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*Original Paper*

# Capital Market Frictions, Leasing and Hedging

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***Abstract***

*This paper examines the hitherto unexplored effect of lease intensity on hedging. Using a sample of 218 small and large non-financial firms drawn from 2006 to 2010, we find that firms leasing more of their Property, Plant and Equipment (PPE) use less financial derivatives, consistent with the theoretical predictions of Rampini and Viswanathan (2010). Further, using broad market microstructure based measures of information asymmetry, we offer empirical evidence consistent with theory that firms with higher information asymmetry hedge more. These results are robust to several alternative measurements of key variables, different regression specifications, estimation techniques and corrections for endogeneity.*

***Keywords***

*capital market frictions, leasing, hedging, and information asymmetry*

## 1. Introduction

The main theory of integrated corporate risk management, financing and investments formalized by Froot, Scharfstein and Stein (FSS hereafter, 1993) is based on the effective risk aversion of firms subject to financial constraints. According to this theory, the rationale for hedging is that, when firms are subject to financial constraints, hedging ensures that firms have sufficient internal funds to take advantage of profitable investment opportunities and avoids the need for costly external financing. Hedging accomplishes this by reducing the volatility of cash flows and thus better aligning the availability of internal funds (financing needs) with capital expenditures (investments). Importantly, this intuition suggests that financially constrained firms should hedge as they are effectively risk averse. However, in practice, large firms, which are arguably less financially constrained, hedge whereas small firms, which are likely more financially constrained, often do not engage in risk management. This is considered as a *hedging puzzle* in the literature.

A missing link in FSS (1993) and other models is that none of them consider the possibility that financially constrained firms can deploy a lot more capital using lease financing. The opportunity cost of engaging in risk management and conserving debt capacity for future financing needs is forgone current investment, which is higher for constrained firms. Indeed, the more constrained the firm, the more likely it is that investment financing needs override hedging concerns. Hence, instead of engaging in hedging to improve debt capacity in order to undertake capital expenditures, financially constrained firms could deploy Property, Plant and Equipment (PPE) through leasing. Based on this intuition Rampini and Viswanthan (2010) expand the FSS (1993) model and develop a dynamic model which provides a unified theory of optimal investment, capital structure, leasing, and risk management. They argue that there is a fundamental trade-off between firms' financing and risk management policies and poorly capitalized firms optimally do not engage in risk management and may abstain from risk management with positive probability.

Theoretical models of DeMarzo and Duffie (1995) and Breeden and Viswanathan (1998) suggest that firms with high information asymmetry should hedge more. Geczy, Minton and Schrand (1997) control for information asymmetry using *institutional ownership and number of analyst following* as proxies in their logit regressions with hedging dummy as the dependent variable and find little support for the prediction that firms with high information asymmetry should hedge more. Dadalt, Gay and Nam (2002) examine whether hedging reduces information asymmetry. In their regressions hedging is the test variable along with other controls. Using *analysts forecast accuracy* and *dispersion in analysts' earnings forecasts* as proxies for information asymmetry, they find evidence consistent with DeMarzo and Duffie (1995) and Breeden and Viswanathan (1998).

The available empirical evidence on the link between hedging and information frictions is relatively scarce and mixed, and it is derived from very broad proxies for information asymmetry. The market microstructure-based proxies for asymmetric information, such as trading illiquidity and bid-ask spread, represent more robust measures and offer a clearer interpretation than the ex ante firm characteristics and other proxies, such as analyst coverage, dispersion of analysts' forecasts, and magnitude of earnings surprises which have multiple, often ad hoc interpretation (Note 1). Therefore, we use market-based proxies for information asymmetry and both fair and notional values of derivatives for hedging, we present a comprehensive examination of the role of information asymmetry and leasing as determinants corporate hedging policies.

This paper contributes to the literature on capital market imperfections, leasing, and hedging. First, using broad market microstructure-based measures of information asymmetry, we offer empirical evidence consistent with theory that firms subject to higher information asymmetry hedge more. Second, we examine the effect of lease intensity on hedging and offer the first empirical evidence on *hedging puzzle*.

The rest of the paper is organized as follows. In Section I we review the literature and develop testable hypotheses. Section II focuses on data collection and variable measurements. Section III covers empirical modeling, estimation and results. Section-IV addresses robustness checks. Section V concludes the paper.

## 2. Literature Review and Hypothesis Development

### *2.1 Determinants of Hedging*

The main objective of the paper is to examine the role of Information Asymmetry (*IA*) and leasing on the extent of corporate hedging. Hence, we first explore the role of information asymmetry and lease financing as determinants of hedging and subsequently review the relevant literature on other motivations for hedging such as financial distress, taxes and managerial risk aversion.

***A. Information Asymmetry***

DeMarzo and Duffie (1991) model information asymmetry as a determinant of corporate hedging. They argue that equityholders can benefit from hedging when managers have private information about an unobservable risk that affects a firm's cash flows. In their model, hedging offers uninformed equityholders reduced noise regarding the variability of a firm's payoffs. Graham, Harvey and Rajagopal (2005), based on a broad survey of financial executives, document that less predictable earnings could lead to low stock prices because investors dislike uncertainty. Thus firms with high information asymmetry should hedge more to reduce adverse selection between managers and markets and mitigate additional costs of external financing, thus relaxing financial constraints.

DeMarzo and Duffie (1995) and Breeden and Viswanathan (1998) consider a different source for information asymmetry that concerns managerial competence/reputation. Both DeMarzo and Duffie (1995) and Breeden and Viswanathan (1998) argue that firms with higher information asymmetry between managers and equityholders should hedge more. In their model, risk management reduces the noise in the learning process concerning the manager's capabilities and corporate hedging is adopted mainly by high quality managers to signal their superior abilities. Noise in this context refers to factors contributing to earnings that are believed to be outside of managerial control. The intuition in Breeden and Viswanathan (1998) is that managers who are skilled at managing some business risks or uncertainties would like their ability to be discovered quickly by the market. To ensure this, managers hedge those risks about which they have no direct control or specific skills. Thus, hedging is an attempt, by higher ability managers, to improve the informativeness of investors' learning process by "locking-in" their superior ability. Based on the above arguments on hedging and information frictions, we posit the following hypothesis:

***H1: The extent of corporate hedging is positively related to information asymmetry about firms' cash flows faced by investors***

***B. Lease financing***

Consider the risk management rationale for the use of lease financing. Lease financing is often preferable in cases where firms want to mitigate the risk of capital expenditures incurred with respect to positive Net Present Value (NPV) projects. Should such investment underperform expectations, leased assets have an embedded put option that can be exercised without risking the balance sheet assets. Further, firms might view leases as a way to transfer the risk of fluctuations in the value of the asset. Bessembinder (1991) argues that hedging improves debt capacity (i.e., the ability borrow additional debt) by reducing the probability of financial distress. Eisfeldt and Rampini (2009) argue that leased capital has higher *debt capacity* than secured debt capital because of the superior ability of a lessor to repossess a leased asset compared to foreclosure on the collateral of a secured loan in case of financial distress of the lessee firm. They further argue that financially constrained firms value the additional debt capacity more and hence lease more of their capital than less constrained firms. Since poorly capitalized firms lease more of their assets (see Eisfeldt and Rampini (2009)), firms that lease more should hedge less as the need for financing the investments and conserving the debt capacity dominate the hedging concerns. Further, in case of lease financing, the leased asset itself acts as collateral to the lessor and the lessee firm does not have to pledge its own assets as collateral, unlike secured debt which could pose collateral constraints for borrowers. The superior repossession rights allow the lessor to extend more credit than a secured lender for the same asset. Therefore, leasing may not only enhance the debt capacity of financially constrained firms but also serve as an effective mechanism to mitigate the risks associated with capital expenditures. Rampini and Viswanthan (2010) note that both lease financing and hedging serve to improve debt capacity and relax financial constraints. They highlight a fundamental trade-off between hedging and lease financing and predict that firms that rely more on leasing tend to hedge less. Based on these arguments, we propose the following empirical relation between leasing and hedging:

***H2: The extent of corporate hedging is negatively related to the ratio of leased capital deployed by firms.***

Other Theories of Hedging:

**C. Tax Incentives**

Smith and Stulz (1985) argue that if taxes are a convex function of earnings, then it is optimal for firms to hedge in order to reduce expected tax liability. Further, Stulz (1996), Ross (1996), and Leland (1998) suggest that tax shields associated with debt financing provide an incentive for risk management. They argue that by reducing risk, hedging enables the firm to increase debt capacity and to reduce tax liabilities due to increases in leverage. Graham and Rogers (2002) report that firms hedge to increase debt capacity and interest deductions and find no evidence that firms hedge in response to tax convexity. They also identify an important link between hedging and the capital structure decisions and argue that hedging-leverage causality can go both ways. On the other hand, using a different sample and control variables, Geczy, Minton, and Schrand (1997) find no support for this hypothesis.

**D. Financial Distress**

According to Smith and Stulz (1985), financial distress costs provide a possible explanation of why firms hedge. If financial distress is costly, firms are better off with hedging activities because they reduce its probability. Assuming a fixed investment policy, they argue that hedging can decrease the present value of financial distress costs even if hedging is costly. Hence, hedging increases shareholders' wealth as it decreases the expected bankruptcy costs and the loss of debt tax shield. However, as argued by Purnanandam (2008) the existing empirical studies find mixed evidence in support of the distress-cost based theories of hedging. For example Graham and Rogers (2002) and Haushalter (2000) find a positive relation between hedging and leverage (a proxy for distress), whereas Mian (1996) and Tufano (1996) do not find a positive relation between the two variables.

***E. Managerial Risk Aversion***

Managers are usually less diversified than regular shareholders because managers have their human capital and current and future compensation tied to the firm's performance or value. Hence corporate volatility can be costly for the managers if they have concave utility functions, i.e., they are risk-averse and if some of their compensation is related to the volatility of corporate income or cash flows. According to Stulz (1984), if managers cannot effectively hedge corporate volatility in their personal accounts or if it is cheaper for the firms to hedge than it is for managers, then managerial welfare may be improved by corporate hedging. Corporate hedging can be optimal if it reduces the compensation required by managers. Tufano (1996) and Schrand and Unal (1998) find evidence that hedging decreases with managerial option ownership and increases with managerial shareholdings (Note 2). However, the empirical evidence on this is mixed as Geczy et al. (1997) and Haushalter (2000) find no evidence that either managerial risk aversion or shareholdings affect corporate hedging. Also, in addition to managerial stock and option ownership, managerial incentive compensation (*MSIC*) can affect the extent of hedging. Firms that rely more on incentive compensation to mitigate shareholder-manager agency issues should rely less on hedging.

## 2. Data Collection and Variables Measurement

Past studies on hedging (see Nance, Smith and Smithson (1993), Mian (1996), Geczy, Minton and Schrand (1997), Graham and Rogers (2002), Lin, Pantzalis and Park (2010), Campello, Lin, Ma and Zou (2011)) use notional values of derivatives as a measure of hedging and end their sample periods by 2002. The Coca-Cola Company has the following note about notional values in its 2006 annual financial statement (10K):

*The notional amounts of the derivative financial instruments do not necessarily represent amounts exchanged by the parties and, therefore, are not a direct measure of our exposure to the financial risks. The amounts exchanged are calculated by reference to the notional amounts and by other terms of the derivatives, such as interest rates, foreign currency exchange rates or other financial indices.*

However, with the adoption of Statement of Financial Accounting Standards (SFAS) 133 the derivative reporting requirements have substantially changed. This Statement requires that firms recognize all derivatives as either assets or liabilities and measure those instruments at fair market value (Note 3). Under this standard, fair value is defined as the price that would be received to sell an asset or paid to transfer a liability (i.e., the "exit price") in an orderly transaction between market participants at the measurement date.

Another important issue acknowledged in prior studies on hedging is the inability of the researcher to distinguish the hedging motivation of an entity from risk management to speculation. For the first time, FASB through SFAS 133 required *hedging performance rather than hedging intent* as the criterion for determining whether to apply deferral accounting for the derivative gain or loss. In March 2008, FASB issued FAS 161 which amends and expands the disclosure requirements of FASB Statement No. 133, *Accounting for Derivative Instruments and Hedging Activities.* FAS 161 requires disclosures related to objectives and strategies for using derivatives; the fair-value amounts of, and gains and losses on, derivative instruments; and credit-risk-related contingent features in derivative agreements. *The main requirement is to disclose the objectives and strategies for using derivative instruments by their underlying risk as well as a tabular format of the fair values of the derivative instruments and their gains and losses.* No longer are companies so willing to speculate, knowing that if the hedge goes wrong, they cannot avoid reporting the derivative losses in their financial statements. While the revised accounting reporting standards may not be able to completely isolate the two, one can at least expect that the recent data to be more reliable. Recently, Lins, Servaes and Tamayo (2011) document that the requirements to report derivatives at fair values had a material impact on derivatives use and conclude that speculative activities have been reduced.

We collect panel data on S&P 100 for large cap, bottom 100 firms of S&P 400 for mid-cap, and middle 100 firms of S&P 600 for small cap firms for the period of (2006-2010) from COMPUSTAT annual database. This sample contains a wide range of firms and thus better reflects differences across firms with respect to firm size, age, information asymmetry, leasing and risk management practice. We chose this time period to account for the recent changes in the derivative usage reporting requirements as per the Statement of Financial Accounting Standards (SFAS) No. 133 and SFAS 161. This time period also covers the great recession of 2008-2009 when firms faced severe financial constraints and hence allows us to test more precisely the role of financial constraints in the hypothesis and hedging and lease financing.

We use *Mergent Online* database to obtain the historical annual financial statements (10-Ks). We hand collect hedging data for both the notional and fair values of currency and interest rate hedging by performing a string search using keywords like hedge, derivatives, swaps, etc., on the 10-Ks. We exclude financial firms as they use derivatives for trading purposes. We also exclude the highly regulated utility and telecom sectors from the sample.

We follow Campello et al. (2010) and define notional hedge ratio (NHR) as the ratio of sum of notional values of both interest rate and foreign exchange derivatives to lease-adjusted total assets. Fair value hedge ratio (*FHR*) is defined as the ratio of sum of fair values of both interest rate and foreign exchange derivatives to lease-adjusted total assets. Hedging Dummy (*HD*) is defined as equal to 1 if either *FHR* or *NHR* is greater than zero, else it is equal to zero. Lease-adjusted total assets are defined as the sum of total assets and capitalized value of operating leases, i.e., (rental expense + present value of future rental commitments for the next 5 years + present value of thereafter portion). Past studies on leasing (Cornaggia et al. (2013), Yan (2002), and Graham, Lemmon and Schallheim (1998)) use 10% as the typical discount rate. Hence, we also use 10% as the discount rate in computing the present value of rental commitments and the thereafter portion. We define Operating Lease Ratio (*OLR*) as the ratio of capitalized value of operating leases to lease-adjusted total assets (Note 4).

Based on an extensive literature survey, Bharath et al. (2009) argue that adverse selection is an important determinant of market liquidity, when liquidity is proxied by either bid-ask spread or trading volume (Note 5). Following Amihud (2002), we use a market microstructure-based measure of stock illiquidity, viz. "*ILLIQ*", measured as the average ratio of daily absolute return to the dollar trading volume on that day, to proxy for information asymmetry (Note 6).

Following Adam and Goyal (2008), we use Tobin's Q, i.e., market to book ratio of assets as a proxy for the firm's growth opportunities (Note 7). Debt Ratio (*DR*) is measured as the ratio of book value of long term debt to the book value of lease adjusted total assets. Recently, Hadlock and Pierce (2010) conclude that firm size and age are particularly useful predictors of financial constraint levels and question the validity of commonly used measures of financial constraints such as Kaplan and Zingales (KZ) and Whited and Wu (WW) indices. Accordingly, we use firm size and firm age as proxies for financial constraints. We measure firm size as a natural logarithm of net sales. Firm age in any given year is measured as ln (1+difference between that year and the year of incorporation). Research and Development intensity (*RD*) is defined as ratio of annual Research & Development expenditure to lease-adjusted total assets. We measure exposure to foreign exchange rate risk (foreign) as the ratio of foreign sales to total sales as per Geczy et al. (1997). Taxrate is defined as the ratio of taxes paid to pretax income. Volatility (*VOLA*) in any sample year is defined as the standard deviation of EBITDA over the 5 years preceding the sample year.

We follow Campello et al. (2010) and Acharya et al. (2007) and compute modified Altman's Z index (MZ) as *3.3 × (Pretax Income/Lease Adjusted Total Assets) +1.0 × (Net Sales/Lease Adjusted Total Assets Total Assets) + 1.4×(Retained Earnings/Lease Adjusted Total Assets) + 1.2 × (Current Assets–Current Liabilities)/(Lease Adjusted Total Assets).* Following Almeida and Campello (2007), we define *debt capacity (DC) = (cash holdings + 0.715 × receivables + 0.547 × inventory + 0.535 × PPE)/total assets.* Another source of market frictions is agency problems. One widely available proxy for firm-level agency issues is Anti-Takeover Provisions (ATPs). More the number of ATPs adopted by a firm, higher are the agency frictions. These structures are created by managers to insulate themselves from the discipline of the market for corporate control and to seek private benefits of control. Since the pursuit of private benefits through more ATPs aggravates the severity of capital market frictions between managers and investors, agency frictions might increase the incentives of managers to resort to lease financing. This line of argument suggests that lease intensity would be positively related to ATPs. Robicheaux et al. (2008) offer empirical evidence that agency cost reducing measures such as corporate governance and lease financing are complements. We use the Entrenchment Index (*EIndex*), a proxy for corporate governance, of Bebchuk, Cohen and Ferrell (2009). The level of EIndex for any given firm in a given year is computed as a sum of points by assigning one point for each of the six components of the index that the firm has: staggered boards, limits to shareholder bylaw amendments, poison pills, golden parachutes, and super majority requirements for mergers and charter amendments. We collect the data on these variables from Governance data set of ***RiskMetrics***. By definition poorly governed firms have higher *EIndex* value.

We measure managerial stock incentive compensation (*MSIC*) as a ratio of value of restricted stock granted during the year to total compensation as in Rogers (2002). Total compensation includes salary, bonus, other annual, total value of restricted stock granted, total value of stock options granted (using Black-Scholes option pricing model), long-term incentive payouts, and all other total (Note 8). We collect the data on these variables from ***Compustat Execucomp*** database.

Table 1 reports summary statistics on the main outcome, test and control variables. The sample covers an average of 218 non-financial leasing (i.e., lessee) firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix, and the number of firm-year observations reported in the first column.

**Table 1. Descriptive Statistics—Full Sample for the period of 2006-2010**

| | #Obs. | Mean | Std.Dev | Minimum | Quartile1 | Median | Quartile3 | Maximum |
|---|---|---|---|---|---|---|---|---|
| *NHR* | 1084 | 0.0279 | 0.0721 | 0 | 0 | 0 | 0.0191 | 0.812 |
| *FHR* | 1084 | 0.0018 | 0.0119 | 0 | 0 | 0 | 0.0003 | 0.2464 |
| *HD* | 1084 | 0.3736 | 0.484 | 0 | 0 | 0 | 1 | 1 |
| *OLR* | 993 | 0.1717 | 0.2004 | 0.001 | 0.0421 | 0.0874 | 0.2113 | 0.879 |
| *ILLIQ* | 1041 | 0.0123 | 0.0846 | 0 | 0.0001 | 0.0013 | 0.0041 | 1.4563 |
| *BASPRD* | 1041 | 0.0414 | 0.0583 | 0.0057 | 0.0185 | 0.029 | 0.0461 | 0.8901 |
| *EINDEX* | 819 | 2.6618 | 1.4165 | 0 | 2 | 3 | 4 | 6 |
| *STOCK* | 1070 | 0.0097 | 0.0115 | 0 | 0.0035 | 0.0059 | 0.0121 | 0.1992 |
| *DR* | 993 | 0.1561 | 0.1493 | 0 | 0.0197 | 0.134 | 0.2316 | 0.7802 |
| *DC* | 953 | 0.3517 | 0.1355 | 0.0513 | 0.2547 | 0.3586 | 0.4456 | 0.8837 |
| *RD* | 993 | 0.0308 | 0.052 | 0 | 0 | 0.0059 | 0.0492 | 0.6423 |
| *SIZE* | 1082 | 21.5973 | 2.0099 | 13.7366 | 20.2333 | 21.1242 | 23.3644 | 26.78 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| *AGE* | 1084 | 3.5891 | 0.8193 | 0 | 3.0445 | 3.5553 | 4.3041 | 5.3279 |
| *Q* | 1070 | 2.0037 | 1.165 | 0.5334 | 1.2991 | 1.7159 | 2.3394 | 15.4038 |
| *VOLA* | 1031 | 0.037 | 0.0379 | 0.0019 | 0.0159 | 0.0276 | 0.0442 | 0.3755 |
| *MZ* | 1047 | 2.1248 | 1.1808 | -7.9252 | 1.4352 | 2.1011 | 2.8056 | 6.152 |
| *FOREIGN* | 1084 | 0.2628 | 0.3241 | 0 | 0 | 0.0827 | 0.499 | 1 |
| *TAXRATE* | 1084 | 0.23 | 0.14 | 0 | 0.11 | 0.26 | 0.36 | 0.4 |

The descriptive statistics for all variables mentioned above are reported in Table 1 and those on the key variables are briefly discussed here. The Notional Hedge Ratio (*NHR*) has a mean of 0.028 (a median of 0 and a maximum value of 0.81), indicating that on average firms in our sample of 1084 firm-years hedge 2.8% of lease-adjusted total assets. The median firm-year has a Fair value Hedge Ratio (*FHR*) of 0 and the maximum value of the ratio is 24.6%. The Hedging Dummy (*HD*) has a mean of 0.374, reflecting that approximately 37% of our sample firm-years are marked by hedging. The Operating Lease Ratio (OLR) has a median of 0.087 and a mean of 0.172. In other words, the average value of capitalized operating lease commitments to lease-adjusted total assets is 17.2%. The Debt Ratio (*DR*) has a median of 0.134 and a mean of 0.156. An average firm on our sample relies more on lease financing than on long-term debt as percent of total (lease-adjusted) assets. The median firm-year has an illiquidity (ILLIQ) of 0.0013 and the mean and maximum values are 0.0123 are 1.4563, respectively. Similarly, bid-ask spread (*BASPRD*) has a minimum of 0.041, a maximum of 0.89 and a median value of 0.029. The median firm-year size is 21.12 (in log of sales), and the median (log) age is 3.56.

Table 2 reports the total dollar amount of interest rate and foreign exchange rate derivatives on both notional and fair value basis for the period of 2006-2010. The sample non-financial firms are taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600. TNIR is the total notional value of interest rate derivatives. TFIR is the total fair value of interest rate derivatives. TNFR is the total notional value of foreign exchange derivatives. TFFR is the total fair value of foreign exchange derivatives. The number of firms is reported in the last column.

**Table 2. Derivative Usage over the Period of 2006-2010**

| Year | TNIR (Millions of $) | TFIR (Millions of $) | TNFR (Millions of $) | TFFR (Millions of $) | # of Firms |
|---|---|---|---|---|---|
| 2006 | 100537.50 | 1582.38 | 28916.25 | 573.90 | 215 |
| 2007 | 200198.10 | 3011.28 | 36647.84 | 824.25 | 218 |
| 2008 | 223932.00 | 3942.31 | 45177.88 | 1502.64 | 218 |
| 2009 | 220694.20 | 6203.74 | 61551.29 | 2365.14 | 218 |
| 2010 | 168068.20 | 3168.22 | 61662.92 | 1814.88 | 215 |

Table 2 reports the total annual dollar amount of both the interest rate and foreign exchange derivatives usage on both notional and fair value basis. It indicates that firms used more interest rate derivatives than foreign exchange derivatives during our sample period. Also, with the onset of the great recession in 2009, it appears that firms have reduced their usage of interest rate and foreign exchange derivatives. The fair value of interest rate derivatives declined by 49% and that of foreign exchange rate decreased by 23% from year 2009 to 2010.

Table 3 presents pairwise correlation coefficients for the key determinants of hedging and leasing. The sample covers an average of 218 non-financial leasing (i.e., lessee) firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix. The star indicates significance at 5% or better.

**Table 3. Pairwise Correlation Coefficients**

| | ***NHR*** | ***FHR*** | ***HD*** | ***OLR*** | ***ILLIQ*** | ***BASPRD*** | ***SIZE*** | ***AGE*** | ***DR*** | ***DC*** |
|---|---|---|---|---|---|---|---|---|---|---|
| ***NHR*** | **1** | | | | | | | | | |
| ***FHR*** | **0.2396*** | **1** | | | | | | | | |
| ***HD*** | **0.5020*** | **0.1908*** | **1** | | | | | | | |
| ***OLR*** | **-0.1062*** | **-0.0456** | **-0.0433** | **1** | | | | | | |
| ***ILLIQ*** | **0.025** | **0.0119** | **0.0824*** | **0.0990*** | **1** | | | | | |
| ***BASPRD*** | **0.0438** | **0.0023** | **0.0334** | **0.0185** | **0.5792*** | **1** | | | | |
| ***SIZE*** | **0.1533*** | **0.0174** | **0.2556*** | **0.0279** | **-0.0664*** | **-0.0647*** | **1** | | | |
| ***AGE*** | **0.0746*** | **0.0484** | **0.1142*** | **-0.0159** | **-0.0001** | **-0.0512** | **0.3759*** | **1** | | |
| ***DR*** | **0.3553*** | **0.0664*** | **0.2306*** | **-0.2451*** | **-0.0565** | **-0.1151*** | **0.1693*** | **0.1228*** | **1** | |
| ***DC*** | **-0.0405** | **-0.0324** | **-0.0183** | **-0.5983*** | **-0.003** | **0.0844*** | **0.1639*** | **-0.0232** | **-0.0863*** | **1** |

The pairwise correlations among the key variables are reported in Table 3 and briefly discussed here. It is reassuring to note that the Fair value Hedge Ratio (*FHR*) has a significant correlation coefficient with the Notional Hedge Ratio (*NHR*). The Hedging Dummy (*HD*) has significant and positive correlation with both the fair value hedge ratio and notional hedge ratio. The operating lease ratio is significantly negatively correlated with notional hedge ratio and negatively correlated with fair value hedge ratio, consistent with our second hypothesis. Illiquidity (*ILLIQ*) has positive correlation with both fair value hedge ratio and notional hedge ratio and significant positive correlation with hedging dummy. Bid-ask spread (*BASPRD*) has positive correlation with fair value hedge ratio, notional hedge ratio and hedging dummy (but not significant). These estimates are in line with our first hypothesis that hedging intensity is positively related to information asymmetry. Firm size is significantly and positively related to notional hedge ratio and hedging dummy. However, the correlation coefficient between size and fair value hedge ratio is negative and insignificant. Firm Age is positively and significantly correlated to notional hedge ratio and hedging dummy but positive and insignificant with respect to fair value hedge ratio. Both of these estimates are consistent with the hedging puzzle—that older and larger firms (likely subject to less financial constraints) hedge more. In line with the distress-cost based theories of hedging, Debt Ratio (*DR*) is positively and significantly related to notional and fair value hedge ratios as well as the hedging dummy. This positive relation between hedging and debt financing is in sharp contrast to the negative correlation between hedging and lease financing. Not surprisingly, long-term debt financing is significantly negatively correlated with lease financing. Debt Capacity (*DC*) is negatively correlated to notional and fair value hedge ratios as well as the hedging dummy but it is not significant.

Table 4 reports the univariate results of hedge ratios. Panel A classifies firms into young and old based on age and reports the notional (*NHR*) and fair value (*FHR*) hedge ratios of young and old firms. Panel B classifies firms into small and large based on size and reports the two hedge ratios by young and small firms. Panel C classifies firms into low and high lease based on operating lease ratio and reports the two hedge ratios by low and high lease firms. Further, the differences across the three dimensions and the corresponding T-statistics are also reported. Variable definitions are included in the Appendix.

**Table 4. Univariate Analysis of Hedge Ratios**

| | | | | | |
|---|---|---|---|---|---|
| | | | **Panel A** | | |
| | | | **BY *AGE*** | | |
| | | **Young** | **Old** | **Diff** | **T -Stat** |
| | Mean | 0.025314 | 0.030669 | -0.00535 | -1.212 |
| ***NHR*** | Std.Dev | 0.0577 | 0.0205 | | |
| | N | 555 | 529 | | |
| | | **Young** | **Old** | **Diff** | **T -Stat** |
| | Mean | 0.001 | 0.003 | -0.002 | -2.21 |
| ***FHR*** | Std.Dev | 0.005 | 0.016 | | |
| | N | 555 | 529 | | |
| | | | **Panel B** | | |
| | | | **BY *SIZE*** | | |
| | | **Small** | **Large** | **Diff** | **T -Stat** |
| | Mean | 0.0185 | 0.0373 | -0.0188 | -4.326 |
| ***NHR*** | Std.Dev | 0.0534 | 0.0857 | | |
| | N | 540 | 544 | | |
| | | **Small** | **Large** | **Diff** | **T -Stat** |
| | Mean | 0.0012 | 0.0022 | -0.001 | -1.372 |
| ***FHR*** | Std.Dev | 0.003 | 0.017 | | |
| | N | 540 | 544 | | |

| | | Panel C<br>BY *OLR* | | | |
|---|---|---|---|---|---|
| | | **Low** | **High** | **Diff** | **T -Stat** |
| | Mean | 0.0348 | 0.0218 | 0.013 | 2.911 |
| ***NHR*** | Std.Dev | 0.0845 | 0.0582 | | |
| | N | 509 | 575 | | |
| | | **Low** | **High** | **Diff** | **T -Stat** |
| | Mean | 0.0026 | 0.001 | 0.0016 | 2.095 |
| ***FHR*** | Std.Dev | 0.0167 | 0.0044 | | |
| | N | 540 | 544 | | |

We present univariate test results on hedging and leasing in Table 4. Panel A indicates that young firms hedge less compared to old firms. The mean difference of the fair value hedge ratio between young and old firms is significant. However, the difference in the notional hedge ratio is not significant. In Panel B, we find that small firms hedge less compared to large firms. While the mean difference of the notional hedge ratio between small and large firms is significant, that based on the fair value hedge ratio is not significant. Further, consistent with our second hypothesis, firms with high operating lease ratios tend to have low hedge ratios, see Panels C and D. The mean differences are significant for both notional and fair value hedge ratios. Overall, we find suggestive evidence to support our arguments that hedging intensity increases with information frictions and that hedging decreases with lease financing.

## 3. Empirical Models, Estimation and Results

### *3.1 Information Asymmetry, Leasing and Hedging*

In the comprehensive hedging model, presented below, Information Asymmetry (*IA*) and Operating Lease Ratio (*OLR*) are test variables. We lag the independent variables to search for potentially causal influences and mitigate spurious correlations among the regressors and the regressand. We correct for time-series dependence among the error terms by clustering the residuals based on firm id (gvkey). Also, we control for industry fixed effects and include year dummies to remove any cross-sectional dependence between observations in the same time period (Note 9). We use these heteroskedasticity and autocorrelation robust standard errors for inference.

$$\boldsymbol{HR_{it} = a_0 + a_1 * IA_{it-1} + a_2 * OLR_{it-1} + a_3 * DR_{it-1} + a_4 * Q_{it-1} + a_5 * Age_{it-1} + a_6 * Size_{it-1} + a_7 * MZ_{it-1} + a_8 * DC_{it-1} + a_9 * Foreign_{it-1} + a_{10} * Vola_{it-1} + a_{11} * Tax\ Rate_{it-1} + a_{12} * RD_{it-1} + a_{13} * MSIC_{it-1} + Industry\ Dummies + Year\ Dummies + \epsilon_{it}} \quad \textbf{(1)}$$

*HR* represents either fair value or nominal hedge ratio. *IA* denotes information asymmetry proxied by either *ILLIQ* (Amihud, 2002) or percent bid-ask spread (*BASPRD*). *OLR* is operating lease ratio. *DR* is debt ratio. *Q* is M/B ratio of total assets, a proxy for growth opportunities. *AGE* is the firm age, since the date of incorporation, and proxies financial constraints. *SIZE* is ln (net Sales) a proxy for the financial constraints. *MZ* is modified Altman's Z-score and proxies financial distress. *DC* is debt capacity. *Foreign* is foreign sales/Total sales and proxies currency exposure. *VOLA* represents standard deviation of cash flows over the past five years. *TAXRATE* is income taxes paid as a fraction of pretax income. *RD* is research and development as a fraction of lease adjusted total assets. *MSIC* is managerial stock incentive compensation and proxies for managerial risk aversion. Tufano (1996) finds industry patterns in hedging practices—while some industries tend to use financial derivatives to hedge their exposures, others rarely use these instruments. We use industry and year fixed effects to control for unobserved heterogeneity that is constant over time and across industries.

Table 5 reports regression results with notional hedge ratio and hedging dummy as the dependent variables and proxies information asymmetry and operating lease ratio as the main test variables. The sample covers an average of 218 non-financial lessee firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix. Industry dummies are included in all models and year dummies are included in all the models except for Fama-MacBeth (1973) regressions but not tabulated. T-statistics are reported below the slope coefficients in parentheses for significant coefficients. The * indicates significant at 10%, ** significant at 5% and *** significant at 1%, respectively. The number of firm-year observations and $R^2$ values for each model are also reported.

**Table 5. Regressions of Hedging Determinants Using Notional Values**

| | | OLS | Fama-Mac | Probit | OLS | Fama-Mac | Probit |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| | Exp. Sign | $NHR_{it}$ | $NHR_{it}$ | $NHD_{it}$ | $NHR_{it}$ | $NHR_{it}$ | $NHD_{it}$ |
| $OLR_{it-1}$ | - | -0.0083** | -0.0074** | -0.8721** | -0.0085** | -0.0072* | -0.9170*** |
| | | (-2.11) | (-2.767) | (-2.577) | (-2.23) | (-2.128) | (-2.6967) |
| $ILLIQ_{it-1}$ | + | 0.0199 | 0.01 | 1.1855 | | | |
| | | (1.9803)** | 1.0504 | (2.8452)*** | | | |
| $BASPRD_{it-1}$ | + | | | | 0.0152 | 0.02 | 1.0932 |
| | | | | | (1.7345)* | (1.799)* | (2.794)*** |
| $MSIC_{it-1}$ | - | -0.5616* | -0.7797*** | -46.3002*** | -0.5636* | -0.7881*** | -47.1391*** |
| | | (-1.9509) | (-8.0061) | (-4.9984) | (-1.7103) | (-7.5806) | (-5.0325) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $DR_{it-1}$ | + | 0.1153*** | 0.1234*** | 1.5733*** | 0.1157*** | 0.1250*** | 1.6069*** |
| | | (4.7856) | (10.3763) | (3.9635) | (6.3605) | (10.963) | (4.0322) |
| $DC_{it-1}$ | - | -0.0226 | -0.0243** | 0.4772 | -0.0235 | -0.0245** | 0.4935 |
| | | (-0.9440) | (-2.9507) | 0.969 | -0.9916 | (-2.9848) | 1.0017 |
| $RD_{it-1}$ | + | 0.1759** | 0.1538*** | 3.0799** | 0.1767*** | 0.1538*** | 3.3842** |
| | | (2.3977) | (11.3623) | (2.1299) | (2.9481) | (10.923) | (2.30) |
| $SIZE_{it-1}$ | + | 0.0014 | 0.0006 | 0.0651** | 0.0013 | 0.0005 | 0.0681** |
| | | 0.8836 | 0.6995 | (2.2975) | 0.8519 | 0.5854 | (2.407) |
| $AGE_{it-1}$ | + | 0.0016 | -0.0028 | -0.1655** | 0.0016 | -0.0028 | -0.1636** |
| | | 0.39 | -0.7915 | (-2.4966) | 0.5178 | -0.7823 | (-2.4646) |
| $Q_{it-1}$ | + | 0.0055** | 0.0081** | 0.2010*** | 0.0054** | 0.0079** | 0.1973*** |
| | | (2.0784) | (4.5926) | (3.5254) | (2.0975) | (4.4961) | (3.4419) |
| $VOLA_{it-1}$ | + | 0.0046 | -0.0812 | -3.2531** | 0.0068 | -0.0786 | -3.3057** |
| | | 0.0514 | -1.5670 | (-2.1064) | 0.0896 | -1.5395 | (-2.1424) |
| $MZ_{it-1}$ | - | 0.003 | -0.0035*** | -0.0809 | -0.003 | -0.0035*** | -0.0927 |
| | | -1.3505 | (-5.2153) | -1.3742 | -1.2025 | (-5.2032) | -1.5702 |
| $FOREIGN_{it-1}$ | + | 0.0148* | 0.0213*** | 0.5585*** | 0.0147* | 0.0212*** | 0.5692*** |
| | | (1.8242) | (5.3318) | (3.5452) | (1.9394) | (5.5141) | (3.6096) |
| $TAXRATE_{it-1}$ | - | -0.0264* | -0.0367** | -0.6054 | -0.0269 | -0.0367** | -0.5766 |
| | | (-1.6765) | (-3.8733) | -1.5951 | (-1.6191) | (-3.6789) | -1.5191 |
| *CONSTANT* | | -0.0419 | 0 | -1.5405** | -0.0407 | 0.0021 | -1.6596** |
| | | -1.0215 | 0 | (-2.2502) | -0.5886 | 0.1419 | (-2.4259) |
| Observations | | 875 | 875 | 875 | 875 | 875 | 875 |
| R-squared | | 0.22 | 0.15 | 0.11 | 0.22 | 0.15 | 0.11 |

We report three different estimates of equation (1) with notional hedge ratio (*NHR*, the ratio of notional values of interest rate and foreign exchange derivatives to lease adjusted total assets) as the dependent variable in Table 5. The first is the panel fixed effects (ordinary least squares, OLS, using industry and year fixed effects) model. In practice, the industry effect may decay over time even though we control for industry fixed effects and so the correlation between residuals changes as the time between them grows. To address unobserved crosssectional biases in the OLS standard errors, we use the Fama-MacBeth (1973) regressions along with industry fixed effects to obtain unbiased standard errors in the second model. Further, it is possible that our *NHR* (a continuous measure) deviates from the true but unobserved hedge ratio. We construct an indicator variable, *NHD*, which is set equal to one if *NHR* is positive, zero otherwise. This variable is a simple indicator of the presence or absence of firm-level hedging practices based on interest rate and exchange rate derivatives. Using *NHD*, to mitigate potential concerns about errors in continuous measure, we generate Probit estimates (while controlling for industry and year fixed effects). In Model (1), the coefficient on *OLR* (-0.0083) is negative and significant, consistent with our second hypothesis that firms that use more leased capital hedge less as the need for financing the investments and conserving the debt capacity dominate the hedging concerns. This evidence supports the arguments by Rampini and Viswanathan (2010) that there is a fundamental trade-off between firms' financing and risk management policies and financing needs can override hedging concerns for financially constrained firms. The coefficient on information asymmetry (0.0199), proxied by *ILLIQ*, is positive and significant, supporting our first hypothesis that firms with high information asymmetry should hedge more to reduce information asymmetry between managers and markets and to mitigate agency costs/costly external financing (see Demarzo & Duffie, 1991).

The coefficient on Managerial Stock Incentive Compensation (*MSIC*) is negative and significant, indicating that firms that rely more on incentive compensation to mitigate shareholder-manager agency issues would rely less on hedging. The coefficient on Debt Ratio (*DR*) is positive and significant as predicted. This is consistent with Graham and Rogers (2002) that hedging increases leverage and vice-versa. The coefficient on Debt Capacity (*DC*) is negative as expected but not significant. The coefficient on R&D (*RD*) is positive and significant. This finding is in line with the idea that firms with high R&D tend to have high growth opportunities and firms with high growth opportunities should hedge more to mitigate the agency costs of underinvestment (see Nance, Smith, Smithson (1997), Lin (2007)) (Note 10). We find a positive (but not significant) coefficient on firm size (*SIZE*), consistent with the argument that large firms are less constrained and hence should hedge more. Another explanation is due to the economies of scale associated with hedging which suggests that large firms should hedge more as they have less cost of setting up and running an in house hedging program, see. Dolde (1993) (Note 11).

The coefficient on firm age (*AGE*) is positive as expected, because older and established firms are less constrained and hence should hedge more, but it is not significant. Supporting the idea that firms with higher investment opportunities suffer the most from the costs of underinvestment and should hedge more to mitigate underinvestment costs, the coefficient on *Q* is positive and significant. The coefficient on cash flow volatility (*VOLA*) is positive as expected but not significant. The coefficient on Modified Z-score (*MZ*) is negative, indicating that firms with high financial distress hedge more to reduce the probability of bankruptcy. Consistent with the notion that firms with higher exposure to exchange rate risk (measured as the ratio of foreign sales to total sales) should hedge more, the coefficient on *FOREIGN* is positive and significant. Finally the coefficient on *TAXRATE* is negative and significant. This is consistent with the argument of Geczy et al. (1997) that firms facing a convex tax function would hedge less, ceteris paribus. The Probit estimation results confirm that the operating lease ratio is negative and highly significant. The coefficient on illiquidity is positive and highly significant as predicted.

Turning to the economic significance of the coefficient estimates on information asymmetry and operating lease ratio. Consider Model (1). A one standard deviation (= 0.0846) increase in illiquidity *ILLIQ* increases the notional hedge ratio by 0.168% (= 0.0199*0.0846) from its expected value. This is considerable given that the mean notional hedge ratio is 2.8%. Similarly, one standard deviation (0.2004) increase in operating lease ratio increases the notional hedge ratio by 0.166% (= -0.0083*0.2004) from its mean.

Table 6 reports regression results with fair value hedge ratio and hedging dummy as the dependent variables and proxies information asymmetry and operating lease ratio as the main test variables. The sample covers an average of 218 non-financial lessee firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix. Industry dummies are included in all models and year dummies are included in all the models except for Fama-MacBeth (1973) regressions but not tabulated. T-statistics are reported below the slope coefficients in parentheses for significant coefficients. The * indicates significant at 10%, ** significant at 5% and *** significant at 1%, respectively. The number of firm-year observations and $R^2$ values for each model are also reported.

**Table 6. Regressions of Hedging Determinants Using Fair Values**

| | | OLS | Fama-Mac | Probit | OLS | Fama-Mac | Probit |
|---|---|---|---|---|---|---|---|
| | | (1) | (2) | (3) | (4) | (5) | (6) |
| | Exp. Sign | $FHR_{it}$ | $FHR_{it}$ | $FHD_{it}$ | $FHR_{it}$ | $FHR_{it}$ | $FHD_{it}$ |
| $OLR_{it-1}$ | - | -0.0054* | -0.0047* | -1.6677*** | -0.0054* | -0.0049* | -1.6653*** |
| | | (-1.761) | (-2.2649) | (-4.8133) | (-1.765) | (-2.4486) | (-4.7963) |
| $ILLIQ_{it-1}$ | + | 0.0062* | 0.001 | -1.1879 ** | | | |
| | | (1.7245) | 0.1255 | (-1.9950) | | | |
| $BASPRD_{it-1}$ | + | | | | 0.0065* | 0.004 | -0.6314* |
| | | | | | (1.7464) | 0.6702 | (-1.7616) |
| $MSIC_{it-1}$ | - | -0.1234 | -0.1777* | -34.5360*** | -0.124 | -0.1791* | -34.6334*** |
| | | (-1.6243) | (-2.2385) | (-3.8691) | (-1.6323) | (-2.2706) | (-3.8739) |
| $DR_{it-1}$ | + | 0.0092** | 0.0036* * | 1.7932*** | 0.0094** | 0.004* * | 1.7711*** |
| | | (2.1929) | (2.744) | (4.4188) | (2.2353) | (2.764) | (4.3562) |
| $DC_{it-1}$ | - | -0.0193*** | -0.0141** | 1.5349*** | -0.0196*** | -0.0143** | 1.5690*** |
| | | (-3.5147) | (-4.0411) | (3.0214) | (-3.5777) | (-4.0910) | (3.0939) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| $RD_{it-1}$ | + | -0.0018 | 0.0011 | 2.1112 | -0.0012 | 0.0011 | 2.0555 |
| | | -0.1284 | 0.3986 | 1.5477 | -0.0871 | 0.5478 | 1.4981 |
| $SIZE_{it-1}$ | + | -0.0016*** | -0.0010** | 0.0395 | -0.0016*** | -0.0010** | 0.0406 |
| | | (-4.5337) | (-3.1217) | 1.3824 | (-4.5712) | (-3.0860) | 1.4224 |
| $AGE_{it-1}$ | + | 0.0012* | 0.0006** | 0.0157 | 0.0013* | 0.0006** | 0.0137 |
| | | (1.7002) | (3.3573) | 0.234 | (1.7403) | (3.1691) | 0.2048 |
| $Q_{it-1}$ | + | 0.0009 | 0.0015 | 0.1271** | 0.0009 | 0.0015 | 0.1332** |
| | | 1.5718 | 1.6147 | (2.199) | 1.4669 | 1.6157 | (2.2846) |
| $VOLA_{it-1}$ | + | 0.0186 | 0.0079 | -2.9388* | 0.0193 | 0.0088 | -3.0277* |
| | | 1.0696 | 0.874 | (-1.8442) | 1.1109 | 1.0432 | (-1.8970) |
| $MZ_{it-1}$ | - | -0.0012** | -0.001* | -0.0053 | -0.0012** | -0.0010* | -0.0034 |
| | | (-2.1383) | (-2.122) | -0.0896 | (-2.1181) | (-2.2075) | -0.057 |
| $FOREIGN_{it-1}$ | + | 0.0034* | 0.0045** | 0.8954*** | 0.0034* | 0.0045** | 0.9000*** |
| | | (1.9447) | (2.743) | (5.6245) | (1.9343) | (2.8369) | (5.6563) |
| $TAXRATE_{it-1}$ | - | -0.0097** | -0.0096* | -0.7176* | -0.0098** | -0.0097* | -0.6972* |
| | | (-2.5134) | (-2.0878) | (-1.8623) | (-2.5616) | (-2.0530) | (-1.8128) |
| Constant | | 0.0375** | 0.0242** | -2.4223*** | 0.0379** | 0.0246** | -2.4378*** |
| | | (2.3508) | (3.2084) | (-3.4601) | (2.3761) | (3.1265) | (-3.4751) |
| Observations | | 875 | 875 | 875 | 875 | 875 | 875 |
| R-squared | | 0.11 | 0.06 | 0.12 | 0.11 | 0.06 | 0.12 |

We repeat the analysis using the Fair value Hedge Ratio (*FHR*) and report the estimation results in Table 6 (Note 12). For brevity, we focus on the statistical and economic significance of our two test variables. In Model (1) the coefficient on operating lease ratio is negative and significant as expected even after controlling for financial constraints proxied by firm size and age. Similarly the coefficient on information asymmetry, proxied by illiquidity, is positive and significant. In terms of economic significance, a one standard deviation increase in operating lease ratio decreases the fair value hedge ratio by 0.1%. This can be compared to the mean fair value hedge ratio of 0.18%. Similarly, one standard deviation increase in illiquidity increases fair value hedge ratio by 0.05%. This is considerable compared to the mean fair value hedge ratio of 0.18%. While using fair values instead of the notional values for hedge intensity has reduced the significance levels of the test variables, the economic significance appears to be considerable.

One can argue that the independent variables leverage and incentive compensation are endogenous choice variables to a firm. As Geczy et al. (1997) noted it is almost impossible to eliminate all these endogeneity problems (Note 13). Since these are the control variables, we do not pursue this issue further. Consistent with previous studies on hedging determinants by Geczy et al. (1997), Tufano (1996), and Nance et al. (1993), we lag the endogenous variables by one period. However, this does not solve the endogeneity bias completely, so we offer several other ways of dealing with endogeneity, in robustness checks, in section IV below.

## 4. Robustness Checks

### *4.1 Instrumental Variable Regressions*

Our first robustness test involves estimating equation (1) with an instrumental variable for the Operating Lease Ratio (*OLR*). We use Fixed Asset Ratio (*FAR*), measured as a ratio of netPPE to total assets, and EIndex Dummy (*EID*) coded as 1 if EIndex is above median else equal to zero, a proxy for corporate governance, as instruments for the Operating Lease Ratio (*OLR*). These instruments are selected on the basis of past studies on the determinants of leasing as well as the pair-wise correlation of these two variables with operating lease ratio in the sample data. The economic intuition is as follows: Robicheaux et al. (2008) offer empirical evidence that agency cost reducing measures such as corporate governance and lease financing are complements. Sharpe and Nguyen (1995) argue that fixed asset ratio can serve as a proxy for capital intensity and that firms with high capital intensity lease more of their capital stock, i.e., PPE. The correlation between *OLR* and *FAR* is 0.2274 with a p-value of 0. The correlation between *OLR* and EIndex dummy is 0.1042 with a p-value of 0.001. We overidentify the system, by including more than one instrument for the endogenous variable, as it is a necessary condition to test instrument exogeneity.

The estimation is carried out using two-step *Generalized Method of Moments* (GMM). This estimator also produces both Heteroskedasticity and Autocorrelation (HAC) consistent estimates of both the slope coefficients and the corresponding standard errors. Only the second-stage regression results are reported in Table VII for brevity. The sign on the predicted *OLR* is negative (-0.0228) as expected and also highly significant confirming our second hypothesis that the firm-level hedge ratio varies inversely with the intensity of leasing. Based on this estimate, a one standard deviation increase in the predicted value of the operating lease ratio decreases the notional hedge ratio by 0.46%. This is considerable given the mean notional hedge ratio is 2.8%. Further, the coefficient on bid-ask spread (*BASPRD*) is positive and significant confirming our first hypothesis that the extent of hedging is positively related to information asymmetry faced by the firms. We repeat the analysis using fair value hedge ratio and report the results in column (2). Again, the sign on the predicted *OLR* is negative as expected and significant. The coefficient on illiquidity (*ILLIQ*) is positive but not significant.

Table 7 reports instrumental variable regression results with notional hedge ratio and fair vale hedge ratio as dependent variables. The sample covers an average of 218 non-financial lessee firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix. Industry and year dummies are included in all models, but not tabulated. The estimation is by two-step GMM and only the results of second stage are presented for brevity. The instruments used for *OLR* are Fixed Asset Ratio and EIndex Dummy. T-statistics reported below the slope coefficients and indicated in parentheses for significant coefficients. The *indicates significant at 10%, ** significant at 5% and *** significant at 1% respectively. The estimation period is from 1974-2006. The number of firm-year observations and $R^2$ along with the Sargan statistic, for overidentification test, is also reported.

**Table 7. Instrumental Variable Regressions of Hedging Determinants**

| | Expected Sign | (1) | (2) |
|---|---|---|---|
| | | $NHR_{it}$ | $FHR_{it}$ |
| $OLR^{*}_{it}$ | - | -0.0228** | -0.006* |
| | | (-1.9867) | (-1.8076) |
| $BASPRD_{it-1}$ | + | 0.023* | |
| | | (1.76) | |
| $ILLIQ_{it-1}$ | + | | 0.004 |
| | | | 1.2894 |
| $MSIC_{it-1}$ | - | -0.2971 | -0.1835* |
| | | (-0.6406) | (-1.6623) |
| $DR_{it-1}$ | + | 0.0969*** | 0.0133* |
| | | (3.3812) | (1.9261) |
| $DC_{it-1}$ | - | -0.0794 | -0.0069 |
| | | -1.321 | -0.4841 |
| $RD_{it-1}$ | + | 0.1463* | 0.0049 |
| | | (1.9083) | 0.2711 |
| $SIZE_{it-1}$ | + | 0.001 | -0.0016*** |
| | | 0.4997 | (-3.2350) |
| $AGE_{it-1}$ | + | 0.0022 | 0.0011 |
| | | 0.5176 | 1.1471 |
| $Q_{it-1}$ | + | 0.0031 | 0.0014* |
| | | 0.8212 | (1.6699) |
| $VOLA_{it-1}$ | + | 0.069 | 0.0045 |
| | | 0.6318 | 0.1745 |
| $MZ_{it-1}$ | - | 0.0048 | 0.0008 |
| | | 1.3601 | 0.9108 |
| $FOREIGN_{it-1}$ | + | 0.013 | 0.0037* |
| | | 1.4634 | (1.7722) |
| $TAXRATE_{it-1}$ | - | -0.0343* | -0.0080* |
| | | (-1.7340) | (-1.7338) |
| Constant | | 0.0227 | 0.0237 |

| | | |
|---|---|---|
| | 0.3301 | 1.4457 |
| Observations | 875 | 875 |
| R-squared | 0.19 | 0.08 |

**Overidentification test of all instruments:**

H0: the instruments are valid

- Sargan Statistic: 0.595 1.584
- Chi-sq(1) P-value 0.440 0.282

**Weak identification test:**

Ho: equation is weakly identified

- Cragg-Donald Wald F statistic 24.18 24.71
- Critical Value(10% maximal IV size) 19.93 19.93

To examine instrument validity, we report Sargan statistic for overidentification at the bottom of Table 7. The Sargan statistic has a value of 0.595 with a p-value of 0.44 thus failing to reject the null hypothesis that instruments are valid. We further check the relevance of instruments through a test of week instruments. The Cragg-Donald Wald F-statistic has a value of 24.18 with a critical F value (at IV size 10%) equal to 19.93. Since the test statistic is larger than the critical value, we reject the null that the equation is weakly identified. This further mitigates potential concerns whether our instruments are weakly correlated with the endogenous regressor.

*4.2 Simultaneous Equation Modeling of Hedging and Leasing*

Now we address the problem of joint determination of hedging and leasing. One can argue that the risk management and financing are strategic decisions and determined simultaneously by a firm as part of its business strategy. However, finance theory does not offer any clear theoretical models to address this problem. Hence, consistent with past empirical studies on hedging by Geczy et al. (1997), Graham and Rogers (2002), Lin and Smith (2007), and Purnanandam (2008) and past studies on leasing by Robicheaux et al. (2008), Eisfeldt and Rampini (2009) and Sharpe and Nguyen (1995), we model hedging and leasing decisions as a simultaneous system using the following structural equations:

$$\boldsymbol{HR_{it} = a_0 + a_1 * IA_{it-1} + a_2 * OLR^*_{it} + a_3 * DR_{it-1} + a_4 * Q_{it-1} + a_5 * Age_{it-1} + a_6 * Size_{it-1} + a_7 * MZ_{it-1} + a_8 * DC_{it-1} + a_9 * Foreign_{it-1} + a_{10} * Vola_{it-1} + a_{11} * Tax\ Rate_{it-1} + a_{12} * RD_{it-1} + Industry\ Dummies + Year\ Dummies + \epsilon_{it}} \quad \textit{(1a)}$$

$$\boldsymbol{OLR_{it} = \beta_0 + \beta_1 * HR^*_{it} + \beta_2 * IA_{it} + \beta_3 * DR_{it} + \beta_4 * DC_{it} + \beta_5 * Size_{it} + \beta_6 * Age_{it} + \beta_7 * Q_{it} + \beta_8 * MZ_{it} + \beta_9 * Taxrate_{it} + \beta_{10} * FAR_{it} + \beta_{11} * EID_{it} + Year\ and\ Industry\ Dummies + \varepsilon_{it}} \quad \textit{(2)}$$

Table 8 reports simultaneous equation regression results with notional hedge ratio and operating lease ratio as dependent variables. The sample covers an average of 218 non-financial lessee firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix. Industry and year dummies are included in all models, but not tabulated. The estimation is by 3-stage least squares and only the results of last stage are presented for brevity. T-statistics reported below the slope coefficients and indicated in parentheses for significant coefficients. The * indicates significant at 10%, ** significant at 5% and *** significant at 1% respectively. The number of firm-year observations and $R^2$ values for each model are also reported in the table.

**Table 8. Simultaneous Equation of Regressions of Notional Hedge Ratio and Leasing**

| | | (1) | | (2) |
|---|---|---|---|---|
| **VARIABLES** | **EXP. SIGN** | $NHR_{it}$ | **EXP. SIGN** | $OLR_{it}$ |
| $OLR^*_{it}$ | - | -0.0442** | | |
| | | (-1.9849) | | |
| $NHR^*_{it}$ | | | - | -1.9607** |
| | | | | (-2.2732) |
| $ILLIQ_{it-1}$ | + | 0.009* | + | 0.0274 |
| | | (1.7342) | | 0.2486 |
| $DR_{it-1}$ | + | 0.1210*** | - | -0.0725 |
| | | (6.4355) | | (-0.5965) |
| $DC_{it-1}$ | - | -0.0437 | - | -0.9735*** |
| | | -1.3401 | | (-20.9286) |
| $RD_{it-1}$ | + | 0.0387 | | |
| | | 1.0483 | | |
| $SIZE_{it-1}$ | + | 0.0013 | - | -0.0042 |
| | | 1.0706 | | -0.9406 |
| $AGE_{it-1}$ | + | -0.0024 | - | -0.012 |
| | | -0.8646 | | -1.4560 |
| $Q_{it-1}$ | + | 0.0066*** | + | 0.0135* |
| | | (3.1499) | | (1.727) |
| $VOLA_{it-1}$ | + | -0.0914* | | |
| | | (-1.9274) | | |
| $MZ_{it-1}$ | - | -0.0040* | - | -0.0373*** |
| | | (-1.738) | | (-6.1909) |
| $FOREIGN_{it-1}$ | + | 0.0187*** | | |
| | | 2.7983 | | |
| $TAXRATE_{it-1}$ | - | -0.0348** | - | -0.1111** |

| | | | |
|---|---|---|---|
| | (-2.1486) | | (-2.0047) |
| $FAR_{it-1}$ | | + | 0.2872*** |
| | | | (7.8143) |
| $EID_{it-1}$ | | + | 0.0119 |
| | | | 1.3634 |
| CONSTANT | -0.002 | | 0.5541*** |
| | (-0.0672) | | (5.8379) |
| Observations | 879 | | 879 |
| R-squared | 0.11 | | 0.21 |

Where $OLR^*$ and $HR^*$ are the predicted values from the first stage OLS regressions. We exclude fixed assets ratio (*FAR*) and Entrenchment Index Dummy (*EID*) from the hedging equation and *FOREIGN*, *VOLA* and *RD* from the leasing equation. The structure of the exclusion restrictions ensures that the system is identified. We use three-stage least squares (3SLS) as the estimation technique. For inference, the standard errors are corrected for the fact that the estimated values are used for the endogenous regressor. The results of the last stage regressions, using notional hedge ratios, are reported in Table 8.

In the hedging equation (Model (1)), the coefficient on operating lease ratio (-0.0442) is negative and highly significant, thus supporting our second hypothesis that firms deploying more leased capital tend hedge less of their risk exposures. In terms of economic significance, a one standard deviation increase in Operating Lease Ratio (*OLR*) from its predicted value would decrease the notional hedge ratio by 0.88% from its mean of 2.8%. Similarly, the coefficient on illiquidity (*ILLIQ*) is positive and significant, thus supporting our first hypothesis that the intensity of corporate hedging is increasing in formation frictions. The coefficients on most controls are consistent with the prior studies.

Table 9 reports simultaneous equation regression results with fair value hedge ratio and operating lease ratio as dependent variables. The sample covers an average of 218 non-financial lessee firms taken from Standard & Poor's (S&P) 100, S&P 400 and S&P 600 over the period of 2006-2010. Variable definitions are included in the Appendix. Industry and year dummies are included in all models, but not tabulated. The estimation is by 3-stage least squares and only the results of last stage are presented for brevity. T-statistics reported below the slope coefficients and indicated in parentheses for significant coefficients. The * indicates significant at 10%, ** significant at 5% and *** significant at 1% respectively. The number of firm-year observations and $R^2$ values for each model are also reported in the table.

**Table 9. Simultaneous Equation of Regressions of Fair Value Hedge Ratio and Leasing**

| | | (1) | | (2) |
|---|---|---|---|---|
| | **EXP. SIGN** | $FHR_{it}$ | **EXP. SIGN** | $OLR_{it}$ |
| **VARIABLES** | | | | |
| $OLR^{*}_{it}$ | - | -0.001* | | |
| | | (-1.7369) | | |
| $FHR^{*}_{it}$ | | | - | -0.4096** |
| | | | | (-1.9826) |
| $BASPRD_{it-1}$ | + | 0.002 | + | 0.0829 |
| | | 1.2532 | | (1.8584)* |
| $DR_{it-1}$ | + | 0.0075* | - | -0.2739*** |
| | | (1.8133) | | (-5.2719) |
| $DC_{it-1}$ | - | -0.0054 | - | -1.0224*** |
| | | -0.7589 | | (-21.3466) |
| $RD_{it-1}$ | + | -0.0053 | | |
| | | -0.6163 | | |
| $SIZE_{it-1}$ | + | -0.0008*** | - | -0.0141*** |
| | | (-2.8577) | | (-4.0217) |
| $AGE_{it-1}$ | + | 0.0009 | - | -0.0013 |
| | | 1.439 | | -0.1365 |
| $Q_{it-1}$ | + | 0.0007 | + | 0.0064 |
| | | 1.5018 | | 1.0721 |
| $VOLA_{it-1}$ | + | -0.0087 | | |
| | | -0.7888 | | |
| $MZ_{it-1}$ | - | 0.0008 | - | -0.0410*** |
| | | 1.5009 | | (6.4424) |
| $FOREIGN_{it-1}$ | + | 0.0048*** | | |
| | | (3.0441) | | |
| $TAXRATE_{it-1}$ | - | -0.0098*** | - | -0.1258** |
| | | (-2.7134) | | (-2.0890) |
| $FAR_{it-1}$ | | | + | 0.3275*** |
| | | | | (12.0653) |
| $EID_{it-1}$ | | | + | 0.0173* |
| | | | | (1.8594) |
| CONSTANT | | 0.0142** | | 0.7371*** |

| | | |
|---|---|---|
| | (2.0685) | (9.9588) |
| Observations | 879 | 879 |
| R-squared | 0.03 | 0.29 |

In the leasing equation, the coefficient on the notional hedge ratio (*NHR*) is negative and highly significant. This indicates that hedging and leasing causality can go both ways. We repeat the analysis using fair value hedge ratios and report the results in Table 9. The main result that firms that lease more hedge less is robust to this alternative measure of hedging intensity.

## 5. Conclusions

Theoretical models of risk management predict that firms subject to financial constraints have greater incentives to hedge their risk exposures to ensure that they have sufficient internal funds to exploit investment opportunities. In practice, however, large firms, which are arguably less financially constrained, hedge whereas small firms, which are likely more financially constrained, often do not engage in risk management which is considered as a *hedging puzzle* in the literature.

Using a sample of 218 non-financial firms drawn from S&P 100, S&P 400 and S&P 600 indices covering a recent five year period from 2006 to 2010, we find that firms that lease more of their PPE use less financial derivatives. The results explain the *hedzing puzzle* and are consistent with the theoretical predictions of Rampini and Viswanathan (2010) because for financially constrained firms, which tend to lease more of their assets, financing needs often override hedging concerns resulting in reduced risk management. The results are robust to several alternative measurements of key variables, different regression specifications, estimation techniques and corrections for endogeneity. Our empirical results suggest that finance researchers should include leasing in the comprehensive analysis of determinants of hedging. Further, corporate finance and risk managers, especially in constrained firms, should not overlook the lease financing as an alternative to hedging in order to enhance debt capacity and mitigate the probability of financial distress.

Some prospective directions for future research may include, but are not limited, to the following: 1) researching determinants for hedging in specific industries. 2) degree of geographic diversification of a firm and its relationship to hedging as corporate risk management strategy and 3) research into the cost-benefit analysis of hedging as a corporate risk management strategy (e.g., transaction costs associated with dynamic hedging programs; adjustment costs associated with managing operating flexibility, etc.) versus the value creation through hedging.

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**Notes**

Note 1. The ***percentage of the firm's shares held by institutions*** is the most popular measure of information asymmetry [Géczy, Minton and Schrand (1997); Graham and Rogers (2002); Rogers (2002); Dionne and Triki (2004, 2005)]. It is important to recognize that a negative coefficient reported for this variable in regressions with hedge ratio as the dependent variable could have another explanation than being an indication of a lower incentive to hedge in order to reduce information asymmetry costs. In fact, institutions are usually well diversified and might find it less useful to manage the risk at the firm level. Consequently, they may encourage a reduction in the hedging ratio.

The ***number of financial analysts following the firm*** [Géczy, Minton and Schrand (1997)] is another proposed measure in the literature for information asymmetry. When the firm is under greater public scrutiny, it should suffer less from information asymmetry. Consequently, information asymmetry should decrease with the number of analysts following its operations and so does the incentive to hedge. However, a positive coefficient for this variable could be interpreted either as evidence supporting the reduction of information asymmetry cost motive or as indication that analysts choose to follow firms with fewer earnings surprises.

DaDalt, Gay and Nam (2002) use earnings related measures of information asymmetry. The first measure they consider is "***the analysts forecast accuracy***" and is defined as the absolute value of the average earnings forecast error. A limitation of this measure is that it captures the magnitude of information asymmetry under the premise that managers disclose unanticipated firm specific information only around earnings announcements. The second measure used in DaDalt, Gay and Nam (2002) is the ***dispersion in analysts' earnings forecast***. According to them, analysts are unable to provide a precise and unanimous forecast of the firm's earnings when there is a lack of information about it. The concern when using this measure is that one never knows whether the dispersion in forecasts is caused by a higher level of information asymmetry or by other factors such as inherent forecasting errors caused by different forecasting models used by analysts.

Note 2. Tufano (1996) finds evidence that CFO tenure is negatively correlated with the probability of hedging but he finds CEO tenure has no significant effect on the derivative usage decision.

Note 3. SFAS #133 requires special accounting for two types of hedges, viz. fair value hedges and cash flow hedges. In a fair value hedge, a derivative is used to hedge or offset the exposure to changes in the fair value of a recognized asset or liability or of an unrecognized firm commitment. Cash flow hedges are used to hedge exposures to cash flow risk, i.e., exposure to the variability of cash flows. The accounting for **fair value hedges** records the derivative at its fair value in the balance sheet with any gains or losses recorded in income. However, derivatives used in **cash flow hedges** are accounted for at fair value on the balance sheet, but gains or losses are recorded in equity as part of other comprehensive income (OCI). The effective portion is recorded in OCI. The ineffective portion goes into current income.

Note 4. Cornaggia, Franzen, and Simin (2013) examine the implications of bringing leased assets onto the balance sheet for a host of common performance and risk metrics.

Note 5. Firm managers constitute a subset of the informed traders who in turn are a subset of all traders (both informed and uniformed) in the market. Further they note that the market microstructure measures of information asymmetry are proxies for this adverse selection, albeit imperfect ones since they also encompass informed traders who are not firm managers. Nonetheless, these proxies capture the financial markets' perception of the information advantage held by firm insiders and the resulting adverse selection costs, which are what ultimately affects the cost of issuing information-sensitive securities.

Note 6. $ILLIQ_{iy} = \frac{1}{D_{iy}} * \sum_{t=1}^{D_{iy}} |R_{iyd}| / VOLD_{iyd}$

where $D_{iy}$ is the number of days for which data are available for stock *i* in year *y*. $R_{iyd}$ is the return on stock *i* on day *d* of year *y* and $VOLD_{iyd}$ is the respective daily dollar volume. The stock price changes without trading when investors agree about the implication of news, while disagreement induces increase in trading volume. Thus, Amihud (2002) argues that ILLIQ can be interpreted as a measure of consensus belief among investors about new information. However, at any point in time, stock liquidity is very likely to be driven by adverse selection but not exclusively so because of inventory and order processing costs. Hence, as a robustness check, I use yearly average of daily closing bid-ask spread from **CRSP** as an alternative measure for information asymmetry and define $\boldsymbol{BASPREAD_{iy}} = \mathbf{(Ask_{iy}-Bid_{iy})/[(Ask_{iy}+Bid_{iy})/2]}$

Note 7. There is a considerable debate on whether Q as measured conventionally is indeed a good measure of growth opportunities. Recently, Adam and Goyal (2008) examine various proxies for the investment opportunities and conclude that the market-to-book assets ratio has the highest information content with respect to investment opportunities.

Note 8. We also measure managerial option compensation (Option) as the ratio of value of options granted to top 5 executives during the year to the total compensation. However, due to the lack of compensation data for many of our sample firms, we ignore this variable from further analysis.

Note 9. Petersen (2009) provides a comprehensive comparison of different approaches used in estimating standard errors in financial panel data sets and the implications for inference.

Note 10. Another interpretation of this result is firms with high R&D tend to have more information asymmetry with respect to their growth opportunities. Hence as argued, in the main text, firms with high information asymmetry should hedge more.

Note 11. Firm size and age could be noisy proxies for the financial constraints as they could also proxy for information and agency frictions. But one can argue that information and agency frictions are the key drivers of financial constraints.

Note 12. In an unreported analysis, in addition to controlling for size and age among other variables, I also interact high size (above median size) dummy with OLR and high age (above median age) dummy with OLR in equation-1 to see the effect of OLR on both NHR and FHR for high vs. low financial constraints. I find that the coefficients on the interaction terms are not significant. Hence, it appears once I control for the financial constraints proxied by size and age, the interaction variables created using dummies based on these two variables have no significant explanatory power. The results are available from the author.

Note 13. Wooldridge (2002) argues that in applied econometrics, endogeneity usually arises in three ways viz. omitted variables, measurement error, and simultaneity. He mentions that the distinctions among the three forms are not always sharp and an equation can in fact have more than one source of endogeneity. The use of lagged dependent variables in dynamic models could be yet another source of endogeneity!

**Appendix: Variable Definitions**

Hedging Variables:

- NHR = Notional value of both interest and currency derivatives scaled by lease-adjusted total assets.
- *FHR* = Fair value of both interest and currency derivatives scaled by lease-adjusted total assets.
- *HD* = Hedging dummy equal to 1 if either *FHR* or *NHR* is greater than zero, else equal to 0.

Leasing Variable:

- Operating Lease Ratio (*OLR*) = (rental expenses plus present value of future rental commitments for the next 5 years and present value of the thereafter portion)/(rental expenses + present value of future rental commitments for the next 5 years and present value of the thereafter portion + Total Assets).

Financial Constraints:

- *AGE* = ln(1+difference between that year and the year of incorporation)
- *SIZE* = ln(Sales).

Information Frictions:

- *BASPREAD* = yearly average of difference between daily closing bid and ask prices reported as a percentage of midpoint of bid ask quotes.
- *ILLIQ* = yearly average of ratio of daily absolute return to the dollar trading volume on that day.

Other Control Variables:

- DR = long-term debt/ lease-adjusted total assets.
- *DC* (debt capacity) = (cash holdings + 0.715 × receivables + 0.547 × inventory + 0.535 × net PPE)/total assets.

- *EIndex* = Sum of points by assigning one point for each of the six components of the index that the firm has viz. staggered boards, limits to shareholder bylaw amendments, poison pills, golden parachutes, and super majority requirements for mergers and charter amendments
- *FAR* = net PPE/lease-adjusted total assets.
- Foreign = foreign sales/total sales
- Modified Altman's Z-score (*MZ*) = 3.3× (Pretax Income/Total Assets) + 1.0 × (Net Sales/Total Assets) + 1.4 × (Retained Earnings/Total Assets) + 1.2 × (Current Assets–Current Liabilities)/(Lease-Adjusted Total Assets).
- *MSIC* = Ratio of value of restricted stock granted during the year to total compensation.
- *Q* = market value of lease adjusted total assets/ book value lease-adjusted of total assets.
- *RD* = R&D expenditure/ Lease-adjusted total assets.
- *TAXRATE* = ratio of tax expense to pretax income.
- *VOLA* = standard deviation of EBITDA over the five years preceding the given sample year.