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Multimarket Contact and Rivalry over Knowledge-based Resources

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Research summary: *Research shows that multimarket contact (MMC) reduces rivalry involving downstream activities. Yet, studies showing that MMC can increase the threat of imitation suggest a need to better understand how MMC affects upstream rivalry over knowledge-based resources. In this study, we argue that MMC increases rivalry over knowledge-based resources since the deterrent threat of retaliation that typically leads to mutual forbearance in downstream activities will not be sufficient to restrain firms from protecting their knowledge from imitation in upstream activities. In support of these arguments we find that MMC increases the likelihood that a firm initiates patent litigation against a rival. This study suggests the relationship between MMC and rivalry may depend on the competitive domain and the type of resources over which firms are competing.*

Managerial Summary: *How does market overlap or MMC affect rivalry between two competitors? Prior studies have largely found that an increase in market overlap decreases rivalry in less knowledge-intensive context because of the deterrent threat of retaliation. However, in this paper, we argue that an increase in market overlap may not reduce rivalry in more knowledge-intensive context because of heterogeneity in capabilities to protect knowledge. We find that a firm is more likely to initiate patent litigation against a rival as market overlap increases. Our findings suggest that the incentive to protect value across multiple product markets may surpass the motivation to cooperate with rivals and that managers should have a more nuanced view of how market overlap with competitors affects rivalry in more knowledge-intensive contexts.*

Knowledge-based resources play an important role for firms in creating a competitive advantage (Grant, 1996; Ndofor, Sirmon, & He, 2011). To achieve competitive advantage from their knowledge, firms need to both create valuable innovations (McEvily & Chakravarthy, 2002; Nelson & Winter, 1982) and protect the value of their knowledge when competing against rival firms (Giarratana & Mariani, 2014; Liebeskind, 1996; Teece, 1986). This competition often occurs across multiple markets, increasing multimarket contact (MMC) with rival firms (Fuentelsaz & Gómez, 2006; Li & Greenwood, 2004).

Prior research on MMC has largely shown that firms can benefit from less intense rivalry as market overlap increases between two competitors—the mutual forbearance hypothesis (Edwards, 1955; Jayachandran, Gimeno, & Varadarajan, 1999; Korn & Baum, 1999; Yu & Cannella, 2013). In particular, prior studies emphasize the benefits of reduced rivalry associated with MMC involving downstream activities such as new product and pricing actions (Kang, Bayus, & Balasubramanian, 2010; Young, Smith, Grimm, & Simon, 2000) and market entry and exit decisions (Haveman & Nonnemaker, 2000; Korn & Baum, 1999). However,

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other research suggests that competition can also encompass upstream activities related to firms' resources (Barney, 1986; Bergen & Peteraf, 2002; Capron & Chatain, 2008; Markman, Gianiodis, & Buchholtz, 2009). Upstream rivalry often entails higher uncertainty than downstream rivalry, since activities such as R&D rely on extensive search and exploration (March, 1991; Nelson & Winter, 1982). Moreover, recent research suggests that MMC heightens the threat of imitation that firms experience from rivals (Lieberman & Asaba, 2006), and studies show that MMC increases patenting (Greve & Mitsuhashi, 2004) and the extent to which rival firms build on one another's knowledge (Cassidy & Loree, 2001; Scott, 2001).

These studies suggest the possibility that firms face a tension on the one hand to leverage knowledge across multiple markets but on the other hand to protect the value of their knowledge from multimarket rivals. In other words, a firm's ability to fully leverage the value from knowledge-based resources may result in increasing MMC with rival firms, which can expose knowledge-based resources to an increased threat of imitation. Hence, MMC encourages firms to be less rivalrous with downstream activities but more rivalrous with upstream activities to protect knowledge-based resources. Extant research on MMC has not fully addressed this tension or examined how MMC affects the decision to protect a firm's knowledge-based resources from rivals.

With the goal of exploring this tension, this current study develops theory about how MMC affects rivalry over knowledge-based resources involving patent litigation. Because MMC increases the threat of imitation (Lieberman & Asaba, 2006) at the same time that heterogeneity exists in rivals' ability to protect their knowledge (Clarkson & Toh, 2010; Teece, 1986), we argue that the motivation to protect knowledge will tend to outweigh the deterrent effect of retaliation by the rival. Accordingly, we propose that the mutual forbearance effect arising from the threat of retaliation by a rival firm will not occur as MMC pushes firms to protect knowledge-based resources. To increase confidence in our causal mechanisms, we develop contingencies related to: (a) a firm's motivation to protect knowledge and (b) the deterrent effect of retaliation by a rival. Hence, we argue that the technological quality of the firm's knowledge and the rival's ability to protect its knowledge will respectively exacerbate and attenuate the positive relationship between MMC and knowledge protection.

This study adds new insights about the relationship between MMC and mutual forbearance by showing that this relationship may depend on the competitive domain and the nature of the resources over which firms are competing. In doing so, we add to prior studies that have begun to unpack the boundary conditions affecting the MMC–mutual forbearance relationship (Yu & Cannella, 2013) by examining factors such as market entry characteristics (Fan, 2010), the observability of strategies (Greve, 2008), and international market characteristics (Yu, Subramaniam, & Cannella, 2009). While we do not question the traditional mutual forbearance hypothesis found in downstream activities and in less knowledge-intensive contexts, we suggest a more nuanced relationship depending on the domain. More specifically, we argue that firms may become more protective of their knowledge-based resources in upstream activities and in more knowledge-based contexts and that MMC may lead to increasing rivalrous behavior.

This study also contributes to strategy research on the defensive strategies that firms use to protect proprietary technological assets. Studies have made important strides advancing understanding of organizational and technological antecedents of knowledge protection efforts (e.g., Hall & Ziedonis, 2007; Lanjouw & Schankerman, 2001; Polidoro & Toh, 2011) and about the deterrent role that a firm's reputation for protecting its resources plays in mitigating the leakage of knowledge and the loss of employees (Agarwal, Ganco, & Ziedonis, 2009; Ganco, Ziedonis, & Agarwal, 2015). We show that MMC between rival firms may be another important determinant of a firm's decision to protect its knowledge-based resources. Furthermore, we also contribute to the resource base theory and competitive dynamics literature by developing theory about how downstream market contact between rivals shapes firms' subsequent upstream competitive interactions in factor markets. We elaborate on these contributions in the discussion section.

Theory and Hypotheses

Multimarket contact (MMC), which is essentially the extent of market overlap between two firms, has been shown to affect the intensity of rivalry

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or multimarket competition.[1] The basic notion of MMC centers on Edwards' (1955) mutual forbearance hypothesis. That is, the intensity of rivalry decreases between two firms as the number of markets that they compete or overlap in increases. Mutual forbearance occurs because familiarity and deterrence increase as two firms compete across more common markets. Familiarity enhances understanding of each other's capabilities and actions while deterrence enhances the threat of retaliation across multiple markets. Consequently, MMC encourages firms to tacitly cooperate with each other for mutual benefit by deterring them from engaging each other aggressively.

By and large, prior studies have found support for the mutual forbearance hypothesis—firms enjoy higher performance and lower rivalry as MMC increases (Baum & Korn, 1999; Jayachandran et al., 1999; Yu & Cannella, 2013). For example, numerous studies have shown a positive relationship between MMC and performance such as market share stability (Heggestad & Rhoades, 1978), cost–price margins (Feinberg, 1985), and yields (Gimeno & Woo, 1999). Similarly, other studies have shown that an increase in MMC reduces aggressive competitive behavior such as new product and pricing actions (Kang et al., 2010; Young et al., 2000) and market entry and exit (Fuentelsaz & Gómez, 2006; Haveman & Nonnemaker, 2000; Korn & Baum, 1999). While much of these studies showed a linear relationship between MMC and reducing rivalry, a few studies that focused on market entry demonstrated a curvilinear (or inverted U-shaped) relationship. That is, entry or rivalry increased at lower levels of MMC and then decreased at higher levels of MMC. In total, these studies provide empirical evidence for the benefits of MMC to firms in reducing rivalry.

Multimarket Contact and Rivalry over Knowledge-Based Resources

As mentioned previously, mutual forbearance, or rivalry restraint, results when competition across more common markets increases the familiarity of rivals' capabilities and actions and the deterrent threat of retaliation across multiple markets (Edwards, 1955; Jayachandran et al., 1999). Hence, mutual forbearance occurs when multimarket competitors act less aggressively in anticipation that rivals have the ability to counterattack. It is important to point out that that the mutual forbearance hypothesis implicitly assumes that rivals have similar action-response capabilities, since this is what ultimately gives rise to the threat of retaliation. Indeed, Jayachandran et al. (1999: p. 58) state that "regardless of multimarket contact, if one firm has a resource advantage over its rival, it may not be motivated to forbear from aggressive competition because of the perception that it can outmaneuver the competition, which cannot match its resources." Similarly, Makadok (2010) proposes that the extent of competitive advantage determines whether a firm refrains or engages a rival and demonstrates that firms with a resource disadvantage or small resource advantage prefer restrained rivalry, while firms with a significant resource advantage prefer aggressive rivalry. Hence, we argue below that MMC will not restrain rivalry over knowledge-based resources because the incentives to protect knowledge will encourage firms with resource advantages to engage rivals.

In knowledge-intensive contexts, the ability to develop heterogeneous resources is a particularly important determinant of competitive success (DeCarolis & Deeds, 1999; Grant, 1996; Nelson & Winter, 1982) and studies show that imitation poses a significant threat to the value of heterogeneous knowledge-based resources (Peteraf, 1993). MMC can increase familiarity of a focal firm's heterogeneous resources leading to a greater imitation threat from rivals, which increases a focal firm's incentives to protect its knowledge. Yet, at the same time resource heterogeneity suggests differences in firms' abilities to take actions to protect knowledge-based resources, which means that rivals may or may not be able to retaliate against a firm's efforts to protect its knowledge. Consequently, when firms compete across multiple markets, the deterrent threat of retaliation that typically leads to mutual forbearance in downstream rivalry will not be sufficient to restrain firms from protecting their knowledge-based resources from imitation in upstream rivalry.

An evolving stream of research suggests that MMC can increase rivalry over knowledge-based resources. Imitation and knowledge spillovers

[1] Karnani and Wernerfelt (1985: p. 87) define multimarket competition as "a situation where firms compete against each other simultaneously in several markets." Yu and Cannella (2013: p. 76) note that "MMC simply indicates that two firms meet each other in more than one market, while multimarket competition refers to both the existence of MMC and how it affects the interfirm engagement, or rivalry."

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can undermine the competitive value of knowledge-based resources and can increase due to competitive proximity (Giarratana & Mariani, 2014; Lippman & Rumelt, 1982). Lieberman and Asaba (2006: p. 377) note that MMC "increases the likelihood of rivalry-based imitation, since it expands the domains where imitation can occur and raises the probability that firms respond to each other in kind." In line with these arguments, Anand, Mesquita, and Vassolo (2009) show a positive relationship between MMC and explorative market entry as measured by R&D investments in a particular market segment. They argue that knowledge-based resources such as R&D investments encourage mimetic behavior to manage competitive uncertainty; hence, MMC leads to increased knowledge-based rivalry. Likewise, in a study of the shipbuilding industry, Greve and Mitsuhashi (2004: p. 17) argue and find support that greater MMC will increase incentives to innovate and encourage firms "to be more active in taking out patents in that market, as they expect higher profits from each patent." Besides patenting activities, two studies of the semiconductor and chemical industries indicate that MMC increases firms' tendency to engage in the citation of other firms' patents (Cassidy & Loree, 2001; Scott, 2001). On the whole, these studies demonstrate that in knowledge-intensive contexts, MMC increases the threat of imitation by rivals. These studies diverge from the typical findings that MMC reduces rivalry and underscore the need to better understand how MMC pushes firms to engage in knowledge-based rivalry to protect their knowledge-based resources from imitation.

A firm's ability to profit from knowledge-based resources depends both on the value of its knowledge and on whether the firm has the ability to prevent imitation by rivals (Teece, 1986). Research shows that firms can use different mechanisms to protect their knowledge-based resources, such as secrecy, lead time, complementary assets, and patents (James, Leiblein, & Lu, 2013; Levin, Klevorick, Nelson, & Winter, 1987). To protect their knowledge, strategy research also recognizes that firms may have to take competitive actions against rivals by initiating patent litigation (Pisano, 2006; Polidoro & Toh, 2011). Studies show that heterogeneity exists in firms' ability to protect their knowledge-based resources. For example, since obtaining a patent presupposes that a firm has established the novelty of its invention (Dam, 1994; Scotchmer & Green, 1990), a firm in possession of a patent often has a unique ability to initiate patent litigation.

The heterogeneity in rival firms' ability to protect their knowledge-based resources creates asymmetry in their ability to initiate and respond to rivals' actions. As a result, the threat of retaliation by a rival that leads to mutual forbearance becomes less likely. For example, Liebeskind (1996: p. 94) proposes that "some firms are able to protect their knowledge from expropriation or imitation more effectively than other firms." Likewise, the role of competitive asymmetry in firms' effort to protect knowledge-based resources is illustrated by an excerpt from an article by a UCLA expert on intellectual property law: "Every time a patent holder thinks about filing a patent lawsuit, the first question to ask is whether the intended target will be able to retaliate"(Lichtman, 2012: para. 2). This asymmetry to initiate and respond to competitive actions may enable firms that possess a superior ability to protect knowledge-based resources as a source of Ricardian action (Grimm, Lee, & Smith, 2006). As Capron and Chatain (2008) argue, firms that possess property-based resources, such as exclusive rights to a technology, are more likely to initiate actions against rivals since rivals do not possess those resources used to counterattack them. Consequently, unlike other types of downstream competitive actions, such as pricing moves and product positioning where rivalry is restrained precisely because of the imminent threat of retaliation from rivals with similar action–response capabilities, the deterrent effect of retaliation by a rival is dampened as a result of the greater heterogeneity that exists in rivals' ability to initiate and respond to actions aimed at protecting knowledge from imitation.

Differences in action–response capabilities between downstream and upstream actions are illustrated by prior research. For instance, research shows a 28% overall likelihood of retaliation to downstream competitive moves (i.e., pricing, route, ticketing, collaboration, service, and cargo-related) in the airline industry (Marcel, Barr, & Duhaime, 2011: p. 127). Studies also indicate that firms will respond to a rival's pricing actions at a higher rate than non-pricing actions (Montgomery, Moore, & Urbany, 2005; Venkataraman, Chen, & MacMillan, 1997). Specifically, 36% of managers surveyed in another study indicated that they would add price promotions in response to competitors' price promotions (Steenkamp, Nijs, Hanssens, & Dekimpe,

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2005: p. 47). Other research shows a 93% competitive response rate to new product introductions by incumbents in the consumer and industrial goods industries (Kuester, Homburg, & Robertson, 1999: p. 101). The relatively high retaliatory responses to pricing and new products compare to an average retaliation rate of approximately 10% for patent litigation countersuits across the computer and research medicine industries (Somaya, 2003: pp. 25–26).[2] Given this disparity, the deterrent threat of MMC may be more pronounced involving downstream pricing and product actions, leading to the typical mutual forbearance. Conversely, the deterrent threat of MMC may be weaker involving upstream efforts to protect knowledge using patent litigation, leading to less restraint.

In sum, we argue that increasing MMC pushes firms to engage in knowledge-based rivalry against competitors to protect the value of their knowledge-based resources. That is, a firm's ability to capture value from knowledge-based resources results in increasing MMC with rival firms, which raises familiarity and can expose knowledge-based resources to an increased threat of imitation. More importantly, when firms compete across multiple markets, the deterrent threat of retaliation that typically leads to mutual forbearance in downstream rivalry will not be sufficient to restrain firms from protecting their knowledge-based resources from imitation in upstream rivalry. Hence, it follows that:

> *Hypothesis 1 (H1): There is a positive relationship between multimarket contact and the likelihood that the focal firm will protect its knowledge-based resources by initiating a patent lawsuit against a rival firm.*

To increase confidence in our argument that increasing MMC leads firms to protect the value of their knowledge-based resources, because the incentives to protect knowledge-based resources amid multimarket competition will tend to outweigh the threat of retaliation by a rival firm, we develop two contingencies that build on these mechanisms. In H2, our first contingency focuses on the focal firm's incentives to protect knowledge-based resources amid multimarket competition by arguing that the technological quality of the focal firm's knowledge should exacerbate the positive relationship between MMC and knowledge protection. In H3, our second contingency focuses on the threat of retaliation by a rival firm by arguing that the rival firm's ability to protect its knowledge should attenuate the positive relationship between MMC and knowledge protection.

Contingent Effect of the Technological Quality of the Focal Firm's Knowledge

In H1, we argue that MMC increases the likelihood that a firm will protect its knowledge-based resources because of the increased threat of imitation that it faces from multimarket competitors. If MMC increases a firm's motivation to protect its resources from imitation by rivals, then factors that further increase a firm's motivation to protect its knowledge-based resources should exacerbate this positive effect. Prior research shows that the technological quality of a firm's knowledge-based resources enhances the value of a firm's innovations (Trajtenberg, 1990) and increases its shareholder value (Hall, Jaffe, & Trajtenberg, 2005). We argue that the technological quality of the focal firm's knowledge will positively moderate the relationship between MMC and the focal firm's decision to protect its knowledge-based resources from a rival.

When deciding whether or not to respond to the increased threat of imitation that results from MMC, the focal firm will take into account the value of its knowledge-based resources. If the technological quality of the focal firm's knowledge is low, a focal firm will be less motivated to protect its knowledge from the increased threat of imitation that results from multimarket competition. Conversely, if a focal firm possesses higher quality knowledge-based resources, its motivation will be even greater to protect the value of these resources from imitation by a multimarket rival. Therefore:

> *Hypothesis 2 (H2): The technological quality of the focal firm's knowledge-based resources will exacerbate the positive relationship between MMC and the likelihood that the focal firm will protect its knowledge-based resources by initiating a patent lawsuit against a rival firm.*

[2] Somaya's (2003: p. 25) 8% countersuit rate for computer firms and 1.5% for medical firms result in a 6% weighted average. The bias corrected rates (footnote 10, p. 26) of 14% and 3% respectively result in a 10% weighted average.

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Contingent Effect of Rival Firm's Ability to Protect Its Knowledge

If as we argued above in H1, MMC creates incentives to protect knowledge-based resources that tend to outweigh the deterrent threat of retaliation, then factors that increase a rival's ability to retaliate by protecting its own knowledge should also moderate the relationship between MMC and knowledge protection. As mentioned previously, research shows that competitive asymmetry between rivals can undermine deterrence by making firms more likely to initiate actions against rivals who lack the resources used to attack them (Capron & Chatain, 2008; Grimm et al., 2006). If indeed MMC tends to increase rivalry over knowledge-based resources, in part, because of asymmetry in rivals' ability to protect their knowledge, then factors that tilt the balance by making rivals more or less able to take actions to protect their knowledge should moderate the effect that MMC exerts on knowledge protection. A recent article from the Washington Post illustrates how competitors' ability to retaliate with patent lawsuits has limited how aggressively Nokia uses patent litigation against its rivals:

> Nokia lays claim to an estimated 30,000 utility patents and 8,500 design patents, according to Microsoft. Last year, it filed lawsuits against device manufacturer HTC in both Germany and the United States, accusing HTC of infringing on dozens of Nokia patents. Yet, Nokia has been deterred from asserting its patents too aggressively by the risk of retaliation by competitors. (Fung, 2013)

When deciding whether or not to take actions to protect knowledge due to the increased threat of imitation that results from MMC, a focal firm will consider the possible responses associated with retaliation by the rival firm. If a focal firm faces a multimarket competitor that has a lower ability to protect its knowledge, this will reduce the likelihood that the rival firm will initiate a counterattack against the focal firm in one or more of the markets in which the firms overlap, thus making the focal firm even more likely to protect its knowledge. Conversely, if a focal firm faces a multimarket competitor that has a greater ability to protect its knowledge, this will increase the likelihood that the rival firm will initiate a counterattack against the focal firm in one or more of the markets in which the firms overlap, thus making the focal firm less inclined to protect its knowledge because of the expected costs associated with retaliation. Consequently:

> *Hypothesis 3 (H3): The rival firm's ability to protect its knowledge-based resources will attenuate the positive relationship between MMC and the likelihood that the focal firm will protect its knowledge-based resources by initiating a patent lawsuit against a rival firm.*

Data and Methods

To examine the influence that MMC has on the likelihood that a firm will protect its knowledge from a rival, it is important to identify an empirical context where we can observe both interfirm rivalry across different markets and firms' actions to protect knowledge-based resources. The medical devices industry is a suitable context to test our theory since competition and efforts to protect knowledge are observable for a broad set of companies. Firms in the medical devices industry frequently use patents to protect their knowledge from imitation by rivals (Levin et al., 1987), and research shows that health and drug firms use patent litigation to protect their innovations (Lanjouw & Schankerman, 2001; Polidoro & Toh, 2011). In addition, the medical devices context has been used as the empirical setting for other strategy studies involving competition among innovation-intensive firms (e.g., Mitchell, 1989; Wu, 2013). Thus, the medical devices context is appropriate to test our theory since we are able to observe both interfirm rivalry and a firm's efforts to protect its knowledge-based resources.

Research involving MMC suggests that the firm–competitor dyad is the appropriate level of analysis to examine interfirm rivalry (e.g., Baum & Korn, 1996; Chen, 1996; Yu & Cannella, 2007). Importantly, the medical devices industry offers a fine-grained means of assessing the degree to which pairs of rival firms compete across different product categories since these firms have to apply for Food and Drug Administration (FDA) approval for medical devices introduced in different product categories. Thus, in addition to allowing us to observe knowledge protection involving rival firms, this setting is also appropriate because it allows us to observe MMC between pairs of rival firms.

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We study firms' actions taken to protect knowledge from rivals by examining the patent lawsuits that were filed by medical devices firms. To help ensure that we include a representative set of firms that are active in the medical devices industry, we develop our sample based on standard industrial classification (SIC) codes and consider firms in COMPUSTAT in SIC code 384 (Chatterji & Fabrizio, 2014). After using the approach described above to identify firms in the medical devices industry at hazard of filing a patent lawsuit, we supplement the firm-level product data gathered from the FDA 510K and PMA databases with patent data from the Harvard Patent Database (Lai, D'Amour, Yu, Sun, & Fleming, 2011). The patent and product measures are developed using the year in which the firm applied for a patent that was subsequently granted by the U.S. Patent and Trademark Office or the year in which it filed for FDA approval of a medical device that was approved by the FDA. Our final sample includes 164 firms from the medical devices industry that held at least one patent. After identifying the firms at hazard of initiating patent litigation, we follow the approach used in prior literature and restricted our analysis to include firm–rival dyads where the two firms meet in at least one common product market (Boeker, Goodstein, Stephan, & Murmann, 1997). To help ensure that both firms are actively developing products in the markets where they overlap, we consider product code overlap during a 5-year window based on the year in which the firms applied for FDA approval of a new device or supplemental changes to an existing device. We next use the Lex Machina IP Litigation Database to identify all patent lawsuits where each of these firms was listed as a plaintiff or defendant to determine whether a patent lawsuit was filed by the focal firm against a specific rival firm. Patent litigation data are available as of 2000. We use data on firms' patent applications made through 2006 that were granted by the end of 2010. Accordingly, our analysis period considers the effect of MMC at years 2000 through 2006 on patent lawsuits in observation years 2001–2007.

Dependent Variable

Consistent with prior literature, we use patent litigation to study the protection of knowledge (Clarkson & Toh, 2010; Polidoro & Toh, 2011). One significant advantage of measuring knowledge protection using patent litigation, instead of other mechanisms (e.g., complementary assets and secrecy) in a dyadic study like this one, is the ability to observe a firm's efforts to protect knowledge from a specific rival (Chen & Miller, 2012; Markman, Espina, & Phan, 2004). Our dichotomous dependent variable is set to "1" if the focal firm filed a patent lawsuit against a specific rival firm in observation year t and to "0" otherwise. Other variables correspond to year t – 1.

Independent Variables

Multimarket contact (H1) is assessed based on the number of FDA product categories in which the firm and its rival both had products approved during a 5-year window from the year of application.[3] Alternate measures based on 4- and 6-year windows produced consistent results. Some prior studies have used scaled measures of MMC (e.g., Baum & Korn, 1999; Gimeno & Woo, 1996; Young et al., 2000). To facilitate interpretation of the results, we use market overlap. However, we ran models with scaled measures of MMC and found that the effect of MMC on knowledge protection is robust both for measures of MMC that are scaled by the number of product categories in which the focal firm competes and by the number of competitors in the categories where the firms overlap.

The technological quality of the focal firm's knowledge-based resources (H2). Prior literature has shown that a firm's forward patent citations capture the technological quality of its knowledge (Trajtenberg, 1990). The technological quality of the focal firm's knowledge-based resources is measured using the focal firm's 5-year average number of citations per patent, where the focal firm's number of citations received during the previous 5 years was divided by the number patents that received citations during the previous 5 years (Ganco et al., 2015). We also checked robustness using a measure of technological quality where the number of citations received during the previous 5 years was divided by the focal firm's total cumulative number of patents, instead of only those cited, and found robust results.

Rival firm's ability to protect its knowledge-based resources (H3) is measured using the rival firm's yearly number of patent lawsuits as plaintiff scaled by the rival firm's total number of patent applications, since rival firms

[3] Models using a measure based on approval year instead of application year generated robust results.

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that have initiated patent litigation have demonstrated the ability to protect their knowledge-based resources. We also checked robustness using an alternative measure of the rival firm's ability to protect its knowledge based on the rival firm's number of patents in the firm's technological classes, because research shows that a patent portfolio provides an arsenal which can deter firms from initiating patent lawsuits (Somaya, 2012). Models using this alternate measure generated robust results.

Control Variables

The analysis controls for a number of different sources of unobserved heterogeneity across firms that may influence both MMC and a firm's decision to protect its knowledge from a rival. Firm size may influence the degree to which firms operate in multiple markets and larger firms are more likely to initiate patent litigation (Hall & Ziedonis, 2007). We control for the size of the focal firm and the rival firm based on each firm's number of employees. Since more profitable firms may be more likely to initiate patent litigation and to engage in MMC, we also control for the focal firm's and the rival firm's yearly net income.

Strategy research shows that similarity in capabilities can affect market entry (Fuentelsaz & Gómez, 2006). Since resource similarity may also increase the likelihood of patent litigation, we control for resource similarity based on the number of overlapping primary technological classes which the focal firm and the rival firm have both used for their patents during the previous 5 years. Also, firms with more patents may be more likely to compete across multiple markets, and research confirms that litigation risk depends on the size of a firm's patent portfolio (Lanjouw & Schankerman, 2004). To account for this influence, we control for the focal firm's number of active patents (i.e., those applied for in the last 20 years) in the technological classes in which the rival firm has patented. Similarly, we also control for the rival firm's number of active patents in the technological classes in which the focal firm has patented. The number of claims made in the firm's patents can affect the propensity to litigate (Lanjouw & Schankerman, 2001). Since firms operating across multiple markets may also make more extensive claims in their patents, we control for the average number of claims made in the focal firm's and rival firm's patents during the last 5 years. Furthermore, a firm's decision to utilize a general versus niche product strategy may influence both its willingness to compete with rivals in multiple markets and its propensity to protect its knowledge-based resources. To help capture this potential alternative explanation, we include control variables that capture the degree to which the focal and the rival firm's products are concentrated or dispersed across different product categories. Specifically, we use a Blau index to assess the level of dispersion across product categories during the previous 5 years.

Research also shows that the firm's previous patent lawsuits can influence the likelihood that it initiates patent litigation (Polidoro & Toh, 2011). To account for prior litigation, we include a control for the focal firm's yearly number of patent lawsuits as plaintiff scaled by its total patent applications. We also include controls for the yearly number of patent lawsuits where the focal firm and rival firm were listed as defendant. Moreover, threats to the specific knowledge domains in which the firms develop products may affect both MMC and litigation. In the medical device industry, FDA product oversight is divided among advisory committees that are grouped by medical specialty (FDA, 2015). Since these advisory committees are organized around the specialized medical knowledge needed to approve different types of devices, adding dummies based on advisory committees helps us control for the different knowledge domains in which each of the firms have developed products. Accordingly, we include dummy variables for the advisory committees (e.g., Cardiology, Immunology Devices, Microbiology Devices, Radiology, etc.) that have overseen the approval of the focal firm's products to account for sources of time–invariant unobserved heterogeneity related to the knowledge domains that may affect MMC and litigation. Finally, we include year dummies to capture time specific factors that may influence MMC and litigation.

Model Specification

Following the approach used in other recent strategy studies that have examined dichotomous outcomes, we use linear probability models to test the hypotheses (e.g., Conti, Gambardella, & Mariani, 2013). Linear probability models allow for a straightforward interpretation of contingency hypotheses and produce marginal effects that are consistent with

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logistic regression (Angrist & Pischke, 2009). We mean centered the independent variables in the reported models to reduce multi-collinearity that can occur in moderated regressions (Aiken & West, 1991), and our reported models include firm-fixed effects to help account for sources of time-invariant heterogeneity across firms. The use of firm-fixed effects in conjunction with our lagged variables also helps to mitigate potential endogeneity concerns (Bettis, Gambardella, Helfat, & Mitchell, 2014).

Since using linear models to examine discrete outcomes can yield biased and inefficient estimates (Greene, 2003), we checked robustness using logistic regression and rare events logistic regression (King & Zeng, 2001). These models produced fully robust results for the relationship between MMC and litigation, thereby alleviating such concerns. We also ran supplemental logistic regression models to conduct split sample econometric tests of marginal effects at high and low levels of the contingency variables (Hoetker, 2007; Wiersema & Bowen, 2009), and these models also generated robust results for the contingencies.[4]

Results

Table 1 reports the descriptive statistics. In total, we identify 45 instances where a focal firm initiated patent litigation against a rival firm in the observation year. Although patent litigation is a low frequency event, it can have billions of dollars of financial impact (Sherry & Teece, 2004), making it consequential especially to knowledge-intensive firms. All of the pair-wise correlations in Table 1 fall below the threshold of 0.8, and the only pair-wise correlations exceeding 0.7 involved control variables for patents and employees. Accordingly, we ran a separate model dropping the control variable for patents, and the reported results remained fully robust. Moreover, to further investigate the possibility that multicollinearity may be affecting the reported results, we also ran variance inflation factors (VIF) for the variables in Table 1. The variance inflation factors (Avg. VIF: 1.81; Max VIF: 3.57) were well below the critical level of 10 (Kennedy, 2003). Taken together, these different tests help to mitigate concerns about multicollinearity.

[4] The logit models used for the split sample econometric test of moderators excluded advisory class dummies.

Table 2 reports linear probability models of influences on patent litigation. Starting with the controls in model 2, we find that the level of technological resource similarity based on overlapping technological classes exerts a positive and significant effect on litigation propensity. This evidence is in line with prior studies showing that technological similarity increases the probability of infringement litigation (Lanjouw & Schankerman, 2001). Importantly, other control variables also offer insight into the strategic considerations underlying a firm's decision to protect its knowledge-based resources. We find evidence that firms approach this decision strategically by considering attributes of the rival firm. Specifically, we find that the focal firm is more likely to initiate patent litigation against a rival firm with higher quality technological resources and when a rival firm has been sued for patent infringement. Moreover, we find that the focal firm is less likely to initiate a patent lawsuit against a rival firm with greater product diversity. This evidence suggests that firms are particularly likely to initiate patent litigation against rivals with more valuable technologies, more concentrated product offerings and those with prior history as a defendant against claims of patent infringement.

After considering these other influences, we next turn to our discussion of the main tests of our theoretical predictions. Our theoretical arguments linking MMC and patent protection build on prior studies showing that MMC increases knowledge spillovers and imitation by competitors (e.g., Cassidy & Loree, 2001; Lieberman & Asaba, 2006; Scott, 2001). However, to increase confidence in this mechanism we conducted our own supplemental analysis using the incidence rate ratio from a negative binomial model with the same set of control variables reported in Table 2 to assess whether MMC increases the extent to which a rival firm builds on the knowledge of the focal firm. As MMC increases by one market between the focal firm and the rival firm, this analysis reveals that the rate at which the rival firm cites the focal firm's patents increases by more than 8%. In line with prior research and consistent with our theoretical arguments, this additional evidence from our empirical context lends support to our argument that MMC increases the extent to which the rival firm imitates the focal firm's knowledge.

The second element underlying our arguments linking MMC and patent protection involves the relatively lower risk of retaliation involving upstream

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Table 1
Descriptive Statistics and Correlation Matrix

	Variable	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Litigation	0.007	0.08	0	1																		
2	Multimarket contact	1.71	1.93	1	21	0.16																	
3	Focal firm's technological quality of knowledge (citations per patent)	11.10	7.04	0	43	0.02	0.10																
4	Rival's ability to protect its knowledge (lawsuits as plaintiff % patents)	0.01	0.03	0	1	−0.01	−0.04	−0.02															
5	Focal firm size (thousands of employees)	5.40	8.69	0.004	37.8	0.04	0.25	0.19	−0.04														
6	Rival firm size (thousands of employees)	5.40	8.69	0.004	37.8	0.04	0.25	0.01	−0.08	−0.08													
7	Focal firm's net income ($ millions)	169.27	552.44	−3,577	2,802	0.03	0.17	0.14	−0.02	0.60	−0.06												
8	Rival firm's net income ($ millions)	169.27	552.44	−3,577	2,802	0.02	0.17	0.02	−0.05	−0.06	0.60	−0.04											
9	Resource similarity (technological class overlap)	2.45	2.70	0	31	0.10	0.44	0.08	−0.06	0.38	0.38	0.23	0.23										
10	Focal firm's patents in rival's technological classes	141.40	372.99	0	3,614	0.06	0.30	0.20	−0.03	0.73	−0.01	0.56	−0.01	0.48									
11	Rival firm's patents in focal firm's technological classes	141.40	372.99	0	3,614	0.05	0.30	0.05	−0.06	−0.01	0.73	−0.01	0.56	0.48	0.05								
12	Focal firm's average claims per patent	21.44	8.70	0	71.8	0.00	0.03	0.15	0.02	0.04	−0.03	0.07	0.00	0.09	0.07	0.01							

Table 1
continued

	Variable	Mean	S.D.	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
13	Rival firm's average claims per patent	21.44	8.70	0	71.8	0.00	0.03	0.02	−0.01	−0.03	0.04	0.00	0.07	0.09	0.01	0.07	−0.01						
14	Rival firm's techological quality of knowledge (citations per patent)	11.10	7.04	0	43	0.04	0.10	0.12	−0.08	0.01	0.19	0.02	0.14	0.08	0.05	0.20	0.02	0.15					
15	Focal firm's product diversity	0.68	0.30	0	0.99	0.02	0.26	0.08	−0.06	0.49	0.01	0.27	−0.01	0.26	0.30	0.04	−0.10	−0.05	0.02				
16	Rival firm's product diversity	0.68	0.30	0	0.99	0.02	0.26	0.02	−0.10	0.01	0.49	−0.01	0.27	0.26	0.04	0.30	−0.05	−0.10	0.08	0.14			
17	Focal firm's lawsuits as plaintiff as a % of patents	0.01	0.03	0	1	0.00	−0.04	−0.08	−0.01	−0.08	−0.04	−0.05	−0.02	−0.06	−0.06	−0.03	−0.01	0.02	−0.02	−0.10	−0.06		
18	Focal firm's lawsuits as defendant	0.73	1.27	0	7	0.04	0.22	0.24	−0.02	0.69	−0.07	0.50	−0.05	0.30	0.50	−0.01	0.06	−0.02	0.03	0.39	−0.01	−0.04	
19	Rival firm's lawsuits as defendant	0.73	1.27	0	7	0.06	0.22	0.03	−0.04	−0.07	0.69	−0.05	0.50	0.30	−0.01	0.50	−0.02	0.06	0.24	−0.01	0.39	−0.02	−0.06

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Table 2
Linear Probability Estimates of Influences on Litigation Propensity

	Model 1 Controls		Model 2 Main effect		Model 3 Main effect & H2		Model 4 Main effect & H3		Model 5 Full model	
Multimarket contact (H1 > 0)			0.007 (0.001)	*.000*	0.006 (0.001)	*.000*	0.006 (0.001)	*.000*	0.005 (0.001)	*.000*
Multimarket contact × Focal firm's technological quality of knowledge (H2 > 0)					0.0004 (0.000)	*.000*			0.0004 (0.000)	*.000*
Multimarket contact × Rival's ability to protect its knowledge (H3 < 0)							−0.24 (0.061)	*.000*	−0.24 (0.061)	*.000*
Focal firm's technological quality of knowledge (citations per patent)	−0.0002 (0.001)	*.77*	−0.0003 (0.001)	*.64*	−0.0002 (0.001)	*.72*	−0.0003 (0.001)	*.59*	−0.0002 (0.001)	*.67*
Rival's ability to protect its knowledge (lawsuits as plaintiff % patents)	0.0008 (0.035)	*.98*	−0.004 (0.035)	*.91*	−0.004 (0.035)	*.92*	−0.15 (0.051)	*.00*	−0.16 (0.051)	*.00*
Focal firm size (thousands of employees)	−0.002 (0.001)	*.15*	−0.002 (0.001)	*.19*	−0.001 (0.001)	*.28*	−0.002 (0.001)	*.16*	−0.001 (0.001)	*.24*
Rival firm size (thousands of employees)	0.000003 (0.000)	*.99*	0.0001 (0.000)	*.69*	0.0001 (0.000)	*.79*	0.0001 (0.000)	*.61*	0.0001 (0.000)	*.71*
Focal firm's net income ($ millions)	0.000001 (0.000)	*.81*	0.000001 (0.000)	*.84*	0.000001 (0.000)	*.88*	0.0000005 (0.000)	*.89*	0.0000003 (0.000)	*.93*
Rival firm's net income ($ millions)	−0.000001 (0.000)	*.68*	−0.000001 (0.000)	*.67*	−0.000001 (0.000)	*.63*	−0.000001 (0.000)	*.72*	−0.000001 (0.000)	*.67*
Resource similarity (technological class overlap)	0.003 (0.001)	*.00*	0.002 (0.001)	*.01*	0.002 (0.001)	*.00*	0.002 (0.001)	*.01*	0.002 (0.001)	*.01*

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Table 2
continued

	Model 1 Controls		Model 2 Main effect		Model 3 Main effect & H2		Model 4 Main effect & H3		Model 5 Full model	
Focal firm's patents in rival's technological classes	0.000007 (0.000)	*.23*	0.0000004 (0.000)	*.94*	−0.000001 (0.000)	*.83*	0.000001 (0.000)	*.93*	−0.000001 (0.000)	*.85*
Rival firm's patents in focal firm's technological classes	−0.000003 (0.000)	*.59*	−0.00001 (0.000)	*.10*	−0.00001 (0.000)	*.13*	−0.00001 (0.000)	*.05*	−0.00001 (0.000)	*.07*
Focal firm's average claims per patent	−0.0002 (0.000)	*.40*	−0.0002 (0.000)	*.45*	−0.0002 (0.000)	*.39*	−0.0002 (0.000)	*.45*	−0.0002 (0.000)	*.39*
Rival firm's average claims per patent	−0.0001 (0.000)	*.39*	−0.0001 (0.000)	*.29*	−0.0001 (0.000)	*.26*	−0.0001 (0.000)	*.28*	−0.0001 (0.000)	*.25*
Rival firm's techological quality of knowledge (citations per patent)	0.0004 (0.000)	*.01*	0.0004 (0.000)	*.04*	0.0004 (0.000)	*.03*	0.0004 (0.000)	*.02*	0.0004 (0.000)	*.02*
Focal firm's product diversity	0.006 (0.015)	*.66*	0.003 (0.015)	*.82*	0.004 (0.015)	*.80*	0.003 (0.015)	*.84*	0.003 (0.015)	*.83*
Rival firm's product diversity	−0.01 (0.004)	*.17*	−0.01 (0.004)	*.00*	−0.01 (0.004)	*.00*	−0.01 (0.004)	*.00*	−0.01 (0.004)	*.00*
Focal firm's lawsuits as plaintiff as a % of patents	−0.03 (0.041)	*.42*	−0.04 (0.040)	*.36*	−0.04 (0.040)	*.37*	−0.04 (0.040)	*.36*	−0.04 (0.040)	*.36*
Focal firm's lawsuits as defendant	0.001 (0.002)	*.45*	0.001 (0.002)	*.54*	0.001 (0.002)	*.55*	0.001 (0.002)	*.51*	0.001 (0.002)	*.51*
Rival firm's lawsuits as defendant	0.003 (0.001)	*.01*	0.002 (0.001)	*.06*	0.002 (0.001)	*.06*	0.002 (0.001)	*.06*	0.002 (0.001)	*.06*
Constant	0.05	*.05*	0.06	*.01*	0.06	*.01*	0.06	*.01*	0.06	*.01*
Number of observations	6,330		6,330		6,330		6,330		6,330	

Standard errors in parentheses, *p*-values in italics.
Includes year dummies, advisory class dummies and firm fixed effects.

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patent litigation actions as compared to the downstream actions that have been the focus of most prior MMC studies. As mentioned previously, prior studies show that while retaliation is relatively common for downstream actions like new product introductions (Kuester et al., 1999) and pricing actions (Marcel et al., 2011; Steenkamp et al., 2005), retaliation is less common for knowledge protection efforts involving patent lawsuits. Going beyond this evidence from prior literature, we also examined the incidence of retaliation involving patent litigation in our own empirical context. Fully in line with the low incidence of countersuits from prior research (Somaya, 2003), we find that approximately 9% of litigation pairs involved a potential retaliatory countersuit.[5] Hence, in support of our arguments, we find evidence both that MMC increases the threat of imitation and that retaliation is relatively uncommon involving patent lawsuits.

Having provided evidence of the proposed route through which the hypothesized relationship develops, we turn next to the empirical tests of the hypotheses. In H1, we argue that there is a positive relationship between MMC and the likelihood that the focal firm will protect its knowledge-based resources by initiating patent litigation against a rival firm. In support of H1, model 2 in Table 2 shows that when MMC increases between the focal firm and the rival firm, the focal firm is more likely to initiate a patent lawsuit against the rival firm ($\beta = 0.007$, p = .000).[6] To better understand the economic impact that MMC has on knowledge protection, we examined the change in the probability of initiating a patent lawsuit at different levels of MMC. The probability of litigation shown in the descriptive statistics in Table 1 is .007, and this corresponds to an average level of MMC of 1.7. Using the coefficient reported in model 2 ($\beta = 0.007$) and holding other variables at their mean values, we note that a one standard deviation (1.9) increase in MMC increases the probability of litigation by .013 (i.e., 0.013 = MMC β of 0.007 × MMC standard deviation of 1.9) and thereby results in more than a 100% increase versus the baseline probability that the focal firm will initiate patent litigation against a rival firm. The magnitude of this change in probability demonstrates that MMC significantly affects a firm's decision to protect its knowledge.

In H2, we argued that the technological quality of the focal firm's knowledge-based resources will exacerbate the positive relationship between MMC and knowledge protection. In support of H2, model 3 in Table 2 shows that the interaction between MMC and the technological quality of the focal firm's knowledge is positive ($\beta = 0.0004$, p = .000), which means that the technological quality of the focal firm's knowledge increases the likelihood that the focal firm initiates patent litigation against a multimarket competitor. This shows that as the technological quality of the focal firm's knowledge increases, the focal firm is even more likely to protect its knowledge from a multimarket competitor.

In H3, we argued that the rival firm's ability to protect its knowledge-based resources will attenuate the positive relationship between MMC and knowledge protection. Also, in support of H3, model 4 in Table 2 shows that the interaction between MMC and the rival firm's ability to protect its knowledge is negative ($\beta = -0.24$, p = .000), which means that the rival firm's ability to protect its knowledge reduces the likelihood that the focal firm initiates patent litigation against a multimarket rival. This model shows that when deciding whether to take actions to protect knowledge from a multimarket competitor that the focal firm considers the rival firm's ability to retaliate, such that the focal firm is less likely to initiate patent litigation when the rival firm has greater ability to initiate a counterattack against the focal firm.

In conjunction with the tests in the reported models based on interactions, we also graphically examined the relationship between the MMC and litigation at high and low levels of the contingency variables. We examined the effects of MMC on litigation for the top 10% of each contingency variable versus the bottom 90%.[7] The graphs show fitted lines for the relationship between the MMC and litigation at high and low levels of the contingency variables.

In line with the empirical test for H2 discussed above, Figure 1 shows a steeper slope for the fitted line corresponding to higher levels of technological quality. A split sample econometric test of

[5] The 9% is the percent of dyads with litigation where a rival initiated litigation against the focal firm in the same year that the focal firm filed a lawsuit against that rival firm. It becomes 15.6% if we also consider countersuits in the subsequent year.

[6] Both our theory development and prior MMC studies in knowledge-based contexts made us expect a positive relationship between MMC and litigation. In line with expectations, we find no evidence of curvilinear effects.

[7] Graphs and tests with high and low split at mean or median values also offer support of H2 and H3.

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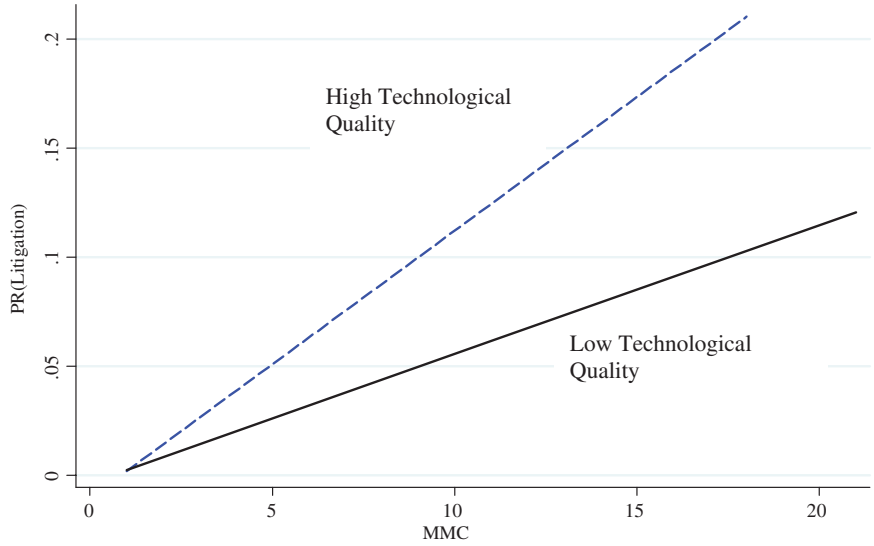

Figure 1. Contingent effect of focal firm's technological quality (H2).

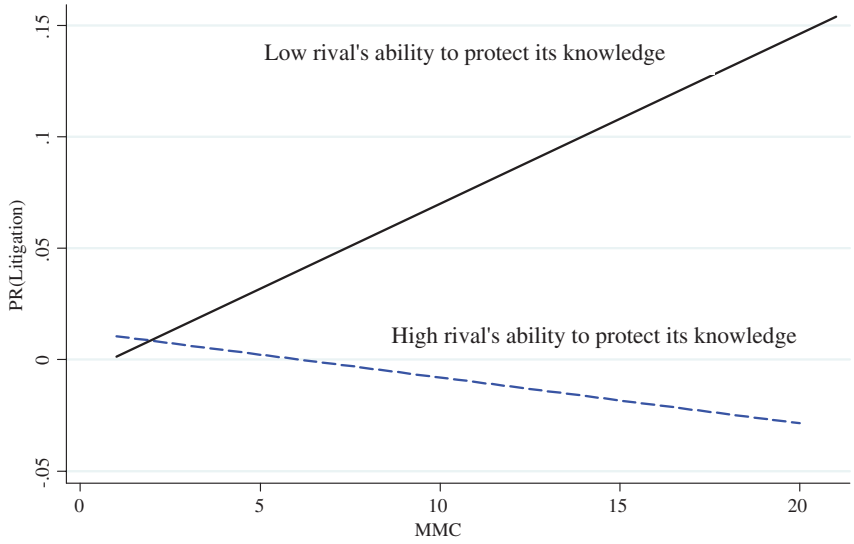

Figure 2. Contingent Effect of rival firm's ability to protect its knowledge (H3).

the difference in the MMC coefficients from linear probability models run at these same low and high levels of firm's technological quality reveals that coefficients are significantly different ($t = 3.1$) in the direction hypothesized in H2. Figure 2 also offers support for H3 and shows divergent slopes for the fitted lines for high and low levels of rival's ability to protect its knowledge. Importantly, Figure 2 shows that when only considering observations with high levels of rival's ability to protect its knowledge (i.e., where we restrict the analysis to only consider those observations where the rival firm is in the top 10%), the relationship between MMC and litigation becomes negative, thereby reverting to the classic MMC mutual forbearance relationship. This graph provides some additional evidence to support the argument that MMC may not result in mutual forbearance because the average threat of retaliation involving upstream rivalry may simply be too low to deter the focal firm from initiating patent litigation against the rival firm. We also ran a split sample analysis comparing these same high and low levels of the rival firm's ability to protect its knowledge. Consistent with the graph, the coefficient for the

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relationship between MMC and litigation changes from a positive coefficient of 0.008 at low levels of the rival's ability to protect its knowledge to a negative coefficient of −0.003 at high levels of the rival's ability to protect its knowledge ($t = -3.8$). Again, the findings are consistent with our argument that the average retaliation threat associated with patent litigation may not be sufficient to restrain rivalry, which is why the MMC relationship reverts to the negative one shown in prior MMC literature only at high levels of the rival firm's ability to protect its knowledge, when the rival firm is most able to retaliate. Taken together, the empirical tests combined with this additional evidence offer consistent support for both of the contingency hypotheses.

Alternative Explanations for Results

Table 3 reports robustness tests developed to investigate potential alternative explanations to a causal relationship between MMC and knowledge protection. While our use of lagged variables in conjunction with firm fixed-effects helps to address concerns about endogeneity, we have developed a variety of robustness tests and supplemental analyses to investigate potential alternative explanations that may interfere with interpretation of the results.

One potential concern is that while the regressions include firm fixed effects, there may be other reasons related to the firm's patents, locations or markets that are correlated with MMC and a firm's decision to initiate patent litigation. For example, it is possible that the relationship between MMC and knowledge protection may be driven entirely by high value patents or highly interconnected patents. If this were the case, then the effect of MMC on knowledge protection may result only from the inclusion of observations related to high value or highly interconnected patents. To investigate this possibility, we examine whether the positive effect of MMC on knowledge protection efforts remained significant when excluding observations where the focal firm has a higher than average level of forward citations or higher than average percentage of self-citations. In other words, the first analysis excludes dyad-year observations where the focal firm has an above average level of forward citations (i.e., focal firm's technological quality), and the second analysis excludes dyad-year observations where the focal firm has an above average level of self-citations. Models 1 and 2 in Table 3 show that the effect of MMC on patent litigation remained significantly positive when restricting the analyses by only considering observations with below average levels of forward citations or those with below average levels of focal firm's percentage of self-citations. Therefore, we do not find evidence that the hypothesized relationship is driven exclusively by the inclusion of observations where focal firms have high value patents or by more interconnected patents.

We also take steps to investigate alternative explanations related to the focal firm's geographic locations and the markets in which it operates that may be correlated with MMC and with the probability of initiating patent litigation. To do so, we develop falsification tests. Given our argument that MMC increases the likelihood that a focal firm will protect its knowledge-based resources from imitation, we would not expect to find a positive relationship between MMC and litigation based solely on the average level of MMC in either the focal firm's markets or its geographic locations. To explore this possibility, in lieu of the MMC variable used in the reported models, we devised falsification tests where we constructed an MMC variable using the average level of MMC for the other firms (excluding the focal firm) operating in those markets or geographic locations. Hence, our falsification tests examine whether, contrary to our dyad-level arguments about the relationship between MMC and litigation, the average level of MMC (excluding the focal firm) in the product markets or geographic locations listed in the firm's FDA filings will produce the same positive effect on litigation. Models 3 and 4 of Table 3 report falsification tests for geographic locations and markets. The fact that the average MMC for markets and geographic locations fails to significantly predict patent litigation offers some additional evidence in support of the argument that MMC between a focal firm and its rivals is driving upstream rivalry involving patent litigation.

Another possibility is that the direction of the relationship between MMC and litigation may be reversed, such that more litigious firms may be particularly likely to compete with rivals in a greater number of product markets. To help us understand whether the firm's willingness to protect its knowledge-based resources may be driving both MMC and litigation, we ran a supplemental analysis based on a subsample of observations where we have excluded cases in which the focal firm has previously initiated a patent lawsuit during the analysis period. Mode1 5 from Table 3 shows

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Table 3
Linear Probability Estimates of Influences on Litigation Propensity

	Model 1 Below average Technological quality		Model 2 Below average Interconnectedness		Model 3 Falsification test - Geo. locations		Model 4 Falsification test - Markets		Model 5 Excluding Litigious firms	
Multimarket contact (H1 > 0)	0.004 (0.00)	*.000*	0.005 (0.00)	*.000*	−0.008 (0.01)	*.49*	0.003 (0.01)	*.59*	0.004 (0.00)	*.000*
Focal firm's technological quality of knowledge	−0.002 (0.00)	*.20*	0.001 (0.00)	*.34*	−0.0002 (0.00)	*.78*	−0.0002 (0.00)	*.72*	−0.0003 (0.00)	*.63*
Rival's ability to protect its knowledge (lawsuits as plaintiff % patents)	−0.01 (0.04)	*.72*	−0.01 (0.04)	*.76*	0.001 (0.04)	*.97*	0.001 (0.04)	*.98*	−0.01 (0.03)	*.84*
Focal firm size (thousands of employees)	0.002 (0.00)	*.44*	−0.002 (0.00)	*.22*	−0.002 (0.00)	*.14*	−0.002 (0.00)	*.14*	0.01 (0.01)	*.19*
Rival firm size (thousands of employees)	0.0001 (0.00)	*.78*	0.0001 (0.00)	*.79*	0.000004 (0.00)	*.99*	0.000001 (0.00)	*.997*	−0.0003 (0.00)	*.19*
Focal firm's net income ($ millions)	−0.00004 (0.00)	*.14*	−0.000004 (0.00)	*.45*	0.000001 (0.00)	*.84*	0.000001 (0.00)	*.81*	−0.00007 (0.00)	*.19*
Rival firm's net income ($ millions)	0.000003 (0.00)	*.28*	0.000002 (0.00)	*.49*	−0.000001 (0.00)	*.69*	−0.000001 (0.00)	*.67*	−0.0000001 (0.00)	*.97*
Resource similarity (technological class overlap)	0.001 (0.00)	*.15*	0.0002 (0.00)	*.77*	0.003 (0.00)	*.00*	0.003 (0.00)	*.00*	0.002 (0.00)	*.14*
Focal firm's patents in rival's technological classes	−0.00003 (0.00)	*.51*	−0.00001 (0.00)	*.39*	0.00001 (0.00)	*.23*	0.00001 (0.00)	*.23*	0.0001 (0.00)	*.42*

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Table 3
continued

	Model 1 Below average Technological quality		Model 2 Below average Interconnectedness		Model 3 Falsification test - Geo. locations		Model 4 Falsification test - Markets		Model 5 Excluding Litigious firms	
Rival firm's patents in focal firm's technological classes	−0.00001 (0.00)	*.22*	−0.00001 (0.00)	*.20*	−0.000003 (0.00)	*.58*	−0.000003 (0.00)	*.59*	0.0000004 (0.00)	*.95*
Focal firm's average claims per patent	−0.0004 (0.00)	*.38*	−0.0003 (0.00)	*.32*	−0.0003 (0.00)	*.37*	−0.0002 (0.00)	*.43*	0.0002 (0.00)	*.34*
Rival firm's average claims per patent	−0.0003 (0.00)	*.04*	−0.0001 (0.00)	*.70*	−0.0001 (0.00)	*.39*	−0.0001 (0.00)	*.40*	−0.0002 (0.00)	*.17*
Rival firm's techological quality of knowledge	0.0003 (0.00)	*.16*	0.0002 (0.00)	*.20*	0.0004 (0.00)	*.01*	0.0004 (0.00)	*.01*	0.0001 (0.00)	*.43*
Focal firm's product diversity	0.01 (0.02)	*.72*	−0.01 (0.02)	*.54*	0.01 (0.02)	*.72*	0.01 (0.01)	*.73*	0.01 (0.02)	*.44*
Rival firm's product diversity	−0.01 (0.01)	*.02*	−0.01 (0.00)	*.02*	−0.01 (0.00)	*.18*	−0.01 (0.00)	*.17*	−0.005 (0.00)	*.30*
Focal firm's lawsuits as plaintiff as a % of patents	−0.05 (0.04)	*.20*	−0.04 (0.04)	*.34*	−0.03 (0.04)	*.43*	−0.03 (0.04)	*.41*		
Focal firm's lawsuits as defendant	−0.002 (0.00)	*.33*	0.001 (0.00)	*.77*	0.001 (0.00)	*.49*	0.001 (0.00)	*.47*	−0.001 (0.00)	*.85*
Rival firm's lawsuits as defendant	0.002 (0.00)	*.22*	0.003 (0.00)	*.02*	0.003 (0.00)	*.01*	0.003 (0.00)	*.01*	0.0002 (0.00)	*.87*
Constant	0.04	*.14*	0.07	*.01*	0.06	*.06*	0.04	*.14*	−0.004	*.76*
Number of observations	3, 667		4, 600		6, 282		6, 330		2, 872	

Standard errors in parentheses, P-values in italics.
Models include year dummies, advisory class dummies and firm fixed effects.

that we continue to find a positive relationship between MMC and litigation, even when excluding these firms that might be most inclined toward initiating patent litigation.

Finally, we also conducted a supplemental analysis using a matching approach to explore the possibility that alternative explanations arising from non-random assignment of observations may be driving the results (Bettis et al., 2014). For each firm-year observation, we looked for a firm-rival dyad with high MMC and matched it with a firm–rival dyad with low MMC where the focal firm was the same across both of these dyads. To ensure that the focal firm was paired with a similar rival across each of these dyads, we matched each of these firm–rival dyads based on the level of resource similarity and based on whether or not the rival firm was a defendant. We continue to find a positive relationship between MMC and patent litigation ($\beta = 0.006$, $p = .000$), even when using this more stringent matching approach where the focal firm is used as its own control group. While it is arguably impossible to fully rule out all endogeneity concerns, our use of firm fixed effects along with an extensive list of control variables in conjunction with these supplemental analyses and falsification tests help to increase confidence in the results.

Discussion and Conclusion

Scholars contend that MMC increases familiarity with and the threat of retaliation against rivals and, in turn, reduces the intensity of rivalry (i.e., mutual forbearance hypothesis) entailing downstream competitive actions such as pricing and market entry. But more recent research finds that MMC in knowledge-intensive industries gives rise to opportunities for firms to manage competitive uncertainty through imitation and to capture more value across multiple markets, which often reduces the incentive to mutually forbear. In this study, we argue that MMC increases the likelihood that a firm will initiate patent litigation against a rival firm to protect its knowledge from imitation. Moreover, we also argue that a firm will be more likely to protect its knowledge when it possesses higher quality knowledge-based resources, but less likely to protect its knowledge when the rival has a greater ability to take retaliatory actions against the firm to protect its own knowledge.

In support of our arguments, we find that as the number of overlapping FDA product codes in the medical devices industry between a firm and its rival increases, that the focal firm was more likely to initiate a patent lawsuit against the rival firm. We also find support for both contingency hypotheses. When the focal firm had a greater number of forward citations it was even more likely to initiate patent litigation against a multimarket rival. Conversely, as the rival firm's number of lawsuits as plaintiff as a proportion of its patents increase, the focal firm was less likely to initiate a patent lawsuit against a multimarket competitor.

Our results do not imply that the traditional mutual forbearance hypothesis associated with MMC found in earlier studies is flawed. But our results do suggest that effects of MMC on rivalry may differ based on the nature of resources (i.e., more versus less knowledge-based resources) and domain of the competitive action (i.e., upstream versus downstream). In other words, the earlier studies focused on downstream activities and less knowledge-based resources have largely found that MMC decreases rivalry. More recent research, including this current study, focused on upstream activities and knowledge-based resources and showed that MMC can encourage rivalry as firms are motivated to protect their knowledge-based resources from imitation.

Limitations

Before turning to the implications of this study, it is important to acknowledge some limitations related to our measures, empirical setting, and data availability. One set of limitations involving our choice of measures and empirical setting may affect the generalizability of the findings. Prior literature has drawn attention to a variety of ways that firms can protect their knowledge, such as secrecy, complementary assets and non-compete agreements (James et al., 2013; Levin et al., 1987; Marx, Strumsky, & Fleming, 2009). In this study, we focus on knowledge protection using patent litigation in part because of the prevalence of patent protection in the medical devices industry, but primarily because patent litigation enables us to observe a focal firm's efforts to protect knowledge directed at a specific rival firm in a way that is not feasible using these alternative means of knowledge protection. It is, however, important to acknowledge that initiating patent litigation is an extreme and costly means of

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protecting technological assets. While this may, on the one hand, add some conservatism to our tests, it also suggests the possibility that the effects of MMC on efforts to protect knowledge may differ depending on the particular knowledge protection mechanisms that firms utilize. Therefore, future research may be needed to assess whether MMC also affects secrecy or investments in complementary assets and whether MMC induces firms to make trade-offs between these alternative mechanisms. Generalizability concerns may also extend to our choice of empirical context. Because the medical devices industry is a highly knowledge-intensive setting where firms typically rely on patent protection, it is also possible that these findings may not extrapolate to less knowledge-intensive contexts or to contexts where firms do not rely as extensively on patent protection. Similarly, while prior research has consistently demonstrated that MMC is an important strategic consideration across some contexts (e.g., airlines, banking), it may be less relevant in other industry contexts. Although the effects of MMC on downstream rivalry have been shown to generalize across a variety of industry contexts (Yu & Cannella, 2013), there is a need for additional studies to investigate whether the effects of MMC on upstream rivalry apply in less knowledge-intensive contexts.

Another set of limitations center around data availability. As mentioned previously, an important advantage of using the medical devices setting as the empirical context for this study is the fact that FDA data provide a fine-grained way to observe MMC across product categories and upstream rivalry involving patent litigation. However, these advantages are accompanied by some limitations that also need to be acknowledged. First, we do not have access to downstream sales information by product category, which means that we are not able to observe downstream rivalry or to assess the strategic significance of product markets. Hence, in this current study we are not able to examine whether MMC leads firms to make trade-offs between upstream and downstream competitive actions or whether the technology domain may provide firms with an opportunity to compensate for downstream effects of MMC. Second, we do not have the ability to observe rival firms' product offerings across geographic markets. Therefore, we caution that future work may be needed to understand whether product and geographic MMC have similar effects on a firm's decision to protect its upstream knowledge.

Implications for Research and Practice

This study offers important contributions to research on multimarket competition. Recent studies have shed light on a number of important boundary conditions affecting the MMC–mutual forbearance relationship (Yu & Cannella, 2013). These studies have drawn attention to moderators involving market entry characteristics (Fan, 2010), the observability of strategies (Greve, 2008), and international market characteristics (Yu et al., 2009). This current study adds new insights about the determinants of mutual forbearance by showing that the relationship between MMC and rivalry may depend on the competitive domain and the nature of the resources over which firms are competing. Scholars underscore the importance of valuable and heterogeneous resources to a firm's effort to achieve competitive advantage (Crook, Ketchen, Combs, & Todd, 2008; Peteraf, 1993; Peteraf & Barney, 2003). Importantly, in this study we show that resource value and heterogeneity in firms' ability to respond to competitive actions can compel firms not to forbear but to attack even in the presence of MMC knowing rivals cannot effectively retaliate. Thus, our study suggests that firms may face a trade-off between the strategic benefits associated with valuable and heterogeneous knowledge-based resources and the increased need to protect such resources from multimarket competitors.

This study also contributes to strategy research on defensive strategies that firms use to protect proprietary technological assets. Studies have made important strides advancing understanding of organizational and technological antecedents of patent litigation (e.g., Hall & Ziedonis, 2007; Lanjouw & Schankerman, 2001; Polidoro & Toh, 2011; Somaya, 2012) and about the role that a firm's reputation for toughness in patent enforcement plays in mitigating the leakage of knowledge and the loss of employees (Agarwal et al., 2009; Ganco et al., 2015). This current study adds to prior research on the defensive strategies devised to protect knowledge-based resources by showing that the structure of the competitive environment may be another important determinant of a firm's decision to initiate patent litigation against a rival. There is an opportunity for future research to integrate these insights with prior work by examining how MMC

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affects a firm's ability to protect technological assets using its reputation for toughness in patent enforcement. For example, an important question pertains to how multimarket competition affects knowledge protection efforts based on reputational deterrence. Future research could investigate whether MMC amplifies or diminishes the deterrent value associated with firm's reputation in its efforts to protect the firm's resources from imitation or substitution.

Scholars have also highlighted the need for greater theoretical integration between resource based theory and competitive dynamics (e.g., Chen & Miller, 2012). We add to a number of recent studies that have examined the interplay between firm resources and competitive actions (e.g., Clarkson & Toh, 2010; Ndofor et al., 2011; Polidoro & Toh, 2011). By developing theory that integrates competition in both factor markets (i.e., knowledge protection) and product markets (i.e., MMC), we show that competitive contact in downstream product markets between rivals can also shape firms' subsequent upstream competitive interactions. A promising path for future research involves examining how MMC affects other forms of upstream rivalry. For example, scholars could examine how MMC influences rival firms' decisions to hire one another's scientists and how such talent poaching affects the subsequent leakage of knowledge between rival firms that compete in multiple markets. Furthermore, scholars can also extend this research by investigating whether firms make trade-offs between upstream and downstream rivalry. For example, it is possible that the technology domain may provide an opportunity to compensate for other downstream effects that MMC produces.

Lastly, our study also offers important managerial implications. This study underscores the increased importance of building strong capabilities to protect knowledge when firms compete in multiple markets. We also suggest that managers should have a more nuanced view of how MMC with rivals affects competition. In most instances, firms expect to benefit from reduced competition as market overlap increases. However, the incentive to protect the value associated with upstream resources across multiple product markets may, at times, overshadow the motivation to cooperate between firms. Hence, managers should be mindful of these differences between upstream and downstream actions as they develop strategies to achieve and sustain competitive advantage from knowledge-based resources.

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References

Agarwal, R., Ganco, M., & Ziedonis, R. H. (2009). Reputations for toughness in patent enforcement: Implications for knowledge spillovers via inventor mobility. *Strategic Management Journal*, *30*(13), 1349–1374.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Anand, J., Mesquita, L. F., & Vassolo, R. S. (2009). The dynamics of multimarket competition in exploration and exploitation activities. *Academy of Management Journal*, *52*, 802–821.

Angrist, J. D., & Pischke, J. (2009). *Mostly harmless econometrics: An empiricists companion*. Princeton, NJ: Princeton University Press.

Barney, J. B. (1986). Strategic factor markets: Expectations, luck, and business strategy. *Management science*, *32*(10), 1231–1241.

Baum, J. A. C., & Korn, H. J. (1996). Competitive dynamics of interfirm rivalry. *Academy of Management Journal*, *39*, 255–291.

Baum, J. A. C., & Korn, H. J. (1999). Dynamics of dyadic competitive interaction. *Strategic Management Journal*, *20*, 251–278.

Bettis, R., Gambardella, A., Helfat, C., & Mitchell, W. (2014). Quantitative empirical analysis in strategic management. *Strategic Management Journal*, *35*(7), 949–953.

Bergen, M., & Peteraf, M. A. (2002). Competitor identification and competitor analysis: A broad-based managerial approach. *Managerial and Decision Economics*, *23*(4–5), 157–169.

Boeker, W. J., Goodstein, J. S., Stephan, J., & Murmann, J. P. (1997). Competition in a multimarket environment. *Organization Science*, *8*, 126–142.

Capron, L., & Chatain, O. (2008). Competitors resource-oriented strategies: Acting on competitors' resources through interventions in factor markets and political markets. *Academy of Management Review*, *33*, 97–121.

Cassidy, C. M., & Loree, D. (2001). Dynamics of knowledge transfer among multimarket competitors. In B. JAC & H. R. Greve (Eds.), *Advances in strategic management* (Vol. 18, pp. 141–174). London, England: Emerald.

Chatterji, A. K., & Fabrizio, K. R. (2014). Using users: When does external knowledge enhance corporate product innovation? *Strategic Management Journal*, *35*(10), 1427–1445.

Chen, M.-J. (1996). Competitor analysis and interfirm rivalry: Toward a theoretical integration. *Academy of Management Review*, *21*, 100–134.

Chen, M.-J., & Miller, D. (2012). Competitive dynamics: Themes, trends, and a prospective research platform. *Academy of Management Annals*, *6*(1), 135–210.

Clarkson, G., & Toh, P. K. (2010). Keep out'signs: The role of deterrence in the competition for resources. *Strategic Management Journal*, *31*(11), 1202–1225.

Conti, R., Gambardella, A., & Mariani, M. (2013). Learning to be Edison: Inventors, organizations, and breakthrough inventions. *Organization Science*, *25*(3), 833–849.

Crook, T. R., Ketchen, D. J., Combs, J. G., & Todd, S. Y. (2008). Strategic resources and performance: A meta-analysis. *Strategic Management Journal*, *29*(11), 1141–1154.

Dam, K. W. (1994). The economic underpinnings of patent law. *Journal of Legal Studies*, *23*, 247–271.

DeCarolis, D. M., & Deeds, D. L. (1999). The impact of stocks and flows of organizational knowledge on firm performance: An empirical investigation of the biotechnology industry. *Strategic Management Journal*, *20*(10), 953–968.

Edwards, C. D. (1955). *Conglomerate bigness as a source of power*. In the National Bureau of Economics Research conference report, Business Concentration and Price Policy. Princeton, NJ: Princeton University Press.

Fan, T. P. C. (2010). De novo venture strategy: Arch incumbency at inaugural entry. *Strategic Management Journal*, *31*, 19–38.

FDA. (2015). *Medical devices advisory committee*. http://www.fda.gov/AdvisoryCommittees/CommitteesMeetingMaterials/MedicalDevices/MedicalDevicesAdvisoryCommittee/default.htm.

Feinberg, R. M. (1985). "Sales at risk": A test of the mutual forbearance theory of conglomerate behavior. *Journal of Business*, *58*, 225–241.

Fuentelsaz, L., & Gómez, J. (2006). Multipoint competition, strategic similarity and entry into geographic markets. *Strategic Management Journal*, *27*, 477–499.

Fung, B. (2013, September 3). Is Nokia about to become a patent troll? *Washington Post*.

Ganco, M., Ziedonis, R. H., & Agarwal, R. (2015). More stars stay, but the brightest ones still leave: Job hopping in the shadow of patent enforcement. *Strategic Management Journal*, *36*(5), 659–685.

Giarratana, M. S., & Mariani, M. (2014). The relationship between knowledge sourcing and fear of imitation. *Strategic Management Journal*, *35*(8), 1144–1163.

Gimeno, J., & Woo, C. Y. (1996). Hypercompetition in a multimarket environment: The role of strategic similarity and multimarket contact in competitive de-escalation. *Organization science*, *7*, 322–341.

Gimeno, J., & Woo, C. Y. (1999). Multimarket contact, economies of scope, and firm performance. *Academy of Management Journal*, *42*, 239–259.

Grant, R. M. (1996). Toward a knowledge-based theory of the firm [Winter Special Issue]. *Strategic Management Journal*, *17*, 109–122.

Greene, W. H. (2003). *Econometric analysis*. Upper Saddle River, NJ: Prentice-Hall.

Greve, H. R. (2008). Multimarket contact and sales growth: Evidence from insurance. *Strategic Management Journal*, *29*(3), 229–249.

Greve, H. R., & Mitsuhashi, H. (2004). Multiunit organization and multimarket strategy: The dynamics of market entry and commitment. *Scandinavian Journal of Management*, *20*, 9–30.

Grimm, C. M., Lee, H., & Smith, K. G. (2006). *Strategy as action: Competitive dynamics and competitive advantage*. New York: Oxford University Press.

Hall, B. H., Jaffe, A., & Trajtenberg, M. (2005). Market value and patent citations. *RAND Journal of Economics*, *36*(1), 16–38.

Hall, B. H., & Ziedonis, R. H. (2007). *An empirical analysis of patent litigation in the semiconductor industry* (Working paper). Berkeley: University of California.

Haveman, H. A., & Nonnemaker, L. (2000). Competition in multiple geographic markets: The impact on growth and market entry. *Administrative Science Quarterly*, *45*, 232–267.

Heggestad, A. A., & Rhoades, S. A. (1978). Multimarket interdependence and local market competition in banking. *Review of Economics and Statistics*, *60*, 523–532.

Hoetker, G. (2007). The use of logit and probit models in strategic management research: Critical issues. *Strategic Management Journal*, *28*(4), 331–343.

James, S. D., Leiblein, M. J., & Lu, S. (2013). How firms capture value from their innovations. *Journal of Management*, *39*(5), 1123–1155.

Jayachandran, S., Gimeno, J., & Varadarajan, P. R. (1999). The theory of multimarket competition: A synthesis and implications for marketing strategy. *Journal of Marketing*, *63*, 49–66.

Kang, W., Bayus, B. L., & Balasubramanian, S. (2010). The strategic effects of multimarket contact: Mutual forbearance and competitive response in the personal computer industry. *Journal of Marketing Research*, *47*, 415–427.

Karnani, A., & Wernerfelt, B. (1985). Multiple point competition. *Strategic Management Journal*, *6*(1), 87–96.

Kennedy, P. (2003). *A guide to econometrics* (5th end ed.). Cambridge, MA: MIT Press.

King, G., & Zeng, L. (2001). Logistic regression in rare events data. *Political Analysis*, *9*(2), 137–163.

Korn, H. J., & Baum, J. A. C. (1999). Chance, imitative, and strategic antecedents to multimarket contact. *Academy of Management Journal*, *42*, 171–193.

Kuester, S., Homburg, C., & Robertson, T. S. (1999). Retaliatory behavior to new product entry. *Journal of Marketing*, *63*(4), 90–106.

Lai, R., D'Amour, A., Yu, A., Sun, Y., & Fleming, L. (2011). *Disambiguation and co-authorship networks*

of the U.S. patent inventor database (1975-2010) (Working paper). Harvard University.
Lanjouw, J. O., & Schankerman, M. (2001). Characteristics of patent litigation: A window on com- petition. *RAND Journal of Economics*, *13*, 129–151.
Lanjouw, J. O., & Schankerman, M. (2004). Protecting intellectual property rights: Are small firms handicapped? *Journal of Law and Economics*, *47*, 45–74.
Levin, R., Klevorick, A., Nelson, R., & Winter, S. (1987). Appropriating the returns from industrial research and development. *Brooking Papers on Economic Activity*, *18*(3), 783–820.
Li, S. X., & Greenwood, R. (2004). The effect of within-industry diversification on firm performance: Synergy creation, multi-market contact and market structuration. *Strategic Management Journal*, *25*(12), 1131–1153.
Lieberman, M. B., & Asaba, S. (2006). Why do firms imitate each other? *Academy of Management Review*, *31*(2), 366–385.
Liebeskind, J. P. (1996). Knowledge, strategy, and the theory of the firm. *Strategic Management Journal*, *17*(S2), 93–107.
Lichtman, D. (2012). *Retaliation as patent strategy*. The Media Institute. http://www.mediainstitute.org/IPI/2012/061212.php
Lippman, S. A., & Rumelt, R. P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. *The Bell Journal of Economics*, *13*, 418–438.
Makadok, R. (2010). The interaction effect of rivalry restraint and competitive advantage on profit: Why the whole is less than the sum of the parts. *Management Science*, *56*(2), 356–372.
Marcel, J. J., Barr, P. S., & Duhaime, I. M. (2011). The influence of executive cognition on competitive dynamics. *Strategic Management Journal*, *32*(2), 115–138.
March, J. G. (1991). Exploration and exploitation in organizational learning. *Organization science*, *2*(1), 71–87.
Markman, G. D., Espina, M. I., & Phan, P. H. (2004). Patents as surrogates for inimitable and non-substitutable resources. *Journal of Management*, *30*(4), 529–544.
Markman, G. D., Gianiodis, P. T., & Buchholtz, A. K. (2009). Factor-market rivalry. *Academy of Management Review*, *34*(2), 423–441.
Marx, M., Strumsky, D., & Fleming, L. (2009). Mobility, skills, and the Michigan non-compete experiment. *Management Science*, *55*(6), 875–889.
McEvily, S. K., & Chakravarthy, B. (2002). The persistence of knowledge-based advantage: An empirical test for product performance and technological knowledge. *Strategic Management Journal*, *23*(4), 285–305.
Mitchell, W. (1989). Whether and when? Probability and timing of incumbents' entry into emerging industrial subfields. *Administrative Science Quarterly*, *34*, 208–230.
Montgomery, D. B., Moore, M. C., & Urbany, J. E. (2005). Reasoning about competitive reactions: Evidence from executives. *Marketing Science*, *24*(1), 138–149.
Nelson, R. R., & Winter, S. G. (1982). *The evolutionary theory of economic change*. Cambridge, MA: Belknap Press.
Ndofor, H. A., Sirmon, D. G., & He, X. (2011). Firm resources, competitive actions and performance: Investigating a mediated model with evidence from the in-vitro diagnostics industry. *Strategic Management Journal*, *32*(6), 640–657.
Peteraf, M. A. (1993). The cornerstones of competitive advantage: A resource-based view. *Strategic Management Journal*, *14*, 179–191.
Peteraf, M. A., & Barney, J. B. (2003). Unraveling the resource-based tangle. *Managerial and Decision Economics*, *24*, 309–323.
Pisano, G. (2006). Profiting from innovation and the intellectual property revolution. *Research Policy*, *35*, 1122–1130.
Polidoro, F., & Toh, P. K. (2011). Letting rivals come close or warding them off? The effects of substitution threat on imitation deterrence. *Academy of Management Journal*, *54*, 369–392.
Scott, J. T. (2001). Designing multimarket-contact hypothesis tests: Patent citations and multimarket contact in the product and innovation markets of the chemicals industry. In J. A. C. Baum & H. R. Greve (Eds.), *Advances in strategic management* (Vol. *18*, pp. 175–200). London, England: Emerald.
Scotchmer, S., & Green, J. (1990). Novelty and disclosure in patent law. *The RAND Journal of Economics*, *21*, 131–146.
Sherry, E., & Teece, D. (2004). Royalties, evolving patent rights, and the value of innovation. *Research Policy*, *33*, 179–191.
Somaya, D. (2003). Strategic determinants of decisions not to settle patent litigation. *Strategic Management Journal*, *24*(1), 17–38.
Somaya, D. (2012). Patent strategy and management: An integrative review and research agenda. *Journal of Management*, *38*, 1084–1114.
Steenkamp, J. B. E., Nijs, V. R., Hanssens, D. M., & Dekimpe, M. G. (2005). Competitive reactions to advertising and promotion attacks. *Marketing Science*, *24*(1), 35–54.
Teece, D. J. (1986). Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy. *Research Policy*, *15*, 285–305.
Trajtenberg, M. (1990). A penny for your quotes: Patent citations and the value of innovations. *The Rand Journal of Economics*, *21*(1), 172–187.
Venkataraman, S., Chen, M.-J., & MacMillan, I. C. (1997). Anticipating reactions: Factors that shape competitor responses. In G. S. Day & D. J. Reibstein (Eds.), *Wharton on dynamic competitive strategy* (pp. 198–219). New York, NY: John Wiley and Sons, Inc.
Wiersema, M., & Bowen, H. (2009). The use of limited dependent variable techniques in strategy research:

Issues and methods. *Strategic Management Journal*, *30*, 679–692.

Wu, B. (2013). Opportunity costs, industry dynamics, and corporate diversification: Evidence from the cardiovascular medical device industry, 1976-2004. *Strategic Management Journal*, *34*, 1265–1287.

Young, G., Smith, K. G., Grimm, C. M., & Simon, D. (2000). Multimarket contact and resource dissimilarity: A competitive dynamics perspective. *Journal of Management*, *26*, 1217–1236.

Yu, T., & Cannella, A. A. (2007). Rivalry between multinational enterprises: An event history approach. *Academy of Management Journal*, *50*, 663–684.

Yu, T., & Cannella, A. A. (2013). A comprehensive review of multimarket competition research. *Journal of Management*, *39*, 76–109.

Yu, T., Subramaniam, M., & Cannella, A. A. (2009). Rivalry deterrence in international markets: Contingencies governing the mutual forbearance hypothesis. *Academy of Management Journal*, *52*, 127–147.

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