Strategic Risk Management and Product Market Competition

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Abstract

The objective of this paper is to test whether corporate risk management strategies are interdependent across firms as Adam, Dasgupta and Titman (2007) and Mello and Ruckes (2006) have recently suggested. A necessary condition for such interdependence would be that aggregate hedging decisions affect product prices. Indeed, we find that output prices are less sensitive to FX shocks if more firms hedge their FX risks. Furthermore, we find that the FX exposure of derivatives users is negatively correlated with the level of hedging in an industry, while the FX exposure of derivatives non-users is positively correlated with the level of hedging. The correlations between exposures and levels of hedging further support the hypothesis of interdependence of derivatives strategies. Finally, we find that industry structure matters for the level of hedging in an industry: the fraction of derivatives users is negatively correlated with the degree of competition. When competition is strong firms may refrain from hedging their FX risks in order to gain a strategic advantage when prices move in their favour. These results indicate that firms consider both internal (firm-specific) factors as well as external (industry-specific) factors when deciding upon their risk management strategies.

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According to the Modigliani-Miller paradigm, corporate risk management is irrelevant for firm value since individual investors can adjust their portfolios to obtain the desired risk exposure. However, corporate use of derivatives has risen steadily. The International Swaps and Derivatives Association reports that the notional amounts of interest rate and currency derivatives held by its members, many of whom are end-user corporations, increased from $865 billion in 1987 to $213 trillion in 2005.[1] Existing theories appeal to managerial incentives or market imperfections such as taxes, financial distress costs and underinvestment costs to explain firms' incentive to lower volatility through hedging. A number of empirical studies examine whether firms' hedging decisions are consistent with existing theory.[2] Cross-sectional evidence regarding these firm-specific reasons for hedging is mixed, with different empirical studies finding conflicting evidence for most theoretical predictions.

Although our understanding of who hedges and why is still poor, a number of studies show that hedging foreign currency and interest rate risk increases firm value. The documented 'hedging premium' appears to be economically large and statistically significant ranging from 4% in Allayannis and Weston (2001) to 14% in Carter, Rogers and Simkins (2006). The size of the hedging premium has lead to concerns that the results may be spurious or that the improvement in value may be caused by some other unobserved factor that also determines the decision to hedge (see Guay and Kothari (2003)). More recently, Jin and Jorion (2006) show that in the oil and natural gas industry, hedging does not affect a firm's market value and thus, cast further doubt on the link between hedging and firm value.

To obtain an understanding of a firm's decision to engage in derivatives hedging and the value implications of hedging, we must have a good grasp of how derivatives affect exposure to the underlying risk. Empirical tests of existing risk management theory consider derivatives usage to be risk-reduction tool. This assumption is supported by Guay (1999) and Allayannis, Ihrig and Weston (2001) who document lower foreign exchange exposures for firms that use foreign currency derivatives. In contrast, Hentschel and Kothari (2001) find no differences in the over-all risk measures of derivatives users and non-users. The mixed evidence in all these areas of research suggests that although corporate risk management literature has made progress on many fronts, we have a lot to learn about how derivatives affect a firm's risk profile, a firm's incentive to engage in risk management and whether hedging increases value.

This paper shows that an important consideration in a firm's incentive to hedge has remained largely unexplored in the finance literature. We provide evidence that the prevalence of derivatives

[1] Source: International Swaps and Derivatives Association, Inc. http://www.isda.org/.

[2] 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 (2003). 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).

hedging in an industry affects how product prices respond to common cost shocks faced by all firms in an industry. Once this effect of hedging on product prices is allowed for, two interesting results emerge. First, an individual firm's exposure to the shock depends not only on its own hedging decision, but also on the hedging decisions of its competitors. Second, firms face lower exposure when they conform to the majority's decision. These are important considerations for a firm's incentive to hedge and the value implications of hedging. Insofar as the risk-management literature ignores these issues, the mixed empirical evidence is not surprising.

Using comprehensive hand-collected data on foreign currency derivatives (FCD) usage, we show that industry output prices become less sensitive to exchange rate shocks when more firms in the industry use FCD. The response of output prices to exchange rate shocks, often referred to as exchange rate pass-through, has been extensively studied but not previously been linked to FCD usage. Our results indicate that when FCD usage in an industry is non-existent, the pass-through elasticity is -0.08. A negative pass-through elasticity implies that as the dollar depreciates and import costs rise, U.S. firms charge higher prices in the domestic market. However, as FCD usage in an industry rises, pass-through elasticity approaches zero. For an industry with an average level of FCD usage, depreciation of the U.S. dollar is not associated with an increase in industry selling prices. This result holds after controlling for industry concentration, reliance on imported inputs, import competition faced by an industry, export sales and industry capital intensity. The results are robust to alternative estimation methods and alternative definitions of hedging in the industry. Our empirical methodology allows FCD usage to be an endogenously determined variable. To our knowledge, this is the first paper to show that the use of FCD reduces the pass-through of foreign exchange shocks to product prices.

In an imperfectly competitive industry, the dampening effect of industry-wide FCD usage on the correlation between industry prices and exchange rate shocks has noteworthy implications for the currency exposure of individual firms. The intuition is similar to the arguments put forth by De Meza (1986) in the context of firms choosing between fixed and variable cost technologies and later applied by Maksimovic and Zechner (1991) to a firm's choice of optimal capital structure. Consider a firm that leaves its foreign exchange exposure unhedged (an FCD non-user) when most of the other firms in the industry are engaged in derivatives hedging. This firm is exposed to any cost shocks that might arise due to changes in the exchange rate. However, since pass-through is low and industry prices insensitive to exchange rate movements, the FCD non-user does not obtain changes in selling prices to offset the cost shocks. An FCD-user, on the other hand, experiences neither the currency cost shock nor a price change. Therefore, in this industry, FCD users (non-users) have low (high) exchange rate exposure. In contrast, consider an industry where very few firms use FCD. In this industry, exchange rate shocks are passed through to prices. FCD non-users have low exposure because changes in selling prices offset exchange rate induced cost shocks. FCD users on the other hand, experience variation in selling prices but have no exchange rate induced cost shock. Thus, if only a few firms in the industry use FCD, the profitability of FCD users (non-users) is expected to fluctuate more (less) with exchange rate shocks.

Our empirical tests provide strong evidence of the above-mentioned patterns in the exposure of FCD users and non-users. We estimate the foreign exchange exposure of each firm and then examine how the exposure varies cross-sectionally with the level of hedging in a firm's industry. We find that as the extent of hedging in an industry increases, the foreign exchange exposure of an FCD user declines while that of an FCD non-user increases. Thus, a firm faces lower exposure to the underlying exchange rate risk when its hedging decision conforms to that of the majority. This result is robust to alternative estimation methods and alternative definitions of hedging in an industry. In our argument, the observed association between an individual firm's exposure and the hedging decision of its competitors arises because exchange rate pass-through in an industry is lower when hedging is more prevalent. To test this argument, we directly examine the effect of exchange rate pass-through on the exposure of FCD users and non-users. The results are strongly supportive of the pass-through explanation. As the extent of exchange rate pass-through to domestic prices increases, the foreign exchange exposure of FCD users increases while that of FCD non-users decreases. As expected, these results are driven by imperfectly competitive industries where firms have the ability to affect output prices. When the sample is restricted to competitive industries (that is, industries with very low values of the Herfindahl index, the four-firm concentration ratio or price-cost margin), the industry level hedging measure is not related to the exposure of individual FCD users or non-users. That the link between an individual firm's exposure and the hedging choices of its competitors holds only in industries where some pricing power exists is further evidence that financial hedging influences product market decisions.

Our findings raise questions about the previously documented relation between currency hedging and firm value. Derivatives users are valued higher presumably because they reduce volatility and the associated financial distress costs, underinvestment costs etc. Our results show that FCD non-users already enjoy low exposure when FCD usage in their industry is low and exchange rate pass-through high. Thus, their need to engage in derivatives-hedging is low. There is little reason for these firms to trade at a discount relative to FCD users. Therefore, we revisit the relation between FCD usage and firm value conditional on the extent of hedging in a firm's industry. We find that the previously documented hedging premium is driven only by industries where FCD usage is very widespread. The decision to not use FCD appears to hurt value only when most competitors are engaged in FCD hedging. While this is consistent with our finding that FCD non-users face high currency risk only when many of their competitors use FCD, it leaves a fundamental question unanswered. Why would a handful of firms refrain from using FCD even though they could improve value by using derivatives like most of their competitors do?

Further analysis shows that these lower-valued FCD non-users in highly hedged industries had lower profit margins, lower return on assets and lower stock returns than the rest of the sample in the five years preceding our value analysis. This suggests that the decision to remain unhedged when many competitors consider it prudent to hedge may be a product of the same unobserved firm characteristics that lead to underperformance and lower firm value. In fact, once we allow these measures of past performance to determine a firm's decision to hedge, the positive association between FCD usage and firm value disappears even in industries where FCD usage is widespread. Over all, our analysis shows there is no observable difference in the value of FCD users and non-users once the hedging choices of competitors are taken into account. When considered in the context of their industry, firms appear to make optimal choices about foreign currency risk management. This finding is consistent with the industry-equilibrium argument of Adam, Dasgupta and Titman (2006) where the level of hedging in an industry adjusts till no difference remains between the value of a hedged and unhedged firm.

The results in this paper are relevant for understanding past evidence as well as for guiding future work on corporate risk management. Empirical studies that consider FCD usage tantamount to risk-reduction and studies that compare the exposure or value of FCD users and non-users without regard to competitors' hedging choices are bound to arrive at mixed or conflicting evidence. The use of derivatives as an empirical proxy for hedging is sometimes criticized on the grounds that some firms admittedly speculate with derivatives and may consequently face higher risk.[3] Our results suggest that even if a firm's derivatives program is completely non-speculative in nature, the firm can face greater exposure to the underlying risk if its competitors are not hedging the same risks. Therefore, it is imperative that researchers consider the interaction between financial hedging and output markets when using derivatives to test corporate risk management theory. Finally, we note that since a firm's exposure is affected by the hedging decisions of competitors, it is no surprise that models that examine risk-management decisions in a single-firm framework enjoy little empirical support. We provide persuasive evidence that a firm's decision to hedge must arise out of a model that allows for strategic interactions between firms' hedging and output choices. Adam, Dasgupta and Titman (2006) and Mello and Ruckes (2006) take a step in this direction by modeling the hedging decision in an industry setting. Our results complement these theories

[3] The Wharton/CIBC World Markets 1998 Survey of Financial Risk Management by U.S. Non Financial Firms asked firms what best describes the motivation behind their risk management activities: 40% of firms chose higher profits rather than lower volatility. Moreover, 32% of firms that use derivatives reported that their market view of exchange rates leads them to "actively take positions" at least occasionally (see Bodnar, Hayt and Marston (1998)). Finally, the findings of Faulkender (2004) and Adam and Fernando (2006) suggest that firms time the market with derivatives and try to generate positive cash flows with their derivatives positions.

and suggest that future empirical research on the decision to hedge draw on the empirical predictions of such industry based models.

The rest of this paper is organized as follows. Section 1 provides a motivation for the empirical questions addressed in this paper along with references to related literature. Section 2 describes the data. Section 3 describes the methodologies used and also presents empirical results. Section 4 contains robustness checks. Section 5 concludes.

1. Motivation for Empirical Tests

In existing risk management literature, a firm's exposure to a risk factor is generally considered to be a function of the firm's own characteristics and its own decision to hedge. For example, a firm's foreign exchange exposure is determined by its involvement in foreign trade, its decision to engage in financial or operational hedges, and the financial constraints faced by the firm (see for example Bartov and Bodnar (1994), He and Ng (1998)).[4] However, in imperfectly competitive industries, a firm's exposure to the underlying risk should depend not only on its own hedging decision but also on the hedging decisions of competitors. To see why, consider an imperfectly competitive industry in which all firms are subject to a common shock to their marginal cost of production. When the shock occurs, firms that are exposed to the shock adjust their profit maximizing output accordingly. If all firms face the cost shock and adjust output, industry prices co-vary with the cost shock (see De Meza (1986)). Suppose that, prior to the realization of the cost shock, firms are able to enter into derivative contracts that enable them to lock in their cost of production. Ceteris paribus, firms that have completely protected themselves from the shock make no change to output when the shock occurs. As more firms choose to hedge the shock, industry price becomes less sensitive to the cost shock because fewer firms adjust output.[5]

This dampening effect of hedging on the correlation between industry prices and costs implies that the volatility of an individual unhedged (hedged) firm increases (decreases) with the fraction of hedged firms in the industry. In an industry where all firms hedge the shock, prices do not fluctuate with the cost shock. If a firm in this industry remains unhedged, it faces the cost shock but does not obtain an offsetting change in prices. Hedged firms, on the other hand, face constant costs as well as constant

[4] Exceptions are Bodnar and Gentry (1993) who model a firm's exchange rate exposure as a function of its industry's involvement in foreign trade and Allayannis and Ihrig (2001) who suggest that firms in more competitive industries face greater foreign exchange exposure.

[5] The hedge could be a forward contract by the firm to buy Y units of an input at t=1 at $X per unit. There are two situations in which this type of contract may not affect a firm's marginal cost of production. First, if the market price M at t=1 is higher than X, it may be optimal for the firm to forego production and sell the input on the market after purchasing it at X, pocketing a profit of $(M-X) per unit. Second, if the contract amount Y falls short of the firm's input requirement forcing the firm to obtain the remaining on the market, the marginal cost will be determined by the market price prevailing at t=1 and not by the contract entered into at t=0. While these scenarios bias us against finding support for the hypothesis that derivatives-hedging reduces price-cost correlation, they also increase the onus of eliminating alternative explanations if support is found.

prices. In this industry, profit volatility of unhedged (hedged) firms is high (low). In contrast, when most firms in an industry are unhedged, prices co-vary with costs, causing the profit volatility of unhedged firms to be low. If a firm in this industry chooses to hedge, it has certain costs but faces uncertain prices because of the output choices of its unhedged competitors. Thus, in largely unhedged industries, unhedged (hedged) firms have low (high) profit volatility.

The fundamental intuition is that as the number of firms adopting a given production technology increases, output price corresponds more closely with the cost of production, providing firms with a natural shelter against changes in production costs (see De Meza (1986), Maksimovic and Zechner (1991)) and Adam, Dasgupta and Titman (2006)). In this paper, we investigate empirically whether derivatives hedging affects the sensitivity of product prices to the shock being hedged, thereby making the exposure of firms in an industry interdependent. If these relationships are found to be robust, then empirical and theoretical research on who hedges with derivatives and why will need considerable rethinking.

Since, in practice, foreign currency exposure is the most commonly hedged risk, the tests are conducted using comprehensive, hand-collected data on the use of FCD by publicly listed firms in the United States. We address the two key questions that arise from our discussion above. First, does the use of FCD reduce the pass-through of exchange rate shocks to domestic producer prices? There is an extensive literature on the effect of exchange rate shocks on import and export prices and a relatively sparse literature on the impact of exchange rates shocks on domestic prices.[6] However, none of these pass-through studies examine how the use of FCD affects the pass-through of exchange rate shocks to product prices. Thus, our first question contributes to both the risk-management and pass-through literatures. The second question we address is the following. Does the exposure of an FCD user (FCD non-user) to foreign exchange fluctuations decrease (increase) as the level of FCD usage in an industry rises and pass-through declines? Numerous papers study firms' exchange rate exposure measured as the sensitivity of stock returns to changes in the exchange rate.[7] The link between exchange rate fluctuations and stock returns is known to be weak. It has been suggested that the weak relation between exchange rate shocks and stock returns exists because of the failure to account for firm's risk-management practices. Our second question addresses this concern by explicitly accounting for firms' use of FCD.

Arguably, the tests in this paper would be the most directly applicable to commodity hedging data where the commodity being hedged is an input used by the industry in question. However, this paper uses

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[6] For exchange rate pass-through to import or export prices see for example, Mann (1986), Feenstra (1987), Krugman (1987), Froot and Klemperer (1989), Ohno (1989), Knetter (1989, 1993), Marston (1990), Yang (1997) and Bodnar, Dumas and Marston (2002). For exchange rate pass-through to domestic prices, see Feinberg (1986, 1989).

[7] See for example, Jorion (1990), Bodnar and Gentry (1993), Bartov and Bodnar (1994), He and Ng (1998) and Griffin and Stulz (2001).

foreign exchange hedging data instead of commodity hedging data for the following reasons. First, commodity hedging is not as widespread as foreign currency hedging and is limited to a handful of industries which makes cross-sectional tests infeasible. An additional data advantage of working with foreign currency hedging is that we can use the same macroeconomic shock (exchange rate fluctuations) for all industries, taking into account each industry's involvement with foreign trade. In contrast, with commodity hedging, one would require a different data series to capture the shock for each industry depending on the commodity being hedged. This places additional constraints on already sparse data.

2. Derivatives Data

Data on currency derivative holdings of U.S. firms as of fiscal year 1999 are obtained by searching the financial footnotes and Management Discussion and Analysis of SEC 10-K filings for text strings such as "hedg," "swap," "cap," "forward" etc. SFAS 105 requires all firms to report information about financial instruments with off balance sheet risk for fiscal years ending after June 15, 1990. If a reference is made to any of the search terms and the firm is not a financial firm, we read the surrounding text to confirm that it refers to foreign currency derivatives holdings and classify the firm as foreign currency derivatives (FCD) user in that year.[8] Information on the gross notional amounts of foreign exchange forwards, swaps and options outstanding is collected as of fiscal year ending in 1999. In cases where there were no contracts outstanding as of fiscal year end, but the firm did engage in foreign exchange risk-management during the year, we take the notional amounts that expired during the year 1999. If there are no references to the keywords, the firm is classified as an FCD non-user in that year. These data are matched with COMPUSTAT and only non-financial firms that have positive values for net sales, total assets and market value of equity are retained in the sample. We also collect less detailed hedging data for 1997. A firm is classified as a foreign currency derivatives user in 1997 if it discloses the use of foreign exchange forwards, swaps and options as of fiscal year ending in 1997.

An advantage of this comprehensive sample is that it enables us to determine, for each firm, how many competitors use foreign currency derivatives. Most previous studies on foreign exchange hedging either focus on a single industry or use sample-selection criteria that do not give a complete picture of hedging activity in any given industry. For example, Allayannis and Weston (2001) use a sample of non-financial firms that have total assets of more than 500 million in each year between 1990 and 1995. Geczy, Minton and Schrand (1997) study *Fortune 500* non-financial firms. Graham and Rogers (2002)

[8] The arguments presented in this paper are applicable to linear derivatives contracts (like forward contracts) and do not hold for non-linear contracts like foreign currency options. Our data show that 91% of derivatives users employ forward contracts. Moreover, less than 10% of the total notional amounts of FCD outstanding are accounted for by options contracts. Given the predominance of forward contracts in the data, excluding options makes no difference to our overall conclusions.

use a randomly selected sample of non-financial firms. Our sample, on the other hand, is more representative of the universe of firms.

For certain tests, we focus on firms that face ex-ante exchange rate exposure. This allows us to interpret the absence of derivatives as a choice not to use derivatives, rather than an indication of lack of exposure to foreign exchange risk. Following Graham and Rogers (2002), firms are defined as having ex-ante currency exposure if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file, or disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files. From the initial sample of 10,400 Compustat firms, 4,300 firms (forty-one percent) face ex-ante exchange rate exposure. 549 firms facing ex-ante exchange rate exposure engage in currency derivatives hedging. The gross notional amounts of foreign exchange swaps, forwards and options outstanding are summarized in Table I, Panel A. The descriptive statistics are comparable to previous studies. Graham and Rogers (2002) report a mean foreign currency derivatives notional amount of $558 million for the year 1994-1995 which is on average 8.06 percent of total assets. The mean in our sample is $745 million, 8.89 percent of total assets. The mean notional amount of swaps, forwards and options scaled by total assets are 4.90 percent, 7.84 percent and 6.35 percent respectively. These numbers are comparable to those reported by Purnanandam (2007) who also uses a more comprehensive sample to study derivatives usage.

Panel B of Table I reports the distribution of two measures of industry level hedging at the 3-digit SIC level. Both measures are a market value-weighted estimate of the fraction of hedgers in an industry. The first measure is based on the sub-sample of firms facing ex-ante exchange rate exposure as defined above. It is calculated as the sum of market values of FCD users in a 3-digit SIC industry who face ex-ante currency exposure divided by sum of market values of all firms in the industry who face ex-ante currency exposure. [9] Market value of a firm is the market value of equity plus the book value of debt. We use a market value-weighted measure of the fraction of hedgers to account for the possibility that firms differ in their ability to affect prices. Larger firms account for a bigger fraction of industry output and thus their hedging choices are more important for the industry. The first column of Panel B shows that in half the industries, the extent of hedging is less than 2.5%. In the top quartile of industries, the fraction of hedgers is 48% or higher.

[9] It is not mandatory for firms to disclose whether they are long or short on a currency and whether they are hedging foreign revenues or expenses. This restricts us from selecting only those firms that hedge foreign expenses. However, since the total number of firms in an industry that use currency derivatives is likely to be positively correlated with the number of firms that use currency derivatives to hedge expenses, our measure of industry hedging serves as an acceptable proxy. Moreover, changes in revenue translate into marginal cost shocks if a firm has positive and convex costs of raising external finance (see Froot, Scharfstein and Stein (1993) and Mello and Ruckes (2006)). Therefore, insofar as firms exposed to foreign exchange revenue shocks are financially constrained, including them in our sample is not unreasonable, and at worst, biases us against finding support for the arguments made above.

A firm's decision to use FCD depends on whether it is exposed to exchange rate risk. Exposure to foreign exchange shocks is difficult to identify accurately. For example, our measure of ex-ante exposure ignores firms that have no involvement in foreign trade and yet face exchange rate exposure due to the export or import activities of competing firms. To avoid biasing our results due to the definition of ex-ante exposure used, we also calculate a measure of industry hedging based on the entire sample regardless of ex-ante foreign exchange exposure. It is calculated as the sum of market values of FCD users in the industry divided by sum of market values of all firms in the industry. Panel B of Table I shows that, as expected, the fraction of hedgers based on the entire sample is lower than the fraction of hedgers based on exposed firms only.

In Table II, a detailed break up of hedging by industry is provided for 43 out of the 48 Fama-French industries.[10] The extent of hedging is the highest in the following industries - Recreation, Automobiles and Trucks, Shipbuilding and Railroad Equipment, and Electronic Equipment. It is the lowest in Printing and Publishing, Tobacco, and Entertainment. It is worth noting here that weighting the fraction of hedgers by market value can make a big difference. For example, Fama-French industry number 35 (Computers) has 1500 firms out of which 752 face ex-ante exchange rate exposure. In this industry, 55 firms disclosed the use of FCD in 1999. Of these 55 FCD users, 53 are classified as have ex-ante exposure. An unweighted measure of the fraction of hedgers would imply that the extent of hedging is 3.6% using the entire sample and 7% using the sample of exposed firms. However, since the largest players in the market (e.g. Microsoft, IBM, and Oracle) use FCD, the market value-weighted measures are 41% and 49% respectively.

For all the tests in Sections 3, we use the market value-weighted measure based on firms with ex-ante exposure. In the robustness section (Section 4), we demonstrate that our main results hold when we use the market value-weighted measure of industry hedging based on the entire sample regardless of ex-ante exposure. In Section 4 we also discuss the outcome of using an unweighted measure of the fraction of hedgers in an industry.

3. Methodology and Results

We begin our empirical investigation with an overview of the foreign exchange exposures of FCD users and FCD non-users in Section 3.1 below. In Section 3.2, we study the pass-through of exchange rate shocks to domestic prices conditional on the extent of hedging in the industry. In Section 3.3, we examine how the foreign exchange exposures of FCD users and FCD non-users are affected by the hedging decisions of the industry as a whole and by the extent of exchange rate pass-through in the

[10] We exclude Financial Services, Real Estate, Trading, and Other due to lack of hedging data.

industry. Section 3.4 examines the relation between derivatives usage and firm value in light of the findings of Sections 3.2 and 3.3.

3.1. Foreign Exchange Exposure of FCD Users and FCD Non-Users

In this sub-section, we calculate the foreign exchange exposure of FCD users and FCD non-users and conduct simple univariate comparison of the exchange rate exposures of the two groups.

3.1.1 Methodology

Existing studies examine exchange rates exposure by regressing stock returns on changes in exchange rates, controlling for the overall market return (see for example Jorion (1990), He and Ng (1998) and Dominguez and Tesar (2001)). Following this literature, we estimate the following time-series regression for each hedged (FCD user) and unhedged (FCD non-user) firm in the sample using monthly data.

$$r_{it} = \beta_{i0} + \beta_{ix}\Delta EXCH_t + \beta_{im} r_{mt} + \varepsilon_{it} \quad (1)$$

In equation (1), r_{it} is the monthly rate of return on the firm's stock for the years 1996 till 2000; r_{mt} is the corresponding monthly rate of return on the value-weighted market index. The variable $\Delta EXCH_t$ is the monthly change in value of the U.S. dollar orthogonal to the market return.[11] The exchange rate is the trade-weighted value of the U.S. dollar in terms of its major trading partners as calculated by the Federal Reserve Board. The coefficient β_{ix} measures a firm's exposure to exchange rate movements after taking into account the overall market's exposure to currency fluctuations. Firms are classified as FCD users if they disclose the use of foreign currency derivatives in 1999. All other firms are classified as FCD non-users.[12] In selecting the estimation period for stock return exposure, we face a trade-off between having a sufficiently long time series to estimate equation (1) for each firm, while remaining reasonably close to the two sample years for which hedging data are available (1997 and 1999). We choose an estimation period from 1996 till 2000. This ensures 60 data points for each time-series estimation of β_{ix}.

3.1.2 Results

Table III presents summary statistics of β_{ix} for all firms, and separately for FCD users and FCD non-users. Note that we have not made any ex-ante judgments about which firms should display high

[11] Using changes in exchange rate that are orthogonal to the market return, $\Delta EXCH$, may lead to econometric difficulties (see Jorion (1991)). We repeat the analyses using changes in the exchange rate, *X*, itself instead of the residuals from a regression of exchange rates on the stock market return. The results of the paper remain unchanged.

[12] In alternative specifications we classify FCD users as firms that disclosed the use FCDs in both 1997 and 1999 and FCD non-users as firms that did not disclose the use of FCDs in either 1997 or 1999. This alternative classification makes no difference to the results in the paper.

stock return exposure to exchange rates. The coefficients are estimated for all firms that have uninterrupted stock return data from 1996-2000 and also meet the data requirements of the multivariate analysis outlined later in Section 3.3 below. As in previous studies, we find that the median foreign exchange exposure coefficients are small. Approximately 11% of the firms have significantly positive or significantly negative foreign exchange exposure. We are interested in comparing the foreign exchange exposure of FCD users with that of FCD non-users regardless of whether the exposure is positive or negative. Therefore, we take the absolute value of all exposure coefficients and calculate the mean 'absolute' exposure for the two groups of firms. Panel A of Table III shows that, on average, firms using FCD have significantly lower exposure to foreign exchange fluctuations than firms that do not use FCD. In Panels B and C we present the same analysis separately for firms with positive and negative β_{ix}. In both sub-samples, the exposure of FCD users is significantly smaller (closer to zero) than that of FCD non-users. Thus, univariate tests suggest that, on average, FCD users are less exposed to currency fluctuations than FCD non-users.[13]

The histograms presented in Figure I provide a pictorial comparison of the distribution of exposure coefficients of FCD users and FCD non-users. Note that to make the scale of the two histograms visually comparable, we have dropped 1% of observations on each side of the distribution for FCD non-users. Despite this, the distribution plots make it evident that the exposure coefficients of FCD users are much more tightly distributed around 0. FCD non-users display a greater incidence of high positive or high negative exposure to exchange rate fluctuations. It is also apparent that both groups of firms display high cross-sectional variation in the extent of foreign exchange exposure. We have hypothesized that competitors' hedging choices affect an individual firm's exposure. Specifically, we expect FCD users (non-users) to have lower (higher) foreign exchange exposure when more firms in the industry use FCD. Next, we conduct a univariate test of this hypothesis.

In this test, we first focus on the sample of FCD users and split this sample into two groups. The first group contains 5% of FCD users with the most positive foreign exchange exposure coefficients and 5% of FCD users with the most negative foreign exchange exposure coefficients. The second group contains 10% of FCD users with exposure coefficients closest to zero. We compare the average level of industry hedging for the two groups of FCD users. As shown in Table IV, FCD users with extreme exposures (first group), belong to industries where, on average, 37% of the industry is hedged. In contrast, FCD users with exposures close to zero (second group) belong to industries where, on average, 48% of the industry is hedged. The difference in the level of industry hedging for the two groups of FCD users is

[13] This finding is consistent with the results of Allayannis and Ofek (2001) who also find that FCD users have lower foreign exchange exposures.

statistically significant. Thus, exposure coefficients of FCD users are lower when they belong to industries where FCD usage is more prevalent.

We repeat the same test for our sample of FCD non-users. FCD non-users are divided into two groups. The first group contains 5% of non-users with the most positive exposure coefficients and 5% of non-users with the most negative exposure coefficients. The second group contains 10% of FCD non-users with exposure coefficients closest to zero. In Table IV, we see that FCD non-users with extreme exposures belong to industries where, on average, 39% of the industry is hedged. In contrast, FCD non-users with exposures closer to zero belong to industries where, on average, 34% of the industry is hedged. Again, the difference in the level of industry hedging for the two groups of FCD non-users is statistically significant. Exposure coefficients of FCD non-users are lower when they belong to industries where FCD usage is less prevalent.

This univariate comparison supports the hypothesis that the foreign exchange exposure of a firm is smaller when the hedging strategy of the industry is similar to its own.[14] We argued that the link between an individual firm's exposure and the hedging choices of competitors arises because hedging interacts with output markets. In the next section, we investigate this idea further.

3.2. Industry Hedging and Pass-through

This section tests the hypothesis that industry output prices are less sensitive to exchange rate shocks in industries where FCD usage is more prevalent.

3.2.1 Methodology

Most of the literature on the pass-through of exchange rate shocks to product prices examines how import prices (the price at which foreign firms sell in the domestic market) respond to exchange rate shocks. Since we do not have hedging data on foreign firms, we cannot study the effect of derivatives usage on import prices. Instead we follow the methodology of a smaller stream of literature which examines the pass-through of exchange rate shocks to U.S domestic producer prices (see, for example, Feinberg (1989)). The dependent variable is the relative producer price index, *RPPI*, at the three-digit SIC level, calculated as the producer price index divided by the overall GDP price deflator.[15] The producer price data are obtained from the Bureau of Labor Statistics. The overall GDP price deflator is obtained from the Bureau of Economic Analysis. Foreign exchange movements, *X*, are measured as the trade-

[14] We present a more detailed, multivariate version of this test in Section 3.3.

[15] We use the producer price index (PPI) instead of the consumer price index (CPI) because the PPI more accurately captures the price of commodities produced in the United States. The CPI is the price paid by U.S. customers for a basket of goods and this basket of goods includes imported products. Since we do not have data on derivatives usage by foreign firms, we exclude import prices from our analysis and focus only on the pricing behavior of domestic firms.

weighted value of the U.S. dollar in terms of its major trading partners as calculated by the Federal Reserve Board. An increase in *X* indicates an appreciation of the U.S. dollar. We obtain monthly data on producer prices and exchange rates from 1996 till 2000, the same period used to estimate stock return exposure in Section 3.1.

The effect of various industry characteristics on the extent of pass-through is obtained by interacting the industry characteristics with the exchange rates in a pooled regression. The main industry variable we are interested in is the fraction of hedgers, *FRACTION*, calculated at the three-digit SIC level as discussed in Section 2 above. We use the fraction of hedgers based on the sub-sample of firms that face ex-ante exchange rate exposure. In industries that are dependent on imported inputs, output prices are expected to increase as the U.S. dollar depreciates (because the cost of importing increases).[16] Therefore, the pass-through of a depreciating dollar into higher domestic prices should be more pronounced in industries that rely on imported inputs. An industry's reliance on foreign inputs, *FORINP*, is calculated as in Allayannis and Ihrig (2001) using monthly industry import data provided by United States International Trade Commission (USITC) and the 1997 benchmark input-output tables provided by the Bureau of Economic Analysis of the U.S. Department of Commerce.

The extent of import competition faced by an industry is also likely to affect pass-through. When the U.S. dollar appreciates, the cost of production of a foreign firm falls relative to that of a U.S. based competitor. If foreign firms reduce prices in the U.S. market when the dollar appreciates, domestic firms face more pressure to remain competitive by lowering prices. [17] Thus, when examining the pass-through of exchange rate shocks to selling prices of domestic firms, it is important to control for the extent of foreign competition in the U.S. market – which we term 'import penetration' as in Feinberg (1989). Import penetration, *IMPORTS*, for an industry is calculated as the monthly general customs value of final goods imports scaled by domestic shipments for that industry in that year.[18] Feinberg (1989) finds that pass-through to domestic prices is lower in more capital intensive industries. Therefore, we control for capital intensity, *KS*, calculated as the average value of total assets as a percentage of sales per three-digit SIC industry group. Since greater competition in an industry is associated with a loss in pricing power, exchange rate pass-through is less likely in more competitive industries (see Allayannis and Ihrig (2001)).

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[16] Firms that have foreign revenues but do not import may also experience cost shocks from exchange rate changes. According to Froot, Scharfstein and Stein (1993), in the presence of convex costs of external financing, a firm's marginal cost of production will be affected by exchange rate shocks.

[17] Past literature suggests that an appreciating dollar can make domestic markets more competitive. Froot and Klemperer (1989) show that foreign firms compete aggressively by lowering prices in response to permanent dollar appreciations, but may compete less aggressively in response to temporary fluctuations in the dollar. Knetter (1994) provides weak evidence that the U.S. domestic market became more competitive during the large dollar appreciation in the 1980s.

[18] Value of domestic shipments is obtained from the Annual Survey of Manufacturers conducted by the Census Bureau.

We include the four-firm concentration ratio, *CONC*, obtained from the 1997 U.S. Census of Manufacturers as a proxy for competition.[19] If an industry is engaged in exports in addition to imports, it is somewhat naturally hedged against exchange rate fluctuations. In this case, domestic prices may be less response to exchange rate shocks. Therefore, we also include industry exports, *EXPORTS*, as a control variable. Industry exports are obtained from USITC and scaled by domestic shipments. Finally, the U.S. dollar LIBOR, *r*, is included to control for the overall macroeconomic environment. Table V presents correlations of the industry level variables. The three foreign trade variables *FORINP*, *IMPORTS* and *EXPORTS* are highly correlated with correlation coefficients ranging from 0.28 to 0.71. We address this concern in the empirical methodology below.

Equation (2) below presents our regression model. Since product prices, exchange rates and interest rates may be non-stationary, these series are included in log differences. The panel data may involve partially correlated errors across time and across industries. We use Newey-West standard errors to account for correlated errors across time and account for industry fixed effects parametrically by including industry dummies.

$$\begin{aligned}\Delta \ln RPPI_{jt} &= \alpha_0 + \alpha_1 \Delta \ln X_{t-1} + \alpha_2 \Delta \ln X_{t-1} * FRACTION_{jt} + \alpha_3 \Delta \ln X_{t-1} * FORINP_{jt} + \alpha_4 \Delta \ln X_{t-1} * IMPORTS_{jt} \\ &+ \alpha_5 \Delta \ln X_{t-1} * KS_{jt} + \alpha_6 \Delta \ln X_{t-1} * CONC_j + \alpha_7 \Delta \ln X_{t-1} * EXPORTS_{jt} + \alpha_8 \Delta \ln r_{it} + \varepsilon_{jt}\end{aligned} \quad (2)$$

Although not shown, all variables that appear in the interaction terms are also included separately as control variables. To reduce the problem of multicollinearity due to the foreign trade variables, we scale the foreign trade variables by subtracting their time series mean from each observation. This significantly reduces the correlation of *EXPORTS* with *IMPORTS* and *FORINP*. However, the correlation between *FORINP* and *IMPORTS* remains high. Therefore, we include *FORINP* and *IMPORTS* in separate regressions.

We need to be wary of a potential endogeneity problem in this regression. If lower pass-through increases the exposure of unhedged firms to exchange rates, thereby, increasing their incentive to hedge, then the level of hedging in the industry will be an endogenously determined variable. To address this concern, we need an instrument for the level of FCD usage in an industry. The instrument must be correlated with the level of foreign currency hedging in an industry but unrelated to foreign exchange pass through in that industry. The instrument we use is the fraction of firms in the industry that use interest rate derivatives. Previous studies show that firms that use derivatives to hedge foreign currency risk are also more likely to use other hedging instruments like interest rate derivatives, possibly due to the high initial cost of setting up hedging programs (see for example, Geczy, Minton and Schrand (1997)). Consistent with this, our data show that the fraction of firms using interest rate derivatives in an industry is significantly positively correlated with the fraction of firms using foreign currency hedging instruments.

[19] In alternative specifications, the Herfindahl index is used instead of the four firm concentration ratio.

Since interest rate derivatives usage is unlikely to affect or be affected by foreign exchange pass-through to product prices, it meets the requirements of a good instrument.[20]

It is possible that in the presence of industry fixed effects, the Newey-West estimation delivers biased standard errors (see Petersen (2005)). In such cases, standard errors clustered along a cross-sectional dimension will be unbiased. Therefore, in Section 4, we estimate equation (2) using clustered standard errors and time dummies. Since cluster standard errors are robust to arbitrary intra-group correlations, the methodology in Section 4 also addresses the concern that there is almost no variation in *FRACTION* over time.

3.2.2 Results

Table VI presents results for equation (2). In Column I, the measure of import competition, *IMPORTS* is excluded. In Column II, the measure of imported inputs, *FORINP* is excluded. Recall that lower values of the exchange rate measure represent depreciation of the U.S. dollar and, consequently, higher cost of imported inputs. The coefficient on the exchange rate, $\Delta\ lnX$, is negative and significant in both specifications indicating that a depreciating U.S. dollar is associated with a rise in the domestic producer price index. The coefficient on the interaction of the exchange rate with *FRACTION*, is positive and significant. Thus, in industries where derivatives usage is widespread, industry prices rise (drop) less in response to a depreciating (appreciating) dollar. The pass-through elasticity is -0.08 if hedging in the industry is non-existent. As the extent of hedging increases, the pass-through elasticity approaches zero. For an industry with the mean level of hedging, depreciation of the U.S. dollar is not associated with a rise in domestic prices. This result provides support for the hypothesis that currency hedging mitigates the correlation between product prices and exchange rate related cost shocks.

Other coefficients in the pass-through regression are largely in agreement with theory. Industries that use more imported inputs experience larger cost shocks when the dollar fluctuates. Consistent with this, we find that the coefficient on the interaction of *FORINP* and the exchange rate is negative, indicating that prices rise more when the dollar depreciates in industries that are more dependent on imported inputs. A negative coefficient on the interaction of *CONC* with the exchange rate implies that

[20] It is worthwhile to discuss one channel through which interest rate derivatives usage could be linked with foreign exchange pass-through. Previous research shows that large firms are more likely to use interest rate derivatives. It is possible that industries that have a high incidence of interest rate derivatives usage are oligopolies with a handful of large firms. Firms in oligopolist industries have pricing power and are more likely to pass exchange rate shocks through to product prices relative to more competitive industries (see, for example, Allayannis and Ihrig (2001)). However, our hypothesis is that FCD usage reduces pass-through. Therefore, if high interest rate derivatives usage proxies for concentrated industries, then using it as an instrument biases us against finding support for the hypothesis.

pass-through to domestic prices is greater in more concentrated industries.[21] The positive coefficient on the interaction of *EXPORTS* with the exchange rate implies that pass-through of currency cost shocks to domestic prices is lower in industries that export more. Since export revenues improve when the dollar depreciates and offset the increase in import costs, this result suggests that the operational hedge provided by export revenues reduces the need to pass-through exchange rate related cost shocks to prices. A negative coefficient on the interaction of *IMPORTS* with the exchange rate indicates that, as expected, pass-through to domestic prices is greater in industries that face more import competition. Finally, we find that an industry's capital intensity appears not to affect pass-through.

These results show that pass-through is lower in industries in which FCD usage is more prevalent. An individual firms' exposure to exchange rate shocks and its need to hedge the shock will depend on how much of the shock is passed through to selling prices. Therefore, the extent of FCD usage in an industry will itself be determined by various industry characteristics that affect pass-through. We do not assert unidirectional causality and nor do we assume that industry hedging is exogenous. Rather, we seek to establish that derivatives usage and exchange rate pass-through are intuitively linked such that an individual firm's exposure and, therefore, its hedging decision, will depend on the hedging choices of its competitors.

3.3. The Effect of Industry Hedging and Pass-through on Individual Firms' Exposures

In the previous section we found that industry prices are less sensitive to foreign exchange related cost shocks in industries where FCD usage is more common. Since prices are less likely to offset foreign exchange shocks in these industries, FCD non-users (users) are expected to be more (less) exposed to exchange rate shocks. This section examines whether the exchange rate exposure of FCD non-users (users) estimated in Section 3.1 is higher (lower) in industries where FCD usage is widespread and pass-through lower.

3.3.1. Methodology

We test the relation between $\hat{\beta}_{ix}$ and fraction of hedgers in a multivariate framework. Since a more negative $\hat{\beta}_{ix}$ or a more positive $\hat{\beta}_{ix}$ can both reflect higher exposure to exchange rates we take the absolute value of the exposure coefficient as a dependent variable. The following regression is estimated using ordinary least squares:

[21] When the Herfindahl index is used in place of the four firm concentration ratio, the coefficient is still negative but not statistically significant.

$$abs(\hat{\beta}_{ix}) = \alpha_0 + \alpha_1 D_i + \alpha_2 D_i * F_j + \alpha_3 F_j + \alpha_4 Size_i + \alpha_5 LTDratio_i + \alpha_6 QuickRatio_i + \alpha_7 ForeignSales_i + \alpha_8 PayoutRatio + u_i \quad (3)$$

The dummy variable D_i takes a value equal to one if the firm disclosed the use of FCD in 1999 and zero, otherwise. F_j is our measure of the prevalence of hedging in firm *i*'s industry and is the same as the variable *FRACTION* used in Section 3.2 with one minor change. When calculating the fraction of hedgers in a firm's industry, we exclude the firm's own hedging decision because the dummy variable, *D*, already captures the firm's hedging decision. Since there is almost no variation in *F* within an industry, we cannot include industry dummies. However, observations on individual firms in a given industry may not be independent and equation (3) could suffer from correlated errors. Therefore, we estimate regression (3) using industry clustered standard errors.[22] Section 4 presents an alternative methodology in which, instead of taking the absolute value of the exposure coefficient, we examine the differential impact of industry hedging on firms with positive and negative $\hat{\beta}_{ix}$.

The univariate analysis in Section 3.1 indicated that on average, FCD users have lower absolute exposure than FCD non-users. Therefore, we expect that coefficient $\alpha_1 < 0$ in equation (3). Since the exposure of an FCD user (non-user) is expected to decrease (increase) with the fraction of hedged firms in the industry, we include an interaction of D with *F*. A wider gap between the exposure of hedged and unhedged firms implies $\alpha_2 < 0$. That is, in industries where hedging is widespread, unhedged firms are increasingly more exposed to the foreign exchange shock relative to hedged firms.

To present the results from the point of view of FCD non-users we repeat this estimation with only an illustrative modification shown in equation (4). We include a dummy that equals 1 if the firm does *not* use FCD and interact this non-user dummy variable with the fraction of FCD non-users in the industry.

$$abs(\hat{\beta}_{ix}) = \alpha_0 + \alpha_1(1 - D_i) + \alpha_2(1 - D_i) * (1 - F_j) + \alpha_3(1 - F_j) + \alpha_4 Size_i + \alpha_5 LTDratio_i + \alpha_6 QuickRatio_i + \alpha_7 ForeignSales_i + \alpha_8 PayoutRatio + u_i \quad (4)$$

Although this equation is econometrically identical to equation (3), it helps us see how the exposure of an FCD non-user is affected as more competitors also choose to remain unhedged. We expect that, FCD non-users are, on average, more exposed to currency fluctuations than FCD users ($\alpha_1 > 0$). However, in industries where FCD usage is less common, unhedged firms have lower exposure and therefore, the gap

[22] It is well recognized that in regression models where the dependent variable is an estimate, variation in the sampling variance causes heteroskedasticity. A common approach to this problem is to use weighted least squares technique. However, Lewis and Linzer (2005) show that weighted least squares usually leads to inefficient estimates and underestimated standard errors. They find that in many cases, OLS with heteroskedasticity consistent standard errors yields better results. The clustered standard errors used here are heteroskedasticity consistent.

between the exposure of hedged and unhedged firms is lower ($\alpha_2 < 0$). In equations (3) and (4), the following control variables are included: *Size* of the firm measured as log of total assets, *LTDratio* which is calculated as long term debt divided by total assets, *QuickRatio* calculated as current assets minus inventories divided by current liabilities, *ForeignSales* calculated as foreign sales divided by total sales, and *PayoutRatio* calculated as dividend per share divided by earnings per share. Table VII presents estimates of equations (3) and (4). Before discussing the results in Table VII, we address an important concern.

These tests are motivated by the argument that in industries where FCD usage is widespread, pass-through of currency shocks to product prices is lower, thus causing the exposure of FCD users (non-users) to be lower (higher). However, we have to be wary of alternative explanations. If the prevalence of hedging in an industry is correlated with an unobserved risk characteristic of that industry, then the predicted coefficients may simply indicate that FCD non-users have greater exposure in industries that are inherently riskier. In this case, it could be argued that our results do not speak to the dampening effect of currency hedging on exchange rate pass-through

To address this concern, we directly examine the relation between the foreign exchange exposure of FCD users (non-users) and the degree of exchange rate pass-through in the industry. We first estimate aggregate foreign currency pass-through to domestic prices over the same estimation period (1996-2000) for each industry using a time series regression. The pass-through coefficient is π_j in the regression $\Delta \ln RPPI_t = \alpha_{j0} + \pi_j \Delta \ln EXCH_{t-1} + \alpha_{j1} \Delta \ln r_t + u_{jt}$. It captures the aggregate sensitivity of domestic producer prices in industry *j* to exchange rate shocks. Since lower values of the exchange rate measure indicate a weaker dollar, a negative value of the pass-through coefficient means that domestic prices rise (fall) when cost of imported inputs increases (decreases). Thus, the pass-through coefficient, π_j, is more negative in industries with greater pass-through of foreign exchange cost shocks to prices.

To examine whether the exposure of FCD users (non-users) is higher (lower) when pass-through is higher, we use the pass-through coefficient, π_j, as an explanatory variable in equations (3) and (4) instead of the level of hedging F_j. The prediction that $\alpha_1 < 0$ in equation (3) and $\alpha_1 > 0$ in equation (4) remains unchanged. Since the estimated pass-through coefficient is more negative in industries with greater pass-through, the coefficient α_2 in equation (3) should be less than 0 when π_j is used instead of *F*. That is, when pass-through is lower (i.e. pass-through coefficient π_j higher), the exposure of FCD users declines relative to that of FCD non-users. In equation (4), if (1- π_j) is used as an explanatory variable instead of (*1-F*), the coefficient $\alpha_2 < 0$. In other words, when pass-through is high (higher values of 1- π_j), the exposure of FCD non-users declines because currency shocks are offset by product price changes. Thus, the gap between the exposure of FCD users and non-users declines.

Table VII presents estimates of equations (3) and (4) with the fraction of hedged firms, *F*, as the right-hand side industry variable. Table VIII presents estimates of the same equations with the pass-through coefficient π_j serving as the right-hand side industry variable instead of *F*.

3.3.2. Results

Estimates of equation (3) and (4) are presented in Columns 1 and 2 respectively of Table VII. The coefficients are as predicted. FCD users, on average, have lower absolute exposure coefficients than FCD non-users. However, the gap in the level of exposure of FCD users and FCD non-users is significantly higher in industries where FCD usage is more widespread. The negative coefficient on α_2 confirms that when more firms in an industry use FCDs, the exposure of FCD users drops further relative to that of FCD non-users. Table VIII shows estimates of equation (3) and (4) if the pass-through coefficient π_j is used instead of *F*. These coefficients are also consistent with our hypothesis. FCD users have lower exposure than FCD non-users ($\alpha_1 < 0$). We see that in industries where the pass-through is lower (that is, pass-through coefficient higher) the gap between the exposure of FCD users and FCD non-users is higher. That is, the negative sign for α_2 confirms that when pass-through is lower, the exposure of FCD users declines relative to that of FCD non-users.[23]

Regarding the control variables used in Tables VII and VIII, we see that exposure is lower for firms that have high foreign sales as a fraction of total sales. In additional analysis not shown here, we find that the negative coefficient on foreign sales is significant only for firms that rely on imported inputs (firms belonging to industries with above median values of *FORINP*). Thus, our results suggest that foreign sales serve as an operational hedge for firms that use imported inputs. Finally, the role of financial constraints on foreign exchange exposure is mixed. Firms with high payout ratios have low foreign exchange exposure coefficients which is consistent with the notion that less financially constrained firms have lower foreign exchange exposure. However, we find that firms with higher long-term debt ratios also have lower foreign exchange exposures.

The link between an individual firm's exposure and competitors' hedging decisions should be a feature of imperfectly competitive industries where some pricing power exits. In highly competitive industries, a firm's output choice does not affect price, and consequently, the relation between industry hedging and exchange rate pass-through to output prices is weak. Thus, in competitive industries, a firm's

[23] Since this regression framework examines relative exposure, the higher gap between the exposure of FCD users and non-users when industry hedging is higher (or pass-through lower) could be driven by lower exposure of FCD users, higher exposure of FCD non-users or both. In additional tests (shown in Section 4) we examine the relation between the exposure coefficient and industry hedging for separate samples of FCD users and FCD non-users. Results indicate that as the level of hedging in an industry increases, the average exposure of the FCD-user sample decreases and that of FCD-non-users sample increases.

exposure is not expected to depend on the hedging choices of competitors. We re-estimate equation (3) separately for highly competitive and less competitive industries. We classify highly competitive industries as those belonging to the bottom quintile of the four-firm concentration ratio. Results for highly competitive (less competitive) industries are reported in Column 1 (Column 2) of Table IX. We find that a statistically significant relation between an individual firm's exposure and the fraction of hedgers in the industry holds only in less competitive industries. In highly competitive industries, an individual firm's exposure is not affected by the hedging decisions of competitors. For robustness, we also use low Herfindahl index and low price-cost margin instead of the four-firm concentration index to identify highly competitive industries and find similar results.

Our results are consistent with Bodnar, Dumas and Marston (2002) who show that lower pass-through is associated with higher foreign exchange exposure. We make two contributions to this line of research. First, we show that pass-through in an industry is closely linked to FCD usage in that industry and second, the exchange rate exposure of FCD users responds very differently to pass-through than the exposure of FCD non-users.

3.4 FCD Usage and Firm Value

A number of previous studies demonstrate a positive relation between FCD usage and firm value.[24] It is argued that derivatives users are valued higher because they reduce volatility and the associated financial distress costs, underinvestment costs etc. Jin and Jorion (2006), on the other hand, find no relation between hedging and firm value in the oil and natural gas industry. They suggest a possible reason for why foreign currency hedging is valuable but oil and gas hedging is not. It is possible that investors buy oil and natural gas stock precisely to gain exposure to these commodity prices and thus, hedging oil and gas exposures is not beneficial for shareholders. In contrast, foreign exchange risk is often incidental to the firm's core business, and usually difficult for an investor to assess properly. Therefore, a corporation can benefit from hedging away foreign exchange risk on behalf of its shareholders.

Even if shareholders want corporations to reduce foreign exchange exposures, our results indicate that the commonly documented link between FCD usage and firm value needs further investigation. We have shown that in industries where FCD usage is low, firms that don't use FCD have naturally low foreign exchange risk because exchange rate shocks are passed through to prices. In fact, in these industries, hedged firms may be more exposed to foreign exchange risk. Thus, the usual explanation for the existence of a currency hedging premium does not hold for industries where FCD usage is rare. In

[24] See, for example, Allayannis and Weston (2001), Graham and Rogers (2002), Allayannis, Lel and Miller (2003), Carter, Rogers and Simkins (2006), Bartram, Brown and Fehle (2004) and Lookman (2004).

order to shed more light on this issue, this section reexamines the link between FCD usage and firm value conditional on level of hedging in the industry.

3.4.1. Methodology

As in previous studies, Tobin's Q is used as a measure of firm value (see, for example, Allayannis and Weston (2001)). It is equal to the market value of equity (price times shares outstanding from CRSP) plus assets minus the book value of equity, all divided by assets. Book value of equity is equal to common equity plus deferred taxes. As in previous literature, the sample is restricted to firms that face ex-ante exposure to exchange rates and, thus, the absence of foreign currency derivatives usage can be interpreted as a decision not to hedge foreign exchange risk rather than a lack of foreign exchange exposure. A firm's hedging decision is captured by a derivatives *non-user* dummy that equals one if the firm does not disclose the use of foreign exchange swaps, forwards or options and zero otherwise. In this test, all data are as of 1999.

When estimating the effect of the hedging decision on firm value, we control for factors that are known to affect firm value, namely, growth opportunities, size, leverage, profitability and industrial diversification. Research and development expense over sales and capital expenditures over sales are used as proxies for growth opportunities. Log of total assets serves as the measure of firm size. Leverage is calculated as total long-term debt divided by total assets. Return on assets serves as a proxy for profitability and is calculated as net income over total assets. Industrial diversification is captured with a dummy that equals one if a firm operates in more than one segment and zero otherwise. Following the findings of Lookman (2004), we use managerial stock-ownership and institutional ownership as controls for potential agency conflicts between managers and shareholders. To reduce the influence of outliers, Q, long-term debt ratio, research and development expense, and return on assets are winsorized at the 1 percent level.

We examine the effect of currency derivative hedging on firm value by modeling firm value as

$$V_i = \delta_0 + \delta_1 X_i + \delta_2 (1 - D_i) + e_i \quad (5)$$

where V_i is value, X_i is a set of exogenous observable characteristics of the firm, *$(1-D_i)$* is a dummy variable that takes the value of 1 if the firm is a currency derivatives non-user and 0 otherwise, and e_i is the error term. A firm's decision to engage in risk management may be correlated with some unobserved variables that also affect firm value. Thus, *$(1-D_i)$* may be correlated with the error term in equation (4.5), rendering OLS estimates of δ_2 biased. To control for potential self-selection of firms that hedge, we use Heckman's (1979) two-stage procedure in which the hedging decision is modeled as a function of firm-specific variables that have been shown to affect a firm's incentives to hedge exchange rate risk, specifically, foreign sales, size, leverage, research and development expense, and institutional ownership. We also use a two-stage least squares approach which we will refer to as the instrumental variable (IV) regression. In the first stage of the IV approach, a firm's hedging decision is predicted using the same instruments as in the Heckman method. For both methods, we require an instrument that is correlated with the hedging dummy but uncorrelated with firm value. Unlike the method in Section 3.2, we cannot use interest rate derivatives usage as an instrument because previous research has shown a link between firm value and interest rate derivatives usage. One possible instrument is the lagged value of the currency derivatives non-user dummy. Recall that the derivatives non-user dummy equals one if a firm did not engage in currency hedging during the year 1999 and zero otherwise. We create another dummy variable, called *lag_hedge* that equals 1 if a firm did not engage in foreign currency hedging in the year 1997 and zero if it did. The derivatives non-user dummy for 1999 is significantly positively correlated with *lag_hedge*. Firms that engaged in foreign currency risk-management in the past are much more likely to do so again in 1999 than firms that did not hedge previously. It is unlikely that the firm's hedging decision in 1997 affects Tobin's Q in 1999 other than through its association with the current hedging decision. Thus, *lag_hedge* satisfies the requirements of a good instrument.

Equation (5) is estimated using the methods described above for three sub-groups – firms with the highest (top $1/3^{rd}$) values for industry hedging, firms with middle $1/3^{rd}$ of values for industry hedging and firms with bottom $1/3^{rd}$ of values for industry hedging. For convenience, we call these samples 'highly hedged' industries, 'moderately hedged' industries and 'unhedged' industries respectively. A firm's market value may be positively correlated with the market value of other firms in its industry. Therefore, splitting the sample using the market value-weighted fraction of hedgers in an industry can lead to a spurious relationship between a firm's value and its hedging decision. To avoid this problem, we split the sample using an unweighted measure of the fraction of hedged firms in an industry. Results are discussed in the next section.

3.4.2. Results

Table X presents estimates of equation (5) for all firms that meet the data requirements as well as for the three sub-samples based on industry hedging. Column I replicates the results of previous studies by estimating equation (5) for the entire sample. The negative and significant coefficient on the FCD non-user dummy confirms the common finding that firms that do not use derivatives suffer a value discount relative to derivatives-users. In Columns, II-IV, we repeat the regression for firms belonging to the three groups of industries using the Heckman procedure. We see that the derivatives non-user dummy is significant only in the sub-sample where industry hedging is high. FCD non-users suffer a value discount only if they belong to industries where FCD usage is widespread. The IV estimation presented in columns

V-VII confirms this finding. In industries where FCD usage is low and unhedged firms enjoy a natural hedge against exchange rate shocks, unhedged firms do not suffer a value discount relative to hedged firms. This outcome is quite consistent with the pass-through and exposure results of Sections 3.2 and 3.3. Unhedged firms in highly hedged industries face greater foreign exchange exposure and are also valued lower. Unhedged firms in relatively unhedged industries face low foreign exchange exposure and do not experience a value discount.

While this finding is consistent with the overall theme of the paper, it does not resolve the fundamental question about why a value difference persists at all. It appears irrational for some firms to remain unhedged even though the choice to not hedge when most competitors are hedging results in lower firm value. If a simple act of hedging can improve firm value significantly, then why do these firms not use derivatives? One possible explanation is that they are unable to use derivatives even if they want to. These could potentially be firms that cannot find counterparties to derivatives transactions due to low credit quality, poor performance etc. Firms that don't hedge when most competitors do hedge may have fundamentally different, but unobservable, characteristics that are associated with lower firm value. Such an explanation challenges the causality between derivatives usage and firm value and suggests instead that the decision not to use derivatives is related to other factors that result in low firm value.

To investigate this idea further, we compare the past five-year (1994-1998) operating and stock performance of FCD non-users in 'highly hedged' industries (which appear to suffer a value discount) with the past performance of (i) FCD non-users in 'moderately hedged' and 'unhedged' industries and (ii) FCD users. Table XI presents comparisons of return on assets, gross profit margins and stock returns of these groups of firms. In Panel A of Table XI, we find significant differences in the performance of the two groups of FCD non-users. FCD non-users in 'highly hedged' industries have significantly lower industry adjusted profit margins, lower return on assets and lower stock returns during the past five years relative to FCD non-users belonging to the remaining industries. In Panel B of the same table, we see that FCD non-users belonging to 'highly hedged' industries also significantly underperform FCD users in the previous five years. They have significantly lower return on assets and profit margins than hedged firms. Thus, the group of firms that experiences a value discount in 1999 happens to have underperformed the rest of the sample in the previous five years. This persistent underperformance may be an explanation for the lower value of FCD non-users in 'highly hedged' industries as well as for their decision to not use derivatives. To test this, we repeat the Heckman estimation of equation (5) for firms belonging to 'highly hedged' industries, this time including the past averages of profit margins, return on assets and stock returns in the self-selection equation. The two-stage least squares method is also repeated with the past performance averages included in the first stage. Table XII presents estimates of these regressions. We see that once these factors are allowed for in the decision to hedge, there is no observable relation between hedging and firm value, even in industries where hedging is widespread.

These results suggest that foreign currency derivatives usage does not cause an observable improvement in firm value. Rather, the failure to hedge risks that most competitors consider prudent to hedge is symptomatic of the same firm characteristics that caused poorer profits and stock returns in the recent past. Although foreign currency risk is often an incidental and not a core business risk, our results demonstrate that once competitors hedging choices are taken into account, firms appear to make optimal decisions about foreign currency risk-management.

4. Robustness

This section demonstrates that our results are robust to alternative measures of industry level hedging. We also revisit the pass-through relation of Section 3.2 and the exposure results of Section 3.3 in order to demonstrate robustness to alternative methodologies.

4.1 Alternative measures for industry level hedging

In the results presented above, hedging at the industry level is measured as the market value of FCD users that face ex-ante foreign exchange exposure divided by market value of all firms that face ex-ante foreign exchange exposure. Firms are defined as having ex-ante currency exposure if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file, or disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files. Since ex-ante foreign exposure is hard to measure, this method may lead us to ignore firms that do face foreign exchange exposure but choose not hedge. To prevent our results from being biased by the measure of ex-ante exposure, we calculate industry-level hedging without restricting the sample to exposed firms only. Our alternative measure of industry hedging is the market value of all FCD users divided by market value of all firms in the industry (see Panel B of Table I for summary statistics of this measure). Table XIII shows that the pass-through results of Section 3.2 are robust to this alternative measure of the level of hedging in an industry. The negative coefficient on the exchange rate indicates that the domestic retail producer price index rises, albeit insignificantly, when the U.S. dollar depreciates. However, pass-through is stronger in industries that use more imported inputs, in more concentrated industries and also in industries that face greater import competition. The pass-through of exchange rate shocks to prices is weaker in industries that use more FCD and in industries that export more.

Table XIV revisits the relation between an individual firm's exposure and the fraction of hedged firms in the industry, as shown in equation (3) of Section 3.3. However, this time the fraction of hedgers is calculated using all firms regardless of ex-ante exposure. Table XIV shows that the foreign exchange exposure of FCD users is lower than that of FCD non-users. Moreover, as the level of hedging in the industry rises, the exposure of FCD users drops further relative to that of FCD non-users. Thus, the results presented in Section 3.3 are robust to a value-weighted measure of industry hedging which is based on all firms and not only on firms with ex-ante exchange rate exposure

In tests not presented here, we also use an unweighted measure of the fraction of hedgers in an industry. The pass-through results are robust to the unweighted measure – a higher fraction of hedgers in an industry is still associated with lower pass-through. However, the association between industry hedging and individual firms' currency exposure becomes weaker (statistically insignificant).

4.2 Exchange rate exposure of FCD-users and non-users

The estimated exposure coefficient, $\hat{\beta}_{ix}$, can be either positive or negative. A more negative or a more positive $\hat{\beta}_{ix}$ both reflect higher exchange rate exposure. Since values closer to zero indicate lower exchange rate exposure, in Section 3.3, we used the absolute value of the exposure coefficient as the dependent variable. We now examine the differential effect of industry hedging on firms with positive and negative exposure coefficients using a methodology based on He and Ng (1998). The following regression is estimated using ordinary least squares with industry clustered standard errors:

$$\hat{\beta}_{ix} = \alpha_0 + \alpha_1(1-P) + \alpha_2 P * F_j + \alpha_3(1-P) * F_j + \alpha_4 Size_i + \alpha_5 LTDratio_i + \alpha_6 QuickRatio_i + \alpha_7 ForeignSales_i + \alpha_8 PayoutRatio + u_i \quad (6)$$

where P is a dummy variable equal to one if $\hat{\beta}_{ix}$ is positive and zero otherwise. All other variables are as described in Section 3.3. The regression is estimated separately for FCD users and FCD non-users. Results are presented in Table XV.

Since the dummy P is equal to 1 for firms with positive $\hat{\beta}_{ix}$, the constant is positive by design and the coefficient on the dummy *(1-P)* negative. In Panel A, which presents the estimates of equation (6) for FCD non-users, we observe that the coefficient on the interaction of P with the level of hedging in the industry, F, is positive and significant. This indicates that FCD non-users with positive exposure to exchange rates have even higher exposure when more competitors are hedged. The coefficient on the interaction of *(1-P)* with the level of hedging in the industry is negative but insignificant. The negative sign of this interaction term suggests that hedging by competitors also exacerbates the exposure for firms with negative $\hat{\beta}_{ix}$ but this effect is not statistically significant. Thus, a rise in the fraction of hedged competitors increases foreign exchange exposure of unhedged firms on average, and this result appears to be driven by firms whose returns improve when the dollar appreciates (i.e., firms with positive $\hat{\beta}_{ix}$). Firms with positive $\hat{\beta}_{ix}$ are more likely to be importing firms whose costs rise as the dollar depreciates. Since the theoretical arguments behind these tests apply to firms that face cost shocks, it is not altogether surprising that the results are driven by firms whose cost of importing changes as the dollar value changes.

Panel B provides estimates of equation (6) for FCD users. We see that the coefficient on the interaction of *(1-P)* with the level of hedging in the industry, *F*, is positive and significant. This means that as the level of hedging in the industry increases, negative exposure coefficients of FCD users move significantly closer to zero. Similarly, the negative sign on the interaction of *P* and *F* indicates that as the level of hedging in the industry increases, positive exposure coefficients of FCD users move insignificantly closer to zero. These results confirm the finding in Section 5 that the foreign exchange exposure of an FCD user is lower in industries where many other firms also use FCD.

4.3 Pass-through analysis with clustered standard errors

In Section 3.2, we examined the relationship between industry hedging and pass-through, by estimating a panel model in which errors are possibly correlated over time and across observations. We dealt with the industry-fixed effect parametrically by including industry dummies and with the time effect by using Newey-West standard errors. The regression was estimated using two-stage least squares. Petersen (2005) suggests that in the presence of industry-fixed effects, Newey-West standard errors may be biased. Another concern of the methodology in Section 3.2 is that, given the low variation in the hedging measure over time, the presence of industry-fixed effects makes it difficult to capture the relation between hedging and industry prices (see Zhou (2001)). Both these issues can be addressed by using standard errors clustered across a cross-sectional dimension. We re-estimate the pass-through equation (2) with standard errors clustered at the 2-digit SIC level using generalized method of moments (GMM). Since producer price data are limited to the manufacturing industries, the number of 2-digit SIC clusters is insufficient to include all time dummies. Therefore, we estimate the equation using year dummies only. Table XVI presents results of equation (2) estimated using GMM with clustered standard errors. As before, we use the extent of interest rate derivatives usage as an instrument for FCD usage in an industry. We see that domestic producer prices rise when the dollar depreciates in industries that use more imported inputs and face greater import competition. However, this pass-through is lower in industries where FCD usage is more prevalent and in industries that export more. Thus, the relation between hedging and industry pass-through is robust to this alternative methodology.

5. Conclusion

The evidence in this paper sheds new light on the corporate risk management literature. We show that when more firms in an industry use FCD, industry output prices become less sensitive to exchange rate shocks. Specifically, as the dollar depreciates and import costs rise, U.S. firms charge higher prices in the domestic market. However, as FCD usage in an industry rises, the correlation between domestic prices and exchange rate shocks drops. For an industry with an average level of FCD usage, depreciation of the U.S. dollar is not associated with an increase in industry selling prices. To our knowledge, this is the first paper to provide evidence that financial hedging influences output markets.

This finding is important for the corporate risk management literature because the link between FCD usage and output markets makes the foreign exchange exposures of firms in an industry interdependent. We find that as the level of hedging in an industry increases (and pass-through decreases), the foreign exchange exposure of an FCD user declines while that of an FCD non-user increases. A firm faces lower exposure to the underlying exchange rate risk when its hedging decision is similar to competitors' hedging decisions. Thus, an FCD user can face more exposure to the underlying risk factor than a non-user, even if the FCD user is not trading speculatively. Not surprisingly, empirical tests of risk management theory that consider FCD usage tantamount to risk-reduction arrive at mixed or inconclusive evidence.

We also find that once the hedging choices of other firms in the industry are taken into account, there is no observable difference between the value of an FCD user and FCD non-user. This suggests that, when studied in the context of their industries, firms make optimal choices about foreign currency risk management. Our finding that a firm's exposure to a risk factor is affected by the hedging choices of competing firms implies that risk-management decisions should be determined within an industry equilibrium. The theoretical work of Adam, Dasgupta and Titman (2006) takes a step in this direction by examining how a firm's hedging choice depends on the hedging choices of competitors.

Existing theories that examine a firm's decision to hedge in isolation from its industry enjoy little empirical support. Guay and Kothari (2003) contend that empirical support for risk-management theory is weak because the usual empirical proxy for risk-management - derivatives usage - constitutes too small a part of a firm's hedging program. However, we demonstrate that the extent of derivatives hedging in an industry significantly affects product prices as well as an individual firm's exposure to exchange rates. Our results suggest that previous empirical research is inconclusive not because derivatives hedging is unimportant for a firm's risk-profile, but because the role derivatives usage plays in the firms' product markets is ignored.

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TABLE I
Descriptive Statistics of Foreign Currency Derivatives Use

Panel A summarizes foreign currency derivatives (FCD) usage as of fiscal year 1999 by 549 U.S. firms that face ex-ante exchange rate exposure. A firm is defined as having exchange rate exposure if it discloses foreign assets, sales or income in the COMPUSTAT Geographic segment file, or discloses positive values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files. A firm is classified as an FCD user if it discloses the use of foreign currency forwards, swaps or options in its 10-K disclosures. Panel A gives mean, 25th percentile, median and 75th percentile of total FCD usage as well as a break up by type of derivative (swaps, forwards and options). The table provides total notional amounts as well as notional amounts scaled by book value of total assets. All values are in dollar millions.
Panel B provides the distribution of FCD usage at the 3-digit SIC industry level. Two measures of FCD usage are presented. The first column gives the distribution of the market value-weighted fraction of hedgers based on the sub-sample of firms facing ex-ante exchange rate exposure. It is calculated as the sum of market values of FCD users in the industry who face ex-ante currency exposure divided by sum of market values of all firms in the industry who face ex-ante currency exposure. Market value of a firm is the market value of equity plus the book value of debt. N is the number of observations. The second column of Panel B gives the distribution of the market value-weighted fraction of hedgers based on the entire sample regardless of ex-ante foreign exchange exposure. It is calculated as the sum of market values of FCD users in the industry divided by sum of market values of all firms in the industry.

PANEL A : Foreign Currency Derivative Usage (FCD) in $ millions

	N	Mean	25th percentile	Median	75th percentile	Std. Dev
Total FCD	549	745.69	7.60	42.90	265.84	3427.99
Scaled by Total Assets		8.89%	1.30%	3.76%	9.74%	23.86%
Foreign Currency Swaps	74	850.48	35.00	158.12	603.00	2917.45
Scaled by Total Assets		4.90%	1.39%	3.08%	6.18%	5.26%
Foreign Currency Forwards	502	606.11	7.00	35.78	210.00	2811.58
Scaled by Total Assets		7.84%	1.12%	3.14%	7.68%	24.13%
Foreign Currency Options	91	463.52	17.70	79.4	403.00	908.77
Scaled by Total Assets		6.35%	0.74%	2.26%	7.06%	11.75%

PANEL B : Distribution of FCD Usage by 3-digit SIC Industry Group

Percentiles	Fraction of Hedgers (Based on Exposed Firms Only)	Fraction of Hedgers (Based on All Firms)
10%	0.00	0.00
25%	0.00	0.00
50%	2.50%	0.30%
60%	19.60%	9.70%
75%	48.20%	37.30%
90%	75.80%	65.40%
95%	94.30%	81.85%
Industries	256	275
Mean	0.25	0.20
Std. Dev	0.32	0.28

TABLE II
Fraction of Firms Using Foreign Currency Derivatives (FCD) by Fama-French Industry Groups

This table reports two measures of the extent of hedging for 43 out of 48 Fama-French industry groups as of fiscal year 1999. The first measure is based only on firms that face ex-ante foreign currency exposure. It is calculated as the sum of market values of FCD users in the industry who face ex-ante currency exposure divided by sum of market values of all firms in the industry who face ex-ante currency exposure. Market value of a firm is the market value of equity plus the book value of debt. Firms are defined as having ex-ante exposure if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file, or disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files. The second measure is based on the entire sample regardless of foreign exchange exposure. It is calculated as the sum of market values of FCD users in the industry divided by sum of market values of all firms in the industry.

Fama French Industry #	Industry Name	N	Fraction of Hedgers (Based on Exposed Firms Only)	Fraction of Hedgers (Based on All Firms)
1	Agriculture	28	0.34	0.19
2	Food Products	136	0.58	0.45
3	Candy & Soda	27	0.45	0.43
4	Beer & Liquor	33	0.80	0.78
5	Tobacco Products	13	0.00	0.00
6	Recreation	88	0.94	0.94
7	Entertainment	201	0.00	0.00
8	Printing and Publishing	76	0.03	0.02
9	Consumer Goods	152	0.27	0.27
10	Apparel	108	0.22	0.20
11	Healthcare	143	0.20	0.09
12	Medical Equipment	275	0.66	0.62
13	Pharmaceutical Products	469	0.57	0.54
14	Chemicals	149	0.34	0.34
15	Rubber and Plastic Products	82	0.47	0.44
16	Textiles	42	0.28	0.22
17	Construction Materials	142	0.30	0.28
18	Construction	110	0.52	0.35
19	Steel Works	122	0.40	0.36
20	Fabricated Products	36	0.24	0.19
21	Machinery	266	0.55	0.55
22	Electrical Equipment	84	0.33	0.33
23	Automobiles and Trucks	163	0.86	0.86
24	Aircraft	118	0.49	0.49
25	Shipbuilding, Railroad Equipment	30	0.86	0.85
26	Defense	15	0.05	0.04
27	Precious Metals	13	0.00	0.00
28	Non-Metallic and Industrial Metal Mining	49	0.55	0.48
29	Coal	42	0.29	0.26
30	Petroleum and Natural Gas	9	0.00	0.00
31	Utilities	340	0.35	0.35
32	Communication	396	0.27	0.16
33	Personal Services	446	0.31	0.24
34	Business Services	94	0.23	0.17
35	Computers	1500	0.49	0.41
36	Electronic Equipment	445	0.75	0.71
37	Measuring and Control Equipment	522	0.31	0.31
38	Business Supplies	195	0.41	0.39
39	Shipping Containers	107	0.56	0.53
40	Transportation	27	0.31	0.29
41	Wholesale	212	0.26	0.20
42	Retail	347	0.41	0.32
43	Restaurants, Hotels, Motels	428	0.58	0.35

Table III
Summary of Foreign Exchange Exposure Coefficient

This table provides the distribution of foreign exchange exposure coefficient, $\hat{\beta}_{ix}$, estimated in the regression $r_{it} = \beta_{i0} + \beta_{ix}\Delta EXCH_t + \beta_{im} r_{mt} + \varepsilon_{it}$, where r_t is the monthly rate of return on a firm's stock for the years 1996 till 2000, r_{mt} is the corresponding monthly rate of return on the value-weighted market index, $\Delta EXCH_t$ is the monthly change in value of the U.S. dollar orthogonal to the market return. Panels A shows summary statistics of $\hat{\beta}_{ix}$ for the entire sample, as well as for sub-samples of FCD Users and FCD Non-Users. FCD users are firms that disclosed the use of foreign currency forwards, swaps or options at the end of fiscal year 1999. All remaining firms are classified as FCD non-users. Panel B (Panel C) shows summary statistics for firms with positive (negative) exposure coefficients only. t-statistics are in parenthesis. For samples with an even number of firms, the median is an average of two coefficients and, therefore, no t-statistic is reported. Significance is indicated by bold font with superscripts a, b, and c denoting significance at the 1%, 5% and 10% levels respectively.

Panel A : All Firms	All Firms	FCD Non-Users	FCD Users
Minimum	**-1.03**[a]	**-1.03**[a]	**-0.06**[a]
	(-10.80)	(-10.80)	(-3.36)
Median	0.003	0.004	0.001
		(0.16)	(0.10)
Maximum	**1.22**[c]	**1.22**[c]	**0.06**[a]
	(1.77)	(1.77)	(2.75)
Mean "Absolute" Exposure Coefficient		0.02	0.01
Difference in Mean "Absolute" Exposure Coefficients		**0.01**[a]	
		(3.59)	
Number of firms with significant exposure at least at the 10% level	344	292	52
Total Number of Firms	3036	2635	401

Panel B : Firms with positive exposure only	All Firms	FCD Non-Users	FCD Users
Minimum	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)
Median	0.012	0.013	0.008
	(0.60)		(0.80)
Maximum	**1.22**[c]	**1.22**[c]	**0.06**[a]
	(1.78)	(1.78)	(2.75)
Mean Exposure		0.020	0.011
Difference in Mean Exposures		**0.018**[a]	
		(2.94)	
Number of firms with significant exposure at least at the 10% level	216	190	26
Total Number of Firms	1777	1558	219

Panel C: Firms with negative exposure only	All Firms	FCD Non-Users	FCD Users
Minimum	**-1.03**[a]	**-1.03**[a]	**-0.06**[a]
	(-10.80)	(-10.80)	(-3.36)
Median	-0.009	-0.009	-0.007
	(-0.60)	(0.52)	
Maximum	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)
Mean Exposure	-0.014	-0.016	-0.010
Difference in Mean Exposures		**-0.005**[b]	
		(1.96)	
Number of firms with significant exposure at least at the 10% level	128	102	26
Total Number of Firms	1259	1077	182

Figure I
Exposure Foreign Exchange Exposure Coefficients of FCD Users and FCD Non-Users

This figure plots the foreign exchange exposure coefficients, $\hat{\beta}_{ix}$, estimated in the regression $r_{it} = \beta_{i0} + \beta_{ix}\Delta EXCH_t + \beta_{im}r_{mt} + \varepsilon_{it}$, where r_t is the monthly rate of return on a firm's stock for the years 1996 till 2000, r_{mt} is the corresponding monthly rate of return on the value-weighted market index, $\Delta EXCH_t$ is the monthly change in value of the U.S. dollar orthogonal to the market return. Figure I-A plots $\hat{\beta}_{ix}$ for FCD Users and Figure I-B plots $\hat{\beta}_{ix}$ for FCD Non-Users. FCD users are firms that disclosed the use of foreign currency swaps, options or forwards at the end of fiscal year 1999. All remaining firms are classified as FCD non-users.

Figure I-A

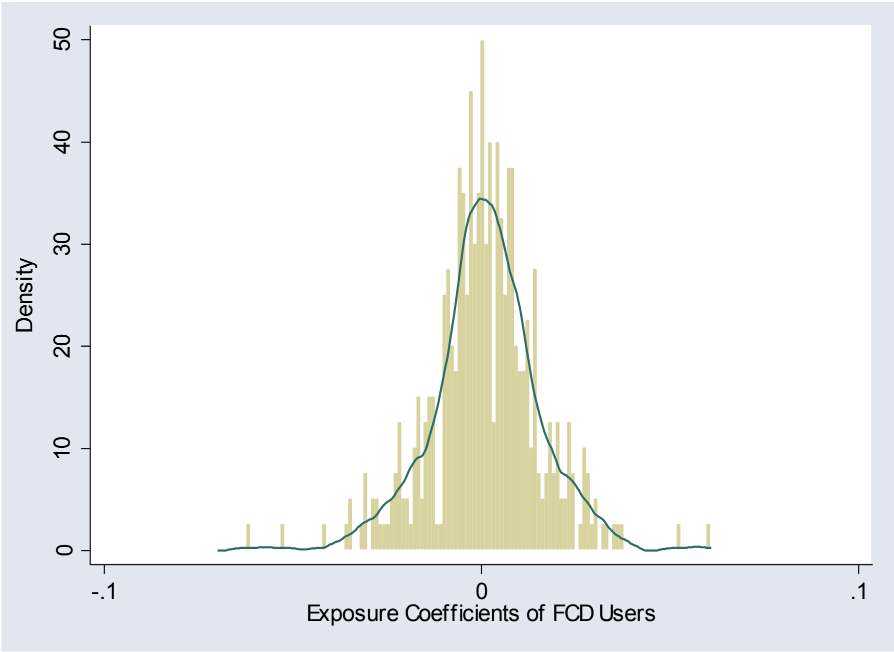

Figure I-B