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Hedging or Market Timing? Selecting the Interest Rate Exposure of Corporate Debt

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ABSTRACT

This paper examines whether firms are hedging or timing the market when selecting the interest rate exposure of their new debt issuances. I use a more accurate measure of the interest rate exposure chosen by firms by combining the initial exposure of newly issued debt securities with their use of interest rate swaps. The results indicate that the final interest rate exposure is largely driven by the slope of the yield curve at the time the debt is issued. These results suggest that interest rate risk management practices are primarily driven by speculation or myopia, not hedging considerations.

WHEN FIRMS SELECT THE INTEREST RATE exposure of their liabilities and use derivatives to alter that exposure, are they hedging or timing the market? The empirical literature has attempted to estimate the sources of value creation stemming from hedging by examining the cross-sectional variation in the use of derivatives by firms (see Nance, Smith, and Smithson (1993), Mian (1996), and Graham and Rogers (2002), for instance). Implicit in most of these examinations is the assumption that firms use derivatives solely for the purpose of hedging. However, before we can estimate the value created by hedging through the selection of firms' interest rate exposures, we must document that the choices of those exposures are for the purpose of hedging, and not attempts to reduce their cost of capital. This paper addresses that issue. Focusing on the selection of the interest rate exposure of newly issued corporate debt, and the use of interest rate swaps to modify that exposure, I examine whether firms really are hedging, or are instead timing the market in an attempt to reduce their cost of capital.

If firms are hedging, then the choice of the interest rate exposure of the firm's liabilities should be driven by the sensitivity of a firm's cash flow to movements

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in interest rates. By matching the interest rate exposure of the liabilities to that of their assets, firms can reduce the variability of their cash flows. As a result, firms may lower their expected costs of financial distress (Smith and Stulz (1985)), as well as minimize how often they have to raise expensive external capital (Froot, Scharfstein, and Stein (1993)). Alternatively, if firms believe they can time the market, thereby reducing their cost of capital, then the interest rate exposure selection should be driven by movements in interest rates. Firms may believe, as suggested in the Harvard Business School case study "Liability management at General Motors" (Tufano (1995)), that they can reduce their interest costs by "actively managing" their interest rate exposure as interest rates change. When the yield curve is steep, firms that select a floating interest rate exposure will have significantly lower interest costs, at least in the short term, than firms with a fixed exposure. This paper seeks to determine which of these objectives is the primary determinant of the ultimate interest rate exposure choice of firm liabilities.

A second critique of the existing empirical literature relates to the implicit assumption that firms that do not use derivatives are not hedging. A firm that issues fixed rate debt has the same interest rate exposure, and therefore receives the same theoretical benefits of smooth cash flows, as one that issues floating-rate debt and swaps it to a fixed rate. Yet, when the empirical risk management literature has examined interest rate hedging, it has often equated firms that borrow floating and swap to a fixed interest rate exposure with being hedgers, while the fixed rate debt users that do not swap were considered nonhedgers (Mian (1996), Nance et al. (1993)). As the above example illustrates, firms may be managing their risks, especially interest rate risk, by means other than derivatives usage. By issuing a debt contract that is correctly aligned with their desired interest rate exposure, there is no need to enter into an accompanying derivative contract. Thus, an empirical examination of whether firms are hedging, and what the benefits are of smooth cash flows, should examine the final interest rate exposure of the debt, not the intermediate step of how many derivatives the firm uses. After all, the theoretical literature does not explore the question of how firms achieve a particular exposure; it focuses on what final exposure a firm should have (see, for example, Smith and Stulz (1985) and Froot et al. (1993)).

Following this argument, the variable of interest in this paper is the final interest rate exposure of newly issued debt instruments. Modifications to the interest rate exposure of debt securities via interest rate swaps are often made at the time the debt is issued. This suggests that the final interest rate exposure of the new debt issue best reflects the implementation of the firm's interest rate risk management program. To construct this measure, I collect data on both bond issuances and bank loan originations, noting the initial interest rate exposure of the debt. These data are combined with hand-collected information from firm annual reports on the interest rate swaps the firm entered as part of its financing. This methodology produces the final risk exposure, which is what the theoretical literature describes, and it makes possible an analysis of how firms choose to arrive at this exposure. Using this measure, I examine

whether the primary objective of the interest rate practices of firms is to hedge their cash flow or to reduce their cost of capital. An additional benefit of this methodology, as opposed to the more traditional examination of derivatives usage, is that by looking at incremental issuances over a 6-year period, I am able to analyze time-series variation at monthly intervals, and not just examine cross-sectional variation.

The empirical results presented in this paper suggest that firms are mostly influenced by market timing considerations. Firm-specific proxies for cash flow interest rate sensitivity perform poorly in predicting the final exposure of the debt. Contrary to the results that would be suggestive of hedging, firms with cash flows that are negatively correlated with interest rates are just as likely to issue floating-rate debt as those with cash flows that are positively correlated with interest rates. These results are robust to the measure of interest rate sensitivity that is used. Instead, the strongest determinant in explaining final interest rate exposure is the yield spread, the difference in yields between long-term and short-term bonds. As the yield curve steepens, firms are more likely to take on floating-rate debt. Specifically, a one standard deviation increase in the spread between the yields of 10-year and 1-year Treasury bonds (44.5 basis points) increases the likelihood of observing a floating final interest rate exposure from 30% to 41%.

This result could be interpreted in several ways. Firms may be responding to changes in market prices, as reflected by the yield spread. Alternatively, the yield spread may be a proxy for expectations of a recession, and firms are actually responding to macroeconomic conditions. In separating these two effects, I find evidence that as the expected economic situation worsens, at both the macro level and the industry level, firms are more likely to choose a fixed rate exposure for their newly issued debt. This finding is consistent with firms measuring risk at the industry level rather than at the firm level, suggesting that firms' interest rate management may still be consistent with risk reduction. However, the yield spread is still a significant determinant of the chosen interest rate exposure, suggesting that firms are trying to lower their short-term cost of capital, even in the face of potential economic downturns. In addition, I examine whether the result is consistent for firms of different size and debt source, and find that small, bank-dependent firms are just as responsive to movements in the yield spread as large firms with access to the bond market.

The sensitivity of the interest rate exposure of newly issued debt to the yield spread is consistent with a couple of possible interpretations. Firms may be speculating by incorporating their views of anticipated interest rate movements into their interest rate exposure decision, resulting in a significant sensitivity to the yield spread, if such views are on average correlated with the shape of the yield curve. Second, this finding is consistent with firms managing short-term earnings via their interest expense by modifying their liability interest rate exposure when the difference in the current interest payment between fixed and floating interest rates is large. In speaking with treasury employees at numerous industrial companies, I heard evidence for both of these interpretations.

The remainder of the paper is organized as follows. Section I reviews the literature on hedging and market timing that relates to this topic. Section II discusses the empirical strategy for examining these alternatives. Section III provides a description of the data used in the empirical investigation as well as summary statistics. The empirical tests on the final exposure of the debt issuances and numerous robustness checks for alternative explanations are presented in Section IV. Section V concludes.

I. Literature Review

The theoretical hedging literature is replete with accounts of the potential benefits that arise from hedging firm cash flow. First, financial distress costs provide a reason to hedge by reducing the probability of entering distress and therefore of enduring such costs (Smith and Stulz (1985)). Hedging can also increase debt capacity, allowing firms to capture a greater tax shield benefit while maintaining the same or even reducing expected costs of financial distress (Leland (1998)). Costly external finance, like that explored in Myers and Majluf (1984), creates a preference for internal cash over external borrowings. Thus, hedging creates value if firms forgo positive NPV projects less often when their cash flows are more stable and require fewer outside capital infusions (Froot et al. (1993)). In the presence of a convex or graduated tax schedule, firms can reduce their expected tax payments by making their earnings less volatile (Smith and Stulz). A final hedging justification (Stulz (1984)) is that if managers bear idiosyncratic risk through their compensation, hedging reduces the volatility of their compensation, which is beneficial to shareholders if expected compensation to managers is a lower amount.

Many early empirical examinations of hedging examine the use of derivatives, essentially equating their use with the desire of the firm to hedge. Some examine whether firms use derivatives (Mian (1996), Nance et al. (1993), and Geczy, Minton, and Schrand (1997)), while others examined the extent of their usage (Berkman and Bradbury (1996), Gay and Nam (1999), Howton and Perfect (1999)). One critique of this line of research is the assumption that the firms that do not use derivatives are not hedging (see Petersen and Thiagarajan (2000) and Graham and Rogers (2002), for instance). Such firms may not face the risk a derivative product remedies or they may hedge using methods other than derivatives.

Further research focuses on firms that face a specific commodity exposure, thereby limiting the analysis to firms in which a particular hedgable risk was present. Such papers examine gold mining firms (Tufano (1996), Petersen and Thiagarajan (2000)), oil and gas producers (Haushalter (2000), Geczy, Minton, and Schrand (1999), and thrifts (Schrand and Unal (1998)). The same idea has been applied to currency hedging by controlling for the level of currency risk, as measured by the amount of foreign assets, sales, or income (Allayannis and Ofek (2001), Graham and Rogers (2002)). Allayannis and Weston, for instance, find that firms with foreign sales that use foreign currency derivatives have

higher values than firms with similar foreign currency exposures that do not hedge that risk with derivatives.

Applying this idea to interest rate risk may be more complex, since identifying a firm's interest rate exposure is not so straightforward. Graham and Rogers (2002) address this by estimating the interest rate exposure of the firm's cash flow prior to the incorporation of interest expense and earnings from derivative transactions. They classify firms as having a hedgable interest rate risk if their estimated exposure is significantly different from zero and is not offset by floating-rate debt, or if the firm does not have a significant interest rate exposure but does have floating-rate debt. Assuming that derivatives are used to hedge, they then analyze the determinants of the level of derivatives usage among those firms having a hedgable interest rate or foreign currency exposure, attempting to determine whether taxes affect the extent of derivatives usage. In this paper, I test whether firms use interest rate derivatives to hedge their interest rate exposure or if they are used for nonhedging purposes. Therefore, rather than using a firm's cash flow interest rate exposure as Graham and Rogers do to determine the existence of a hedgable risk, I use it as an explanatory variable, that if the objective of the firm is to hedge its cash flow, should predict the likelihood of choosing fixed versus floating-rate debt.

However, hedging may not be the only factor in a firm's decision regarding the interest rate exposure of their debt. Firms may also be timing the market by responding to changes in macroeconomic conditions, in an attempt to reduce their cost of capital.[1] Baker and Wurgler (2000) find evidence that firms are timing the equity market, increasing the percentage of total issues that are raised in the form of equity prior to unusually low equity market returns. Others find market timing effects in debt markets as well. Barclay and Smith (1995) find that outstanding debt maturity is negatively related to the yield spread, while Guedes and Opler (1996) find that the maturity of new public debt issues is negatively related to the yield spread. Baker, Greenwood, and Wurgler (2003) find that changes in aggregate debt maturity are negatively correlated with subsequent excess bond returns, consistent with firms trying to reduce their cost of capital through their maturity choice. Allayannis, Brown, and Klapper (2003) find that firms are more likely to borrow in a foreign currency as the difference between LIBOR and local interest rates increases, taking on currency risk in an attempt to reduce the firm's cost of capital. In the case "Liability Management at General Motors," GM states that the goal of their interest rate management program is: "To actively manage the Central Office liabilities to take advantage of the cyclical nature and volatility of domestic interest rates and shifts in the shape of the yield curve to reduce GM's overall cost of funds" (Tufano (1995, p. 4)). Thus, both the empirical and clinical literatures suggest that market conditions may influence the timing and characteristics of new

[1] Market timing can be thought of as responding to issue-specific mispricings due to information asymmetries as in Myers and Majluf (1984). Alternatively, market timing can refer to responses to changing macroeconomic conditions that are correlated with the cost of capital, such as risk premia or measures of risk that have cyclical components. This paper uses market timing in the latter context.

debt issues. This paper examines whether the selected interest rate exposure is also influenced by market prices.

II. Empirical Strategy

Firms face interest rate risk from two sources: the interest rate sensitivity of their assets and the sensitivity of their debt. Therefore, if firms consider volatile cash flows to be sufficiently costly, their risk management goal is to match the final exposure of their debt instruments to the interest rate sensitivity of their cash flows. This suggests that if the objective of a firm's interest rate management policy is to hedge, then firms that have cash flows that are positively correlated with interest rates should prefer interest payments on their liabilities that float, whereas firms with cash flows that are either uncorrelated or negatively correlated with interest rates would prefer fixed interest payments. Alternatively, if firms do not perceive significant benefits from hedging the interest rate risk that they face, then they may have an alternative objective in choosing the interest rate exposure of their newly issued debt. Specifically, they may be timing the market in an attempt to reduce their cost of capital. The goal of this paper is to determine which behavior firms are engaging in.

To separate these effects, I examine the final interest rate exposure of incremental debt issuances, which is defined as the combination of the initial exposure of the debt and firm's use of swaps to alter the debt's exposure. This method improves upon the existing literature by constructing a panel series that allows for both cross-sectional and time-series analyses. By looking at incremental issuances, I can specifically determine which debt instrument the firm is modifying with the swap. Also, since firms choose the exposure at the time of the debt issuance, examining that choice most closely reflects the strategy of the firm. Alternative analyses, which I also investigate as robustness checks, are to examine the level of interest rate exposure of firms at yearly intervals, since derivative usage is disclosed annually, and to examine average interest rate exposures of firms over time. The benefit of looking at the individual debt issues is that I can observe the month that the interest rate exposure was chosen and the structure of interest rates during that month. Since interest rates can be volatile, measuring rates at the monthly level rather than at the annual level should greatly improve the statistical power of the tests. Using the final interest rate exposure of the new issues, numerous potential measures of hedging and market pricing, and a number of control variables, I estimate probit regressions to examine whether firms are primarily concerned with matching the exposure of their assets to their liabilities or whether they are timing the market.

The primary measure of the interest rate exposure of the firm's cash flow prior to raising debt funds is similar to that used by others in the literature (Graham and Rogers (2002), Visvanathan (1998), Fenn, Post, and Sharpe (1996)). The methodology is described in Section III. If firms are hedging, then the results should be that firms that are more positively exposed to interest

rates (meaning their cash flow rises when interest rates rise) should choose to have their interest payments positively correlated with interest rates. Therefore, as firm interest rate exposure increases, its preference for floating-rate debt should increase.[2] In addition to the primary measure of interest rate exposure broadly used in the literature, I modify that measure to verify that results are robust to the specification of interest rate exposure.

The other set of variables of interest measure macroeconomic conditions at the time when the debt funds were raised. If firms are trying to reduce their short-term cost of capital in response to changing market prices, then their interest rate exposure should vary with changes in the term structure. The yield spread is measured as the difference in the 10-year and 1-year yield on the U.S. Treasury bonds. I also use the credit spread as another measure of market pricing conditions, where the credit spread is defined as the difference between the average Baa corporate bond and Aaa corporate bond, as rated by Moody's. Additionally, if a firm's likelihood of distress changes over time with changes in the economy, then the decision regarding the interest rate exposure of the firm's debt may change with the state of the economy. Therefore, I use the value of the Index of Leading Indicators from the Conference Board, Inc. and the University of Michigan's Survey Research Center to measure expectations regarding future macroeconomic activity at the time of the debt issue. I also control for the conditions of the chemical industry at the time of the debt issuance. In their industry survey of the chemical industry, Standard & Poor's cites the Federal Reserve Board Industrial Production Index as being an important measure of industry strength (O'Reilly (2000)). Thus, I also use the value of this index to measure whether current industry strength impacts a firm's willingness to take on interest rate risk.

Control variables include firm leverage, potential costs of financial distress, size, and profitability. Firms with less debt should be less concerned about incurring financial distress and therefore may be less concerned about the volatility of their interest rate payment (as similarly argued by Tufano (1996), Geczy et al. (1999), and Haushalter (2000), among others). I examine research and development expenditures, advertising expenditures, and capital expenditures (each standardized by the sales of the firm) as measures of potential distress costs (following others, such as Graham and Rogers (2002), Geczy et al. (1997), and Allayannis and Ofek (2001)). As these measures increase, firms may become more concerned about interest rate fluctuations that may force such investment expenditures to be cut in times of distress, and therefore impact the desired interest rate exposure. Larger firms may be better able to manage risk, so firm size may affect the interest rate choice of firms due to a difference in the ability of firms to achieve a particular exposure. I also use the profit margin to test whether profitability affects a firm's decision whether to endure interest rate risk.

[2] Theoretically, firms whose cash flow sensitivity to interest rates is negative should actually prefer an inverse floating rate debt instrument, if their objective is to hedge. However, I found no evidence in the data of firms choosing such an exposure.

After presenting the initial regressions testing whether firms are hedging or timing the market, I use alternative specifications to separate out different interpretations of the finding. Following these are numerous robustness checks to determine if the effects found for the entire sample are symmetric or if the factors that motivate a particular exposure differ, based upon the source of the funds and the relative size of the debt issue. Finally, I decompose the final exposure into the source of funds, the initial exposure, and the use of swaps to determine at which stage firms consider the final exposure of their debt. As documented later, the empirical findings are robust to all of these alternative specifications.

III. Data and Summary Statistics

In order to test these theoretical implications, I build a data set of debt fundings for firms in the chemical industry for the period from 1994 to 1999. I choose this period because it is the first year that the Statement of Financial Accounting Standards (SFAS) 119 required firms to report detailed information regarding the direction of their derivatives positions. The chemical industry was chosen because it is a manufacturing industry and is presumably affected by changes in interest rates. Second, firms in this industry are consistently raising funds for ongoing investment purposes, allowing for a large enough sample size. In addition, there are a number of subindustries within the chemicals classification that provide a rich heterogeneity in the interest rate exposure of the firms and the availability of investment opportunities.

The source of the data for these debt fundings is SDC Platinum for the bond issues and DealScan for the bank loans. The fundings are consolidated into one observation if there are multiple loans or multiple bond issues because of different maturities issued in the same month, unless they have different initial interest rate exposures. Credit lines are dropped because the flexibility characteristic of such a product complicates the comparisons with term loans or bond issues. 10-Ks in the EDGAR (Electronic Data Gathering, Analysis, and Retrieval system at the Securities and Exchange Commission (SEC)) database are used to verify the raising of the debt, to identify the initial interest rate exposure (fixed or floating), and to determine whether or not the firm swapped the debt issue.[3] Examples of disclosures made with respect to swaps in the 10-Ks are provided in the Appendix. If the firms are not in COMPUSTAT or in EDGAR for the year the debt funds were raised, then the observation is dropped. Quarterly cash flow amounts, as well as annual income statement

[3] In a few instances, only notional values were given, so it was determined whether or not the issue was swapped by looking at the change in the notional swap amount in that fiscal year for the exposure that would be attached to the initial loan. For instance, if the loan was floating and the change in the notional amount of the firm's pay fixed, receive floating swaps for that year was equal to or greater than the amount of the loan, then the loan was considered to have been swapped to fixed. If the direction of the notional amounts were not stated for the firm, the observation was dropped.

and balance sheet information are obtained from COMPUSTAT.[4] Using these selection criteria, a sample of 275 debt issuances from 133 firms, spanning this 6-year period, remains. The interest rate and macroeconomic data come from DRI and the Federal Reserve Board.

For each observation, the quarterly cash flows for a 5-year period prior to the debt issue are used to determine the sensitivity of the firm to changes in LIBOR. Since commercial debt is primarily tied to LIBOR if it is floating, the effective choice for firms in my sample is to have fixed rate debt or floating-rate debt tied to LIBOR. If those are the choices, then it is the comovement with LIBOR that is relevant for determining the hedging benefits.

Ideally, I would like to have an interest rate sensitivity measure for the potential future cash flow distribution. However, this is not readily available. Instead, the observed quarterly cash flows for the 5 years prior to the borrowings are used to estimate interest rate betas. Cash flow analysis allows for a measure of interest rate exposure prior to the incorporation of interest expense or derivatives usage that would alter the underlying exposure that the firm is trying to match. Specifically for the 5-year period prior to the raising of the debt funds, using quarterly data, I run the following regression for each observation:

$$(\text{Cash flow}_{it}/\text{Book Assets}_{it}) = \alpha + \beta_{CF,i}(LIBOR_t) + \varepsilon_{it}, \tag{1}$$

where $LIBOR_t$ is the average 6-month LIBOR interest rate during quarter t. I use $\beta_{CF,i}$, which I refer to as the cash flow beta, as my measure of the firm's interest rate exposure at the time the debt funds were raised. In the regressions using β_{CF}, I truncate the values at the 10^{th} and 90^{th} percentiles because a few of the measured betas were outliers, due to the small number of observations of quarterly cash flow prior to the issue.[5]

Table I provides summary information on the debt issuances in the sample, divided by the source of funds. Of the observations, 32% are funds raised from banks. Of these, 90% were floating-rate loans, whereas only 7% of the nonbank debt instruments were floating rate. There is a pronounced correlation between the source of funds and the initial interest rate exposure. Banks predominately lend to firms using floating rates while bond issuances are primarily fixed, resulting in a correlation coefficient of 82.4% between the source of funds and the initial interest rate exposure.

The data also suggest that there are substantial differences in firm characteristics between the two sources of debt funds. Firms that raise public debt are more than 10 times larger than firms raising funds from banks on average, when measured either by sales or by the market value of the firm. This data (consistent with Cantillo and Wright (2000) and Faulkender and Petersen (2004)) support the theory that smaller, less transparent firms access banks for

[4] Cash flow is defined as operating income before depreciation minus tax expense minus capital expenditures minus the change in current assets (reduced by cash holdings) plus the change in current liabilities (excluding long-term debt due within 1 year).

[5] The coefficients are even smaller when the measure is not truncated and the statistical significance of the coefficient is unchanged.

Table I
Summary Statistics by Debt Source

This table provides summary statistics on the interest rate exposure of the debt in the sample, separated by the source of the debt. It includes the initial exposure, the swap information, and the final exposure statistics for the different sources. It also provides the means, and medians in parentheses, of the dollar value of sales (in millions), and the market value (in millions) of the firm corresponding to the debt funds.

	Bank Loans	Bond Issues	Total Number
Number	89	186	275
Initially floating	80	13	94
	89.9%	7.0%	34.2%
Swapped to floating	0	12	12
	0.0%	6.5%	4.4%
Swapped to fixed	17	1	18
	19.1%	0.5%	6.5%
Floating after swap inclusion	63	24	87
	70.8%	12.9%	31.6%
Sales	559	6,826	4,798
	(96)	(3,865)	(1,266)
Natural log of sales	4.66	7.78	6.77
	(4.56)	(8.26)	(7.14)
Market value of assets	1,638	23,433	16,379
	(270)	(6,449)	(2,442)
Natural log of market value of assets	5.79	8.70	7.76
	(5.60)	(8.77)	(7.80)

funds, whereas larger, more transparent firms tend to raise funds in the bond market.

Among the bank loans, 19% were swapped, all from floating to fixed. Thus after incorporating the swaps, 71% of debt issues raised from banks ended up having a floating interest rate exposure and the remaining 29% were fixed. In examining the funds raised in the form of bonds, 7% were swapped from fixed to floating, and there was one issue swapped from floating to fixed. Following incorporation of the swaps, the final interest rate exposure was floating for 13% of the bond issues and was fixed for the remaining 87%. Overall, after the incorporation of swaps, 32% of the debt issuances are floating, as opposed to 34% of them that were initially floating. Thus, the use of swaps does not substantially change the fraction of debt that is floating during the sample period; rather, it rearranges the interest exposure among firms across time.

Summary statistics of the firm-specific measures of potential hedging benefits, the market pricing variables, and the control variables are presented in Table II. For each of these variables, the mean, median, and standard deviation are provided for the entire sample and segmented by their final interest rate exposure. The final column lists the difference in the means and medians of the two samples and denotes the statistical significance of those differences.

These univariate results forecast the findings in the multivariate regressions. The average debt issue that ends with a fixed rate corresponds to a firm with a more positive cash flow interest rate exposure than the exposure for those

Table II
Summary Statistics by Final Exposure

This table provides summary statistics on the hedging and market timing variables for the entire sample, and then separately by the final exposure of the debt instrument. The final exposure is defined as the exposure of the debt instrument obtained by combining the initial exposure with any interest rate swaps used to modify that exposure. The mean, median, and standard deviation are provided for each of the variables. The last column is the difference in the mean and median, respectively, for the two groups. Cash flow interest rate beta is the beta from regressing the corresponding firm's quarterly cash flow on LIBOR (as outlined in Section IV). Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month the debt funds were raised. Index of leading indicators is the value of that index during the month the debt funds were raised. Leverage is defined as long-term debt over market value of the corresponding firm. Profit margin is defined as operating income before depreciation divided by sales for the corresponding firm during the year of the debt issue.

	Entire Sample	Ending Floating	Ending Fixed	Difference
Cash flow interest rate beta				
Mean	0.150	0.093	0.177	−0.083
Median	0.019	0.031	0.017	0.013
Standard deviation	1.774	2.058	1.632	
Yield spread (basis points)				
Mean	67.0	76.9	62.4	14.5**
Median	58.0	78.0	53.0	25.0***
Standard deviation	44.8	45.1	44.0	
Index of leading indicators				
Mean	103.0	103.2	102.9	0.3
Median	103.4	102.6	103.9	−1.3**
Standard deviation	3.6	3.3	3.7	
Leverage				
Mean	17.0%	17.2%	16.9%	0.3%
Median	13.0%	11.8%	14.2%	−2.4%*
Standard deviation	14.6%	17.1%	13.3%	
Advertising-to-sales ratio				
Mean	1.9%	1.3%	2.2%	−0.9%
Median	0.0%	0.0%	0.0%	0.0%
Standard deviation	5.9%	4.0%	6.6%	
Natural log of sales				
Mean	6.77	5.60	7.32	−1.72***
Median	7.14	5.17	7.41	−2.24***
Standard deviation	2.30	2.59	1.92	
Profit margin				
Mean	12.4%	0.5%	18.0%	−17.5%***
Median	17.3%	14.3%	18.9%	−4.5%***
Standard deviation	22.3%	30.2%	14.6%	
Number of observations	275	87	188	

*, **, and *** correspond to the differences being significant at 10%, 5%, and 1% respectively.

issues that end up floating, although the difference is statistically insignificant. This finding is in contrast to what we would expect if firms were hedging. Consistent with market timing, however, debt issues that end up floating are issued when there is a larger difference in the yield spread, evaluated at both the mean and median, than issues that end fixed. Specifically, the median fixed

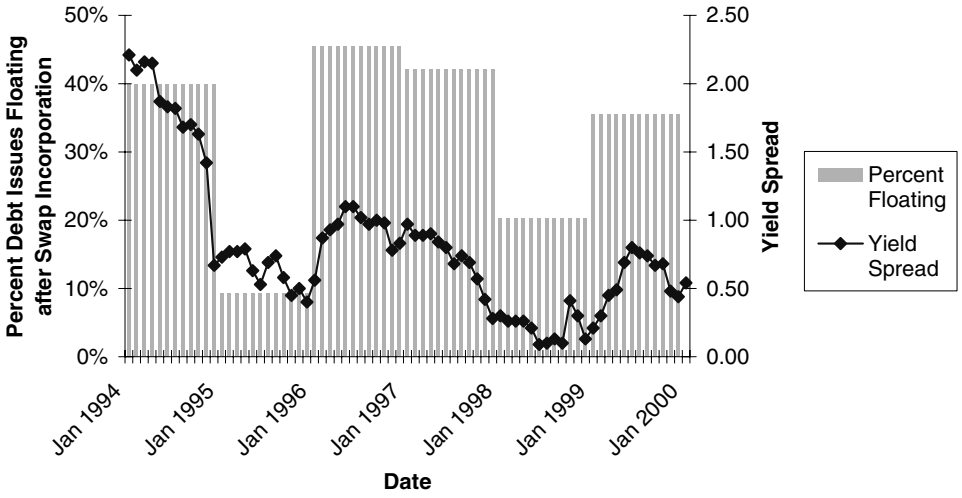

Figure 1. Percentage of debt with floating exposure after swap incorporation relative to the yield spread over time. This figure displays the patterns of the choice of interest rate exposure of newly issued debt in the chemicals industry (SIC 2800s) and the movement in the yield spread over the sample period 1994 through 1999. The bars correspond to the percentage of debt that has a floating interest rate exposure after incorporating swaps used to modify the exposure of the newly issued debt, with the units listed on the left side. The line represents the average yield spread for each month, defined as the yield on 10-year Treasury bonds minus the yield on 1-year Treasury bonds, with the units listed on the right side.

rate debt issue is done when the difference between the 10- and 1-year debt is 53 basis points, as opposed to 78 basis points for the median debt issuance that floats, a difference of roughly 40%. This univariate result can also be seen in Figure 1, which graphs the movement of the yield spread over the sample period and the annual percentage of debt issued in the industry that ends with a floating interest rate exposure. In 1994, the average yield spread was 177 basis points and 40% of the issuances had a final interest rate exposure that was floating, whereas in 1998, the average yield spread was 21 basis points and only 20.3% of the issuances had a floating rate exposure.

IV. Empirical Findings

This section examines the empirical findings that result from testing the predictions presented earlier. The first series of regressions examines the determinants of the final interest rate exposure of the incremental debt instrument. Finding that firms are responding to changes in the term structure, I then decompose the yield spread to test multiple interpretations of that finding. Following that, multiple robustness checks are performed to further substantiate the finding. Finally, I examine the determinants of the individual steps firms take to reach the final exposure to determine why different firms arrive at a particular exposure through different means.

A. Determinants of the Final Interest Rate Exposure

It is the final interest rate exposure on their incremental debt issue, not the use of a particular instrument, that represents the interest rate risk management decision made by firms. Therefore, in analyzing whether the goal of corporate interest rate risk management is to hedge or to time the market, I use the final interest rate exposure of new debt issues as the explanatory variable. Table III presents the results of such analysis.

The first thing to notice is that, as shown in column 1, the interest rate sensitivity of the firm's cash flow does not predict whether the firm chooses a final fixed or floating exposure on its debt security. If firms are hedging, the sign of the coefficient for this variable should be positive, indicating that they are matching the exposure of their assets to the exposure of their debt. Instead, the estimated coefficient is slightly negative and statistically insignificant. This result suggests that firms with cash flows that are positively correlated with interest rates are no more likely to have floating-rate debt than those that are negatively correlated. This finding is inconsistent with firms hedging the interest rate exposure of their cash flows.

I also examine alternative measures of the cash flow sensitivity to interest rates to determine whether firms really are not matching the firm-specific cash flow interest rate sensitivity of their assets to their liabilities, or whether the measure is merely misspecified. The second column uses a cash flow sensitivity measure that takes the value of the estimated cash flow beta when it is statistically significant and is zero when the estimate is insignificant. The third column uses a discrete measure of the cash flow beta, taking the value 1 when the estimated sensitivity is significantly positive, -1 when significantly negative, and is 0 otherwise. However, as the results show, neither of the specifications yields a statistically significant coefficient. These results suggest that hedging the firm-specific interest rate risk of their cash flows may not be a primary objective of most of the firms in the sample.[6]

Instead, a key determinant of the final interest rate exposure appears to be the yield spread. Firms are much more likely to have a floating-rate exposure when there is a steep yield curve than when the yield curve is relatively flat. Statistically, the coefficient of the yield spread variable is significant at better than 1%. Also, its magnitude implies a large economic significance. Evaluated at the means, a one standard deviation increase in the difference between the 10-year and 1-year government bond yields of 44.5 basis points increases the likelihood of having a floating final interest rate exposure from 30% to 41%.

[6] In unreported regressions, I used estimates of interest rate sensitivity using quarterly dummies to capture any cyclicality that may be present. Moreover, I ran regressions in which capital expenditures were not subtracted, since firms may be engaging in capital expenditures only when there are sufficient internal funds, as opposed to a strategy of investing when they have good projects. In neither of these specifications was the coefficient on that variable significant, nor did it significantly alter the other estimated coefficients.

Table III

Determinants of Final Interest Rate Exposure

This table presents the results of probit regressions where the dependent variable takes the value 1 if the final exposure of the debt funds is floating, and is 0 otherwise. The final exposure is defined as the exposure of the debt instrument, obtained by combining the initial exposure with any interest rate swaps used to modify that exposure. Free cash flow beta is the estimated exposure to LIBOR of the corresponding firm's quarterly free cash flow for the 5 years (subject to data availability) prior to the debt issue. Free cash flow is defined as operating income before depreciation minus taxes minus capital expenditures and minus the change in working capital. Free cash flow beta (significant exposures) is the same as for the previous measure when the estimated coefficient was significantly different from 0, and is 0 otherwise. Discrete free cash flow beta takes the value 0 if the estimated free cash flow beta was positively significant, −1 if negatively significant, and is 0 otherwise. Credit spread is the difference between the BAA and AAA Corporate Debt in the month the debt funds were raised. Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month the debt funds were raised. Percent currently floating is the percentage of the firm's total debt at the end of the fiscal year prior to the debt issue that had a floating interest rate exposure after accounting for any swaps the firm had entered, assuming that short-term debt has a floating interest rate exposure. The standard errors are White heteroskedastic consistent (White (1980)), adjusted for clustering by company.

	(1)	(2)	(3)	(4)	(5)	(6)
Interest rate exposure						
Free cash flow beta	−0.022			−0.044		
	0.051			0.062		
Free cash flow beta		0.000			−0.001	
(significant exposures)		0.003			0.003	
Discrete free cash flow beta			0.006			0.005
			0.151			0.165
Percent currently floating				0.283	0.278	0.280
				0.407	0.404	0.409
Market timing						
Credit spread	0.526	0.531	0.531	−0.037	−0.041	−0.026
	0.643	0.643	0.642	0.702	0.697	0.691
Yield spread	0.676***	0.683***	0.684***	0.582**	0.592**	0.597**
	0.238	0.238	0.234	0.252	0.251	0.247
Control variables						
Leverage	0.326	0.314	0.315	0.324	0.298	0.294
	0.582	0.585	0.583	0.673	0.673	0.671
Advertising over sales	−2.783*	−2.787*	−2.790*	−1.789	−1.852	−1.848
	1.541	1.537	1.526	1.538	1.535	1.510
CapEx over sales	−0.390	−0.396	−0.394	−0.380	−0.384	−0.389
	0.337	0.343	0.341	0.366	0.375	0.370
R&D over sales	1.892	1.874	1.869	1.242	1.123	1.121
	2.278	2.280	2.276	2.511	2.503	2.481
Ln(Sales)	−0.138**	−0.133**	−0.133**	−0.130*	−0.122*	−0.119*
	0.059	0.060	0.059	0.069	0.071	0.070
Profit margin	−1.302**	−1.358**	−1.357**	−1.832**	−1.912**	−1.943**
	0.664	0.664	0.650	0.845	0.841	0.822
Constant	−0.310	−0.345	−0.346	−0.056	−0.020	−0.004
	0.616	0.618	0.615	0.812	0.814	0.812
Pseudo R^2	0.166	0.165	0.165	0.165	0.163	0.163

*, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

This finding is extremely robust to the definition of the yield spread as well. I have also measured the yield spread as the difference in the 30-year Treasuries relative to the 1-year, the 5-year relative to the 1-year, and the 10-year relative to the 2-year (regressions not reported). In all cases, this term had the same strong statistical and economic significance.

A number of the control variables are also significant predictors of the final exposure. As firms spend more on advertising as a percentage of their sales, they are less likely to float. Such a finding may suggest that firms view interest rate variability as costly, regardless of whether their cash flows move with interest rates or in the opposite direction of interest rates, and that the perceived cost of that interest rate variability depends upon the type of assets they have. If a firm's assets are particularly vulnerable to high costs of financial distress, specifically those assets associated with having high-advertising expenditures, they take on less floating-rate debt.

Larger and more profitable firms are more likely to have a fixed interest rate exposure, while smaller, less profitable firms are more likely to float. The size finding is consistent with the clientele effect illustrated in the summary statistics contained in Table I. Smaller firms borrow from banks at floating interest rates, whereas large firms borrow in the bond market at fixed interest rates. The fact that size is significant suggests that firms may not fully overcome the clientele effect, even in the presence of a swap market. Additionally, the profit margin is significantly negative in all of the specifications. Considering that the yield spread was positive over the entire sample period, meaning that fixed rate debt probably had a higher interest rate than did floating-rate debt, one interpretation of this result is that less profitable firms preferred the less expensive floating-rate debt and were more willing to take on the interest rate exposure associated with the lower cost financing than were more profitable firms.

A natural criticism of the methodology above is that looking only at the interest rate exposure of new issues ignores the interest rate exposure of existing issues. If firms are in fact hedging, then the choice of the exposure of the new debt issue depends upon the existing mix of fixed and floating debt they already have outstanding, including any modifications made using swaps to the existing debt. For instance, firms may be managing their aggregate liability interest rate exposure toward a long-term average, issuing floating debt when their percentage of floating-rate debt is low and vice versa. If firms are following such a strategy, then upon including the existing percentage of floating-rate debt in the econometric specification, one would expect a negative and statistically significant coefficient corresponding to the current floating-rate percentage. In addition, if firms are hedging, then after controlling for the current percentage of debt that is floating, we should find that firms with a positive cash flow exposure to interest rates are more likely to issue floating-rate debt than are those with a negative cash flow exposure. Therefore, I have collected from the firm's 10-Ks the amount of their long-term debt that is floating at the end of the fiscal year prior to the debt issue. To that amount, I add the firm's short-term debt, essentially assuming that the interest rate exposure of short-term debt is

floating.[7] I then subtract the notional value of pay fixed, receive floating swaps, and add the notional value of pay floating, receive fixed swaps to get a measure of the amount of floating-rate debt the firm has in its capital structure, prior to the new debt issue. I then divide that amount by the total debt of the firm, to get a percentage of the firm's capital structure comprised of floating-rate debt, before the new issue.[8] The results of these regressions are in columns 4–6 in Table III.

Consistent with the earlier results, the coefficient on the three measures of interest rate exposure are still statistically insignificant. Even after controlling for the current percentage of floating debt in their capital structure, hedging the interest rate exposure of their cash flow does not appear to be a significant objective in determining the interest rate exposure of corporate debt. Interestingly, the coefficient corresponding to the current percentage of floating-rate debt is positive, contrary to the hypothesis, and statistically insignificant. The yield spread retains its statistical and economic significance found in the previous regressions. This finding is inconsistent with firms managing their aggregate liability interest rate exposure toward a long-term average. Instead, the positive coefficient suggests that firms that have previously issued floating-rate debt continue to prefer that exposure for their new issues.

A further check on whether hedging is a motivation in the interest rate risk management practices of firms is to regress the percentage of floating-rate debt on the estimated interest rate exposure of the firm's cash flows. Firms may be both hedging their cash flows and timing the market by operating within a percentage range of floating-rate debt, where this range is determined by the underlying interest rate exposure, whereas movements within this range are based upon market prices. This would suggest that the percentage of all debt that is floating would be positively correlated with the estimated interest rate exposure, while individual issuances may not show that correlation. Having controlled for the current percentage of floating-rate debt, the new issuance should still show a significant coefficient if firms are indeed hedging. However, directly measuring the mix prior to the issuance of the new debt security provides additional robustness to the evidence found so far. Therefore, such regressions are presented in the first three columns of Table IV, using a tobit specification where the bounds are truncated at zero and one. All measures of interest rates are for the month in which the fiscal year ended prior to the debt issuance and all control variables are for the previous fiscal year.

[7] Since short-term debt is maturing within 1 year, the amount of short-term debt the firm has is subject to interest rate fluctuations over the next fiscal year, justifying it being treated as having a floating interest rate exposure. In unreported regressions, I used only long-term debt in constructing the measure of existing interest rate exposure and found similar results.

[8] For a few observations in the sample, the firm's capital structure had no debt prior to this new debt issue. In addition, for some of the observations, the 10-K for the year prior to the debt issue was not available on EDGAR, so a measure of the existing percentage of floating-rate debt was unavailable. For the regressions in which the percentage of existing debt is included as a control variable, these observations are not included in the estimation. Thus, there are 256 observations for regressions that include this measure.

Table IV

Determinants of the Existing Interest Rate Exposure

This table presents the results of tobit regressions where the dependent variable is the percentage of the total debt that has a floating interest rate exposure after accounting for any swaps the firm had entered, under the assumption that all short-term debt is floating. The first three columns examine the floating percentage at the end of the fiscal year prior to a debt issue. The last three columns examine the average floating percentage of each firm at the end of fiscal years prior to a debt issuance and the independent variables are averages of the stated variables over the fiscal years prior to a debt issue. Since each firm is only represented once, there are 108 observations in the specifications presented in columns 4–6. The upper truncation is at 1 and the lower truncation is at 0. Free cash flow beta is the estimated exposure to LIBOR of the corresponding firm's quarterly free cash flow for the 5 years (subject to data availability) prior to the debt issue. Free cash flow is defined as operating income before depreciation minus taxes minus capital expenditures and minus the change in working capital. Free cash flow beta (significant exposures) is the same as for the previous measure when the estimated coefficient was significantly different from 0, and is 0 otherwise. Discrete free cash flow beta takes the value 1 if the estimated free cash flow beta was positively significant, −1 if negatively significant, and is 0 otherwise. Credit spread is the difference between the BAA and AAA Corporate Debt in the month of the fiscal year end prior to the firm raising new debt. Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month of the fiscal year end prior to the firm raising new debt.

	(1)	(2)	(3)	(4)	(5)	(6)
Interest rate exposure						
Free cash flow beta	0.019			0.023		
	0.012			0.019		
Free cash flow beta		0.001			0.003	
(significant exposures)		0.001			0.002	
Discrete free cash flow beta			−0.001			−0.011
			0.031			0.055
Market timing						
Credit spread	0.232*	0.260*	0.242*	0.435	0.502*	0.508*
	0.136	0.138	0.137	0.265	0.259	0.265
Yield spread	0.174***	0.174***	0.171***	0.202**	0.215***	0.208**
	0.038	0.038	0.038	0.082	0.082	0.083
Control variables						
Leverage	−0.279**	−0.298***	−0.281***	−0.171	−0.218	−0.199
	0.108	0.110	0.109	0.189	0.187	0.188
Advertising over sales	−0.492*	−0.483*	−0.489*	−0.562	−0.730	−0.508
	0.258	0.259	0.259	0.471	0.494	0.471
CapEx over sales	−0.081	−0.087	−0.091	−0.073	−0.086	−0.078
	0.074	0.074	0.074	0.079	0.079	0.080
R&D over sales	−0.251*	−0.258*	−0.230	−0.388**	−0.398**	−0.339*
	0.145	0.148	0.145	0.195	0.195	0.196
Ln(Sales)	−0.041***	−0.044***	−0.046***	−0.038**	−0.039**	−0.443***
	0.010	0.010	0.010	0.017	0.017	0.017
Profit margin	−0.236	−0.216	−0.180	−0.432*	−0.434*	−0.311
	0.160	0.160	0.157	0.242	0.237	0.234
Constant	0.697***	0.701***	0.717***	0.550**	0.528**	0.529**
	0.125	0.126	0.126	0.221	0.220	0.223
Pseudo R^2	0.309	0.301	0.297	0.263	0.269	0.249

*, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

The results of these regressions also suggest that the overall floating percentage is unaffected by the estimated interest rate exposure of the cash flows. Using the same three measures of interest rate exposure as in the regressions of the interest rate exposure of the new debt issue, the coefficients on these variables are all statistically insignificant. Also consistent with the previous results, the coefficient on the yield spread is significant in all three specifications. In these regressions, the yield spread is the measure of the yield on the 10-year Treasury bond minus the yield on the 1-year Treasury bond at the end of the month of the fiscal year ending prior to the debt issue. Economically, this coefficient suggests that a one standard deviation increase in the yield spread corresponds to an increase of 10% in the percentage of the firm's debt that is floating.

Finally, I take the average of the percentage of debt outstanding with a floating-rate exposure for each of the fiscal years prior to a debt issue for each firm and regress that average exposure on the averages of the corresponding independent variables. Therefore, each firm is represented only once in each of the specifications, presented in columns 4–6 of Table IV. This methodology reduces the impact of firms that access debt markets more often, should such firms be more likely to time the debt market and less likely to hedge. Additionally, an average measure of the mix of floating-rate debt in a firm's capital structure may best measure the target interest rate exposure of firms, if they have targets and those targets are driven by the estimates of their cash flows interest rate exposure, arrived at using a methodology similar to the one I have used to estimate cash flow exposure. However, using averages minimizes the impact of variables with considerable time-series variation. Therefore, we should expect to find that the impact of the yield spread in these specifications is diminished.

The estimated coefficients corresponding to the cash flow interest rate exposure variables remain statistically insignificant in these specifications as well. Firms that have an estimated interest rate exposure that is positive on average are not more likely to have a higher average percentage of floating-rate debt than those with an estimated exposure that is negative on average, as would be expected if firms are matching the interest rate exposures of the liabilities to their assets. The yield spread retains its strong statistical significance and the credit spread is marginally significant in these specifications, despite the expected reduction in the power of time-series variables.

Regardless of how the final interest rate exposure is measured, the results suggest that the primary objective in selecting the interest rate exposure for corporate liabilities is to time the interest rate market, not to match the interest rate sensitivity of the liabilities to that of the firm's cash flows.

B. Interpretation of the Yield Spread Result

The finding that the yield spread predicts the choice of final interest rate exposure is consistent with a number of explanations. Some firms may be systematically timing the market because a particular interest rate exposure offers

them a relatively lower cost of capital at the time they are raising the debt funds (consistent with Baker et al. (2003) as well as with the survey results of Bodnar, Hayt, and Marston (1998) and Graham and Harvey (2001)). Such a setting would imply that the risk-return tradeoff of bearing interest rate volatility changes with movements of the yield spread. This tradeoff may change for two reasons: the compensation for bearing interest rate risk changes over time or the cost of bearing interest rate volatility varies over time. Alternatively, the risk-return tradeoff may be constant, but firms' time preferences differ from those of the marginal investor, so that managers place greater emphasis on short-term cash flow than do the shareholders. This section investigates these alternatives by decomposing the elements of the yield spread and determining to which components firms are responding.

Firms would indeed be lowering their risk-adjusted cost of capital if their ability to endure risk was constant over time, but the premium for taking on interest rate risk was to vary.[9] Firms would be more likely to take on interest rate risk when the premium was high and more likely to lay off that risk when the return for bearing that risk was low. In a setting with a time-varying risk premium, some firms would alter their choice between fixed and floating as the premium, and therefore the risk-return tradeoff, changes. If the slope of the term structure proxies for a time-varying risk premium, this type of setting may explain why a firm's choice of interest rate exposure is determined by the yield spread.

A second interpretation is that the yield curve is a proxy for a time-varying cost of interest rate risk. Specifically, Estrella and Mishkin (1996) find that the yield spread is correlated with the likelihood of an economic recession. Flat or inverted yield curves may suggest a higher likelihood of an impending recession, whereas a steep yield curve suggests that there is a low likelihood of an impending recession. Since the likelihood of distress is probably higher in recessionary times than in nonrecessionary times, the cost of bearing interest rate volatility may be greater when the yield curve is flat than when it is steep. If volatile interest payments are especially costly during recessions, firms would be more likely to lock in their interest payments when there is a small difference between long- and short-term interest rates (when a recession is more likely) than when that difference is large (when a recession is less likely). If the compensation for bearing interest rate risk remains constant, but a firm's cost of bearing interest rate risk changes with movements in the term structure, then some firms may respond to this yield spread change in the risk-return tradeoff by altering their choice of exposure.

Finally, firms may simply be moving their interest costs across time, without reducing their overall risk-adjusted cost of capital because managers have

[9] The term risk-adjusted is used because the literature (Fama and French (1993), for instance) finds that historically, long-term bonds earn higher returns than do short-term bonds, suggesting that long-term bonds have a systematic risk component. Therefore, floating rates are expected to be lower, but as a result, the firm bears interest rate risk and the difference is the compensation for that risk. Therefore, the term risk-adjusted cost of capital is used to recognize this difference.

a different time preference than the market does or because they are speculating on interest rate movements. Increases in the yield curve occur because expected short-term rates in the future have risen relative to current short-term interest rates. Such a movement in interest rates would increase the difference between the current interest payments under floating rates versus under fixed rates. The firm can reduce its short-term interest expense by entering into a floating-rate debt instrument rather than fixing the rate, even though over the life of the debt instrument, the expected risk-adjusted cost of capital remains the same. However, this is optimal from the perspective of a manager who has a higher rate of time preference than the market does because the relative benefit of moving forward cash flows increases as the yield curve steepens. Similarly, if managers take rate views that are correlated with the shape of the yield curve and this rate view is incorporated into the selection of interest rate exposure, then we may see a correlation between the yield curve and the interest rate exposure choice of firms.

To decompose the yield spread into its components, and to capture the effects of a time-varying risk premium separate from the portion simply capturing the difference between current and expected future interest rates, I use the single factor proposed by Cochrane and Piazzesi (2002) that has been found to covary with bond risk premia. If firms are responding to time-series variation in the compensation paid to take on interest rate risk, then the coefficient on the risk premium variable should be statistically significant.

To capture variations in the cost of bearing interest rate risk over time, I use two measures of macroeconomic conditions. The first is the value of the Index of Leading Economic Indicators at the time of the debt issue. The coefficient on this variable is expected to be positive if firms are less averse to locking in the interest rate on their debt issue when economic conditions are expected to be strong. As an alternative measure, I use the Industrial Production Index for the chemical manufacturing sector for the month in which the debt was issued, as reported by the Federal Reserve Board. According to Standard and Poor's Industry Survey on the chemical industry, this index is considered a "key industry ratio" that provides "an indication of industry production trends" (O'Reilly (2000, p. 27)). The coefficient on this variable is also expected to be positive if firms are better able to bear interest rate volatility when the industry is performing strongly.

Adding measures of time-varying risk premia and expected macroeconomic conditions allows the yield spread term to capture the residual effects of movements in the term structure. Specifically, the coefficient on this variable should be measuring responses to changes in future expected short-term interest rates. If firms are merely moving their interest payments across time without changing their risk-adjusted cost of capital, then the coefficient on the yield spread should still be significant, even after adding the other controls. Such a finding would be consistent with the interpretation that interest rate exposure decisions are driven by either myopic behavior or speculation on the part of managers.

Interestingly, firms are not responding to the time-varying risk premia. As shown by the results in Table V, the coefficient on this variable is insignificant

Table V

Further Examination of Final Interest Rate Exposure

This table presents the results of probit regressions where the dependent variable takes the value 1 if the final exposure of the debt funds is floating, and is 0 otherwise. The final exposure is defined as the exposure of the debt instrument obtained by combining the initial exposure with any interest rate swaps used to modify that exposure. Cash flow beta is the estimated exposure to LIBOR of the corresponding firm's quarterly free cash flow for the 5 years (subject to data availability) prior to the debt issue. Credit spread is the difference between the BAA and AAA Corporate Debt in the month the debt funds were raised. Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month the debt funds were raised. The Return forecasting factor is a proxy for the expected bond risk premium during the month of the debt issue (Cochrane and Piazzesi (2002)). Index of leading indicators and chemical production index are the values of those indices during the month the debt funds were raised. The standard errors are White heteroskedastic consistent (White (1980)), adjusted for clustering by company.

	(1)	(2)	(3)	(4)	(5)
Interest rate exposure					
Cash flow beta	−0.019	−0.023	−0.026	−0.021	−0.023
	0.051	0.051	0.052	0.051	0.051
Market timing					
Credit spread	0.430	−0.359	0.142	−0.432	0.055
	0.678	0.787	0.666	0.837	0.719
Yield spread	0.771***	0.949***	1.153***	1.024***	1.232***
	0.290	0.250	0.277	0.312	0.340
Return forecasting factor	−0.067			−0.057	−0.059
	0.124			0.125	0.125
Index of leading indicators		0.072**		0.071**	
		0.035		0.035	
Chemical production index			0.080***		0.080***
			0.029		0.029
Control variables					
Leverage	0.354	0.100	0.019	0.124	0.043
	0.597	0.567	0.568	0.579	0.579
Advertising over sales	−2.758*	−2.829*	−2.875*	−2.801*	−2.843*
	1.542	1.543	1.559	1.537	1.552
CapEx over sales	−0.386	−0.326	−0.370	−0.323	−0.366
	0.338	0.347	0.346	0.348	0.346
R&D over sales	1.997	1.301	1.075	1.403	1.178
	2.355	2.065	2.074	2.145	2.153
Ln(Sales)	−0.141**	−0.146***	−0.151***	−0.148***	−0.153***
	0.059	0.057	0.057	0.057	0.058
Profit margin	−1.288*	−1.252*	−1.254*	−1.239**	−1.240*
	0.674	0.665	0.676	0.677	0.687
Constant	−0.005	−7.241**	−8.097***	−6.878**	−7.768***
	0.802	3.445	2.885	3.348	2.753
Pseudo R^2	0.167	0.178	0.189	0.179	0.190

*, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

in all of the specifications. This lack of significance is not due to multicollinearity, even though the correlation between the risk premium factor and the yield spread is 63.8% over the sample period, as the coefficient on the yield spread remains significant. This finding indicates that all of the explanatory power comes from changes in the yield spread that are independent of the price of risk, as

measured by Cochrane and Piazzesi (2002). This implies that managers' choice of interest rate exposure is not driven by changes in the compensation paid to firms that bear interest rate risk.

Conversely, firms are responding to changes in expected macroeconomic conditions, consistent with the cost of bearing interest rate risk changing over time. As shown by the results in Table V, the coefficients on both of the additional variables measuring expected future economic conditions are statistically significant (p-value < 0.05) in the respective specifications and their signs are as predicted. These findings suggest that as the market's expectation of a recession declines or as chemical sector production increases, debt instruments are relatively more likely to be floating than when the likelihood of a recession is high or when sector production is low. This finding of significance for both economic indicator variables lends support to an interpretation that the cost of bearing interest rate risk changes over time, altering a firm's risk-return tradeoff and for some, their choice of interest rate exposure. It is evidence that firms are managing macroeconomic and industry risk, rather than firm-specific interest rate risk.

However, in all of the specifications, the coefficient on the yield spread remains positive and statistically significant (p-value < 0.01). A one standard deviation decrease in the yield spread (44.5 basis points) decreases the likelihood of having floating-rate debt from 28% to 16%. In contrast, a one standard deviation decrease in the Index of Leading Indicators decreases the likelihood of having floating-rate debt from 28% to 20%. The larger economic magnitude and greater level of statistical significance of the yield spread coefficient provide strong support for the interpretation that firms are timing the market, attempting to reduce their short-term cost of capital.

C. Robustness Checks

Still another interpretation of this finding is that the yield spread is picking up movements in the level of interest rates. Firms may actually be floating when interest rates are at high nominal levels and going fixed when interest rates are relatively low. To determine whether firms are responding to the spread or to the level, I regress the final interest rate exposure of the new debt issues on both the spread and measures of the nominal level of interest rates. The results are presented in Table VI.

It appears that firms are in fact responding to the spread, not to the level of interest rates. In the first column, I include the yield on 1-year Treasuries and the difference in the yield between the 10-year Treasury and the 1-year Treasury. In the second column, the 10-year Treasury yield and the yield spread are used. In both specifications, the coefficient on the yield spread is significantly different from zero while the coefficient on the level of interest rates, captured by the Treasury yield, is not statistically different from zero. Firms appear to choose the security that has relatively lower interest costs at the time of the issue, fixed when the difference is small and floating when the difference is large. They do not appear to be basing their choice on the nominal level of interest rates.

Table VI
Level of Interest Rates versus Yield Spread

This table presents the results of probit regressions where the dependent variable takes the value 1 if the final exposure of the debt funds is floating, and is 0 otherwise. The final exposure is defined as the exposure of the debt instrument obtained by combining the initial exposure with any interest rate swaps used to modify that exposure. Cash flow beta is the estimated exposure to LIBOR of the corresponding firm's quarterly free cash flow for the 5 years (subject to data availability) prior to the debt issue. Credit spread is the difference between the BAA and AAA Corporate Debt in the month the debt funds were raised. Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month the debt funds were raised. The 1-year Treasury yield and the 10-year Treasury yield are the yields for those bonds during the month the debt funds were raised. Chemical production index is the value of that index during the month the debt funds were raised. The standard errors are White heteroskedastic consistent (White (1980)), adjusted for clustering by company.

	(1)	(2)
Interest rate exposure		
Cash flow beta	−0.030	−0.030
	0.052	0.052
Market timing		
Credit spread	0.922	0.922
	0.886	0.886
Yield spread	1.129***	0.829**
	0.275	0.361
1-year Treasury yield	0.299	
	0.200	
10-year Treasury yield		0.299
		0.200
Chemical production index	0.083***	0.083***
	0.029	0.029
Control variables		
Leverage	−0.082	−0.082
	0.584	0.584
Advertising over sales	−2.709*	−2.709*
	1.544	1.544
CapEx over sales	−0.393	−0.393
	0.346	0.346
R&D over sales	0.725	0.725
	2.153	2.153
Ln(Sales)	−0.150***	−0.150***
	0.058	0.058
Profit margin	−1.331*	−1.331*
	0.686	0.686
Constant	−10.506***	−10.506***
	3.228	3.228
Pseudo R^2	0.194	0.194

*, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

Having determined that firms are primarily responding to pricing conditions, specifically the yield spread, I now examine whether that response is robust to the source of the debt funds. Is the responsiveness to pricing conditions the same for firms that borrow from banks as for those that issued their debt in the bond market? Firms that borrow from different sources may have different

risk management strategies, or their ability to manage risk may vary with their debt source. Since the firms that go to banks are smaller and more risky (Faulkender and Petersen (2004)), they may be less able to endure interest rate variability and therefore respond differently to movements in the yield spread.

I examine this by separating the yield spread variable into two variables. One takes the value of the yield spread if the debt source is a bank, and is zero otherwise, and the second takes the value of the yield spread if the source is the bond market, and is zero otherwise. If firms are responding differently to pricing conditions because risk management practices are indeed correlated with debt source, then the coefficients on these two terms should differ. I also include debt source in the regression to ensure that any differences in the coefficients are due to different reactions to the yield spread, not due to the source of funds. In the second specification, I do the same separation for the Industrial Production Index for the chemical industry to determine whether firms are also responding differently to current industry conditions. The results are presented in Table VII.

The results in the first column show that both types of firms—those that borrow from banks and those that issue in the bond market—are more likely to have a floating interest rate exposure as the yield spread increases. Although both coefficients are significantly different from zero, they are not significantly different from each other (p-value $= 0.68$). Thus there does appear to be symmetry in responses to changes in market pricing, regardless of whether the firm borrowed from banks or from the bond market. This finding of symmetry is evidence that swap costs are not prohibitively large, since the smaller, bank-dependent firms that should be more affected by these costs are not any less responsive to yield spread changes.

The second column of Table VII includes the separated measures of the Index of Industrial Production for the chemical industry as well. Both coefficients on the Index variable are positive, statistically significant, and are not significantly different from each other (p-value $= 0.97$). As industry conditions improve, firms are more likely to have a floating interest rate exposure regardless of whether they borrowed from a bank or from the bond market, suggesting that firms are less able to withstand interest rate fluctuations when economic conditions are expected to be poor. Even after including these terms, the coefficients on the yield spread terms are still significantly different from zero and not from each other (p-value $= 0.80$). These results suggest that the primary purpose of the interest rate risk management policies of firms, independent of the source of their debt funds, is to time the interest rate market and to manage industry-wide risk, not to hedge firm-specific interest rate exposure.

Another possibility is that firms are only timing the market when choosing the interest rate exposure of their smaller debt issuances.[10] Since timing interest rates can increase the firm's risk, they may only be responding to market prices when the issue size is small relative to the amount of debt the firm has. If that is the case, then the yield spread should only be a significant predictor of the observed interest rate exposures for those debt issuances that are relatively

[10] I thank an anonymous referee for pointing out this possible alternative explanation.

small. To test this, I divide the sample based on the size of the issue relative to the firm's long-term debt. If the issue size as a percentage of the firm's long-term debt is larger than the median, it is considered to be a large issue; otherwise it is considered a small issue. Following the procedure implemented with the yield spread and the source of funds, the first interaction variable measures the yield spread for those issuances that are relatively large (and is zero otherwise),

Table VII

Yield Spread Effect, Conditional on Source and Amount

This table presents the results of probit regressions where the dependent variable takes the value 1 if the final exposure of the debt funds is floating, and is 0 otherwise. The final exposure is defined as the exposure of the debt instrument obtained by combining the initial exposure with any interest rate swaps used to modify that exposure. Cash flow beta is the estimated exposure to LIBOR of the corresponding firm's quarterly free cash flow for the 5 years (subject to data availability) prior to the debt issue. Credit spread is the difference between the BAA and AAA Corporate Debt in the month the debt funds were raised. Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month the debt funds were raised. Yield spread ∗ bank takes the value of the yield spread in the month the debt funds were raised for firms that borrowed the funds from a bank, and is 0 otherwise. Yield spread ∗ bond takes the value of the yield spread in the month the debt funds were raised for firms that issued bonds, and is 0 otherwise. Chemical production ∗ bank and Chemical production ∗ bond are the values of that index during the month the debt funds were raised if the source was a bank or bond, respectively, and are 0 otherwise. Yield spread ∗ small takes the value of the yield spread in the month the debt funds were raised for firms whose debt issue as a fraction of total long-term debt was smaller than the median of that fraction for the sample, and is 0 otherwise. Yield spread ∗ large takes the value of the yield spread in the month the debt funds were raised for firms whose debt issue as a fraction of total long-term debt was larger than the median of that fraction for the sample, and is 0 otherwise. Debt source is bank takes the value 1 if the source of the debt funds was a bank, and is 0 otherwise. Large debt issue takes the value 1 if the debt issue as a fraction of the firm's total long-term debt was larger than the median of that fraction for the sample, and is 0 otherwise. The standard errors are White heteroskedastic consistent (White (1980)), adjusted for clustering by company.

	(1)	(2)	(3)
Interest rate exposure			
Cash flow beta	−0.046	−0.055	−0.026
	0.060	0.062	0.051
Market timing			
Credit spread	0.032	−0.470	0.511
	0.704	0.683	0.642
Yield spread ∗ bank	0.879*	1.436**	
	0.488	0.604	
Yield spread ∗ bond	0.636*	1.258***	
	0.344	0.370	
Yield spread ∗ small			0.904**
			0.394
Yield spread ∗ large			0.473**
			0.240
Chemical production ∗ bank		0.105**	
		0.046	
Chemical production ∗ bond		0.102***	
		0.034	

(*continued*)

Table VII—*Continued*

	(1)	(2)	(3)
Control variables			
Leverage	0.167	−0.256	0.312
	0.705	0.698	0.592
Advertising over sales	−4.096**	−4.197**	−2.753*
	1.833	1.919	1.523
CapEx over sales	−0.236	−0.208	−0.384
	0.382	0.410	0.336
R&D over sales	1.500	0.250	1.862
	2.342	2.205	2.358
Ln(Sales)	0.154**	0.142*	−0.150**
	0.075	0.076	0.066
Profit margin	−1.760**	−1.713**	−1.255*
	0.726	0.776	0.660
Debt source is bank	1.870***	1.760	
	0.507	5.884	
Large debt issue			0.240
			0.387
Constant	−2.571***	−12.604***	−0.361
	0.688	3.290	0.686
Pseudo R^2	0.355	0.384	0.170

*, **, and *** correspond to significance at 10%, 5%, and 1%, respectively.

and the second does the same for the relatively smaller issuances. The results are presented in column 3 of Table VII.

The two yield spread variables both have positive and significant coefficients, suggesting that firms alter the interest rate exposure of their debt instruments as the yield spread changes, regardless of whether the new issue is a large or small percentage of the debt in their capital structure. Also, the difference between the coefficients is positive, as would be expected if firms were more likely to time the market on their smaller issuances than their larger ones, but they are not significantly different from each other (p-value $= 0.335$). This suggests that firms do not view market timing to be an overly risky strategy, since we should otherwise see that they are unwilling to take on this risk with larger issuances.

D. Decomposing the Final Exposure

Firms respond to changes in the yield spread, but at which point in arriving at their ending exposure is the yield spread taken into account? This section looks at various intermediate steps taken in arriving at the final exposure to answer that question. Table VIII presents the results of analyzing the determinants of the source of debt funds, the initial exposure of those funds, and the direction of a swap if one was used.

The first column provides the results of examining from where firms raise their debt funds. Recall from Table I that there is a high correlation between the

Table VIII
Decomposition of Final Exposure

The first column in this table presents the results of a probit regression where the dependent variable takes the value 1 if the debt funds were raised from a bank, and is 0 otherwise. The second column presents the results of a probit regression where the dependent variable takes the value 1 if the initial exposure of the debt funds is floating, and is 0 otherwise. The third column presents the results of an ordered probit regression where the dependent variable takes the value 1 if the exposure of the debt funds was swapped from fixed to floating, −1 if the debt funds were swapped from floating to fixed, and is 0 if the debt funds were not swapped. Cash flow beta is the estimated exposure to LIBOR of the corresponding firm's quarterly free cash flow for the 5 years (subject to data availability) prior to the debt issue. Credit spread is the difference between the BAA and AAA Corporate Debt in the month the debt funds were raised. Yield spread is the difference between the 10-year Treasury bond and the 1-year Treasury bond in the month the debt funds were raised. Chemical production index is the value of that index during the month the debt funds were raised. The standard errors are White heteroskedastic consistent (White (1980)), adjusted for clustering by company.

Dependent Variable	(1) Source of Funds	(2) Initial Exposure	(3) Swap Direction
Interest rate exposure			
Cash flow beta	0.020	0.015	−0.049
	0.045	0.043	0.055
Market timing variables			
Credit spread	1.480**	0.561	−0.610
	0.677	0.598	0.531
Yield spread	0.085	0.446**	1.015***
	0.234	0.228	0.357
Chemical production index	−0.017	0.046	0.049
	0.029	0.029	0.030
Control variables			
Leverage	0.306	0.543	−1.045
	0.566	0.559	0.758
Advertising over sales	0.223	0.388	−3.409***
	1.697	1.192	1.294
CapEx over sales	−0.440	−0.086	−0.252
	0.299	0.284	0.354
R&D over sales	−0.080	1.432	−0.783
	2.180	2.198	2.109
Ln(Sales)	−0.489***	−0.220***	0.126**
	0.068	0.058	0.052
Profit margin	−0.214	−0.751	−0.762
	0.752	0.639	0.583
Constant	3.197	−4.280	
	2.984	3.043	
Cut point 1			3.815
			3.033
Cut point 2			7.456
			3.058
Pseudo R^2	0.388	0.189	0.133

*, **, and *** correspond to significance at 10%, 5%, and 1%, respectively.

source of funds and the initial interest rate exposure ($\rho = 0.82$). The findings suggest that even despite that correlation, firms do not choose their source of funds based on the likely interest rate exposure they will receive from that source. Notice that the yield spread is not a significant determinant of where the funds were raised. Instead, the determinants are the credit spread and the size of the firm. The statistical significance of the coefficient on the credit spread suggests that as riskier, lower rated corporate debt becomes more expensive relative to highly rated debt, firms are more likely to borrow from banks.

The finding that firm size, as measured by the log of sales, is a significant predictor is consistent with the theoretical literature's argument that banks are better at piercing the information asymmetry between the firm and its lenders or perhaps they better monitor firms than the market does (Diamond (1991)). Larger firms are likely to be more informationally transparent and are therefore more likely to borrow from the public market, whereas smaller, more opaque firms should be borrowing from banks. These results are also consistent with the empirical findings of Cantillo and Wright (2000) and Faulkender and Petersen (2004), who find that as firm size increases, firms are less likely to borrow from banks. Evaluated at the means, the coefficient on sales suggests that a one standard deviation decrease in sales results in the likelihood of using bank debt increasing from 23% to 65%. Thus, there appear to be segmented lending markets, based on size, that drive the source of funds, and the determinants of the final interest rate exposure have little power to explain the source of funds.

The second column of Table VIII looks at the initial interest rate exposure of the debt instruments in the sample. While highly correlated with the source of funds, as Table I illustrated, there are some firms that are able to borrow from banks at fixed interest rates and there are some firms that do issue floating-rate bonds. The coefficient on the yield spread is significantly positive in this specification, indicating that firms change the default exposure of the source of funds due to movements in the yield spread. So even though there is a high correlation between the source of funds and the initial exposure, the small difference between these measures accounts for a large change in the coefficient on the yield spread. Notice that moving from the first to the second column, the coefficient on the yield spread has increased by a factor of five.

The third column examines the direction of a swap, using an ordered probit where the dependent variable takes the value 1 if swapped from fixed to floating, -1 if swapped from floating to fixed, and is 0 otherwise. The coefficient on the yield spread is statistically significant in this specification as well, suggesting that interest rate swaps are being used in response to movements in the yield spread, not in attempts to hedge cash flow exposure. The combination of these results indicates that there are segmented lending markets where the source of funds is determined by the size of the firm. When firms find the default interest rate exposure of that source to be sufficiently costly, as a function of the steepness of the term structure, some firms are able to alter that exposure as part of the debt contract, while others use swaps in order to achieve their desired exposure.

V. Conclusion

Firms respond to market pricing conditions in an effort to reduce their short-term cost of capital. I find strong evidence that the shape of the yield curve is a key determinant of whether a firm's newly issued debt instruments are fixed or floating. As the yield curve steepens, firms are more likely to have floating-rate debt, reducing their short-term interest payment relative to locking in at a higher fixed rate. As the yield curve flattens, firms are more likely to raise debt funds that have a fixed final interest rate exposure. In addition, I find that as the expectation of a recession increases, firms are more likely to lock in the interest rate of their newly issued debt. This finding is consistent with a higher cost of interest rate volatility during economic downturns relative to economic booms. However, even after controlling for expected macroeconomic activity and industry conditions, the yield spread remains a strong determinant of the selected interest rate exposure, suggesting that managers may be myopic and/or they are speculating.

I do not find evidence that firms are hedging, as firm-specific measures of interest rate sensitivity are not predictive of firms' choices of their interest rate exposure. The evidence is mixed with respect to potential financial distress costs influencing the exposure firms choose. Firms with higher advertising to sales ratios are marginally more likely to have fixed rate debt. Additionally, profitable firms are more likely to issue debt with a fixed interest rate exposure.

The source of funds does not affect the responsiveness of firms to market timing variables. While firms that borrow from banks are smaller, and arguably face higher costs in accessing more complex financial securities, they are just as likely to respond to movements in the yield spread and to changing macroeconomic conditions as firms that raise their funds from the bond market. Contrary to the existing literature, these results suggest that managing risk is not prohibitively complex or expensive. The data further suggest that there are segmented lending markets based on firm size, where the initial interest rate exposure of the debt is highly correlated with the source of funds. Despite this correlation, firms do not change their source of funds as the yield spread changes. Instead, some firms are able to alter the initial interest rate exposure that is the default for that source of funds, while others use swaps to alter that exposure.

These results naturally lead to the question of why firms engage in this type of behavior. In speaking with a number of individuals who work in corporate treasury departments, I heard evidence for both short-term earnings management and speculation. Modifying the interest rate exposure of liabilities when there is a large difference between fixed and floating rates allows firms to reduce their short-term interest expense, and thus report higher quarterly earnings. This is rational on the part of managers if they have a higher rate of time preference because their incentive contracts place greater emphasis on current rather than on long-term performance, or perhaps because they are approaching retirement age. Alternatively, some managers appear to be guided by their views regarding anticipated movements of interest rates in the future and that such movements are correlated with the shape of the yield curve. While it is

questionable whether such actions actually increase shareholder value, my discussions with corporate treasury employees, in conjunction with my empirical findings, suggest that some firms believe that they do.

Appendix

The following are excerpts taken from 10-Ks to demonstrate how it was determined that a debt instrument was swapped. Most explicitly disclose if the debt issue was swapped. However, in a few instances, like in the second example, it was inferred based on the changes in the notional amount of swaps and the amount of the debt issue.

Engelhard Corp., 10-K filed March 27, 1997

> In 1996, in connection with the $150 million 7% Notes due 2001 and the $100 million 7.375% Notes due 2006, the Company entered into ten forward starting swaps. These swap agreements were based on amounts and maturities which coincided with the debt agreements. These agreements were closed concurrent with the debt issuance. The resulting impact on the weighted-average interest rate for 1996 was not material.

In the following example, the firm issued $142 million in fixed rate debt during the 1997 fiscal year. The change in notional swap amounts for the category "Fixed to Variable" is $217.5 million. Since this change exceeded the amount of the issued debt, it was considered part of the increase and therefore I considered the debt to have been swapped.

Air Products & Chemicals Inc., 10-K405 filed December 11, 1997

> The table below illustrates the contract or notional (face) amounts outstanding, maturity dates, weighted average receive and pay rates as of the end of the fiscal year, and the net unrealized gain (loss) of interest rate swap agreements by type at 30 September 1997 and 1996. The notional amounts are used to calculate contractual payments to be exchanged and are not generally actually paid or received, except for the currency swap component of the contracts. The net unrealized gain (loss) on these agreements, which equals their fair value, is based on the relevant yield curve at the end of the fiscal year.

Notional (Millions of dollars)	Amount	Maturities
30 September 1997		
Fixed to Variable	$461.0	1998–2007
Variable to Variable	60.0	2000–2001
Interest Rate/Currency	354.1	1998–2005
	$875.1	
30 September 1996		
Fixed to Variable	$243.5	1997–2005
Variable to Fixed	54.0	1997
Variable to Variable	60.0	2000–2001
Interest Rate/Currency	273.6	1998–2005
	$631.1	

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