital markets, a myriad of legal regimes, political risks, and exchange rate uncertainty. We have little understanding of how this affects the financing patterns of multinational firms.

In this article, we study a sample of large U.S. firms and examine their decision to issue foreign currency–denominated debt. There has been a dramatic

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increase in the amount of debt finance raised in foreign currencies. Firms in the United States increased foreign currency–denominated debt from around $1 billion in 1983 to $62 billion in 1998. This increase can also be seen at the individual currency level. Over this period borrowing increased from $0.3 billion to $9.4 billion in German marks, from $0.6 billion to $22 billion in U.K. pounds, and from $0.2 billion to $2.5 billion in Japanese yen. Despite this increasing importance, there is little understanding of why firms issue foreign currency–denominated debt. In this article, we examine the various factors that influence the firm's choice of currency for issuing debt.

Choice of currency of debt is also important because it throws light on firms' risk management activities. There has been a surge of interest in the hedging policies of firms and management of foreign exchange risk. Although most of this attention has been focused on the derivative usage of firms, issuing debt in a currency in which the firm has exposure is an alternate form of hedging. Anecdotal evidence from the testimony of top managers suggests that derivative usage is only one aspect of an integrated policy of managing foreign exchange risk. For example, in the 1995 Bank of America Round-Table on Derivatives and Corporate Risk Management, Tom Jones, vice president and treasurer of Union Carbide, said: "We use natural hedges any place we can—for example, funding in currencies where we produce and sell; or when possible, locating manufacturing and sourcing in countries where we sell. But there is still considerable room for financial solutions to risk management after the natural hedges are in place" (Jones et al. 1995, p. 65).

Studying the role of foreign currency–denominated debt as a hedging instrument complements the current literature by developing a comprehensive understanding of a firm's risk management activities. Prior work by Geczy, Minton, and Schrand (1997) and Allayannis and Ofek (2001) examines foreign currency–denominated debt at the aggregate level. In this article we study the role of foreign currency debt in hedging exposure at the individual currency level.

Reasons other than hedging could also explain the decision of firms to issue foreign currency–denominated debt. Legal and information barriers in world capital markets generate preferences and restrictions on investor demand for securities. Firms' choices of currency of debt might be dictated by differences in cost of financing in different currencies arising on account of capital market imperfections. There are many studies that document segmentation of capital markets (Jorion and Schwartz 1986; Wheatley 1988; Gultekin, Gultekin, and Penati 1989; Hietala 1989; Campbell and Hamao 1992). We provide evidence that the existence of such information asymmetries between domestic and foreign investors affects the choice of currency for denomination of debt by multinationals.

Liquidity of the underlying debt market influences debt issuance in foreign currencies. Markets with greater liquidity reduce transactions costs in financing. A firm's choice of currency could also be influenced by the prevailing legal system. La Porta et al. (1998) show that different legal regimes differ

in the level of investor protection rights. Weak creditor rights are likely to raise the cost of borrowing, reducing debt issuance in that currency. Finally, firms have an incentive to arbitrage differences in tax rates across the world. This might also generate a weak preference for denominating debt in the currency of the high-tax countries.

We use Moody's data to get a detailed currency-wise breakdown of the foreign debt issued by large U.S. firms. We study the firm's decision to issue foreign currency–denominated debt, both at the aggregate and the individual currency levels. In particular, we examine the decision of firms to issue debt in the following 10 currencies: the Australian dollar, the Canadian dollar, the French franc, the German mark, the Italian lira, the Japanese yen, the Dutch guilder, the Swedish kroner, the Swiss franc, and the British pound. We use the fraction of subsidiaries of a firm that operate in these countries to proxy for underlying exposure in the currency.

We find strong evidence that the probability of issuing debt in foreign currencies is influenced by foreign operations. Firms with greater foreign operations are more likely to use foreign currency debt to hedge their increased exposure. Firms with greater operations abroad are also more likely to have informed foreign investors and consequently to face lower information asymmetries. This significance of foreign operations is therefore consistent both with the hedging role of foreign currency–denominated debt and with segmented capital markets. We use two methods to distinguish between the hedging and the segmented capital markets hypotheses. In the first method, we exploit the covariance structure of exchange rates. Correlation between currencies has implications for the hedging motive but not for the segmented markets hypothesis. In the second method, we exploit prior work on why firms hedge to establish the relationship between foreign debt and firm characteristics that is implied by the hedging motive and not by the segmented capital markets motive. Both sets of tests provide strong evidence in support of the hedging motive. Firms use foreign currency–denominated debt to hedge their exposure both in the underlying currency and in closely correlated currencies.

We also find significant evidence that segmented capital markets influence the choice of currency of debt. Firm characteristics, such as large size and good credit rating, that ameliorate the severity of the information asymmetries between domestic and foreign investors, significantly increase the probability of issuing foreign currency–denominated debt. However, there is little evidence that tax-based motives, the liquidity of underlying debt markets, or exigencies of the legal regimes influence the probability of issuing debt in that currency.

The rest of the article is organized as follows. Section II discusses the determinants of the choice of foreign currency–denominated debt (hereafter referred to as foreign debt). Section III discusses the sample selection procedure, provides a brief description of the data, and presents some interesting descriptive statistics about patterns of foreign debt issuance by firms. Section

IV reports the results of our main tests on the determinants of foreign debt issuance. Section V details some robustness checks, and Section VI concludes.

II. Determinants of Foreign Currency–Denominated Debt

In this section, we examine possible explanations for the choice of currency of debt. A firm has the choice of raising debt in the local currency or in a foreign currency. With risk neutral investors, expected yields in the two currencies would be equalized.[1] Firms basing their decision on expected costs should be indifferent with respect to the choice of currency of denomination of debt. However, currency of debt becomes relevant for several reasons, which are described below.

A. Exposure

Firms issue debt in the currencies of countries in which they operate to hedge the underlying exposure. For example, the French subsidiary of a U.S. firm generates revenues in French francs. This causes the U.S. firm to be exposed to the U.S. dollar–French franc exchange rate. By issuing debt denominated in French francs, the U.S. firm can hedge this exposure. We refer to this as a straight hedge. Further, firms can exploit the correlation between currencies for hedging. As the correlation between the French franc and the German mark is high, a firm may use mark-denominated debt to hedge its French franc exposure. We refer to this exposure as cross exposure and to the corresponding hedge as a cross hedge. Firms should have greater debt denominated in the currency in which they have exposure or in currencies that are highly correlated with the currency of their exposure.

However, foreign debt can only hedge foreign exchange exposure arising from the revenue side. If the firm is exposed to changes in foreign exchange rates through its cost side, issuing foreign debt increases rather than offsets this exposure.

B. Segmented Capital Markets

If capital markets are integrated, then financial assets traded in different markets but with identical risk characteristics will have identical expected returns. Segmentation of capital markets and barriers to international investment could give rise to opportunities for choosing the currency of debt to minimize expected cost. Two sources of segmentation have been identified in the literature.

The first source of segmentation is legal barriers, which consist of a wide variety of restrictions, including different tax treatment for foreign and domestic investments, capital controls, security law, and ownership restrictions

1. Empirical evidence supporting covered interest rate parity is provided by Frenkel and Levich (1975, 1977) and McCormick (1979). Uncovered interest parity need not always hold in the data.

(Jorion and Schwartz 1986; Gultekin et al. 1989). The second source of segmentation is informational and argues that foreign investors have higher costs of information gathering (Hietala 1989). The difficulty of capturing the complexity of the capital control regimes of countries makes the task of controlling for legal barriers very difficult. We do, however, control for information barriers to integrated global capital markets. The existence of information barriers implies that firms that face foreign investors who are not informationally disadvantaged vis-à-vis domestic investors are more likely to issue foreign debt.

C. Taxes

There are two ways in which taxes affect multinational firms' sourcing of debt. The first is due to differences in the tax treatment of interest and exchange rate gains and losses, while the second is due to firms arbitraging differences in corporate tax rates across countries. As the U.S. tax code does not generate any preferences for interest or exchange rate gains and losses, the first reason is not relevant for our sample.[2]

Multinationals have incentives to arbitrage tax differentials across countries by locating debt in the highest-tax country to maximize the value of tax shields generated (Hodder and Senbet 1990; Desai 1997; Newberry and Dhaliwal 1998). This preference for locating debt in the high-tax subsidiaries might generate an indirect preference for issuing debt in the currency of high-tax subsidiaries.

D. Liquidity

Liquidity in underlying debt markets allows firms to reduce transaction costs and issue securities with lower expected yields. Firms are more likely to issue foreign debt if the corresponding debt market has higher liquidity.

E. Legal Regimes and Currency of Debt

La Porta et al. (1998) show that countries differ in the degree of investor protection provided by the legal regimes. In equilibrium, differences in the degree of legal protection provided to creditors will be reflected in the costs of raising external finance. Countries belonging to the legal regimes with weak creditor rights will be associated with higher costs of borrowing. Therefore, multinationals with a choice of borrowing in different currencies are less likely to borrow in currencies with weak creditor rights.

2. The expected cost of issuing foreign currency–denominated debt consists of the foreign interest rate and the expected exchange rate gain or loss on the principal and the interest. If the exchange rate gain or loss has a different tax treatment than does the interest, it generates currency preference for the issuance of debt. Shapiro (1984) showed that if the exchange rate losses on the principal of foreign debt are not tax deductible, firms would prefer to issue debt in the weaker currency. Such conditions arise in England, Sweden, and Australia, inter alia. Hodder and Senbet (1990) show that if exchange rate gains and losses are treated as ordinary income and cannot be deferred, as in the United States, there exists no preference for currencies.

III. Data Description

A. *Sample Selection*

We examine the choice of currency for denomination of debt by large U.S. firms. The sample consists of all firms reported on Compustat with sales greater than $1.6 billion in 1996.[3] Financial firms and utilities were excluded from this sample. Data from Moody's Investor Services were used to obtain the currency of denomination of debt issues.[4] Firms for which no Moody's data were available were excluded from the sample. Finally, wholly-owned firms or majority-owned subsidiaries of other firms were also excluded from the sample and consolidated with their parent firms. This yielded a total of 523 firms.

B. *Foreign Currency–Denominated Debt*

The Moody's data specify the currency of denomination of all public debt issues. Some firms also disclose the currency of denomination of bank debt. We recorded the amount of debt issued in individual currencies. In view of measurement problems associated with debt denominated in several of the smaller currencies, we restrict attention to debt issues in 10 prominent currencies. These currencies are the Australian dollar, the Canadian dollar, the French franc, the German mark, the Italian lira, the Japanese yen, the Dutch guilder, the Swedish kroner, the Swiss franc, and the British pound, and they account for 67% of total foreign debt issued by firms in our sample. A category called "other foreign debt" recorded the debt in all other currencies.[5] Sometimes the firms simply indicated that the debt was issued in a foreign currency and did not specify the currency. In these cases also, the debt was classified under the category of other foreign debt. The data consist of dollar values of foreign debt.[6]

This attempt to estimate the currency-wise breakdown of firms' debt is undermined by the fact that many firms have domestic and foreign subsidiaries that might be involved in the issuance of debt. Therefore, we also collect Moody's data on the debt issues of all majority-owned (greater than 50%)

3. The cutoff value of $1.6 billion was chosen in order to keep the sample size manageable.
4. In the process of rating the debt issues, Moody's collects details of all the firm's debt and other firm-level information. The level of detail is, however, a function of the data disclosed by the firm to Moody's.
5. The other currencies reported were the Belgian franc, the Luxembourg franc, the European Currency Unit (ECU), the New Zealand dollar, and the Hong Kong dollar. The instances of usage of these currencies were few.
6. Moody's converted foreign currency debt into dollars using beginning of year 1996 exchange rates. Exchange rates used were 1 U.S. dollar equals 1.3543 Australian dollars, 1.3818 Canadian dollars, 5.1361 French francs, 1.4919 German marks, 1,667 Italian lira, 106.4 Japanese yen, 1.6708 Dutch guilders, 6.9493 Swedish kroners, 1.2093 Swiss francs, and 0.6651 British pound.

TABLE 1 Foreign Currency–Denominated Debt: Intensity of Usage and Firm Characteristics

	No. of Firms	Total Assets	Net Sales	Debt Rating	Market to Book
All firms	523	2,994.59	3,786.28	10	.998
Firms with no foreign debt	408	2,648.61	3,423.21	10	.962
Firms with some foreign debt	115	7,661.24	7,156.42	8	1.041
Foreign debt/total debt:					
.9 and above	4	2,243.79	2,641.67	8	.872
.8–.9	0				
.7–.8	1	2,710.35	6,534.57		.918
.6–.7	5	18,441.65	14,080.30	6	2.402
.5–.6	4	16,161.00	18,546.00	5	1.639
.4–.5	5	27,588.05	39,220.30	7.5	1.026
.3–.4	5	20,010.00	19,499.00	4	1.806
.2–.3	12	6,441.40	7,218.10	10	1.423
.1–.2	26	7,538.00	5,616.05	8.5	1.113
Below .1	53	6,786.00	7,526.50	8.5	.979

NOTE.—This table reports the distribution of the fraction of foreign currency–denominated debt to total debt for firms in the sample. It also reports median values of total assets, net sales, senior debt rating, and asset market-to-book ratios for these firms. Foreign currency–denominated debt consists of all non-U.S.-dollar debt reported by firms. Assets and sales are in millions of U.S. dollars. Debt rating translates Standard & Poor's alphabetical rating scale to a numerical scale, as reported by Compustat: AAA corresponds to 2, AA+ to 4, AA to 5, etc., until D, which corresponds to 27.

subsidiaries (domestic and foreign) of these firms.[7] The final currency-wise breakdown of debt for firms in our sample reflects all disclosed debt issued by majority-owned subsidiaries.

We have data only on the currency of denomination at the time of the public debt issue. Firms might, however, decide to swap the debt into another currency or back into U.S. dollars. Some firms report details of swaps entered, and those are taken into account when constructing currency-wise breakdown of foreign debt held. However, very few firms report details of their swap transactions. This article, therefore, is only able to shed light on the choice of currency at the time of issuance.

Table 1 reports how the fraction of foreign debt to total debt is distributed in our sample. About 22% of our sample (115 firms) has issued foreign debt. Firms issuing foreign debt are larger than those that do not, both as measured by total assets and sales. Among the firms with some foreign debt, there is substantial cross-sectional variation in the amount of foreign debt. Foreign debt accounts for less than 20% of total debt for 79 firms (about 70%) and is more than 50% of total debt for only 14 firms (about 12%).

Table 2 displays how foreign debt is distributed across the 10 currencies.

7. Many firms issue debt through their financing subsidiaries or through a wholly owned foreign subsidiary. For example, Eastman Kodak had two wholly owned subsidiaries, Kodak Ltd. in the United Kingdom and Kodak A.G. in Germany. Identification of domestic and foreign subsidiaries was made possible by the organization structure of parent firms, also reported by Moody's. Details of debt issues of subsidiary- or majority-owned firms were obtained from Moody's and are reflected in the parent's debt portfolio.

TABLE 2 Description of Foreign Currency–Denominated Debt: Currency-Wise Breakdown

Currency	No. of Firms	US$ Value (Mean)	US$ Value (Median)	% of Total Debt (Mean)	% of Total Debt (Median)
All foreign currency debt	115	113	103	20	12
Australian dollar	10	316	117	12	3
Canadian dollar	24	249	105	9	3
French franc	14	209	195	5	2
German mark	29	323	146	17	6
Italian lira	10	137	55	3	1
Japanese yen	24	313	13	15	7
Dutch guilder	6	161	141	5	3
Swedish kroner	1	72	72	.2	.2
Swiss franc	24	240	107	4	3
British pound	29	437	105	10	8
Other foreign currency debt*	54	246	89	10	6

NOTE.—This table gives the breakdown of foreign currency–denominated debt into individual currencies. All values of debt are reported in millions of U.S. dollars.

* This category consists of all other currencies. It also includes total foreign debt held by firms that do not report the breakdown of foreign debt by currencies.

The mean level of foreign debt, among firms with some foreign debt, is $113 million, while the median level is $103 million. The Canadian dollar, the German mark, the Japanese yen, the Swiss franc, and the British pound are the most commonly used currencies for the denomination of debt. Not only is the number of firms issuing debt in these currencies large but the average U.S. dollar value of debt denominated in these currencies is also large.

Table 3 displays the distribution of the number of currencies used by firms to denominate debt. A large fraction of firms has debt denominated in only one foreign currency: 69 (60%) of the 115 firms that report having some foreign debt have one currency, and only 17 firms (15%) have more than four currencies in their debt portfolio. Firms using only one currency have a higher fraction of total debt denominated in that currency.

C. Empirical Proxies for Explanatory Variables

Exposure. Economic exposure is defined as the sensitivity of the value of the firm to exchange rate movements.[8] In measuring foreign exchange exposure, we run into problems encountered and documented by previous research. Jorion (1990) was the first to estimate foreign exchange exposure of firms as the regression coefficient of firm equity value on exchange rate changes, controlling for market returns. Although the exposure was imprecisely estimated and was unstable over time, Jorion showed that it was pos-

8. See Dumas (1978), Adler and Dumas (1980), and Hodder (1982).

TABLE 3 Description of Foreign Currency–Denominated Debt: Number of Currencies Used

Currency	1	2	3	4	% of Total Debt for Firms with One Currency (Mean)	Maximum % of Total Debt for Firms with One Currency
Full sample	69	22	6	17	16	93
Australian dollar	3	0	1	6	23	65
Canadian dollar	9	6	2	7	16	90
French franc	2	1	0	11	11	21
German mark	7	6	4	12	33	93
Italian lira	2	0	1	7	7	12
Japanese yen	7	5	2	10	35	64
Dutch guilder	1	0	3	2	4	4
Swedish kroner	0	0	0	1	0	0
Swiss franc	5	5	2	12	6	16
U.K. pound	6	6	5	12	11	18

NOTE.—This table displays the number of currencies used for denomination of debt. The firms included are those among the full sample that had some foreign currency debt outstanding.

itively correlated with the degree of foreign involvement proxied by the fraction of total sales abroad.[9]

In accordance with this evidence, and in line with Geczy et al. (1997) and Allayannis and Ofek (2001), we use the fraction of total sales in foreign countries (FORSALE) and the fraction of total assets held abroad (FORASSET) as proxies for the overall foreign exchange exposure of firms. We also include the fraction of total income generated abroad (FORINC).

However, these accounting variables capture foreign operations only at the aggregate level, and they are unable to proxy for individual-country-level activity.[10] A firm's operations in a country are the major determinants of exposure in that currency. Following Caves (1971), we use the fraction of foreign subsidiaries to proxy for the intensity of a firm's foreign operations and therefore its exposure.[11] Foreign operations are measured at the aggregate level by FORSUB, the ratio of foreign subsidiaries to total subsidiaries. At the currency level, it is measured by SUB_{ij}, the fraction of subsidiaries firm

9. See Bodnar and Gentry (1993) for further support. Exposure could be imprecisely estimated due to mispricing (Bartov and Bodnar 1994) or time variation (Allayannis 1997).

10. Firms are not required to report sales and assets by country, only by geographical areas. As there is no uniformity in the definition of geographical areas and it still gives aggregate sales and asset by geographical region, sales and assets cannot be used to proxy for individual currency exposure.

11. Caves (1971) finds that setting up foreign subsidiaries is a significant commitment to foreign operations. Firms export when there are economies to scale and no adaptation required; they license when they have a proprietary process; and they operate a foreign subsidiary when the firm's competitive advantage is embodied in research and development, marketing, and managerial expertise.

TABLE 4 Summary Statistics for Proxies of Aggregate Exposure

Variable	No. of Firms	Mean	Median	SD
Foreign sales/total sales	472	.185	.125	.21
Foreign assets/total assets	289	.277	.28	.19
Foreign income/total income	311	.17	.14	.29
Foreign subsidiaries/total subsidiaries	515	.35	.34	.31
Foreign debt/total debt	523	.04	.00	.13

SOURCES.—The data for foreign sales and foreign assets are obtained from the geographical segment file of Compustat. The foreign income data are from Compustat. The data on foreign currency–denominated debt and foreign subsidiaries are from Moody's Investor Services.

NOTE.—This table reports the summary statistics for the different proxies of aggregate foreign exchange exposure of firms.

i operates in country *j*.[12] The variable SUB_{ij} captures exposure at the individual-currency level, which has not been possible in earlier work.[13]

Data on country-wise distribution of firms' subsidiaries are obtained from Moody's.[14] Table 4 presents the summary statistics for the various proxies of foreign exchange exposure. Firms, on average, generate 19% of total sales abroad and 17% of total income abroad. On average, they hold about 28% of their assets abroad and have 35% of total subsidiaries abroad. All four proxies of exposure are positively correlated with each other (table 5). Table 6 reports summary statistics for exposure to individual currencies as proxied by the fraction of total subsidiaries operating in these countries. Three hundred and sixty-five firms (71%) have some foreign activity as proxied by foreign subsidiaries. Canada, the United Kingdom, and Germany are the most preferred countries for locating subsidiaries. Two hundred and eighty-five firms (55%) have a subsidiary in Canada, 265 firms (52%) have a subsidiary in the United Kingdom, and 223 firms (43%) have a subsidiary in Germany. Firms, on average, have 1.76 subsidiaries in Canada, 1.98 subsidiaries in Germany, and 3.26 subsidiaries in the United Kingdom.

There are limitations to using foreign subsidiaries to proxy for exposure. As all subsidiaries are regarded as equal contributors to exposure, our proxy does not take into account differences among subsidiaries in the fraction of

12. We use the Jorion (1990) methodology to test whether the fraction of foreign subsidiaries is related to economic exposure over the period 1990–96. We find no evidence that economic exposure is related to any of the proxies for foreign operations. This is not surprising given similar results reported (for some subperiods) by Jorion (1990) and Amihud (1994). As stock returns reflect exposure after the firm's hedging policy is in place, it is not surprising that there is no significant relation observed with underlying exposure.

13. We examined the possibility of using U.S. imports and exports to foreign countries to proxy for exposure in those currencies. The limitations of using trade data are that (1) exposure is measured at the industry level rather than at the firm level, (2) the sample is restricted to firms in one-digit SIC, and (3) the harmonization of SIC with SITC creates further noise in the measurement of exposure.

14. Moody's relies on disclosure by firms of its operations. To the extent that firms do not fully disclose, it will not be captured by our variables. There were 10 firms that did not report the country of operation of their subsidiaries, and these were assigned missing value codes.

TABLE 5 Correlation across Proxies of Aggregate Exposure

Variable	Foreign Sales/ Total Sales	Foreign Assets/ Total Assets	Foreign Income/ Total Income	Foreign Subsidiaries/ Total Subsidiaries
Foreign sales/ total sales	1	.77	.39	.49
Foreign assets/ total assets	.77	1	.41	.39
Foreign income/ total income	.39	.41	1	.27
Foreign subsidiaries/ total subsidiaries	.49	.39	.27	1
Foreign debt/ total debt	.35	.32	.16	.25

NOTE.—This table reports the correlation matrix between the proxies of foreign operations of firms.

foreign currency costs allocated.[15] Although locating foreign subsidiaries to lower production costs is going to be important in the case of emerging economies (see Vernon 1966), it is unlikely to explain the fraction of subsidiaries in our sample of developed countries.

More important, foreign subsidiaries could proxy for segmented capital markets along with being a proxy for exposure. Information asymmetries between U.S. and foreign investors regarding U.S. firms are likely to be less for firms with operations in foreign countries. This is likely to create a greater demand among foreign investors for debt issued by U.S. firms with subsidiaries abroad. A significant coefficient on fraction of subsidiaries abroad is thus consistent with both hedging and segmented markets. We distinguish between the hypotheses in two ways.

First, the two theories have different implications for foreign debt denominated in currencies other than the country of operation. Only the hedging

TABLE 6 Summary Statistics for Proxy of Currency-Level Operations

Country	No. of Firms	Average No. of Subsidiaries	Median No. of Subsidiaries
Any subsidiary	492	65	32
Any foreign subsidiary	365	29	9
Australia	183	1.05	0
Canada	284	1.76	1
France	220	1.61	0
Germany	223	1.98	0
Italy	180	.82	0
Japan	162	.71	0
Netherlands	214	1.56	0
Sweden	125	.44	0
Switzerland	148	.63	0
United Kingdom	265	3.26	1

NOTE.—This table displays the distribution of the number of subsidiaries across countries for firms in our sample.

15. Poor quality data on the distribution of profits by subsidiary or other measures of ranking the importance of subsidiaries make it very difficult to control for the difference in net revenue base among subsidiaries.

motive implies that firms will cross hedge. We develop a proxy for cross exposure of firm i in currency j (CROSS_{ij}) as the weighted average of firm i's foreign subsidiaries in all countries other than j. The weights are ρ_{jk}, correlation of currency j with currency k, and they have been estimated using monthly exchange rate data from 1990 to 1996, that is, $\text{CROSS}_{ij} = \sum_{k \neq j} \rho_{jk} \text{SUB}_{ik}$. A large CROSS_{ij} implies that firm i faces significant exposure in currencies that are correlated with currency j. The hedging motive implies that the firm will issue more debt in currency j if CROSS_{ij} is large, that is, that its coefficient is positive and significant. The segmented markets hypothesis implies that the coefficient of CROSS_{ij} is insignificant.

Second, we rely on prior work that identifies firm characteristics affecting corporate hedging activities. Although firms with these characteristics are more likely to hedge with foreign debt, they are not any more likely to issue foreign debt on account of segmented markets. Froot, Scharfstein, and Stein (1993) argue that, with diminishing marginal returns to investment and costly external finance, firms will hedge to reduce the variability of internally generated cash flows. Firms with tighter financial constraints are therefore more likely to hedge their exposure. Following Geczy et al. (1997), we use the current ratio to proxy for financial constraints.

Another reason why firms hedge is the high cost of bankruptcy.[16] The costs of bankruptcy are likely to be high if the firm has (1) a low value under liquidation and (2) a high value of growth options. We use the ratio of net fixed assets to total assets (asset tangibility) to proxy for the value of the firm under liquidation, and we use research and development expenses (RND/SALES) and market to book value of assets to proxy for growth options. Significant negative coefficients for current ratio and asset tangibility and significant positive coefficients for RND/SALES and market to book are evidence in support of the hedging motive.[17]

However, firms with low asset tangibility and high RND/SALES are also likely to have greater information asymmetries. The segmented markets hypothesis would therefore predict that these firms are likely to issue less foreign debt, which is opposite to the predictions from the hedging motive. Table 7 summarizes the predictions of both hypotheses.

Segmented capital markets. In addition to foreign subsidiaries, asset tangibility, and RND/SALES, all discussed above, we identify other firm characteristics that facilitate greater information flows to foreign investors. These firm characteristics are size and credit rating. The informational disadvantage of foreign investors is likely to be lower for large firms (SIZE is proxied by log of total assets) and for firms with high credit quality (RATING is the firm's senior debt rating as reported in Compustat). Compustat assigns small numeric values to firms with superior credit rating. Thus, the segmented mar-

16. See Smith and Stulz (1985), Nance, Smith, and Smithson (1993), and Mian (1996).

17. Other explanations of corporate hedging have also been suggested. See, e.g., Stulz (1990), DeMarzo and Duffie (1995), Breeden and Viswanathan (1996), and Tufano (1996).

TABLE 7 Determinants of the Choice of Foreign Currency–Denominated Debt

Variable	Exposure Motive	Segmented Markets (Information Asymmetry)	Taxes	Legal Regimes	Liquidity
Foreign subsidiaries/total subsidiaries	+	+			
Cross exposure	+				
Firm characteristic:					
RND/SALES	+	−			
Net fixed asset/total asset	−	+			
Current ratio	−				
Market to book ratio	+				
Credit rating		+			
Size	+	+			
NOL			+		
Currency/country characteristics:					
Tax rates			+		
French legal dummy				−	
German legal dummy				?	
Liquidity in debt markets					+

NOTE.—This table summarizes the various motives for the issuance of foreign currency–denominated debt and their empirical proxies. RND = research and development expenses. NOL = firm-level incentives for tax arbitrage.

kets hypothesis predicts the coefficient of RATING to be negative and that of SIZE to be positive.

Taxes. To proxy for the incentive to arbitrage tax differentials across countries, we include the tax rates (TAXRATE) for countries in our sample.[18] In our sample, Australia, Canada, France, Germany, Italy, Japan, and Sweden have higher tax rates relative to the United States, while the Netherlands, Switzerland, and the United Kingdom have lower rates.

We also control for firm-level differences in the incentives to arbitrage tax differences. As firms with a tax loss carried forward have greater incentives to shift interest deductions abroad, they are more likely to issue foreign debt. This firm-level incentive is proxied by net operating loss carried forward (NOL) from Compustat and is normalized by sales (the coefficient is expected to be positive and significant).

Liquidity. We use average annual U.S. dollar value of nonconvertible debt raised in a given currency from 1990 to 1995 to proxy for liquidity of the underlying debt market. We normalize the amount of debt issuance by the gross domestic product (GDP) of the country to control for size of the market. The average annual value of debt raised in millions of U.S. dollars for the different currencies, obtained from Securities Data Corporation, are Japanese yen ($55,717), German mark ($45,434), British pound ($26,648),

18. Difference in tax rates could arise on account of differences in (1) statutory corporate tax rates, (2) tax base through differences in the allowed deductions, and (3) tax holidays and other local tax concessions. We use data from Desai and Hines (1998), who calculate tax rates applicable to U.S. firms as the smaller of the statutory corporate tax rate for 1989 or the average tax rate paid by U.S. firms.

TABLE 8 Average Foreign Currency–Denominated Debt Held

	High		Low		Difference
	Mean	Number	Mean	Number	in Means
Tax rates	.025	503	.009	503	.017**
Liquidity	.026	503	.008	503	.018**
Legal regimes	.031	503	.003	503	.028**
Firm size	.065	261	.022	262	.041**
Credit rating	.078	197	.025	215	.053**

NOTE.—This table displays the mean values of the fraction of debt denominated in foreign currency for two groups. The group categorized as high liquidity consists of the five most liquid currencies. The other currencies are in the low-liquidity group. The group with low legal enforcement consists of currencies that belong to the French legal system. The group with a high tax rate consists of currencies of countries with tax rates higher than the tax rate of the United States. Large firms are those with total assets greater than the median total assets for firms in our sample. Firms with high credit quality consist of those with a Compustat senior credit rating of 9 or below.

** Significant at the 1% level.

Swiss franc ($21,648), French franc ($20,561), Canadian dollar ($15,251), Italian lira ($10,308), Dutch guilder ($8,801), Australian dollar ($6,494), and Swedish kroner ($848).

Legal regimes and currency of debt. We use dummy variables for legal regimes based on the classification proposed by La Porta et al. (1998). In our sample, the English system countries are Australia, Canada, and the United Kingdom; the French system countries are France, Italy, and Netherlands; the German system countries are Germany, Japan, and Switzerland; and the Scandinavian system country is Sweden. We expect lower issuance in currencies of countries with weak creditor rights and weak law enforcement, that is, in those countries belonging to the French legal system.

IV. Results

A. *Univariate Tests*

In this subsection we report the results of some univariate tests of the determinants of foreign debt. As shown in table 8, firms, on average, issue more debt in currencies of countries with higher tax rates than those of the United States (2.5% vs. 0.9%), with more liquid debt markets (2.6% vs. 0.8%), and with stronger creditor rights (3.1% vs. 0.3%). We also find that foreign debt varies with firm characteristics. Larger firms and higher credit-rated firms issue significantly more foreign debt.

Average foreign debt also varies with foreign subsidiaries. As seen in table 9, firms with foreign subsidiaries have a higher fraction of foreign debt in comparison to firms with no foreign subsidiaries. This difference is significant for all proxies of foreign operations except for the fraction of income earned abroad. This relationship also holds at the individual currency level for seven currencies.

TABLE 9 Average Foreign Currency–Denominated Debt across Exposure Categories

Measure of Exposure	Firms with Foreign Operations		Firms with No Foreign Operations		Difference in Means
	Mean	Number	Mean	Number	
Foreign sales/total sales	.06	273	.007	199	.05**
Foreign assets/total assets	.07	257	.02	32	.05*
Foreign income/total income	.086	191	.024	120	.06
Foreign subsidiaries/total subsidiaries	.055	365	.014	150	.04**
Currency-wise breakdown of foreign subsidiaries:					
Australian dollar	.003	182	0	334	.003
Canadian dollar	.007	284	.001	232	.006
French franc	.003	216	0	299	.003**
German mark	.017	219	.004	296	.013*
Italian lira	.001	176	0	347	.001^{+}
Japanese yen	.014	154	.004	361	.01*
Dutch guilder	.001	211	0	304	.001^{+}
Swiss franc	.006	141	0	374	.006**
U.K. pound	.01	263	.001	252	.009**

NOTE.—This table presents the mean values of the fraction of foreign currency debt to total debt for the group of firms with and without foreign operations. Foreign operations are measured by the fraction of foreign sales to total sales, fraction of foreign assets to total assets, fraction of foreign income to total income, and fraction of foreign subsidiaries to total subsidiaries. The firm is defined as having exposure if the exposure proxy has a nonzero value. For exposure as measured by fraction of foreign income to total income, firms are defined as having no exposure if the fraction of foreign income is less than 10% of total income.

$^{+}$ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

B. Estimation Methodology

We have data on the fraction of total debt denominated in foreign currency and in each of the individual currencies. We create a dummy variable (FORDEBT_D), which takes a value of one when the firm has any foreign debt and zero otherwise. We then fit a probit model to explain the probability of issuing foreign debt, first at the aggregate level and then in individual currencies.

C. Aggregate Foreign Currency–Denominated Debt

In this specification, we control for firm characteristics that influence aggregate foreign debt issuance, but we are unable to control for currency/country differences. We include proxies for foreign operations (FORSALE, FORASSET, FORINC, and FORSUB), for segmented markets (SIZE and RATING), and for firm-level incentives for tax arbitrage (NOL). Finally, we control for the firm's capital structure by including the ratio of long-term debt to total assets (LEV).

As reported in table 10, aggregate foreign operations, for all proxies with the exception of FORINC, are highly significant in explaining the probability of issuing foreign debt. An increase in the fraction of foreign sales, by 0.001 from its mean of 0.19, increases the probability of issuing foreign debt by

TABLE 10 Determinants of Aggregate Foreign Currency–Denominated Debt

	Model 1	Model 2	Model 3	Model 4
Constant	−5.34**	−5.88**	−4.00**	−5.86**
	(1.12)	(1.30)	(1.20)	(1.09)
Foreign sales/total sales (FORSALE)	3.00**			
	[.86]			
	(.48)			
Foreign assets/total assets (FORASSET)		2.54**		
		[.97]		
		(.62)		
Foreign income/total income (FORINC)			.55	
			[.21]	
			(.52)	
Foreign subsidies/total subsidies				2.42**
				[.73]
				(.56)
Senior debt rating (RATING)	−.02	.01	−.05	−.01
	[−.006]	[.004]	[−.02]	[−.03]
	(.04)	(.05)	(.04)	(.04)
Log of assets (SIZE)	.46**	.54**	.43**	.56**
	[.13]	[.21]	[.16]	[.16]
	(.11)	(.13)	(.12)	(.10)
NOL	−1.29	−1.67	.42	−.54
	[−.37]	[−.64]	[.16]	[−.16]
	(2.61)	(2.95)	(2.23)	(2.15)
Long-term debt/total assets	1.18	1.12	1.46	.48
	[.34]	[.43]	[.55]	[.14]
	(.84)	(.99)	(.91)	(.74)
No. of observations	255	163	174	281
Maximized log likelihood function	−106.07	−86.08	−101.95	−130.53

NOTE.—This table reports the results of the probit estimation for the decision to issue foreign debt. The dependent variable is a dummy, which takes a value of one when the firm has debt denominated in any foreign currency and zero otherwise. Each model reports the results with a different proxy for aggregate foreign operations. The variable NOL is the tax loss carried forward normalized by sales. The estimated marginal effects are reported in brackets, and the standard errors are reported in parentheses. We also estimated the model using dummies for the aggregate exposure. The results are qualitatively similar and have not been reported here.

** Significant at the 1% level.

1%. A similar picture emerges with other measures of the degree of foreign operations. An increase in the fraction of foreign assets (subsidiaries), by 0.001 (0.001) from its mean of 0.26 (0.17), increases the probability of issuing foreign debt by 1%. These results are not only statistically significant but also economically significant. An increase of around 0.6% from the mean level of foreign operations increases the probability of issuing foreign debt by 1%. The exception appears to be the fraction of income abroad. This is not too surprising in light of the firm's ability to control the foreign income reported through the use of transfer pricing and other mechanisms.

There is mixed support for the effect of segmented markets. The significance of the coefficients of foreign operations and firm size reinforces the effect of

segmented markets on the choice of currency. However, the coefficient of credit rating is not significant. There exists no evidence in support of tax arbitrage being a motivation for choice of currency for denomination of debt.

D. Individual Currency Exposure

Next we examine the relation between foreign debt and foreign subsidiaries at the individual currency level, and we distinguish between the hedging and segmented markets hypotheses. For each currency in our sample, we create a dummy variable (CURR_DEBT_{ij}), which takes a value of one if firm i has debt outstanding in currency j and zero otherwise. We first estimate the basic model as specified below:

$$\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \alpha_2 \text{SUB}_{ij} + \alpha_3 \boldsymbol{X}_i + \alpha_4 \boldsymbol{Z}_j + \varepsilon_{ij}),$$

where $\Phi(.)$ is the standard normal distribution, SUB_{ij} is the fraction of subsidiaries of firm i in country j, $\boldsymbol{X}_i$ is the set of firm characteristics (SIZE, RATING, LEV, NOL), and $\boldsymbol{Z}_j$ is the set of country/currency characteristics (TAXRATE, debt market liquidity, legal system dummy). The results, presented in table 11, provide strong evidence that foreign operations affect the issuance of foreign debt at the currency level. The coefficient is positive and significant at the 1% level. As discussed above, this evidence is consistent with both the hedging and the segmented capital markets hypotheses. There is further evidence in support of the segmented markets hypothesis as the coefficient of firm size is positive and significant and that of credit rating is negative and significant. There is no evidence to support tax arbitrage–based rationales for foreign debt as the coefficients of tax rate and NOL are both insignificant. The coefficients of the French and German legal dummies, as well as the coefficient of market liquidity, are not significant. There is little evidence in support of these rationales for issuance of foreign debt.

Another variation of the above specification (model 2), which relaxes the constraint that the relationship between foreign subsidiaries and foreign debt be the same for all currencies, is also estimated. The relationship between foreign operations and foreign debt is positive for all currencies, and it is significant for six currencies. There is considerable variation in how foreign operations affect debt issuance across the different currencies. This difference across currencies could arise due to differences in the degree to which foreign debt in a currency is used to cross hedge.

We develop a proxy for cross hedging that facilitates differentiation between the hedging and the segmented markets hypotheses. We estimate the following model:

$$\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \alpha_2 \text{SUB}_{ij} + \alpha_3 \text{CROSS}_{ij} + \alpha_4 \boldsymbol{X}_i + \alpha_5 \boldsymbol{Z}_j + \varepsilon_{ij}),$$

where CROSS_{ij} is firm i's cross exposure in currency j and other terms are as defined before. We estimate three different models, the results of which are reported in table 12. In model 1, we constrain the relationship between

TABLE 11 Determinants of the Choice of Currency of Foreign Currency Debt

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
Constant	−7.60**	1.64	−9.50	2.11
Foreign subsidiaries/total subsidiaries	6.04**	.93		
Subsidiaries in Australia/total subsidiaries			10.33*	4.50
Subsidiaries in Canada/total subsidiaries			2.30	2.09
Subsidiaries in France/total subsidiaries			8.17*	3.87
Subsidiaries in Germany/total subsidiaries			10.75**	2.52
Subsidiaries in Italy/total subsidiaries			13.26*	5.36
Subsidiaries in Japan/total subsidiaries			5.51^{+}	3.30
Subsidiaries in the Netherlands/total subsidiaries			5.71	5.29
Subsidiaries in Switzerland/total subsidiaries			6.98	6.88
Subsidiaries in the United Kingdom/total subsidiaries			7.78**	1.76
Log of assets (SIZE)	.49**	.05	.51**	.05
Senior debt rating (RATING)	−.06*	.02	−.05*	.02
Long-term debt/total assets	.26	.55	.16	.56
Net operating loss (NOL)	.31	1.36	−.01	1.42
Tax rates	1.50	1.55	3.13	1.98
Liquidity in debt markets	.42	.33	.77^{+}	.42
French legal system dummy	−.02	.20	.001	.26
German legal system dummy	.23	.12	.19	.15
No. of nonzero observations	124		124	
Total no. of observations	2,640		2,640	
Maximized log likelihood function	−369.087		−361.730	

NOTE.—This table reports estimated coefficients, standard errors, and marginal effects from two probit models of the choice of currency of denomination of foreign currency debt. Model 1 uses the specification $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \alpha_2 \text{SUB}_{ij} + \alpha_3 \boldsymbol{X}_i + \alpha_4 \boldsymbol{Z}_j + \varepsilon_{ij})$, while model 2 instead uses the specification $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \sum_j \alpha_{2j} \text{SUB}_{ij} + \alpha_3 \boldsymbol{X}_i + \alpha_4 \boldsymbol{Z}_j + \varepsilon_{ij})$. The dependent variable CURR_DEBT_{ij} has a value of one if the firm i has debt denominated in currency j and zero otherwise. The variable SUB_{ij} is the fraction of firm i's subsidiaries in country j; $\boldsymbol{X}_i$ is the vector of firm-specific explanatory variables: size (log of total assets), debt rating, long term debt-assets ratio, and net operating loss carried forward; $\boldsymbol{Z}_j$ is the vector of country-specific explanatory variables: tax rates, debt market liquidity (debt market size normalized by GDP), and dummies for the French and German legal systems. Model 1 constrains the relationship between foreign operations and the probability of foreign currency debt issuance to be the same for all currencies, while model 2 estimates a separate coefficient for each currency. Since there is just one firm in the sample with Swedish kroner debt, estimates of Swedish kroner-related coefficients are unreliable and have not been reported.

$^{+}$ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

foreign debt and foreign subsidiaries as well as that between foreign debt and cross exposure to be the same for all currencies. The coefficient of SUB_{ij} is positive and significant, implying that foreign operations are significantly related to issuance of foreign debt in that currency. We find significant evidence in support of our hedging motive as the cross exposure term is also positive and significant at the 1% level. There continues to be support for segmented markets as both the coefficients of firm size and credit rating are significant. There is some evidence that firms are less likely to issue debt in currencies with weak legal regimes. The coefficient of French legal regime is negative and significant. There is no evidence that liquidity of debt markets or tax arbitrage motives are significant explanatory factors in the issuance of foreign debt.

In model 2, we allow the relationship between foreign debt and foreign

subsidiaries to differ across all currencies but constrain the relationship between foreign debt and cross exposure to be the same. The results are qualitatively the same. For most currencies other than the Swiss franc and the Dutch guilder, there is a significant positive relationship between foreign operations and foreign debt. The cross exposure term continues to be significant at the 1% level.

In model 3, we allow the relationship between foreign debt and cross exposure to also differ by currencies. A significant relationship between foreign debt and foreign subsidiaries exists for five of the currencies. The cross exposure term is significant for three currencies, that is, for the German mark, the Japanese yen, and the British pound. This suggests that firms are likely to issue debt in these three currencies to cover their exposure in other currencies that are correlated with these currencies. This is not surprising as these are the three most common currencies for the denomination of debt. The coefficients of straight exposure in the German mark and the British pound are also significant. Firms' issuance of mark and pound debt is not only related to operations in these countries but also related to operations in currencies that are highly correlated with the mark and the pound. However, the coefficient of straight exposure in the yen is not significant. Firms have few subsidiaries in Japan (average of 0.71) but hold more yen debt. Issuance of debt in yen is more likely to hedge exposure in other currencies that are positively correlated with the yen rather than to hedge yen exposure. The straight exposure coefficients of the Australian dollar, the French franc, and the Italian lira are significant, but the cross exposure coefficients are not, indicating that issuance of debt in these currencies is related to operations in these countries but that they are not used to hedge exposure in other currencies.

The significance of the coefficient of cross exposure for these three currencies, as well as the significance of cross exposure at the aggregate level, demonstrates the importance of the hedging motive in the issuance of foreign debt. There continues to be evidence in favor of the segmented capital markets hypothesis (the coefficients of both size and credit rating are significant), though there is little evidence for the other motives for issuance of foreign debt.

Next we examine firm characteristics, which helps us to distinguish further between the hedging and the segmented capital markets hypotheses. The coefficient of asset tangibility is negative and significant, as reported in table 13. This supports the hedging motive and contradicts the segmented markets hypothesis. The coefficient of current ratio is also negative and significant, as predicted by the hedging motive. The coefficient of cross exposure continues to be significant. In summary, the evidence supports the hedging hypothesis.

Although the coefficient of size continues to be significant, that of credit rating is not significant at conventional levels. This could be due to reduction in sample size as many firms did not report data needed for the firm-specific variables. To test whether this is a function of sample selection, we estimate model 2, where we exclude NOL. In this larger sample, the coefficient of credit

TABLE 12 Model for the Issuance of Foreign Debt at the Currency Level

	Model 1		Model 2		Model 3	
	Coefficient	SE	Coefficient	SE	Coefficient	SE
Constant	−6.42**	.68	−6.74**	.75	−7.50**	.91
Foreign subsidiaries/total subsidiaries	5.35**	.97				
Subsidiaries in Australia/total subsidiaries			9.88*	4.50	11.52*	4.64
Subsidiaries in Canada/total subsidiaries			3.50^{+}	1.96	3.16	2.02
Subsidiaries in France/total subsidiaries			6.85^{+}	3.97	9.25*	4.59
Subsidiaries in Germany/total subsidiaries			8.06*	2.76	7.76*	3.42
Subsidiaries in Italy/total subsidiaries			9.89^{+}	5.20	13.78^{+}	7.27
Subsidiaries in Japan/total subsidiaries			5.64^{+}	3.27	3.73	3.55
Subsidiaries in the Netherlands/total subsidiaries			7.10	5.28	5.69	5.70
Subsidiaries in Switzerland/total subsidiaries			2.68	7.38	4.32	7.70
Subsidiaries in the United Kingdom/total subsidiaries			6.67**	1.92	6.74**	1.98
Cross exposure	2.26**	.62	2.09**	.66		
Cross exposure (Australian dollar)					−4.93	11.02
Cross exposure (Canadian dollar)					8.56	8.51
Cross exposure (French franc)					−.60	1.84
Cross exposure (German mark)					2.75*	1.31
Cross exposure (Italian lira)					−.29	2.46
Cross exposure (Japanese yen)					6.83*	2.67
Cross exposure (Dutch guilder)					1.56	1.90

Cross exposure (Swiss franc)					1.81	1.33
Cross exposure (British pound)					3.89**	1.42
Log of assets (SIZE)	.51**	.05	.52**	.05	.53**	.05
Senior debt rating (RATING)	−.05*	.02	−.04^{+}	.02	−.04^{+}	.02
Long-term debt/total assets	.56	.56	.45	.57	.57	.57
Net operating loss (NOL)	−.05	1.43	−.25	1.47	−.32	1.51
Tax rates	−.07	.18	−.14	.23	−.34	.30
Liquidity in debt markets	.10	.14	.15	.17	.36	.23
French legal system dummy	−.36*	.18	−.39^{+}	.21	.003	.26
German legal system dummy	.05	.13	.05	.15	.04	.18
No. of nonzero observations	124		124		124	
Total no. of observations	2,640		2,640		2,640	
Maximized log likelihood function	−362.967		−358.269		−353.435	

NOTE.—This table reports estimated coefficients and standard errors from three probit models of the choice of currency of denomination of foreign debt. The specifications used are the following: model 1: $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \alpha_2\text{SUB}_{ij} + \alpha_3\text{CROSS}_{ij} + \alpha_4\boldsymbol{X}_i + \alpha_5\boldsymbol{Z}_j + \varepsilon_{ij})$; model 2: $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \sum_j \alpha_{2j}\text{SUB}_{ij} + \alpha_3\text{CROSS}_{ij} + \alpha_4\boldsymbol{X}_i + \alpha_5\boldsymbol{Z} + \varepsilon_{ij})$, and model 3: $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \sum_j \alpha_{2j}\text{SUB}_{ij} + \sum_j \alpha_{3j}\text{CROSS}_{ij} + \alpha_4\boldsymbol{X}_i + \alpha_5\boldsymbol{Z}_j + \varepsilon_{ij})$. The dependent variable CURR_DEBT_{ij} has a value of one if firm i has debt denominated in currency j and zero otherwise. The variable SUB_{ij} is the fraction of firm i's subsidiaries in country j. The variable CROSS_{ij} measures the cross exposure between currency j and operating exposure in all other currencies for firm i; it is calculated as $\text{CROSS}_{ij} = \sum_{k \neq j} \rho_{jk}\text{SUB}_{ik}$, where ρ_{jk} is the correlation coefficient between currencies j and k, estimated from monthly exchange rates over the period 1990–96; $\boldsymbol{X}_i$ is the vector of firm-specific explanatory variables: size (log of total assets), senior debt rating, long term debt-assets ratio, and net operating loss carried forward; $\boldsymbol{Z}_j$ is the vector of country-specific explanatory variables: tax rates, debt market liquidity (debt market size normalized by GDP), and dummies for the French and German legal systems. Model 1 constrains the relationship between foreign operations and the probability of foreign debt issuance to be the same for all currencies, both for operating exposure to the same currency as the foreign debt currency (SUB_{ij}) and for operating cross exposure to all other currencies (CROSS_{ij}). Model 2 estimates a separate coefficient for each currency for SUB_{ij} but constrains the coefficient on CROSS_{ij} to be the same for all currencies. Model 3 estimates a separate coefficient for each currency for both SUB_{ij} and CROSS_{ij}. Since there is just one firm in the sample with Swedish kroner debt, estimates of Swedish kroner–related coefficients are unreliable and have not been reported.

$^{+}$ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

TABLE 13 Distinguishing between Hedging- and Segmented Markets–Based Explanations of the Choice of Currency of Foreign Debt

	Model 1		Model 2	
	Coefficient	SE	Coefficient	SE
Constant	−7.23**	1.96	−7.07**	1.70
Foreign subsidiaries/ total subsidiaries	5.49**	1.01	4.97**	.81
Cross exposure	2.60**	.73	2.59**	.62
Log of assets (SIZE)	.45**	.07	.45**	.06
Debt rating	−.05	.03	−.06*	.03
Long-term debt/total assets	.32	.67	.48	.56
NOL	.27	1.61	.	
RND/SALES	−2.32	2.05	−.73	1.51
Market to book ratio	−.03	.16	−.15	.14
Current ratio	−.31*	.12	−.37**	.11
Net fixed assets/total assets	−.46*	.32	−.58*	.28
Tax rates	2.30	1.77	2.34	1.54
Liquidity in debt markets	.50	.37	.49	.32
French legal system dummy	−.27	.23	−.33^{+}	.20
German legal system dummy	.03	.14	−.01	.12
No. of nonzero observations	99		129	
Total no. of observations	2,210		3,090	
Maximized log likelihood function	−303.091		−402.350	

NOTE.—This table reports estimated coefficients and standard errors from two probit models of the choice of currency of denomination of foreign debt. Both models use the specification $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \alpha_2\text{SUB}_{ij} + \alpha_3\text{CROSS}_{ij} + \alpha_4\boldsymbol{X}_i + \alpha_5\boldsymbol{Z}_j + \varepsilon_{ij})$. The dependent variable CURR_DEBT_{ij} has the value of one if firm i has debt denominated in currency j and zero otherwise. The variable SUB_{ij} is the fraction of firm i's subsidiaries in country j. The variable CROSS_{ij} measures the cross exposure between currency j and operating exposure in all other currencies for firm i: it is calculated as $\text{CROSS}_{ij} = \Sigma_{k \neq j}\rho_{jk}\text{SUB}_{ik}$, where r_{jk} is the correlation coefficient between currencies j and k, estimated from monthly exchange rate data over the period 1990–96; $\boldsymbol{X}_i$ is the vector of firm-specific explanatory variables. Model 1 includes size (log of total assets), senior debt rating, long-term debt–assets ratio, net operating loss carried forward, research and development expense normalized by net sales, market to book ratio for assets, current ratio (current assets/current liabilities), and asset tangibility measured by net fixed assets/total assets. Model 2 includes all variables from model 1 except NOL. In the specification, $\boldsymbol{Z}_j$ is the vector of country-specific explanatory variables: tax rates, debt market liquidity (debt market size normalized by GDP), and dummies for the French and German legal systems. Since there is just one firm in the sample with Swedish kroner debt, estimates of Swedish kroner–related coefficients are unreliable and have not been reported.

$^{+}$ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

rating is significant. The lack of significance of credit rating earlier is likely on account of sample selection and should not be interpreted as evidence against the segmented markets hypothesis. There is again little evidence to support either the tax, liquidity, or legal regimes rationales for issuing foreign debt.

V. Robustness Checks

We do a number of robustness checks with different empirical proxies for the explanatory variables and different specifications of the model. We briefly summarize the results, which remain qualitatively the same.

A. Definitions of Variables

We estimated the model with dummies to proxy for foreign operations rather than the extent of foreign operations. The use of dummies deemphasizes the notion that the number of foreign subsidiaries or the value of foreign sales captures the degree of foreign exchange exposure. This was done both at the aggregate level and at the currency level, where we created a dummy variable (SUB_{ij}_D), which takes a value of one when firm *i* has operations in country *j* and zero otherwise. The use of SUB_{ij}_D also allows us to control for the dependence of organizational form (number of subsidiaries formed) and regulatory environment in the country in question. The results with the use of foreign operations dummies were qualitatively similar.

We also estimated the model (1) with tax dummies (takes a value of one when the tax rate in a country is greater than that of the United States and zero otherwise) instead of tax rates, (2) with the number of nonconvertible debt issues instead of their dollar values, and (3) without NOL to estimate the model with a larger number of observations. We found no significant change in the results.

B. Specification of the Model

We also estimated the model using the fraction of foreign debt in a currency (in lieu of the dummy variable) as the independent variable. As only 115 of the 523 firms in our sample have foreign debt, we estimated a tobit model. The results were found to be qualitatively similar.

Although the tobit is the right specification for the amount of foreign debt to be issued and the probit is the right specification for the decision to choose a currency, firms in our sample have a choice to issue debt in more than one currency. This might suggest estimating a multinomial logit. However, this is difficult as the firm's decision is not to choose one currency among many but potentially to choose many (even all) currencies. To examine whether the relationship between firm characteristics and foreign debt differs across currencies, we estimate currency level coefficients for firm variables. The results, reported in table 14, show little difference across currencies in the effect of firm characteristics on foreign debt issuance and provide justification for our use of the probit model.

VI. Conclusion

We examine the issuance of debt in 10 major currencies by a sample of large U.S. firms and study the determinants of choice of currency of debt. We find

TABLE 14 Determinants of the Choice of Currency of Foreign Debt: Separate Coefficients for Individual Currencies for Firm-Level Variables

	Australian Dollar	Canadian Dollar	French Franc	German Mark	Italian Lira	Japan Yen	Dutch Guilder	Swiss Franc	British Pound	Probit Model
Constant										−11.44
										(21.18)
Foreign subsidiaries/ total subsidiaries	15.62**	1.52	10.81*	8.22*	15.08^{+}	3.03	5.85	4.30	6.28**	
	(5.35)	(2.15)	(5.09)	(3.53)	(7.78)	(3.66)	(6.19)	(9.31)	(2.07)	
Cross exposure	−9.75	7.15	−.42	2.59^{+}	−.56	5.06^{+}	1.50	2.96^{+}	3.36*	
	(13.50)	(9.30)	(2.27)	(1.49)	(3.19)	(3.01)	(2.21)	(1.71)	(1.49)	
Log of assets (SIZE)	.31**	.35**	.74**	.61**	.69**	.42**	.47*	1.07**	.51**	
	(.11)	(.12)	(.16)	(.10)	(.16)	(.12)	(.22)	(.21)	(.11)	
Senior debt rating	−.05	−.01	−.08	.01	−.09	−.03	−.11	−.03	−.05	
	(.07)	(.06)	(.09)	(.05)	(.08)	(.06)	(.11)	(.07)	(.06)	
Long-term debt/total assets	1.62	1.27	2.43	−.97	1.84	−1.08	1.74	−.81	−.08	
	(1.66)	(1.31)	(2.31)	(1.58)	(2.15)	(1.73)	(2.50)	(2.17)	(1.35)	
NOL	3.25	−7.85	−1.89	−4.72	2.57	−2.40	2.00	.91	1.78	
	(3.60)	(8.15)	(8.23)	(5.49)	(5.00)	(5.55)	(6.20)	(4.51)	(2.96)	
Tax rates										15.86
										(20.43)
Liquidity in debt markets										.22
										(4.58)
French legal dummy										−4.08
										(2.85)
German legal dummy										−2.21
										(1.48)
No. of nonzero observations										124
Total no. of observations										2,640
Log likelihood function										−343.325

NOTE.—This table reports estimated coefficients, with standard errors in parentheses, from the following probit model of the choice of currency of denomination of foreign debt: $\Pr(\text{CURR\_DEBT}_{ij} = 1) = \Phi(\alpha_1 + \sum_j \alpha_{2j}\text{SUB}_{ij} + \sum_j \alpha_{3j}\text{CROSS}_{ij} + \sum_j \alpha_{4j}\boldsymbol{X}_i + \alpha_5\boldsymbol{Z}_j + \varepsilon_{ij})$. The dependent variable CURR_DEBT_{ij} has the value of one if firm i has debt denominated in currency j and zero otherwise. The variable SUB_{ij} is the fraction of firm i's subsidiaries in country j; CROSS_{ij} measures the cross exposure between currency j and operating exposure in all other currencies for firm i, and it is calculated as $\text{CROSS}_{ij} = \sum_{k \neq j} \rho_{jk}\text{SUB}_{ik}$, where ρ_{jk} is the correlation coefficient between currencies j and k; $\boldsymbol{X}_i$ is the vector of firm-specific explanatory variables: size (log of total assets), senior debt rating, long-term debt–assets ratio, and net operating loss carried forward; $\boldsymbol{Z}_j$ is the vector of country-specific explanatory variables: tax rates, debt market liquidity (debt market size normalized by GDP), and dummies for the French and German legal systems. A separate vector of coefficients $\boldsymbol{\alpha}_{4j}$ is estimated for each currency j. Since there is just one firm in the sample with Swedish kroner debt, estimates of Swedish kroner–related coefficients are unreliable and have not been reported.

$^{+}$ Significant at the 10% level.

* Significant at the 5% level.

** Significant at the 1% level.

strong evidence that debt issuance in foreign currency is related to foreign activity. This result holds for different proxies of foreign operations and at both the aggregate and individual currency levels.

The significance of foreign operations in determining the probability of issuing foreign debt is consistent with both the role of foreign debt as a hedging instrument and the existence of information barriers. Both sets of tests provide significant evidence in favor of the hedging motive for issuing foreign debt. Firms issue debt in currencies in which they have exposure or in currencies that are positively correlated with currencies of exposure.

There is also significant support for information asymmetries between foreign and domestic investors arising from segmented capital markets being an important reason for the issuance of foreign debt. We find that U.S. firms with well-informed foreign investors are more likely to issue foreign debt. The coefficients of firm size and credit quality, our proxies for the degree of information asymmetry, are both significant. We find little evidence to support that any of the other rationales are important in the decision to issue foreign debt. It is unlikely that incentives to arbitrage taxes, liquidity of the underlying debt markets, or legal regimes affect the decision of firms to issue foreign currency–denominated debt.

By providing evidence of the role of foreign currency debt in hedging activities of firms, this article lends support to the view that firms have a comprehensive view of risk management. It underscores the need to go beyond the firms' derivative positions and look at other financial and operational hedges to fully comprehend the firms' exposures and risk management activities.

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