A Panel Data Analysis of Interest Rate Risk Management*

Sergey Chernenko†
PhD Student, Harvard University

Michael Faulkender‡
Visiting Assistant Professor of Finance
Kellogg School of Management, Northwestern University
Assistant Professor of Finance
Olin Business School, Washington University in St. Louis

Abstract:

Using a large, hand-collected panel data set of debt structure and interest rate swap usage by non-financial firms over a ten year period, we examine which characteristics are stable in explaining variation in interest rate risk management relative to those that are more transitory, and therefore more likely to be associated with speculation. We find that previously documented executive compensation results are transitory effects, driven by variation in the term structure, more consistent with incentivizing speculation than with hedging. Average interest rate exposures are partially driven by hedging motivations, but only for high investment firms, consistent with costly external financing affecting derivatives usage.

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† Email: schernenko@hbs.edu
‡ Corresponding author. Address: Kellogg School of Management, Finance Department, 2001 Sheridan Road, Evanston, IL 60208. Telephone: (847)491-5861. Email: m-faulkender@kellogg.northwestern.edu

1. Introduction

There has been extensive empirical research examining financial derivatives usage as a risk management tool, generating results that have often differed across the samples evaluated and the measures used.[1] As a result, the literature appears to still be searching for the durable set of explanations for the extensive use of derivatives by firms, particularly non-financial firms. One large impediment to a more exhaustive evaluation of corporate derivatives usage is the laborious task of hand-collecting large data samples from the footnotes of financial disclosures. We have engaged in such a task, constructing the most comprehensive database of interest rate swap usage by non-financial firms that we are aware of (up to ten years of data for 1,854 firms), enabling us to revisit a number of the findings that have been previously documented so that their robustness or lack thereof can be established.

Since almost all of the previous results have been purely cross-sectional for a particular time period, many of those findings are subject to the potential problem that they only hold for the macroeconomic conditions in place during that particular sample period and are not robust to alternative macroeconomic conditions. A primary contribution of our examination is that we are able to distinguish between results that are truly cross-sectional, and therefore durable to varying macroeconomic conditions, and those that are the result of speculative activities of firms based upon the macroeconomic conditions at the time. We examine two recent papers (Chava and Purnanandam (2007) and Graham and Rogers (2002)) that largely focus on cross-sectional variation in a particular year and find that their results do not hold in other time periods. In

[1] An incomplete list of this body of work includes 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 (2007), and Bartram, Brown, and Carpenter (2007) as well as analyses in specific industries such as gold mining in Tufano (1996), Tufano (1998), Petersen and Thiagarajan (2000), and Brown, Crabb, and Haushalter (2006) and the oil and gas industry in Haushalter (2000).

Chava and Purnanandam (2007) for instance, they find that managers with high powered compensation contracts use more fixed rate debt to reduce the variability of the firm's debt but that mangers whose compensation rises with equity volatility use more floating rate debt. We are able to largely replicate their results using the subset of our observations whose fiscal year ends in 1996 (the year corresponding to most of their observations). We then rerun their specification using the subset of our observations with a 2002 fiscal year end, a year with a rather steep term structure rather than the relatively flat term structure of 1996. In the 2002 fiscal year specifications, we find that firms with managers compensated for strong stock performance actually use more floating rate debt, the exact opposite result. In the broader sample (the whole ten years), the compensation variables are not statistically significant. Instead, we demonstrate that the main variable of interest in Chava and Purnanandam (2007) varies quite significantly with the spread between long-term and short-term interest rates, consistent with Faulkender (2005). Considering that the primary purpose of an interest rate swap is to alter the interest rate on the corresponding debt security from the short-term to the long-term rate, or vice-versa, it is not surprising to find that the characteristics driving the mix of short-term and long-term exposures in a particular year are sensitive to the contemporaneous differential in those interest rates.

These findings demonstrate that when firms are timing their risk management strategy based upon current macroeconomic conditions, panel data must be used to distinguish hedging effects from speculative ones. If firms have a target fixed / floating mix based upon their firm's hedging considerations, then deviate from that target for speculative reasons, the appropriate way to examine firm's derivative usage is to focus on "between" estimates to determine hedging motivations and to look at "within" results to establish covariates that are correlated with speculative behavior. That is how we proceed.

We find that deviations from average fixed / floating levels are partially explained by movements in the term structure (consistent with Faulkender (2005) and in contrast to Chava and Purnanandam (2007)) and the effect is larger for firms where the compensation contracts of senior management are more performance sensitive. These results are robust to numerous measures of executive compensation and are consistent with Geczy, Minton, and Schrand (2007) who, using survey data, find that non-financial firms at which managers have performance sensitive compensation are firms that are more likely to use derivatives for speculative purposes. We also use the alternative approach of estimating firm-specific estimates of their sensitivity to the term structure and find these individual firm estimates of speculative activity to be positively correlated with the average performance sensitivity of executive compensation. These results demonstrate that speculative activity can be examined empirically and that researchers are not limited to using surveys to investigate the speculative activities of firms.

In terms of the average fixed / floating mix after the incorporation of interest rate swap effects, we do find evidence of hedging, i.e. matching the interest rate exposure of their liabilities to that of their cash flows. However, the finding is limited to those firm-years in the highest quartile of capital investment (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 fall use more floating rate debt than high investment firms whose cash flows have the opposite interest rate sensitivity. This is important evidence consistent with Froot, Scharfstein, and Stein (1993) that funding investment internally is a driver of the risk management activities of investment-intensive, non-financial firms.

Our final result comes from further analysis of the variation in the Graham and Rogers (2002) results on leverage effects. Our findings shows that firms averaging more debt in their capital structure over the sample period use less floating rate debt (after incorporating swap effects) on average (the between effect). However, in fiscal years in which firms are above their average leverage ratio during the sample period, they use more floating rate debt than their sample average (the within effect). This distinction again confirms why using panel data is key to comprehensively understanding interest rate risk management practices.

The rest of the paper is organized as follows. Section 2 describes the data that we have gathered and how we measure the different variables used in this examination. We then move to the replications of a couple recent papers in Section 3 to test the robustness of those results across different time periods as well as for our whole sample. Given the differences in results that we find, we then move to various panel specifications in Section 4 so that we can distinguish between effects that are likely to be related to speculation (coming from fixed effects specifications) and those that are likely to be hedging related (resulting from tests using between effects). We then discuss value implications of speculating with interest rate swaps in Section 5 and conclude in Section 6.

2. Data and Summary Statistics

2.1. Constructing the Data Sample

We start with the sample of nonfinancial firms contained in Compustat's ExecuComp database covering the period from 1993 to 2003 and augment it with hand-collected data on interest rate swap usage by each firm in our sample. The ExecuComp set of firms is ideal for our study since recent analysis of risk management practices of firms has examined the effects of managerial characteristics (which this dataset provides) as well as the fact that this subset of publicly traded firms are larger in size and therefore will account for most of the dollar volume of interest rate swaps used by non-financial firms. The choice of the sample period is governed by the availability of 10-Ks in EDGAR, which are available from 1993 onwards, and the fact that starting in 1993, firms were required to report individual compensation items for the "top 5" executives owing to the Compensation Disclosure Act of 1993.

Specifically, we use 10-Ks in the EDGAR database to record 1) the amount of floating-rate long-term debt and 2) 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, which is defined as the pay-floating-receive-fixed notional amount minus the pay-fixed-receive-floating notional amount. Dividing the absolute value of this variable by the contemporaneous book value of assets generates the normalized value of interest rate derivatives usage that we use to replicate the results of Graham and Rogers (2002). For all of the other analysis, we divide the net swaps amount by the debt outstanding at the end of the fiscal year, generating the net percentage 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)). Note that the absolute value of this figure represents the net interest rate swaps outstanding at the end of the fiscal year as a percentage of the firm's total debt. We then combine the underlying floating-rate debt amount with the net notional value of floating rate swaps (where net fixed rate swaps take a negative value) to estimate 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 percentage of floating-rate debt after interest rate swap effects (taking values between 0 and 1). The details on how these variables are calculated are available in the Appendix. Overall, after dropping observations that a) do not have any debt, b) do not have 10-Ks filed with Edgar, or c) 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)), serving as 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 balance sheet data obtained from Compustat (data numbers given in parentheses). We calculate the market leverage ratio of the firm as the total debt (long-term debt (9) plus debt in current liabilities (34)) divided by the market value of the firm (defined as book assets (6) minus book equity (11) plus the product of the share price at the end of the fiscal year (199) and the number of shares outstanding (54)). We also calculate the percentage of debt that has more than five years to maturity by taking the long-term debt (9) of the firm and subtracting the debt that matures in years two through five (91 to 94) and then dividing that difference by the firm's 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 whether the firm has access to the public debt market.

We also include a number of measures of the firm's financial condition that may impact is target fixed / floating mix. Motivated by the work of Froot, Scharfstein, and Stein (1993), we include various measures of investment by the firm such as the sum of capital expenditures (128) and acquisition expenditures (129) scaled by book assets (6) which we label as investment. Additionally, we include a measure of R&D Expense (46) scaled by assets as well as Advertising Expense (45) scaled by book assets. 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. To measure the size of the firm, we use the natural log of the firm's sales (6) in the corresponding fiscal year. Finally, we estimate the sensitivity of the firm's free cash flow to interest rates to determine whether the minimization of residual cash flow volatility would better be achieved via a fixed or floating interest rate exposure on the firm's debt. Since the firm would prefer to fund investment internally (Froot, Scharfstein, and Stein (1993)), we measure free cash flow as operating income before depreciation (13) minus investment and normalize this difference by book assets. Following Faulkender (2005), for each firm, we then regress free cash flow over the time period of our sample on contemporaneous LIBOR to determine the firm's interest rate beta. If firms are hedging their interest rate exposure, we would expect that firms whose cash flows are positively exposed to interest rates to be more likely to choose a fixed interest rate exposure relative to those negatively exposed to interest rates.

Our primary measure of the interest rate environment is the swap yield spread, defined as the average difference between the 5-year swap rate and 6-month LIBOR over the fiscal year, calculated using data from Datastream. Most floating-rate commercial loans are tied to 6-month LIBOR so to qualify for hedge accounting treatment, their interest rate swap would also have to be tied to 6-month LIBOR. This difference therefore represents the estimated difference in interest rates that the firm would face were they to access the swap market. We also control for changes in the credit markets using a measure of the credit spread, defined as the average difference between Moody's Baa and Aaa rated debt over the fiscal year, and a measure of the swap spread, defined as the average difference between the 5-year swap rate and the 5-year Treasury bond during the fiscal year. 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 Accounts of the United States data published by the Federal Reserve Board, we construct a measure of the economy-wide percentage of floating-rate debt, defined as the ratio of commercial paper and bank loan liabilities over the sum of commercialpaper, 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 a firm's initial interest rate exposure.

Turning to the compensation variables of interest, we rely on the ExecuComp database for detailed disclosure of cash, stock, and stock option compensation for each of the firm's top five executives. This list naturally includes the CEO, but for a large percentage of firms it also includes the firm's CFO, who arguably plays the key role in a firm's interest-rate swap usage.[2] Such detailed disclosure, in particular for the stock option holdings, will also allow us to delve a bit further than Tufano (1996) could, owing to the fact that only aggregate option holdings were disclosed for the management teams heading up the gold-mining firms. Following recent literature, for each CFO and CEO, we estimate their sensitivity to a 1% change in the stock price, measured using both her stock and stock option portfolios (defined as delta), and the sensitivity of the stock option portfolio to the underlying stock return volatility (defined as vega). In estimating the deltas and vegas for the CFOs and CEOs, we rely on the empirical method of Core and Guay (2002).[3]

[2] 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 dataset, and carried out a word search for the keywords of 'chief finance' or "CFO". A similar method was undertaken for the CEOs.

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

2.2. Description of the Resulting Data Sample

Summary statistics for all of our variables over the entire sample can be found in Table 1. 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 their debt floating. While the mean swap amount appears relatively small, observe that the standard deviation of swap usage is 17.8%, indicating that there is a fair amount of variability across firms in the direction and amount of swap usage. Because we are interested in explaining swap usage, many 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. Notice that the number of observations is reduced by nearly 45% and that the average size swap has correspondingly increased 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 which a swap was used, the average swap corresponds to 25.7% of the outstanding debt. As these statistics suggest, *when* firms use swaps, the magnitude of their usage can be rather large.

Average 1-year Treasury rates over this time period fluctuated widely, ranging from a low of 1.5% to a high of 6.2%. The spread between yields on 5-year swaps and LIBOR averaged 1.1%, ranging from 0.1% to 2.7%. The standard deviation of the spread over this ten-year period was 74 basis points, and therefore in most of the economic interpretations of our findings we will look at one percentage point changes in the yield spread to correspond to just above this one standard deviation movement. Consistent with other studies that rely on the ExecuComp dataset, these firms are larger than the average Compustat firm, and more than half of the observations are firm-years in which there was public debt outstanding. Comparing the entire sample (panel A) with the subsample of swap users (panel B), we see that swap users appear to be larger firms and more likely to have access to public debt markets, but are otherwise very similar.

Looking at the financial characteristics of the firms in our study, leverage ratios average 18.5% of the market value of the firm, with swap users slightly higher at 20.3%. The average and median sensitivity of cash flows to short-term interest rates is negative, consistent with firms generating higher cash flows when interest rates are low. If firms are hedging, then the average firm should prefer to use fixed rate debt since floating rate debt would actually increase the variation in their residual cash flow. We also see that there is significant variation in measures of investing activities, R&D Expenditures, and advertising. Since the theoretical risk management literature argues that it may be usage of cash flow for these purposes that will induce greater hedging demands, variation in these measures is necessary for testing their importance.

Moving on to our compensation variables, we see that a one percent increase in shareholder value increases CFO (CEO) compensation by $56,000 ($584,000) and that a 1% increase in share volatility increases CFO (CEO) compensation by $18,000 ($64,000). In the average year, CEOs gain $1,238,000 from exercising their stock options and sell $3,675,000 worth of shares. These numbers are quite a bit smaller than those published in Chava and Purnanandam (2007) but an analysis of the 25th and 75th percentiles of the distributions reveals that the two are relatively close. We have winsorized these items at the 1st, and more importantly, the 99th percentiles of the distribution so both our maximums and our means are significantly smaller.

3. Cross-Sectional Analyses

To demonstrate the importance of examining corporate risk management in a panel specification, we begin by replicating some past works for the single year examined in the respective studies and then estimate those same regressions for different years as well as for the entire sample. Our objective is not to "undo" the work of others. We are replicating these results to better demonstrate the importance of estimating the drivers of risk management in a panel setting where stable cross-sectional results can be distinguished from variation caused by changing market conditions, as is done in much of the rest of the empirical corporate finance literature. We recognize that the reason that the risk management literature has focused on cross-sectional variation is the difficulty of generating a panel data set. However, our results are meant to show why generating such a panel is critical for making proper inferences.

3.1. Chava and Purnanandam (2007)

Chava and Purnanandam (2007) explores the effects of managerial incentives on risk management by looking at the extent to which executive compensation impacts the mix of fixed and floating rate debt in the firm's capital structure. Their specification regresses the portion of the firm's debt with a floating rate exposure on various firm characteristics including attributes of executive compensation. They primarily focus on firms whose fiscal years ended in 1996 and 1997 with some augmentation of firm-years ending in 1999. To try to replicate their results, we focus on firm-years with fiscal years ending in 1996 that are in our dataset. As can be seen in the results provided in the first column of Table 2, we find results very similar to theirs in which higher CEO delta and CFO delta are estimated to decrease the portion of the firm's debt that has a floating exposure while CEO vega is estimated to be positively related to the portion of the firm's debt that is floating.[4] Chava and Purnanandam (2007) argue that these results demonstrate that when corporate managers have wealth incentives aligned with shareholders (high delta), they are more likely to hedge (have a fixed rate exposure) but that when they are incentivized by higher volatility (high vega), they choose more floating rate debt.

To determine whether these results are robust across different macroeconomic conditions, we re-estimate their specification in the other Compustat fiscal years in our sample. For purposes of comparison, we provide the results of the 2002 fiscal year in column 2 of Table 2. The results are strikingly different. The coefficient on CFO delta is of the same economic magnitude but now positive, though statistically insignificant. CEO delta retains its negative coefficient but is also statistically insignificant and both vega estimates are also statistically insignificant. Note that the change is not a power issue; there are more observations in the 2002 specification than in the 1996 specification. When we run this specification on the entire sample for which we have the necessary variables (column 3), we find estimated coefficients with economic magnitudes that are much closer to zero and all of which are statistically insignificant.[5]

Because of the high multicollinearity between the various compensation variables, we re-estimate the three specifications above with just CFO delta (columns 4 through 6 of Table 2). Consistent with the original Chava and Purnanandam (2007) result, the coefficient estimate corresponding to CFO delta is statistically significantly negative, again suggesting that greater incentive alignment leads to less floating rate debt. When that same regression is run for 2002 though, we find a significantly positive coefficient suggesting that greater incentive alignment

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[4] These findings do not perfectly replicate Chava and Purnanandam (2007) since they find CFO vega to be significantly positive and CEO vega to be insignificantly negative whereas we find the opposite. These two measures are highly correlated so small differences in our sample our estimation of vega could cause the results to flip. What is common is that delta significantly loads negatively and when vega is significant, its estimated coefficient is positive for the 1996 data.

[5] Following Petersen (2007), all OLS regression results include standard errors that are adjusted for both heteroskedasticity (White (1984)) and clustering within firms.

leads to more floating rate debt. For the entire sample, the estimated coefficient is essentially zero, statistically and economically. In untabulated results, we just include a measure of vega (either CEO or CFO) and for all three specifications, the coefficient is insignificant.

These results demonstrate that one has to be careful about generating inferences using purely cross-sectional data. Because firms are known to time their fixed / floating mix (Faulkender (2005)), cross-sectional findings may only be valid for the macroeconomic conditions in place during the fiscal year in which the cross-sectional analysis in conducted and may greatly differ when an alternative time period is examined. On the other hand, looking at the results in Table 2, one can look for results that are persistent across the subsamples and the entire dataset. Firms that are rated have significantly less floating rate debt in the 1996 fiscal year, the 2002 fiscal year, and the entire sample. Interestingly, none of the other variables are persistently significant in the annual specifications or for the entire sample. Below, we will return to the compensation results by looking at interaction terms in panel specifications as well as potential hedging activities associated with the estimated cash flow beta.

3.2 Graham and Rogers (2002)

Before moving to the panel specifications, we also replicate Graham and Rogers (2002) to demonstrate that the issue of coefficient stability in cross-sectional results is likely not limited to a single paper and may instead be quite common across much of the risk management literature. Because Graham and Rogers (2002) look at usage of both interest rate and foreign exchange derivatives, we will not be able to perfectly replicate their results. Not only is our sample different in terms of the firms it analyzes, we also only have interest rate derivatives data so some of the differences / changes we find could possibly be dominated by the effects coming from foreign currency derivatives usage. However, since they state that their results hold for just interest rate derivatives usage and just for foreign currency derivatives usage, we believe that replicating their results using just the interest rate swap component is appropriate for examining how the results may differ across years.

Graham and Rogers use fiscal years ending in 1994 and 1995 to estimate tax incentives associated with hedging. They find that firms that have higher debt ratios use more derivatives, arguing that the tax benefits of leverage induce more hedging. Following their methodology, we run a 2-stage least squares specification in which we predict book leverage in the first stage and then use the predicted leverage in a tobit specification in the second stage where derivatives scaled by assets is the dependent variable. We use the absolute value of our net swap measure (recall that we coded a swap to a fixed rate exposure as a negative swap amount) and divide by the book value of assets. The results of the second-stage tobit replication on firms with a Compustat fiscal year of 1994 are found in the first column of Table 3. Consistent with their results, we find a positive coefficient on predicted leverage; however our estimate is statistically insignificant. Unlike their results, we find much of the power explaining derivatives usage coming from the variable measuring floating rate debt as a percentage of book assets whereas they find that variable to have an insignificant coefficient. We believe that our finding makes sense since it is likely the floating rate debt that is being altered via the interest rate derivatives (swaps) to create a potential hedging benefit. Again, floating rate debt would unlikely impact currency derivatives so this distinction likely accounts for some of the difference in estimates.

When we run this same specification on those firm fiscal years ending in 1998 (results located in column 2), once again the coefficient of interest changes sign and is statistically significant. The coefficient corresponding to estimated leverage is negatively associated with the use of interest rate swaps, the opposite finding from Graham and Rogers (2002). This negative estimated coefficient on predicted leverage also emerges in specifications looking at our entire ten year period as well as when we use panel specifications to estimate within effects. In all cases, a positive and strongly statistically significant coefficient is estimated for the variable measuring floating debt as a percentage of assets, consistent with the presence of floating debt driving the desire to use interest rate swaps. Size is also found to be positively associated with greater use of interest rate derivatives in all of these specifications. The fact that some results change over time and others are stable demonstrates one of our main points: in order to estimate which effects have a durable impact on risk management, one should estimate the effects in a panel setting. Findings from purely cross-sectional specifications may result from the macroeconomic conditions at the time and would therefore not necessarily hold in other years with alternative macroeconomic conditions.

4. Panel Specifications

Having established the need to use panel data when estimating variation in risk management, we now turn our attention to estimates generated in various panel specifications and discuss how these different specifications should be used to test for different effects. If one hypothesizes that firms likely have a target hedge ratio conditioned by their hedging demands and that deviations from that target hedge ratio result from firms altering the timing or amount of their derivatives usage because they are incorporating a rate view (Bodnar, Hayt, and Marston (1998)), then we can think about the average fixed / floating mix representing the target hedge ratio (assuming stationarity) and the deviations from the mean representing the timing / speculative activities of firms. Recall that a between estimator generates results from regressing the means of the dependent variable (in our case, the mean for the firm across the sample period) on the means of the independent variables and that a within estimator (or a fixed-effects specification) is essentially a regression of the difference between the realization and the mean of the dependent variable regressed on the deviation from the mean for the corresponding independent variables. We therefore argue that within effects regressions are the right way to test for speculative activity and that between effects regressions should be used to estimate hedging effects. This section separately runs those econometric specifications.

4.1. Within (Firm Fixed) Effects

Given the variation over time in Chava and Purnanandam (2007)'s result, it appears that the effect of managerial compensation on interest rate risk management depends upon the macroeconomic conditions during the corresponding fiscal year. This variation over time is therefore more likely to be speculative in nature rather than the result of a stationary hedging policy. To test that hypothesis, one approach is to use panel data and estimate a firm fixed effects specification to control for average firm characteristics over time and test for how differences in risk management activities across time are explained by differences in firm and macroeconomic conditions.[6] We begin by using the percentage of the firm's debt swapped to floating (swapping to fixed produces a negative measure) and regressing it on the firm and macroeconomic measures that will likely impact a firm's desire to use pay-floating interest rate swaps. Since interest rate swaps are an easier way to adjust interest rate exposure than would be modifying the structure of the underlying debt, we should see the effects of macro-economic conditions being most apparent in analyses of swap usage. We follow up these results with an analysis of the ending interest rate exposure of the firm's debt, combining both initial exposure and swap usage. Following Faulkender (2005), one of the primary variables we include is a

[6] An alternative approach is to examine first differences (difference relative to previous year) as opposed to deviations from the mean. We have likewise estimated these specifications and the results are not materially different. Available upon request.

measure of the average slope of the yield curve (specifically the difference between the 5-year swap rate and LIBOR) during the corresponding fiscal year.

Our results confirm those of Faulkender (2005); firms are indeed timing their use of interest rate swaps based upon the yield curve. According to the results located in Table 4, firms increase their use of floating rate swaps and decrease their use of fixed rate swaps when the term structure steepens. The estimated coefficient suggests that a one percentage point increase in the difference between long-term rates and short-term rates increases the percentage of debt swapped to floating by 2.1% for the whole sample. When the regression is estimated just on those firms that use swaps at least once in the sample period (since inclusion of non-users will necessarily reduce the absolute size of the estimated coefficient), the estimated coefficient increases to a 3.4% increase in pay floating swaps as a percentage of debt for a one percentage point increase in the slope of the term structure. As argued by Faulkender (2005), these results suggest that firms are modifying their use of interest rate swaps to use what is cheapest in the short-run, most likely for speculative reasons. The other significant coefficients in the specification are that when firms have more of their debt issued with a floating interest rate exposure, they use fewer pay floating swaps, and when leverage is higher than average, they use more floating rate swaps.

To better understand the change over different time periods we found in replicating Chava and Purnanandam (2007), we estimate whether measures of managerial compensation may be related to this documented timing of swap usage. To test this hypothesis, we interact the slope of the swap yield spread with the four measures of managerial compensation and are primarily interested in the estimated coefficient corresponding to the interaction term. As seen in column 3 of Table 4, the interaction of the yield spread with the CFO’s delta on swap usage generates an estimated coefficient that is positive and statistically significant at better than one percent. This suggests that as the CFO receives more of the gains that arise from reductions in interest expense, the firm's use of swaps becomes more sensitive to the term structure. For the average firm that uses interest rate swaps with a CFO delta at the sample mean ($56,000), a one percent increase in the swap spread corresponds to a 3.90% net increase in the use of pay-floating swaps. However, for an otherwise similar firm in which the CFO delta is one standard deviation ($95,000) above the mean, such a firm on average increases the net usage of pay-floating swaps by 5.33% (= 3.90% + 1.43%) for that same one percent increase in the swap spread, a 37% increase in sensitivity. Since the average swap position in the sample is equivalent to 12.3% of the firm's debt, for a firm in which the CFO's delta is one standard deviation above the mean, a 100 basis points increase in the swap yield spread corresponds to a 43% change in the average swap position.

Similarly strong results are uncovered when we examine the CFO vega, which measures the increase in compensation associated with a 1% increase in stock volatility. Statistically, the estimated coefficient is again significant at better than one percent, indicating that at firms where managers are induced to take risks via their compensation contracts, managers are significantly more likely to adjust their use of swaps to changes in the yield spread (column 4 of Table 4).[7] Economic significance also remains strong. For the average firm with a CFO vega at the mean ($18,000), a one percent increase in the yield spread is associated with a 4.26% increase in the percentage of debt swapped to floating, whereas for a CFO with a vega of $48,000 (the mean plus one standard deviation), that same one percent increase in the yield spread corresponds to a

[7] There is a rather high correlation between managers' deltas and vegas. As a result, when both terms are placed in the regression, the high degree of multicollinearity often generates insignificant coefficients for both variables. In some of the specifications, only the CFO delta interaction term is statistically significant while the CFO vega term is insignificant. While this suggests that the CFO delta is likely to have a stronger impact, we only display the results when they are estimated separately because of the lack of stability in the findings. The regression results from including both terms are available upon request.

5.39% increase in the percentage of debt swapped to floating, a 27% increase.[8] These results are consistent with our hypothesis that compensation schemes that pay more when shareholders do well and/or that induce risk-taking appear to motivate managers to speculate in interest rate markets. It is also consistent with the survey results of Geczy, Minton, and Schrand (2007) who document that firms in which managers have higher compensation delta are more likely to incorporate a rate view into their timing and / or amount of derivatives usage.

We also evaluate the role of CEO compensation instead of for the CFO. We initially focused on the CFO's compensation structure since, arguably, it is the CFO that plays a greater role in conducting interest rate swap transactions than would the CEO. However, we have compensation data for the CEO for more of the firm-years in the sample and there does appear to be a high correlation between the CEO and CFO pay characteristics. On the other hand, the correlation is not perfect and there have been recent studies (Geczy, Minton, and Schrand (2007), Chava and Purnanandam (2006)) that suggest that CFO compensation is a more important determinant than CEO compensation.

Looking at the results, we find that both the delta (column 5) and the vega (column 6) for the CEO are statistically significant at better than one percent and better than five percent in their respective specifications. Economically, for a firm where the CEO has the average delta ($579,000 increase in CEO wealth for a 1% gain in shareholder value), a one percent move in the yield spread corresponds to a 3.18% increase in the percentage of debt that is swapped to

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[8] Because delta and vega are measured as the dollar value of the addition to managerial wealth from a 1% increase in the value (volatility for vega) of the firm's equity, there is a positive correlation between firm size and these measures (using the natural log of sales as the measure of size, the correlation with CFO delta is 0.30 and with CFO vega is 0.41). To ensure that our results are not driven by size but instead by compensation, we estimated specifications adding a term that allows the natural log of sales to interact with the yield spread. In all of these specifications, we found that the coefficient corresponding to the interaction with size was statistically insignificant and that the coefficients on the compensation interaction variables retained their statistical and economic significance. We also normalized delta and vega by CFO compensation and found estimated coefficients that are of similar economic magnitude but weaker statistical significance.

floating. For a firm-year where the CEO delta is one standard deviation above the mean for the sample ($2.167M for a 1% gain in shareholder wealth), the estimated sensitivity of swaps to the term structure is 4.44%, a 40% increase. Similarly, when we estimate the impact of vega, the sensitivity changes from 3.41% to 3.97%.

Since it is ultimately the final interest rate exposure of the firm, after including both the underlying debt structure and the usage of interest rate swaps, that determines the interest expense the firm will pay and therefore the benefits of any speculative activity, we re-run all of the above regressions using the post-swap inclusion percentage of debt with a floating exposure. Since we are interested in the speculative component, all of the regressions include firm fixed effects so that we can estimate how deviations from the average (target) fixed / floating mix vary with movements in the term structure as well as firm and managerial characteristics. The results of these regressions are found in Table 5.

The first result to notice is that in the baseline specifications of columns 1 (entire sample) and 2 (firms that use interest rate swaps at least once in the sample period), the term structure is a statistically and economically significant predictor of the final interest rate exposure of firms. This result is consistent with the findings of Faulkender (2005) and contradicts the results of Chava and Purnanandam (2007). There are at least two reasons for the different result. First, we are measuring the contemporaneous swap yield spread rather than a weighted average yield spread based on when the firm previously issued debt. Since firms can adjust their interest rate exposure after issuance via the swap market, it is the contemporaneous measure that is most likely relevant in explaining a firm's overall fixed / floating mix at a point in time. Because they are largely looking over a single fiscal year, they have very little variation in the contemporaneous yield spread. Second, there appears to be significant measurement error in

Chava and Purnanandam (2007)'s measure of the term structure since the median observation has a term structure slope of zero. During most of the ten years in our sample period, and in fact most of the historical time period for which data exists, the term structure was upward sloping so the median should be significantly above zero. The reason is that they are unable to find debt issuance information for more than half of their observations, so these missing estimates of the term structure when the firm issued debt are coded as zero. Such an approach will bias the estimated coefficient for the effects of the yield curve towards zero, as they find.

A number of other factors also partially explain variation in the firm's final interest rate exposure. Since we already have estimated how firms use swaps to achieve their final exposure, many of these other factors essentially explain the interest rate exposure of the underlying debt. First, we see that firms with more long-term debt and those that have access to the public debt markets tend to have a greater proportion of their debt with a fixed interest rate exposure.[9] Additionally, as more of the aggregate debt issued in the economy is from sources normally associated with lending at floating rates, a larger portion of a firm's debt has a floating interest rate exposure. Thus, as macroeconomic conditions change such that firms increase their borrowing from banks, their transactions in the swap market do not sufficiently offset the natural floating interest rate exposure of bank debt and we see firms ending up with more of their debt having a floating exposure. We also see that the coefficient on leverage is positive and statistically significant, indicating that once we control for the average leverage of the firm

[9] In unreported regressions, we find that our estimated coefficients on the Treasury yield spread and the swap yield spread are particularly sensitive to including the percentage of debt that has a long-term maturity. In the period from 2000 to 2003, we saw the level of both long- and short-term interest rates fall to historically low levels, but the spread was actually rather high relative to the rest of the sample period. So, later in the sample, firms were moving away from short-term floating-rate debt towards long-term fixed-rate debt, even though the interest rate spread was rather high. This can be seen in the Federal Reserve Flow of Funds report L.102 (Nonfarm Nonfinancial Corporate Business). Over the period 2000-2003, aggregate commercial paper outstanding among these firms fell from $278.4 billion to just $85.9 billion. The strong statistical significance of the coefficient corresponding to maturity demonstrates that this change in debt maturity is an important factor affecting the fixed/floating mix.

(through the fixed effect), leverage levels above the firm's average correspond to greater use of floating-rate debt.

When we look at the effect of the interactions of the CFO compensation variables with the yield spread on overall floating-rate debt, located in columns 3 and 4 of Table 5, we find very similar statistical and economic magnitudes to the results looking at swap usage. For a CFO delta that is one standard deviation above the mean, a one percent increase in the swap yield spread corresponds to a 3.55% increase in the percentage of the firm's debt that floats with interest rates relative to a 1.87% increase when the CFO delta is at the mean. This difference is a 90% increase in the sensitivity of the firm's debt structure to interest rates. While only significant at the ten percent level, we again find that when the CFO vega is higher, the overall percentage of debt that is floating is more sensitive to changes in the term structure. Also notice that the levels of CFO delta and vega have corresponding coefficients that are statistically insignificant from zero. These results confirm that the effect of compensation on interest rate risk management is not the level effect argued by Chava and Purnanandam (2007), it is a time-varying effect coming from movements in the term structure.

Moving to the results for CEO compensation on the overall floating rate structure of firm debt, we also find similar results. CEO delta is statistically significant at better than five percent, but with a magnitude somewhat lower than that found for CFOs. We find that the vega interaction term is insignificant in this specification. Overall, regardless of whether we look at swap usage specifically or at the ending interest rate exposure of debt, we find that compensation considerations significantly affect the sensitivity of the firm's interest rate management to movements in the yield curve.

A final way to look for variation in speculative behavior related to changes in the term structure with panel data is to estimate firm-specific sensitivities to the term structure and then regress those estimated sensitivities on average levels of firm and managerial characteristics to verify the robustness of the previous findings. Since we previously found that more performance sensitive compensation is correlated with greater sensitivity to the term structure, we should find that firms with more performance sensitive compensation structures have, on average, greater term structure sensitivity. The results of these tests are located in Table 6.

Consistent with our previous results, all four compensation measures are statistically significant at better than five percent. Economically, the magnitudes are similar to the panel regression results. For a firm that uses interest rate swaps with a CFO delta one standard deviation above the sample mean, a 100 basis point increase in the slope of the term structure corresponds to an average increase in pay-floating swaps of 1.27% more than the increase for a firm with a CFO delta equal to the sample mean. Firms corresponding to high average compensation incentives are the firms whose interest rate swap transactions appear to be more speculative in nature. None of our non-compensation related variables are statistically significant in any of these specifications.

4.2. Between Effects

We now turn to the question of what drives the target fixed / floating mix. In other words, what are the persistent variables that drive the average hedge ratio we observe in the data? These specifications should include variables that the literature has argued make cash flow volatility more costly and that will therefore induce greater risk management. Econometrically, we address this question using both OLS and by estimating the between effects, the results of which are located in Table 7. Since we are interested in estimating durable cross-sectional covariates that explain target hedging behavior, we only include measures of firm characteristics. Inclusion of macroeconomic conditions, like those in the fixed effects regression, would be meaningless in a between effects regression since any differences in firm averages will come from the fact that the panel is unbalanced, and not underlying differences in the firms.

The first result to focus on is the estimated coefficients for the interest rate beta. For the average firm in the sample, firms that are more positively exposed to short-term interest rates use marginally more floating rate debt. However, when we interact the interest rate beta with our measure of investment (both the interest rate beta measure and the ratio of investment to assets have been normalized to have mean zero and a standard deviation of one to ease economic interpretation), we find a statistically insignificant coefficient for the level of the cash flow interest rate beta but a positive coefficient on that interaction term which is statistically significant at better than five percent in the OLS specification (column 2) and significant at better than one percent in the BE specification (column 4). These results suggests that firms with an average amount of investment firms do not match the interest rate sensitivity of their liabilities to their cash flows, as demonstrated by the insignificant term on the level of the beta. However, as investment increases, the coefficient term on the interaction variable demonstrates that firms are more likely to engage in interest rate hedging behavior.[10] To further explore this finding, we separately estimate the effect of the interest rate beta on the mix of fixed and floating rate debt for the firms in the highest quartile of investment relative to those in the bottom three quartiles. As demonstrated by the results in columns 5 through 8, the high investment firms match the interest rate sensitivity of their liabilities to their cash flows whereas the low investment firms do not, with statistical significance exceeding five percent in all four

[10] A working paper version of Chava and Purnanandam (2007) had a similar result even though it does not appear in the published version.

specifications. We argue that this finding is important evidence consistent with Froot, Scharfstein, and Stein (1993) that it is firms' desire to internally fund investment that is an important reason to hedge.[11] Interestingly, high investment firms also use more floating rate debt, as seen by the persistently significant coefficient for the ratio of investment to assets (columns 1 to 4) and the high investment dummy variable (columns 5 to 8).

There are a couple of other variables that are robustly significant in explaining target hedge ratios. As firms have more long-term debt and more of their debt is rated, the firm has less of its debt with a floating interest rate exposure. Since bank debt is generally of shorter maturity and its default interest exposure is generally floating whereas bond issuances are generally of longer maturity with a fixed interest rate exposure (Faulkender (2005)), the significantly negative coefficients are likely resulting from cross-sectional variation in the average source of debt funds.

The other interesting coefficient estimates are those corresponding to leverage. In the OLS specifications, leverage is insignificantly related to the mix of fixed and floating rate debt whereas in the BE specifications, it has a significantly negative estimated coefficient. Recall from the results in Table 5 that in the FE specification, the coefficient on leverage was significantly positive. What these results say is that on average, a firm with more leverage has less floating rate debt post-swap incorporation (the BE result) but that when an individual firm is above its average leverage ratio, more of its debt is floating (the FE result). Since the OLS result will be impacted by both the FE and the BE estimates, that estimate turns out to be statistically insignificant. It is this change in the result across different panel specifications that could

[11] In unreported regressions, we similarly estimated the coefficients on interest rate beta for high R&D firms and high advertising firms. We did not find similar distinctions in the results. Perhaps because investments in capital expenditures and acquisitions are significantly larger, hedging those expenditures is more important.

explain why the coefficient estimated in the Graham and Rogers (2002) specification changed in different time period samples.

5. Value Creation

Does interest rate speculation on the part of non-financial firms create value for shareholders? This is a natural question given our results that managers with high powered compensation contracts appear to be the ones engaging in the type of speculation that we as well as Geczy, Minton, and Schrand (2007) have documented. Consistent with this type of speculation, Baker, Greenwood, and Wurgler (2003) document that firms have created value by successfully timing the maturity choices of their corporate debt issues. However, Butler, Grullon, and Weston (2006) challenge these findings, and a debate about how successful managers are at timing financial markets has emerged in the literature.

On the one hand, the term structure literature has documented that the Expectations Hypothesis has not held historically in the data and that a simple strategy of issuing / swapping to floating rate debt in a steep term structure environment has reduced overall interest costs. Results such as Fama and Bliss (1987) and Campbell and Shiller (1991) demonstrate that when the term structure is particularly steep, future short-term rates have not reached the higher levels implied by the long-term rate. Therefore, a financial manager looking to reduce expected funding costs would have, at least historically, achieved that objective by swapping to a floating rate exposure when the term structure was steep.

On the other hand, if the reduction in interest costs achieved from increasing the usage of floating rate debt in steep term structure environments is the result of past market inefficiencies, continued improvement in the liquidity of that market will likely reduce or eliminate any excess interest differential.[12] As a result, firms swapping to a floating interest rate exposure in times of a steep term structure are speculating that they will face lower future funding costs even though they are moving away from their optimal hedge ratio, increasing their firm's interest rate risk in the process. Ex ante, it is not clear that this pattern will continue to hold as markets continue to become more integrated and more sophisticated. In addition, if part of this result arises from a time-varying risk premium (as argued in such work as Dai and Singleton (2002) and Ang and Bekaert (2007)), then some of the reduction in interest costs is merely compensation to the firm's equity holders for the risk that is being passed on to them from the swap, and therefore does not create value for shareholders.

We do not think that the data that we have gathered is the right data to determine whether or not managers can create value in the *long-run* by speculating using interest rate swaps based upon the shape of the yield curve. While we have a large cross-section in our panel, we do only have ten years of data, equivalent to about one business cycle. Were we to estimate value differences based upon whether or not firms did speculate based upon the slope of the term structure, that would only tell us whether the set of interest rate realizations over the sample period were profitable and would not enlighten us as to whether such a strategy would be expected to create value ex ante. Just as an asset pricing researcher would never estimate the equity risk premium using ten years of data, we do not think it appropriate to estimate long-term expected value creation from interest rate speculation over a similarly short time period. How much each of the historical result regarding the cash flow generated from this issuance strategy is

[12] Baker, Stein, and Wurgler (2004), building on such work as Baker and Stein (2004) argue that due to the closed-end nature of a firm's capital structure, it could be that firms are actually in a better position than other market participants to capture value arising from market inefficiencies. Therefore, while this strategy may well create value, we still argue that such trading is more consistent with speculating that such a strategy reduces interest costs than with this strategy being effective risk management.

explained by inefficiencies leaving rents on the table versus time-varying risk premia is a question that we rightly defer to the term structure literature.

However, in a companion paper (Chernenko, Faulkender, and Jenkins (2007)), we do investigate the *short-run* impact on value from using interest rate swaps to manipulate earnings. In particular, we investigate whether the market reacts differently to earnings announcements when the firm makes the analyst consensus earnings forecast but would have missed the forecast had they not modified their usage of interest rate swaps. We find that firms are able to avoid the 'torpedo effect' of missing the forecast but that the earnings generated by the change in interest rate swap usage and the slope of the yield curve during the fiscal year are not capitalized the same as they would have been had the higher earnings come from operational improvements.

6. Conclusion

Using hand-collected data on corporate debt structure and interest rate swap activity for 1,854 non-financial firms for up to ten years, we estimate the drivers of interest rate risk management and are able to distinguish between factors that are durable covariates explaining corporate hedging activities and those that are dependent upon macroeconomic conditions and are therefore more likely to be related to speculation. We demonstrate that some previously documented (Chava and Purnanandam (2007)) relationships between interest rate risk management activities and firm characteristics are sensitive to the year for which the data is analyzed because they are related to time-varying speculative behavior rather than the hedging motivation initially interpreted. Specifically, we find that higher powered managerial compensation contracts are associated with interest rate swap activity that is more sensitive to changes in the term structure, consistent with these compensation structures incentivizing speculation. We also find that the effect of leverage on risk management previously examined by Graham and Rogers (2002) is mixed; firms prefer less interest rate volatility if they are more levered relative to other companies but that they have a higher floating rate exposure when they are above their average leverage ratio.

These results are important for two reasons. First, the results remind us that to determine whether an effect is truly robust, it needs to be analyzed in a panel setting where it emerges despite changes in macroeconomic conditions. It is important to distinguish between durable results related to target hedge ratios and transitory drivers of speculative activity. Second, these results demonstrate that we need not rely on survey data to conduct empirical investigations of speculative behavior on the part of firms. By using realized firm activities and analyzing deviations from average behavior, we can estimate which firm and managerial characteristics are associated with outcomes that are more likely to be speculation-induced.

Just as important, we report findings consistent with the theory of Froot, Scharfstein, and Stein (1993) that firms with large investments to make prefer to do so with internal funds and are hedging their cash flows to increase that likelihood. These high investment firms are significantly more likely to match the interest rate exposure of their liabilities to that of their cash flows, thus minimizing residual cash flow volatility. Together with the earlier results on speculation, these findings suggest that hedging motivations do partially contribute to the determination of a target hedge ratio but firms speculate around that target based upon interest rate conditions at the time, especially when compensation contracts are more high-powered.

While we recognize the large cost of generating a large panel dataset to conduct analyses of corporate risk management (after all, we incurred that cost), we hope our results convince researchers of the necessity of generating such a large sample across firms and time to ensure the robustness of estimated results.

Appendix

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.[13] 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 1) swaps reported as hedging non-debt items such as investments, preferred stock, operating leases, etc. and 2) 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.

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 below. 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.[14]

[13] 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 seven 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 derivative 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 short-cut 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.

[14] 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.

Table A1

The table below 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).

	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%

(a) Approximately 32.5 percent 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 percent.

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, i.e., 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;[15]
- "other" is treated as fixed rate.

An example of our application of these assumptions is shown below. Because we examine firms' 10-Ks over time, we believe that we are able to make more accurate judgments, taking

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

into consideration changes in the reported interest rates paid on various instruments and disclosures made in some years but not in others.[16]

Table A2

The following table, taken from Pennzoil-Quaker State Company's 2000 10-K, filed on March 20, 2001, provides an example of firm's 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.

Debt outstanding was as follows:	December 31	
	2000	1999
	(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:

1) debentures and notes are recorded as fixed-rate;

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

3) 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 a floating interest rates;

4) other debt is recorded as fixed-rate.

[16] 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 Data148, “Long-Term Debt Tied 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 Data148 a) is missing for 37.6% of our observations, b) appears to be inconsistent about whether interest rate swap effects are taken into account, and c) sometimes ignores certain items such as commercial paper and credit lines which 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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Table 1
Summary Statistics

The full sample consists of 1,854 firms in the ExecuComp database over the period June 1993 - May 2003 that have positive amount of debt outstanding at some point during the sample period. The swap users subsample consists of firms that report using interest rate swaps at some point during the sample period. Initial(final) floating-rate debt ratio is the share of outstanding debt that has floating interest rate exposure before(after) accounting for interest rate swaps. Share swapped to floating is the share of outstanding debt that is swapped to a floating interest rate. Long-term debt ratio is the share of outstanding debt that has more than five years to maturity. Swap yield spread is the average spread between the 5-year swap rate and 6-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 5-year swap rate and the 5-year Treasury bond during the fiscal year. Economy-wide floating-rate debt ratio 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 of the United States published by the Federal Reserve Board. Investments / Assets is capital expenditures and acquisitions over book assets. Missing values of R&D and advertising expenses are treated as zeros. CEO(CFO) Delta and Vega are the changes (in millions of dollars) in CEO(CFO)'s stock and option portfolio value for a 1% change in the stock price and for a 0.01 change in the annualized standard deviation of stock returns respectively. CEO(CFO) Delta and Vega are calculated using Core and Guay (2002) one-year approximation method. Delta and Vega are wisorized at the 1st and 99th percentiles. Free cash flow interest rate beta is the beta from regressing firm's free cash flow to assets ratio on the average value of 3-month LIBOR during the fiscal year. It is estimated using at least five years worth of data and is winsorized at the 1st and 99th percentiles. Firm-specific yield spread beta is the firm-specific sensitivity of swap usage to swap yield spread. It is estimated using at least five years worth of data and is winsorized at the 1st and 99th percentiles.

	Num. Obs.	Mean	Median	SD	Min	Max
Panel A: Full Sample						
Initial floating-rate debt ratio	11261	0.416	0.333	0.351	0.000	1.000
Share swapped to floating	11261	−0.034	0.000	0.178	−1.000	1.000
Absolute value of the share swapped to floating	11261	0.068	0.000	0.168	0.000	1.000
Final floating-rate debt ratio	11261	0.383	0.308	0.333	0.000	1.000
Long-term debt ratio	11261	0.474	0.495	0.345	0.000	1.000
1-year Treasury yield	11261	0.049	0.053	0.012	0.015	0.062
Swap yield spread	11261	0.011	0.008	0.007	0.001	0.027
Swap spread	11261	0.005	0.005	0.002	0.002	0.009
Credit spread	11261	0.008	0.007	0.002	0.006	0.013
Economy-wide floating debt ratio	11261	0.327	0.343	0.041	0.206	0.363
Log(Sales)	11261	6.958	6.918	1.440	0.046	12.410
Market leverage	11261	0.185	0.159	0.140	0.000	0.853
Debt or CP rating	11261	0.555	1.000	0.497	0.000	1.000
Investment / Assets	10491	0.103	0.077	0.090	−0.106	0.937
RD / Assets	11261	0.027	0.000	0.069	0.000	2.091
Advertising / Assets	11261	0.012	0.000	0.038	−0.003	0.582
CEO Delta	9787	0.584	0.132	1.623	0.000	12.520
CFO Delta	5949	0.056	0.024	0.095	0.000	0.617
CEO Vega	9969	0.064	0.021	0.120	0.000	0.754
CFO Vega	6199	0.018	0.008	0.030	0.000	0.184
Cash flow interest rate beta	9027	0.001	−0.002	0.031	−0.092	0.116
Firm-specific yield spread beta	5738	2.904	1.937	10.749	−31.810	36.510
Panel B: Swap Users Subsample						
Initial floating-rate debt ratio	6269	0.426	0.355	0.326	0.000	1.000
Share swapped to floating	6269	−0.061	0.000	0.235	−1.000	1.000
Absolute value of the share swapped to floating	6269	0.123	0.000	0.210	0.000	1.000
Final floating-rate debt ratio	6269	0.368	0.316	0.290	0.000	1.000
Long-term debt ratio	6269	0.493	0.511	0.320	0.000	1.000
1-year Treasury yield	6269	0.049	0.053	0.012	0.015	0.062
Swap yield spread	6269	0.011	0.008	0.007	0.001	0.027
Swap spread	6269	0.005	0.005	0.002	0.002	0.009
Credit spread	6269	0.008	0.007	0.002	0.006	0.013
Economy-wide floating debt ratio	6269	0.327	0.343	0.041	0.206	0.363
Log(Sales)	6269	7.420	7.360	1.344	1.619	12.410
Market leverage	6269	0.203	0.183	0.133	0.000	0.853
Debt or CP rating	6269	0.679	1.000	0.467	0.000	1.000
Investment / Assets	5795	0.106	0.080	0.092	−0.094	0.815
RD / Assets	6269	0.017	0.000	0.036	0.000	0.301
Advertising / Assets	6269	0.011	0.000	0.036	0.000	0.521
CEO Delta	5597	0.591	0.148	1.596	0.000	12.520
CFO Delta	3372	0.064	0.029	0.103	0.000	0.617
CEO Vega	5707	0.081	0.028	0.140	0.000	0.754
CFO Vega	3508	0.022	0.010	0.034	0.000	0.184
Cash flow interest rate beta	5363	−0.002	−0.003	0.027	−0.092	0.116
Firm-specific yield spread beta	5738	2.904	1.937	10.749	−31.810	36.510

Table 2

Floating Rate Debt and Managerial Incentives

This table reports the results of OLS regressions, similar to the ones in table 4 in Chava and Purnanandam (2007), analyzing the impact of managerial incentives on the floating-rate debt ratio. The dependent variable is the share of outstanding debt that is floating after accounting for interest rate swaps. Columns 1 and 4 report the results for fiscal years ending in 1996, columns 2 and 5 report the results for fiscal years ending in 2002, while columns 3 and 6 report the results for the whole sample. CEO(CFO) Delta and Vega are the changes (in millions of dollars) in CEO(CFO)'s stock and option portfolio value for a 1% change in the stock price and for a 0.01 change in the annualized standard deviation of stock returns respectively. CEO(CFO) Delta and Vega are calculated using Core and Guay (2002) one-year approximation method. Cash flow beta is calculated as in Chava and Purnanandam (2007). Specifically, using quarterly Compustat data, we first regress average cash-flow-to-assets ratio of all firms in a three-digit SIC code on average value of 3-month LIBOR during the quarter. Cash flow beta is then calculated as the decile rank of the coefficient on 3-month LIBOR. Herfindahl index is calculated using sales for all firm-fiscal year observations within the same 3-digit SIC code. Low Z-score is a binary variable equal to one whenever Z-score is less than 1.81. Improved Z-score is a binary variable equal to one if the firm improved its Z-score over the subsequent year. Heteroscedasticity robust standard errors, adjusted for clustering by company when the whole sample is used in columns 3 and 6, are reported in parenthesis below the coefficients. *, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
CFO Delta	−0.035*	0.024	0.002	−0.037**	0.020	0.001
	(0.019)	(0.022)	(0.009)	(0.015)	(0.015)	(0.007)
CEO Delta	−0.034**	−0.016	−0.008			
	(0.016)	(0.016)	(0.008)			
CFO Vega	−0.025	0.001	−0.003			
	(0.030)	(0.017)	(0.008)			
CEO Vega	0.066***	0.002	0.010			
	(0.025)	(0.012)	(0.007)			
Cash flow beta	−0.007	0.008*	0.001	−0.005	0.008*	0.001
	(0.006)	(0.004)	(0.003)	(0.005)	(0.004)	(0.003)
Debt or CP rating	−0.163***	−0.179***	−0.205***	−0.154***	−0.176***	−0.203***
	(0.033)	(0.032)	(0.017)	(0.033)	(0.031)	(0.017)
Log(Herfindahl Index)	0.027	−0.003	0.021*	0.018	−0.002	0.020*
	(0.020)	(0.016)	(0.011)	(0.020)	(0.016)	(0.011)
Log(Market / Book)	0.024	0.029	0.025	0.025	0.031	0.024
	(0.045)	(0.034)	(0.018)	(0.046)	(0.034)	(0.018)
Log(Sales)	−0.012	−0.004	0.001	−0.006	−0.004	0.002
	(0.013)	(0.012)	(0.006)	(0.013)	(0.011)	(0.006)
Log(1 + RD Expense / Assets)	0.348	−0.537*	−0.275	0.401	−0.539*	−0.262
	(0.360)	(0.299)	(0.237)	(0.358)	(0.294)	(0.235)
Low Z-score	0.003	−0.022	−0.013	0.011	−0.017	−0.012
	(0.047)	(0.028)	(0.018)	(0.045)	(0.028)	(0.018)
Improved Z-score	0.016	−0.027	0.007	0.011	−0.030	0.006
	(0.028)	(0.026)	(0.009)	(0.028)	(0.025)	(0.008)
Constant	0.615***	0.414***	0.513***	0.534***	0.416***	0.497***
	(0.107)	(0.097)	(0.053)	(0.102)	(0.093)	(0.052)
Num. Obs.	510	692	5116	517	697	5166
R^2	0.113	0.092	0.099	0.092	0.088	0.096
Sample	1996	2002	all	1996	2002	all

Table 3
Simultaneous Equations Analysis of Debt and Hedging Decisions

This table reports the results of the second-stage of the simultaneous equations analysis of leverage and interest rate swap usage similar to the one in Graham and Rogers (2002). The dependent variable is the absolute value of the ratio of net swap position to book assets. Columns 1-3 report the results of second-stage Tobit regressions, column 4 reports the results of the within estimator, while column 5 reports the results of the between estimator. Book leverage (predicted) is the predicted value of book leverage from untabulated first-stage regressions of book leverage on PPE/Assets, RD/Assets, Log(Sales), negative book equity indicator, and marginal tax rate. CEO Delta/(Salary + Bonus) and CEO Vega/(Salary + Bonus) are winsorized at the 1st and 99th percentiles. For Tobit regressions in columns 1-3, pseudo R^2 is reported. *, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)
Book leverage (predicted)	0.076	−0.239***	−0.091***	−0.062**	−0.009
	(0.150)	(0.091)	(0.032)	(0.026)	(0.019)
RD / Assets	0.266	−0.321**	−0.149***	−0.011	−0.023*
	(0.179)	(0.140)	(0.037)	(0.016)	(0.013)
Book equity / market equity	−0.024	0.015*	0.002	−0.000	0.001
	(0.016)	(0.008)	(0.002)	(0.000)	(0.001)
Negative book equity	−0.038	0.074***	0.029***	0.016**	0.007
	(0.041)	(0.027)	(0.010)	(0.007)	(0.006)
Floating debt / Assets	0.477***	0.576***	0.458***	0.104***	0.196***
	(0.060)	(0.043)	(0.014)	(0.006)	(0.009)
Log(Assets)	0.026***	0.019***	0.023***	0.004***	0.002***
	(0.005)	(0.004)	(0.001)	(0.001)	(0.001)
Insitutional ownership	0.042	0.051*	0.055***	0.001	0.025***
	(0.035)	(0.029)	(0.009)	(0.005)	(0.005)
CEO Delta/(Salary + Bonus)	−0.004	−0.002	−0.002***	0.001*	−0.000
	(0.004)	(0.003)	(0.001)	(0.000)	(0.000)
CEO Vega/(Salary + Bonus)	−0.057	0.070	0.055***	0.004	0.025*
	(0.163)	(0.059)	(0.019)	(0.007)	(0.014)
Constant	−0.335***	−0.242***	−0.289***	−0.002	−0.028***
	(0.059)	(0.045)	(0.014)	(0.012)	(0.007)
Num. Obs.	596	931	7896	7896	7896
R^2	0.694	0.719	0.701	0.050	0.267
Estimation	Tobit	Tobit	Tobit	Within	Between
Sample	1994	1998	all	all	all

Table 4
Timing Interest Rate Swap Usage and Managerial Incentives

This table reports the results of executive compensation hypotheses tests for interest rate swap usage. All regressions are estimated with firm fixed effects. Column 1 is estimated using the whole sample, while columns 2-6 are estimated using the subsample of interest rate swap users, firms that report using interest rate swaps at any point during the sample period. Swap yield spread is the average spread between the 5-year swap rate and 6-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 5-year swap rate and the 5-year Treasury bond during the fiscal year. CEO(CFO) Delta and Vega are the changes (in millions of dollars) in CEO(CFO)'s stock and option portfolio value for a 1% change in the stock price and for a 0.01 change in the annualized standard deviation of stock returns respectively. CEO(CFO) Delta and Vega are calculated using Core and Guay (2002) one-year approximation method. CFO(CEO) Delta, Vega, and Options / Compensation are first winsorized at the 1st and 99th percentiles and then standardized so that interaction term coefficients measure the change in the sensitivity of swap usage to yield spread due to one standard deviation change in CFO(CEO) Delta, Vega, and Options / Compensation. Long-term debt ratio is the share of outstanding debt that has more than five years to maturity. Economy-wide floating-rate debt ratio 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 of the United States published by the Federal Reserve Board. Heteroscedasticity robust standard errors, adjusted for clustering by company, are reported in parenthesis below the coefficients. *, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
1-year Treasury yield	0.175	0.395	−0.847	−0.998	0.335	0.275
	(0.299)	(0.500)	(0.809)	(0.801)	(0.542)	(0.541)
Credit spread	0.210	−0.013	−0.047	0.705	2.252	0.528
	(1.346)	(2.265)	(3.409)	(3.398)	(2.343)	(2.351)
Swap yield spread	2.105***	3.383***	3.901***	4.260***	3.179***	3.405***
	(0.304)	(0.495)	(0.785)	(0.771)	(0.524)	(0.522)
Swap spread	0.957	1.073	7.766***	7.286***	1.653	1.345
	(1.097)	(1.871)	(2.586)	(2.651)	(2.004)	(2.008)
CFO Delta			−0.013**			
			(0.006)			
CFO Delta * Yield spread			1.426**			
			(0.587)			
CFO Vega				−0.003		
				(0.006)		
CFO Vega * Yield spread				1.129**		
				(0.442)		
CEO Delta					−0.008	
					(0.007)	
CEO Delta * Yield spread					1.260***	
					(0.488)	
CEO Vega						0.004
						(0.004)
CEO Vega * Yield spread						0.560**
						(0.253)
Initial floating-rate debt ratio	−0.157***	−0.305***	−0.332***	−0.334***	−0.318***	−0.315***
	(0.012)	(0.020)	(0.027)	(0.027)	(0.022)	(0.021)
Long-term debt ratio	−0.002	−0.012	0.010	0.012	−0.016	−0.016
	(0.009)	(0.018)	(0.021)	(0.021)	(0.020)	(0.020)
Market leverage	0.032	0.089**	0.079	0.103*	0.060	0.075
	(0.026)	(0.044)	(0.064)	(0.061)	(0.052)	(0.050)
Log(Sales)	−0.000	−0.000	−0.012	−0.012	−0.004	−0.006
	(0.005)	(0.009)	(0.013)	(0.014)	(0.011)	(0.010)
Debt or CP rating	−0.011	−0.020	−0.040*	−0.034	−0.016	−0.014
	(0.009)	(0.015)	(0.021)	(0.022)	(0.016)	(0.016)
Economy-wide floating debt ratio	0.191	0.356	0.753**	0.969***	0.406*	0.485**
	(0.133)	(0.222)	(0.322)	(0.321)	(0.232)	(0.234)
Constant	−0.066	−0.106	−0.115	−0.199	−0.100	−0.104
	(0.061)	(0.108)	(0.156)	(0.156)	(0.124)	(0.120)
Num. Obs.	11261	6269	3372	3508	5597	5707
R^2	0.078	0.146	0.178	0.182	0.154	0.154
Swap users only	No	Yes	Yes	Yes	Yes	Yes

Table 5
Timing Floating-rate Debt Ratio and Managerial Incentives

This table reports the results on the timing of floating-rate debt ratio and executive compensation. All regressions are estimated with firm fixed effects. Specification in column 2 is estimated using the swap users subsample, all other specifications are estimated using the whole sample. Swap yield spread is the average spread between the 5-year swap rate and 6-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 5-year swap rate and the 5-year Treasury bond during the fiscal year. CEO(CFO) Delta and Vega are the changes (in millions of dollars) in CEO(CFO)'s stock and option portfolio value for a 1% change in the stock price and for a 0.01 change in the annualized standard deviation of stock returns respectively. CEO(CFO) Delta and Vega are calculated using Core and Guay (2002) one-year approximation method. CFO(CEO) Delta, Vega, and Options / Compensation are first winsorized at the 1st and 99th percentiles and then standardized so that interaction term coefficients measure the change in the sensitivity of swap usage to yield spread due to one standard deviation change in CFO(CEO) Delta, Vega, and Options / Compensation. Long-term debt ratio is the share of outstanding debt that has more than five years to maturity. Economy-wide floating-rate debt ratio 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 of the United States published by the Federal Reserve Board. Heteroscedasticity robust standard errors, adjusted for clustering by company, are reported in parenthesis below the coefficients. *, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
1-year Treasury yield	0.297	0.247	0.797	0.708	0.467	0.534
	(0.508)	(0.646)	(0.793)	(0.772)	(0.548)	(0.547)
Credit spread	1.869	0.620	2.328	3.126	1.605	1.180
	(2.325)	(2.866)	(3.304)	(3.236)	(2.358)	(2.375)
Swap yield spread	1.174**	2.151***	1.873**	1.938**	1.346**	1.450***
	(0.507)	(0.649)	(0.789)	(0.762)	(0.533)	(0.535)
Swap spread	3.323*	2.049	4.879*	5.078*	2.777	2.744
	(1.832)	(2.272)	(2.619)	(2.599)	(1.980)	(1.985)
CFO Delta			−0.012			
			(0.008)			
CFO Delta * Yield spread			1.678***			
			(0.636)			
CFO Vega				0.001		
				(0.007)		
CFO Vega * Yield spread				0.786*		
				(0.471)		
CEO Delta					−0.011	
					(0.008)	
CEO Delta * Yield spread					1.043**	
					(0.468)	
CEO Vega						0.004
						(0.005)
CEO Vega * Yield spread						0.355
						(0.279)
Long-term debt ratio	−0.202***	−0.201***	−0.203***	−0.196***	−0.212***	−0.210***
	(0.015)	(0.020)	(0.020)	(0.020)	(0.017)	(0.017)
Market leverage	0.205***	0.249***	0.243***	0.241***	0.199***	0.211***
	(0.043)	(0.059)	(0.062)	(0.059)	(0.049)	(0.048)
Log(Sales)	0.017*	0.012	0.010	0.011	0.010	0.009
	(0.010)	(0.013)	(0.015)	(0.015)	(0.011)	(0.011)
Debt or CP rating	−0.131***	−0.105***	−0.153***	−0.149***	−0.114***	−0.112***
	(0.017)	(0.021)	(0.022)	(0.022)	(0.019)	(0.018)
Economy-wide floating debt ratio	0.845***	1.006***	0.786**	0.900***	0.772***	0.807***
	(0.204)	(0.264)	(0.308)	(0.299)	(0.223)	(0.223)
Constant	0.064	0.022	0.083	0.034	0.119	0.114
	(0.103)	(0.142)	(0.153)	(0.148)	(0.117)	(0.115)
Num. Obs.	11261	6269	5949	6199	9787	9969
R^2	0.094	0.095	0.109	0.102	0.096	0.094
Swap users only	No	Yes	No	No	No	No

Table 6
Firm Specific Sensitivities

This table presents the results of regressing firm specific sensitivities of swap usage to swap yield spread on various firm characteristics. Firm specific sensitivities are estimated using at least five years worth of data. All explanatory variables are firm-level means. Heteroscedasticity robust standard errors are reported in parenthesis below the coefficients. *, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)
CFO Delta	1.267***			
	(0.480)			
CFO Vega		1.079**		
		(0.434)		
CEO Delta			1.154***	
			(0.399)	
CEO Vega				0.748**
				(0.371)
Initial floating-rate debt ratio	2.392	2.775	3.231	2.806
	(2.580)	(2.571)	(2.421)	(2.452)
Log(Sales)	−0.404	−0.488	−0.352	−0.411
	(0.416)	(0.424)	(0.359)	(0.392)
Long-term debt ratio	0.162	0.150	1.554	1.252
	(2.454)	(2.460)	(2.283)	(2.293)
Debt or CP rating	2.215	2.392	1.836	1.857
	(1.531)	(1.530)	(1.480)	(1.475)
Market leverage	−2.743	−2.581	−4.389	−4.826
	(4.222)	(4.258)	(3.810)	(3.788)
Constant	3.834	4.150	3.096	3.891
	(4.102)	(4.130)	(3.683)	(3.918)
Num. Obs.	653	659	718	719
R^2	0.018	0.014	0.018	0.011

Table 7
Floating-rate Debt Ratio Target

This table reports the results of regressions analyzing the determinants of the floating-rate debt ratio target. Specifications in columns 1, 2, 5, and 7 are estimated using OLS, the ones in columns 3, 4, 6, and 8 are estimated using the between estimator. Free cash flow interest rate beta is the beta from regressing firm's free cash flow to assets ratio on the average value of 3-month LIBOR during the fiscal year. It is estimated using at least five years worth of data and is winsorized at the 1st and 99th percentiles. High level of investment is a binary variable set to one whenever investment-to-assets ratio is above its 75th percentile. Investment is the sum of capital expenditures and acquisitions. Both free cash flow interest rate beta and investment-to-assets ratio are standardized. Long-term debt ratio is the share of outstanding debt that has more than five years to maturity. Heteroscedasticity robust standard errors, adjusted for clustering by company in case of OLS estimation, are reported in parenthesis below the coefficients. *, **, and *** correspond to the coefficients being significant at 10%, 5%, and 1%, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cash flow interest rate beta	0.013*	0.011	0.014**	0.008				
	(0.007)	(0.007)	(0.006)	(0.007)				
Cash flow beta * (Investment/Assets)		0.009**		0.024***				
		(0.004)		(0.009)				
Investment/Assets	0.033***	0.033***	0.025**	0.024**				
	(0.006)	(0.006)	(0.011)	(0.011)				
Cash flow beta * High investment					0.037***	0.070***	0.038***	0.089***
					(0.009)	(0.017)	(0.012)	(0.022)
Cash flow beta * Low investment					0.002	−0.014	0.002	−0.029**
					(0.008)	(0.010)	(0.011)	(0.014)
High level of investment					0.070***	0.054**	0.068***	0.044
					(0.011)	(0.026)	(0.013)	(0.030)
RD / Assets	−0.220	−0.220	−0.433***	−0.429***	−0.227	−0.427***	−0.064	−0.203
	(0.182)	(0.181)	(0.136)	(0.136)	(0.180)	(0.135)	(0.283)	(0.239)
Advertising / Assets	0.174	0.175	0.181	0.182	0.185	0.187	0.252	0.222
	(0.188)	(0.187)	(0.183)	(0.182)	(0.188)	(0.182)	(0.246)	(0.213)
Long-term debt ratio	−0.223***	−0.222***	−0.220***	−0.221***	−0.220***	−0.219***	−0.206***	−0.187***
	(0.020)	(0.020)	(0.030)	(0.029)	(0.020)	(0.029)	(0.024)	(0.033)
Market leverage	−0.074	−0.074	−0.215***	−0.217***	−0.075	−0.220***	−0.064	−0.206***
	(0.046)	(0.046)	(0.064)	(0.064)	(0.046)	(0.064)	(0.059)	(0.074)
Log(Sales)	−0.002	−0.002	−0.005	−0.006	−0.003	−0.006	−0.007	−0.010
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.008)
Debt or CP rating	−0.145***	−0.146***	−0.142***	−0.142***	−0.146***	−0.142***	−0.122***	−0.121***
	(0.016)	(0.016)	(0.021)	(0.021)	(0.016)	(0.021)	(0.019)	(0.023)
Constant	0.597***	0.598***	0.652***	0.655***	0.585***	0.645***	0.597***	0.650***
	(0.042)	(0.042)	(0.047)	(0.047)	(0.042)	(0.048)	(0.051)	(0.059)
Num. Obs.	8701	8701	8701	8701	8701	8701	5160	5160
R^2	0.153	0.154	0.204	0.209	0.154	0.212	0.139	0.203
Estimation	OLS	OLS	BE	BE	OLS	BE	OLS	BE
Swap users only	No	No	No	No	No	No	Yes	Yes