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The Two Sides of Derivatives Usage: Hedging and Speculating with Interest Rate Swaps

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Abstract

Existing cross-sectional findings on nonfinancial firms' use of derivatives that are usually interpreted as the result of hedging may alternatively be due to speculation. Panel data examinations can distinguish between derivatives practices that endure over time and are therefore more likely to result from hedging, and those that are more transient, thus more consistent with speculation. Our decomposition results indicate that hedging of interest rate risk is concentrated among high-investment firms, consistent with costly external finance. Simultaneously, firms appear to use interest rate swaps to manage earnings and to speculate when their executive compensation contracts are more performance sensitive.

I. Introduction

Why do nonfinancial firms use interest rate derivatives? Are they hedging interest rate risk to reduce the expected costs of financial distress (Smith and Stulz (1985))? To lower the expected tax payments under a convex tax schedule (Smith and Stulz)? To avoid costly external financing by better matching internal cash flow with financing needs (Froot, Scharfstein, and Stein (1993))? To reduce the volatility of executive compensation (DeMarzo and Duffie (1995))? Or are they using interest rate derivatives to speculate on movements in interest rates and to

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manage earnings (Bodnar, Hayt, and Marston (1998), Faulkender (2005), and Geczy, Minton, and Schrand (2007))?

A significant body of work in the empirical risk management literature has been trying to improve our understanding of how firms use derivatives.[1] The identifying assumption in nearly all of this literature has been that firms use derivatives for hedging. Thus, firm characteristics correlated with derivatives usage are interpreted as capturing the costs and benefits of hedging. And the existing literature finds correlations offering support for nearly all theories of hedging.

However, if, as the survey evidence suggests, firms use derivatives not only for hedging but also for speculation, then it is no longer clear how to interpret the existing empirical results. For example, are leverage and use of interest rate derivatives positively correlated because the tax deductibility of interest incentivizes hedging to increase the amount of leverage that firms can sustain (Graham and Rogers (2002)), or because greater debt levels entail larger benefits from successful speculation? Similarly, do high-powered executive compensation contracts motivate more hedging, because managers internalize part of the surplus created through hedging (Chava and Purnanandam (2007)), or more speculation, because given their highly convex compensation contracts, managers capture some of the benefits but not the costs of speculation? Do significant investment opportunities encourage firms to hedge, so that they can fund investment internally and avoid costly external financing (Froot et al. (1993))? Or are they more likely to use derivatives to speculate in an effort to lower their cost of funds?

Unfortunately, these types of questions are very difficult to answer with the cross-sectional data on derivatives usage over short periods of times such as a single fiscal year that most existing analyses have been limited to.[2] In this paper we argue that only an examination using panel data can distinguish between hedging and speculative motivations for using derivatives. If firms are truly hedging, then previously documented cross-sectional relationships between firm characteristics and derivatives usage should be observed not only in the time period examined in a given study but in all other years as well. Assuming that nonfinancial firms' exposure to interest rate risk is stable over time, the firms' optimal interest rate hedge ratio should stay constant as well, and we should observe the same correlation between firm characteristics and derivatives usage in different periods. If, on the other hand, the relationship between a given firm characteristic (e.g., executive compensation) and derivatives usage varies from year to year depending on the interest rate environment, then this characteristic is more likely to capture speculative rather than hedging motivations.

The first step in assessing whether inclusion of the time-series dimension might alter the interpretation of previous findings is to document the variation in

[1]Examples include broad cross-sectional analyses such as Nance, Smith, and Smithson (1993), Mian (1996), Geczy, Minton, and Schrand (1997), Graham and Smith (1999), Guay (1999), Allayannis and Ofek (2001), Graham and Rogers (2002), Guay and Kothari (2003), Bartram, Brown, and Fehle (2009), and Bartram, Brown, and Conrad (2011), as well as analyses in specific industries such as gold mining in Tufano (1996), (1998) and Petersen and Thiagarajan (2000), and the oil and gas industry in Haushalter (2000).

[2]Important exceptions include Brown (2001), Faulkender (2005), Brown, Crabb, and Haushalter (2006), and Adam and Fernando (2006).

interest rate derivatives usage over time and to compare it to the variation in the cross section. Using our hand-collected data covering interest rate swap activity for 1,854 firms for up to 10 years, we find that the time-series variation in swap usage is of similar magnitude as the cross-sectional variation. Among firms using interest rate swaps at least once during our sample period, the average standard deviation over time of firm-level swap usage is equivalent to the standard deviation of the average swap usage across firms.

To the extent that firms are not significantly altering the interest rate exposure of their operations, their interest rate hedging activities should not vary significantly over time. Unless their underlying liability structure is similarly changing over time, evidence that derivatives usage does vary significantly over time is consistent with firms using interest rate derivatives to speculate. This does not mean that firms are not also hedging; in fact, we argue that firms are doing both. However, if speculative activities vary with cross-sectional differences across firms, then previously documented cross-sectional determinants of derivatives usage may have been mischaracterized as capturing the costs and benefits of hedging and may instead be cross-sectional determinants of speculative activities.

In light of the documented time-series variation, a more careful empirical approach to documenting hedging activities is required. Following Faulkender (2005), our primary empirical analyses are of the final interest rate exposure of the firm's debt (i.e., after adjusting the original interest rate exposure of the firm's debt for its interest rate swap activity). Since the purpose of a swap contract is to alter the interest rate exposure of the firm's debt, it is the ultimate interest rate exposure of their debt toward which firms are managing. If firms manage toward a target fixed/floating mix because they perceive significant value benefits from hedging, their average hedge ratio during the sample period should be explained by average firm characteristics theorized to create hedging benefits. Estimates from both Fama-MacBeth (1973) and "between" specifications allow us to capture these enduring effects.

Our results are consistent with firms using interest rate swaps to hedge (i.e., matching the interest rate exposure of liabilities to that of operating cash flows). Such hedging activity is concentrated among firm-years with high levels of capital expenditures (CAPEX) (as a percentage of assets). High-investment firms whose cash flows rise when short-term interest rates increase and fall when short-term interest rates decrease use more floating-rate debt than high-investment firms whose cash flows have the opposite interest rate sensitivity. Such risk management practices make it more likely that internally generated cash flows will cover both the firm's interest expenses and its investment needs. This evidence is consistent with the model of Froot et al. (1993), who show that firms may benefit from risk management if they confront costly external financing and have valuable investment opportunities.

We also find that more levered firms, those with a greater portion of their debt being long-term, and those that engage in more research and development (R&D) use less floating-rate debt, consistent with interest expense volatility being particularly costly for these firms. However, we do not find that firms with these characteristics engage in more matching of the interest exposure of their liabilities to that of their cash flows, as would be consistent with hedging. We also fail to find evidence that executive compensation structure is associated with firm hedging activities.

In contrast to hedging, the firm's speculative activities can be characterized as the deviations from its optimal hedging position as a result of the firm's views about the interest rate environment. To the extent that firms' average interest rate risk management activities capture their desired hedging position, deviations from that average should capture most of the speculative activities of firms. Econometrically, this is what a firm fixed effects (within) specification accomplishes. By allowing each firm to have its own unique intercept term, the within specifications remove the firm's average interest rate swap activity and estimate the extent to which independent variables explain movements away from the firm's average hedge ratio across time.

We find that the time-series variation in interest rate derivatives usage is significantly explained by movements in the term structure consistent with Faulkender (2005). This effect is stronger for firms in which compensation of senior management is more sensitive to (stock) performance. These results are robust to alternative measures of executive compensation and are consistent with Geczy et al. (2007), who using survey data find that nonfinancial firms whose managers have high-powered incentives are more likely to use derivatives for speculative purposes. We also find interest rate timing to be greater in years in which firms are more likely to have managed earnings, consistent with interest rate swaps being used to meet earnings forecasts. Since interest rate swaps move earnings across time in ways that are rather predictable in the 1st year, they can serve as a substitute to accruals and other previously documented earnings management devices. Overall, our findings suggest that firms are using derivatives to hedge *and* to speculate.

The rest of the paper is organized as follows. Section II describes in more detail our empirical strategy of distinguishing the time-series and cross-sectional factors that explain the variation in the use of interest rate derivatives by nonfinancial firms. Section III describes our data, in particular our measures of interest rate swap usage, the share of outstanding debt that is floating after accounting for the effects of interest rate swaps, and the cross-sectional versus time-series statistics of these activities. Section IV presents our benchmark multivariate analysis for the entire panel. The cross-sectional determinants are examined in Section V, followed by an analysis of the time-series effects in Section VI. Section VII concludes.

II. Empirical Strategy

The identifying assumption of nearly all of the empirical risk management literature has been that firms use derivatives for hedging. Thus, variables explaining variation in derivatives usage are interpreted as capturing the costs and benefits of hedging. However, if firms are also using derivatives for speculative reasons, it is no longer clear how to interpret the existing empirical results, and variables documented as explaining variation in derivatives usage can just as appropriately be interpreted as capturing the costs and benefits of speculation. For instance, do performance-sensitive compensation contracts or high leverage levels incentivize hedging or speculation? Testing theories of hedging thus requires separating the speculative and hedging components of risk management policies.

Econometrically, a "between" specification in a panel data set regresses the mean of the dependent variable on the means of the independent variables. Similarly, the Fama-MacBeth (1973) approach estimates the cross-sectional variation each year and then averages the estimated coefficients over the sample period. We argue that these methodologies enable the identification of the hedging component of firm risk management practices. If a firm's risk exposure is constant over time, the optimal hedge ratio remains constant. If firms are hedging, their risk management activities should be centered around that constant optimal hedge ratio. While firms' speculative activities may move them away from their optimal hedge ratio at a particular point in time, a panel covering a sufficiently long time period should generate an estimate of the mean risk management activity that is an unbiased estimate of that optimal hedge ratio. In that case, coefficient estimates from between regressions could appropriately be interpreted as explaining the cross-sectional variation in optimal hedge ratios. Likewise, the Fama-MacBeth specifications capture the cross-sectional relationships that endure over time.

A firm-level "within" specification regresses the firm-specific deviations from the mean of the dependent variable on the firm-specific deviations from the means of the independent variables. We argue that results from firm-level "within" regressions can be interpreted as explaining speculative activities, since these specifications focus on movements away from our estimate of the firm's constant hedge ratio. The coefficients generated by this specification explain which firm variables are associated with deviations from the firm's average position. As such, significant coefficients estimated in "within" specifications are more likely to be associated with the speculative activities of the firm. This decomposition enables us to determine which previously documented variables affecting variation in risk management activities have been properly characterized as the result of hedging from those that are actually speculative.

We examine nonfinancial firms' use of interest rate swaps, the derivative that according to the Office of the Comptroller of the Currency accounted for most of the outstanding notional value of derivatives over our sample period. We do not include currency and commodity transactions, as we do not have the prehedging outcomes necessary to estimate firm-level exposure to hedgeable risks.[3] These transactions are generally included with the operating activities of firms because they offset operating revenues or expenses. Interest rate swaps are included with interest expense and therefore are separate from operating activities, enabling prederivatives usage estimation of the sensitivity of the firm's operations to interest rates.

Our identifying assumption is that nonfinancial firms' exposure to interest rate risk should be stable over time. If a manufacturing firm expects that its cash flows will be lower if interest rates are high next year and higher if interest rates are low; these expectations are likely to be the same many years later, as long as

[3]For this reason, most research examining commodity hedging has focused on particular industries such as gold mining (Tufano (1996), (1998), Petersen and Thiagarajan (2000), and Brown et al. (2006)) and the oil and gas industry in Haushalter (2000).

the firm does not significantly alter its operations. As a result, a firm's optimal interest rate hedge ratio should stay relatively constant over time. On the other hand, a firm's beliefs on the direction of interest rates will likely vary significantly with market conditions, leading their interest rate exposure to move with changes in those beliefs. If firms are both hedging and speculating on movements in interest rates, one can empirically model firms' interest rate risk management practices as having a target hedge ratio driven by the interest rate sensitivity of their operations, with deviations from that target driven by firms' interest rate views. When a firm believes that interest rates are going to rise more than implied by the term structure, it will deviate from its optimal hedge ratio by using more fixed rate debt or by entering into pay-fixed interest rate swaps, depending upon which transaction is less costly for the firm.[4] The opposite holds for firms that believe that interest rates are going to rise less than implied by the term structure. Over time, average hedge ratios should approach the firm's optimal hedge ratio, and market timing activities can be captured by the difference between the observed hedge ratio and its firm-specific time-series average.

As indicated previously, firms can use interest rate swaps to hedge or speculate in interest rate markets, but they can also do so via the choice of the interest rate exposure of their debt. As pointed out by Faulkender (2005), a firm that issues a floating-rate debt security and then swaps that debt security to a fixed rate exposure (using an interest rate swap that matches i) the face value of the debt to the notional value of the interest rate swap, ii) the frequency of interest payments, iii) the index of the floating rate (e.g., 6-month London Interbank Offered Rate (LIBOR)), and iv) the maturity of the debt) has the same interest rate exposure as a firm that issues a fixed rate liability. Therefore, we will look at both the interest rate swap activities of the firm and the interest rate exposure of the firm's debt. After all, it is the combination of these choices that determines the overall interest rate exposure of the firm's liabilities.

III. Data and Summary Statistics

A. Construction of the Data Sample

We start with the sample of nonfinancial firms in Compustat's ExecuComp data set during the 1993–2003 period, and we augment it with hand-collected data on interest rate swap usage by each firm in our sample.[5] Specifically, we use 10-Ks

[4]Based on our discussions with investment bankers, the cost of entering an interest rate swap is significantly lower than the cost of issuing a new debt security. As a result, we expect that most of the speculative activity of firms will take place via their interest rate swap transactions. However, if the firm is issuing a new debt security anyway (because it is refinancing a maturing debt instrument or raising new funds), then the speculation could take place via the interest rate exposure selection of the debt security itself.

[5]Focusing on the ExecuComp set of firms allows us to examine the effects of managerial characteristics, in particular executive compensation, on risk management practices. Also, these firms are larger in size and therefore account for most of the dollar volume of interest rate swaps used by nonfinancial firms. The choice of the sample period is determined by the availability of 10-Ks in EDGAR and by the fact that the Compensation Disclosure Act of 1993 required firms to report individual compensation items for the top 5 executives.

in EDGAR to record i) the amount of floating-rate long-term debt and ii) the notional amounts and directions of interest rate swaps outstanding at the end of each fiscal year. Using these hand-collected data, we calculate the net floating swap amount as the pay-floating-receive-fixed notional amount minus the pay-fixed-receive-floating notional amount. We divide the net floating swap amount by the debt outstanding at the end of the fiscal year, generating the net share of the firm's debt that is swapped to floating, taking values between –1 (all debt swapped to fixed) and 1 (all debt swapped to floating). The absolute value of this variable represents the net amount of interest rate swaps outstanding at the end of the fiscal year as a share of the firm's total debt.

We then combine the underlying floating-rate debt amount with the net notional value of floating-rate swaps to calculate the amount of the firm's debt that is floating after accounting for interest rate swap effects. Dividing this variable by the firm's total debt level yields the share of floating-rate debt after interest rate swap effects (taking values between 0 and 1).[6] Overall, after dropping observations that do not have any debt or do not provide enough information in their 10-Ks to determine the amount of floating-rate long-term debt and the notional amounts of outstanding interest rate swaps, we are left with 11,261 firm-year observations.

Our explanatory variables come from recent papers in the literature (Graham and Rogers (2002), Faulkender (2005), and Chava and Purnanandam (2007)), and include controls for the debt structure of the firm, variables related to the state of the macroeconomy, the financial condition of the firm, and compensation measures. Our measures of the debt structure that were not hand collected come from the balance sheet data obtained from Compustat. We calculate market leverage as total debt (long-term debt plus debt in current liabilities) divided by the market value of the firm, calculated as book assets minus book equity plus the product of the share price at the end of the fiscal year and the number of shares outstanding. We also calculate the percentage of debt that has more than 5 years to maturity as the difference between the overall amount of long-term debt and debt maturing in years 2–5, divided by total debt. Following Faulkender and Petersen (2006), we define a binary variable indicating whether the firm has a debt or commercial paper rating to capture access to the public debt market.

The firm's financial condition may also impact its target fixed/floating mix. Motivated by the work of Froot et al. (1993), we include various measures of firm investment such as the sum of CAPEX and acquisition expenditures scaled by book assets, which we label as investment, and R&D expenditures scaled by book assets.[7] All of these are intended to measure the benefit of generating internal cash so that these investments can be made without reliance on external capital markets. We use the natural log of sales to measure firm size.

[6]The details of how these variables are constructed are available in the Appendix.

[7]Firms are not required to separately disclose accounting values that are not material. Therefore, the values for R&D expense in Compustat data are generally missing because the firm considered their values not to be material. Rather than dropping these observations, we follow most of the literature and set them equal to 0.

Finally, we estimate the sensitivity of the firm's free cash flow to interest rates to determine whether matching the interest rate exposure of the firm's operations would be better achieved via a fixed or floating interest rate exposure on the firm's debt. We measure free cash flow as operating income before depreciation minus investment and normalize this difference by book assets. It is important to include investment in the calculation of free cash flow because we want to estimate how operating cash flow net of investment varies with changes in interest rates. For example, consider a firm whose operating cash flow and investment opportunities are both positively correlated with interest rates. For this firm, free cash flow is uncorrelated with interest rates; the firm is naturally hedged and therefore less concerned with managing the interest rate exposure of its debt. Contrast that firm with one whose operating cash flow is positively correlated with interest rates but whose investment opportunities are negatively correlated with interest rates. For this firm, free cash flow is positively correlated with interest rates; the firm therefore prefers floating-rate debt. The difference between these examples arises from how investment varies with operating cash flow across interest rate environments. This is why it is important to estimate the interest rate sensitivity of postinvestment cash flow.[8]

Additionally, note that we use a preinterest expense measure of operating cash flow, since we want an estimate of cash flow interest rate sensitivity before incorporating interest rate risk management activities. To estimate each firm's cash flow interest rate beta, we regress free cash flow for a given year on the average value of 3-month LIBOR during that year.[9] If firms are hedging their interest rate exposure, we would expect firms whose cash flows are positively exposed to interest rates to be more likely to choose a floating interest rate exposure relative to those negatively exposed to interest rates.

Our primary measure of the interest rate environment is the term spread, which we measure as the average difference during the fiscal year between the 3-year swap rate and 3-month LIBOR. Most floating-rate commercial loans are tied to either 3- or 6-month LIBOR, so to qualify for hedge accounting treatment their interest rate swap would have to be tied to the corresponding LIBOR. The term spread represents the estimated difference in interest rates that the firm would face were it to enter into an interest rate swap.[10] We control for changes in credit market conditions using a measure of the credit spread, defined as the average difference during the fiscal year between the yields on Moody's Baa- and Aaa-rated debt, and a measure of the swap spread, defined as the average difference

[8]Results are statistically weaker when we instead use operating cash flow, consistent with the important role of internally funding investment in firms' risk management strategies. Results are robust to truncation of both free cash flow and estimated coefficients, using t-statistics instead of estimated coefficients, and using directional exposure measures defined by the sign of the estimated coefficient or the value of the t-statistic.

[9]To get more precise estimates, we require firms to have at least 5 observations in order to estimate their cash flow interest rate beta. Firms with fewer observations have missing values of cash flow interest rate beta but remain in the sample and are used in specifications that do not include cash flow interest rate beta.

[10]The 10-Ks and conversations with traders suggest that average swap maturity is between 2 and 3 years. We have repeated our analysis using other swap rate terms (in particular, 2- and 5-year rates) and find that the results are robust across different term selections.

between the 3-year swap rate and the 3-year T-note. Our analysis also controls for changes in the macroeconomy that may affect the firm's choice of interest rate exposure and the source of funds. Using the Flow of Funds data published by the Federal Reserve Board, we construct a measure of the economywide percentage of floating-rate debt, defined as the ratio of commercial paper and bank loan liabilities over the sum of commercial paper, bank loan, and corporate bond liabilities of nonfarm, nonfinancial corporations (table L.102 of the Flow of Funds Accounts of the United States). This variable is meant to capture changes in lending sources over time that may impact firms' initial interest rate exposure.

Turning to the compensation variables of interest, we rely on ExecuComp for detailed disclosures of cash, stock, and stock option compensation for chief executive officers (CEOs) and chief financial officers (CFOs).[11] Following recent literature and using the empirical methodology of Core and Guay (2002), we estimate the delta and vega of each CFO's and CEO's stock and option portfolios. Delta is defined as the change in the value of the stock and option portfolio for a 1% change in the stock price. Vega is the change in portfolio value for a 1-percentage-point change in the annualized stock return volatility.[12] To reduce the effect of outliers we winsorize delta and vega at the 1st and 99th percentiles.

B. Description of the Resulting Data Sample

Panel A of Table 1 reports summary statistics for interest rate swap usage and final floating-rate debt for the entire sample. For the mean (median) firm-year in our sample, 41.6% (33.3%) of the outstanding debt has a floating interest rate exposure. The average swap is equivalent to 6.8% of the firm's debt, but since some firms swap to floating while others swap to fixed, a net average of 3.4% of the firm-year's debt is swapped to a fixed interest rate exposure, leaving the average firm-year with 38.3% of floating-rate debt. While the mean swap amount may appear relatively small, note that the standard deviation of swap usage is 17.8%, indicating that there is substantial variation across firms and time in the direction and amount of swap usage. Because we are interested in explaining the effects of swap usage on the ultimate interest rate exposure of firms, some of our specifications will only look at those firms that use interest rate swaps at least once during the sample period. The summary statistics for this subsample appear in Panel B of Table 1. The number of observations is reduced by nearly 45%, and average swap size correspondingly increases to 12.3% of the firm's debt. In fact, in untabulated statistics, when we limit our analysis to the 2,999 firm-years in

[11]In identifying both the CEO and CFO of each firm (where available), we use the *annual title* field in ExecuComp to insure that we extract the fullest sample possible. Many CFOs, in particular, have multiple titles, or their titles are spelled out in relatively obscure ways. Therefore, we sorted on all available job titles within the data set and carried out a word search for the keywords of "chief finance" or "CFO." A similar method was undertaken for the CEOs.

[12]We thank John Core and Wayne Guay for graciously sharing their delta and vega estimation programs to ensure that our work was accurate.

which a swap was used, the average swap corresponds to 25.7% of the outstanding debt. These statistics suggest that *when* firms do use swaps, the magnitude of their usage is quite large.

TABLE 1

Swap Usage and Floating-Rate Debt Summary Statistics

Table 1 reports summary statistics for swap usage and floating-rate debt percentages for the sample of nonfinancial firms in the ExecuComp data set. The sample period is June 1993–May 2003. Swap users are firms that use interest rate swaps at least once during the sample period. Initial floating-rate debt is the percentage of outstanding debt that is floating before accounting for the effect of interest rate swaps. Final floating-rate debt is the percentage of outstanding debt that is floating after accounting for the effect of interest rate swaps. Swapped to floating is the percentage of outstanding debt that is swapped to a floating interest rate. Long-term debt is the percentage of outstanding debt that has more than 5 years to maturity.

Variable	*N*	Mean	Median	Standard Deviation (SD)	Min	Max
Panel A. Full Sample						
Initial floating-rate debt (%)	11,261	41.579	33.273	35.064	0.000	100.000
Swapped to floating (%)	11,261	–3.404	0.000	17.804	–100.000	100.000
|Swapped to floating (%)|	11,261	6.839	0.000	16.787	0.000	100.000
Final floating-rate debt (%)	11,261	38.323	30.783	33.275	0.000	100.000
Long-term debt (%)	11,261	47.413	49.521	34.503	0.000	100.000
Panel B. Swap Users						
Initial floating-rate debt (%)	6,269	42.619	35.533	32.609	0.000	100.000
Swapped to floating (%)	6,269	–6.114	0.000	23.513	–100.000	100.000
|Swapped to floating (%)|	6,269	12.285	0.000	20.960	0.000	100.000
Final floating-rate debt (%)	6,269	36.770	31.579	28.995	0.000	100.000
Long-term debt (%)	6,269	49.335	51.146	31.986	0.000	100.000

Panel C. Cross-Sectional and Time-Series Variations in Swap Usage and Floating-Rate Debt

	Full Sample				Swap Users			
Variable	Mean	Overall SD	Cross-Sectional SD	Time-Series SD	Mean	Overall SD	Cross-Sectional SD	Time-Series SD
Swap usage (%)	–3.404	17.804	13.167	12.177	–6.114	23.513	18.261	16.321
Final floating-rate debt (%)	38.323	33.275	29.138	20.607	36.770	28.995	21.688	20.069

Since we are interested in how much of the variation in interest rate risk management is explained by cross-sectional versus time-series variation, in Panel C of Table 1 we decompose swap usage and final floating debt percentages into those 2 components. We calculate the standard deviation of swap usage for each firm and estimate an average within-firm standard deviation of 12.2%. This number increases to 16.3% when we limit the sample to just interest rate swap users. These results demonstrate that swap activity varies significantly over time at the individual firm level. Similar magnitudes result when we calculate the standard deviations of the final floating percentage at the firm level, 20.6% and 20.1%, respectively. For the cross-sectional component, we use the firm-level average of each of these 2 measures and calculate the standard deviations of those averages, finding cross-sectional standard deviations of 13.2% for swap usage and 29.1% for the final floating percentage. The similarities in magnitudes, particularly for the subsample of swap users, indicate that there is as much time-series variation within firms as there is cross-sectional variation across firms in interest rate risk management practices. In contrast, untabulated results indicate that there is almost twice as much cross-sectional (12.4%) variation as there is time-series variation (6.8%) in market leverage, consistent with Lemmon, Roberts, and Zender

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(2008). These statistics suggest that there is much less persistence in swap and floating-rate debt usage than in leverage, as well as the importance of analyzing both cross-sectional and time-series variations in firms' use of derivatives.

Table 2 reports further summary statistics for variables that we use to explain variation in interest rate risk management. The average 1-year Treasury rate fluctuated widely over our sample period, ranging from a low of 1.5% to a high of 6.2%. The spread between the 3-year swap rate and 3-month LIBOR averaged 93 basis points (bp), ranging from 16 bp to 207 bp. The standard deviation of the term spread over this period was 55 bp, and therefore in most of the economic interpretations of our findings we will look at 1-percentage-point changes in the term spread, just below a 2-standard-deviation movement.

Consistent with other studies using the ExecuComp data set, the firms in our sample are larger than the average Compustat firm, and more than ½ of the observations are firm-years in which there was public debt outstanding. Comparing the entire sample in Panel A of Table 2 with the subsample of swap users in Panel B,

TABLE 2

Summary Statistics

The sample is nonfinancial firms in the ExecuComp data set. The sample period is June 1993–May 2003. Swap users are firms that use interest rate swaps at least once during the sample period. In Panel B of Table 2, *, **, and *** indicate statistically significant differences at the 10%, 5%, and 1% levels, respectively, between swap users and nonusers. Leverage is total debt divided by the market value of the firm, calculated as book assets minus book equity plus the market value of equity. Debt or CP rating is a binary variable equal to 1 if the firm has a debt or commercial paper rating. Missing values of R&D expenditures are treated as 0s. Cash flow beta is the beta from regressing free cash flow to assets ratio on the average value of the 3-month LIBOR during the fiscal year. Cash flow beta is estimated using at least 5 observations. Firm-specific term spread beta is the firm-specific sensitivity of swap usage to the term spread, estimated using at least 5 observations. Delta is the change (in thousands of dollars) in the value of stock and option portfolio for a 1% change in the stock price. Vega is the change (in thousands of dollars) in the value of stock and option portfolio for a 0.01 change in the annualized standard deviation (SD) of stock returns. Delta and vega are calculated using Core and Guay's (2002) 1-year approximation method. Term spread is the average spread between the 3-year swap rate and the 3-month LIBOR during the fiscal year. Credit spread is the average difference between Moody's Baa- and Aaa-rated debt during the fiscal year. Swap spread is the average difference between the 3-year swap rate and the 3-year Treasury note during the fiscal year. Economywide floating-rate debt is the ratio of commercial paper and bank loan liabilities to the sum of commercial paper, bank loan, and corporate bond liabilities of nonfarm, nonfinancial corporate businesses, as reported in table L.102 of the Flow of Funds Accounts.

Variable	*N*	Mean	Median	SD	Min	Max
Panel A. Full Sample						
log(Sales)	11,261	6.958	6.918	1.440	0.046	12.410
Market leverage (%)	11,261	18.461	15.885	14.037	0.000	85.312
Debt or CP rating	11,261	0.555	1.000	0.497	0.000	1.000
CAPEX/Assets (%)	11,259	6.988	5.386	5.840	0.000	31.659
R&D/Assets (%)	11,261	2.501	0.000	4.992	0.000	27.275
Cash flow beta	9,027	0.067	–0.200	3.089	–9.197	11.550
Term spread beta	5,738	3.926	2.325	13.853	–38.230	48.618
CEO delta	9,787	583.510	131.528	1,622.978	0.056	12,519.897
CFO delta	5,949	55.506	23.824	95.202	0.000	616.753
CEO vega	9,969	64.237	20.915	120.220	0.000	753.742
CFO vega	6,199	18.152	7.698	29.741	0.000	184.102
Panel B. Swap Users Subsample						
log(Sales)	6,269	7.420***	7.360	1.344	1.619	12.410
Market leverage (%)	6,269	20.303***	18.334	13.298	0.003	85.312
Debt or CP rating	6,269	0.679***	1.000	0.467	0.000	1.000
CAPEX/Assets (%)	6,268	6.879**	5.361	5.523	0.000	30.030
R&D/Assets (%)	6,269	1.653***	0.000	3.558	0.000	27.275
Cash flow beta	5,363	–0.207***	–0.336	2.706	–9.197	11.550
Term spread beta	5,738	3.926	2.325	13.853	–38.230	48.618
CEO delta	5,597	591.089	147.680	1,595.876	0.056	12,519.897
CFO delta	3,372	64.369***	28.804	103.041	0.000	616.753
CEO vega	5,707	80.761***	27.943	140.012	0.000	753.742
CFO vega	3,508	22.363***	10.121	34.034	0.000	184.102

(continued on next page)

TABLE 2 (continued)
Summary Statistics

Variable	*N*	Mean	Median	SD	Min	Max
Panel C. Nonusers Subsample						
log(Sales)	4,992	6.379	6.365	1.345	0.046	10.720
Market leverage (%)	4,992	16.069	12.441	14.304	0.074	72.547
Debt or CP rating	4,992	0.401	0.000	0.490	0.000	1.000
CAPEX/Assets (%)	4,991	7.124	5.408	6.213	0.000	31.659
R&D/Assets (%)	4,992	3.566	0.000	6.188	0.000	27.275
Cash flow beta	3,664	0.468	0.138	3.539	–9.197	11.550
CEO delta	4,190	573.385	108.295	1,658.628	0.056	12,519.897
CFO delta	2,577	43.909	17.218	82.438	0.000	616.753
CEO vega	4,262	42.111	14.390	81.875	0.000	753.742
CFO vega	2,691	12.661	5.580	21.787	0.000	184.102
Panel D. Interest Rates and Spreads						
1-year Treasury yield (%)	11,261	4.876	5.310	1.219	1.548	6.248
Term spread (%)	11,261	0.933	0.774	0.545	0.155	2.069
Swap spread (%)	11,261	0.441	0.461	0.203	0.206	0.811
Credit spread (%)	11,261	0.765	0.689	0.190	0.587	1.313
Economywide floating debt (%)	11,261	32.710	34.254	4.087	20.623	36.349

we see that swap users are larger, more likely to have access to public debt markets, and engage in less investment expenditures, as a percentage of assets. The size and capital market access differences are consistent with swap users having greater financial sophistication and a lower cost of accessing derivatives products. Debt usage is rather similar; leverage ratios average 18.5% of the market value of the firm for the entire sample, with swap users slightly higher at 20.3%. The median sensitivity of cash flow to short-term interest rates is negative for the entire sample and for the subsample of swap users, consistent with most firms generating higher cash flows when interest rates are low. If firms are hedging, then the average firm should prefer to use primarily fixed rate debt, since floating-rate debt would actually increase the variation in their residual cash flow. Looking finally at the compensation variables, a 1% increase in shareholder value increases CFO (CEO) compensation by $55,506 ($583,510), and a 1-percentage-point increase in share volatility increases CFO (CEO) compensation by $18,152 ($64,237).

IV. Benchmark Multivariate Analysis

We begin with standard multivariate regression analysis of the determinants of interest rate swap usage without distinguishing between the time-series and cross-sectional variation and using numerous variables that have been previously documented to be correlated with use of derivatives. The objective of reporting these specifications is to provide a benchmark that is comparable to specifications estimated in prior research and against which we can compare the results from our various panel specifications. The 1st set of results, reported in the first 3 columns of Table 3, examines the net share of debt that is swapped to a floating-rate exposure. Firms that are larger use more pay-floating interest rate swaps. Not surprisingly, firms with more floating-rate debt outstanding are more likely to swap toward fixed. Otherwise, most of our baseline covariates are not significant in simultaneously explaining the time-series and cross-sectional variation in swap usage. Adding macroeconomic variables in column 2, we find that firms swap more to floating when the term structure is steep, consistent with Faulkender (2005), and when floating-rate debt comprises a greater percentage of outstanding debt in the macroeconomy. Compensation metrics largely have an insignificant effect on the direction of interest rate swap activity.

TABLE 3

OLS Regressions of Swap Usage and Floating-Rate Debt

Table 3 reports the results of ordinary least squares (OLS) regressions of swap usage and final floating-rate debt percentages. Swap usage is the percentage of outstanding debt that is swapped to a floating interest rate. Final floating-rate debt is the percentage of outstanding debt that is floating after accounting for the effect of interest rate swaps. Swap usage regressions in columns 1–3 are estimated using the sample of swap users, firms that use interest rate swaps at least once during the sample period. Final floating-rate debt regressions in columns 4–6 are estimated using the full sample. The sample period is June 1993–May 2003. Cash flow beta is the beta from regressing free cash flow to assets ratio on the average value of the 3-month LIBOR during the fiscal year. Cash flow beta is estimated using at least 5 observations. Long-term debt is the percentage of outstanding debt that has more than 5 years to maturity. Standard errors are adjusted for clustering by firm. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Swap Usage			Final Floating-Rate Debt		
Variable	(1)	(2)	(3)	(4)	(5)	(6)
log(Sales)	0.922** (0.419)	1.042** (0.419)	0.993** (0.467)	–0.675 (0.555)	–0.691 (0.558)	–0.911 (0.703)
Leverage (%)	–0.066* (0.038)	–0.056 (0.039)	–0.010 (0.041)	–0.116** (0.046)	–0.122*** (0.047)	–0.053 (0.053)
Debt or CP rating	1.516 (1.374)	1.644 (1.373)	0.534 (1.546)	–14.364*** (1.608)	–14.155*** (1.604)	–14.346*** (1.823)
Long-term debt (%)	0.002 (0.020)	0.002 (0.020)	0.004 (0.021)	–0.219*** (0.019)	–0.217*** (0.019)	–0.191*** (0.023)
Operating margin (%)	–0.019 (0.044)	–0.016 (0.045)	0.009 (0.050)	0.014 (0.053)	0.009 (0.053)	–0.020 (0.071)
CAPEX/Assets (%)	–0.060 (0.152)	–0.068 (0.152)	–0.015 (0.170)	–0.066 (0.098)	–0.089 (0.099)	0.005 (0.114)
R&D/Assets (%)	–0.029 (0.246)	–0.017 (0.244)	0.197 (0.239)	–0.539*** (0.198)	–0.551*** (0.198)	–0.443* (0.247)
Cash flow beta	0.347* (0.197)	0.324 (0.198)	0.336 (0.225)	0.455** (0.225)	0.442** (0.224)	0.514* (0.264)
Initial floating-rate debt (%)	–0.323*** (0.020)	–0.318*** (0.020)	–0.365*** (0.024)			
1-year Treasury yield (%)		–0.466 (0.569)			1.134* (0.587)	
Term spread (%)		4.145*** (0.573)			–0.073 (0.647)	
Swap spread (%)		1.363 (2.248)			7.512*** (2.291)	
Credit spread (%)		–1.640 (2.658)			6.682** (2.699)	
Economywide floating-rate debt (%)		0.583** (0.258)			0.559** (0.237)	
CFO delta			–0.148 (0.868)			0.974 (0.931)
CFO vega			1.322** (0.592)			0.238 (0.722)
Constant	1.874 (3.845)	–19.539** (9.064)	0.270 (4.363)	64.723*** (4.469)	32.789*** (8.975)	62.614*** (5.700)
N	5,357	5,357	2,899	9,018	9,018	4,789
Adjusted R^2	0.23	0.24	0.29	0.15	0.15	0.13

Firms manage interest rate risk both by using interest rate swaps and by selecting the initial interest rate exposure of their debt. The ultimate exposure of the firm's debt, incorporating both the initial interest sensitivity of the debt and the effects of interest rate swaps, gives the complete measure of the firm's interest rate risk management activities. Therefore, in columns 4–6 we repeat the ordinary least squares (OLS) analysis conducted previously using the final floating-rate debt share as the dependent variables. Firms with more debt and those that engage in more R&D have less floating-rate debt, potentially consistent with interest rate risk being more costly for these types of firms. In addition, firms with rated debt have less floating-rate debt, most likely the result of these firms having more corporate bonds in their debt structure, with most bonds having a fixed rate exposure. Most importantly, it does appear that the average firm is matching the interest rate exposure of its liabilities to that of its cash flows, in contrast to the lack of such a finding in Faulkender (2005). Firms with positive interest rate exposure of their cash flows are more likely to swap toward a floating interest rate exposure, thereby reducing the variability of after-interest-expense cash flows. Conversely, firms with negative interest rate exposure of operating and investing cash flows reduce the variability of after-interest-expense cash flows by swapping toward fixed rate exposure.

Contrary to the results for swap usage and of Faulkender (2005), the term spread does not affect the amount of floating-rate debt firms have. However, other measures of the interest rate environment such as the level of interest rates, the spread between swap rates and Treasury rates, and credit spread are statistically significant. Contrary to the results of Chava and Purnanandam (2007), none of the compensation measures are statistically significant.

Although suggestive, these results are difficult to interpret because they do not distinguish between cross-sectional and time-series variations. They are provided so that they can be compared with previous studies of corporate risk management and to show how a simple OLS approach can be misleading. For example, if a result is entirely driven by the time series, then a full panel specification that also includes cross-sectional variation may be obscuring its effect. We therefore move to the results from decomposing the cross-sectional and time-series variations in swap and floating-rate debt usage.

V. Cross-Sectional Variation

Testing the various hedging theories of risk management requires isolating the component of firms' interest rate risk management decisions that is driven by hedging considerations from the component driven by speculative activities. Assuming that the optimal hedge ratio is stable over time and that deviations from it caused by speculative activities average to 0, we can use the between effects and Fama-MacBeth (1973) specifications to estimate firms' interest rate hedging activities. Table 4 reports the results, focusing on the share of debt that has a floating interest rate exposure after accounting for interest rate swaps.

Both the Fama-MacBeth (1973) specification in column 1 and the between specification in column 2 suggest that firms do select their average floating-rate debt exposure in a manner consistent with hedging. Specifically, the coefficient on the interest rate sensitivity of the firms' net operating and investing cash flows is positive and statistically significant. Firms whose cash flows are positively

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TABLE 4

Cross-Sectional Variation in Floating-Rate Debt

Table 4 reports the results of regressions explaining the cross-sectional variation in final floating-rate debt percentage. Final floating-rate debt is the percentage of outstanding debt that is floating after accounting for the effect of interest rate swaps. The Fama-MacBeth (1973) specification is reported in column 1; between specifications are reported in all other columns. The sample period is June 1993–May 2003. Cash flow beta is the beta from regressing free cash flow to assets ratio on the average value of the 3-month LIBOR during the fiscal year. Cash flow beta is estimated using at least 5 observations. Long-term debt is the percentage of outstanding debt that has more than 5 years to maturity. Total number of firm-year observations is reported. Average R^2 is reported in the Fama-MacBeth specification in column 1. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(Sales)	–0.755***	–1.107*	–1.876**	–1.097	–1.106*	–1.105*	–1.060	–1.893**
	(0.193)	(0.671)	(0.795)	(0.669)	(0.671)	(0.671)	(0.671)	(0.795)
Leverage (%)	–0.124***	–0.283***	–0.331***	–0.287***	–0.280***	–0.284***	–0.296***	–0.333***
	(0.026)	(0.081)	(0.086)	(0.081)	(0.082)	(0.082)	(0.082)	(0.086)
Debt or CP rating	–14.266***	–14.742***	–15.212***	–14.780***	–14.716***	–14.740***	–14.809***	–15.178***
	(1.169)	(2.213)	(2.394)	(2.208)	(2.215)	(2.214)	(2.213)	(2.394)
Long-term debt (%)	–0.229***	–0.208***	–0.163***	–0.207***	–0.209***	–0.208***	–0.207***	–0.165***
	(0.022)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Operating margin (%)	0.042	0.086	0.020	0.087	0.089	0.086	0.081	0.020
	(0.024)	(0.062)	(0.069)	(0.061)	(0.062)	(0.062)	(0.062)	(0.069)
Z-score	0.117	–0.047	–0.715**	–0.054	–0.033	–0.051	–0.170	–0.714**
	(0.271)	(0.354)	(0.352)	(0.353)	(0.356)	(0.356)	(0.364)	(0.352)
CAPEX/Assets (%)	–0.092*	–0.239	–0.084	–0.242	–0.241	–0.239	–0.236	–0.085
	(0.050)	(0.155)	(0.172)	(0.155)	(0.156)	(0.156)	(0.155)	(0.172)
R&D/Assets (%)	–0.504***	–0.823***	–0.811***	–0.804***	–0.804***	–0.824***	–0.858***	–0.816***
	(0.122)	(0.182)	(0.214)	(0.181)	(0.186)	(0.182)	(0.183)	(0.214)
Cash flow beta	0.571***	0.442**	0.474**	–0.284	0.508**	0.482	0.042	0.492**
	(0.156)	(0.208)	(0.237)	(0.352)	(0.247)	(0.368)	(0.344)	(0.238)
CFO delta			2.978***					2.904**
			(1.145)					(1.148)
Cash flow beta × CAPEX/Assets (%)				0.096**				
				(0.038)				
Cash flow beta × R&D/Assets (%)					–0.017			
					(0.034)			
Cash flow beta × Leverage (%)						–0.002		
						(0.017)		
Cash flow beta × *Z*-score							0.104	
							(0.071)	
Cash flow beta × CFO delta								0.289
								(0.293)
Constant	65.083***	71.855***	78.057***	71.832***	71.717***	71.848***	72.240***	78.286***
	(3.120)	(5.492)	(6.493)	(5.478)	(5.501)	(5.495)	(5.496)	(6.497)
N	8,594	8,594	4,560	8,594	8,594	8,594	8,594	4,560
Adjusted R^2	0.163	0.204	0.172	0.208	0.203	0.203	0.205	0.172

exposed to interest rates have higher cash flows when interest rates are high and lower cash flows when interest rates are low. By using more floating-rate debt, these firms also have higher interest payments when interest rates are high and lower interest payments when interest rates are low. Matching the realizations of their operating and investing cash flows with their interest payments allows these firms to reduce the variation in residual cash flow, thereby minimizing the potential deadweight costs of having significantly negative total cash flow realizations. Conversely, firms whose operating and investing cash flows are negatively exposed to interest rates are best served by having more fixed rate debt. The economic magnitude of this hedging effect, however, is relatively modest. A 1-standard-deviation increase in the interest rate sensitivity of operating and investing cash flows increases floating-rate debt by $3 \times 0.6\% = 1.8\%$, or just about 5% of average floating-rate debt share.[13]

We also find that larger firms, those with a bond rating, those that engage in more R&D, and those with high leverage ratios have significantly less floating-rate debt. Because rated publicly traded debt usually carries a fixed rate whereas bank debt generally carries a floating rate, larger firms with credit ratings are likely to have less floating-rate debt if they do not find interest rate risk to be particularly costly or if altering the exposure of their fixed rate bonds via an interest rate swap is sufficiently costly. If higher leverage and more R&D-intensive firms find floating-rate debt more risky than fixed rate obligations, these results could also be consistent with hedging. However, it is arguably the interaction of these variables with the interest rate sensitivity of the firm's operating and investing cash flows that is more relevant, specifications that we estimate later.

Before proceeding to the interaction terms, we examine the role of compensation in determining the average interest rate exposure firms choose by adding the estimated delta of the CFO's compensation contract as another independent variable. The results are provided in column 3 of Table 4. We look at the CFO, since this executive is more likely to be involved in selecting the firm's interest rate exposure.[14] We find that compensation incentives do appear to affect the firms' average interest rate exposure. Firms whose CFOs have higher stock price sensitivity on average over the sample period use significantly more *floating*-rate debt, the opposite of the finding documented by Chava and Purnanandam (2007). This finding is difficult to reconcile with a hedging motivation, an issue we will return to later.

If firms are hedging because it is costly to fund investment opportunities with external finance, then firms with the greatest investment expenditures should have the strongest incentive to match the interest rate exposure of their debt to that of their cash flows. We test this hypothesis by interacting various measures of investment with the interest rate sensitivity of the firm cash flow and adding these interaction terms to the between specifications. Columns 4 and 5 of Table 4 report the results. Firms that engage in significant CAPEX have significantly higher matching of the interest rate exposures of their debt and cash flows. Specifically, the floating-rate debt share of firms whose CAPEX are twice the sample of mean of 7% is almost 3 times as sensitive to the interest rate exposure of their cash flows $(0.097 \times 14\% - 0.3\% = 1.1\%)$ as the floating-rate debt share of firms whose CAPEX are at the sample mean $(0.097 \times 7\% - 0.3\% = 0.4\%)$. In contrast to the results for CAPEX, the coefficient on the interaction term with R&D is not statistically significant. Note, however, that the R&D variable by itself retains its significantly negative coefficient, consistent with R&D-intensive firms finding floating-rate debt to be more costly than fixed rate debt regardless of our estimate of their sensitivity to interest rates.

[13]Interest rate sensitivity of 3 indicates that operating and investing cash flows increase by 3% of assets for each percentage-point increase in 3-month LIBOR.

[14]We get similar results using the CEO delta.

Firms may also be matching the interest rate sensitivity of their debt to their cash flows to reduce the costs of financial distress (Smith and Stulz (1985)). If that is the case, then we should see that highly levered firms with lower Z-scores engage in greater matching. Columns 6 and 7 of Table 4 present the results of interacting the interest rate sensitivity of the firm's cash flows with leverage and Z-score. We do not find that more levered firms with lower Z-scores have more matching of their liabilities to their cash flows, but highly levered firms do continue to have less floating-rate debt. Overall, our results are more consistent with firms hedging to avoid relying on costly external capital (Froot et al. (1993)) than they are with hedging to minimize the costs of financial distress (Smith and Stulz) or to take advantage of the tax deductibility of interest (Graham and Rogers (2002)).

Finally, to see if the compensation structure of senior management is associated with firm hedging behavior, we include an interaction of our cash flow beta with the CFO delta. We again do not find support for the hypothesis that performance-sensitive compensation contracts encourage hedging. Firms with a high CFO delta are no more likely to match the interest rate exposure of their liabilities to their operating cash flows. High average CFO deltas continue to be associated with greater use of floating-rate debt.

VI. Time-Series Variation

We now turn to explaining the time-series variation in the share of floating-rate debt, which we argue captures firms' speculative activities. Table 5 reports the results of firm fixed effects specifications.[15] The coefficient on leverage is now significantly positive, compared to being significantly negative in the between specifications of Table 4. Although highly levered firms on average have less floating-rate debt, when firm leverage is above its firm-specific average, firms actually use more floating-rate debt. In addition, the coefficient on CAPEX is significantly positive, indicating that even though high CAPEX firms seem to be hedging, their use of floating-rate debt increases when CAPEX are high. These results may indicate that when firms rely on external financing to fund investment opportunities, they may be more likely to use floating-rate bank debt at the time the investments are made. This would explain why floating-rate debt increases with both CAPEX and leverage. Long-term debt retains its significantly negative coefficient found in the between regressions, indicating that long-term debt is more likely to have a fixed rate exposure.

Column 2 of Table 5 adds various interest rate variables to test whether firms use more floating-rate debt when the yield curve is particularly steep to capture the current difference between long- and short-term interest rates. Consistent with Faulkender (2005) and in contrast to the earlier OLS results, deviations from average floating-rate debt usage are associated with the average term spread during

[15] Because the sensitivity of cash flow to interest rates is estimated for the whole sample period, it is constant for an individual firm and is therefore absorbed by the firm fixed effects.

TABLE 5

Time-Series Variation in Floating-Rate Debt

Table 5 reports the results of regressions explaining the time-series variation in final floating-rate debt percentage. Final floating-rate debt is the percentage of outstanding debt that is floating after accounting for the effect of interest rate swaps. Delta and vega are standardized so that the interaction term coefficient measures the change in the sensitivity of swap usage to term spread due to a 1-standard-deviation change in delta or vega. Firm fixed effects are included in all specifications. Standard errors are adjusted for clustering by firm. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variable	(1)	(2)	(3)	(4)	(5)
log(Sales)	–0.022	1.464	–0.350	0.651	0.730
	(0.890)	(0.985)	(1.382)	(1.449)	(1.432)
Leverage (%)	0.224***	0.231***	0.295***	0.285***	0.281***
	(0.045)	(0.045)	(0.063)	(0.064)	(0.061)
Debt or CP rating	–13.822***	–13.182***	–16.055***	–15.342***	–14.979***
	(1.684)	(1.682)	(2.257)	(2.247)	(2.257)
Long-term debt (%)	–0.203***	–0.203***	–0.206***	–0.204***	–0.197***
	(0.015)	(0.015)	(0.020)	(0.020)	(0.020)
Operating margin (%)	0.015	–0.022	0.015	–0.030	–0.025
	(0.036)	(0.036)	(0.056)	(0.057)	(0.054)
CAPEX/Assets (%)	0.481***	0.357***	0.571***	0.421***	0.413***
	(0.085)	(0.085)	(0.118)	(0.121)	(0.118)
R&D/Assets (%)	–0.181	–0.169	–0.430	–0.438	–0.458*
	(0.192)	(0.191)	(0.279)	(0.284)	(0.270)
1-year Treasury yield (%)		0.294		0.644	0.556
		(0.519)		(0.807)	(0.787)
Term spread (%)		1.234**		2.058**	2.096**
		(0.563)		(0.877)	(0.842)
Swap spread (%)		3.854*		5.879**	6.172**
		(2.073)		(2.984)	(2.962)
Credit spread (%)		3.424		4.127	5.099
		(2.349)		(3.391)	(3.306)
Economywide floating-rate debt (%)		0.829***		0.802**	0.922***
		(0.215)		(0.324)	(0.315)
CFO delta			0.505	–1.409*	
			(0.926)	(0.846)	
CFO vega			0.266		–0.153
			(0.655)		(0.759)
CFO delta × term spread (%)				2.338***	
				(0.905)	
CFO vega × term spread (%)					1.184*
					(0.684)
N	11,228	11,228	5,933	5,933	6,181
Adjusted R^2	0.086	0.097	0.097	0.112	0.105

the firm's fiscal year. Economically, a 1% increase in the spread between the 3-year swap rate and the 3-month LIBOR corresponds to 1.2% more floating-rate debt.[16] Compared to the average floating percentage of 38.3%, this corresponds to 3.1% more floating-rate debt.[17] The share of debt in the macroeconomy that is floating and the swap spread, the difference between the 3-year swap rate and

[16]In untabulated results, we separately run these regression specifications where the dependent variable is the interest rate exposure of the underlying debt and then the signed interest rate swap usage. The findings indicate that most of the timing activity is coming from the time-series variation in interest rate swap activity.

[17]These results are robust to using Treasury yields instead of LIBOR yields and to alternative maturities (results available from the authors).

the 3-year T-note, are also significant in explaining the time-series variation in floating-rate debt.

A. Executive Compensation and Interest Rate Timing

To determine whether variation in executive compensation is correlated with the portion of firm debt that is floating in the time series, we add the CFO delta and vega as covariates to our baseline specification. We find that neither measure corresponds to significantly different floating-rate debt usage. In other words, when a particular firm's CFO delta is above its average, that firm is no more likely to increase its use of floating-rate debt than when the CFO's delta is below its average. This makes sense, since most of the variations in delta and vega are in the cross section, not the time series.

Instead, the way to look for time-series variation resulting from compensation-induced speculation is to include a measure of the interest rate view of the firm, since changes in where the firm thinks interest rates are going would lead to changes in the firm's chosen interest rate exposure. The term structure results in column 2 of Table 5 are consistent with the yield curve capturing some of those expected movements in interest rates on the part of firms. To assess the role of compensation in interest rate speculation, we ask whether firms with performance-sensitive compensation contracts engage in more interest rate timing than others. Similar to the interaction terms used in the between regressions, we interact measures of compensation with the term structure to find out which characteristics are associated with greater speculation. Results are reported in columns 4 and 5 of Table 5.

We find that higher delta and vega (the results hold for the CEO as well) correspond to greater sensitivity of floating-rate debt usage to the term structure. For a firm with the mean value of CFO delta in our sample, we see that when the spread between the 3-year swap rate and the 3-month LIBOR is 1% higher, the use of floating-rate debt is also higher by 2.06% of outstanding debt. When the CFO delta is 1 standard deviation above the sample mean, the same 1% higher term spread is associated with greater floating-rate debt usage by 4.40% (= 2.06% + 2.34%), a 114% increase in the sensitivity of floating-rate debt to the term structure. Similarly, when the CFO delta is 1 standard deviation below the sample mean, the same 1% higher term spread is associated with *less* floating-rate debt usage, equivalent to −0.28% (= 2.06% – 2.34%) of outstanding debt, though not significantly different from 0.

While the coefficient on CFO delta itself is also marginally statistically significant, this coefficient corresponds to the effect of CFO delta on the choice of floating-rate debt share when the term spread is 0. For the average macroeconomic conditions during our sample period (the mean term spread is 93 bp), a 1-standard-deviation increase in the CFO delta is actually associated with *higher* floating-rate debt, by 0.77% (= −1.41% + 2.34 × 0.93%) of outstanding debt. These results are consistent with the findings in Table 4 showing that the average relationship between the CFO delta and the average floating-rate percentage was positive. Since the average term spread during the sample period was nearly a full percentage point and CFO delta is associated with greater use of floating-rate debt when the term structure is steep, it follows that firms with greater CFO delta on average should have had more floating-rate debt over our sample period. In untabulated results, we find these results to be even stronger when we solely focus on interest rate swap usage, conditional on using interest rate swaps at any time during our sample period. These stronger results are consistent with interest rate swaps being a less expensive way for firms to speculate on movements in interest rates than would be altering their outstanding debt composition. Overall, our results suggest that firms with more high-powered compensation structures engage in more speculation, consistent with the survey evidence documented in Geczy et al. (2007).

An alternative methodology for estimating speculative effects related to movements in the term structure is to estimate how sensitive a firm's interest rate risk management choice is to movements in the term structure.[18] As stated previously, firms primarily alter their interest rate exposure over time via their interest rate swap transactions. Therefore, we estimate firm-specific sensitivities by regressing the firm's realized interest rate swap position on LIBOR. We then estimate the cross-sectional variation in these sensitivities related to the sample period averages of various characteristics, including compensation structure. This approach asks whether firms with more performance-sensitive compensation structures have greater adjustments in their use of interest rate swaps with increases in the term spread. Table 6 reports the results of this approach. While none of the other control variables we use in our earlier specifications are statistically significant, we do find positive and statistically significant coefficients on all 4 compensation variables. Firms with more performance-sensitive compensation arrangements have greater average increases in their floating-rate swap usage with increases in the term structure than firms whose compensation contracts are less sensitive to performance. Overall, results from alternative econometric specifications document that high-powered compensation structures are more consistent with inducing speculation than with affecting hedging.

B. Earnings Management and Interest Rate Timing

Faulkender (2005) argues that firms may also be timing the term structure to manage earnings. We test this hypothesis by interacting the term spread with various measures of earnings management. The stock market's asymmetric reaction to earnings announcements around the consensus analyst forecast has led some researchers to hypothesize that firms are more likely to manipulate their earnings when it enables them to report earnings at or just above the consensus analyst forecast (e.g., Burgstahler and Dichev (1997), Kasznik and McNichols (2002), Bartov, Givoly, and Hayn (2002), and Matsumoto (2002)). We calculate whether the firm would have missed its earnings per share (EPS) forecast if it kept its final floating-rate debt percentage at the prior year level, but would have met

[18]We require firms to have at least 5 observations in order to estimate the sensitivity of their swap usage to the term spread.

TABLE 6

Firm-Specific Sensitivities of Swap Usage to Term Spread

Table 6 reports the results of regressing firm-specific sensitivities of swap usage to the term spread on firm characteristics. Firm-specific sensitivities are estimated from univariate regressions of swap usage on the term spread using at least 5 observations. All explanatory variables are standardized values of firm-level means and thus represent the effect of a 1-standard-deviation change in the firm-level means. Robust standard errors are reported. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Variable	(1)	(2)	(3)	(4)
CFO delta	1.506**			
	(0.623)			
CFO vega		1.285**		
		(0.625)		
CEO delta			1.232***	
			(0.447)	
CEO vega				0.988*
				(0.545)
log(Sales)	–0.986	–1.086	–0.843	–1.017
	(0.743)	(0.758)	(0.620)	(0.709)
Leverage	–0.552	–0.456	–0.700	–0.723
	(0.688)	(0.696)	(0.643)	(0.632)
Debt or CP rating	0.582	0.610	0.235	0.295
	(0.799)	(0.789)	(0.752)	(0.752)
Long-term debt	–0.092	–0.162	0.238	0.164
	(0.689)	(0.691)	(0.637)	(0.636)
Operating margin	0.466	0.594	0.687	0.636
	(0.579)	(0.575)	(0.493)	(0.526)
CAPEX/Assets	–0.960*	–0.990*	–1.175**	–1.157**
	(0.576)	(0.581)	(0.552)	(0.552)
R&D/Assets	–0.226	–0.158	0.022	–0.058
	(0.798)	(0.819)	(0.753)	(0.765)
Constant	3.907***	3.934***	4.058***	4.000***
	(0.565)	(0.567)	(0.535)	(0.538)
N	652	658	717	718
Adjusted R^2	0.017	0.014	0.017	0.013

the earnings forecasts if it set the final floating-rate debt percentage to 100%.[19] In other words, would altering the interest rate exposure of the firm's debt (most likely through the use of interest rate swaps) allow it to make its earnings forecast, which it would otherwise miss, ceteris paribus? We then estimate whether changes in the interest rate exposure of outstanding debt are more sensitive to the term structure for those firm-years in which increases in the amount of floating-rate debt used by the firm would enable the firm to meet its consensus analyst earnings forecast relative to those for which such a change would not alter their ability to meet consensus analyst forecast. If firms are not managing earnings via their interest rate risk management practices, we should find no difference in floating-rate debt usage among these 2 groups. The results are located in Table 7.

We find a difference. Firms for which increases in the share of floating-rate debt would enable the firm to meet its consensus analyst earnings forecast have floating-rate debt usage and floating-rate swap usage that are significantly more sensitive to movements in the term structure (columns 1 and 3, respectively).

[19]We estimate EPS using previous period floating debt percentage by taking realized EPS and subtracting (current floating percentage – lagged floating percentage) × (swap yield spread) × (1 – marginal tax rate) × (total debt) / (number of outstanding shares).

TABLE 7

Earnings Management

Table 7 reports the results of earnings management hypotheses tests. The dependent variable in columns 1 and 2 is the final floating-rate debt percentage; in columns 3 and 4 it is the percentage of outstanding debt that is swapped to a floating rate. EPS close is a binary variable equal to 1 when a firm would have missed its earnings forecast using the lagged value of floating-rate debt percentage, but would have met its earnings forecast if all of its debt was floating. Discretionary accruals are calculated using a modified version of the Jones (1991) model (see, e.g., Dechow, Sloan, and Sweeney (1995)). Discretionary accruals are first scaled by lagged assets and then standardized so that the interaction term coefficient measures the change in the sensitivity of floating-rate debt percentage or swap usage to the term spread due to a 1-standard-deviation change in discretionary accruals. Firm fixed effects are included in all specifications. Standard errors are adjusted for clustering by firm. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Floating-Rate Debt		Swap Usage	
Variable	(1)	(2)	(3)	(4)
EPS close	0.793		1.281	
	(2.267)		(2.074)	
EPS close × term spread (%)	8.554***		5.471***	
	(2.300)		(1.922)	
Accruals		3.017***		2.474***
		(0.596)		(0.524)
Accruals × term spread (%)		–1.150*		–1.561***
		(0.659)		(0.508)
Term spread (%)	0.893	1.221**	3.088***	3.758***
	(0.691)	(0.572)	(0.607)	(0.569)
1-year Treasury yield (%)	0.800	0.090	1.553*	–0.050
	(0.832)	(0.531)	(0.853)	(0.527)
Swap spread (%)	2.369	4.970**	–1.634	1.734
	(2.545)	(2.119)	(2.481)	(2.143)
Credit spread (%)	2.585	2.845	0.818	0.936
	(2.780)	(2.397)	(2.771)	(2.387)
Economywide floating-rate debt (%)	0.676**	0.875***	–0.096	0.402
	(0.290)	(0.221)	(0.298)	(0.244)
Initial floating-rate debt (%)			–0.310***	–0.314***
			(0.025)	(0.020)
CAPEX/Assets (%)	0.291***	0.355***	0.105	0.145
	(0.105)	(0.088)	(0.119)	(0.097)
R&D/Assets (%)	0.315	–0.217	0.265	–0.399
	(0.231)	(0.196)	(0.386)	(0.338)
log(Sales)	3.060**	1.725*	0.340	0.015
	(1.544)	(1.032)	(1.266)	(0.949)
Leverage (%)	0.374***	0.236***	0.150**	0.062
	(0.060)	(0.047)	(0.061)	(0.047)
Debt or CP rating	–14.688***	–12.681***	–3.846**	–1.593
	(2.230)	(1.721)	(1.761)	(1.509)
Long-term debt (%)	–0.235***	–0.202***	–0.042*	–0.017
	(0.019)	(0.015)	(0.024)	(0.019)
Operating margin (%)	0.009	–0.033	–0.067	–0.105**
	(0.052)	(0.038)	(0.045)	(0.052)
Constant	–4.295	2.700	–1.312	–8.207
	(14.612)	(10.645)	(13.460)	(11.399)
N	7,102	10,734	4,096	5,930
Adjusted R^2	0.129	0.105	0.140	0.154

Statistically, this difference is significant at better than 1%. Economically, firms that did not need to adjust their floating-rate debt usage to meet their earnings forecast are estimated to have 0.89% more of their total debt outstanding have a floating interest rate exposure for a 1% increase in the yield spread. However, for the firm-years in which a movement to all of the firm's debt having a floating-rate exposure would allow them to meet their forecast (that they would otherwise miss), we estimate 9.44% (= 0.89% + 8.55%) more debt with a floating-rate exposure for that same 1% increase in the yield spread. The magnitudes are statistically and economically similar when we focus on interest rate swap usage.

Alternatively, we examine the relationship between the sensitivity of floating-rate debt usage to the term spread and the use of discretionary accruals. Because these are potentially earnings management substitutes, firms that can manipulate earnings using discretionary accruals have less incentive to try to meet their earnings forecasts by altering the interest rate exposure of their debt. The results presented in columns 2 and 4 of Table 7 are consistent with this argument.

The sensitivity of floating-rate debt usage and interest rate swap usage to the term spread is significantly lower for firms with higher discretionary accruals than for firms reducing their use of discretionary accruals. Economically, firms with the sample mean level of discretionary accruals (–0.5% of lagged assets) are estimated to have 1.22% more floating-rate debt for each 1% increase in the swap yield spread. By comparison, firm-years in which reported earnings were managed upward by 7.8% of lagged assets (a 1-standard-deviation increase in discretionary accruals) have an estimated sensitivity of floating-rate debt usage to the swap yield spread of only 0.07%.[20] The estimated effects are even larger in magnitude for interest rate swap activity. We caution that these specifications assume that debt composition and interest rate swap activities are a function of the level of discretionary accruals. It is more likely that the choices are made simultaneously or that the causation goes in the opposite direction (that greater floating-rate debt and swap usage in a steep term structure environment reduces the need to increase discretionary accruals). Still, the findings are consistent with short-term earnings considerations affecting nonfinancial firms' interest rate risk management policy.

VII. Conclusion

Interest rate risk management decisions of nonfinancial firms are determined by both hedging and speculative motivations. We decompose interest rate risk management activities into their cross-sectional and time-series components. This decomposition is only possible when a panel data set is employed. Assuming that the optimal hedge ratio is stable over time, the cross-sectional component identifies which firm characteristics are associated with hedging, while the time-series variation is more likely to result from speculation. Our results demonstrate that some previously documented findings that were characterized as hedging instead appear to be more consistent with speculation. Additionally, some of our results do not appear in the pooled specifications due to the simultaneous estimation of hedging and speculative activities. However, when these 2 components are separately estimated, they emerge strongly. We conclude that true identification of how and why firms use derivatives necessitates the use of panel data and decompositions similar to the ones we employ. Our work also demonstrates that

[20]Recall that for our continuous variables with which we generate interaction terms, we standardize the variable to represent the number of standard deviations it is away from the variable's mean value for the entire sample. The coefficient estimates for the interaction terms thereby represent the difference in interest rate sensitivity of swap usage for a 1-standard-deviation move in the corresponding variable.

examinations of firm derivatives usage to engage in speculative activities do not need to rely on survey evidence like that documented in Geczy et al. (2007).

Our cross-sectional results are consistent with firms hedging to reduce their need to access external capital markets to fund investment opportunities (Froot et al. (1993)). Our results are less consistent with firms hedging to mitigate the costs of financial distress or tax rate convexity (Smith and Stulz (1985)). The time-series results are consistent with firms altering their use of interest rate swaps and floating-rate debt over time with movements in the term structure. The incentives to time swap and floating-rate debt usage are particularly strong when executives have high-powered incentives and when adjusting floating-rate debt exposure can enable firms to meet analyst earnings forecasts.

These results are especially timely given the changes in the regulatory landscape currently under consideration by policy makers, particularly for financial derivatives. Because firms use derivatives to both hedge and speculate, regulators need to make sure that any regulatory changes continue to enable firms to use derivatives for risk management but do not make it too easy to disguise speculative activities as hedging transactions.

Appendix. Data

We now discuss in more detail how interest rate swap and floating-rate long-term debt data were hand collected and coded. Starting in 1990, the Statement of Financial Accounting Standards (SFAS) 105 required detailed disclosures about the amounts, nature, and terms of financial derivative instruments with off-balance-sheet risk of accounting loss, which include interest rate swaps.[21] Because of these reporting standards, we are generally able to determine whether a firm used any interest rate swaps during a fiscal year and, if so, the notional amounts and directions of interest rate swaps outstanding at the end of the fiscal year. Since the variable we are ultimately interested in is *the net percentage of the firm's debt that is swapped to floating*, we record only debt-related interest rate swaps effective at the end of each fiscal year. Thus we exclude the notional amounts of i) swaps reported as hedging nondebt items such as investments, preferred stock, operating leases, etc., and ii) forward-starting interest rate swaps. Some firms, in addition to plain interest rate swaps, report using combined currency interest rate swaps. Most of these do not modify the nature of the firm's interest rate exposure and hence are not included in our swap variables. However, those swaps that change both currency and interest rate exposure of the firm's debt are included.

[21]While accounting standards have changed over the sample period related to the qualifications for using hedge accounting treatment (see SFAS 119 and 133), it was rather straightforward under all of the different regimes to classify interest rate swaps transforming debt from a floating to a fixed interest rate exposure (and vice versa) as hedges for hedge accounting treatment. Most swaps by firms in the sample are structured to fit under the "shortcut accounting method," which requires the swap to fulfill 7 conditions, including most importantly that "the index on which the variable leg of the swap is based matches the benchmark interest rate" on the liability (Trombley (2003)). This is important because hedge accounting treatment enables the firm to avoid marking the swaps to market on their financial statements. If the derivatives were marked to market, the changes in value would also be accounted for in earnings, meaning that interest rate movements would impact earnings by more than just the difference in interest rates between short- and long-term debt. If the firm would like to swap less than the full amount of the corresponding debt, the shortcut method may still be applied provided that all other criteria are satisfied (http://www.fasb.org/derivatives/issuee10.shtml), and can therefore still claim hedge accounting treatment. Since the swaps in our sample were held for hedging purposes, we only concern ourselves with the differences in interest costs under fixed versus floating exposures.

To measure the amount of floating-rate long-term debt outstanding at the end of the fiscal year, we study interest rate risk discussions usually found in Item 7A, "Quantitative and Qualitative Disclosures about Market Risk," and in the long-term debt footnote of the 10-K. We get our most precise estimates of floating-rate long-term debt for those firm-years that include a table reporting principal amounts of long-term debt obligations broken down by year of maturity and interest rate exposure. A sample table, taken from Black Hills Corporation's (2003) 10-K, is shown as Table A1. By examining individual debt instruments reported in the long-term debt footnote, we double-check that the firm's classification of its debt as either variable or fixed is consistent with our own classification criteria.[22]

TABLE A1

Black Hills Corporation's Long-Term Debt Obligations: 2003

Table A1 presents principal (or notional) amounts and related weighted average interest rates by year of maturity for our short-term investments and long-term debt obligations, including current maturities (in thousands). [a]Approximately 32.5% of the variable rate long-term debt has been hedged with interest rate swaps moving the floating rates to fixed rates with an average interest rate of 4.62%.

	2004	2005	2006	2007	2008	Thereafter	Total
Cash Equivalents							
Fixed rate	$172,771	—	—	—	—	—	$172,771
Long-Term Debt							
Fixed rate	$2,845	$2,854	$2,865	$2,049	$2,062	$449,149	$461,824
Average interest rate	8.5%	8.5%	8.5%	9.6%	9.6%	7.1%	7.2%
Variable rate[a]	$14,814	$15,504	$238,274	$113,468	$19,165	$23,069	$424,294
Average interest rate	2.7%	2.7%	2.2%	2.7%	1.7%	3.1%	2.4%
Total long-term debt	$17,659	$18,358	$241,139	$115,517	$21,227	$472,218	$886,118
Average interest rate	3.7%	3.6%	2.2%	2.8%	2.5%	6.9%	4.9%

When no table similar to the one above is included in the 10-K, classifying long-term debt instruments as either floating or fixed rate requires some subjective decisions on our part. In general, we are conservative in classifying long-term debt as floating, that is, by treating most instruments as fixed unless explicitly reported otherwise, we bias our data against finding any results in the regressions of the percentage of total debt that is floating. More specifically, our default assumptions, unless the 10-K explicitly reports otherwise, are that:

- commercial paper, credit facilities, and short-term debt classified as long-term are floating rate;
- bank loans are floating rate;
- bonds, industrial revenue bonds, debentures, and notes are fixed rate;
- capital leases are treated as fixed rate;[23]
- "other" is treated as fixed rate.

An example of our application of these assumptions is shown in Table A2. Because we examine firms' 10-Ks over time, we believe that we are able to make more accurate judgments, taking into consideration changes in the reported interest rates paid on various instruments and disclosures made in some years but not in others.[24]

[22]Some firms, for example, report commercial paper and credit facilities classified as long-term debt as fixed-rate instruments, even though due to their short-term nature, they should be treated as floating.

[23]In unreported regressions, we classified all capital leases as floating rate and obtained similar results.

[24]To verify the reliability of our estimation procedure, we compared our estimates of the percentage of debt with a floating interest rate exposure to Compustat data item 148, "Long-Term Debt Tied

TABLE A2

An Example of Disclosure and Classification of Long-Term Debt Instruments

The following table from Pennzoil-Quaker State Company's (2000) 10-K filed on March 20, 2001, provides an example of the disclosure of long-term debt instruments in the long-term debt footnote and of our classification of long-term debt instruments as either floating or fixed rate.

	December 31	
	2000	1999
Debt outstanding was as follows:	(expressed in thousands)	
7.375% Debentures due 2029, net of discount	$398,105	$398,038
6.750% Notes due 2009, net of discount	199,159	199,057
8.65% Notes due 2002, net of discount	149,746	—
6.625% Notes due 2005, net of discount	99,708	99,647
Commercial paper	57,709	242,578
Revolving credit facility	195,000	—
Pollution control bonds, net of discount	50,522	50,549
International debt facilities	51,808	23,460
Other variable-rate credit arrangements with banks	—	16,000
Other debt	6,455	7,534
Total debt	1,208,212	1,036,863
Less amounts classified as current maturities	(13,786)	(10,710)
Total long-term debt	$1,194,426	$1,026,153

According to our classification criteria:

i) debentures and notes are recorded as fixed rate;

ii) commercial paper, revolving credit facility, international debt facilities, and other variable-rate credit arrangement with banks are recorded as floating rate;

iii) absent explicit discussion, pollution control bonds would have been recorded as fixed rate; however, in this particular case, the footnote specifically states that in 2000, 11,800 pollution control bonds carry a fixed interest rate and 38,722 carry floating interest rates;

iv) other debt is recorded as fixed rate; and

v) total debt in Compustat includes 67,678 in capital lease obligations, which are recorded as fixed rate.

Therefore, the total amount of floating-rate debt in 2000 is 343,239. Initial floating-rate debt percentage is 343,239 / (1,208,212 + 67,678) = 26.90%. Footnote 10, "Financial Instruments with Off-Balance-Sheet Risk and Concentration of Credit Risk," states that in "connection with the issuance of $150.0 million of two-year fixed rate notes in 2000, Pennzoil-Quaker State entered into a fixed to floating interest rate swap to maintain its mix of variable rate versus fixed rate debt." As a result, percentage swapped to floating is 150,000/(1,208,212 + 67,678) = 11.76%. Final floating-rate debt percentage is 26.90% + 11.76% = 38.66%.

to Prime." There is a high correlation (0.882) between the two. However, we believe that we have a much better measure of floating-rate debt because Compustat data item 148 i) is missing for 37.6% of our observations, ii) appears to be inconsistent about whether interest rate swap effects are taken into account, and iii) sometimes ignores certain items such as commercial paper and credit lines that should be treated as floating. In terms of the effects of our results, we used this measure in unreported regressions and find that swap usage results are not affected, as expected, but the results for the percentage of debt that has a floating-rate exposure are weaker. This is consistent with having fewer observations and with the measure having greater noise.

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