

ARE ACQUISITIONS AN OPERATIONAL HEDGE?

THE INTERACTION OF FINANCIAL AND OPERATIONAL HEDGING

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ABSTRACT

This paper investigates the substitution of financial and operational hedging choices. Income volatility can be costly due to capital market imperfections. Both financial hedging and operational hedging can reduce income volatility and, in turn, the potential costs of such volatility. I present a simple model of the tradeoffs between such hedging choices to motivate an empirical investigation into firm behavior. Using a large sample of bank holding companies, I find that acquisitions can provide operational hedging and that this is a substitute for financial hedging. First, I document that acquisitions lower income volatility for most acquirers. Second, financial hedging declines after an acquisition. Lastly, the decrease in financial hedging is related to the acquisition's impact on income volatility. Those acquisitions that provide the most operational hedging are followed by the largest declines in financial hedging.

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1. INTRODUCTION

In the world of Modigliani and Miller, risk management is not a tool for value maximization. However, capital market imperfections such as financial distress, tax convexity, and external financing create a cost to cash flow volatility (Smith and Stulz (1985), Tufano (1996)). Empirical evidence confirms the importance of these costs: 71% of the large¹ bank holding companies (BHC) utilize derivative hedges against interest rate, foreign exchange, equity, or commodity risks. Yet income volatility also can be reduced with operational hedging, such as adjusting operating leverage or diversifying cash flows through project choice or acquisitions. Using a large sample of BHCs, I find that acquisitions can reduce income volatility and that managers substitute this operational hedging for financial hedging. In spite of this, acquisitions and other firm organization decisions are frequently considered independent of derivatives use.

If operational hedges are a risk management tool, appreciating their relationship to financial hedging is essential to the capital budgeting, hedging, and diversification literatures. This paper investigates this relationship both by introducing a simple model of optimal hedging when multiple avenues for risk management exist and empirically analyzing the relationship between financial and operational hedging. In the model, management aims to maximize firm value by limiting costly volatility while taking into account the expense of hedging. Optimal risk management balances the relative costs of each hedging choice with its contribution to reducing volatility. Any increased use of one hedge should result in an offsetting decline in the alternative hedging tool. That is, if BHC manage total firm risk and not just specific transitional exposures,

¹ Large BHCs are defined as those with at least \$1 billion in total assets.

then operational decisions which reduce idiosyncratic risk will impact the use of derivatives for hedging.

Dramatic changes in operational hedging should provide the easiest observation of risk management tradeoffs. Amihud and Lev (1981) and Aggarwal and Samwick (2003) argue that diversifying idiosyncratic risk is a key motivation for mergers and acquisitions (M&A). Thus, I focus on how this firm organization decision affects hedging with derivatives using a dataset of bank holding companies. I concentrate on interest rate hedging because this exposure comprises the overwhelming majority of BHC derivatives hedging. Consistent with my hypothesis, I document a substitution between hedging with derivatives and acquisition activity. Not only is an acquisition more likely if risk exposures are not actively hedged with derivatives, but financial hedging decreases after most acquisitions.

It should be noted that acquisitions could influence financial hedging even in the absence of operational hedging. If the acquirer's intrinsic risk exposure shifts with an acquisition, derivatives use should adjust. This provides some information about risk management (e.g., that managers respond to changing exposures), but it does not address whether some acquisitions serve as an operational hedge and how that influences derivatives use. As aforementioned, the reliance on financial hedging decreases following acquisitions. Evidence of this substitution exists even after controlling for changing risk exposure. For example, assume a firm hedges a certain percentage of its risk exposure. If the firm hedges a significantly smaller percent after an acquisition, controlling for the change in exposure due to the acquisition, operational hedging may have increased.

I also test whether an acquisition's impact on financial hedging varies with its contribution to operational hedging. Acquisitions which increase the scale of the firm, but do not

affect cash flow volatility in any material manner, offer little in the way of operational hedging. Conversely, acquisitions which alter volatility should be factored into the total risk management. The empirical evidence presented in this paper suggests that those acquisitions offering the most operational hedging lead to the largest reductions in hedging with derivatives.

If acquisition activity provides operational hedging, then this research pertains to not only the hedging literature but also basic theory of the firm issues. Coase (1937) established the discussion on what determines the boundaries of a firm and whether those boundaries affect resource allocation. More recently, Berger *et al.* (2005) provided empirical support for the notion that organizational form influences the choice of business activities. This implies that if risk management impacts firm organization, the core business activities of a firm may change. Hedging choices could influence firm value not just by minimizing the costs of volatility but also by changing project selection or business practices.

This research also may contribute to understanding some of the unexplained cross-sectional variation in diversification discount literature (Stein (2003)). Benston, Hunter, and Wall (1995) conclude that banks value more highly those acquisitions which diversify earnings. This could be explained by the reduction in volatility and, possibly, financial hedging costs.

The remainder of the paper is organized as follows. Section 2 reviews the existing literature. In Section 3, a basic model of hedging alternatives is described. Section 4 presents the data and Section 5 discusses the methodology and results. Section 6 concludes.

2. FINANCIAL VERSUS OPERATIONAL HEDGING

No comprehensive survey exists of the multiple avenues for corporate hedging. Prior research focuses primarily on the relationship of derivatives to either firm value or leverage but

overlooks the risk management aspects of corporate decisions such as capital budgeting and diversification. Hedging decisions have been found to affect debt ratios (Graham and Rogers, 2002; Purananandam, 2004a), but it is less clear whether hedging affects firm value. Allayannis and Weston (2003) document a positive correlation between firm value and foreign exchange hedging while Jin and Jorion (2004) find no such relationship with commodity hedging in the oil and gas industry. The industry effect on hedging decisions also is ambiguous. Nain (2004) finds within-industry practices are important influences on risk management decisions while Carter, Rogers, and Simkins (2002) and Haushalter (2000) document great variation in within-industry hedging practices.

The relationship between firm size and hedging is equally murky. Most small firms do not employ financial hedging – an observation frequently attributed to the fixed costs of establishing a hedging program. However, Haushalter (2000) finds some evidence that fraction of production hedged is negatively associated with size amongst actively hedging oil and gas producers. This is somewhat surprising given the assumption that hedging with derivatives has a low marginal cost. This paper offers a potential explanation of this phenomenon. It is feasible that firm size is positively correlated with operational hedging if firms increase their total assets through acquisitions, geographic expansion, or any other project selection that diversifies cash flow. Larger firms may substitute this increased operational hedging for alternative risk management, such as derivatives use, leading to the observed relationship between financial hedging and firm size.

The banking literature provides additional evidence that corporate decisions are related to risk management. Both Diamond (1984) and Brewer *et al.* (2000) find that bank lending is related to hedging. Hughes *et al.* (1999) argue that bank expansion which diversifies risk will

reduce risk management costs. Also Cebenoyan and Strahan (2004) note that active credit risk hedgers hold less capital.

Numerous papers consider the relative importance of financial versus operational hedging. Guay & Kothari (2003) contend that derivatives appear to cover only a small part of a firm's risk profile. They conclude most risk stems from sources that cannot be financially hedged. This finding, coupled with the Froot and Stein (1998) conclusion that unhedgable risks will alter both capital structure and investment policy, highlights the potential importance of operational hedging. The prior evidence on whether operational and financial hedging are substitutes or complements is ambiguous. Nance, Smith, and Smithson (1993) briefly note that other financial policies, such as adjustments to leverage or dividends, may substitute for derivatives, while operational and financial hedging are found to be complements in the theoretical work of Lim and Wang (2003) and the empirical study of exchange rate exposures by Allayannis, Ihrig, and Weston (2001). Geczy, Minton and Schrand (1999) examine risk management choices in the natural gas industry and find mixed evidence on whether hedging alternatives are complements or substitutes. In contrast, my investigation documents evidence of operational hedging (through acquisitions) substituting for derivatives use.

This paper is not the first to suggest that acquisitions may provide an operational hedge. The *Wall Street Journal* often highlights an acquisition's effect on risk exposures and volatility (Editors (2004), Samor (2004)). Moreover, the academic literature has recognized the potential risk management benefits of M&A activity since Lewellen (1971). Stulz (1990) asserts that costless acquisitions which reduced cash flow volatility would benefit shareholders and Santomero (1997) notes that credit risk is diversifiable through acquisitions. Amihud and Lev (1981) conclude that managerial risk aversion is a significant determinant of acquisition activity;

although my empirical results are not consistent with this agency motivation. I document a decline in derivatives use after an increase in operational hedging. Risk aversion would lead the manager to seek an overall decrease in volatility and not maintain the current level by substituting operational hedging for financial hedging. Also, Esty, Narasimhan, and Tufano (1999) examine how the interest rate environment affects bank acquisitions. They find the competitive dynamics of bank mergers change with interest rates movements and acquisition prices are a function of the current interest rate. Unlike Esty *et al.*, I examine acquisitions as a risk management tool, rather than a byproduct of risk exposure. Most relevant to this inquiry is the finding of Benston, Hunter, and Wall (1995) that banks bid more for targets that diversify earnings. This lends indirect support to my hypothesis that acquisitions can provide operational hedging. *Ceteris paribus*, acquisitions which reduce volatility should command a premium.

Still, there is little consensus in the literature on acquisitions and firm value. Recent work on the diversification discount indicates that the discount may disappear or possibly become a premium after accounting for selection bias (Graham, Lemmon, and Wolf (2002), Villalonga (2004)). To the extent that acquisitions vary in their contribution to risk management (some reduce volatility greatly while others have no effect), differences in operational hedging benefits may explain some of the cross-sectional variation in the value of diversification. I now present a brief model of risk management choices. This model demonstrates how increased operational hedging will reduce the expenditure on financial hedging which, in turn, could affect firm value.

3. MODEL OF HEDGING ALTERNATIVES

Cash flow volatility is costly for a firm due to capital market imperfections such as tax convexity and costly external financing. Froot, Scharfstein, and Stein (1993) model optimal hedging in response to these costs. I use their model as a foundation but focus on optimal hedging when multiple risk management choices are available. Furthermore, I incorporate the cost of hedging which must (logically) affect a manager's risk management decisions. For simplicity, assume there are two risk management choices, which may be thought of as financial hedging and operational hedging. Each hedging choice (h_1, h_2) has a positive cost and we assume hedging increases firm value only by means of reducing costly volatility. The manager wishes to select the optimal hedging portfolio that maximizes firm value.

$$\text{Max}_{h_i} \quad \text{VRM} = -\gamma(\sigma(h_1, h_2)) - C_1(h_1) - C_2(h_2), \quad (1)$$

where VRM is the value of risk management,

γ is a parameter representing the cost of volatility which is a function of the level of volatility,

σ is firm volatility, a function of the hedging choices,

h_i is the level of hedging choice i ,

and C_i is the cost of hedging choice i .

Existing evidence on the costs of hedging suggests that initiating a derivatives program has a high fixed cost (Mian (1996)). Acquisitions also have a high fixed cost. Therefore, I assume a basic linear cost function for both h_1 and h_2 :

$$C_i(h_i) = F_i + c_i h_i, \quad (2)$$

where F_i is the fixed cost of hedging choice i ,

and c_i is the marginal cost of hedging choice i .

In making hedging choices, managers are constrained in their hedging expenditure. This constraint is assumed to be a function of how costly volatility is for the firm. I therefore maximize (1) subject to the constraint:

$$c_1 h_1 + F_1 + c_2 h_2 + F_2 \leq K(\gamma), \quad (3)$$

where K is the hedging budget which is a function of γ .

The first order conditions of this constrained maximization problem are:

$$\frac{\partial VRM}{\partial h_1} = -\gamma \left(\frac{\partial \sigma}{\partial h_1} \right) - c_1 - \lambda(c_1) = 0, \quad (4a)$$

$$\frac{\partial VRM}{\partial h_2} = -\gamma \left(\frac{\partial \sigma}{\partial h_2} \right) - c_2 - \lambda(c_2) = 0, \quad (4b)$$

$$\text{and } \frac{\partial VRM}{\partial \lambda} = c_1 h_1 + F_1 + c_2 h_2 + F_2 - K(\gamma) = 0. \quad (5)$$

Solving (4a) and (4b) for λ and equating the first order conditions with respect to h_1 and h_2 :

$$\frac{\frac{\partial \sigma}{\partial h_1}}{c_1} = \frac{\frac{\partial \sigma}{\partial h_2}}{c_2}. \quad (6)$$

Optimal risk management balances each hedging choice's contribution to reducing volatility against its marginal cost. This holds even without the budget constraint. Next, I solve (5) for h_1 and substitute (6) to find the impact of the budget constraint:

$$h_1^* = \frac{K(\gamma) - F_1 - F_2}{c_1} - \frac{\partial \sigma / \partial h_2}{\partial \sigma / \partial h_1} h_2. \quad (7)$$

That is, the optimal choice of h_1 is a function of the maximum amount of h_1 (the amount available to spend on hedging divided by the cost of h_1) minus the relative effectiveness of the other hedging choice (h_2).

Equation (7) illustrates that hedging decisions are a function of the other risk management tools available and that the relative costs affect the optimal hedging strategy. If M&A activity increases operational hedging (h_2) and there is a budget constraint, then management should reduce its use of financial hedging (h_1) if the BHC already was hedged optimally. As financial hedging becomes more expensive (or less useful), operational hedging may be substituted. The model also indicates that hedging increases with the cost of volatility (γ).

This basic model motivates three empirically testable hypotheses concerning the risk management tradeoffs between operational and financial hedging.

1) **Acquisitions can be an operational hedge.** Whether an acquisition is an operational hedge depends on its potential to reduce volatility. To test this, I estimate how an acquisition will impact an acquirer's income volatility. For acquisitions where income data is available for the twelve quarters preceding the acquisition for both the target and acquirer, I compare the income volatility of acquirer alone with that of the target and acquirer's income if it were combined on a quarterly basis over the same twelve quarters.

2) **Financial hedging is related to acquisition activity.** If BHCs utilize acquisitions to manage risk, acquisitions and derivatives will not be independent. I investigate whether current risk management predicts future acquisition activity by estimating a probit model of the

propensity to acquire. In addition, if acquisitions are an alternative tool to reduce volatility, a trade-off should exist and derivatives usage should decline. I test this by measuring the change in derivatives following an acquisition using both a Heckman selection model and panel analysis.

3) **Operational hedging and financial hedging are substitutes.** The degree to which an acquisition reduces volatility determines the change in financial hedging. To test this, I model the post-acquisition change in the level of derivatives use as a function of the acquisition's impact on volatility.

4. DATA

Measuring the hedging activity for most types of firms requires laborious data collection from 10-K filings. However, BHCs report their derivatives use in the quarterly Federal Reserve Y-9C filings. Beginning in 1995, derivatives used for trading purposes and non-trading purposes were reported separately. Therefore, this paper will use data from BHCs to examine how firms adjust financial hedging following acquisitions. The dataset constructed from 1995 - 2003 Federal Reserve quarterly filings includes the entire universe of bank holding companies with total consolidated assets of \$150 million or more. Only top-tier BHCs are examined since risk may be managed across subsidiaries. The Y-9C filings categorize the derivatives into interest rate, foreign exchange, equity derivative, and commodity/other contracts, and identify non-trading (hedging) versus trading positions. The empirical analysis of this paper is limited to hedging with interest rate derivatives since such contracts comprise 97% of BHC hedging.

Detailed deal information for BHCs involved in business combinations valued at \$50 million or more is obtained from the SDC Platinum Mergers database.²

From the SDC Platinum database, there are 487 M&A deals identified involving a bank holding company. This deal information is combined with the panel of BHC quarterly filings. To be included in the sample, both parties must be bank holding companies. This excludes the acquisitions of non-banks or partial acquisitions (such as the acquisition of bank branches or business segments). Of the 487 deals, BHC information was available and matched for 448 acquirers. Quarterly bank information, including derivatives usage, is matched to acquirers. All of these variables are winsorized at the 1st and 99th percentiles to remove potential outliers.

Historically, bank regulation has varied by state. Restrictions on bank merger activity were no exception. Some states began to permit M&A before 1970 while others resisted deregulation until the early 1990s (Strahan (2003)). To control for differences in state legislation which might affect acquisition activity, the time since deregulation (Strahan (2003)) is matched to each BHC by state.

In addition, I control for the composition of the balance sheet since business structure may shape hedging decisions. BHC control variables represent the percent of assets devoted to each of the main balance sheet categories each quarter. They are generated by dividing the BHC asset categories by the total assets (Schedule HC of the FR-Y9C). However, Allen and Saunders (1992) show that these quarter end numbers are susceptible to ‘window-dressing’ adjustments. They note that the most active window-dressing on the asset side is in securities, Federal funds, and loans. To minimize the potential impact of window-dressing, the quarterly average is

² A minimum deal value of \$50 million limits possible data errors (such as deal values of zero) and inconsequential acquisitions. At the time of an acquisition, the median total assets for a BHC are \$5,309,524,000. The conclusions are robust to a minimum deal value of \$20 million.

substituted for each of these three asset groups as well as the total assets throughout the dataset (Schedule HC-K of the FR-Y9C).

4.1 Measures of Interest Rate Exposure and Hedging

Interest rate exposure is expected to influence the level of interest rate hedging. Following the methodology of Flannery and James (1984), a measure of interest rate sensitivity – the one year maturity gap – is constructed by subtracting the reported liability exposure subject to repricing within a year from the asset exposures subject to the same repricing time period (Schedule HC-H of the FR-Y9C). This net sensitivity is measured relative to the average quarterly total assets. Similar one year gap measures of the mismatch between the asset and liability exposures are used by Brewer, Jackson, and Moser (2001) and Purnanandam (2004a). The sensitivity measure used by Flannery and James is :

$$IR\ Sensitivity_t = \frac{ST\ Assets_t - ST\ Liabilities_t}{TA_t}, \quad (8)$$

where *ST Assets* are those assets which mature or reprice within one year,

ST Liabilities are those liabilities which mature or reprice within one year,

and *TA* is the quarterly average of consolidated assets.

The measure of financial hedging is the BHC's end-of-quarter gross notional amount of interest rate derivatives used for hedging divided by total assets. To detect the substitution of operational hedging for financial hedging, I measure the changing use of derivatives for hedging purposes over one and two year horizons:

$$\Delta IR Hedging = \frac{IRG_{t+4 \text{ (or } t+8)}}{TA_{t+4 \text{ (or } t+8)}} - \frac{IRG_t}{TA_t}, \quad (9)$$

where *IRG* is the gross notional amount of derivatives used to hedge interest rate risk at quarter t plus 4 quarters or quarter t plus 8 quarters.

The gross notional amount of derivatives does not capture the true hedging position if some of the derivative contracts offset one another (Graham and Rogers (2002)). This introduces an upward bias into this measurement. While the net derivatives would be preferable, empirical examinations indicate that the difference between net and gross positions is minor.³ Furthermore, gross notional amounts bias against finding any decline in financial hedging. Controlling for the change in interest rate sensitivity, a BHC's gross notional volume of derivatives would be expected to increase or remain constant following an acquisition. First, acquiring a target without a derivatives program provides economies of scale with respect to the fixed costs of a hedging program. The target could hedge without incurring the initial fixed costs of establishing its own program. Therefore, derivatives use would increase for the combined firm. Second, combining two firms with derivatives programs would sum the two derivatives program and increase the reported derivatives use of the acquirer. And, lastly, derivative contracts are not normally cancelled; new ones are just written.⁴ Therefore, the reorganization of any existing contracts with the combination of two firms would increase derivatives use. All of these issues bias the empirical analysis against finding a decrease in financial hedging.

Given that the measure of financial hedging is defined relative to the quarterly average assets, changes in the asset size could impact the empirical findings. If the gross notional

³ Graham and Rogers (2002) state, "We conclude, however, that using net, as opposed to total, positions is only marginally important in helping identify factors that affect corporate hedging decisions." "Our important findings with respect to the tax incentives to hedge are unchanged [between gross notional and net positions.]"

⁴ Stulz (2004) discusses the fact that closing derivatives positions often involves purchasing an offsetting contract.

amount of hedging is constant in the year following an acquisition ($IRG_{t+4} = IRG_t$), the $\Delta IR Hedging$ could decline simply due to an acquisition's impact on the size of assets. To control for this, a new dependent variable ($\Delta IR Hedging_Size$) is generated:

$$\Delta IR Hedging_Size = \frac{IRG_{t+4(or\ t+8)} - IRG_t}{TA_t}. \quad (10)$$

This variable removes the potential size effect. The empirical analysis is conducted using both measures for the change in hedging with qualitatively similar results.

4.2 Measures of Volatility

To evaluate if acquisitions provide operational hedging, this paper analyzes the target's impact on the acquirer's volatility. Acquisitions which reduce income volatility contribute to risk management just as derivatives that limit volatility. Since volatility calculations based on the BHC net income would include the effect of current financial hedging, a new variable OI is created:

$$OI_t = NI_t - Deriv_t, \quad (11)$$

where OI is operational income,

NI is net income,

and $Deriv$ is the impact on income of derivatives held for hedging.

The net change in interest income and expense due to hedging is provided on Schedule HI of the FR-Y9C and is subtracted from the net income on a quarterly basis. From OI , volatility is calculated without the influence of derivatives. This provides a measure of the underlying volatility before any risk management.

Next, I measure the level of operational hedging introduced by an acquisition. Comparing the volatility before and after the acquisition introduces potential time-series concerns since the volatility change between the two periods could be attributed to numerous external factors such as management changes or broader economic conditions. For a more precise estimate of how management expected the target to impact the acquirer's income volatility, I look at the quarterly income of the acquirer and target for the three years preceding the acquisition. Using these pre-acquisition numbers, I calculate the volatility of the firms had they been a combined entity. This pro-forma volatility calculation provides an estimate of how the acquisition will impact the acquirer's volatility:

$$OV_{Combined} = St. Dev. \left(\frac{OI_{t-12,A} + OI_{t-12,T}}{TA_{t-12,A} + TA_{t-12,T}}, \dots, \frac{OI_{t-1,A} + OI_{t-1,T}}{TA_{t-1,A} + TA_{t-1,T}} \right). \quad (12a)$$

The volatility of the twelve combined quarterly observations is compared to the volatility of the twelve quarterly observations of the acquirer alone, i.e.,

$$OV_{Acquirer} = St. Dev. \left(\frac{OI_{t-12,A}}{TA_{t-12,A}}, \dots, \frac{OI_{t-1,A}}{TA_{t-1,A}} \right) \quad (12b)$$

The resulting effect is calculated as:

$$Impact\% = \frac{OV_{Acquirer} - OV_{Combined}}{OV_{Acquirer}}, \quad (13)$$

where **Impact%** is the expected percentage change in operational volatility due to the acquisition,

$OI_{t,A}$ is the operational income of the acquirer at quarter t,

and **$OI_{t,T}$** is the operational income of the target at quarter t.

5. METHODOLOGY & RESULTS

Managing interest rate risk is a priority for BHCs' risk management. Table 1 shows that interest rate derivatives are employed more than other derivative contracts. The sample is divided into two groups; observations where an acquisition is made and observations where no acquisition is made. The median and mean derivatives levels relative to the quarterly average of total assets are presented for both sub-samples. While interest rate hedging and trading dominate derivatives use, other derivatives use informs the likelihood of an interior solution. Panel A indicates that BHCs, on average, exhibit a higher level of hedging, as well as trading, when an acquisition is made. However, Panel B reveals that the reverse holds when the sample is limited to BHCs that use each derivative contract. For active hedgers, the mean amount of interest rate hedging at the time of an acquisition is 3.9% of average quarterly total assets versus 7.8% when no acquisition is made. Table 2 shows that target BHCs exhibit a similar pattern but – perhaps due to the small sample size - the difference is not statistically significant.

While the statistics documented in Table 1 support the hypothesis that acquirers have different risk management practices than non-acquirers, these BHCs simply may have a lower level of interest rate exposure – leading to a lower need for hedging. Therefore, Table 3 presents the average *IR Sensitivity* (equation 8) by target and acquirer status. Acquirers and targets both have significantly more interest rate exposure than non-merging institutions,⁵ but the larger exposure does not explain the difference in financial hedging. Merging BHCs have more exposure to interest rate movements but hedge less than other institutions.

However, Table 4 shows that acquisitions do not significantly change the average BHC's interest rate sensitivity. There is no statistically significant change in interest rate exposure

⁵ *IR Sensitivity* is significantly higher for acquirers and targets than BHCs not involved in M&A activity. This is true whether it is measured at the time of the M&A or one year prior to the event.

between the year before and the year after the acquisition. This implies that while acquirers appear to manage risk differently, acquisitions are not being used to directly reduce interest rate exposure.

5.1 Do Acquisitions Affect Income Volatility?

To investigate why acquirers hedge less of their interest rate exposure than other BHCs, I explore whether acquisitions can provide operational hedging. *Impact%* (equation 13) is generated for a sample of 208 pairs of acquirers and targets where both are bank holding companies and have at least three years of data before the acquisition. A deal's *Impact%* is, relative to the acquirer's volatility, the difference between the acquirer's volatility for the three years preceding the deal versus the volatility of the acquirer and the target if they were combined during that period. Volatility is measured as the standard deviation of the quarterly operational income divided by total assets. If the volatility of the combined net income is smaller than that of the acquirer alone, *Impact%* is positive. A positive impact implies the acquisition would reduce income volatility *ceteris paribus*. Reductions in income volatility indicate the target has potential operational hedging benefits or potential savings associated with lower costs of convex taxation, potential financial distress, and/or external capital.

Panel A of Table 5 shows that, on average, BHC acquisitions increase operational hedging by reducing income volatility. The *Impact%* coefficient indicates that, on average, volatility decreases 5.9%. Furthermore, this average decrease is not driven by outliers as 86% of acquisitions create operational hedging (Panel B).

5.2 Do Managers Use Acquisitions to Manage Risk?

While the majority of acquisitions reduce income volatility, it is not clear whether these are intentional operational hedges. Managers pursue M&A for any number of motivations, only one of which may be risk management. To evaluate whether managers recognize the operational hedging benefits of an acquisition, I first ask whether certain BHCs are more likely to engage in M&A activity. I examine the likelihood of making an acquisition or being a target given current exposures and risk management. A BHC's propensity to be either an acquirer or target is evaluated as a function of its prior quarter characteristics. A probit model, with year dummies and clustering at the individual BHC level, is estimated. The model is as follows:

$$M\&A_dum_{t+1} = IR\ Sensitivity_t + IR\ Hedging_t + BHC\ Controls_t + \varepsilon_t, \quad (14)$$

where *M&A_dum* is a binary variable equaling unity in columns 1-2 of Table 6 if the BHC makes an acquisition in the subsequent quarter, and equaling unity in columns 3-4 if the BHC is a target in the next quarter.

IR Sensitivity is the net interest rate exposure over the next year (one year maturity gap),

IR Hedging is the gross notional amount of interest rate derivatives used for hedging divided by the quarterly average of total assets,

and *BHC Controls* are the log of the quarterly average of total assets and the BHC asset categories (Securities, Federal funds sold and securities repurchase under agreements to resell, Loans and lease financing receivables, Trading assets, Premises and fixed assets, Other real estate owned, Investments in unconsolidated subsidiaries and associated companies, Intangible assets, Other assets) divided by the quarterly average of total assets,

Table 6 presents the results of this analysis. *IR Sensitivity* and *IR Hedging* both appear to predict merger activity. The first row shows that the likelihood of being an acquirer or a target increases with interest rate sensitivity. And the second row shows that the probability of being an acquirer decreases with interest rates hedging. As M&A offers operational hedging benefits,

these results indicate that interest rate exposure is positively associated with pursuing operational hedges while financial hedging is negatively related. These findings are consistent with the hypothesis that both derivatives and M&A are hedging choices and support Proposition #2 that financial hedging is related to acquisition activity.

5.3 Is Derivatives Use Responsive to Operational Hedging?

The results presented in Table 6 indicate acquisition activity may be correlated with risk exposures and risk management. If managers actually recognize the potential hedging benefits of acquisitions and believe they can substitute for financial hedging, they should adjust the use of other risk management activities. To test this, I estimate a Heckman selection model using the following regressions:

$$\begin{aligned} \Delta IR Hedging_{t, t+4 (t, t+8)} = & Acquirer_t + \Delta IR Sensitivity_{t, t+4 (t, t+8)} \\ & + BHC Controls_t + \Delta BHC Controls_{t, t+4 (t, t+8)} + \varepsilon_t, \end{aligned} \quad (15)$$

$$\begin{aligned} \Delta IR Hedging, Size_{t, t+4 (t, t+8)} = & Acquirer_t + \Delta IR Sensitivity_{t, t+4 (t, t+8)} \\ & + BHC Controls_t + \Delta BHC Controls_{t, t+4 (t, t+8)} + \varepsilon_t, \end{aligned} \quad (16)$$

where $\Delta IR Hedging$ is the change in hedging relative to total assets over the next year (or two),

$\Delta IR Hedging, Size$ is the change in hedging over the next year (or two), controlling for Size,

$Acquirer$ is a binary variable equaling unity if an acquisition is made that quarter,

and $\Delta BHC Controls$ are the change in the quarterly assets and BHC categories over the same period as the dependent variable.

Obviously, addressing the endogenous relationship between acquisitions and derivatives – as both appear to be risk management choice variables – is important for unbiased and

consistent estimates of how firms manage risk. The average impact of making an acquisition on financial hedging is estimated using the Heckman two-stage selection model which attempts to minimize the selection bias as an explanation for the treatment outcomes. The selection lambda, commonly referred to as the inverse Mill's ratio, is included in the second stage estimation to correct for the potential selection bias. This approach estimates the acquisition decision with a probit model based on the results of Table 6. The selection criteria are *Total Assets* and *IR Sensitivity*. It should be noted that the coefficient estimates presented in this paper are robust to alternative Heckman selection criteria.

Table 7 presents the Heckman two-stage coefficient estimates. Regardless of the time horizon and dependent variable specification, and controlling for changes in interest rate sensitivity, financial hedging declines following an acquisition (as seen in the first row). The selection lambda is positive and, for the two year horizon measures, significant. Since the acquisition decision is modeled as a function of risk exposure and BHC size, acquisitions considered unexpected by this model may not be motivated by risk management. The positive lambda implies that such unexpected acquisitions decrease their financial hedging less following an acquisition as might be expected with acquisitions driven by concerns other than risk management.

A shortcoming of the Heckman approach is that it neglects the data's panel attributes. Therefore, in Table 8, the change in financial hedging following an acquisition is examined using both random and fixed effect models (again, estimating equations 15 and 16). Once again, derivatives hedging decreases significantly over both the one and two year horizons even after controlling for the change in interest rate exposure and the composition of the BHC.

If the post-acquisition decline in derivatives is due to the increase in operational hedging, then acquisitions which create the most operational hedging should lead to the largest declines in financial hedging. Therefore, I regress *Impact%* against the change in derivatives use as follows:

$$\Delta IR Hedging_{t,t+4(t,t+8)} = Impact\%_t + BHC Controls_t + \Delta BHC Controls_{t,t+4(t,t+8)} + \varepsilon_t \quad (17)$$

Table 9 indicates that acquisitions which reduce volatility are followed by reduced financial hedging. Since *Impact%*, the measure of operational hedging, is positive when the acquisition contributes to operational hedging, negative coefficients indicate the post-acquisition hedging is negatively related to the volatility impact. That is, the more operational hedging created by the acquisition, the more financial hedging will decline. This supports Proposition #3 that operational and financial hedging are substitutes.

6. CONCLUSION

This paper provides empirical evidence on risk management tradeoffs between M&A activity and derivatives use for bank holding companies. After providing a simple model of optimal risk management, I present three main findings. First, acquisitions can provide operational hedging. Second, managers recognize the risk management potential of acquisition activity. And, lastly, operational hedging is substituted for derivatives use. The results imply that risk management is not exogenous to firm organization. This has vast implications for the analysis, specifically the econometric specification, of hedging and firm value.

Furthermore, the implications of this paper extend beyond the hedging literature. Variations in the diversification discount may relate to an acquisition's contribution to hedging. Also, the documented trade off between financial and operational hedging implies that

managerial risk aversion may not be a primary motivation for M&A activity. And, most significantly, risk management may affect firm value not only by minimizing the cost of volatility, but also by influencing firm organization.

It must be restated that this dataset only examines bank holding companies. Whether non-financial firms recognize acquisitions as an operational hedge is unknown. Clearly, there is much more work to be done at this intersection of risk management and corporate finance. That being said, this paper highlights some of the possible issues for future researchers to consider.

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Table 1. Summary of Derivatives Use for Acquirers

The sample is split into observations where an acquisition was made and observations where one was not made. This table summarizes the level of derivatives use for hedging and trading purposes over the four derivatives categories of interest rate (IR), foreign exchange (FX), equity, and commodity. Derivatives use is measured as the gross notional amount relative to total assets. (Derivatives = Gross Notional Amount of Derivatives / Total Quarterly Average Consolidated Assets) A positive level of hedging exists if the BHC uses the derivatives of interest in quarter t. Statistical significance is denoted by *** for the 1% level, ** for the 5% level, and * for the 10% level.

	An Acquirer in Qtr t				Not an Acquirer in Qtr t				Difference between Means	
	# Obs	Median	Mean	St.Dev.	# Obs	Median	Mean	St.Dev.	Diff.	Signif.
Panel A: All Observations										
Hedging										
IR	448	0.000	0.016	0.034	54165	0.000	0.007	0.050	0.009	***
FX	448	0.000	0.001	0.002	54109	0.000	0.000	0.003	0.001	***
Equity	448	0.000	0.000	0.000	54097	0.000	0.000	0.000	0.000	***
Commodity	448	0.000	0.000	0.000	54093	0.000	0.000	0.000	0.000	
Trading										
IR	448	0.000	0.046	0.122	54102	0.000	0.007	0.088	0.039	***
FX	448	0.000	0.012	0.039	54093	0.000	0.002	0.022	0.010	***
Equity	448	0.000	0.000	0.000	54078	0.000	0.000	0.001	0.000	***
Commodity	448	0.000	0.000	0.000	54079	0.000	0.000	0.000	0.000	***
Panel B: Positive Level of Hedging										
Hedging										
IR	186	0.020	0.039	0.044	4665	0.036	0.078	0.154	-0.040	***
FX	101	0.003	0.003	0.004	1111	0.004	0.008	0.019	-0.004	***
Equity	9	0.000	0.000	0.000	527	0.001	0.002	0.003	-0.002	***
Commodity	0				0					
Trading										
IR	158	0.025	0.131	0.176	2001	0.068	0.197	0.415	-0.066	***
FX	109	0.030	0.050	0.066	1666	0.025	0.066	0.106	-0.016	***
Equity	18	0.002	0.002	0.001	539	0.002	0.003	0.004	-0.001	***
Commodity	31	0.000	0.000	0.000	363	0.000	0.000	0.000	0.000	***

Table 2. Summary of Derivatives Use for Targets

The sample is split into observations where the BHC was a target and observations where it was not a target. This table summarizes the level of derivatives use for hedging and trading purposes over the four derivatives categories of interest rate (IR), foreign exchange (FX), equity, and commodity. Derivatives use is measured as the gross notional amount relative to total assets. (Derivatives = Gross Notional Amount of Derivatives / Total Quarterly Average Consolidated Assets) A positive level of hedging exists if the BHC uses the derivatives of interest in quarter t. Statistical significance is denoted by *** for the 1% level, ** for the 5% level, and * for the 10% level.

	A Target in Qtr t				Not a Target in Qtr t				Difference between Means	
	# Obs	Median	Mean	St.Dev.	# Obs	Median	Mean	St.Dev.	Diff.	Signif.
Panel A: All Observations										
Hedging										
IR	448	0.000	0.009	0.061	54165	0.000	0.007	0.050	0.002	
FX	448	0.000	0.000	0.001	54109	0.000	0.000	0.003	0.000	***
Equity	448	0.000	0.000	0.000	54097	0.000	0.000	0.000	0.000	
Commodity	448	0.000	0.000	0.000	54093	0.000	0.000	0.000	0.000	
Trading										
IR	448	0.000	0.012	0.066	54102	0.000	0.008	0.089	0.004	
FX	448	0.000	0.004	0.026	54093	0.000	0.002	0.022	0.002	*
Equity	448	0.000	0.000	0.000	54078	0.000	0.000	0.001	0.000	
Commodity	448	0.000	0.000	0.000	54079	0.000	0.000	0.000	0.000	
Panel B: Positive Level of Hedging										
Hedging										
IR	64	0.027	0.068	0.158	4787	0.035	0.077	0.152	-0.009	
FX	15	0.004	0.003	0.002	1197	0.004	0.007	0.019	-0.004	***
Equity	4	0.001	0.002	0.002	532	0.001	0.002	0.003	0.000	
Commodity	0				0					
Trading										
IR	38	0.034	0.148	0.193	2121	0.065	0.193	0.405	-0.044	
FX	33	0.022	0.066	0.079	1742	0.026	0.065	0.104	0.001	
Equity	11	0.002	0.002	0.001	546	0.002	0.003	0.004	-0.001	***
Commodity	10	0.000	0.000	0.000	384	0.000	0.000	0.000	0.000	

Table 3. Pre-Acquisition Interest Rate Sensitivity

The sample is split into observations where M&A occurred and those where it did not occur, both for acquirers and targets. This table presents the average *IR Sensitivity* for each of these groups from one year before the observation. This measure is the difference between the short term asset and liability exposure to interest rate movements relative to the quarterly average of total assets. Statistical significance is denoted by *** for the 1% level, ** for the 5% level, and * for the 10% level.

	An Acquirer in Qtr t			Not an Acquirer in Qtr t			Difference between Means	
	# Obs	Mean	St Dev	# Obs	Mean	St Dev	Diff.	Signif.
IR Sensitivity _{t-4}	446	0.146	0.137	49680	0.068	0.191	0.078	***
	A Target in Qtr t			Not a Target in Qtr t				
	# Obs	Mean	St Dev	# Obs	Mean	St Dev		
IR Sensitivity _{t-4}	447	0.118	0.193	49679	0.068	0.191	0.050	***

Table 4. Acquisitions' Impact on Interest Rate Sensitivity

This table summarizes the acquisitions' average impact on interest rate sensitivity for the acquirer. There are 439 acquisitions where the interest sensitivity can be calculated both one year before and one year after the acquisition. $\Delta IR Sensitivity$ is the difference in between *IR Sensitivity* at the two times.

	# Obs	Mean	St Dev	Significance
$\Delta IR Sensitivity$	439	-0.010	0.128	-

Table 5. Acquisitions' Impact on Volatility

To evaluate potential operational hedging provided, the acquisitions' impact on volatility is measured. There are 208 acquisitions where income data is available for both the target and acquirer for the twelve quarters preceding the acquisition. Panel A presents the mean percent change in volatility, *Impact%*. It measures the difference between the prior 12 quarters income (relative to total assets) volatility of the acquirer alone (*Vol_Acquirer*) versus the prior 12 quarters if the target and acquirer were a combined entity over that period (*Vol_Combined*) and divides this by the volatility of the acquirer alone. A positive mean indicates that volatility decreased with the acquisition and that operational hedging increased. Panel B shows the percentage of the 208 acquisitions which decreased volatility for the acquirer. Statistical significance is denoted by *** for the 1% level, ** for the 5% level, and * for the 10% level.

Panel A: Average Impact on Volatility				
	# Obs	Mean	St Dev	Significance
Impact %	208	0.059	0.116	***

Panel B: Percent of Acquisitions Decreasing Volatility		
	# Obs.	Percentage
Decrease Volatility	179	86%
Increase Volatility	29	14%
	208	

Table 6. Risk Management & the Propensity to Merge

The likelihood of being an acquirer or target during the next quarter is predicted using the current quarter's BHC information. A probit, with year dummies, is conducted. Errors are clustered at the BHC level. This table presents the marginal effects. *IR Sensitivity* is measured by the difference in short term asset and liability exposure to interest rate movements divided by the quarterly average of total assets. *IR Hedging* measures the gross notional amount of derivatives used for hedging divided by the quarterly average of total assets. *BHC Controls* are included. P values are in parentheses.

$$M\&A_dum = IR\ Sensitivity_t + IR\ Hedging_t + BHC\ Controls_t + \varepsilon_t$$

	<i>Marginal Effects</i>			
	Acquirer _{t+1}		Target _{t+1}	
	(1)	(2)	(3)	(4)
IR Sensitivity	0.004 (0.086)	0.001 (0.650)	0.008 (0.000)	0.005 (0.026)
IR Hedging	-0.047 (0.000)	-0.028 (0.009)	-0.002 (0.860)	0.004 (0.580)
BHC Controls	Yes	Yes	Yes	Yes
Year Dummies		Yes		Yes
Observations	52888	52888	52888	52888

Table 7. Derivatives Use Following Acquisitions – Controlling for Selection

This table examines the change in financial hedging following an acquisition. A Heckman selection model is used with the selection criteria of quarterly assets and interest rate sensitivity. The dependent variable is the change in the ratio of interest rate hedging to total assets ($\Delta IR Hedging$) in the year (or two years) following the observation. To prevent the acquisition's impact on the total assets from changing the hedging ratio, a size controlled change which divides the change in the gross notional amount of hedging over the year (or two years) following the observation by the beginning period quarterly total assets also is presented ($\Delta IR Hedging, Size$). *Acquirer* is an indicator variable equaling unity if the BHC makes an acquisition during quarter t . $\Delta IR Sensitivity$ is the change in interest rate exposure during the period over which the change in interest rate hedging is measured. *BHC Controls* and $\Delta BHC Controls$ also are included. P values are in parentheses.

$$\Delta IR Hedging_{t, t+4 (or t, t+8)} = Acquirer_t + \Delta IR Sensitivity_{t, t+4 (or t, t+8)} + BHC Controls_t + \Delta BHC Controls_{t, t+4 (t, t+8)} + \varepsilon_t$$

$$\Delta IR Hedging, Size_{t, t+4 (or t, t+8)} = Acquirer_t + \Delta IR Sensitivity_{t, t+4 (or t, t+8)} + BHC Controls_t + \Delta BHC Controls_{t, t+4 (t, t+8)} + \varepsilon_t$$

	1 Year Horizon		2 Year Horizon	
	<u>$\Delta IR Hedging$</u> (1)	<u>$\Delta IR Hedging, Size$</u> (2)	<u>$\Delta IR Hedging$</u> (3)	<u>$\Delta IR Hedging, Size$</u> (4)
Acquirer t	-0.003 (0.799)	-0.027 (0.091)	-0.031 (0.047)	-0.072 (0.005)
$\Delta IR Sensitivity$	0.007 (0.002)	0.008 (0.006)	0.010 (0.000)	0.018 (0.000)
Constant	-0.010 (0.187)	-0.017 (0.086)	-0.010 (0.340)	-0.007 (0.706)
BHC Controls	Yes	Yes	Yes	Yes
$\Delta BHC Controls$	Yes	Yes	Yes	Yes
hazard: lambda	0.000 (0.980)	0.009 (0.189)	0.012 (0.078)	0.026 (0.021)
# Obs	26206	24909	21107	19968

Table 8. Derivatives Use Following Acquisitions – Controlling for Panel Attributes

This table examines the change in financial hedging following an acquisition using random and fixed effects models. The dependent variable is the size controlled change which divides the change in the gross notional amount of hedging over the year (or two years) following the observation by the beginning period quarterly total assets ($\Delta IR Hedging, Size$). *Acquirer* is an indicator variable equaling unity if the BHC makes an acquisition during quarter t . $\Delta IR Sensitivity$ is the change in interest rate exposure during the period over which the change in interest rate hedging is measured. *BHC Controls* and $\Delta BHC Controls$ also are included. P values are in parentheses.

$$\Delta IR Hedging, Size_{t, t+4 (or t, t+8)} = Acquirer_t + \Delta IR Sensitivity_{t, t+4 (or t, t+8)} + BHC Controls_t + \Delta BHC Controls_{t, t+4 (t, t+8)} + \varepsilon_t$$

	ΔIR Hedging, Size			
	1 Year Horizon		2 Year Horizon	
	Random Effects	Fixed Effects	Random Effects	Fixed Effects
	(1)	(2)	(3)	(4)
Acquirer	-0.007 (0.035)	-0.006 (0.073)	-0.011 (0.012)	-0.010 (0.032)
Δ IR Sensitivity	0.009 (0.002)	0.010 (0.002)	0.013 (0.001)	0.012 (0.004)
Constant	-0.006 (0.513)	-0.005 (0.818)	-0.021 (0.164)	-0.057 (0.123)
BHC Controls	Yes	Yes	Yes	Yes
Δ BHC Controls	Yes	Yes	Yes	Yes
# Obs	27054	27054	21791	21791
# Groups	1871	1871	1644	1644
R ²		0.033		0.052

Table 9. Volatility and the Change in Financial Hedging

This table shows how changes in operational hedging affect hedging with derivatives using an OLS regression with standard errors clustered at the BHC level. The dependent variable is the one year change in interest rate hedging following the acquisition adjusted for size ($\Delta IR Hedging, Size$) over both a one and two year horizon. *Impact%* measures the change in volatility due to the acquisition – based on the difference of the acquirer’s prior twelve quarters income (divided by the quarterly average of total assets) volatility and the combined firms’ volatility over the same period – relative to the volatility of the acquirer alone. A positive *Impact%* implies that operational hedging increased as the volatility of the combined target and acquirer is smaller than that of the acquirer alone. Therefore, the negative coefficient on *Impact%* indicates that the deal's contribution to reducing volatility is followed by a similar decrease in financial hedging. $\Delta IR Sensitivity$ is the change in interest rate exposure during the period over which the change in interest rate hedging is measured.

$$\Delta IR Hedging, Size_{t, t+4 (t, t+8)} = Impact\%_t + BHC Controls_t + \Delta BHC Controls_{t, t+4 (t, t+8)} + \varepsilon_t$$

	<u>$\Delta IR Hedging, Size$</u>	
	<u>1 Year Horizon</u>	<u>2 Year Horizon</u>
Impact%	-0.022 (0.072)	-0.050 (0.000)
Constant	-0.191 (0.000)	-0.393 (0.000)
BHC Controls	Yes	Yes
Δ BHC Controls	Yes	Yes
# Obs	189	171
R ²	0.111	0.348