Multimarket Contact, Market Structure, and Hedging Decisions: An Investigation of the U.S. Property and Casualty Insurance Industry

ABSTRACT

This study extends current knowledge on competition and corporate hedging strategy by examining how firms hedge in response to their contacts with other firms in multiple geographic and product markets. Drawing on the theory of multimarket competition, we propose an inverted U-shaped relationship between multipoint contact (MMC) and hedging level. We also propose that, to gain competitive advantages over its rivals, the extent to which a firm hedges will be opposite to that of its competitors. Finally, we propose that market concentration will moderate the relationship between MMC and hedging level because a concentrated industry facilitates mutual forbearance and thus alleviates competitive pressure among rivals. Analysis of reinsurance usage in the U.S. property and casualty (PC) insurance industry generally supports our model and shows that, given a market structure, firm-specific competitive conditions are salient to a firm's hedging level.

Keywords: multimarket competition, market structure, risk management, hedging, mutual forbearance, differentiation

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The study of risk management — a process implemented by firms for identifying, assessing, managing, and monitoring risk — is at the core of finance, insurance, and strategic management (Palmer & Wiseman, 1999; Ruefli & Collins, 1999). As Miller (1998: 497) noted, "If we conceptualize strategy as the alignment of the firm with its external environment …, then the measurement and management of (risk) exposures are central concerns for strategists." Among the various issues concerned by risk researchers, corporate hedging (actions taken by firms to transfer a particular risk exposure) is possibly at the very top of the list given that today's market environment for many companies is becoming more volatile prompted by economic downturns, erratic exchange rates, global political instability and unrest, emergence and diffusion of new technologies, and heightened trade tensions between major economies of the world.

Risk is embedded in interfirm rivalry, which, in turn, influences corporate risk management decisions. Competitive uncertainty arises when firms "strive for something that all cannot obtain" (Vickers, 1995: 3). The idea that uncertainty imposed by rivalry on firm value may affect a firm's hedging level has been raised in some studies (see Brown, 2001; Froot, Scharfstein, & Stein, 1993). While this line of research has recognized the importance of market context, early work on the impact of competition on hedging typically relies on an aggregate approach by considering competition as a trait of the market that is the same to all firms in the industry (e.g., Adam, Dasgupta, & Titman, 2007; Adam & Nain, 2013). In these studies, competition is measured by the number of firms, the concentration ratio, or the Herfindahl index of an industry.

The aggregate approach, however, as noted by Baum and Korn (1996: 256), "fails to recognize the relational nature of competition and rivalry and neglects variations in firms' strategic interactions that depend on firm-specific competitive conditions." Indeed, the literature on rivalry

has considered competition as a multilevel concept (Chen, 1996; Gnyawali & Madhavan, 2001). From a firm's point of view competition is more than just an objective state of the overall market structure; rather, it may vary across firms depending on their individual conducts. For example, firms doing business in multiple markets may confront different sets of competitors in each of the markets. Given their own unique portfolios, the amount of competition a firm experiences can be considerably different from that exposed to another firm even though they are in the same industry. *Multimarket contact* or *multimarket competition* (MMC) between a firm and its competitors can shape the risk dynamics in corresponding markets, but not necessarily that of the whole industry (cf. Gimeno & Woo, 1999; Nomani, 1990). In keeping with Abell (1980: 17), we define a product market as "a set of goods and services that serve similar functions, are created with the use of similar technology, and are used by similar users." To date, no study on hedging has systematically looked at effects of competitive conditions at both the firm and the industry levels. While there is reason to believe that both the conditions matter, little is known about how these conditions may differ in their effects, and even less is known about whether the effect of one condition may be contingent on the state of the other.

In an attempt to fill the gap, this study seeks to build a more complete model of hedging by incorporating both firm-specific competitive condition in MMC and two characteristics of market structure (contenders' hedging level and market concentration). Building on the theory of multimarket contact, we argue that there is an inverted U-shaped relation between a firm's hedging ratio and its MMC because of two related effects of MMC on competitive intensity and mutual forbearance. When the level of MMC is low, it is difficult for firms to fully understand each other's motives and behaviors. In this situation, the intensity of rivalry between the firm and its rivals will be high and an increase in MMC will escalate the potential of rivalry cross markets (Chuang,

Dahlin, Thomson, Lai, & Yang, 2015). Competition in multiple battlefields can wear down a firm's ability to defend its market positions and leave room for its rivals to exploit its vulnerabilities (McGrath, Chen, & MacMillan, 1998; Stigler, 1988). Greater competition between the firm and its rivals in multiple markets is also associated with a loss in power for setting price, and thus the firm will need to hedge more to mitigate the impact of a potential shock.

As the extent of MMC reaches higher levels, the number of jointly occupied markets increases, which facilitates firms' ability to understand each other's strategies and competitive arenas and recognize their interdependent fates. That is, a competitive attack by a firm in one market can spark retaliatory reaction from its multimarket rivals in other markets (Jayachandran et al. 1999). In this regard, close correspondence in markets provides firms incentives to coordinate and abstain from defection by practicing mutual forbearance (Haveman & Nonnemaker, 2000). In an industry where mutual forbearance predominates, firms' profit volatility will be lower as reduction in competition offers firms more flexibility to use natural hedging by matching output price to the cost of production (see Adam et al., 2007; De Meza, 1986; Maksimovic & Zechner, 1991). Thus, in an industry with a higher possibility of collusion between firms, we expect that firms will hedge less.

We argue that a firm's hedging decision will also depend on the hedging level of its competitors and the concentration of the industry. When rivals hedge more, there will be a lower impact of market shocks to their performance. Meanwhile, a more concentrated industry will alleviate competitive pressure among firms. Both of the effects will reduce the aggressiveness of firm actions, which will lower the needs for a focal firm to hedge. Competitive pressure caused by the degree of industry concentration that each market participant experiences may also moderate relationship between MMC, on the one hand, and a firm's hedging level, on the other. In an

industry with only a few firms, this group of firms can effectively control over the price. The concentration of pricing power will make competition less desirable while making it easier for firms to collude (Bernheim & Whinston, 1990), both of which will influence the effects of MMC on hedging. In the simplest (and an extreme) situation where the level of industry output and price are subject to the decisions of just a couple of firms, the oligopoly market structure will make overt collusion a viable option, which reduces profit volatility and thus lowers the need for hedging. Given this line of reasoning, we argue that industry concentration will moderate the relationship between MMC and hedging level.

We test our hypotheses using data on 1,601 property and casualty (PC) insurance companies in the U.S. over a 21-year time period. The insurance industry in the U.S. is suitable for examining hedging in a competitive environment for a couple of reasons. First, the insurance industry is featured by intense competition. To reduce this risk, reinsurance constitutes a particularly important hedging method available to insurers to mitigate performance uncertainty. Second, insurance providers commonly offer various products in different geographical locations and concurrently compete with the same sets of rivals in multiple markets. The fact that our data contain the breakdown of direct premiums written from all product lines in all states and territories of all U.S. PC insurers enables us to examine factors that influence the whole competitive landscape. Therefore, we can capture competitive interactions between insurers and explore the impact of MMC on an insurer's hedging decision.

THEORY AND HYPOTHESES

Hedging as a Value Creating Strategy

In a perfect market environment, mitigating profit volatility by hedging does not add value for shareholders (Modigliani & Miller, 1958). However, in reality markets are not perfect, and

theoretical and empirical research has suggested several plausible value-increasing explanations for corporate hedging behavior. First, due to limited tools or market instruments available, stakeholders like top executives and employees, albeit their disproportionate share of personal wealth linked to the future performance of the company, are unable to fully diversify their personal risk of firm-specific investments (Miller, 1998). In this regard, corporate risk management offers a feasible alternative, and hedging can improve firm value by reducing additional compensation required by stakeholders for their risk bearing. Second, due to imperfections of capital markets, external financing (debt and equity financing) is more costly than internal financing (Froot et al., 1993). Hedging can lower the frequency of internal cash flow shortfalls and reduce the need for raising funds from the outside, which curtail expected financing costs of future investment projects.

Third, and related to the second, shortfalls of internal cash flows can exacerbate the underinvestment problem caused by the divergence of interests between shareholders and debtholders. The underinvestment problem is the problem that shareholders will forgo positive net present value (NPV) projects when their firm is in financial distress or bankruptcy as the expected gains from the projects mainly accrue to debtholders (Myers, 1977). In line with this, Minton and Schrand (1999) find that firms with higher cash flow volatilities invest less in capital expenditures. Hedging allows firms to smooth income and reduce default probability. If a firm is less likely to fail, shareholders are less likely to reject good investment opportunities as they can maintain all or the majority of benefits from undertaking any positive NPV project. In this regard, hedging can mitigate the underinvestment problem. Moreover, Graham and Rogers (2002) find that hedging can enhance firm value by increasing corporate debt capacity as greater debt financing increases interest deduction and tax shield benefits.

Building on these insights, scholars have used modeling and empirical techniques to investigate corporate hedging under various market contexts including, but not limited to, the electricity industry (Aïd, Chemla, Porchet, & Touzi, 2011), the oil and gas industry (Haushalter, 2000), the newsvendor industry (Van Mieghem, 2007), the insurance industry (Lin, Yu, & Peterson, 2015), the bank holding industry (Hankins, 2011), and oversea markets (Batra, Donnenfeld, & Hadar, 1982). Evidence from this body of research not only supports the view of a positive impact of hedging on firm value, but also emphasizes organizational characteristics such as financial leverage (He & Ng, 1998), firm size (Nance, Smith, & Smithson, 1993), ownership structure (Mayers & Smith, 1990), R&D expenditure (Knopf, Nam, & Thornton, 2002), and growth options (Graham & Rogers, 2002) as key determinants of hedging level.

Rivalry constitutes another important determinant of hedging level due to its effect on business operation. Studies show that increased competition can reduce slack (Gil & Ruzzier, 2018), induce organizational change (Thomas, 1996), disturb firm performance (Andrevski & Ferrier, Forthcoming), increase the likelihood of organizational failure (Ingram & Inman, 1996), and interrupt strategic actions (Ferreira & Kittsteiner, 2016). So far, studies on the effects of competition on hedging have largely treated competition as a property of market structure. For example, Adam et al. (2007) predict that a firm's hedging choice should depend on the aggregate hedging decisions of other firms in the industry. No research has examined how firm-specific competitive conditions in MMC may affect hedging. A primary purpose of this study is to fill the gap in the literature.

Hedging Level and Multimarket Contact

Multimarket competition refers to situations in which firms compete against each other concurrently in two or more markets (Haveman & Nonnemaker, 2000). Two firms have a contact

or market overlap when they both operate in a same market. Technically, MMC between two firms is the aggregation of all their contacts across all markets (Gimeno & Woo, 1996).

Understanding MMC is important as market contacts generate rivalry, which "stems from firms interacting and striving in the same environments and for the same resources" (Fuentelsaz, Gomez, & Polo, 2002: 250). As the number of shared markets increases, so does the level of competitive tensions; and an assault by a firm in the business domain of another firm may trigger retaliation by the latter in the aggressor's territory. The move and countermove are not necessarily a one-to-one correspondence, but can be dispersed across markets and spaces. Studies show that competitive interactions of this sort are common between rivals across a number of business sectors, such as the airline industry (Prince & Simon, 2009), the pharmaceutical industry (Anand, Mesquita, & Vassolo, 2009), the insurance industry (Greve, 2008), the automobile industry (Yu, Subramaniam & Cannella, 2009), and the banking industry (Fuentelsaz & Gomez, 2006; Shipilov, 2009). In those markets, MMC is not just another structural character of the market that affects all firms equally but rather varies by firms with different business and location profiles.

Research has established that MMC is a strong and significant predictor of the intensity of interfirm rivalry (Baum & Korn, 1996; Haveman & Nonnemaker, 2000). At low levels of MMC, a firm will act more aggressively as it tends to have an incomplete picture of its multipoint competitors due to limited channels available for learning about their behaviors. The lack of understanding may blur structures of domination in the market and obscure behavioral codes or "rules of the game" between firms, which specify what will be tolerated and what actions must be avoided as they can be interpreted as disruptive moves or even threat of dethronement by leading firms in the market. As a result, "uncalled for" defection and turf wars can occur frequently as firms actively explore unknown areas and launch aggressive actions to enhance their competitive

position relative to their rivals. The increased competition will also motivate firms to establish footholds in rivals' markets to better know of their behaviors as well as to strengthen retaliation or deterrence abilities.

More intense rivalry among competing companies in the same markets would increase profit volatility due to uncertain pass-through of a cost shock to price. To illustrate, consider a multi-niche industry in which only one firm is in each of its niche markets. When a shock occurs, the firm in a particular market can easily adjust its profit maximizing output due to lack of competition in the market. In this industry, as price covaries precisely with cost shocks, profit volatility will be low. In contrast, consider another industry in which firms concurrently encounter each other in several markets and face a cost shock. Greater competition between a firm and its rivals in multiple markets is associated with a loss in power for pricing. As a result, price does not effectively correlate with the level of production, and consequently, the pass-through of a cost shock to the product price is less likely and uncertain (Allayannis & Ihrig, 2001). In other words, due to the presence of MMC, a firm's price in each market will be less sensitive to a cost shock than that without MMC, implying a higher profit volatility.

Hedging allows firms to smooth cost fluctuations, lower income volatility, and charge competitive prices. This function of hedging offers firms flexibility, making their output choice less subjective to the impact of market shocks (Brown, 2001). This is especially true when the level of MMC is low or moderate where the competitive pressure that results from MMC outweighs the role of multimarket interactions as a deterrent to aggressive actions. Therefore, we predict that, at low to moderate levels of MMC, firms will be more likely to benefit from risk management as an *ex ante* defense strategy and they will hedge more accordingly.

> ***Hypothesis 1.*** *At low to moderate levels of MMC, the number of markets in which a firm meets with its rivals across all markets is positively related to its hedging level.*

Although greater market overlap increases the likelihood that rivals will compete with each other, more market interactions may not result in higher aggressiveness of competitive behavior if a firm has a high degree of market overlap with its rivals. The mutual forbearance hypothesis, grounded on multimarket competition theory (Edwards, 1955; Greve, 2008; Haveman & Nonnemaker, 2000), maintains that the intensity of competition between multipoint rivals may be dampened if firms have the mutual recognition of their interdependences. Multiple points of contact raise the possibility of collusion because it offers firms incentives to avoid the outbreak of an all-out war by taking forbearance actions. Extant theory suggests that familiarity and deterrence (Haveman & Nonnemaker, 2000) may help explain mutual forbearance as a result of a high degree of MMC (Jayachandran, Gimeno, & Varadarajan, 1999). Familiarity is a gauge of the extent to which a firm is acquainted with the strategies, business scopes, and actions of its rivals. Deterrence is a firm's ability to effectively retaliate against its rivals' attack with credible threats to cause serious financial damage to its rivals. When MMC reaches a high level, it provides more opportunities for firms to observe and detect their rivals' behavior and generates more channels for retaliation that form a credible threat for deterring aggressive actions, which facilitates mutual forbearance and leads to less rivalry. As firms refrain from aggressive rivalries, we expect that the hedging level will be low due to low competitive risk.

> ***Hypothesis 2.*** *At moderate to high levels of MMC, the number of markets in which a firm meets with its rivals across all markets is negatively related to its hedging level.*

Taken together, Hypotheses 1 and 2 depict an inverted-U shaped effect of MMC on hedging ratio changes.

Hedging Level and Competitors' Hedging Decisions

A firm's incentive to hedge may also depend on the risk aversion of its competitors. Two contradicting views exist with regard to how firms may act in response to their competing firms. On the one hand, behavioral and institutional scholars posit that firms will tend to mimic or converge toward their competitors for uncertainty reduction or legitimacy reasons (Cyert & March, 1963; DiMaggio & Powell, 1983). On the other hand, a structural view on competition (Gimeno & Woo, 1996; Porter, 1991) suggests that conformity is not always good as conformity will provoke similar competence development, increasing competition. In this respect, the extent to which a firm is able to secure competitive advantage "rests mainly on how well it positions and differentiates itself in an industry" (Hoskisson, Hitt, Wan, & Yiu, 1999: 426). Froot et al.'s (1993) conceptual model on risk management strategy offers a view similar to the differentiation proposition.

A firm will possess a significant advantage over its rivals if it has more cash flows to invest in high profit opportunities. If most firms do not hedge or hedge only a small portion of their positions, the sensitivity of their cash flows and investment to a negative common shock will be high. Upon occurrence, a cost shock will cause a drain on aggregate cash flows, a drop in aggregate output, and a rise in the equilibrium price. Under this condition, a firm will have an incentive to hedge and hedge more because hedging helps reduce production costs (Adam et al., 2007), allowing the firm to retain more capital and invest more in those states in which its rivals have limited capabilities to capture high profit opportunities.

In contrast, if the industry hedge level is high or most firms hedge a large fraction of their risk exposure, the equilibrium price will be low due to the high ensuing aggregate cash flows and aggregate output level. Therefore, the industry as a whole is not much sensitive to a cost shock.

Under this circumstance, a firm will gain more from speculating than hedging. As illustrated by the model of Adam et al. (2007), remaining unhedged allows a firm to enjoy real option benefits of production flexibility, the gain from which is more than the loss of cost reduction from hedging. Specifically, when a cost shock occurs, a nonhedger can reduce its volume of production to adjust to the already low price of commodity. In the absence of a cost shock, the unhedged firm will be able to retain more funds for investment and thus secure a higher market share than its hedged competitors. The interplay between firms' hedging choices suggests that a firm has the incentive to initiate a hedging action opposite to the decision of its rivals.

While there is reason to believe that the differentiation effect should overshadow the conformity effect in our context for hedging, we propose two competing hypotheses as eventually how a firm will hedge vis-à-vis its competitors is an empirical question.

> ***Hypothesis 3a.*** *The hedge level of a firm is negatively correlated with its competitors' hedge level.*
>
> ***Hypothesis 3b.*** *The hedge level of a firm is positively correlated with its competitors' hedge level.*

Hedging Level and Market Concentration

Analysis of competitive risk involves firm-level decisions on how to position a firm within its multimarket environment. Nevertheless, to better understand the effect of competition on risk management decisions, structural factors of competition such as market concentration should also be taken into account. Although concentration at the industry level is not particularly useful in predicting how specific firms are likely to respond to their rivals (Chen, 1996), this structural characteristic is certainly useful in explaining corporate behavior in response to competitive pressure of the overall market (Bain, 1956; Turner, Mitchell, & Bettis, 2010), which can affect

corporate risk decisions. That is, rivalry is not just a function of relational contacts, but it is also subject to the influence of the broad market context in which firms compete.

Market concentration refers to the extent to which market shares are concentrated in the hand of a small set of major firms in an industry. The literature on industrial organization (Bain, 1956; Mason, 1939; Caves, 1972) suggests that concentration may reduce market competition for a couple of reasons. First, increasing concentration calcifies market structure and bestows power on dominant firms, which prevents affronts and provocations by others (Cummins, Denenberg, & Scheel, 1972; Dobrev, Kim, & Carroll, 2002). Second, in concentrated markets, the stakes of firms at risk make them more willing to coordinate (Turner et al., 2010). In addition, as concentration increases, firms can more easily monitor and signal to each other, making collusion more likely to take place (Bain, 1951). Therefore, under high concentration, a firm is subject to a lower degree of product market competition and thus will need to transfer less risk. When the industry is less competitive, the firm has a higher pricing power to adjust its output so that a cost shock can be incorporated into its product price more easily. As the price and cost co-vary more closely, the firm is subject to a lower profit volatility. As such, there is a lower need to transfer risk when the product market competition overall is less intense. In line with this argument, Allayannis and Weston (1999) note that in an industry with a lower price-cost margin, ceteris paribus, a higher number of firms in an industry, firms are more likely to hedge with foreign currency derivatives. Therefore, we propose:

> ***Hypothesis 4.*** *As the industry concentration increases, the hedging level of multimarket firms decreases.*

Moderating Role of Market Concentration

Furthermore, although the effects of industry concentration and MMC could be separate, these factors may also interact to influence corporate hedging decisions. The influence of MMC

on hedging, as explained above, is made through the effects of competitive intensity and mutual forbearance, both of which may change as industry concentration increases. When MMC is low to medium, increased rivalry is the deciding factor for hedging decisions. Over this range of MMC, if concentration is low, even leading market players only hold small shares of the industry. The lack of domination will add more incentives to firms with low MMC to behave aggressively in hope of gaining greater market shares and higher profitability. As concentration increases, dominants start to emerge, which will stake out their territories of control and wield power to decrease competition for self-interests. The solidification of market structure will curb competitive tendency of firms with low MMC. Together, these arguments suggest that at low to medium levels of MMC, market concentration will negatively moderate the positive relationship between MMC and hedging ratio.

When MMC is medium to high, mutual forbearance is the major concern for hedging decisions. Over this range of MMC, if industry concentration is high, firms possess better abilities to deter others because the firms have higher stakes in the industry (Areeda & Turner, 1979). A more concentrated industry increases the credibility of retaliation expectations, which deflects firms from excessively aggressive behaviors. As concentration decreases, collusion becomes harder to sustain as coordination of activities across markets is easier for a small group of oligopolists than a large number of rivals (Bemheim & Whinston, 1990). Together, these arguments suggest that at medium to high levels of MMC, higher market concentration will magnify the negative relationship between MMC and hedging ratio. Therefore, we hypothesize:

> ***Hypothesis 5a.*** *At low to moderate levels of MMC, higher industry concentration will alleviate the positive effect of MMC on hedging.*
>
> ***Hypothesis 5b.*** *At moderate to high levels of MMC, higher industry concentration will aggravate the negative effect of MMC on hedging.*

METHODS

Sample

We tested our hypotheses using National Association of Insurance Commissioners (NAIC) data on PC insurance groups under common ownership and unaffiliated single insurance firms in the U.S. from 1995 to 2015. We aggregated the NAIC data on affiliated firms at the group level "because insurers formulate investment and risk management strategies at the overall corporate level" (Cummins, Dionne, Gagne, & Nouira, 2009: 148). The NAIC, formed in 1871, is a voluntary association of the chief insurance regulators of all states in the U.S., the District of Columbia, and five U.S. territories (American Samoa, Guam, Northern Mariana Islands, Puerto Rico, and the Virgin Islands). It mandates all active public and private insurance firms and their affiliates conducting business in the U.S. to file annual statutory financial statements prepared in conformity with Statutory Accounting Principles (SAP). The dataset compiled by the NAIC provides detailed information that allows us to construct measures on organizational characteristics such as firm size, leverage, and performance as well as industry-wide and firm-specific competitive factors that can potentially influence an insurer's risk management decisions.

Compared to many other datasets, this dataset is unique in the sense that the Exhibit of Premiums and Losses (Statutory Page 14) of the database contains extensive and detailed information on the breakdown of direct premiums written (transaction values) from L=28 product lines in the S=58 geographical areas for all insurers in each year, something which is unavailable for many other industries. The 28 product lines include the following insurance categories defined by the NAIC: fire, allied lines, farmowners' multiple peril, homeowners' multiple peril, commercial multiple peril, mortgage guaranty, ocean marine, inland marine, financial guaranty, medical professional liability, earthquake, group accident and health, credit accident and health,

all other accident and health, workers' compensation, other liability, products liability, auto liability, auto physical damage, aircraft, fidelity, surety, glass, burglary and theft, boiler and machinery, credit, warranty, and aggregate write-ins for other lines of business. The 58 geographical areas in the NAIC data are the 50 states in the U.S., District of Columbia, 5 major territories (American Samoa, Guam, the Northern Mariana Islands, Puerto Rico, and the U.S. Virgin Islands), Canada, and aggregate other alien. Thus, in total there are 1624 (i.e., L ×S = 28 lines × 58 geographical areas = 1624) markets in the U.S. PC insurance industry according to our data. Having a complete inventory of sales information of all insurers during this period allows us to more accurately assess the role that contact across markets plays in influencing reinsurance purchase decisions.

For the purpose of this study, we focused on the risk transfer of primary insurers and examined how their market overlap with other insurers affects the level of their reinsurance usage. We followed A. M. Best in defining a primary insurer as an insurer whose reinsurance assumed from nonaffiliates is less than 75 percent of the direct premium written plus reinsurance assumed from affiliates (Cole, Lee, & McCullough, 2007). We excluded from our sample insurers that have missing data and/or report zero or negative surplus, assets, premiums, losses, or expenses. The resulting sample is an unbalanced panel containing 15,994 observations (1,601 distinct insurers) for the 21-year period. Our sample accounts for 93.9 percent of total industry premium volume from 1995 to 2015.

Dependent Variable

Reinsurance is a commonly used hedging method for insurers to transfer catastrophic risk and stabilize profits. In such an arrangement, the primary insurer cedes part of its insurance

business to another insurer (called a reinsurer) by paying a premium. In exchange, the reinsurer will pay a share of the claims incurred by the primary insurer after a loss occurs.

To measure reinsurance demand, we used the level of reinsurance usage, which is defined as the percentage of reinsurance premium ceded over the sum of direct premium written and reinsurance premium assumed (Cole & McCullough, 2006). It represents the proportion of loss exposures that a primary insurer passes to a reinsurer or a group of reinsurers. If this ratio is 0, the primary insurer retains all of its underwriting risk and does not purchase any reinsurance. If this ratio is 1, the primary insurer hedges 100 percent of potential losses associated with its business and completely removes its risk exposure. This may occur when an insurer exits the insurance market. In most cases, the reinsurance ratio is between 0 and 1.

Independent Variables

Multimarket contact. PC insurance firms in the U.S. often compete with each other in more than one distinct product and geographical market. As such, the PC insurance industry in the U.S. offers a suitable setting for investigating rivalry in multiple product-geographic markets and its impact on an insurer's risk transfer. The theory developed above proposes first that the extent of MMC with market incumbents influences insurers' reinsurance purchase (Hypotheses 1 and 2). We employed a count measure, the most common measure of MMC, which adds up the number of markets in which the focal firm competes with its rivals (Evans & Kessides, 1994; Gimeno & Woo, 1996; Kalnins, 2004; Fuentelsaz & Gómez, 2006). Specifically, a count measure of MMC counts the number of contacts firms are competing in the same markets and the degree to which they overlap. Let the indicator $I_{ils} = 1$ if insurer i is competing in market (l,s) with positive direct premium written and 0 otherwise where l represents product line l and s denotes state s. Similarly, if insurer j is competing in market (l,s), $I_{jls} = 1$ and 0 otherwise. Insurers i and j have a contact

(shared market) in market (l,s) if both have positive premiums (sales) in line l (l = 1, 2, …, L) and state s (s = 1, 2, …, S). In this case, $I_{ils} \times I_{jls} = 1$. Then we compute the MMC of insurer i with insurer j in market (l,s) as follows:

$$MMC_{ijls} = I_{ils} \times I_{jls} \sum_{\widehat{ls} \neq ls, j \neq i}^{M} I_{i\widehat{ls}} \times I_{j\widehat{ls}},$$

where M (=L×S=28x58=1624) is the total number of product and geographical markets. Next we aggregate individual measure of MMC between the focal insurer i and insurer j into a measure of MMC between the focal insurer i and all its rivals in market (l,s):

$$MMC_{ils} = \frac{\sum_{j \neq i}^{N_{ls}} MMC_{ijls}}{N_{ls} - 1},$$

where N_{ls} is the number of competing firms in market (l,s). The prominence of market contacts can vary from market to market simply because contacts in markets critical to the firm's success and survival are more important than those in less strategically important markets. As pointed out by Chen (1996), the sheer number of shared markets may not fully capture the extent of competitive aggressiveness or implicit offers to collude that two firms may reach in a multimarket context. For example, two firms may only compete in a few markets, but they are the major rivals to each other in these markets. To account for the extent to which multipoint competition in a particular market is critical to the focal insurer, following Sengul and Gimeno (2013), we multiply total number of contacts of insurer i with its competitors in each market by its market share in that market to construct our firm-level MMC measure, MMC_i:

$$MMC_i = \sum_{l=1}^{L} \sum_{s=1}^{S} w_{ils} MMC_{ils},$$

where w_{ils} is the percentage of insurer i's total direct premium written in line l and state s:

$$w_{ils} = \frac{DPW_{ils}}{\sum_{l=1}^{L} \sum_{s=1}^{S} DPW_{ils}}. \qquad (1)$$

In the above equation for w_{ils}, DPW_{ils} is insurer i's direct premium written in market (l,s).

Level of reinsurance usage of competitors. Hypotheses 3a and 3b focus on the influence of competitors' hedging level on a focal firm's risk transfer. To test these hypotheses, we calculated the average reinsurance ratio of a focal firm's competitors. While the U.S. insurance industry contains a large number of multimarket firms, it also has some insurers that only focus on a single market. To study how the reinsurance levels of different competitors may shape the focal firm's reinsurance purchase, we further calculate the average reinsurance ratios of multi- and single-market competitors of the focal insurer respectively.

Market concentration. Our theory also proposes that the extent to which an industry is dominated by one or a few players directly affects a firm's hedging decision (Hypothesis 4) and indirectly changes a firm's hedging level through its moderating influence on effects of MMC (Hypotheses 5a and 5b). To better account for a focal insurer's state-line market space, we adopt a market space weighted Herfindahl index widely used in the insurance literature to capture industry-level competition (Liebenberg & Sommer, 2008; Berry-Stölzle, Liebenberg, Ruhland & Sommer, 2012). Based on the data reported for each business line within each state in the Exhibit of Premiums and Losses (Statutory Page 14), this market space weighted concentration faced by insurer i is calculated as follows:

$$\text{Weighted Herfindahl index}_i = \sum_{l=1}^{L} \sum_{s=1}^{S} w_{ils} HHI_{ls},$$

where w_{ils}, defined in (1), is the proportion of insurer i's premiums written in line l in state s. HHI_{ls} is the Herfindahl index of direct premiums written for line l in state s:

$$HHI_{ls} = \sum_{i=1}^{N_{ls}} \left(\frac{DPW_{ils}}{DPW_{ls}} \right)^2,$$

where DPW_{ls} is the total direct premiums written by all insurers in line l in state s. A higher value of Weighted Herfindahl index implies a more concentrated market space.

This weighted market concentration measure is more appropriate for testing our theory, which focuses on the actual industry-level competition pressure encountered by each insurer, than is the unweighted Herfindahl index, which incorporates market spaces where an insurer does not have business.

Control Variables

In addition to the variables used to test for the developed hypotheses, we also controlled for other factors suggested by the risk management and multimarket competition literatures. Our analysis included a range of additional firm characteristics, as well as industry-specific environmental factors. Hannan and Freeman (1984) predict that a firm's structural inertia is affected by firm age and size. To control for the inertia that may accompany firm aging and growth, we controlled for the age, Firm Age_i, defined as the number of years since insurer i was incorporated, and the size of insurer i, $Log(BV\ of\ assets)_i$, defined as the natural logarithm of total assets.

Reducing cash-flow volatility via insurance purchase can mitigate a firm's financial distress and bankruptcy costs and lower a firm's expected tax payments (Nance et al., 1993; Smith & Stulz, 1985). Following Myers and Read (2001) and Lin et al. (2015), to control for the effect of cash-flow volatility on an insurer's decision to purchase reinsurance, we calculated an insurer's overall volatility, σ, as follows:

$$\sigma = \sqrt{\sigma_A^2 + \sigma_L^2 - 2\sigma_{AL}},$$

where σ_A is the volatility of an insurer's assets based on six asset total return series and the weights invested in these six asset categories. The six asset categories are equities, government bonds,

corporate bonds, real estate, mortgages, and cash.[1] The volatility of an insurer's losses σ_L was estimated from a time series of loss ratios of six property lines of business and seven liability lines of business and their weights as a percentage of the insurer's total liabilities.[2] The term σ_{AL} is the covariance of losses and assets. Please refer to Cummins, Lin, and Phillips (2008) for the detailed estimation procedures.

A long-term contracting relationship with the same reinsurers reduces information problems and deters opportunism, leading to a lower reinsurance cost. As such, we expect a positive correlation between the level of reinsurance usage and the duration of contract relationships. To control for the impact of contract sustainability on reinsurance purchases, following Garven, Hilliard, and Grace (2014), we calculated a reinsurance sustainability index for each insurer at time t, defined as the proportion of premiums ceded over a 3-year period in the [t − 3, t] window to reinsurance providers that are present in all these 3 years.

Apart from firm-specific factors, reinsurance level may also be affected by the ability of firms to acquire market resources. Reinsurance purchase allows an insurer to increase underwriting capacity and capture more new value-enhancing business when market opportunities are abundant. Without reinsurance, an insurer has to forgo new business with liability losses in excess of its retention limit. Reinsurance makes it possible for an insurer to issue a single policy in excess of its retention limit for the full amount of insurance. As such, we expect insurers to hedge more in

[1]The proxies for these six asset categories are as follows: (1) equities—the Standard & Poor's 500 stock index; (2) government bonds—the Lehman Brothers intermediate term bond index; (3) corporate bonds—Moody's corporate bond index; (4) real estate—the National Association of Real Estate Investment Trusts (NAREIT) index; (5) mortgages—the Merrill Lynch mortgage-backed securities index; and (6) cash and invested assets—the 30-day U.S. Treasury bill.

[2]We classify property and liability business lines based on Schedule P of the NAIC regulatory annual statement. Specifically, the property lines of business include automobile physical damage, special property, fidelity and surety, accident and health, credit, and financial and mortgage guarantee. Liability lines include automobile liability, other (commercial) liability, medical malpractice, workers' compensation, special liability, commercial multiple peril, and homeowners/farmowners.

highly munificent environments. To control for this effect, we used market munificence as a measure of opportunities and options available to firms. Following Dess and Beard (1984) and Walters, Kroll, and Wright (2010), we first obtained the regression coefficient from a time-trend regression on total premiums written for each market (l,s) in line l (l= 1, 2, …, L) and state s (s = 1, 2, …, S). We then divided the regression coefficient by the mean value of total premiums in each market in the preceding five years. After calculating this ratio for all markets, we took a weighted average based on the percentage of an insurer's total premiums in each market in a given year, which gives us market munificence for that insurer. A higher value of market munificence represents a higher growth opportunity to an insurer offered by the industry.

We also controlled other firm characteristics with the following variables: (1) performance of the firm was approximated as return on assets; (2) leverage was measured as the ratio of total liabilities over total assets on the balance sheet; (3) effect of price regulation was measured by the percentage of premiums in price regulated lines (primarily personal auto and workers' compensation); and (4) dummy variables were included to indicate whether a firm is a stock or a mutual company.

Analysis Model

To shed light on the effect of market completion and mutual forbearance on an insurer's reinsurance level, we estimated the following two-way fixed effect model of reinsurance usage using a cross-sectional time series data with each insurer as a panel spanning a 21-year period:

$$Y_{i,t} = \alpha + \beta' X_{i,t} + \gamma' Z_{i,t} + \upsilon_i + \eta_t + \varepsilon_{i,t},$$

where the dependent variable $Y_{i,t}$ represents the reinsurance level, which is the ratio of reinsurance ceded to the sum of direct business written and reinsurance assumed (Cole and McCullough, 2006). The equation of reinsurance usage is specified as a function of independent $X_{i,t}$ and control

$Z_{i,t}$ variables. In this equation, two sets of the dummy variables υ_i and η_t control for the firm- and year-fixed effects respectively. This method mitigates the issue of non-independence of errors common in panel data (Hsiao, 1986). The Hausman test justifies a fixed-effects panel model over a random-effects specification ($p < 0.001$). Therefore, we report the results based on the fixed-effects model only. In addition to the fixed effects, to avoid some sources of heteroscedasticity identified by the White test and the Breusch-Pagan test, we corrected standard errors for heteroskedasticity. Moreover, the Wald Chi-Squared test suggests the significance of including independent variables in our regressions.

RESULTS

Table 1 presents the descriptive statistics and bivariate correlations matrix for the variables in the overall sample. The estimation data contain 15,994 observations representing 1,601 unique firms during the period 1995–2015. The average level of reinsurance usage is 24.19 percent. That is, on average, a primary insurer transfers 24.19 percent of its total premiums written and assumed from nonaffiliates to its reinsurers.

Insert Table 1 about here

To reduce the problem of multicollinearity caused by the linear terms of variables and its higher order terms (squared term and the linear and quadratic interactions used to test our hypotheses), we scaled all variables by subtracting the industry time series means from each observation prior to creating the quadratic and interaction terms (Cohen, Cohen, West, & Aiken, 2003). In addition, we checked the variance inflation factors (VIFs) for all regressions. All VIFs are below the recommended cutoff of 10. Therefore, multicollinearity should not be a concern to our data.

In Hypothesis 1, we predicted that over the low to moderate range of MMC, the number of markets in which a firm meets with its rivals across all markets will be positively related to its hedging level. In line with the hypothesis, Model 2 of Table 2 shows that the linear term for the MMC coefficient is significant and has a positive sign ($b=0.104$, $p < 0.001$), indicating that at lower levels increasing MMC increases reinsurance usage due to higher competitive pressure. Hypothesis 2 predicts that over the range of moderate to high levels of MMC, the number of markets in which a firm meets with its rivals across all markets will be negatively related to its hedging level. Model 2 reveals that the quadratic term is negative and significant ($b=-0.013$, $p<0.001$), indicating that at higher levels of MMC firms practice mutual forbearance to avoid competition as contact increases. The implied economic impact of these estimates is also substantial. For MMC one standard deviation larger than the mean, reinsurance ratio is 7.7% higher (31.9% larger than mean reinsurance ratio) after we consider both multipoint competition and mutual forbearance. Taken together, the main conclusions from empirical results on Model 2 confirm an inverted U-shaped relationship between an insurer's reinsurance level and the level of MMC it has with market incumbents.

Insert Table 2 about here

Hypotheses 3a and 3b offer competing predictions on the effect of competitors' hedging behavior on a firm's hedging level. Model 3 of Table 2 shows that the coefficient for average reinsurance ceded of all competitors is significantly negative ($b= -0.105$, $p < 0.001$). The result reveals that an insurer will purchase more reinsurance if its competitors have a lower level of reinsurance usage. Hedging catastrophic risk when other insurers do not allows an insurer to capture high profit opportunities in those states in which a cost shock depletes aggregate cash flows of most insurers in the industry. Hypothesis 3a is thus strongly supported.

While most PC insurers in the U.S. compete with each other simultaneously in multiple markets, they also meet with a small number of single-point competitors. Previous research on the impact of product market competition on corporate risk management has not investigated, logically or empirically, how the hedging levels of single-market and multimarket competitors affect a firm's hedging decision differently. As pointed out by Haveman and Nonnemaker (2000: 233), "potential competition (possible harm from aggressive competitive action by rivals) is greater among rivals who meet in multiple domains than among rivals who meet in a single domain." Accordingly, we expect that activities of multimarket competitors will have a more significant impact on a firm's hedging decision. Thus, to add to our knowledge of a firm's risk transfer affected by different types of rivals, we created two variables, average reinsurance ceded of single market competitors and average reinsurance ceded of multimarket competitors. Model 2 of Table 3 shows that the average reinsurance ratio of single market competitors does not affect an insurer's reinsurance level while Model 4 of Table 3 indicates that the average reinsurance ratio of single market competitors has a negative and significant impact on an insurer's reinsurance level ($b = -0.103$, $p < 0.05$). This result suggests that the negative relation between the average reinsurance ceded of all competitors and an insurer's reinsurance ratio is driven by multimarket competitors.

Insert Table 3 about here

Our investigation of the influences of market concentration over reinsurance decision continues in Model 4 of Table 2. We included a weighted Herfindahl index in our regressions. The variable measures the extent to which a market is dominated by one or a few large players. Market concentration is negatively related to reinsurance demand ($b = -0.084$, $p<0.05$), which supports Hypothesis 4. This pattern of results suggests that an insurer in a more concentrated industry has

a lower reinsurance usage because it has more pricing power to adjust its price in response to a cost shock, leading to a lower profit volatility and reinsurance need.

In addition to the main effect of market concentration, Hypotheses 5a and 5b predict that market concentration will moderate the effects of MMC on the level of reinsurance usage. Model 5 shows that the coefficient of the interaction between MMC and market concentration is negative and significant ($b = -0.168$, $p<0.05$), offering support to Hypothesis 5a. The coefficient of the interaction between MMC squared and market concentration is also significant ($b = 0.073$, $p<0.05$), but the sign is opposite to what Hypothesis 5b predicted.

Insert Figure 1 about here

Figure 1 graphically depicts the results of the interaction effects based on the parameter values generated by Model 6 of Table 2. There are two effects of MMC: (1) one is intensified competition that increases reinsurance demand and the other is mutual forbearance that reduces reinsurance need. Figure 1 shows that the two effects of MMC differ across markets with different levels of concentration. When concentration is low, both effects appears to work and mutual forbearance becomes more salient at the high level of MMC, resulting in a nonlinear, inverted-U shaped relationship between MMC and reinsurance level, supporting Hypotheses 1 and 2.

Figure 1 also shows that when market concentration is high, a firm actually hedges more at the very high levels of MMC than it does at low levels of MMC. This indicates that when both market concentration and MMC are high, risk exposure increases. This finding is consistent with Froot et al. (1993) who argue that a firm's risk exposure depends on the interdependence of its investment opportunities with product market rivals. Both Kovenock and Phillips (1997) and Zingales (1998) show that the risk that underinvestment leads to a loss of investment opportunities and market share to product market rivals is higher in more concentrated industries in which there

is greater interdependence in investment decisions. A high level of MMC may deepen such interdependence in a concentrated market. That is, a firm may have more similar operations and greater interdependence in investment opportunities with rivals due to their interactions in multiple battel fields, which amplifies the firm's risk exposure (Haushalter, Klasa, & Maxwell, 2007). As a result, an insurer with a high level of MMC will purchase more reinsurance than another with a lower level of MMC when market concentration is high.

Robustness Checks

Causal ambiguity. To ensure that our results are not driven by reverse causality, that is, a higher reinsurance usage enables a firm to increase the number of battlefields where it competes with the same group of rivals, we reran all of our models with one-year lagged independent and control variables. The results are qualitatively the same.

Familiarity among rivals. The square term of MMC we included in our regressions is used to account for the effect of mutual forbearance. Mutual forbearance relies on the assumption of familiarity or the extent to which rivals are able to decode each other's strategic intention (Jayachandran, Gimeno, & Varadarajan, 1999). Li and Greenwood (2004) argue that a firm can better monitor its rivals' actions and estimate their likely future responses if the rival firms are similar in terms of their size and market overlap. To investigate the robustness of our results, we replaced the square term of MMC with a similarity weighted MMC measure used by Li and Greenwood (2004) and reran all regressions. In results not reported here, we find that the coefficient of MMC is positive and significant and the coefficient of similarity weighted MMC is negative and significant, both of which echo the findings in Table 2. Similar to the interaction terms of MMC and weighted Herfindahl index in Table 2, the interaction term of MMC and weighted Herfindahl index is negative and significant and the interaction term of similarity

weighted MMC and weighted Herfindahl index is positive and significant. In sum, our main results are robust to an alternative measure of mutual forbearance that explicitly controls for firm similarity.

Endogeneity concern. As a firm's MMC is not at random, it is likely that organizational decisions that affect MMC may also affect the level of reinsurance usage. To address the concern of endogeneity, we conducted Durbin–Wu–Hausman and Wu–Hausman tests. The instrument we used is the percentage of total expenses in advertising. In our data, advertising expenses are highly correlated with a firm's level of MMC due to the fact that higher advertising expenses are often required when a firm meets more rivals in a broader scope of markets. However, advertisement spending is unlikely to affect the level of reinsurance usage beyond its effect through MMC. Thus, the instrument satisfies the relevance and exogeneity conditions of instrument validity. The results of the Durbin–Wu–Hausman and Wu–Hausman tests reveal that the null hypothesis that the MMC variable is exogenous cannot be rejected. Thus, while it is unlikely we can completely ruling out the potential effects of firm decisions on MMC, the tests indicate that endogeneity should not be a serious issue in our sample.

DISCUSSION AND CONCLUSION

This study sets out to better understand how firms hedge in response to multimarket competition and properties of market structure. Consistent with the argument that competition is relational dynamic, we find that MMC has a curvilinear impact on hedging level. Specifically, we find that over the range of low to moderate levels of MMC, an increase in MMC induces firms to hedge more. When the MMC frontier among rivals reaches high, firms hedge less when MMC increases. We also find that a firm's hedging decision depends on the overall hedging level of its competitors. In the insurance industry, instead of mimicry, differentiation appears to be the main

guiding principle used in directing hedging behavior. Finally, our findings provide evidence that besides its direct effect, the concentration of the market also moderates the relationship between MMC and hedging level. While an increase in market concentration erodes the positive effect of MMC on hedging ratio at low to moderate levels of MMC, a firm actually hedges more when market concentration and MMC are both high.

Our study extends existing work in the strategy literature on risk and firm decisions. Despite an early distinction made between managerial risk taking and organizational risk (Palmer & Wiseman, 1999), previous strategy research has mostly looked at the risk-taking propensity of firms under different performance conditions. Much less attention has been devoted to how firms are able to manage and offset risk through adjustment of their strategies. Given that risk management is value enhancing, understanding how firms respond to risk exposure is important because such knowledge will help uncover an important, but under-researched source of competitive advantages. As one of the few exceptions, Das and Teng (2001) demonstrate theoretically how trust and control involved with strategic alliances can be used to reduce risk in those alliances. Our study adds to this emerging line of strategy research by showing how firms hedge to respond to risk caused by interfirm rivalry.

Our work complements finance research on the effects of interfirm rivalry to hedging by highlighting the role of firm-specific competitive conditions in the process. This is the first study, to our knowledge, that shows a firm's hedging level is related to its multimarket contacts. While market concentration and MMC are both related to aggressiveness of competitive behavior, they affect interfirm rivalry through different mechanisms. Market concentration captures the structural aspect of competition at the industry level, which affects all market participants uniformly. The logic of the concept is built on the availability of growth opportunities (an incentive or a driving

force for competition) and/or the presence of dominating firms (a restraining force for competition) in the market. As concentration increases, opportunities start to vanish while dominance emerge. Thus, market concentration will reduce competitive activity monotonically. By contrast, MMC captures the relational aspect of rivalry, which is independent of the overall structure of the market and can vary across firms given their individual conducts. The effect of MMC is more complicated as the number of contacts between firms has two opposite effects. As the number of contacts between firms across markets increases, it not only expands the potential of rivalry, but also makes firms vulnerable to actions of competitors. Together, these effects predict a nonlinear relationship between MMC and competitive activity. Thus, the nature of the effects of market concentration and MMC is fundamentally different. More importantly, our results suggest that the two aspects of competition may interact to influence hedging level. It appears the need for hedging peaks when both MMC and market concentration are high. This might be explained by the fact that under this circumstance, firms face greater risk because if a price war breaks out among the few leading firms, the competition will quickly escalate across markets and lead to a devastating outcome to the firms. Being aware of the possibility, firms will hedge more to prepare for the worst.

Our results show that a firm's hedging ratio depends on the hedging levels of its competitors. This can be attributed to the fact that a firm has an incentive to transfer its cash flow to those states in which its competitors are relatively cash constrained as the firm gains more from additional investment when other firms in the industry invest less. Hedging represents a defensive action aimed at stabilizing cash flow and improving financial stability. This type of action is different from attacks, which are used to disrupt competitors. In this sense, this study also enriches the literature on competitive dynamics (Chen, 1996; Gao, Yu, & Cannella, 2017), which has

traditionally focused on attack/response dyads. We show empirically that firms also act to respond to rivals' defensive actions.

Moreover, this paper advances the theory of multimarket competition and its empirical foundation. MMC has been found to be important to firm decisions on market entry and exit (Baum & Korn, 1996), internal resource allocation (Sengul & Gimeno, 2013), and investment on technology (Anand, Mesquita, & Vassolo, 2009). In his study on investment banks in the U.K., Shipilov (2009) shows that MMC also serves as a governance mechanism in reducing risk of partner noncooperation. Adding to this line of research, we show that MMC is related to hedging level. We explicitly recognize that the multipoint effect may not be monotonic across the entire range of MMC levels. Our paper extends recent studies that have found a nonlinear relationship between MMC and corporate strategy (Baum & Korn, 1999; Haveman & Nonnemaker, 2000). We show that there is an inverted-U shaped relation between MMC and hedging level depending on competitive rivalry and collusion between firms.

There are several limitations of the study, which offer directions for future research. First, in this study, we only looked at one particular industry. While the U.S. PC insurance industry offers an ideal setting for an initial study on the effects of different levels of competition on hedging like this one, it would be meaningful for future research to test whether our findings can be generalized to other industries. For example, in our study, the effect of MMC on the reinsurance ratio turns from positive to negative only if a firm's MMC level with its rivals reaches approximately 95 percentile of the whole sample. The high inflection point or "competitive cusp" named by Porac, Thomas, and Baden-Fuller (1989) suggests that in the U.S. PC insurance industry, the competitive pressure is high and mutual forbearance comes to take over only at the high level of market overlap. Given the relevance of inflection points for the practice of risk management, research efforts

should be dedicated to study how the inflection point can change across industries and what contributes to the variations. Second, our study is limited by our focus on reinsurance purchase. While this focus is well justified as reinsurance is widely used by insurance firms and it stands for a better empirical proxy for hedging than some others, for example, financial derivatives, which can be used by firms to speculate and take higher risk (Adam and Nain, 2013), there may be merit in examining the effects of rivalry on other hedging techniques.

In summary, the present article provides a number of predictions and empirical evidence that contribute to researchers' understanding of the effect of competition on corporate risk management. By measuring MMC and accounting for the structure of markets, we highlight the significance of both industry-level and firm-specific competitive relationships in explaining a firm's hedging level. The measures of MMC refine the important idea of product market competition, which gains great attention in the management, finance and risk management literatures in recent years. The micro-focus on firm-specific competitive relationships and their interactions with industry risk factors contribute toward the ultimate goal of explaining corporate hedging behavior.

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TABLE 1
Descriptive statistics

Variables	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1 Reinsurance ceded	24.19	22.82	1.00															
2 Multimarket contact	43.80	83.40	-0.09	1.00														
3 Log(BV of assets)	18.33	2.27	-0.26	0.65	1.00													
4 Return on assets (%)	2.60	5.97	-0.09	0.00	0.03	1.00												
5 Leverage	0.56	0.18	-0.03	0.17	0.31	-0.22	1.00											
6 Reinsurance sustainability index	0.59	0.36	0.05	0.13	0.14	-0.07	-0.01	1.00										
7 Premiums in price regulated lines (%)	0.23	0.31	-0.19	0.00	0.18	-0.07	0.31	-0.02	1.00									
8 Firm age	58.80	50.11	-0.03	0.32	0.23	-0.06	-0.17	0.19	-0.13	1.00								
9 =1 if mutual company	0.29	0.45	0.05	-0.21	-0.24	-0.04	-0.18	0.10	-0.09	0.36	1.00							
10 =1 if stock company	0.47	0.50	-0.04	0.06	0.14	0.01	0.05	-0.07	0.13	-0.23	-0.61	1.00						
11 Firm's overall volatility	0.22	0.15	0.07	-0.17	-0.21	0.00	-0.26	0.02	-0.35	0.09	0.20	-0.14	1.00					
12 Market munificance	0.04	0.05	0.06	0.03	-0.02	0.05	-0.01	-0.07	-0.09	0.08	0.06	-0.04	-0.04	1.00				
13 Weighted Herfindahl index	10.10	7.51	-0.09	-0.08	0.12	0.05	0.08	-0.03	-0.04	-0.15	-0.08	0.06	0.06	-0.01	1.00			
14 Average reinsurance ceded of all competitors	19.82	4.12	0.03	-0.60	-0.43	0.01	-0.06	-0.09	0.01	-0.21	0.14	-0.09	0.10	0.06	0.09	1.00		
15 Average reinsurance ceded of single market competitors	20.81	8.34	0.08	-0.27	-0.25	0.03	-0.06	-0.03	-0.09	-0.12	0.07	-0.05	0.06	0.07	0.04	0.48	1.00	
16 Average reinsurance ceded of multimarket competitors	19.35	4.68	0.03	-0.67	-0.47	0.00	-0.08	-0.09	0.03	-0.20	0.16	-0.10	0.11	0.05	0.09	0.88	0.26	1.00

# of obs: 15,994

TABLE 2
Results of the Two-Way Fixed Effects Regression Analyses for the Level of Reinsurance Usage

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	56.428 ***	78.499 ***	80.964 ***	79.636 ***	80.987 ***	83.411 ***
	(7.86)	(9.95)	(10.18)	(10.03)	(10.09)	(10.32)
Control variables						
Log(BV of assets)	-3.612 ***	-5.051 ***	-5.067 ***	-5.083 ***	-5.115 ***	-5.130 ***
	(8.57)	(10.71)	(10.75)	(10.76)	(10.78)	(10.82)
Return on assets (%)	-0.102 ***	-0.098 ***	-0.097 ***	-0.096 ***	-0.096 ***	-0.095 ***
	(3.54)	(3.37)	(3.35)	(3.32)	(3.31)	(3.28)
Leverage	14.676 ***	14.331 ***	14.362 ***	14.337 ***	14.236 ***	14.269 ***
	(7.51)	(7.30)	(7.32)	(7.30)	(7.25)	(7.27)
Reinsurance sustainability index	2.148 ***	2.076 ***	2.072 ***	2.067 ***	2.056 ***	2.052 ***
	(5.58)	(5.41)	(5.40)	(5.39)	(5.36)	(5.35)
Premiums in price regulated lines (%)	-1.081	0.129	0.152	-0.040	-0.076	-0.049
	(0.50)	(0.06)	(0.07)	(0.02)	(0.04)	(0.02)
Firm age	0.030 *	0.002	0.003	0.000	0.001	0.002
	(1.94)	(0.12)	(0.17)	(0.01)	(0.07)	(0.12)
=1 if mutual company	1.829 **	2.028 ***	1.912 ***	2.022 ***	2.020 ***	1.905 ***
	(2.55)	(2.83)	(2.66)	(2.82)	(2.82)	(2.65)
=1 if stock company	-1.635 ***	-1.569 ***	-1.662 ***	-1.584 ***	-1.581 ***	-1.673 ***
	(2.91)	(2.80)	(2.95)	(2.82)	(2.82)	(2.97)
Firm's overall volatility	-3.975 **	-4.255 ***	-4.279 ***	-4.314 ***	-4.320 ***	-4.343 ***
	(2.51)	(2.74)	(2.74)	(2.76)	(2.77)	(2.78)
Market munificance	15.640 ***	13.778 ***	13.693 ***	14.373 ***	14.295 ***	14.205 ***
	(5.07)	(4.51)	(4.49)	(4.74)	(4.69)	(4.67)
Firm-specific competitive conditions						
Multimarket contact		0.104 ***	0.101 ***	0.103 ***	0.104 ***	0.101 ***
		(7.68)	(7.46)	(7.63)	(7.74)	(7.52)
Multimarket contact square (/100)		-0.013 ***	-0.014 ***	-0.013 ***	-0.014 ***	-0.014 ***
		(3.61)	(3.65)	(3.61)	(3.79)	(3.83)
Market-level competitive conditions						
Average reinsurance ceded of all competitors			-0.105 ***			-0.105 ***
			(2.66)			(2.65)
Weighted Herfindahl index				-0.084 **	-0.132 ***	-0.131 ***
				(2.03)	(2.71)	(2.69)
Interaction effects						
Weighted Herfindahl index x Multimarket contact (/100)					-0.168 **	-0.166 *
					(1.97)	(1.94)
Weighted Herfindahl index x Multimarket contact square (/10000)					0.073 **	0.074 **
					(2.30)	(2.32)
Diagnostics						
R^2	67.04%	67.26%	67.27%	67.27%	67.28%	67.29%
ΔR^2		0.22%	0.23%	0.23%	0.24%	0.25%
Wald Chi-Squared Test for ΔR^2		98.17 ***	102.85 ***	103.08 ***	107.09 ***	111.71 ***
Test - H_0: no fixed effects (F-value)	17.9 ***	18.1 ***	18.1 ***	18.1 ***	18.0 ***	18.0 ***
No. of observations	15,994	15,994	15,994	15,994	15,994	15,994

The t-statistics based on heteroscedasticity-consistent (HCC) standard errors are reported in parentheses.
***, **, and * denote signicance at the 1%, 5%, and 10% level (two-sided), respectively.

TABLE 3
Results of the Two-Way Fixed Effects Regression Analyses for the Level of Reinsurance Usage
Single-Market Competitors vs. Multimarket Competitors

	(1)	(2)	(3)	(4)
Intercept	78.857 ***	81.312 ***	80.577 ***	83.080 ***
	(9.96)	(10.10)	(10.17)	(10.31)
Control variables				
Log(BV of assets)	-5.058 ***	-5.121 ***	-5.056 ***	-5.119 ***
	(10.73)	(10.79)	(10.73)	(10.80)
Return on assets (%)	-0.097 ***	-0.096 ***	-0.097 ***	-0.095 ***
	(3.37)	(3.30)	(3.36)	(3.29)
Leverage	14.342 ***	14.246 ***	14.356 ***	14.262 ***
	(7.31)	(7.26)	(7.32)	(7.27)
Reinsurance sustainability index	2.077 ***	2.057 ***	2.071 ***	2.050 ***
	(5.41)	(5.37)	(5.39)	(5.35)
Premiums in price regulated lines (%)	0.108	-0.094	0.195	-0.005
	(0.05)	(0.04)	(0.09)	(0.00)
Firm age	0.002	0.001	0.001	0.001
	(0.13)	(0.08)	(0.08)	(0.03)
=1 if mutual company	2.022 ***	2.014 ***	1.894 ***	1.885 ***
	(2.83)	(2.81)	(2.64)	(2.62)
=1 if stock company	-1.567 ***	-1.579 ***	-1.688 ***	-1.700 ***
	(2.79)	(2.82)	(2.98)	(3.01)
Firm's overall volatility	-4.259 ***	-4.324 ***	-4.284 ***	-4.347 ***
	(2.74)	(2.78)	(2.74)	(2.77)
Market munificance	13.793 ***	14.308 ***	13.564 ***	14.069 ***
	(4.52)	(4.70)	(4.45)	(4.63)
Firm-specific competitive conditions				
Multimarket contact	0.104 ***	0.104 ***	0.101 ***	0.101 ***
	(7.66)	(7.72)	(7.46)	(7.52)
Multimarket contact square (/100)	-0.014 ***	-0.014 ***	-0.014 ***	-0.014 ***
	(3.61)	(3.79)	(3.69)	(3.88)
Market-level competitive conditions				
Average reinsurance ceded of single market competitors	-0.008	-0.008		
	(0.49)	(0.45)		
Average reinsurance ceded of multimarket competitors			-0.101 **	-0.103 **
			(2.51)	(2.55)
Weighted Herfindahl index		-0.132 ***		-0.132 ***
		(2.71)		(2.71)
Interaction effects				
Weighted Herfindahl index x Multimarket contact (/100)		-0.168 **		-0.168 **
		(1.96)		(1.97)
Weighted Herfindahl index x Multimarket contact square (/10000)		0.073 **		0.076 **
		(2.30)		(2.40)
Diagnostics				
R^2	67.26%	67.28%	67.27%	67.29%
Test - H_0: no fixed effects (F-value)	18.1 ***	18.0 ***	18.1 ***	18.0 ***
No. of observations	15,994	15,994	15,994	15,994

The t-statistics based on heteroscedasticity-consistent (HCC) standard errors are reported in parentheses.
***, **, and * denote signicance at the 1%, 5%, and 10% level (two-sided), respectively.

FIGURE 1
Interaction between Weighted Herfindahl Index and Multimarket Contact