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The Strategic Motives for Corporate Risk Management

Job Market Paper

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Abstract

This paper demonstrates that the extent of foreign currency hedging in an industry affects the pass-through of cost shocks to product prices. Using domestic producer price index data, we show that product prices are less responsive to foreign exchange rates in industries where currency hedging is more common. For this reason, an individual firm's foreign exchange exposure depends on the hedging decisions of its competitors. Specifically, the exposure of an unhedged firm increases with the level of hedging in its industry while that of a hedged firm decreases. Thus, a firm faces lower exposure to foreign exchange rates when it conforms to the majority. We also find that if a firm chooses to remain unhedged while many of its competitors are hedging currency risk, it appears to suffer a value discount. Consistent with these findings, a firm is more likely to begin hedging new exposure if many of its competitors are already hedged. This effect is particularly strong in less competitive industries where firms' output decisions are more likely to influence industry prices. These strategic incentives for hedging are robust and appear to be more important for currency hedging than many of the firm-specific factors highlighted by existing theory.

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According to the Modigliani-Miller paradigm, corporate risk management is irrelevant for firm value since individual investors can always 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 $ 164 trillion in 2004.[1] Existing theories appeal to managerial incentives or market imperfections such as taxes, financial distress costs and underinvestment costs to explain why firms actively engage in risk-management. It is argued that, in the presence of such frictions, it may be in the manager's or firm's interest to reduce the volatility of cash flows through derivatives hedging. In these theories, a firm's incentive to hedge is generally studied in isolation from its industry and hedging is assumed to reduce the volatility of cash flows. However, cross-sectional evidence regarding these firm-specific reasons for hedging is mixed with different empirical studies finding conflicting evidence for most theoretical predictions.[2]

In this paper, we argue that existing research overlooks an important consideration in a firm's incentive to hedge. We demonstrate that the prevalence of 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, hedged firms are not necessarily less exposed to the shock than unhedged firms. It is not surprising, then, that existing studies that equate derivatives hedging with lower volatility and examine a firm's decision to hedge independent of its competitors have found inconclusive results.

To motivate the empirical tests in this paper, we use an illustrative Cournot-Oligopoly model in which all firms are subject to a common shock to their cost of production. When every firm faces the cost shock and adjusts its profit maximizing output accordingly, industry prices co-vary with costs. However,

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

[2] See, for example, Smith and Stulz (1985) and Froot, Scharfstein and Stein (1993) for risk-management theory. For empirical findings, see Nance, Smith and Smithson (1993), Mian (1996), Geczy, Minton and Schrand (1997) and Graham and Rogers (2002)

as more firms hedge the shock, output prices become less sensitive to the cost shock. This effect of hedging on product prices implies that the volatility of an individual unhedged (hedged) firm increases (decreases) with the extent of hedging in the industry. To see this, consider an industry where all firms hedge the shock and consequently, 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 prices. Thus, unhedged firms in a largely hedged industry have more volatile profits than hedged firms. In contrast, when all 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 its costs, it has certain costs but faces uncertain prices because of the output choices of its unhedged competitors. Thus, in largely unhedged industries, hedged firms have more volatile profits than unhedged firms.

The externality that hedging by competitors imposes on a firm's exposure should be an important consideration for its decision to hedge. However, existing literature does not account for the effect industry hedging may have on the sensitivity of prices to cost shocks, on an individual firm's exposure or on its decision to hedge. This paper adds to the literature by answering the following questions empirically. First, does hedging dampen the correlation between prices and costs as argued above? Second, does the exposure of an unhedged (hedged) firm's profits to a common cost shock increase (decrease) with the level of hedging in its industry? If answers to these questions are in the affirmative, we must revisit recent evidence documenting a hedging premium (see Allyannis and Weston (2001) and Graham and Rogers (2002)). It is argued that hedging is valuable because, by reducing the volatility of profits, it lowers financial distress costs, underinvestment costs, expected taxes etc. The possibility that hedged firms may actually have more volatile cash flows in industries where hedging is rare begs an examination of the effect of hedging on firm value conditional on the level of hedging in the industry. This is the third empirical objective of our paper.

We note that if each firm's exposure is affected by the hedging decisions of its competitors, then the level of hedging in an industry will itself be an endogenously determined variable. We account for this endogeneity in our empirical tests. Although we are not concerned with deriving the equilibrium level of hedging in an industry, we do provide an informal discussion of what implications the empirical findings in this paper might have for the optimal level of hedging in an industry.

Since in practice, foreign currency risk is one of the most commonly hedged risks, the tests are conducted on comprehensive, hand-collected data on the usage of foreign currency derivatives in the United States. The data allow us to determine how many firms in an industry use foreign currency derivatives and the size of their derivatives portfolios. To address the first question, the relation between domestic producer prices and exchange rates is examined conditional on the extent of derivatives hedging in the industry. Results indicate that when hedging in an industry is non-existent, a depreciation of 10 percent in the real external value of the dollar results in an increase in domestic producer prices relative to overall inflation by 1.8 percent on average by the following month. This suggests that when a depreciating dollar increases the cost of imported inputs, domestic industry prices tend to rise and vice-versa. However, when hedging in an industry is widespread, prices are significantly less responsive to fluctuations in the dollar. If fifty percent of an industry is hedged, prices rise by 0.9 percent only. Thus, the sensitivity of the industry price to exchange rates drops by about half when fifty percent of an industry is hedged. This result is robust for different measures of the exchange rate and to adjustments for non-stationarity in prices. To our knowledge, this is the first paper to show that foreign currency hedging affects the pass-through of foreign exchange shocks to prices.

Next, we test whether the variance of an unhedged (hedged) firm's profit increases (decreases) with the number of hedged firms in the industry once unobserved industry characteristics have been controlled for. Since we use foreign currency hedging data, the tests focus on the variance attributable to foreign exchange rate shocks. Accounting data for profits are noisy and only infrequently available. Therefore, the empirical tests follow the previous literature and use stock returns as a proxy for profits (see He and Ng (1998) and Dominguez and Tesar (2001)). The empirical design first identifies firms that are likely to be importers and therefore face exchange rate related fluctuation in costs. Panel data estimates disclose that in industries where hedging is widespread, the negative effect of a depreciating dollar on an unhedged (hedged) firm's stock return is exacerbated (mitigated). That is, the foreign exchange exposure of unhedged (hedged) firms increases (decreases) with the level of hedging in the industry. This result is consistent with the prediction that as the level of hedging rises, unhedged firms become more volatile and hedged firms less volatile. Again, to our knowledge, this is the first paper to argue theoretically and to demonstrate empirically that the level of hedging in an industry affects the exposure of individual hedged and unhedged firms.

The third test looks at the effect of hedging on firm value conditional on the level of hedging in the industry. Using Tobin's Q as a proxy for firm-value, we find that there is no difference in the value of hedged and unhedged firms in industries where hedging is rare or non-existent. This appears to stand in contrast to some recent literature which shows that foreign currency hedging increases firm value (e.g. Allayannis and Weston (2001)). However, we do find that unhedged firms are valued lower than hedged firms if they belong to industries where hedging is more common. When the extent of hedging in the industry is at its 25th percentile, a firm's decision to remain unhedged results in a value loss of 2.4%. For the median value of hedging in the industry, a firm's decision to remain unhedged is associated with a value loss of 3.8%. Since Tobin's Q is calculated as of fiscal year ending 1999, we consider the possibility that a handful of unhedged firms in a highly hedged industry have lower Tobin's Q because exchange rate movement hurt the operating performance of the unhedged firms in that year. We find that the return on assets and return on operating income of hedged and unhedged firms are not significantly different during 1999, even in industries where hedging is widespread. Therefore, the difference in value cannot be explained as an ex-post result and is likely to be the market's forward-looking assessment of firm value.

There are two possible explanations for our finding that the hedging premium exists only in industries where hedging is widespread. The first explanation relies on the common notion in the risk management literature that volatility is costly due to frictions such as taxes, agency costs, financial distress costs etc.. Our results strongly indicate that the foreign exchange exposure of unhedged firms is low (high) in industries where hedging is rare (common). In these industries, financial distress or agency costs for unhedged firms are likely to be already low due to the natural hedge provided by the higher correlation between industry prices and exchange rate related cost shocks. Therefore, hedging with foreign currency derivatives has little additional benefit. In contrast, when hedging is common in an industry, unhedged firms are significantly more exposed to the foreign exchange shock than hedged firms. In this case, derivatives hedging may add value by reducing exposure and therefore, lowering financial distress costs, agency costs etc. Another possible explanation arises from Brown's (2001) finding that the risk-management program of the firm he studies is concerned with "minimizing the impact of changes in foreign exchange rates on cash flow and reported earnings". His discussions with firm management and analysts following the company reveal that "any material impact on earnings from foreign exchange rates would be viewed negatively". We have shown that in industries where hedging is widespread, an unhedged firm looks significantly riskier than its competitors. Thus, it is possible that the decision to remain unhedged when many competitors are hedging is viewed as a negative signal about management's ability to recognize and manage unnecessary foreign exchange risk.

Since unhedged firms become riskier and are valued lower when more competitors are hedged, it is conceivable that a firm's incentive to hedge increases with the number of hedged rivals. Therefore, we examine whether a firm's decision to hedge is affected by the hedging decisions of rivals. This hypothesis must be tested with caution. If at a given point in time, many firms in an industry face foreign exchange exposure, a positive relationship between a firm's probability of hedging and the extent of hedging in the industry may be observed not because the firm is strategically responding to its competitors' hedging decisions, but simply because it faces similar foreign exchange risk as its competitors. To minimize the effect of industry factors, we examine the probability that an unhedged firm will begin hedging in response to a firm-specific change in foreign exchange exposure.

Logit estimates indicate that a one percent increase in the extent of hedging in an industry results in a five percent significant increase in the probability that an unhedged firm will start hedging. Although this finding is consistent with the notion that unhedged firms are more exposed to currency shocks when many competitors hedge, it may simply reflect an element of herding in firms hedging decisions.

However, we find that the positive association between a firm's decision to hedge and the level of hedging in its industry is stronger in less competitive industries where firms' output decisions and hedging decisions are likely to have a bigger effect on industry prices. This difference makes it harder to discount the result as just evidence of herding. We note that the extent of hedging in an industry has a larger effect on a firm's decision to hedge than many firm-specific characteristics highlighted by previous empirical research. Factors such tax incentives, financial distress costs, and underinvestment costs, do not appear to have any effect on a firm's decision to hedge foreign exchange risk.

To summarize, this paper has the following key findings. First, industry prices are less responsive to foreign exchange rates in industries where currency hedging is widespread. Second, an unhedged (hedged) firm's foreign exchange exposure increases (decreases) with the extent of hedging in the industry even after controlling for unobserved industry characteristics. That is, a firm has lower exposure if it conforms to the majority's hedging decision. Third, if a firm is unhedged while many of its competitors are hedging, it appears to suffer a value discount. Consistent with these findings, a firm is more likely to engage in foreign currency risk-management if many rivals are doing so, particularly in less competitive industries. To our knowledge, this paper is the first to demonstrate that exchange rate pass-through to prices depends on the extent of hedging in an industry. We are also the first to show that a firm's foreign exchange exposure, its hedging decision and the value implications of hedging all depend on the extent of hedging in a firm's industry. Together these results suggest that a firm's decision to hedge should be modeled such that competitors hedging decisions are accounted for. Also, since we find that hedged firms in largely unhedged industries are more exposed to the underlying uncertainty, theory must allow for the possibility that some firms may engage in derivatives hedging for reasons other than reducing volatility.[3]

This paper is related to recent research suggesting that industry factors matter for a firm's decision to engage in risk-management. Allayannis and Ihrig (2001) show that firms operating in

[3] Adam, Dasgupta and Titman (2004) provide a potential explanation. The greater price uncertainty that hedged firms face when most competitors are unhedged may provide hedged firms with a valuable real option to adjust production as conditions change.

industries with lower mark-ups face higher foreign exchange exposures and thus may have a greater need to engage in foreign currency risk management. In Brown's (2001) study of a large foreign exchange hedger, internal documents and interviews with treasury personnel reveal that a stated goal of the firm's currency hedging program is to the reduce the negative impact of currency movements on competitiveness. In keeping with this, the company actively collects information on the hedging program of its U.S. based competitors. The paper is also related to Adam, Dasgupta and Titman (2004) who examine hedging decision in an industry equilibrium. In another related theoretical piece, Mello and Ruckes (2004) study the optimal hedging and production strategies of financially constrained firms in imperfectly competitive markets.

The paper is organized as follows. Section 1 provides an overview of related literature. Section 2 presents a simple oligopoly model of hedging to illustrate the key concepts. Section 3 describes the data. Section 4 describes the regression methodology and results. Section 5 discusses robustness and Section 6 concludes.

1. Related Literature

1.1 Derivatives Usage

Research on derivatives usage largely focuses on understanding why firms hedge. Prior research suggests different theories, most of which rely on capital market imperfections, to explain a firm's incentives to hedge. Corporate hedging can be optimal if it reduces the risk premium demanded by managers, and therefore, reduces required compensation. Smith and Stulz (1985) argue that a risk-averse manager who owns a large number of the firm's shares will direct the firm to hedge when he believes that it is cheaper for the firm to hedge than it is for him to hedge on his own account. In contrast, when managers own stock options, the value of which increases with firm volatility, they are less likely to engage in risk-management. Tufano (1996), Schrand and Unal (1998) and Knopf, Nam and Thornton (2002) find evidence consistent with managerial incentives. In contrast, Geczy, Minton and Schrand

(1997) and Haushalter (2000) do not find evidence that managerial risk aversion or shareholdings affect corporate hedging.

Other theories (e.g. Froot, Scharfstein and Stein (1993)), suggest that hedging can reduce underinvestment problems (Myers (1977)). Evidence on the underinvestment theory is also mixed. Since the underinvestment problem is the most severe for firms with valuable investment opportunities, studies have used research and development (R&D) expense and market-to-book as explanatory variables. Mian (1996) and Allayannis and Ofek (2001) find no relation between market-to-book and hedging. Several papers, however, find that R&D expense increases a firm's incentive to hedge (e.g. Geczy, Minton and Schrand (1997), Dolde (1995)).

Smith and Stulz (1985) argue that hedging can increase firm value by reducing the probability of financial distress. Many papers use the debt ratio to measure deadweight costs of financial distress and find that hedging increases with the debt ratio (e.g. Graham and Rogers (2002), Dolde (1995), Purnanandam (2004)). Others, however, find no evidence or mixed evidence for the relationship between hedging and leverage (e.g. Nance, Smith and Smithson (1993), Geczy, Minton and Schrand (1997)). Smith and Stulz (1985) also suggest that firms might hedge in response to tax function convexity. Evidence regarding this incentive is also unclear. For example, Nance, Smith and Smithson (1993) find that firms that hedge face more convex tax functions. Graham and Rogers (2002), on the other hand, use a more refined measure of tax function convexity and find no relation between hedging and tax function convexity. Lel (2003) finds that governance structures that mitigate agency conflicts, such as the existence of non-managerial blockholders and better country-level governance structures, increase corporate hedging activities.

In DeMarzo and Duffie (1991), equity holders can benefit from hedging when managers have private information that outsiders do not, because hedging reduces the noise in the information shareholders receive and helps them make better investment decisions. Their model suggests that equity holders of firms with greater information asymmetry benefit more from hedging and therefore, firms which face greater information asymmetry should be more likely to hedge. Institutional ownership is commonly used as a control for information asymmetry. Higher institutional ownership is expected to be positively related to the amount of information available and therefore, negatively associated with the probability of hedging. However, empirical tests consistently show a positive association between institutional ownership and the probability of hedging.

While evidence about why firms hedge is mixed and does not support any one theory, recent studies show that derivatives usage has significant effects on firm value. Allayannis and Weston (2001) find that the use of foreign currency derivatives increases total firm value by as much as 4.8 percent on average. Graham and Rogers (2002) document a positive relation between derivatives use and debt capacity and argue that derivatives-induced debt capacity increases firm value by 1.1 percent on average. Allayannis, Lel and Miller (2003) find that the hedging premium is statistically significant and economically large for firms that have strong internal and external corporate governance. Carter, Rogers and Simkins (2003) investigate jet fuel hedging and conclude that hedging is associated with higher firm value by 12 to 16 percent, possibly due to the reduction of underinvestment costs. Bartram, Brown and Fehle (2003) find that interest rate hedging increases firm value by 4 to 9 percent. Finally, Lookman (2003) suggests that the observed relation between firm value and hedging is related to agency costs between managers and shareholders. He shows that once these factors are controlled for, valuation effects associated with hedging become largely insignificant.

1.2 Pass-through and Exposure

Previous empirical studies of exchange rate pass-through, such as Mann (1986), Feenstra (1987), primarily examine adjustment of export or import prices to exchange rate changes. Marston (1990) and Knetter (1989, 1993) examine variation of export prices relative to domestic prices of the same producers. Studies on the pass-through of exchange rates to domestic prices are sparse. Feinberg (1986, 1989) models and empirically examines the relation between currency value fluctuations and domestic producer prices. No empirical study of which we are aware examines exchange rate pass-through conditional on the extent of hedging in an industry.

Numerous papers study firms' exchange rate exposure measured as the sensitivity of share prices to changes in the exchange rate. See for example, Jorion (1990), Bodnar and Gentry (1993), He and Ng (1998) and Griffin and Stulz (2001). The link between exchange rate fluctuations and stock returns is known to be weak. Bartov and Bodnar (1994) attribute the insignificant relation between exchange rate changes and stock returns to problems with sample selection procedures of many studies. Others suggest that the weak relation between exchange rate shocks and stock returns exists because of the failure to account for firm's hedging practices. More recently, Bodnar, Dumas and Marston (2002) study pass-through and exposure simultaneously. Again, no study of which we are aware explicitly examines foreign exchange exposure conditional on firms' hedging strategies.

2. An Illustrative Model

This section illustrates the key arguments of the paper with a simple Cournot-Nash oligopoly model. Consider an industry with *n* identical firms. All firms in the industry face an exogenous shock to the cost of production. For example, fluctuations in the dollar value relative to other currencies can be considered a common shock for all importing firms in an industry. At t = 0, each firm decides whether or not to hedge its cost. We assume for simplicity that a firm either hedges completely or not at all. If a firm decides to hedge, its marginal cost of production is $c_h = \bar{k}$. If a firm decides not to hedge, its marginal cost of production is $\tilde{c}_u = \bar{k} + \tilde{k}$ where $\tilde{k}$ is the common cost shock faced by every firm with $E(\tilde{k}) = 0$ and $Var(\tilde{k}) = \sigma^2$. Each firm makes its hedging decision taking the hedging strategies of other firms as given. At t = 1, costs are realized and firms choose output to maximize profits. In their output decisions, firms take into account the effect of their decision on industry price. The industry is assumed to face a linear demand curve of the form $Q = \frac{a - P}{b}$.

We analyze the model backwards starting from t = 1 given that *m* firms chose to hedge at t = 0. All derivations are provided in the appendix. Each firm's profit maximizing output is $q_i^* = \frac{P - c_i}{b}$ where *i*

= *h, u* for a hedged and unhedged firm respectively. The output of unhedged firms depends on the random cost shock $\tilde{k}$. When costs are high (low), an unhedged firm scales down (up) output. Since output choices affect industry prices, the equilibrium price is a function of the number of unhedged firms in the industry.

$$P^* = \frac{a + n\bar{k} + (n-m)\tilde{k}}{(n+1)} \tag{2.1}$$

The sensitivity of the industry price to the cost shock, $\tilde{k}$, depends on how many firms are affected by the cost shock. If all firms in the industry have hedged costs, that is, *(n-m)* is zero, prices do not respond to the cost shock because total industry output remains unaffected. However, if the fraction of unhedged firms *(n-m)* is positive, some firms adjust output in response to the change in costs causing industry prices to co-vary with the cost. When $\tilde{k}$ >0, unhedged firms experience higher costs and cut back output causing industry price to rise. When $\tilde{k}$ < 0, unhedged firms face lower costs and increase output, causing industry price to fall. The higher the fraction of unhedged firms in the industry, higher the correlation between industry prices and costs. This result holds regardless how the number of hedgers, *m*, was determined at t = 0. This result is important because it implies, as we show next, that the level of hedging in an industry affects the variance and expected value of the profits of an individual firm. Therefore, in the empirical section, our first test examines the association between industry prices and cost shocks conditional on the level of hedging in the industry.

To illustrate how the level of hedging in an industry affects an individual firm's expected profits and variance of profits we derive realized profits, expected profits and variance of profits for hedged and unhedged firms (see Appendix).

Note that the variance of an unhedged (hedged) firm's profit is increasing (decreasing) in the number of hedged firms in the industry. This is driven by the reduced correlation between prices and cost shocks when more firms in an industry choose to hedge. When *m* (the number of hedged firms) is high, an unhedged firm experiences the cost shock but does not realize an offsetting change in prices. Thus, its profits are more volatile. In contrast, a hedged firm – which has constant costs – faces variable prices when *m* is low but relatively constant prices when *m* is high. Thus, the variance of its profits declines as more firms in the industry hedge. This leads to another central test of our paper. In the empirical section, we examine whether hedged (unhedged) firms' exposure to a common cost shock decreases (increases) with the level of hedging in the industry as implied by the discussion above.

An important question is how this result affects an individual firm's decision to hedge at t = 0 and what the industry equilibrium level of hedging would be. Although the empirical tests in this paper do not address equilibrium issues, we provide an informal discussion of possible equilibrium outcomes. If we assume that firms use derivatives to minimize variance, a firm's incentive to hedge increases with the level of hedging in the industry.[4] As more firms choose to hedge, unhedged (hedged) firms have more (less) volatile cash flows, increasing the need of unhedged firms to start hedging. There is safety in conformity and firms tend to adopt the same strategies as their competitors. However, this argument results in arbitrary multiple equilibria where either all firms hedge or none do. This outcome is somewhat unsatisfactory. Since in the real world, derivatives hedging in most industries must have been rare or non-existent at some point in the past, this type of equilibrium argument does not help us understand us why some firms decided to start hedging and why some industries have gradually moved towards widespread hedging.

However, there is reason to believe that corner solutions of this type may not arise. Since firms choose output after observing costs, variance in prices or costs provides firms with a valuable real option. If all or most rivals are hedged, an unhedged firm faces relatively constant industry prices but has random costs. This gives the firm flexibility to cut output when its costs are high and increase output when costs are low. Thus, the real option value to remaining unhedged increases as more rivals hedge. Likewise, if many firms in an industry are unhedged, a hedged firm faces constant costs but random prices. This provides firms with an opportunity to produce more (less) when prices are high (low). The real option

[4] Anecdotal evidence suggests that a firm's decision to hedge is at least partly motivated by a desire to reduce the variance of profits. For example, Anheuser Busch, primarily a beer manufacturer, states in its 2004 10-K filings *"Anheuser-Busch uses derivatives to mitigate the company's exposure to volatility in commodity prices, interest rates and foreign currency exchange rates. The company hedges only exposures in the ordinary course of business and company policy prohibits holding or trading derivatives for profit"*.

value of hedging rises as more competitors choose to remain unhedged. This is the idea behind De Meza (1986) and Adam, Dasgupta and Titman (2004). Expected profits of a hedged (unhedged) firm, which capture the value of the real option described above, are decreasing (increasing) in the number of hedged firms in the industry. Therefore, there exists an interior level of hedging, m^*, for which the expected profits from hedging or not hedging are equal. If firms are expected profit maximizers, the simple model presented here implies that the equilibrium number of hedged firms is (n-1)/2.[5] The key points here are the following. First, a firm may decide to hedge even if no one else does because doing so provides the firm with a valuable real option on production and second, interior solutions for an equilibrium level of hedging are possible.

We conclude by noting that firms face a trade-off when choosing to be different from the crowd in their hedging decision. On the one hand, firms face more volatile earnings. As existing risk-management literature suggests, this volatility may be costly for firms that are financial constrained, have high growth opportunities, convex tax schedules etc. On the other hand, by being different from their competitors, firms obtain greater production flexibility which is likely to be valuable for firms or industries that are able to adjust output in the short-term. There is likely to be significant cross-sectional variation in the firm and industry characteristics that affect this trade-off for each firm. Therefore, when studying industry equilibrium issues, objective functions can be written to capture this trade-off and account for both the value of production flexibility and the usual notion that volatile earnings are costly for some firms in the presence of market frictions. This paper makes a case for rethinking risk-management theory in this manner by demonstrating empirically that derivatives hedging does affect price-cost pass through and that an individual firm's exposure to cost shocks does depend on the hedging decisions of its competitors.

[5] This simple equilibrium is provided as an illustration only and will suffice for the purpose of this discussion. See Adam, Dasgupta and Titman (2004) for a more elaborate equilibrium where the fraction of hedged firms in an industry depends on various industry characteristics like slope of the demand function, intercept of the marginal cost function etc.

3. 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. In particular, firms are required to report the notional amounts of the financial instruments used. 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. 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.[6]

An advantage of this comprehensive sample is that it enables us to determine, for each firm, how many competitors with exchange rate exposure choose to hedge, as well as how much competitors hedge. 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) 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 the absence of derivatives usage to be interpreted as a choice not to use derivatives, rather than an indication

[6] 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.

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 6,389 firms, 3,259 firms (fifty-one percent) face ex-ante exchange rate exposure. Moreover, 548 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, 8.86 percent of total assets. The mean notional amount of swaps, forwards and options scaled by total assets are 4.90 percent, 7.80 percent and 6.35 percent respectively. These numbers are comparable to those reported by Purnanandam (2004) who also uses a more comprehensive sample to study derivatives usage.

In Panel B of Table I, the distribution of hedging across 234 industries is reported. An industry is defined as all firms within same three-digit SIC code. We restrict attention to firms that face ex-ante exposure as described above. Two measures are used to capture the extent of hedging in an industry. The first, based directly on the oligopoly example of Section 2, is the fraction of hedged firms in the industry, calculated as the number of foreign currency derivatives users divided by the total number of firms in that industry who face foreign exchange exposure in that industry. This measure, which we label '*fraction of hedgers'*, does not account for the possibility that firms differ in their ability to affect prices. If an industry comprises of one large hedged firm with a dominant market share and numerous small unhedged firms, the first measure will very likely understate the importance of hedging in that industry. For this reason, a second measure that takes into account the size of hedged firms is used. This measure is calculated as the total market value of equity of foreign currency derivatives users divided by the market value of equity of all firms in the industry that face ex-ante foreign exchange exposure. We refer to this measure as '*market value fraction of hedgers*'.

The market value fraction measure of hedging (Table I, Panel B) indicates that in at least half the industries, the extent of hedging is less than ten percent. In another twenty percent of the industries, the extent of hedging is sixty percent or higher. Thus, for most industries, the extent of hedging appears to lie towards the extremes - almost non-existent in many industries and quite widespread in others. The second column of the same table presents the distribution of the fraction of hedgers in each industry. This measure is generally lower than the market value fraction measure suggesting that derivatives users tend to be larger firms, possibly due to the high fixed costs of setting up hedging programs. Clustering is evident in this measure as well. In half the industries, less than ten percent of the firms are hedged, while in many industries a significant fraction of firms engage in foreign currency hedging.

Before concluding this section we note the following caveats. First, the gross notional value of contracts outstanding represents derivative ownership and may not accurately estimate derivatives hedging if a firm holds offsetting contracts. Graham and Rogers (2002) collect both gross and net notional amounts for their sample and conclude that using net rather than gross positions is only marginally important in helping identify factors that affect corporate hedging decisions. Second, derivative holdings may measure speculative activity, not hedging. SFAS 119 requires firms to explicitly state whether they use derivatives hedging or trading purposes. We exclude firms that claim to use derivatives for trading purposes and thus classify any firm using foreign currency derivatives as a 'hedger'.

4. Methodology and Results

4.1 Exchange Rate Pass-through to Domestic Prices

4.1.1 Methodology

In Section 2, it was demonstrated that the sensitivity of industry prices to cost shocks declines as the extent of hedging in the industry increases. If firms rely on imported inputs, then exchange rates translate directly into cost shocks. This section describes the methodology used to examine how domestic producer prices respond to foreign exchange shocks conditional on the extent of hedging in an industry. The tests are based on Feinberg (1989) who examines, theoretically and empirically, the relationship between exchange rate fluctuations and domestic producer prices.

We obtain monthly data on producer prices and exchange rates for the years 1997 till 1999. Data on producer price index are obtained for three-digit SIC industries from Bureau of Labor Statistics (BLS). As in Feinberg (1989), the dependent variable of interest is the relative producer price index, *RPPI*, calculated as the producer price index divided by the overall GDP price deflator obtained from the Bureau of Economic Analysis. Foreign exchange movements, *REXCH,* are measured as the real value of the U.S. dollar per unit of SDR (Special Drawing Rights), calculated by the International Monetary Fund. This measure is based on the U.S. dollar values of specified quantities of the Euro, Japanese Yen and Pound Sterling.[7] Data on the extent of foreign exchange hedging, *F*, are calculated as described above for the three digit SIC industries. These data are available for 1997 and 1999 as described in Section 3. Since hedging data for 1998 are not available, we assume that firms hedged in 1999 were also hedged in 1998.[8] Since firms disclose information on derivatives usage on annual basis only, annual values are imputed to each month.

As in Feinberg (1989), we control for capital intensity of an industry, import penetration in the industry, reliance of the industry on imported inputs, and the overall macroeconomic environment. All of these are calculated at the three-digit level. Capital intensity, *KS*, is calculated as the average value of total assets as a percentage of sales for all firms in the three digit industry; import penetration, *IMP,* is industry imports of final goods divided by the sum of industry imports and domestic shipments. Imported input reliance, *IMPINP*, is calculated using 1997 benchmark input-output tables and industry imports of final goods as described in Allayannis and Ihrig (2001). Industries engaged in both exports and imports are somewhat naturally hedged against fluctuations in the dollar value. In such cases, domestic prices may be less responsive to exchange rate changes. To control for this possibility, *EXP*, calculated as industry exports divided by the sum of industry exports and domestic shipments is included as an explanatory

[7] In Section 5, we demonstrate that the results are robust to alternate foreign exchange rate measures.
[8] We note that this assumption may be restrictive since it limits the information contained in the time-series variation of the hedging decision

variable. Since greater competition in an industry is associated with a loss in pricing power, exchange rate passthrough is less likely in more competitive industries. We include an interaction of the exchange rate with an industry's Herfindahl index. The Herfindahl index is calculated as the sum of squares of sales market share of each firm in an industry. The U.S. dollar LIBOR, *r*, controls for the overall macroeconomic environment. I estimate the following panel regression allowing for industry fixed effects on a sample of 3,080 observations from 89 industries over 36 months.[9]

$$\begin{aligned}\ln RPPI_{it} = {} & \alpha_i + \beta_1 \ln REXCH_t + \beta_2 \ln REXCH_{t-1} * F_{it} + \beta_3 REXCH_{t-1} * KS_{it} + \beta_4 \ln REXCH_{t-1} * IMP_{it} + \\ & \beta_5 \ln REXCH_{t-1} * IMPINP_{it} + \beta_6 \ln REXCH_{t-1} * EXP_{it} + \\ & \beta_7 \ln REXCH_{t-1} * HERFINDAHL_{it} + \ln ir_t + u_{it}\end{aligned} \qquad (4.1)$$

In equation (4.1), F_{it} captures the extent of hedging in the industry. The exchange rate measure is dollars per unit of foreign currency and, thus, higher values of *REXCH* are indicative of a depreciating dollar. Since a weaker dollar implies a higher cost of imports, we expect that β_1 is greater than zero. That is, prices are likely to rise if exchange rate related costs of production rise. However, prices are less responsive to exchange rates when the extent of foreign currency hedging in the industry is high. That is, we expect that β_2 is less than zero. Feinberg (1989) demonstrates that more capital intensive industries are less likely to pass through foreign exchange rate changes to prices. Therefore, β_3 should be negative. Coefficients on the interaction of exchange rates with import penetration (β_4) and imported input reliance (β_5) are expected to be positive because industries that are more reliant on imports are more likely to raise prices in response to foreign exchange depreciation. The coefficient on the interaction of exchange rates with *EXP* is expected to be negative. Higher an industry's exports, the more likely it is that a change in cost of imports is offset by an change in export revenues, possibly mitigating the need to raise domestic prices. Finally, the coefficient on the interest rate *r*, should be positive since periods of high interest rates are generally associated with higher prices.

[9] The sample drops to 89 industries because foreign trade data are available for manufacturing industries only. Equation (4.1) is also estimated for a sample of 136 industries without controls for imports and exports. Results remain qualitatively unchanged.

4.1.2 Results

Results of regression equation (4.1) are presented in *Table II*. In the first column of this table, the extent of hedging is measured by fraction of hedgers. In the second column, the extent of hedging is measured by the market value fraction of hedgers.

Recall that the real exchange rate is in terms of dollars per foreign currency unit and higher values of the exchange rate represent a depreciating dollar. The positive and significant coefficient on $ln\ REXCH_{t-1}$ suggests that a depreciating dollar is associated with a rise in domestic prices relative to inflation reflecting the higher cost of imported inputs. The coefficient on the interaction of $ln\ REXCH_{t-1}$ with F_{it} is negative and significant indicating that when the extent of hedging in an industry is high, industry prices are less responsive to depreciating dollar. For example, the coefficients in Panel A (Column 1) suggest that a depreciation of 10 percent in the real external value of the dollar results in an increase in domestic producer prices relative to overall inflation by 1.8 percent by the following month if hedging in the industry is non-existent. If twenty five percent of an industry is hedged, prices rise by 1.3 percent. If fifty percent of an industry is hedged, producer prices rise by 0.9 percent. Thus, the sensitivity of the industry price to exchange rates drops by about half when fifty percent of an industry is hedged.

This finding holds for both measures of the extent of hedging, although the coefficient on the interaction term is smaller when the extent of hedging is measured as the market value fraction of hedgers. These results provide support for the hypothesis that industry prices become less sensitive to currency cost shocks when the extent of hedging in an industry is high. Other results of interest in Table II are as follows. As in Feinberg (1989), more capital intensive industries are less like to pass-through foreign exchange shocks to domestic prices. Moreover, higher the industry exports, lower the rise in domestic producer prices in response to a depreciating dollar. This result suggests that when higher export revenues offset higher import costs, the need to raise domestic prices is lower. Import penetration and imported input reliance do not appear to significantly affect the pass-through. The coefficient on the interaction with the Herfindahl index is negative as expected but it is not significant.

In summary, the empirical findings in this section provide strong support for the prediction that currency hedging mitigates the correlation between prices and exchange rate related cost shocks.

4.2 Firm Exposure to Foreign Exchange Shocks

4.2.1 Methodology

The previous section demonstrated empirically that industry prices are less sensitive to foreign exchange related cost shocks in industries where currency hedging is more common. For this reason, variance of profits of unhedged (hedged) firms are expected to increase (decrease) with the level of hedging in the industry. In the model, uncertainty in profits arises solely from the random cost shock, $\tilde{k}$. In practice, many factors contribute to the variance of a firm's profits. Therefore, empirically we must examine variance in profits attributable to a cost shock that firms can choose to hedge– in our case, foreign exchange rate shocks. This section examines how the performance of unhedged and hedged firms fluctuates with exchange rates conditional on the extent of currency hedging in the industry.

Since accounting data for profits is only infrequently available, this paper follow previous literature and using stock returns as a proxy for profits. If the performance of a firm is sensitive to foreign exchange fluctuations, one expects the firm's stock return to mirror this sensitivity to exchange rates. The hypotheses to be tested in this section arise from a model in which firms face cost shocks. Therefore, a clean test requires a sample of firms that are net cost-exposed to exchange rates. If firm-level data on imports were available, this sample could be easily identified. However, since import data are not available for firms, we use two different methodologies to identify firms that are possible importers.

An unhedged, importing firm suffers when the home currency depreciates as imports become more expensive in terms of the home currency. Consequently, an unhedged importing firm's value is likely to be hurt by a depreciating dollar. In the first methodology, we select all unhedged firms whose stock returns decline when the dollar depreciates. Existing studies examine the effect of exchange rates on firm value by regressing stock returns on changes in exchange rates, controlling for the overall market return (see for example He and Ng (1998) and Dominguez and Tesar (2001)). Following these studies, the following time-series regression is estimated for all unhedged firms in the sample.

$$r_t = \alpha + \beta_1 r_{mt} + \beta_2 \Delta s_t + u_t \tag{4.2}$$

In this regression, r_t is the monthly rate of return on the firm's stock for the years 1997 till 1999, r_{mt} is the corresponding monthly rate of return on the value weighted market index. The variable Δs_t is the monthly change in value of the U.S. dollar orthogonal to the market return. The coefficient β_2 measures a firm's exposure to exchange rate movements after taking into account the market's exposure to currency fluctuations. Firms that are net-importers are likely to have a negative β_2 since a depreciating dollar (increases in the dollar/SDR rate) hurts importing firms. We limit our sample to all unhedged firms with $\beta_2 < 0$. These firms (which we sometimes refer to as "net-importing" firms) are classified as unhedged firms with a cost exposure to exchange rates. To examine how the exposure of these firms is affected by the level of hedging in its industry, the following panel regression is estimated with firm-fixed effects. The inclusion of firm-fixed effects ensures that time-constant firm characteristics like a firm's industry are controlled for

$$\begin{aligned} r_{it} = \alpha + \beta_1 r_{mt} + \beta_2 \Delta s_t + \beta_3 \Delta s_t F_{jt} + \beta_4 \Delta s_t LTDRatio_{it} + \beta_5 \Delta s_t QuickRatio_{it} + \beta_6 \Delta s_t EXP_{jt} \\ + \beta_7 \Delta s_t IMP_{jt} + \beta_8 \Delta s_t KS_{jt} + \beta_9 \Delta s_t Herfindahl_{jt} + u_{it} \end{aligned} \tag{4.3}$$

In this equation, i is a firm subscript, j is an industry subscript and t is a time subscript. F_{jt} captures the extent of hedging in the industry. In this specification, β_2 is less than zero by design since in the previous step, we selected firms whose stock returns are lower when the dollar depreciates. The coefficient of interest here is β_3 which captures how an unhedged firm's exposure varies conditional on the extent of hedging in its industry. If, as theory suggests, unhedged firms' exposure increases with the level of hedging in the industry, then β_3 should be less than zero. $LTDRatio_{it}$ is firm's long-term debt divided by total assets, $QuickRatio_{it}$ is firm i's quick ratio. Long-term debt ratio and quick ratio are included to allow for the possibility that financially constrained firms suffer more when adverse economic shocks occur (see He and Ng(1998)). Levels of all variables in the interaction terms are included in the estimation but not shown in equation (4.3). IMP_j, is industry imports of final goods as a percentage of the sum of industry imports and domestic shipments. EXP_j, is calculated as industry exports divided by the sum of industry exports and domestic shipments. In Section 4.1, it was shown that more capital intensive industries are less likely to passthrough exchange rate shocks to domestic prices. This may exacerbate the foreign exchange exposure of unhedged importing firms. To account for this, we include capital intensity, *KS*, calculated as the average value of total assets as percentage of sales for all firms in the three digit industry. Results are presented in *Table III*.

In the absence of firm-level import data we created a sample of likely importers by selecting firms whose stock returns decline when the dollar depreciates, that is, firms with $\beta_2 < 0$ in equation (4.2). Since the sample for estimating panel equation (4.3) is selected on the time-series association of the dependent variable with exchange rates, there is some concern that the primary coefficient of interest, β_3 in equation (4.3) is biased by the sample selection procedure. Another drawback of this method is that it is difficult to identify hedged firms who are cost exposed since the response of a hedged firm's stock price to exchange rates is clouded by whether the firm is hedging foreign exchange costs or revenues and whether it is fully or partially hedged. To address these concerns we use an alternative procedure to select possible importing firms. We use industry level trade data provided by the United States International Trade Commission to identify importing firms. For each industry we calculate the ratio of final goods imports to final goods exports. We rank industries by this ratio and select the top quartile as import oriented industries. All firms in these import oriented industries are classified as importers who face foreign exchange cost shocks. Regression (4.3) is estimated for both hedged and unhedged firms in this sample. Note that industry exports and imports are not included as explanatory variables in this sample because the sample is selected on the basis of these variables. Results are presented in *Table IV*.

4.2.2. Results

This section discusses the regression estimates of equation (4.3) presented in Tables III and IV. In Table III we present estimates of equation (4.3) for unhedged firms selected using the first method, i.e. unhedged firms whose stock returns suffer during periods of a depreciating dollar. The coefficient β_2 in Table III is less than zero by design. The coefficient of interest, β_3, is significantly negative for both measures of industry hedging. Thus, stock returns of unhedged firms suffer more when the level of hedging in the industry is higher. The inclusion of firm-fixed effects ensures that time-constant firm characteristics like a firm's industry are controlled for. The coefficient β_3 is significantly negative for both measures of industry hedging. None of the other firm and industry factors significantly affect a firm's foreign exchange exposure. Although the level of industry exports and imports do not appear to significantly affect firm exposure, the signs are in the expected direction. Since we are working with firms that are likely to be net-importing firms, higher exports (imports) are expected to reduce (increase) stock return exposure to exchange rates. Table III shows that the signs of β_6 and β_7 are consistent with this.

Table IV presents estimates of equation (4.3) for hedged and unhedged firms belonging to import oriented industries. Column 1 contains estimates for unhedged firms and Column 2 for hedged firms. The negative sign of coefficient β_2 suggests that stock returns of unhedged importing firms are insignificantly lower when the dollar depreciates. However, as the level of hedging in the industry increases, so does the negative reaction of unhedged firms stock to a weaker dollar ($\beta_3 < 0$). This demonstrates that our finding that unhedged firms are more exposed to exchange rate shocks if more rivals are hedged is robust to the sample selection procedure. Column 2 shows that stock returns of hedged firms decline when the dollar depreciates, but decline significantly less in industries where hedging is widespread. Thus, as the level of hedging in an industry increases, the exposure of unhedged firms increases and that of hedged firms declines. These results persist despite controlling for a firm's industry and are consistent with the model.

4.3 Firm Value

This section examines the effect of hedging on firm value, conditional on the extent of hedging in the firm's industry.

4.3.1 Methodology

As in previous studies, Tobin's Q is used as a measure of firm value.[10] 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. 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. 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. 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. Competitors hedging activity is captured by the fraction of competitors with the same three-digit SIC code that disclose the use of foreign currency derivatives. 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 impact firm value. Previous studies show that firm value is affected by 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 (2003), 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

[10] See, for example, Allayannis and Weston (2001)

$$V_i = \delta_0 + \delta_1 X_i + \delta_2 D_i + \delta_3 D_i F_j + \sum_{j=1}^{J} \lambda_j I_j + e_i \qquad (4.4)$$

where X_i is a set of exogenous observable characteristics of the firm, D_i is a dummy variable that takes the value of 1 if the firm is currency derivatives *non-user* and 0 otherwise, F_i is a measure of the frequency of derivatives usage by competitors, I_j are industry dummies, and e_i is the error term. Since a firm's market value may be positively correlated with the market value of other firms in its industry, we do not use the market value fraction of hedgers as a measure for F_j. For this test, we use only the fraction of hedged competitors to capture the extent of hedging in an industry.

A firm's decision to engage in risk management may be correlated with some unobserved variables that also affect firm value. Thus, D_i may be correlated with the error term in equation (4.4) 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. In the selection equation, we require an instrument that is correlated with the hedging dummy but uncorrelated with firm value. One possible instrument is the lagged value of the 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 be hedged in 1999 than firms that did not hedge previously. Moreover, it is unlikely that the firm's hedging decision in 1997 affects current firm value other than through its association with the current hedging decision. Thus, *lag_hedge* satisfies the requirements of a good instrument. As a robustness check, we also use industry foreign sales as an instrument for a firm's hedging decision. Industry foreign sales are positively correlated with a firm's decision to hedge. Since industry foreign sales are not an obvious determinant of firm value, this variable can also serve as a good instrument.

Note that the possibly endogenous variable D_i, also appears indirectly in the interaction of a firm's decision to hedge, D_i, with the frequency of derivatives usage by its competitors, *F*. Thus, the interaction $D_i.F$ may be correlated with the error term, causing estimates of δ_3 to be biased as well. Although the Heckman two-stage procedure addresses the bias in δ_2, it does not correct for a potential bias in δ_3. Therefore, we turn to the two-stage least squares approach which we will refer to as the instrumental variable (IV) regression. When instrumenting, two first stages are performed, one for the direct effect of the hedging dummy D_i and another for the interaction term $D_i.F_i$. This approach addresses endogeneity concerns for both δ_2 and δ_3

4.3.2. Results

Results of the Heckman procedure and the instrumental variable regressions are provided *Table V*. Panel A presents results of Heckman's two-step procedure. Panel B presents results of the IV regression. The first column in each panel provides estimates without industry dummies while industry dummies are included in the second column.

The coefficient on the derivatives non-user dummy is insignificant in all specifications except for one. However, the interaction of the derivatives non-user dummy with the fraction of competitors who hedge is negative and significant in all specifications. This indicates that the decision to remain unhedged hurts firm value only if many competitors are hedged. Coefficients from the specifications including industry dummies suggest that the decision to remain unhedged is not associated with a value loss if hedging is rare or non-existing in the firm's industry. When the extent of hedging in the industry is at its 25th percentile, a firm's decision to remain unhedged results in a value loss of 2.4%. For the median value of hedging in the industry, a firm's decision to remain unhedged is associated with a value loss of 3.8%.[11] The results reject the null that hedged and unhedged firms are valued the same regardless of the level of

[11] This is in line with the finding of Allayannis and Weston (2001) that foreign currency derivatives use increases firm value on average by 4.8%.

hedging in the industry. Firms are penalized for not hedging foreign exchange exposure when many competitors are managing foreign exchange risk.[12]

As discussed earlier, there are two possible explanations for this finding. First, the decision not to hedge when many competitors are hedging may be viewed as a negative signal about management's ability to recognize and manage unnecessary foreign exchange risk. Second, if volatile earnings create deadweight costs of financial distress or underinvestment costs, then unhedged firms may be valued lower when industry hedging is higher because their profit volatility and, therefore, the associated costs, are higher.

Before concluding this section, we note the following. First, as expected, firms with more growth opportunities (measured by higher research and development expense) and fewer agency conflicts (measured by managerial ownership) are valued higher. More profitable firms, as measured by return on assets are also valued higher. Firms with more leverage and multiple segments are valued lower. Second, it is possible that Tobin's Q as of fiscal year ending 1999 is lower for unhedged firms in highly hedged industries because exchange rate movements hurt the operating performance of the unhedged firms in that year. However, we find that the return on assets and return on operating income of hedged and unhedged firms are not significantly different during 1999 even in industries where hedging is widespread.[13] Therefore, the difference in value cannot be explained as an ex-post result and is likely to be the market's forward-looking assessment of firm value.

4.4 Firms' Hedging Decision

4.4.1 Methodology

Results in the previous sub-sections provide compelling evidence that an unhedged firm's exposure to exchange rates is higher and its value lower when the extent of hedging in its industry is high. In this section, we examine how this affects a firm's decision to hedge. If a firm dislikes exposure to

[12] Results remain qualitatively unchanged if (i) institutional ownership is used as a control for agency conflicts instead of managerial ownership and (ii) industry foreign sales are used as an instrument for a firm's hedging decision instead of the lagged hedging dummy.
[13] These results are not shown but are available upon request.

foreign exchange risk, it is more likely to hedge when the extent of hedging in the industry is higher. This hypothesis is challenging to test. Previous studies have generally examined the probability of hedging by estimating logit or probit models where the dependent variable equals one if the firm is foreign exchange hedger and zero otherwise. Explanatory variables include various firm-specific characteristics that theory suggests predict a firm's need to hedge. One cannot simply include the extent of hedging in the industry as another explanatory variable in the probability model. If at a given point in time, many firms in an industry face foreign exchange exposure, a positive relationship between a firm's probability of hedging and the extent of hedging in the industry may be observed not because the firm is strategically responding to its competitors' hedging decisions, but simply because all firms in an industry face similar foreign exchange risk.

Since the extent of derivatives usage by competitors is an industry level variable, it is clearly difficult to distinguish a firm's response to derivatives hedging by competitors from the effect of common industry level exposures on a firm's need to hedge. One solution is to identify exogenous changes in the foreign exchange exposure of a firm that do not affect the industry as a whole and study how the firm's hedging decision changes in response to the shock. To implement such a test, we first select firms that were unhedged in 1997 and whose earnings did not appear to have been affected by foreign exchange rate changes in that year. Specifically, a firm is selected if (i) it did not disclose the use of foreign currency derivatives in 1997 and (ii) it did not disclose any gains or losses in income arising from changes in foreign exchange rates (Compustat Annual data item 150 is zero or missing) during 1997. These firms are assumed to not have been significantly exposed to foreign exchange rates during 1997. From this subset, we further select all firms that ex-ante may have a reason to engage in foreign currency hedging in 1999. Firms are assumed to have potential ex-ante exposure in 1999 if they disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files or if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file.

We wish to examine whether a firm that was unhedged in 1997 is more likely to 'begin' hedging in 1999 if it belongs to an industry where hedging was more common in 1997. Before proceeding with this test, it is important that we eliminate firms belonging to industries where there appeared to be an increase in the level of hedging during this period. Focusing on industries where the level of hedging did not rise significantly makes it more likely that our sample captures a firm-specific change in the firms need to hedge rather than an industry level shift towards hedging. We eliminate all firms belonging to industries where the market value fraction of hedged firms increased by more than 10 percent during this period. We are left with a sample of 1,292 firms which were unhedged in 1997 and experienced a potential firm-specific change in the need to hedge in 1999. Out of these, 104 firms were engaged in derivatives hedging in 1999.

To examine a firm's decision to start hedging, a logit model is estimated. In the logit model, the dependent variable is equal to one if a firm is engaged in derivatives hedging in 1999 and zero otherwise. Since all firms in this sample are unhedged as of 1997, the model estimates the probability that a firm will start hedging the change in exposure. The primary explanatory variable of interest is the extent of hedging in the firm's industry as of 1997. We control for firm-specific characteristics that, according to existing research, create incentives for a firm to hedge. Theory suggests that firms hedge to reduce tax function convexity. As in most previous research, tax function convexity is measured with net operating loss carryforwards scaled by total assets. More liquid firms are less likely to need risk-management. Therefore, a firm's quick ratio, measured as current assets minus inventories over current liabilities is included as an explanatory variable. Derivatives usage is associated with economies of scale in that larger firms are much more likely to engage in derivatives risk management. Thus, log of total assets is used as an explanatory variable. According to existing theory, firms hedge to reduce costs of underinvestment and financial distress. As in Geczy, Minton and Schrand (1997), long-term debt ratio is used as a proxy for financial distress. Since underinvestment costs are likely to be the most severe for firms that have more growth options, research and development expense is included as an explanatory factor. Following Geczy, Minton and Schrand, we also use the product of long-term debt ratio and research and development expense as a proxy for underinvestment costs. To control for managerial incentives, two variables are used. The first is the market value of stocks owned by the executives of the firm scaled by total assets and the second is the Black-Scholes value of the options held by executives of a firm also scaled by total assets. Finally, we include total foreign sales divided by net sales as a proxy for foreign exchange exposure.

DeMarzo and Duffie (1991) suggest that firms that face more information asymmetry are more likely to hedge. As in previous studies, I use institutional ownership as a proxy for information asymmetry. If firms owned primarily by institutional owners face less informational asymmetry, then the theory of DeMarzo and Duffie implies that firms with more institutional ownership should be less likely to engage in foreign exchange risk management. For robustness, we also estimate a censored tobit model where the dependent variable is the notional amount of foreign currency derivatives (scaled by total assets) outstanding in 1999. Since this sub-sample did not use foreign currency derivatives in 1997, the dependent variable captures the change in derivatives usage during this period. All explanatory variables are the same as in the logit model.

4.4.2 Results

Logit estimates and marginal changes in probability are presented in *Table VI*, tobit estimates are provided in *Table VII*.

Logit regression estimates suggest that firms are significantly more likely to begin hedging in 1999 if they belong to industries where the extent of hedging was high in 1997. The size of the marginal change in probability depends on how the extent of hedging in an industry is measured. A one percent increase in the extent of hedging in the industry results in a five to nine percent increase in the probability that an unhedged firm will choose to hedge foreign exchange exposure. This effect of industry hedging is large compared to the firm-specific control variables in the regression. A one percent increase in size results in one percent increase in the probability of hedging. The effect of foreign sales is similar. A one percent increase in the ratio of foreign sales to total sales increases the probability of hedging by two percent. The regression coefficient on the quick ratio suggests that more liquid firms are significantly less likely to hedge. A one percent increase in the quick ratio reduces the probability of hedging by one percent. Finally, a one percent increase in institutional ownership increases the probability of hedging by five percent. This result appears to contradict the prediction of DeMarzo and Duffie but is consistent with previous empirical research. None of the other firm-specific variables significantly affect a firm's decision to start hedging exchange rate risk.[14] Tobit estimates in Table VII provide qualitatively similar results. The increase in derivatives hedging is more pronounced for firms belonging to industries where hedging was widespread in 1997.

While these results are consistent with the notion that unhedged firms respond to hedging by rivals because of the product-market related externalities described above, alternative explanations exist. If the cost of remaining unhedged is inherently higher in some industries than in others, an association between a firm's decision to begin hedging in 1999 and the extent of hedging in its industry in 1997 may be observed not because of the strategic reasons presented in this paper but simply because all firms in the industry face a higher cost for not hedging foreign exchange exposure. Alternatively, our results may simply capture some element of herding if firms hedging decisions. The strategic arguments are clearly more important for industries in which firms have the ability to affect prices. In highly competitive industries, firms' output decisions are expected to have little effect on industry prices and therefore a firm's exposure is less dependent on the hedging decisions of competing firms. We can use this to distinguish the strategic story from the alternative explanations. If the association between a firm's hedging decision and that of its competitors is driven by the strategic factors described previously, the relation should be stronger in more concentrated industries. In contrast, if the positive relation between a firm's hedging decision and that of its competitors is driven simply by common risk factors or herding behavior, there is no compelling reason to expect the relation to differ based on industry concentration. We subdivide the sample of 1,292 firms described above using the Herfindahl index. Firms with Herfindahl index below the median are classified as belonging to competitive industries and those with

[14] Managerial stock and option ownership are not significant in any specification. Since including these variables cause the sample size to drop significantly without adding any explanatory power to the regression, we drop them from the regressions reported here.

Herfindahl index above the median are classified as belonging to concentrated industries. The logit regression is estimated for each sub-sample and for both measures of industry hedging. Marginal probability estimates are presented in *Table VIII*.

Panel A presents estimates from a regression in which the extent of hedging in an industry is measured by the fraction of hedgers. In the low Herfindahl index sub-sample, the association between a firm's hedging decision and that of its competitors is not significant. In concentrated industries, a one percent increase in the extent of hedging in the industry results in a fifteen percent increase in the probability that a firm will hedge in response to a change in foreign exchange exposure. A similar picture emerges in Panel B, where the extent of industry hedging is measured as the market-value fraction of hedgers. In the low Herfindahl index sub-sample, a one percent increase in the extent of hedging in the industry results in a five percent increase in the probability that a firm will hedge. This relation is significant at the ten percent confidence level. In the high Herfindahl index sub-sample, a one percent increase in the extent of industry hedging, results in a ten percent increase in the probability that a firm will hedge. The latter is significant at the one percent confidence level. Thus, the effect of industry hedging on the hedging decision of an individual firm appears to be stronger in more concentrated industries. This difference provides support for the notion that firm's care about the level of hedging in their industry because of strategic factors. These findings are consistent with the notion that in less competitive industries, hedging by rivals increases the exposure of unhedged firms, thereby increasing their incentive to hedge.

5. Robustness

Exchange rate measure and non-stationarity of prices

A key finding in this paper is that industry prices rise when the dollar depreciates but rise less in industries where hedging is widespread. The exchange rate used was dollars per unit of SDR (Special Drawing Right) calculated by the International Monetary Fund. This section demonstrates that the result is robust to an alternative trade-weighted exchange rate. In equation (4.1) $REXCH$ is now the inverse of the lagged trade-weighted value of the U.S. dollar against currencies of its major trading partners obtained from the Board of Governors of the Federal Reserve System. Higher values of *REXCH* are indicative of a depreciating dollar. Panel estimates with industry fixed effects are presented in *Table IX*. We see that a ten percent depreciation of the dollar is associated with a 2.7% increase in prices by the following month. However, prices rise significantly less in industries where more firms are hedged. Thus, results are robust to an alternative measure of exchange rates. We also allow for non-stationarity in prices and estimate equation (4.1) in differences instead of levels. Results are qualitatively the same (not shown).

Operational hedging

This paper uses foreign currency derivatives usage as a proxy for firm's hedging activity. Some firms, (large multinational firms for example) are also operationally hedged because costs of production and sales revenues are often incurred in the same foreign currency. Moreover, firms that operate in multiple countries hold a diversified portfolio of currencies and exchange rate movements in these currencies may offset each other providing the firm with a natural hedge. To account for the possibility that some firms may be hedged without using currency derivatives, we include the total number of geographical segments a firm operates in as a control variable in all regressions presented in the previous section. Results remain qualitatively unchanged.

Hedging or speculating with derivatives

Another concern about using derivatives usage as a proxy for hedging is that firms may use derivatives for speculative purposes. Firms are required to disclose any trading of derivatives for profitable or speculative purposes. As noted earlier in the paper, firms that disclose trading in derivatives for non-hedging reasons are eliminated from the sample. However, even if firms use derivatives primarily to limit exposure to exchange rates, it is likely that managers' market views about future exchange rate movements influence whether or not to hedge an exposure. The 1998 Wharton Survey of Financial Risk Management by US Non-Financial Firms by Bodnar, Hayt and Marston found that 32% of the firms that use derivatives reported that their market view of exchange rates leads them to "actively take positions" at least occasionally. Moreover, Faulkender (2004) finds evidence that firms use interest rate derivatives to speculate rather than hedge. We argue here that the central arguments of our paper hold even if market views influence derivatives usage by firms. To see this, consider an industry of importing firms who hedge selectively. When managers expect the dollar to appreciate, and therefore, the cost of imports to decline, they decide to leave foreign exchange exposure unhedged. However, when the dollar is expected to depreciate, firms lock in the cost of imports with forward contracts. In the former case, if most firms choose not to hedge in order to benefit from lower importing costs, some of the lower cost may be passed through in the form of lower prices. If any one firm chooses to hedge, it faces constant costs but lower prices, and therefore, more variable profits. In the latter case, if most firms choose to hedge a depreciating dollar, industry prices will not rise much in response to exchange rate changes. If any firm decides not to hedge the depreciating dollar, it will experience rising costs but constant prices, and therefore, more volatile profits. The key takeaway here is that even if firm's hedge selectively based on their views about the market, the effect of industry hedging on the price-cost relationship holds and hedging by competitors imposes externalities on a firm's own exposure.

Asian Financial Crisis

When studying the decision to hedge, we limit our sample to firms that experienced a change in foreign exchange exposure and estimate the probability that a firm will start hedging this exposure. The change in exposure occurs between the years 1997 and 1999. One concern is that the Asian financial crisis of 1997 may have caused many industries to start hedging Asian exposure that had previously been left unhedged. To ensure that our results are not driven by firms exposed to Asian currency risk, we re-estimate the decision to hedge after eliminating firms that disclose geographical segments located in Asia and find that the results still hold.

6. Conclusion

We show that a firm's foreign exchange exposure, its incentive to hedge the exposure and the value implications of hedging depend on the extent of hedging in its industry. Using comprehensive, hand-collected data on the usage of foreign currency derivatives in the U.S., we show that domestic producer prices rise during periods of a depreciating dollar, reflecting the higher dollar cost of imports. However, prices increase by a smaller amount in industries where currency hedging is widespread. This finding suggests that in industries where currency hedging is widespread, profits of an unhedged (hedged) firm are more (less) exposed to foreign exchange related cost shocks. Using stock returns as a proxy for profits, we examine the exposure of hedged and unhedged firms that face foreign exchange related cost shocks, conditional on the level of hedging in the industry. We find that unhedged firms face significantly higher exposure, and hedged firms significantly lower exposure, if they belong to industries where hedging is widespread. Thus, firms face lower exposure if they conform to the majority and hedging is not necessarily associated with lower exposure. Moreover, if a firm chooses to remain unhedged while many of its competitors are hedging, it appears to suffer a value discount. Thus, as the level of hedging in an industry rises, unhedged firms not only look riskier relative to their hedged competitors, they are also valued lower. Consistent with this, a firm is more likely to engage in foreign currency risk-management if many competitors are doing so. As expected, this relation is stronger in less competitive industries where firms' output and hedging decisions are more likely to affect industry prices, providing support for the strategic incentives to hedge.

Our empirical tests find little support for existing theory that considers a firm's decision to hedge in isolation from its industry. In this respect, our results are no different from previous studies that find mixed support for current theories of risk-management. 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 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 existing research ignores the role derivatives hedging plays in the firms' product markets and consequently, overlooks the possibility that hedging is not always a volatility reducing strategy.

APPENDIX

In this appendix, we provide derivations for the model discussed in Section 2.

A1. Output choice at t = 1

At t = 1, each firm in the oligopoly chooses output to maximize profits, given that *m* firms in the industry hedge. The first order condition facing each firm is

$$q_i \frac{dP}{dQ} + P - c_i = 0 \,, \tag{A1}$$

where $i = h, u$ stands for a hedged or unhedged firm. Substituting from the industry demand curve $Q = \frac{a-P}{b}$, the first order condition reduces to

$$q_h^* = \frac{P - \bar{k}}{b} \tag{A2}$$

for hedged firms, and

$$q_h^* = \frac{P - (\bar{k} + \tilde{k})}{b} \tag{A3}$$

for unhedged firms.

Industry output is, therefore

$$Q^* = m\frac{P - \bar{k}}{b} + (n-m)\frac{P - (\bar{k} + \tilde{k})}{b} \,. \tag{A4}$$

Substituting for Q from the demand function, the industry price P^* is obtained

$$P^* = \frac{a + n\bar{k} + (n-m)\tilde{k}}{(n+1)} \tag{A5}$$

A2. Realized profits

Profits at t = 1 are $\pi_i^* = q_i^*(P^* - c_i) = \frac{(P^* - c_i)^2}{b}$ (A6)

Substituting for industry price P^* into equation (A6) gives

$$\pi_h = \frac{1}{b(n+1)^2}\left\{a - \bar{k} + (n-m)\,\tilde{k}\right\}^2 \tag{A7}$$

for hedged firms, and

$$\pi_u = \frac{1}{b(n+1)^2}\left\{a - \bar{k} - (m+1)\,\tilde{k}\right\}^2 \qquad \text{(A8)}$$

for unhedged firms.

A3. Expected Profits and Variance of Profits

Since $E(\tilde{k}) = 0$ and $Var(\tilde{k}) = \sigma^2$, expected profits are

$$E(\pi_h) = \frac{1}{b(n+1)^2}\left\{(a-\bar{k})^2 + (n-m)^2\sigma^2\right\} \qquad \text{(A9)}$$

for hedged firms, and

$$E(\pi_u) = \frac{1}{b(n+1)^2}\left\{(a-\bar{k})^2 + (m+1)^2\sigma^2\right\} \qquad \text{(A10)}$$

for unhedged firms.

Expected profits of a hedged (unhedged) firm are decreasing (increasing) in *m*, the number of hedged firms.

Variance of hedged and unhedged firms can be calculated by substituting for π_i and $E(\pi_i)$ into the expression $Var(\pi_i) = E[\pi_i - E(\pi_i)]^2$

Assuming that the distribution of the cost shock $\tilde{k}$ is symmetric (i.e. $E(\tilde{k}^3) = 0$)

$$Var(\pi_h) = \frac{1}{b^2(n+1)^4}\left[(n-m)^4\{E(\tilde{k}^4) - \sigma^4\} + 4(n-m)^2(a-\bar{k})^2\sigma^2\right] \qquad \text{(A11)}$$

$$Var(\pi_u) = \frac{1}{b^2(n+1)^4}\left[(m+1)^4\{E(\tilde{k}^4) - \sigma^4\} + 4(m+1)^2(a-\bar{k})^2\sigma^2\right] \qquad \text{(A12)}$$

Note that,

$$E(\tilde{k}^4) = E(\tilde{k}^2\,\tilde{k}^2) = E(\tilde{k}^2)\,E(\tilde{k}^2) + Var(\tilde{k}^2) = \sigma^4 + Var(\tilde{k}^2) \qquad \text{(A13)}$$

Since variance is non-negative, equation (A13) implies that $E(\tilde{k}^4) - \sigma^4 \geq 0$

Thus, from equations (A11) and (A12) variance of a hedged (unhedged) firm's profit decreases (increases) with *m*, the number of hedged firms.

A4. Hedging choice at t = 1

If firms are risk-neutral, variance of profits does not matter. The decision to hedge or not is depends on whichever delivers higher expected profits. In equilibrium, neither firm has an incentive to deviate. That is, $E(\pi_h) = E(\pi_u)$. Using (A9) and (A10),

$$\frac{1}{b(n+1)^2}\left\{(a-\bar{k})^2 + (n-m^*)^2\sigma^2\right\} = \frac{1}{b(n+1)^2}\left\{(a-\bar{k})^2 + (m^*+1)^2\sigma^2\right\} \qquad \text{(A14)}$$

Thus, the equilibrium number of hedgers, $m^* = \frac{n-1}{2}$

By substituting m^* into equations (A11) and (A12), we see that the equilibrium variance of hedged and unhedged firms' profits is given by the expression

$$Var(\pi_h) = Var(\pi_u) = \frac{1}{b^2(n+1)^4}\left[\left(\frac{n+1}{2}\right)^4 \{E(\tilde{k}^4) - \sigma^4\} + 4\left(\frac{n+1}{2}\right)^2 (a-\bar{k})^2\sigma^2\right] \qquad \text{(A15)}$$

Thus, at the equilibrium level of hedging, the variance of hedged and unhedged firms' profits is equal and determined by the intercept, *a*, and slope, *b*, of industry demand function, the number of firms in the industry *n*, and distribution of the cost shock faced by the industry.

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TABLE I
Descriptive Statistics of Foreign Currency Derivative Use

This table summarizes foreign currency derivatives (FCD) usage as of fiscal year 1998-1999 by 548 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. All data are from 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 (TA). Panel B provides, by industry, the number of FCD users, non-users and fraction of FCD users along with the mean and median notional amounts held by FCD users in each industry. Industry classification is based on Campbell (1996). All values are in dollar millions. Panel B presents the distribution of two measures of industry hedging. Column I presents the distribution of Market *Value Fraction of Hedgers* which is calculated as the sum of market value equity of all hedged firms in a 3-digit industry divided by the sum of market value of equity of all firms in the industry. Column II presents the distribution of the *Fraction of Hedgers* calculated as the number of firms in a three-digit SIC industry that engage in foreign currency hedging divided by the total number of firms in that industry

PANEL A : Foreign Currency Derivative Usage (FCD)

	N	Mean	25th	Median	75th	Std Dev
Total FCD	548	745.61	7.57	42.45	268.92	3431.02
Scaled by TA		8.86%	1.27%	3.74%	9.70%	23.87%
Foreign Currency Swaps	74	840.23	35.00	158.12	600.00	2917.45
Scaled by TA		4.90%	1.39%	3.30%	6.18%	5.24%
Foreign Currency Forwards	502	606.44	7.00	35.78	210.00	2811.58
Scaled by TA		7.80%	1.12%	3.13%	7.59%	24.12%
Foreign Currency Options	90	466.47	17.70	79.2	403.00	913.42
Scaled by TA		6.35%	0.74%	2.10%	7.06%	11.80%

PANEL B : Distribution of FCD Usage by Industry

Percentiles	Market Value Fraction of Hedgers	Fraction of Hedgers
10%	0.00	0.00
25%	0.00	0.00
50%	0.06	0.10
60%	0.24	0.16
75%	0.52	0.26
80%	0.60	0.30
90%	0.84	0.50
95%	0.93	0.60
99%	1.00	1.00
Industries	234	234
Mean	0.27	0.16
Std Dev	0.33	0.21

Table II
Sensitivity of Domestic Producer Price Index to Foreign Exchange Rates

This table shows the relation between domestic industry prices and the real external value of the U.S. dollar conditional on the extent of currency hedging in an industry. Monthly data from 1997 till 1999 are used to estimate a panel regression with industry fixed effects. The dependent variable is the natural log of relative producer price index, ***RPPI***, calculated as the producer price index divided by the overall GDP price deflator. Producer price index data are collected for three-digit SIC industries from the Bureau of Labor Statistics. The overall GDP price deflator is obtained from the Bureau of Economic Analysis. $\boldsymbol{REXCH_{t-1}}$ is the lagged real value of the U.S. dollar per unit of SDR (Special Drawing Right). It is calculated by the International Monetary Fund based on the U.S. dollar values of specified quantities of the Euro, Japanese Yen and Pound Sterling. The variable $\boldsymbol{F_{it}}$ captures the extent of hedging in an industry. In Column 1, F_{it} is calculated as the number of firms in a three-digit SIC industry that engage in foreign currency hedging divided by the total number of firms in that industry. In Column 2, F_{it} is calculated as the sum of market value equity of all hedged firms in an industry divided by the sum of market value of equity of all firms in the industry. $\boldsymbol{KS_{it}}$ is a measure of capital intensity of an industry and is calculated as the average value of total assets as percentage of sales for all firms in the three digit industry. $\boldsymbol{IMP_{it}}$ measures import penetration in an industry and is calculated as industry imports divided by the sum of industry imports and domestic shipments. $\boldsymbol{IMPINP_{it}}$ captures an industries reliance on imported inputs and is calculated as in Allayannis and Ihrig (2001). $\boldsymbol{EXP_{it}}$ is calculated as industry exports divided by the sum of industry exports and domestic shipments. Macroeconomic conditions are controlled for by the U.S. dollar LIBOR, $\boldsymbol{r_t}$. Bold font indicates significance at least at the ten percent level. P values are provided in parenthesis.

	F_{jt} = Fraction of Hedged Firms	F_{jt} = Market Value Fraction of Hedged Firms
ln $REXCH_{t-1}$	***0.183***	***0.184***
	(0.03)	(0.03)
ln $REXCH_{t-1} * F_{it}$	***-0.184***	***-0.089***
	(0.00)	(0.00)
$ln\ REXCH_{t-1} * KS_{it}$	***-0.055***	***-0.057***
	(0.00)	(0.00)
ln $REXCH_{t-1} * IMP_{it}$	-0.021	-0.048
	(0.89)	(0.75)
ln $REXCH_{t-1} * IMPINP_{it}$	-0.011	-0.008
	(0.45)	(0.60)
ln *REXCHt-1* * EXP_{it}	-***0.482***	***-0.513***
	(0.01)	(0.00)
ln *REXCHt-1* * $HERFINDAHL_{it}$	-0.127	-0.104
	(0.48)	(0.57)
ln r_t	***0.077***	***0.076***
	(0.00)	(0.00)
Observations	3080	3080
Number of Industries	89	89
F value	***17.62***	***19.03***
R-squared	0.02	0.02

TABLE III
Exposure of Unhedged 'Net-Importing' Firms to Foreign Exchange Fluctuations

This table shows the relation between the stock return of an unhedged firm and changes in the real external value of the U.S. dollar conditional on the extent of currency hedging in an industry. Time series regressions are estimated for each unhedged firm to select firms whose stock returns decline when the dollar depreciates after controlling for the overall market return. These firms are classified as importing firms. For this set of firms, monthly data from 1997 till 1999 are used to estimate the following panel regression with firm-fixed effects. Given the sample selection procedure, coefficient β_2 in the equation below is negative by design.

$$r_{it} = \alpha + \beta_1 r_{mt} + \beta_2 \Delta s_t + \beta_3 \Delta s_t F_{jt} + \beta_4 \Delta s_t LTDRatio_{it} + \beta_5 \Delta s_t QuickRatio_{it} + \beta_6 \Delta s_t EXP_{jt}$$
$$+ \beta_7 \Delta s_t IMP_{jt} + \beta_8 \Delta s_t KS_{jt} + \beta_9 \Delta s_t Herfindahl + u_{it}$$

The dependent variable is the monthly stock return of firm *i*. r_{mt} is the corresponding return on the value-weighted market index. The variable Δs_t is the monthly change in value of the U.S. dollar orthogonal to the market return. $\boldsymbol{F_{jt}}$ captures the extent of hedging in an industry. In Column 1, F_{jt} is calculated as the number of firms in the three-digit SIC industry that engage in foreign currency hedging divided by the total number of firms in that industry. In Panel B, F_{it} is calculated as the sum of market value equity of all hedged firms in the industry divided by the sum of market value of equity of all firms in the industry. $\boldsymbol{LTDRatio_{it}}$ is the long-term debt ratio calculated as long-term debt divided by total assets. $\boldsymbol{QuickRatio_{it}}$ is the firm's quick ratio calculated as current assets minus inventories divided by current liabilities. $\boldsymbol{KS_{jt}}$ is a measure of capital intensity of an industry and is calculated as the average value of total assets as percentage of sales for all firms in the three digit industry. $\boldsymbol{IMP_{jt}}$ measures import penetration in an industry and is calculated as industry imports divided by the sum of industry imports and domestic shipments. $\boldsymbol{EXP_{jt}}$ is calculated as industry exports divided by the sum of industry exports and domestic shipments Levels of all variables in the interaction terms are also included in the estimation but not shown in the table below. Bold font indicates significance at least at the 10 percent level. P-values are provided in parenthesis.

	Coefficient	F_{jt} = Fraction of Hedged Firms	F_{jt} = Market Value Fraction of Hedged Firms
r_{mt}	β_1	***1.051***	***1.053***
		(0.00)	(0.00)
Δs_t	β_2	***-1.066***	***-1.218***
		(0.01)	(0.00)
$\Delta s_t * F_{jt}$	β_3	***-3.716***	***-1.133***
		(0.02)	(0.01)
$\Delta s_t * LTDRatio_{it}$	β_4	0.808	0.687
		(0.21)	(0.29)
$\Delta s_t * QuickRatio_{it}$	β_5	0.055	0.058
		(0.20)	(0.17)
$\Delta s_t * EXP_{jt}$	β_6	1.240	1.713
		(0.39)	(0.23)
$\Delta s_t * IMP_{jt}$	β_7	-1.421	-1.237
		(0.11)	(0.17)
$\Delta s_t * KS_{jt}$	β_8	0.021	-0.009
		(0.11)	(0.44)
Δs_t * Herfindahl	β_9	0.479	0.439
		(0.56)	(0.59)
Firm Fixed Effects		Yes	Yes
Number of Observations		14,115	14,115
Number of Firms		422	422
R squared		0.08	0.07

TABLE IV
Exposure of Hedged and Unhedged Importing Firms to Foreign Exchange Fluctuations

This table shows the relation between the stock return of a firm and changes in the real external value of the U.S. dollar conditional on the extent of currency hedging in an industry. The sample is restricted to firms that belong to import oriented industries. Monthly data from 1997 till 1999 are used to estimate the following panel regression with firm-fixed effects.

$$r_{it} = \alpha + \beta_1 r_{mt} + \beta_2 \Delta s_t + \beta_3 \Delta s_t F_{jt} + \beta_4 \Delta s_t LTDRatio_{it} + \beta_5 \Delta s_t QuickRatio_{it} + \beta_6 \Delta s_t KS_{jt} + \beta_7 \Delta s_t Herfindahl + u_{it}$$

The dependent variable is the monthly stock return of firm *i*. r_{mt} is the corresponding return on the value-weighted market index. The variable Δs_t is the monthly change in value of the U.S. dollar orthogonal to the market return. $\boldsymbol{F_{jt}}$ captures the extent of hedging in an industry. F_{jt} is calculated as the sum of market value equity of all hedged firms in the industry divided by the sum of market value of equity of all firms in the industry. $\boldsymbol{LTDRatio_{it}}$ is the long-term debt ratio calculated as long-term debt divided by total assets. $\boldsymbol{QuickRatio_{it}}$ is the firm's quick ratio calculated as current assets minus inventories divided by current liabilities. $\boldsymbol{KS_{jt}}$ is a measure of capital intensity of an industry and is calculated as the average value of total assets as percentage of sales for all firms in the three digit industry. Levels of all variables in the interaction terms are also included in the estimation but not shown in the table below. Bold font indicates significance at least at the 10 percent level. P-values are provided in parenthesis.

Variable	Coefficient	Unhedged Firms	Hedged Firms
r_{mt}	β_1	**1.029**	**1.081**
		(0.00)	(0.00)
Δs_t	β_2	-0.338	**-0.821**
		(0.30)	(0.09)
$\Delta s_t * F_{jt}$	β_3	**-1.091**	**0.937**
		(0.00)	(0.04)
$\Delta s_t * LTDRatio_{it}$	β_4	-0.911	1.220
		(0.21)	(0.15)
$\Delta s_t * QuickRatio_{it}$	β_5	0.036	0.058
		(0.32)	(0.55)
$\Delta s_t * KS_{jt}$	β_6	**0.103**	0.055
		(0.01)	(0.22)
$\Delta s_t * Herfindahl$	B_7	0.924	-0.806
		(0.20)	(0.43)
Firm fixed effects		YES	YES
Number of Observations		13,752	4,396
Number of Firms		447	136
R squared		0.05	0.12

Table V
Foreign Currency Derivative (FCD) Use and Firm Value

This table displays the effect of FCD use on firm value for a sample of firms that face foreign exchange exposure. A firm is defined as having ex-ante 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. The dependent variable is the natural log of Tobin's Q, which is calculated as market value of equity (calculated as shares outstanding times share price) plus total assets less common equity and deferred taxes, all scaled by book value of assets. FCD non-user dummy equals 1 if the firm does *not* disclose the use of foreign currency swaps, options or forwards in its 1998-1999 10K reports and 0 otherwise. Fraction of competitors who use FCD is calculated as the number of firms with the same 3-digit SIC code who face exchange rate exposure and disclose the use currency swaps, forwards or options divided by the total number of firms with the same 3-digit SIC who face foreign exchange exposure. Size is the log of total assets. R&D Expense/Sales is Research and Development Expense divided by Net Sales. CAPEX/Sales is capital expenditures divided by Net Sales. Long-term Debt Ratio is long-term debt divided by total assets. Multiple Segment Dummy equals one if the firm operates in more than one segment and zero otherwise. Return on Assets is calculated as net income over total assets. Managerial Stockownership/ Total Assets is the market value of shares owned by executives of the company divided by total assets. Panel A contains estimates of Heckman's (1979) two-step estimation procedure. Panel B provides estimates of an instrumental variable estimation where the FCD non-user dummy is instrumented with its lagged value. In the Heckman two-step estimation, the decision not to use FCD is modeled as a function of firm size, leverage, research and development expense, foreign sales, institutional ownership and the lagged hedging dummy. *Lambda* is the self-selection parameter. The coefficient on lambda indicates the prevalence of self-selection in the model. Bold font indicates significance at least at the ten percent level. P-values are provided in parenthesis.

	PANEL A		PANEL B	
Variable	HECKMAN		IV	
Derivatives non-user dummy	**-0.215**	-0.073	-0.043	0.021
	(0.04)	(0.47)	(0.64)	(0.85)
Derivatives non-user dummy * Fraction of Competitors who hedge	**-0.518**	**-0.274**	**-0.698**	**-0.292**
	(0.00)	(0.09)	(0.00)	(0.09)
Size	**-0.033**	0.010	-0.017	0.021
	(0.04)	(0.56)	(0.26)	(0.25)
RND/Sales	**0.192**	**0.165**	**0.193**	**0.165**
	(0.00)	(0.00)	(0.00)	(0.00)
CAPEX/Sales	**-0.188**	**0.161**	**-0.189**	**-0.162**
	(0.00)	(0.00)	(0.00)	(0.00)
Leverage	**-1.615**	**1.313**	**-1.640**	**-1.329**
	(0.00)	(0.00)	(0.00)	(0.00)
Multiple Segment Dummy	**-0.205**	**0.198**	**-0.202**	**-0.197**
	(0.00)	(0.00)	(0.00)	(0.00)
Return on Assets	**1.014**	**0.961**	**1.007**	**0.959**
	(0.00)	(0.00)	(0.00)	(0.00)
Managerial Stockownership/Total Assets	**0.048**	**0.044**	**0.048**	**(0.044)**
	(0.00)	(0.00)	(0.00)	0.00
Self selection parameter	**0.185**	0.070		
	(0.00)	(0.24)		
Number of Observations	1086	1086	1086	1086
Industry Dummies	NO	YES	NO	YES

TABLE VI
Logit Regression Estimates of Change in Foreign Currency Derivatives (FCD) Usage

This table examines how the extent of hedging in an industry affects a firm's own decision to hedge in response to a firm-specific foreign sales shock. The sample is restricted to firms that were (i) unhedged (did not disclose the use of FCD) in 1997 and did not disclose any foreign currency adjustment to income during 1997, (ii) potentially faced exposure in 1999 insofar as they disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files or if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file (iii) belonged to industries in which the extent of hedging did not increase by more than 10 percent between 1997 and 1999. The dependent variable in Panel A (logit estimates) is a hedging dummy that equals one if a firm chooses to hedge in 1999 and zero otherwise. Thus, the hedging dummy captures a firm's decision to begin hedging in response to a foreign sales shock. In Panel A, the extent of hedging in an industry is measured as the number of FCD users in 1997 divided by the total number of firms in the industry at that time. In Panel B, the extent of hedging in an industry is calculated as the sum of market values of equity of hedged firms divided by the sum of market values of equity of all firms in the industry. In both panels, the first column contains the regression coefficients and the second column contains the marginal changes in probability implied by the regression coefficients. Size is the log of total assets. NOL carryforwards/TA is the net operating loss carry forwards scaled by book value of assets. Quick Ratio is current assets minus inventories all divided by current liabilities. R&D Expense/Sales is research and development expense divided by net sales. Long-term Debt Ratio is long-term debt divided by total assets. Institutional Ownership is the percentage of firm's stock held by institutional investors. Bold font indicates significance at least at the ten percent level. P-values are provided in parenthesis.

Extent of hedging in the industry measured as :	**PANEL A** Fraction of Hedgers		**PANEL B** Market Value Fraction of Hedgers	
	Coefficient	Δ prob	Coefficient	Δ prob
Extent of Hedging in the Industry	**2.545**	**0.09**	**1.436**	**0.05**
	(0.04)		(0.00)	
Foreign Sales/Net Sales	**0.575**	**0.02**	**0.533**	**0.02**
	(0.01)		(0.01)	
Size	**0.355**	**0.01**	**0.369**	**0.01**
	(0.00)		(0.00)	
NOL Carryforwards	-0.720	-0.03	-0.806	-0.03
	(0.35)		(0.31)	
Quick Ratio	**-0.140**	**-0.01**	**-0.165**	**-0.01**
	(0.02)		(0.02)	
R&D Expense/Sales	-0.679	-0.02	-0.996	-0.03
	(0.41)		(0.27)	
Long-Term Debt Ratio	-1.223	0.04	-0.824	-0.03
	(0.11)		(0.28)	
Long-Term Debt x R&D Expense	2.387	0.09	3.172	0.09
	(0.40)		(0.27)	
Institutional Ownership	**1.252**	**0.05**	**1.229**	**0.04**
	(0.00)		(0.00)	
Observations	1292		1292	
R squared	0.15		0.16	
LR chi squared	109.93		115.4	

TABLE VII
Tobit Regression Estimates of Change in Foreign Currency Derivatives (FCD) Usage

This table examines how the extent of hedging in an industry affects a firm's own decision to hedge in response to a firm-specific change in exposure. The sample is restricted to firms that were (i) unhedged (did not disclose the use of FCD) in 1997 and did not disclose any foreign currency adjustment to income during 1997, (ii) potentially faced exposure in 1999 insofar as they disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files or if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file (iii) belonged to industries in which the extent of hedging did not increase by more than 10 percent between 1997 and 1999. The dependent variable is the notional amount of FCD (scaled by total assets) outstanding in 1999. Since this sub-sample did not use FCD in 1997, the dependent variable captures the change in derivatives usage during this period. In Panel A, the extent of hedging in an industry is measured as the number of FCD users in 1997 divided by the total number of firms in the industry at that time. In Panel B, the extent of hedging in an industry is calculated as the sum of market values of equity of hedged firms (as of 1997) divided by the sum of market values of equity of all firms in the industry. Size is the log of total assets. NOL carryforwards/TA is the net operating loss carry forwards scaled by book value of assets. Quick Ratio is current assets minus inventories all divided by current liabilities. R&D Expense/Sales is research and development expense divided by net sales. Long-term Debt Ratio is long-term debt divided by total assets. Institutional Ownership is the percentage of firm's stock held by institutional investors. Bold font indicates significance at least at the ten percent level. P-values are provided in parenthesis.

	PANEL A Fraction of Hedgers	PANEL B Market Value Fraction of Hedgers
Extent of Hedging in the Industry	**0.190**	**0.099**
	(0.08)	(0.00)
Foreign Sales/Net Sales	**0.049**	**0.047**
	(0.00)	(0.00)
Size	**0.02**	**0.024**
	(0.00)	(0.00)
NOL Carryforwards	-0.05	-0.060
	(0.30)	(0.27)
Quick Ratio	**-0.009**	**-0.010**
	(0.02)	(0.01)
R&D Expense/Sales	-0.072	-0.103
	(0.31)	(0.20)
Long-Term Debt Ratio	0.11	0.142
	(0.54)	(0.40)
Leverage x R&D Expense	0.219	0.286
	(0.33)	(0.22)
Institutional Ownership	**0.079**	**0.076**
	(0.01)	(0.02)
Observations	1292	1292
R squared	0.260	0.280
LR chi squared	99.24	103.69
Left Censored Variables	1188	1188
Uncensored Variables	104	104

Table VIII
Marginal Probability Estimates of Foreign Currency Derivatives (FCD) Usage by Industry Concentration

This table presents marginal probability estimates from a logit model. The initial sample consists of firms that were (i) unhedged (did not disclose the use of FCD) in 1997 and did not disclose any foreign currency adjustment to income during 1997, (ii) potentially faced exposure in 1999 insofar as they disclose non-zero values of foreign currency adjustment, exchange rate effect, foreign income, or deferred foreign taxes in the annual COMPUSTAT files or if they disclose foreign assets, sales or income in the COMPUSTAT Geographic segment file (iii) belonged to industries in which the extent of hedging did not increase by more than 10 percent between 1997 and 1999. In both Panels A and B, the dependent variable is a hedging dummy that equals one if a firm chooses to hedge in 1999 and zero otherwise. Thus, the hedging dummy captures a firm's decision to begin hedging in response to a foreign sales shock. In Panel A, the extent of hedging in an industry is measured as the number of FCD users in 1997 divided by the total number of firms in the industry at that time. In Panel B, the extent of hedging in an industry is calculated as the sum of market values of equity of hedged firms divided by the sum of market values of equity of all firms in the industry. The sample is divided into two groups. In the first column of each panel, the sample consists of firms from industries whose Herfindahl index lies below the median (more competitive industries). In the second column of each panel, the sample consists of firms from industries with Herfindahl index above the median (more concentrated industries). Size is the log of total assets. NOL carryforwards/TA is the net operating loss carry forwards scaled by book value of assets. Quick Ratio is current assets minus inventories all divided by current liabilities. R&D Expense/Sales is research and development expense divided by net sales. Long-term Debt Ratio is long-term debt divided by total assets. Institutional Ownership is the percentage of firm's stock held by institutional investors. Bold font indicates significance at least at the ten percent level. P-values are provided in parenthesis.

	PANEL A Fraction of hedgers		PANEL B Market Value Fraction of Hedgers	
	Low Herfindahl	High Herfindahl	Low Herfindahl	High Herfindahl
Extent of Hedging in the Industry	0.114	**0.154**	**0.051**	**0.097**
	(0.41)	(0.08)	(0.07)	(0.00)
Foreign Sales/Net Sales	**0.025**	0.025	**0.018**	0.023
	(0.03)	(0.12)	(0.04)	(0.12)
Size	**0.008**	**0.026**	**0.008**	**0.026**
	(0.00)	(0.00)	(0.00)	(0.00)
NOL Carryforwards	-0.026	-0.014	-0.023	-0.017
	(0.35)	(0.83)	(0.34)	(0.80)
Quick Ratio	0.002	-0.013	0.003	-0.012
	(0.19)	(0.12)	(0.16)	(0.12)
R&D Expense/Sales	-0.008	0.003	-0.011	-0.012
	(0.72)	(0.98)	(0.68)	(0.92)
Long-Term Debt Ratio	-0.022	-0.098	-0.005	-0.081
	(0.45)	(0.14)	(0.84)	(0.21)
Leverage x R&D Expense	0.061	-0.087	0.053	-0.037
	(0.36)	(0.87)	(0.42)	(0.95)
Institutional Ownership	**0.035**	**0.071**	**0.027**	**0.062**
	(0.03)	(0.04)	(0.06)	(0.06)
Number of Observations	737	555	737	555
R squared	0.15	0.14	0.16	0.15
LR chi2	50.18	52.58	53.22	57.81

Table IX
Sensitivity of Domestic Producer Price Index to Foreign Exchange Rates
(Using Trade Weighted Exchange Rate)

This table shows the relation between domestic industry prices and the real external value of the U.S. dollar conditional on the extent of currency hedging in an industry. Monthly data from 1997 till 1999 are used to estimate a panel regression with industry fixed effects. The dependent variable is the natural log of relative producer price index, *RPPI*, calculated as the producer price index divided by the overall GDP price deflator. Producer price index data are collected for three-digit SIC industries from the Bureau of Labor Statistics. The overall GDP price deflator is obtained from the Bureau of Economic Analysis. $REXCH_{t-1}$ is the inverse of the lagged trade-weighted value of the U.S. dollar against currencies of its major trading partners obtained from the Board of Governors of the Federal Reserve System. Thus, higher values of $REXCH_{t-1}$ are indicative of a depreciating dollar. The variable F_{it} captures the extent of hedging in an industry. In Column 1, F_{it} is calculated as the number of firms in a three-digit SIC industry that engage in foreign currency hedging divided by the total number of firms in that industry. In Column 2, F_{it} is calculated as the sum of market value equity of all hedged firms in an industry divided by the sum of market value of equity of all firms in the industry. KS_{it} is a measure of capital intensity of an industry and is calculated as the average value of total assets as percentage of sales for all firms in the three digit industry. IMP_{it} measures import penetration in an industry and is calculated as industry imports divided by the sum of industry imports and domestic shipments. $IMPINP_{it}$ captures an industries reliance on imported inputs and is calculated as in Allayannis and Ihrig (2001). $TRDRATIO_{it}$ is calculated as industry exports divided by industry imports. Macroeconomic conditions are controlled for by the U.S. dollar LIBOR, r_t. *HERFINDAHL* is the sum of squares of the market share of each firm. Bold font indicates significance at least at the ten percent level. P values are provided in parenthesis.

	F_{jt} = Fraction of Hedged Firms	F_{jt} = Market Value Fraction of Hedged Firms
ln $REXCH_{t-1}$	***0.272***	***0.264***
	(0.00)	(0.00)
ln $REXCH_{t-1} * F_{it}$	***-0.114***	***-0.056***
	(0.00)	(0.00)
ln $REXCH_{t-1} * KS_{it}$	***-0.042***	***-0.044***
	(0.00)	(0.00)
ln $REXCH_{t-1} * IMP_{it}$	-0.077	-0.104
	(0.40)	(0.25)
ln $REXCH_{t-1} * IMPINP_{it}$	-0.012	-0.011
	(0.19)	(0.23)
ln $REXCHt\text{-}1 * TRDRATIO_{it}$	***-0.011***	***-0.011***
	(0.00)	(0.00)
ln $REXCHt\text{-}1 * HERFINDAHL_{it}$	-0.170	*-0.141*
	(0.11)	(0.19)
ln r_t	***0.078***	0.076
	(0.00)	(0.00)
Observations	3080	3080
Number of Industries	89	89
R-squared	0.06	0.06