Interest Rate Cycles and Corporate Risk Management

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Abstract

We study the ability of US firms to manage interest rate risk during changes in monetary policy. From annual reports we extract interest rate derivative positions and analyze how they change with the cyclical movements in interest rates. Our hand-collected data follows firms' year-end positions in interest rate derivatives from 1990 through 2000, allowing us to evaluate their performance over time as well as in the cross-section. The 1990s constitute a unique period with pronounced interest rate cycles and with derivatives reporting requirements conducive to our analysis. We also investigate whether users of interest rate derivatives differ from non-users, and whether those that appear to be speculating using interest rate derivatives differ from hedgers.

JEL Codes: G32, G34
EFM Codes: 110, 180, 450

1. Introduction

The International Swaps and Derivatives Association (2008) reports that, globally, the notional amounts of total interest rate derivatives (including cross-currency swaps) outstanding increased from $3.45 trillion in 1990 to $63 trillion at the end of 2000 and then to $464.7 trillion in the first half of 2008. Given the drastic increase in the use of derivatives, much of the theory in corporate risk management attempts to identify conditions under which corporate risk-management is value enhancing. Theory suggests that risk-management may enhance shareholder value in the presence of financial distress costs or agency costs, or when a firm faces convex tax schedules. Empirical research finds mixed and inconclusive evidence in support of existing theory.[1] A common explanation is that derivatives usage, which is the most common empirical proxy for hedging, does not necessarily capture hedging. In the 1998 CIBC Wharton survey, about half the firms reported, that they sometimes allowed their market views to affect the timing of their hedges and the size of their hedges.[2] Faulkender (2005) provides further evidence that firms may use derivatives for speculating rather than hedging. He finds that the final interest rate exposures of newly issued debt securities are largely driven by the slope of the yield curve at the time of the debt issue.

Anecdotal evidence also suggests that some firms follow a policy of hedging exposure to interest rates while others use derivatives to reduce cost of capital by timing the yield curve. For example, Honeywell International explicitly acknowledges that it uses interest derivatives to reduce its cost of capital. Quoting from its 1998 financial statements – "(the) Company issues both fixed and variable rate debt and uses interest rate swaps to manage the Company's exposure to interest rate movements and reduce borrowing costs." In contrast, Genuine Parts Company claims to use interest derivatives primarily to reduce exposure to interest rates by converting floating rate exposure to fixed rates.[3] Due to scarcity of detailed derivatives usage data, we understand relatively little about why some firms hedge interest rate risk while other firms speculate with derivatives to reduce their cost of capital. We understand even less about firms'

[1] For risk-management theories, see Stulz (1984), Smith and Stulz (1985), Froot, Scharfstein and Stein (1993), DeMarzo and Duffie (1991, 1995), Breeden and Viswanathan (1998), Leland (1998) and Morellec and Smith (2007). For empirical findings, see Nance, Smith and Smithson (1993), Dolde (1995), Mian (1996), Tufano (1996), Geczy, Minton and Schrand (1997), Schrand and Unal (1998), Haushalter (2000), Graham and Rogers (2002), and Knopf, Nam and Thornton (2002). For evidence from a case study, see Brown (2001).

[2] See Bodnar, Hayt and Marston (1998)

[3] See page 4 of Exhibit 13 of the year 2000 financial report

ability at market timing.[4] In this paper, we use hand-collected data on interest rate derivatives usage and attempt to improve our understanding of these issues. We identify firms that are likely to be consistent hedgers and distinguish them from potential speculators. We then ask a number of questions that have remained unanswered in the corporate risk-management literature. First, do firms actively adjust derivatives positions to take advantage of changes in interest rates? Second, in their choice of interest derivatives instruments, how often do firms correctly anticipate changes in the interest rates? Third, can one predict which firms are likely to be good at correctly anticipating shocks to interest rates, or are correct and incorrect decisions random? Finally, if firms do correctly anticipate the shock to interest rates (even if by accident) what advantages if any does this give them relative to firms that took incorrect positions or took no positions prior to an interest rate shock.

We address these questions using hand-collected data on interest rate derivatives usage by a randomly selected sample of 100 S&P 500 firms from the years 1990 to 2000. For each firm, we aggregate the exposures generated by all the interest rate derivatives instruments outstanding in a given year to determine whether the net effect of the instruments is to convert fixed rate to floating rate or vice-versa. We identify four episodes during the 1990s when interest rates underwent a significant change and examine firms' net derivatives positions as of the fiscal year-end preceding the interest rate shock. Firms are classified as possibly speculating with derivatives, following a consistent hedging policy or not using derivatives using the following method: Firms that maintained either a net fixed to floating rate exposure prior to all four shocks or a net floating to fixed rate exposure prior to all four shocks are classified as *Consistent*. Firms that switched their net derivative exposures from floating rates to fixed rates, or vice versa, at least once during these four periods are labeled *Reverse*. Firms classified as *Consistent* are more likely to be using derivatives as hedging tools while firms classified as *Reverse* are more likely to be using derivatives to speculatively reduce the cost of capital. Firms that had no open derivatives positions prior to the interest rate shock are classified as *Do Nothing*. In our sample, 50 percent of the sample firms fall in the *Consistent* category, 36 percent fall in the *Reverse* category and 14 percent fall in the *Do Nothing* group. Thus, the strategy of reversing net exposures prior to interest rate shocks is quite common. This finding points to the possibility that

[4] Although Faulkender (2005) finds evidence that firms attempt to time the yield curve, the focus of that paper is not to evaluate how well the firms do in their ability to predict changes in interest rate policy.

a significant fraction of firms attempt to take advantage of changes in interest rates by allowing their views on future market movements to affect derivatives positions. The most prevalent strategy, however, seems to be that of consistently maintaining either a net fixed exposure or a net floating exposure. Next, we examine whether firms who consistently follow one strategy are different from firms that reverse their portfolio exposures at least once. According to existing theory, financial distress and agency costs create incentives for firms to hedge. Thus, theory predicts that firms in the consistent category (who are likely to be hedgers rather than speculators) face higher financial distress costs or agency costs. We use leverage and quick ratio as proxies for financial distress and market-to-book and research and development (R&D) expense as proxies for agency costs and find no differences between the *Consistent* and *Reverse* category. Thus, even though we try to distinguish between hedgers and possible speculators, support for existing risk-management theory remains elusive. We do find, however, that operating cash flows of firms in the *Consistent* category are significantly more sensitive to changes in interest rates than firms in the *Reverse* category. This suggests that firms whose underlying business is more exposed to interest rates attempt to hedge interest rate risk. In contrast, firms that face low ex-ante exposure to interest rates appear more likely to take on the added risk of speculating with interest rate derivatives.

Next we examine whether firms that reversed strategies made the right decision, i.e. did they correctly anticipate the interest rate shock. For example, in 1990 when rates were high but falling, Avery Dennison, a manufacturer of pressure sensitive materials, was holding swaps that had fixed rates on $100 million of debt. The firm continued to hold floating to fixed rate swaps throughout 1991 despite the steady decline in interest rates. However, in 1992 and 1993, when interest rates seem to have bottomed out, the firm reversed its position by taking on $150 million worth of fixed to floating rate swaps. Unfortunately for the firm, interest increased sharply through 1994 and the firm found itself on the wrong end of the interest rate shock yet again. In 1995, Avery Dennison wound up its swaps positions and did not use swaps again in our sample period. Examples of this type motivate us to examine whether firms, in general, are able to anticipate interest rate movements. We divide firms in the *Reverse* category into the sub-groups depending on how often the derivatives position taken prior to an interest shock was profitable ex-post. We find that the sample is evenly split between firms that made mostly correct choices

and firms that mostly made wrong choices. Thus, on average, firms in our sample are not skilled at predicting interest rate movements and taking advantage of interest rate changes.

The remainder of the paper is organized as follows. In Section 2, we describe the interest rate environment and define four episodes with monetary policy shocks. In Section 3, we briefly chronicle changes in reporting requirements relevant for our analysis. Section 4 gives a detailed account of our hand-collected derivatives and other firm-specific data. Section 5 contains the main analysis broken down as follows: We first look at whether derivatives users are different from non-users, then compare the firms that are hedging or speculating, and finally compare the post-policy-shock performance of firms in terms of changes in their profitability. Section 6 concludes.

2. The Monetary Policy Environment and Interest Rate Shocks in the 1990s

In this section, we briefly describe the monetary policy environment in the 1990s and identify four different interest rate shocks that will facilitate our analysis of corporate interest rate risk management below.

Most corporate debt contracts are based on the LIBOR (London Inter-Bank Offer Rate). Before entering into a description of the monetary policy environment it is, therefore, important to first check if monetary policy shocks had a sufficiently direct bearing on the value of corporate swap contracts through commensurate changes in LIBOR. To this end we plot the intended Fed Funds rates along with the LIBOR rate in Figure 1. They can be seen to move quite closely together during the sample period. The sample correlation between LIBOR and the intended Fed Funds rate is 0.99 during the period shown in Figure 1.

The 1990s was an eventful and interesting decade in terms of interest rate movements and policies: There were at least four distinct and sustained, credit tightening or easing periods. We identify the following four interest rate shocks.

2.1 Interest Rate Shock 1: The 1992 Continued Easing

Our sample period begins in 1990, when the Fed Funds Target Rate started to gradually come off its peak in 1989, and was just over 8%. Midway through the year, as the recession began in conjunction with the first Gulf War, the Fed lowered the interest rate slightly (see

Figure 2). It stepped up the pace of decreases only halfway through the recession and continued well into the second half of 1992, ending up with a near zero real interest rate in early 1993. The recession ended in March 1991 according to the NBER, but the unemployment rate actually rose sharply in the period after the recession, arguably because the Fed had initially been slow to respond. The reason for the Fed's initial hesitation in aggressively easing credit had been the presence of inflationary pressures in part due to factors related with the war. This suggests that, under Alan Greenspan, the Fed's priority was to contain inflation while not hesitating to offer stimulus in the face of unemployment as long as inflation was in check.

2.2 Interest Rate Shock 2: The 1994 Tightening

The next major move in our interest rate sample came on February 4 1994, after almost eighteen months at a very low rate. This move was in anticipation of increased inflationary expectations, and the FOMC decided to explain its pre-emptive action to the public immediately after its meeting for the first time. On May 17 1994, when the discount rate (not the Fed Funds Target) was increased by 50 bps, an explanatory statement was also issued. Even more information was available in the statement of August 16 1994, when for the first time the exact magnitude of increase in the Fed Funds Target of 50 bps was stated by implication. The following increase of 75 bps on November 15 1994 was similarly announced. By July 6 1995, when the FOMC eased its policy for the first time after sustained increases, the statement explicitly referred to both the current and the new target rates.

2.3 Interest Rate Shock 3: The 1999 Tightening

The next economic shock came in 1998 in the form of the Russian debt crisis and its ensuing effects on LTCM and US markets in general. While decreasing rates, the Fed was careful to emphasize its fundamental commitment to low inflation and this was repeated for future decreases as well. The decrease of September 29, 1998 would have been very difficult to anticipate due to the Fed's tendency to smooth interest rates and its "policy inertia" (Piazzesi 2005) implying further gradual increases at first.[5] However, the series of reductions that followed due to this 'external shock' were abruptly reversed on June 30 1999. We consider this the third significant period in our sample, when rates increased by 175 b.p. over nine months.

[5] Note that it is pointed out above that the FOMC statement in March 1997 appears to have attempted to reduce the probability of further increases by implication through carefully chosen language, possibly due to such an expectation.

The first 7 of the 8 scheduled meetings in 2000 were followed by statements reflecting inflationary risks, though rates were increased only three times (in February, March and May).

Rasche and Thornton (2002) test whether the market was surprised by the announcements.[6] They find that the market was not surprised when the Fed left interest rates untouched. Further, when the FOMC reversed their view completely towards dangers of "economic weakness" on December 19 2000, the futures market had already anticipated this in mid-December. The Fed went on to decrease the rate by 50 bp on January 3 2001, well before the scheduled meeting.

2.4 Interest Rate Shock 4: The 2001 Easing

The abrupt change in 2001, where the Fed began to aggressively decrease interest rates following a sudden and absolute reversal in its outlook is our fourth "shock". This time, with inflation appearing to be under control, the Fed decided to take advantage of its flexibility to counter the slowdown (Greenspan, 2004). They moved even before the recession began, having reduced a full percentage point in less than two months. By the end of 2001, the rate was a full 500 bps lower.

Rasche and Thornton (2003) argue that the market is unable to anticipate far enough ahead (more than six months) what the interest rate will be. This is consistent with Swanson's (2006) argument that while the understanding of the Fed's policy reactions to economic news might have improved, the ability to forecast the underlying economic variables themselves (GDP, etc.) is still limited. Yet, the futures market does anticipate FOMC moves on occasion. Though the evidence suggests that improvements in their forecasts are mainly due to increased FOMC transparency, it is difficult to ascertain whether certain types of firms are more sensitive to the information about the real economy that they gather in the course of doing business. Clearly, this additional information might help them condition publicly available information to their advantage.

Figure 2 displays the history of the intended Fed Funds rate over the period 1990-2001 as in Figure 1, but it now has the two NBER recessions shaded as well as our four interest rate shocks circled.

[6] They use the Poole and Rasche (2003) measure of FOMC meeting surprises based on the Fed funds futures market, whereby a significant post-announcement jump (>5 b.p.) implies a surprise.

Interest rates steadily and steeply declined starting in 1990 until the middle of 1992, and then stayed low for over one year before the FOMC made its first public announcement in 1994 indicating a tightening bias. Following this, rates steadily rose for a year, then adjusted slightly and made another significant move upwards at the end of 1999, only to sharply reverse direction after 2000. As discussed above we will focus on the years ending in December of 1991, 1993, 1998 and 2000 respectively. For the year following these dates, it would have been profitable to have had an increased floating rate exposure in 1992 and 2001 and an increased fixed rate exposure in 1994 and 1999. This is true when we are considering the exposure on debt, and the reverse would be true for exposure to swaps that have investments as their underlying (and for which we adjust).[7]

Figure 3 provides an alternative justification of the choice of shocks. The markers on the graph represent the 6-9 month old forecasts in light grey and the 9-12 month old forecasts in black. The forecasts are matched in time with the quarter for which the forecasts were intended. We do not have forecast data prior to 1993. Nevertheless, it is interesting to note that the forecasts seem to consistently lag the realizations during the three interest rate shocks for which we have forecasts, namely the 1994 and the 1999 tightening as well as the 2001 easing.

3. The Regulatory Framework for Reporting on Derivatives Use

In this section we give a brief overview of the reporting requirements regarding derivatives use in the 1990s.

In December 1989, the Federal Accounting Standards Board (FASB) issued the Statement of Financial Accounting Standards No. 104 (FAS104) that amended FAS95 (November 1987) to allow for hedge based accounting classification *as long as the accounting policy was disclosed*. Hedge-based accounting classification refers to the practice of assigning derivatives based cash flows to the same category as an identifiable underlying. Under the original FAS95, such transactions were required to be classified according to the nature of the

[7] Please note that we refer to swaps rather than interest rate instruments although we do account for forwards/futures and caps or floors where the implications are clear – this is because swaps are by far the predominant instrument used by the firms for interest rate management.

cash flows, and not under the headings of the items being hedged. The Statement was made effective for financial years ending after June 15, 1990.

FAS95 was followed by FAS105 in March 1990 which was entitled: Disclosure of Information about Financial Instruments with Off-Balance-Sheet Risk and Financial Instruments with Concentrations of Credit Risks. FAS105 was introduced as a first step toward a general system of reporting financial instruments whose usage and variety was steadily increasing. It required fuller disclosure by corporations about their off-balance sheet financial transactions that included the notional principal accompanied by information/discussions about the applicable market and credit risk.[8] FAS105 was also applicable for financial years ending after June 15, 1990 and has since been superseded by a series of other statements beginning with FAS107 (Disclosures about Fair Value of Financial Instruments) that was issued in December 1991. FAS107 mainly had the impact of extending and generalising the applicability of FAS105 and it was applicable for financial years ending after December 15, 1992.[9]

In October 1994, the FASB issued FAS119: Disclosure about Derivative Financial Instruments and Fair Value of Financial Instruments, which would be effective for financial statements ending December 15, 1994 (see footnote 11). This statement extended the applicability of disclosure requirements to instruments that did not have market risk, required identification of instruments held for trading purposes, and specified further classification of instruments, while "encouraging" but not requiring increased quantitative disclosures. Thus, during the period beginning in 1990, companies disclosed relatively more information about their actual derivatives positions in the footnotes to their annual financial statements.

The propensity to provide quantitative and transparent information about the actual positions in swaps was reduced after 1999, when FAS133 (Accounting for Derivative Instruments and Hedging Activities) was initially set to come into effect. FAS133 was deferred by a year to 2000 under FAS137. FAS133 and subsequent statements laid down rules for an accounting treatment of derivatives that incorporated them into the balance sheet (and earnings statements). They also removed the emphasis on provision of specific position information in the

[8] "…applies to all financial instruments with off-balance-sheet risk of accounting loss and all financial instruments with concentrations of credit risk…" with some exceptions that are not relevant to this current paper (FAS105, 1990). Note that, in the "nature and terms", companies were not absolutely required to disclose the specific positions if they included a discussion on the credit and market risk and the cash requirements, along with accounting policies.
[9] For entities with assets below $150 million, the date was December 15, 1995.

footnotes as long as risk management methods and accounting policies were clearly enunciated. Thus, the period offering distinct information on the companies' derivative transactions ended around 2000.

4. Data on Derivative Use from Corporate Filings

Having surveyed the interest rate environment and the disclosure requirements on derivatives use in the 1990s we are now ready to describe our derivative data collection methodology.

In order to construct our sample, we randomly picked a company from the S&P 500 index, and checked to see if there was a history of annual financial statements available for it in the 1990s through a combination of Mergent Online which provides EDGAR SEC filings data typically starting with the fiscal year 1994, as well as Lexis-Nexis for the earlier years. If not, then we randomly drew another company. In this manner, we collected data on 100 companies for the financial years 1990 through 2000. As discussed above, the choice of this period is dictated by the creation of a window in time when corporate disclosures on derivative usage were more informative.

4.1 Derivative Position Data

The data we collected includes the types of derivatives used by the company in a given year, with detailed information on interest rate derivatives. We searched the financial footnotes through the use of multiple search terms in addition to looking for certain sections of the footnotes manually to ensure detailed and accurate data.[10] Our initial experience showed that searching for standard terms such as "swap", "cap", "futures", "forward", "floor", "collar", and "hedg" was not sufficient as companies often use terms such as "interest rate protection agreement" and "interest rate exchange agreement". In order to ensure completeness, we read the sections that referred to fair value disclosures, risk management, off-balance sheet instruments, and debt. When companies mention the hedging of investments as one of their reasons for using interest rate derivatives, we also read the section on investments.

[10] The practical arrangements for collecting the data are described further in Appendix 2.

We classified interest rate instruments as either changing the firm's exposure from floating rates to fixed rates or vice versa. By floating to fixed, we imply an instrument that changes the interest rate exposure from a US Dollar denominated (and thus US monetary-policy sensitive) floating rate such as USD LIBOR to a fixed US dollar rate, directly or indirectly. The exposure is always seen from the point of view of a liability, so that an increase in interest rates is a negative development for a firm with floating rate exposure and a positive development if you have fixed rates instead. Similarly, a reduction in interest rates is good if you have floating rates and bad if you have fixed rates.[11] We ignored the use of cross-currency swaps when they were being used to hedge foreign exchange exposure unless they were clearly shown to have an effect that would fit them into one of our two main categories, viz. floating to fixed and fixed to floating.

We also collected data on the variety of interest rate instruments used by the companies. Finally, we recorded whether the firm hedges other exposures, for example currencies and commodities, using derivatives.

The level and clarity of the disclosures vary significantly across companies. Some companies report individual contracts, since swaps are usually on large sums and are not very frequent. Other companies only provide aggregate level information on the notional and fair values and the direction of the swaps (fixed to floating or vice versa). This latter format is sufficient for our purposes as long as the underlying item(s), whose exposure is being "hedged," are delineated. We merely need it to be clear that underlying items are either liabilities or assets, and not a combination of both.

Effectively, the data gives us a snapshot at the end of each year as to whether companies were taking on more fixed rate or floating rate exposure on their debt through derivatives. After collecting detailed information about all the instruments in the disclosures, we aggregated the exposures generated by derivatives into floating to fixed or fixed to floating. Where the disclosures were not sufficiently clear or we were not confident that we were obtaining a clear picture of the companies' positions, we dropped those companies from our sample. As a result,

[11] When rates fall, the fair value of fixed rate debt increases while that of a swap converting floating to fixed rates falls.

we have a final sample containing 91 firms over the eleven-year period with some missing observations in specific years generated by missing clarity in disclosures.

Table 1 and Figure 4 summarize the derivative usage statistics of firms in the sample by year. The first three columns in Table 1 refer to companies' disclosure about using *any type of derivative*. The number of companies making an informative disclosure is provided, followed by the number (and percentage) of firms among those disclosing that actually used a derivative instrument in the given year. The next three columns repeat this exercise for firms that use *any interest rate derivatives*, reporting the number of firms and their proportion among all disclosing firms and those that use derivatives. On average, around 80% of firms in our sample were using derivatives in a particular year and around 70% of derivative users were using interest rate derivatives. The final three columns in Table 1 present the number of firms using swaps, and show that almost all interest rate derivative users in a given year were using swaps. Figure 4 presents the same information graphically. Visually, there appears to be a pattern in usage of interest rate derivatives over the period that is not as pronounced for all derivatives and that might be linked to the interest rate movements.

It is important to note that the actual makeup of derivative users varies from year to year, implying that a larger proportion of companies used derivatives at *some* point over the eleven-year period. Also, several companies stated that they used derivatives while at the same time stating that they had no open positions for more than two successive annual statements. Further, Faulkender (2005) presents evidence that firms are minimizing their short term interest costs when they decide on the kind of exposure for newly issued debt. Similarly, several firms state in their footnotes that they explicitly wish to reduce the cost of debt. This approach would imply that swaps are taken on for short periods and reversed regularly.[12] Yet, the initial duration of typical swap contracts in our sample tends to be in line with the long-term debt, which is longer even than the tightening and loosening cycles for monetary policy. In addition, there is no consistent pattern among firms whereby they would all be changing their exposure regularly in a particular direction. In the cases where the firms change the direction regularly, we have again no evidence of a directional pattern as the firms are quite evenly divided in terms of the positions they take. Thus, we need to study how well firms anticipate the changes in the regimes, how they

[12] If this were not true, merely the minimizing of short-term costs would not be consistent with rational behavior and we would need other reasons for the managers to severely sacrifice the future for very short-term gains.

react to the changes, and what they do during periods of flat rates when there may be more uncertainty. These observations point to the potential usefulness of a sample that covers a longer period of time and also of checking for actual exposures as opposed to standard statements in the annual reports indicating the possibility of taking up derivative contracts.[13]

4.2 Interest Rate Data

While the derivative usage and position data helps us look at what types of firms use derivatives and distinguish their usage style (hedging or speculating), we need interest rate data to use this information in the context of their interaction with monetary policy. Specifically, we need to identify points when interest rates underwent a significant change or the direction of monetary policy was shifted from one of tightening to one of loosening credit or vice versa. To this end we use the four interest rate shocks defined in Section 2. We then use these periods to evaluate the performance of firms' derivative strategies and also the impact of monetary policy shocks on firms' subsequent performance.

4.3 Firm Characteristics

Based on existing theories on why firms hedge or use derivatives, we collect data from Compustat on market value, sales, leverage, liquidity, research and development, and profitability measures including cash flow margins and return on assets. The data are collected for the years 1989 through 2001 and are summarized in Table 2, with the pair-wise correlations in Table 3. Market value (mv) is calculated as the product of data items 25 (common shares outstanding in millions) and 199 (share price at the close of the fiscal year) in the industrial annual Compustat file. Similarly, sales is item 12, leverage (lev) is total liabilities (long term debt – item 9, plus debt in current liabilities - item 34) divided by total assets (item 6), while research and development (rnd) expenditure (item 46) is normalized by sales (item 12). For liquidity, we define the variable quickratio as cash plus short term investments (item 1) divided by current liabilities (item 5). Cash flow margins (cfm) are calculated as operating income before depreciation divided by sales (item 13/item 12), and return on assets as income before extraordinary items divided by total assets (item 18/ item 6).

In Table 2 and Table 3, we also include the variables forex and commodities, which each

[13] Some of the corporate statements are taken verbatim from FASB guidelines such as FAS 105, paragraph 45.

take the value 1 if a firm used foreign exchange derivatives or commodities derivatives respectively at any time during the sample period, 0 otherwise. Commodities derivatives are not meant to include long-term supply or purchase contracts which are different from the financial derivatives we consider, as in the latter, financial settlement is an alternative to physical delivery.

Thus, our three main sources of data are the financial statement footnotes for derivative position disclosures, the Federal Reserve for interest rates, and Compustat for balance sheet and income statement variables. In the next section, we report the analyses conducted.

5. Analysis and Results

In this section, we attempt to classify firms as potential hedgers or speculators and examine whether there are any observable differences between the two types of firms. We also examine how good firms are at correctly anticipating interest rate shocks. Finally, we test whether correctly anticipating interest rate shocks confers a competitive advantage to a firm.

5.1 A Case Study

Before proceeding with the analysis, we first consider the example of Avery Dennison (AVY), a manufacturer of pressure sensitive materials, to help clarify our approach and note the kind of actions a firm could take based on its opinion of interest rate trends. The positions taken by the firm are summarized in Figure 5.[14] In 1990, when rates were high but falling, the company was holding swaps that fixed rates on $100 million of debt, which the firm retained throughout 1991. They fixed rates on another 50 million dollars in 1992, though this time it was when rates were quite low, and had 150 million in fixed rate swaps in total. However, rates remained low in 1993, and by the end of 1993, the firm had reversed its position by taking on 150 million dollars of floating rate swaps (under which they received a much lower fixed rate as per the market conditions). Unfortunately for them, rates were raised in 1994, while they had taken on another 20 million dollars of floating rate exposure through swaps. In 1995, they wound up all their swap positions (while the others expired), and they did not use swaps for the rest of the period in the sample. Between 1990 and 1996, the total long term debt of the firm remained between 311 and 376 million dollars, starting at 376 in 1990 and ending at 370.7 in 1996. In this

[14] Please see Appendix 1 for a footnote extract for this company.

case, we see a firm that fixed rates when they were high (ostensibly as a hedge against further increases). However, when they were losing the benefits of lower rates, they reversed their positions on less favorable terms only to find themselves at the wrong end of a policy shock again. If they had maintained a consistent hedge or position in one direction only, one could argue that they would have been better off (or at least no worse off) than in the scenario that unfolded. One could argue then, that firms that take on only one type of exposure are more likely to be doing so to hedge their interest rate exposures than those that are regularly reacting to market conditions ostensibly to reduce costs.

5.2 Derivatives Use and Firm Characteristics

We begin by classifying firms into several categories depending on whether they use interest rate derivatives, the direction of interest rate exposure conferred by the derivative positions, and the frequency with which the firm changes the direction of their swap positions. We sort the companies according to whether they had open interest rate derivative positions at the year-ends 1991, 1993, 1998 and 2000. Those that had no open positions are classified as Do Nothing. We then sort the remaining firms based on whether their net exposure from derivatives was either floating to fixed or fixed to floating throughout for any years in which they took positions. Firms which had only one type of exposure throughout the period (whenever they had open positions) are classified as Consistent. Note that we do not distinguish between those that had only floating to fixed positions and those that had only fixed to floating positions. We could think of this category as more likely to be hedgers, when compared to the next category which we consider as more likely to be speculators. This last category consists of firms that at least once in the period had switched their net derivative exposures from floating rates to fixed rates or vice versa and is labeled Reverse. It is not necessarily the case that the switch happened in consecutive years, but just that these firms were opportunistically using derivatives to go in both directions at different points in time. We further break down the Reverse firms into Mostly Correct, Half Correct, and Mostly Wrong. In order to split them so, we count the number of times the firms took a position before the four shocks, and the number of times the position they took would be profitable in light of the following year's interest rates. Those that had a proportion of profitable positions at more than 50% were classified as Mostly Correct. Similarly, Half Correct had a 50% success rate and Mostly Wrong less than 50% success. When making category comparisons we lump those that are correct 50% or less (Half Correct and Mostly

Wrong) into a single group. Table 4 lists the categories and the averages (over the entire period) of their characteristics which include sales, market value, leverage, quick ratio, research and development expenditure, cash flow margins, return on assets, and market to book ratios.

Of the 91 firms, 78 used interest rate derivatives at some point during the sample period. Of these, 45 (58%) fall in the Consistent category suggesting that the majority of firms (half the total sample) might be taking up derivative positions to follow a simple strategy. That only 13 firms are in the Do Nothing category is not surprising given that our sample is drawn from S&P 500 firms. However, it does provide us with a reasonable balance in the sample to conduct our tests. We see 33 firms, a significant fraction at 42% of derivative users, are categorized as Reverse, suggesting that speculation could be quite prevalent among certain types of firms. Among the Reverse firms, they are evenly split between Mostly Correct (10), Half Correct (10) and Mostly Wrong (13). This suggests that those firms that switched their net derivative exposures were on average just as likely to be correct or wrong in anticipating the future direction of interest rates. In terms of their usage of derivatives on other underlying exposures (currency and commodities), we observe that a higher proportion of the Reverse firms also use forex (82%) and commodities (39%) derivatives as compared to the Do Nothing firms (54% and 23% for forex and commodities respectively). Only two of the ten Mostly Correct firms use commodities derivatives while approximately half of the 23 Half Correct or Mostly Wrong firms do so. Approximately half of the Consistent firms also use commodities derivatives, while two-thirds also use currency derivatives.

In the last five columns of Table 4, we report the differences in the average firm characteristics between the following selected pairs of categories: All users vs. Do Nothing, Consistent vs. Do Nothing, Do Nothing vs. Reverse, Consistent vs. Reverse, and Mostly Correct vs. Half Correct or Mostly Wrong. Derivative users on average have higher leverage and lower return on assets, market to book ratios, and liquidity (though the quick ratio difference is only weakly significant) than the Do Nothing group. Although Do Nothing firms have higher return on assets and market to book ratios than Consistent firms, the differences between their leverage ratios are only weakly significant. On the other hand, Reverse firms are significantly more levered than Do Nothing firms and appear to have lower return on assets (though this latter difference is only weakly significant). When comparing the Do Nothing firms with the sub-categories of the Reverse group, we have very few observations, but find that Mostly Correct

firms are larger than Do Nothing firms while Mostly Wrong or Half Correct firms do not have significantly larger sales than the Do Nothing firms. This appears to be consistent with existent literature, where larger firms are accorded an advantage from the point of view of ability and intent to use derivatives. No significant differences in the selected firm characteristics present themselves between the various sub-categories among the derivative users.

The results of the basic univariate comparisons seem to indicate that the average characteristics of firms are quite similar in the various categories, except that larger firms, firms that have other types of derivatives programs, those with higher leverage, tend to be more active in their use of interest rate derivatives. The higher leverage and weak support for differences in quick ratios would seem to suggest a hedging motive, except that it is the Reverse firms that have significantly higher leverage than Do Nothing firms, and their quick ratios are higher (though not significantly so). At the same time, derivative users have lower market to book ratios, while research and development expenditures do not appear to be significantly different across the firms. While providing mixed evidence on growth opportunities, this seems to be contrary to what we would expect from hedging arguments. This is not surprising given that 35% of firms explicitly listed cost reduction as a reason for using interest rate derivatives in their financial statements.

Next, to consider the firm characteristics in a multivariate setting, we run a series of cross-sectional logistic regressions. To avoid losing observations, we follow a common practice by assigning a value of 0 where no research and development expenditure is provided by the firms (according to the Compustat database).

In Table 5, we present three probit regressions. In the first, the dependent variable is 1 if the firm used interest rate derivatives at any point in the sample period, 0 otherwise. In the second, we restrict the sample to users and set the dependent variable equal to 1 if the firm is Consistent (and thus 0 if it is Reverse). The third regression sets the dependent variable to 1 if the firm is a Reverse firm, and 0 otherwise. The regressors include all the firm characteristics (we drop sales in favour of market value as a "size" variable), and the dummies forex and commodities that represent use of the respective derivative types. We use robust standard errors and report the p-values below the estimates. The estimates reported are not the raw estimates, but the marginal effects estimated at the mean of the variables. Higher size is associated with a

higher probability of the firm using interest rate derivatives, as well as the presence of a derivatives program for foreign exchange. Among derivative users, the probability of a firm being Consistent is associated positively with the cash flow margins, and negatively with market to book ratios. A firm is more likely to be in the Reverse category if it has higher leverage, lower cash flow margins, and also uses forex derivatives.

The multivariate regressions also provide conflicting evidence for a hedging motive. Firms are more likely to follow a hedging rather than a speculative approach when they have higher operating profit margins and lower market to book ratios, while those that have higher leverage are more likely to be speculating as opposed to doing nothing or hedging. Although higher leverage would be associated with higher interest rate risk, it would be consistent with both a hedging and speculation motive. Since the other hedging oriented variables offer at best conflicting support, the findings could be seen as suggesting that interest rate derivatives might not be used only for hedging purposes as much as other kinds of derivatives.

5.3 Cash Flow Sensitivities

In addition to the indirect model-based variables used to test for hedging incentives above, there is also the direct question of whether firms' cash flows are sensitive to interest rate changes. Faulkender (2005) uses sensitivity of cash flows to interest rates estimated from a quarterly regression on a firm-by-firm basis for this purpose. The cash flow measure he uses is operating income before depreciation normalized by book assets, while the interest rate is LIBOR. He uses data from five years preceding the date of debt issuance. Purnanandam (2007) suggests that a firm-by-firm regression presents a very noisy estimate of this sensitivity, and thus estimates a single sensitivity measure for all firms in a particular industry instead. In this paper, we are interested in knowing whether there is any difference between the Reverse, Consistent and Do Nothing groups in terms of their cash flows' sensitivity to interest rates. Thus, we adopt a slightly different approach by grouping all firms into a single panel regression, using data over all the quarters from January 1989 through December 2001. The dependant variable is cash flows/book assets as in earlier papers, regressed on LIBOR, dummies for two of the three groups, and their respective interaction terms with LIBOR to estimate the slope differences.[15] As we are

[15] We also use cash flows/sales for robustness, and find that the main finding about differences between groups holds for this alternative specification.

interested to see if the Reverse group firms have a motivation to more actively change their derivative exposures, we consider them as the base group, and use dummies for Do Nothing and Consistent firms. Also, to account for firm-specific characteristics in a simple way, we use a fixed-effects specification for the regression. The regression results are presented in Table 6 for the following two specifications (fixed effects and random effects).

$$CF_{it} = \beta_{0,i} + \beta_1 LIBOR_t + \beta_2 DoNothing_i * LIBOR_t + \beta_3 Consistent_i * LIBOR_t + u_{it}$$

Since the mean cash flow dummy would lead to collinearity in the fixed effects regression, this specification provides us with estimates only of the difference between the sensitivities of the cash flows of the Consistent and Do Nothing groups with that of the Reverse group. Thus, we also run a random effects regression specified as

$$CF_{it} = \beta_0 + \beta_1 LIBOR_t + \beta_2 DoNothing_i + \beta_3 DoNothing_i * LIBOR_t + \beta_4 Consistent_i + \beta_5 Consistent_i * LIBOR_t + \alpha_i + u_{it}$$

which we estimate by the Feasible Generalized Least Squares method. In both cases, we estimate robust standard errors, and we find that the Do Nothing firms are not different from Reverse firms in terms of their cash flows, and only very marginally different from them in terms of their cash flows' sensitivity to LIBOR. On the other hand, Consistent firms have lower cash flows and higher sensitivity of cash flows to interest rates than Reverse firms.

5.4 Policy Shock Analysis

We now consider the impact on firms of being in an ex-post profitable or loss-making derivatives position at the end of the years 1991, 1993, 1998, and 2000. In December 1991, the rates had been falling continuously and at a steep rate for two years, and had come down from 8.25% to 4% already. However, the FOMC policy stance was not publicly known and the rates continued to fall for a further year before bottoming out. At the end of 1993, in fact in February 1994, the Federal Reserve announced their intention to target a higher interest rate for the first time, and this was followed by a sustained increase of approximately 3 percentage points over the course of 1994. In contrast to such large changes, the rate increase in 1999 was less than a percentage point, and the rate kept increasing to 6.5%, when at the end of 2000, there was a sudden and sharp reversal downward. If companies are able to anticipate policy, they may not be able to adjust their debt exposures directly, but they can adjust their swap exposures to reduce

their cost of debt. The earlier part of the analysis was whether there were any characteristics recognized in the standard theory that would help predict which types of firms are more or less successful at anticipating changes in interest rate policy. The question we ask in this analysis is whether anticipating these changes makes any real difference to the performance of firms. In order to look at this, we compare the percentage change in sales, change in leverage, and also the change in cash flow margins as a metric for profitability.

In Table 7 we group together the observations from 1991-92, 1993-94, 1998-99, and 2000-01 and then classify the firms first based on whether they had an interest rate derivative-based net exposure on the relevant date. Those that "do nothing" turn out to have an improvement in cash flow margins, while those that had active positions have a fall in cash flow margins, more so for those that had the wrong exposure. The sales for all firms increased with the highest percentage increase being for firms that were right, and the lowest for those that did nothing.

Now we consider the differences between the groups. We focus on two comparisons: those that do something versus those that do nothing, and those that were wrong versus all others. For the first comparison, in Table 8, we see that the two groups had a statistically different growth in sales, with those that used interest rate derivatives growing more aggressively. However, these firms also had a greater increase in leverage, a decrease in the quick ratio to a relatively lower level, a decrease in their cash flow margins, an increase in their interest expense, and a higher level of market share (though the change was not significantly higher). There was also weak significance in the difference between the two groups' research and development expenditure to sales ratios.

We also compared the firms that were right and wrong, and found limited significance in their differences (See Table 9). This leads us to believe that an important source of the differences arises between those that were wrong and those that did not take up derivative exposures in the relevant years. This clearly stands out in the case of changes in cash flow margins, which we focus on in a multivariate setting below. From this part of the analysis, it appears that companies that had wrong exposures fared worse than others in terms of their profitability, while those that had the right exposures did not necessarily gain much.

The findings from the univariate comparisons are also confirmed in a multivariate setting,

where we find that those who took interest rate derivatives positions suffered in terms of their cash flow margins. However, when we separate those that had an ex-post profitable exposure, we find no effect. This leads us to the conclusion that the result is driven by those who have an ex-post negative outcome. As we see in the specification 3 of Table 10**,** cash flow margins for firms that had the wrong direction of net exposure suffered in the years immediately following the exposures.

6. Summary and Conclusions

In the paper, we have controlled for a wide range of firm specific variables and found that size, leverage, and existing derivatives programs (e.g. use of currency derivatives) are positively related to a firms' decision to use interest rate derivatives. This finding is consistent with existing literature. However, in a multivariate logistic regression, only leverage and to an extent, sales appear significant. These analyses are conducted using data about the firms aggregated over the entire sample period. Further, we find that those firms that were more often successful in their anticipation of interest rate shocks over the entire period, or those that maintained a consistent single-exposure policy in their derivatives usage throughout the period were larger than those that were not so successful.

We may still need to consider holdings of insiders, industry performance, and distance to default of firms for the hedging versus speculation or user versus non-user comparison.[16] We could also consider the effect of tax non-linearity, if any, on hedging incentives. Finally, Froot, Scharfstein and Stein (1993) show that internal cash flow variability could have effects on investment, and this has led to the use of cash flow sensitivity to interest rates as a measure of hedging performance. We would need to consider a duration-based measure to directly account for interest rate risk rather than rely on any specific hypothetical objective for risk management.

Note, however, that these considerations only apply to questions of whether firms are hedging or speculating. They do not affect the results related to the *impact* of using derivatives or on the *success in predicting shocks*, nor the differences between users and non-users of

[16] Theoretical justifications for these variables could be drawn from, for holdings of insiders, Stulz 1984, for industry performance, Breeden and Viswanathan 1990, DeMarzo and Duffie 1995, and for distance to default, Smith and Stulz 1985.

derivatives. The first question has recently been addressed in several papers and our conclusions are in line with these papers as they find that firms use interest rate derivatives in a manner that is not fully consistent with hedging. On the latter set of questions, we have used our unique dataset to observe the behavior of firms over a longer period of time and in the case of both upward and downward shocks in interest rates. Here, our main conclusion is that firms that do not have open derivative positions and those that have correctly anticipated the change in direction of interest rates do not benefit much when shocks occur. However, those that have the wrong exposures experience a significant decrease in margins. While the latter outcome should be expected, the former brings into question the overall usefulness of using interest rate derivatives by firms, especially as a device to reduce borrowing costs.

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Appendix 1: Sample Footnotes

Avery Dennison – Jan 01, 1994

"The Company enters into interest rate swap agreements and collars to reduce the impact of changes in interest rates on its short− and long-term variable rate borrowings. Interest paid or received on interest rate swap agreements is recognized as an adjustment to interest expense.

During 1993, the Company entered into five 2−year interest rate swap agreements for an aggregate of $100 million under which it will pay interest based on LIBOR (the weighted average rate at year end was 3.4 percent). The Company will receive interest at a weighted average rate of 4.1 percent.

During 1992, the Company entered into two 3−year interest rate swap agreements for an aggregate of $50 million under which it will pay interest based on LIBOR (the weighted average rate at year end was 3.4 percent). The Company will receive interest at a weighted average rate of 6.4 percent. The Company also entered into a $50 million 3−year interest rate swap agreement under which it will pay interest at a rate of 9.4 percent. The Company will receive interest based on LIBOR (the weighted average rate at year end was 3.4 percent).

During 1990, the Company entered into four 5−year interest rate swap agreements for an aggregate of $100 million under which it will pay a weighted average rate of 9.0 percent. The Company will receive interest based on LIBOR (the weighted average rate at year end was 3.5 percent). The fair value of all interest rate swap agreements at the end of 1993 was estimated by obtaining dealer quotes and was a net liability of approximately $13 million.

During 1989, the Company entered into two agreements with a domestic bank which effectively set interest rate limits on $35 million of the Company's short-term borrowings. The interest rate collars, which were effective June 1989, limit the interest rate to a range of 7 to 11 percent through June 1994. The fair value of these agreements at the end of 1993 was estimated based on dealer quotes and was a net liability of approximately $1 million."

Appendix 2: Data Collection Procedures

Undergraduate students were selected to collect the data as much for their finance or accounting background as for their ability to read and correctly interpret long, winding or complicated sentences. The selected students were then provided a refresher on the types of derivatives used by corporations and how to classify and distinguish those with similar terms. This classification was filtered as we moved along and came across the use of basis swaps and commodity swaps, for instance.

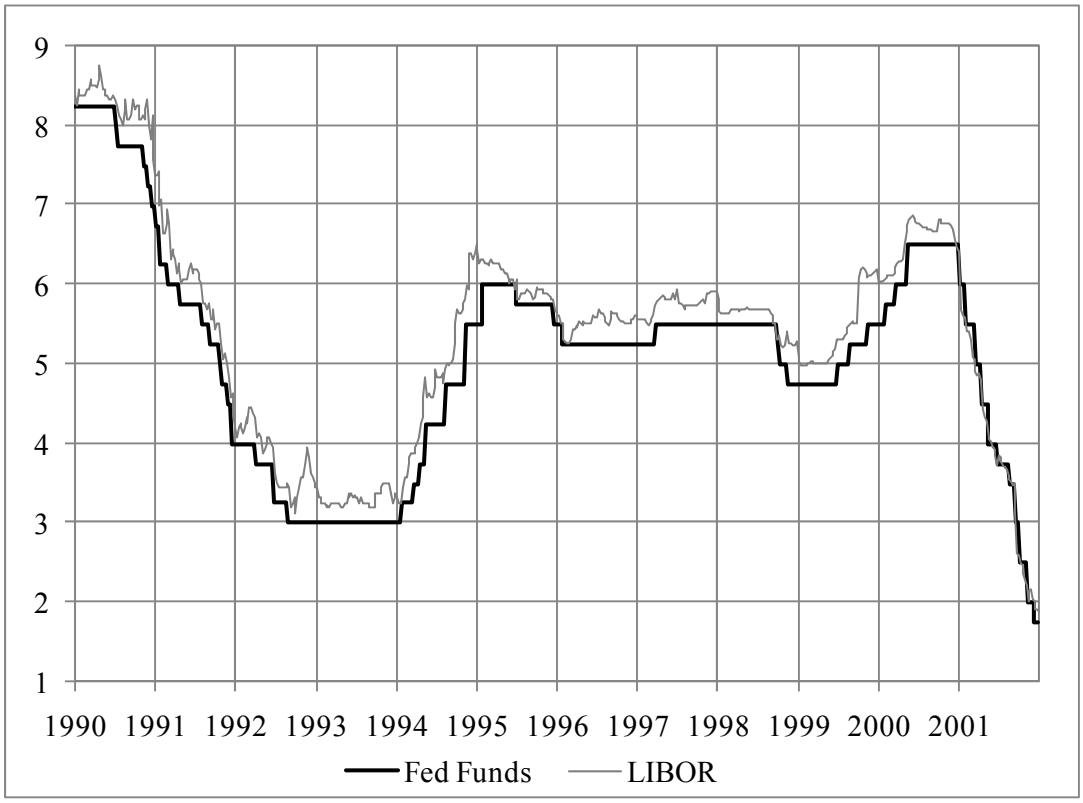
During the actual coding process, the first task for each student was to take the randomly selected firms in sequence and check if there was a public record of financial statements available for the sample period in question. As the EDGAR filings are available only after 1994, we first relied on an old set of CDs containing monthly digests of financial results until we discovered that annual reports/10K filings were also available through the Lexis-Nexis database system.

The lack of a precise standard for corporate statements implied we had to learn over the course of data collection and improve our processes.[17] To achieve this, when initially starting with reports from the early years, we began with as wide a search as possible, reading the entire sections on debt, investments, financial instruments, and using wide search terms such as "interest", "interest rate", "risk", and "hedg" apart from the standard terms like "swap". The students entering the data were supervised or supported so that any questions they may have were immediately answered. Initially, at least two students worked independently on the same company, and their files were compared to ensure standardization. There was also an intermediate confirmation procedure in place so that they could cross-check their interpretation of disclosures with their neighbor as they worked together. The resulting sharing of observations led to a rapid learning process about where in the notes to look and how to record the data. Also, a student would work on one company at a time, taking advantage of any continuity in the reporting and cross-checking occasional typos with the following or previous years' reports.

[17] A study by Roger Merritt of Fitch (the rating agency) on the hedge accounting practices of 57 companies with more than USD 1 trillion of debt found the quality of disclosure to be very varied and lacking in clarity. Inconsistent and inadequate disclosure is a persistent problem related to accounting for derivatives, and thus the window of data we collect is a very useful snapshot of corporate risk management activities.

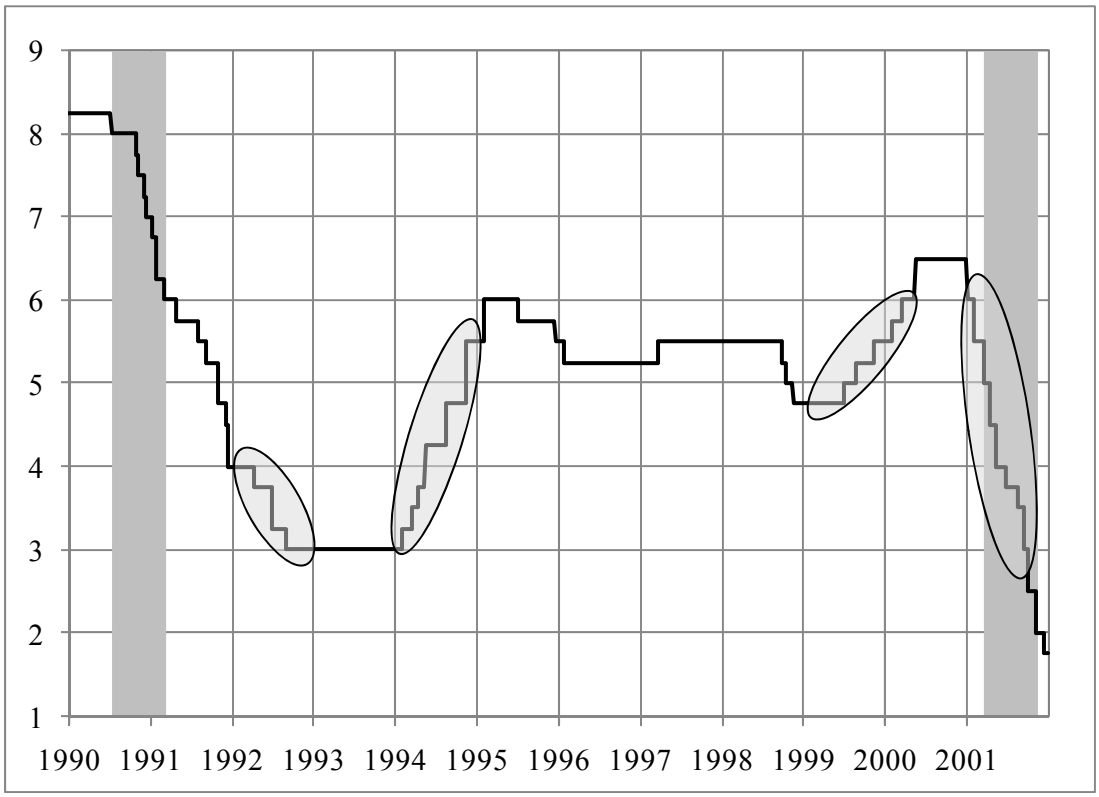
Despite all these checks and balances, the awkward and non-standard use of terminology and differences in emphasis on disclosure by firms led to challenges for slotting all the information into clear categories. Thus, where information was reported differently, students were required to insert a new column and record the data as originally classified by the company, and incorporating a "remarks" column if necessary. Simultaneously as these reports were prepared, we also attempted to retain a standard format for the data classifications, ultimately compiling all the firms into a standard coded database containing the key pieces of data with separate room for recording any remarks that were needed.

Figure 1: Weekly Intended Fed Funds and LIBOR Rates (Percent).



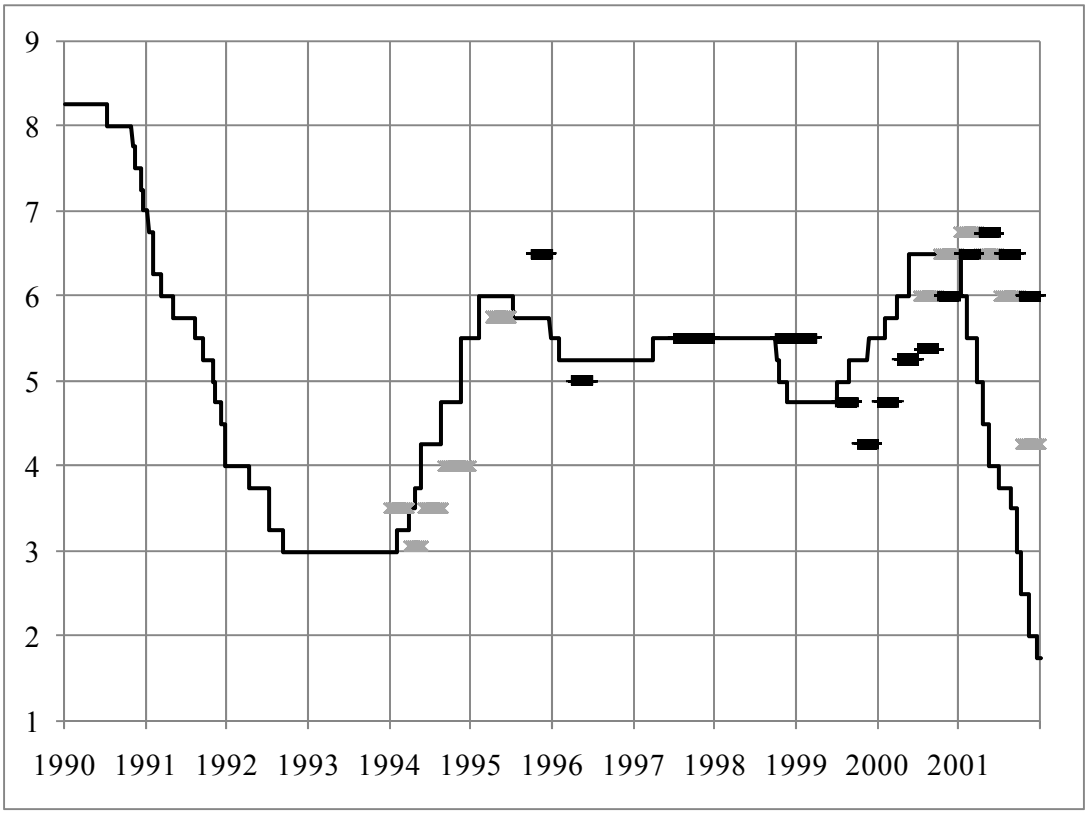
Notes to Figure: We plot the intended Fed Funds rate and the LIBOR rate on every Friday during 1990 through 2001.

Figure 2: Intended Fed Funds Rate, NBER Recessions, and Interest Rate Shocks



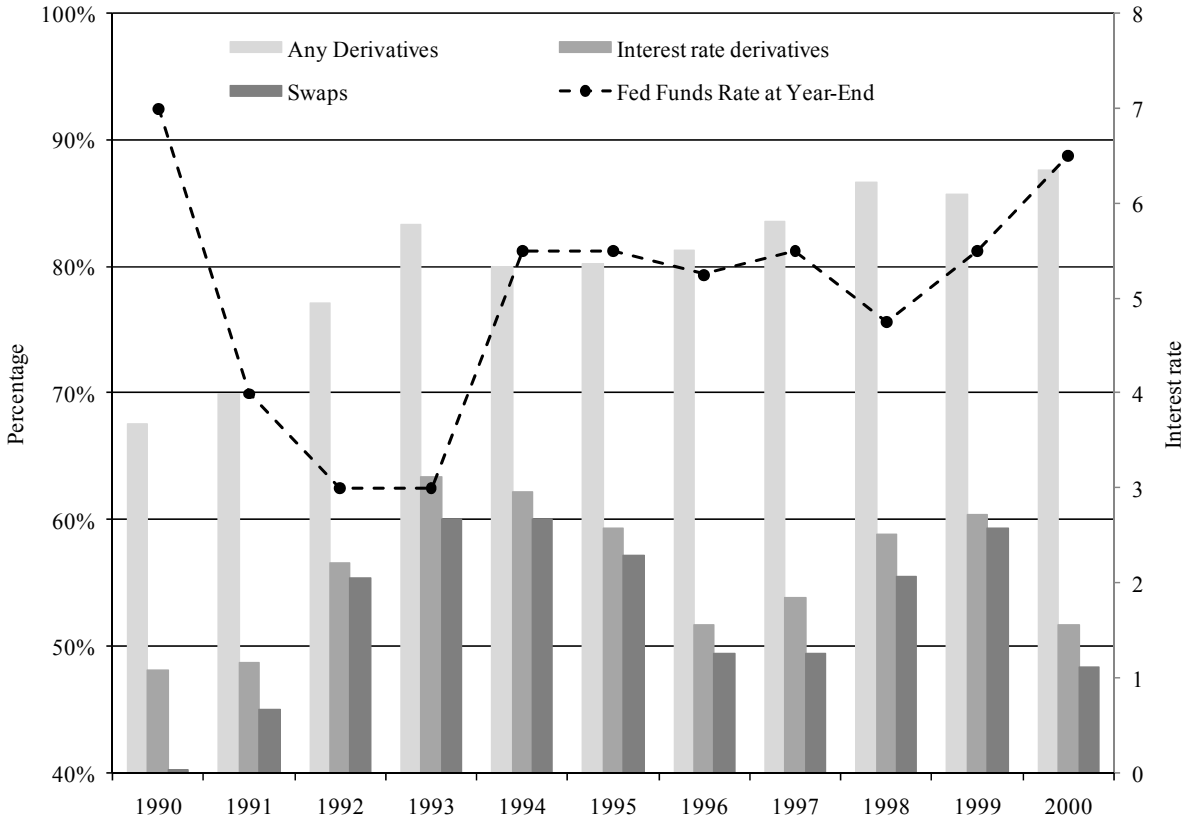
Notes to Figure: We plot the intended Fed Funds rate with the NBER recessions imposed as shaded areas. We also encircle the four interest rate shocks identified in Section 2.

Figure 3: Consensus Survey Forecasts and Fed Funds Rate Realizations



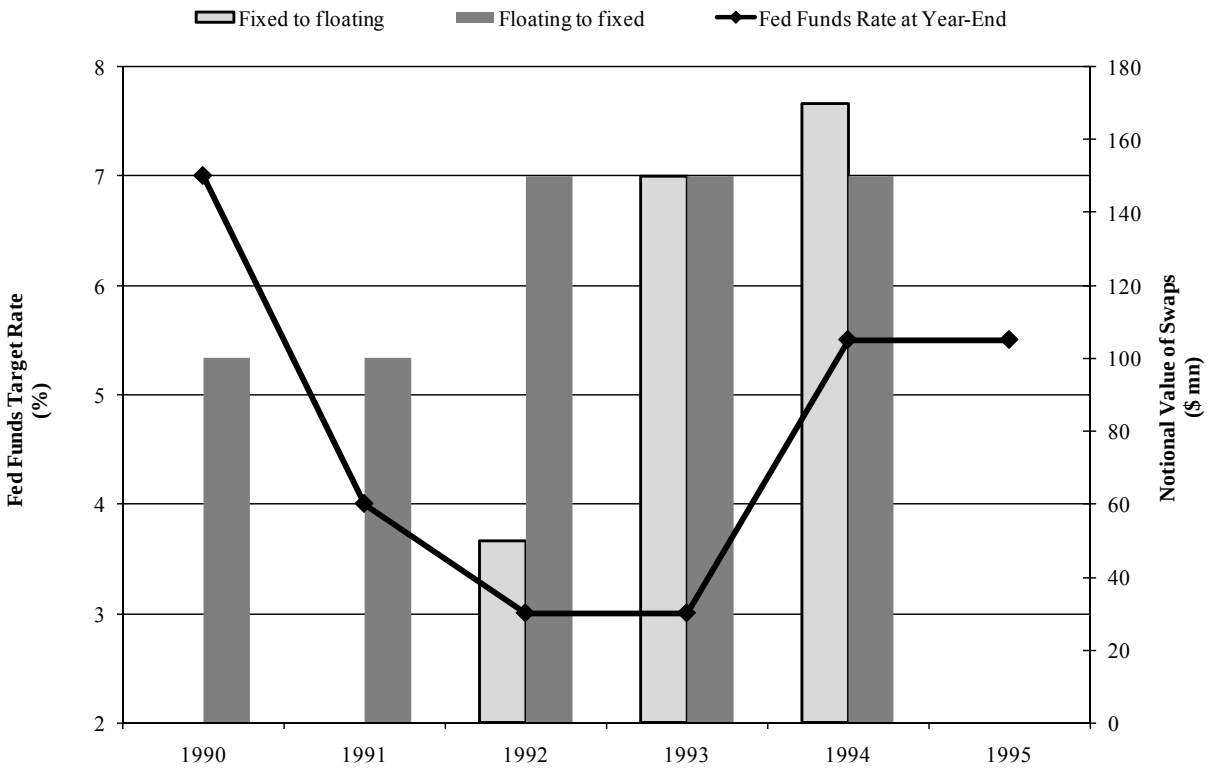
Notes to Figure: We plot the intended Fed Funds rate (solid line) along with consensus forecasts from economist surveys from Bloomberg. The forecasts are plotted on the date matching the relevant Fed Funds rate realization. The light markers denote forecasts made 6-9 months prior, and the dark markers denote forecasts made 9-12 months prior. The forecast data begins in 1993.

Figure 4: Firm Use of Derivatives (Percent)



Notes to Figure: The bars show the corporate use in percent of swaps, interest rate derivatives, and any kind of derivative as extracted from the annual reports. The dashed line denotes the Fed Funds rate at year-end.

Figure 5: Swap Positions of Avery Dennison (AVY) versus Fed Funds Rate



Notes to Figure: We show the fixed-to-floating and floating-to-fixed swap positions (using the right axis) for AVY. The solid line denotes the Fed Funds target rate (using the left axis).

Table 1: Corporate Derivatives Use

	Companies reporting	Companies using derivatives	Percentage	Companies using interest rate derivatives	Proportion of total	Proportion of derivative users	Companies using swaps	Proportion of total	Proportion of interest rate derivative users
1990	77	52	68%	37	48%	71%	31	40%	84%
1991	80	56	70%	39	49%	70%	36	45%	92%
1992	83	64	77%	47	57%	73%	46	55%	98%
1993	90	75	83%	57	63%	76%	54	60%	95%
1994	90	72	80%	56	62%	78%	54	60%	96%
1995	91	73	80%	54	59%	74%	52	57%	96%
1996	91	74	81%	47	52%	64%	45	49%	96%
1997	91	76	84%	49	54%	64%	45	49%	92%
1998	90	78	87%	53	59%	68%	50	56%	94%
1999	91	78	86%	55	60%	71%	54	59%	98%
2000	89	78	88%	46	52%	59%	43	48%	93%
Total	963	776		540			510		

Notes to Table: We summarize the derivative use by year of the firms in our sample. A firm is only counted as using derivatives if it has open exposures at the end of the particular year. The last three columns refer to companies that specifically stated using swaps.

Table 2: Descriptive Statistics on Firm Characteristics

Variable	Mean	Std. Dev.	Min.	Max.
sales	9,275	8,708	678	35,265
mv	15,508	23,184	991	138,407
lev	0.266	0.119	0.002	0.530
quickratio	0.267	0.412	0.014	2.864
rnd	0.029	0.042	0.000	0.214
forex	0.706	0.458	0.000	1.000
commodities	0.388	0.490	0.000	1.000

Notes to Table: We summarize the firm characteristics used in our analysis. “sales” is item 12 from the Compustat Industrial Annual file, while “mv” denotes market value defined as the product of data items 25 (common shares outstanding in millions) and 199 (share price at the close of the fiscal year). “lev” denotes leverage and is total liabilities/total assets calculated as the sum of items 9 and 34, divided by item 6 or (long term debt + debt in current liabilities)/total assets. “rnd” denotes research and development, computed as item 46 divided by sales. “quickratio” is defined as cash and short term investments (item 1) divided by current liabilities (item 5). Cash flow margins, “cfm” are calculated as operating income before depreciation divided by sales (item 13/item 12), and return on assets as income before extraordinary items divided by total assets (item 18/ item 6). “forex” and “commodities” are part of the hand-collected data and take the value 1 if the firm uses foreign exchange or commodities derivatives respectively, and 0 otherwise.

Table 3: Correlations of Firm Characteristics

	sales	**mv**	**lev**	**quickratio**	**rnd**	**forex**	**commodities**
sales	**1**						
significance							
N	91						
mv	**0.35**	**1**					
significance	0.001						
N	91	91					
lev	**0.05**	**-0.34**	**1**				
significance	0.667	0.001					
N	91	91	91				
quickratio	**-0.07**	**0.56**	**-0.38**	**1**			
significance	0.508	0.000	0.000				
N	85	85	85	85			
rnd	**0.07**	**0.50**	**-0.44**	**0.61**	**1**		
significance	0.505	0.000	0.000	0.000			
N	91	91	91	85	91		
forex	**0.10**	**0.21**	**-0.08**	**0.10**	**0.35**	**1**	
significance	0.331	0.041	0.439	0.342	0.001		
N	91	91	91	85	91	91	
commodities	**0.19**	**-0.05**	**0.09**	**-0.22**	**-0.15**	**0.19**	**1**
significance	0.071	0.665	0.422	0.044	0.159	0.064	
N	91	91	91	85	91	91	91

Notes to Table: We report the sample correlations between the firm characteristic variables. Please see Table 2 for definitions of these variables. N denotes the number of observations in each case. The significance of the correlation coefficients is reported below each estimate.

Table 4: Derivative Use and Firm Characteristics

	I	II	III	IV	V	VI	VII	II-IV	III-IV	IV-V	III-V	VI-VII
	All	**All Users**	**Consistent**	**Do Nothing**	**Reverse**	**Mostly Correct**	**Half Correct + Mostly Wrong**					
Sales	11,224	12,174	9,856	5,525	15,335	14,286	15,792	6,649	4,331	-9,811	-5,480	-1,506
	[6424]	[6725]	[6158]	[3461]	[7918]	[8276]	[6699]	(1.25)	(1.43)	(-1.32)	(-1.27)	(-0.15)
mv	15,970	15,526	16,350	18,630	14,403	16,597	13,449	-3,104	-2,280	4,227	1,947	3,148
	[7500]	[7654]	[6394]	[5208]	[10271]	[10588]	[10271]	(-0.44)	(-0.26)	(0.56)	(0.41)	(0.60)
lev	0.273	0.285	0.276	0.201	0.299	0.302	0.297	0.084	0.074	-0.098	-0.023	0.004566
	[0.262]	[0.267]	[0.293]	[0.220]	[0.262]	[0.267]	[0.262]	(2.26)	(1.87)	(-2.46)	(-0.81)	(0.10)
quick ratio	0.267	0.236	0.268	0.439	0.193	0.213	0.183	-0.203	-0.170	0.246	0.075	0.029822
	[0.146]	[0.144]	[0.165]	[0.156]	[0.118]	[0.174]	[0.113]	(-1.65)	(-1.16)	(1.54)	(1.04)	(0.26)
rnd	0.0276	0.0253	0.0258	0.0415	0.0246	0.0246	0.0246	-0.016	-0.016	0.017	0.001	0.000
	[0.0068]	[0.0061]	[0.0004]	[0.0325]	[0.0114]	[0.0265]	[0.0103]	(-1.32)	(-1.18)	(1.26)	(0.13)	(0.00)
cfm	0.194	0.194	0.211	0.193	0.170	0.158	0.176	0.001	0.018	0.023	0.041	-0.017844
	[0.169]	[0.167]	[0.173]	[0.182]	[0.157]	[0.141]	[0.164]	(0.02)	(0.48)	(0.82)	(1.65)	(0.59)
roa	0.062	0.058	0.056	0.088	0.061	0.058	0.062	-0.029	-0.031	0.027	-0.005	-0.003531
	[0.051]	[0.047]	[0.040]	[0.078]	[0.053]	[0.050]	[0.053]	(-2.30)	(-2.30)	(1.90)	(-0.48)	(0.22)
mtb	2.15	2.04	1.93	2.79	2.18	1.98	2.27	-0.748	-0.853	0.605	-0.248	-0.287372
	[1.83]	[1.69]	[1.55]	[2.31]	[1.84]	[1.75]	[1.84]	(-1.96)	(-2.17)	(1.21)	(-0.96)	(0.56)
N	91	78	45	13	33	10	23					

Notes to Table: We report the mean (with medians in square brackets below) sales, mv, lev, quickratio, cfm, rnd and mtb values for the different categories of firms based on their derivatives positions and success in anticipating the four major shocks in interest rates. "Consistent" firms report only one kind of net exposure (either fixed-to-floating or floating-to-fixed) from their interest rate derivative positions throughout the period. "Do Nothing" firms do not use interest rate derivatives to change exposures over the entire period. "Reverse" firms report both types of net exposures at different times over the period. Among Reverse, those that had the right exposure more than 50% of the time are labeled "Mostly Correct", those with 50% "Half Correct" and the other "Mostly Wrong". Note that firms need not have reported an exposure in all years or even in all the four shock years. The last five columns to the right contain differences between selected categories with the t-statistics in parentheses below.

Table 5: Probit Regression of Derivative Use on Firm Characteristics

	User = 1, else 0	**Consistent = 1, all other users 0**	**Reverse = 1, else 0**
mv	0.0829	-0.0361	0.0582
p-value	*0.01*	*0.63*	*0.36*
lev	0.3242	-0.8342	1.0228
p-value	*0.29*	*0.25*	*0.10*
rnd	-0.8127	2.5508	-1.6972
p-value	*0.49*	*0.35*	*0.44*
quickratio	-0.0148	0.2083	-0.1842
p-value	*0.88*	*0.42*	*0.27*
roa	-2.1081	1.2187	-0.8212
p-value	*0.18*	*0.71*	*0.77*
cfm	0.1764	1.7868	-1.4405
p-value	*0.54*	*0.02*	*0.05*
mtb	0.0007	-0.2362	0.1484
p-value	*0.99*	*0.08*	*0.21*
forex	0.1472	-0.2010	0.2332
p-value	*0.09*	*0.20*	*0.08*
commodities	-0.0193	0.0152	-0.0290
p-value	*0.81*	*0.91*	*0.81*
N	85	72	*85*
Pseudo R^2	0.2041	0.1324	0.1314

Notes to Table: We report probit regression analysis based on the average characteristics of the firms over the entire sample period. Please see Table 2for a description of the variables. Estimates reported are the marginal effects estimated at the mean of the explanatory variables. "mv" refers to the log of market value in this table. Light shading denotes significance at the 10% level and darker shading at the 5% level.

Table 6: Cash Flow Sensitivity Regressions

	Random Effects	Fixed Effects
Constant	0.045	0.041
	0.003	0.001
LIBOR	-0.00011	-0.00011
	0.000274	0.00028
Do Nothing	0.0044	
	0.0075	
Do Nothing*LIBOR	0.000842	0.000843
	0.000515	0.000521
Consistent	-0.009651	
	0.0041	
Consistent*LIBOR	0.0011	0.0011
	0.0004	0.0004
No. of observations	4267	4267
No. of groups	90	90
R^2		
Within	0.0062	0.0062
Between	0.0606	0.0035
Overall	0.0322	0
Joint test	26.37	6.59
Joint test statistic	Wald(5)	F(3,4174)
Prob>chi^2	0.0001	0.0002

Notes to Table: We estimate the sensitivity of firm cash flows to interest rates, based on the interest rate derivative usage style of the firms. The dependent variable is operating income before depreciation divided by book assets. The data frequency is quarterly in a panel format, with dummies for two of the three groups and their interaction terms with LIBOR used to determine, if on average, the cash flows and their sensitivities to interest rates are different from the Reverse group. Robust errors are provided below the estimates. Light shading denotes significance at the 10% level and medium shading at the 5% level, and dark shading at the 1% level.

Table 7: Post Shock Comparisons

	N	Sales	Leverage	CFM
Right	91	0.10098	-0.007	-0.0006
2-sided p-value from t-test		0.0000	0.31	0.856
Wrong	78	0.09977	0.004	-0.0093
2-sided p-value from t-test		0.0002	0.54	0.032
Do Nothing	194	0.06301	-0.001	0.0056
2-sided p-value from t-test		0.0000	0.84	0.088
Do Something	169	0.10043	-0.002	-0.0046
2-sided p-value from t-test		0.0000	0.70	0.081

Notes to Table: We categorize the observations from the four post-shock years for changes in sales, leverage and cash flow margins based on whether the firms correctly (Right) anticipated the interest rate changes or not (Wrong). The last category (Do Something) combines all those with positions at the time of the shock (i.e. both Right and Wrong).

Table 8: Policy Shock Exposure Comparisons. Do Something versus Do Nothing

	sales %Δ	Δ lev	Δ quick	Δ rnd	Δ cfm	Δ roa	Δ as_turn	Δ capx
Do Something	0.10	-0.002	-0.007	0.00014	-0.0046	0.0023	-0.012	-0.006
Do Nothing	0.06	-0.001	0.044	0.00028	0.0056	0.0020	-0.032	-0.001
Difference	0.037	-0.001	-0.05	-0.00014	-0.0101	0.0003	0.020	-0.005
t-stat p-value*	0.09	0.88	0.04	0.89	0.02	0.97	0.33	0.10

Notes to Table: We conduct univariate comparisons across the firms that had open net interest rate derivative exposures at the time of the shock versus those that did not. We report the change (pre-shock year to post-shock year) in sales, leverage, quick ratio, research and development, cash flow margins, as well as return on assets, asset turnover, capital expenditure. Light shading denotes significance at the 10% level and darker shading at the 5% level.

Table 9: Policy Shock Exposure Comparisons. Wrong and Right versus Do Nothing. Right versus Wrong

	Δ sales	Δ mv	Δ lev	Δ quick	Δ rnd	Δ cfm	Δ roa	Δ as_turn	Δ capx
Right	1060.97	915.22	-0.0068	-0.0349	0.0000	-0.0006	0.0023	-0.0235	-0.0090
Wrong	1720.09	8.35	0.0041	0.0280	0.0003	-0.0093	0.0024	0.0018	-0.0032
Difference	-659.12	906.87	-0.0108	-0.0630	-0.0002	0.0087	-0.0001	-0.0253	-0.0058
p-value	0.39	0.57	0.25	0.05	0.80	0.10	0.99	0.36	0.16

	Δ sales	Δ mv	Δ lev	Δ quick	Δ rnd	Δ cfm	Δ roa	Δ as_turn	Δ capx
Wrong	1720.09	8.35	0.004	0.028	0.00026	-0.0093	0.0024	0.002	-0.003
Do Nothing	781.20	873.22	-0.001	0.044	0.00028	0.0056	0.0020	-0.032	-0.001
Difference	938.90	-864.87	0.005	-0.02	-0.00002	-0.0148	0.0003	0.034	-0.002
t-stat p-value*	0.22	0.61	0.53	0.50	0.99	0.01	0.97	0.21	0.61

	Δ sales	Δ mv	Δ lev	Δ quick	Δ rnd	Δ cfm	Δ roa	Δ as_turn	Δ capx
Right	1060.97	915.22	-0.0068	-0.0349	0.0000	-0.0006	0.0023	-0.0235	-0.0090
Do Nothing	781.20	873.22	-0.0008	0.0437	0.0003	0.0056	0.0020	-0.0319	-0.0013
Difference	279.78	42.00	-0.0059	-0.0787	-0.0002	-0.0061	0.0002	0.0084	-0.0077
p-value	0.48	0.98	0.45	0.02	0.81	0.18	0.98	0.71	0.03

Notes to Table: We report on univariate comparisons between Wrong and Do Nothing, Right and Do Nothing, and between Right and Wrong firms at the time of the shock. The variables reported are the same as in Table 8 above.

Table 10: Post Shock Firm Performance

Dependent variable: Change in cash flow margins

	1	2	3
constant	0.0567	0.0586	0.0580
	0.020	*0.018*	*0.019*
mv (t-1)	-0.0064	-0.0034	-0.0065
	0.019	*0.475*	*0.019*
lev (t-1)	-0.0095	-0.0134	-0.0112
	0.561	*0.428*	*0.499*
quick (t-1)	-0.0029	-0.002	-0.0038
	0.689	*0.744*	*0.611*
rnd (t-1)	0.1991	0.2076	0.2151
	0.087	*0.079*	*0.076*
fx (t-1)	0.0019	-0.0006	0.0001
	0.746	*0.912*	*0.993*
commod (t-1)	0.0050	0.0041	0.0051
	0.380	*0.4680*	*0.372*
Δ long term debt	0.000005	0.000004	0.000005
	0.307	*0.425*	*0.354*
yr1994	0.0083	0.0076	0.0051
	0.044	*0.079*	*0.217*
yr1999	0.0083	0.0093	0.0060
	0.265	*0.227*	*0.4270*
yr2001	dropped	dropped	dropped
do_sthg (t-1)	-0.0112		
	0.010		
good (t-1)		-0.0034	
		0.475	
wrong (t-1)			-0.0111
			0.022
N	185.00	185.00	185.00
R^2	0.135	0.109	0.127

Notes to Table: Regression explaining post-shock performance of firms based on whether they had interest rate derivative positions at the time of the interest rate shocks, and whether they had been right or wrong in anticipating the shocks based on their net derivative based exposures. P-values are provided below the estimates.