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Litigate or let it go? Multi-market contact and IP infringement-litigation dynamics

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ABSTRACT

We explore how multimarket contact (MMC) explains competitors' intellectual property (IP) infringement-litigation dynamics. We build on role congruity theory to propose that the role played by each firm in shared markets generates expectations about their behavior, determining which of the following dynamics arise: mutual forbearance (low probability of IP infringement and high probability of litigation) or mimetic behavior (high probability of IP infringement and low probability of litigation). We look into two possible roles, imitators and innovators, and claim that (1) mutual forbearance dynamics are more likely to arise when firms play the role of innovators, whereas (2) mimetic behavior dynamics are more likely to arise when firms play the role of imitators. We find support for our predictions in a sample of 813 patent infringement cases in the biopharmaceutical industry. Increasing MMC from one standard deviation below the mean to one standard deviation above the mean leads to a 21.6 (20.6) percent decrease in the probability of infringement and a 22.7 (65.1) percent increase in the probability of litigation after infringement when the rival (focal firm) plays the role of an innovator in shared markets. Alternatively, this increase in MMC leads to a 14.3 % increase (no increase) in the probability of infringement and a 5.2 (16.4) percent decrease in the probability of litigation when the rival (focal firm) plays the role of an imitator in shared markets.

1. Introduction

Intellectual property (IP) rights are one of the main sources of competitive advantage (Grant, 1996; Teece et al., 1997; Pisano, 2006). Thanks to IP rights, firms can avoid imitation and accrue quasi-monopolistic rents (Ahuja and Yayavaram, 2011; Gallie and Legros, 2012; Teece, 1986). It is not rare, however, that rivals infringe on each other's IP rights, leaving the infringed firm the option to litigate in response (Agarwal et al., 2009; Buss and Peukert, 2015; Lanjouw and Lerner, 1996; Polidoro and Toh, 2011). The 10-year litigation between VirnetX and Apple for patent infringement (McCarthy, 2020) and the recent $2.15 billion patent infringement case involving Teva Pharmaceuticals Industries, Sun Pharmaceutical Industries and Pfizer (Ail, 2013) illustrate the very serious implications of litigation after IP infringement. Understanding infringement-litigation dynamics is important both for firms and for policy makers. On the one hand, firms need to be able to better protect their innovation. It goes through preventing and knowing how to react to patent infringement and possible ensuing litigation. Indeed, such litigations are often costly and time-consuming and may come with significant reputational and financial damage. On the other hand, IP rights are a central instrument of public policy. It is of primary relevance for policy makers to use appropriate IP tools for promoting dissemination and transfer of technology.

Different infringement-litigation dynamics between a pair of firms may arise. Prior work has shown that the type of competitive dynamics between two competitors depends on the degree of multimarket contact (MMC) between them, i.e., the extent to which they are active in the same markets (Baum and Korn, 1999; Chen and Miller, 2012; Yu and Cannella, 2013). Continuous interactions in multiple markets are likely to lead to the development of a set of implicit norms and expectations that determine future competitive behavior (Chen and Miller, 2012; Gimeno, 1999; Yu and Cannella, 2013). Accordingly, the level of MMC between a pair of firms should be a strong determinant of infringement-litigation dynamics. It is not clear, however, what particular *type* of infringement-litigation dynamics arises as a consequence of greater levels of MMC.

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At the theoretical level, two main perspectives may inform us about how MMC could affect infringement-litigation dynamics. First, early work in the competitive dynamics literature proposed the *mutual forbearance* logic (Chen, 1996; Chen and Miller, 2012; Yu and Cannella, 2013). This logic states that MMC between a pair of firms leads to the development of a collusive agreement where the expectation is that the firms will keep a healthy distance and avoid harmful confrontation that could spill over to other shared markets (Chen, 1996; Gimeno, 1999; Yu and Cannella, 2013). This logic implies that as MMC increases, the probability of IP infringement should decrease (i.e., as a result of a common understanding of nonaggression), while the probability of litigation should increase (i.e., more retaliation after an attack due to the violation of the tacit nonaggression agreement). Alternatively, scholars have proposed the *mimetic behavior* rationale (Lieberman and Asaba, 2006; Yu and Cannella, 2013). This perspective states that MMC leads to the implicit agreement that firms will converge in their technological trajectories to cope with uncertainty (Anand et al., 2009; Lieberman and Asaba, 2006). Thus, this logic suggests that greater levels of MMC should increase the probability of IP infringement (i.e., imitation stems from the implicit agreement supporting technological convergence) and reduce the probability of litigation as a response (i.e., infringement is not inherently perceived as an aggression). Overall, then, there seems to be a lack of consensus at the conceptual level since extant theories point to opposing directions with respect to how MMC should affect infringement-litigation dynamics.

Prior work at the empirical level does not help address this lack of consensus for two main reasons: (1) there is no study fully testing the impact of MMC on both infringement and litigation simultaneously, and (2) both views receive partial support in the evidence reported to date. For instance, Theeke and Lee (2017) find evidence that is consistent with the mutual forbearance view: in their study, MMC is associated with a greater probability of litigation. However, Anand et al. (2009) find evidence consistent with the mimetic behavior perspective: they show that MMC increases the probability that firms step into each other's technologies, suggesting, if anything, that MMC leads to a greater probability of IP infringement. Consequently, given the lack of consensus at the theoretical level and the mixed evidence at the empirical level, it is unclear how MMC affects infringement-litigation dynamics.

The goal of our study is to shed light on this puzzle by developing a conceptual model that reconciles the two opposing theoretical perspectives. What makes these two perspectives apparently incompatible is that each one makes very different assumptions about the kind of norms and expectations that arise from market overlap, i.e., whether firms should keep a healthy distance (mutual forbearance) or become technologically closer (mimetic behavior). In our study, we claim that these two views are not incompatible. We argue that different dyads develop different expectations. Thus, we propose a model that predicts which of these expectations, and what kind of dynamics, are more likely to arise in a given dyad. Specifically, we argue that the way competitors see each other in shared markets, i.e., the particular role they play, determines which of these expectations arises. We draw on role congruity theory to argue that distinct roles are associated with different stereotypes, and stereotypes create expectations that shape future behavior (Diekman and Goofriend, 2006; Eagly and Karau, 2002; Fiske et al., 2002; Um et al., 2022). Each firm assumes that its competitor will act in a way that is consistent with the stereotypical expectations associated with that competitor's role (Cuddy et al., 2008; Hsu et al., 2009). Hence, each firm behaves correspondingly, and when its expectations about its rival are violated (i.e., the behavior of the rival is not congruent with its assumed role), the firm will react negatively (Cuddy et al., 2008, Hsu et al., 2009). Thus, the stereotyped competitor likely faces pressure to conform to the expectations that its role carries (Biddle, 1986; Eagly and Karau, 2002; Johnson et al., 2008; Jourdan et al., 2017).

Building on this perspective, we look at the decisions made by the rival firm (the one that decides whether to infringe on the focal firm's IP) and the focal firm (the one that decides whether to litigate after infringement), and we distinguish between two roles these firms can play in innovation activities: imitators and innovators (Chen, 1996; Haleblian et al., 2012; Nelson and Winter, 1982). Innovators build and keep a competitive edge by introducing new products and technologies, while imitators compete by developing products that are extremely similar to those already available in the market. We propose that the presence of these fundamental differences in how each firm competes in the market leads to the emergence of two different stereotypes, and thus expectations, on how each firm perceives IP rights. On the one hand, we claim that innovators are expected to believe that novelty and creativity should be the main determinants of firm success (Nelson and Winter, 1982), so they are expected to perceive that free-riding on others' IP efforts is a clear inappropriate behavior. On the other hand, we propose that imitators are expected to see IP rights as resources that can be replicated to the extent that they see technological convergence as a logical and appropriate strategy to cope with the uncertainties inherent in innovation activities (Nelson and Winter, 1982; Roberts, 1999).

Therefore, we look at how MMC leads to different infringement-litigation dynamics depending on whether the focal firm and the rival firm play innovator or imitator roles in shared markets. First, we look at the role played by the rival and predict that MMC is more likely to lead to mutual forbearance dynamics (i.e., low infringement and high litigation after infringement) when the rival plays the role of an innovator in shared markets but to mimetic behavior dynamics (i.e., high infringement and low litigation after infringement) when the rival plays the role of an imitator in shared markets. Because a rival who plays the role of an innovator is expected to see IP infringement as an inappropriate and aggressive competitive action, such a rival is more likely to exhibit a behavior that is consistent with such expectations (i.e., less likely to infringe on the focal firm's IP), and the focal firm is more likely to react negatively (i.e., litigate) if such a rival breaks those expectations (i.e., infringes on its IP rights). Conversely, because a rival who plays the role of an imitator is expected to see IP infringement as an appropriate competitive behavior, such a rival is likely to behave in a way that is consistent with that expectation (i.e., more likely to infringe the focal firm's IP), and the focal firm is less likely to react negatively (i.e., litigate) after such an expected behavior.

Second, we look at the role played by the focal firm to make analogous predictions: MMC is more likely to lead to mutual forbearance dynamics when the focal firm plays the role of an innovator but to mimetic behavior dynamics when the focal firm plays the role of an imitator in shared markets. Focal firms that play the role of an innovator are more likely to behave in a way that is consistent with their role and respond negatively to infringement (i.e., litigate) because they are expected to see IP infringement as an aggressive behavior, which suggests a lower probability that rivals will infringe on the IP rights of such a firm. In contrast, we propose that focal firms playing the role of an imitator will behave according to such a role and exhibit a lower probability of litigation to the extent that they are expected to see IP infringement as an acceptable action, leading to a greater probability that rivals will infringe on their IP rights in the first place.

We test our predictions in a sample of 813 patent infringement cases in the biopharmaceutical industry by looking at the introduction of generic versions of branded drugs that are still under patent protection (i.e., infringement) and the subsequent responses by infringed firms (i.e., litigation). We find support for our theoretical arguments. We find that an increase in MMC from one standard deviation below the mean to one standard deviation above the mean leads to a 21.6 % decrease in the probability of infringement and a 22.7 % increase in the probability of litigation after infringement when the rival plays the role of an innovator in shared markets. However, it leads to a 14.3 % increase in the probability of infringement and a 5.2 % decrease in the probability of litigation when the rival plays the role of an imitator. Similarly, we find that this increase in MMC leads to a 20.6 % decrease in the probability of infringement and a 65.1 % increase in the probability of litigation when the focal firm plays the role of an innovator in shared markets, but there

is no increase in the probability of infringement and a 16.4 % decrease in the probability of litigation when the focal firm plays the role of an imitator in shared markets.

We believe our study contributes to several bodies of literature and policy aspects. First, we offer ways to reconcile the mutual forbearance and mimetic behavior perspectives within the MMC and competitive dynamics literature. Second, we contribute to the litigation and IP literature (Clarkson and Toh, 2010; Jones et al., 2021; Polidoro and Toh, 2011) by providing a plausible explanation for why some firms decide not to litigate after an IP infringement, whereas others respond quite aggressively. At a broader level, our study joins recent efforts to better understand the reasons behind the lack of response to a competitor's attack (Andrevski and Miller, 2022; Hughes-Morgan et al., 2018). Third, we expand role congruity theory and show how it can enrich our understanding of competitive dynamics. Finally, our study may help regulators understand whether greater levels of MMC will lead to collusive behavior or more aggressive competition.

2. Theory and hypotheses

We examine how MMC affects competitive dynamics in the context of IP rights. Specifically, we look at the following type of action-response: the probability that a rival infringes on a focal firm's IP (attack) and the probability that the focal firm decides to litigate after such infringement (response). We argue that infringement-litigation decisions are determined by the roles these firms play in the markets they share. We draw from role congruity theory to argue that roles are associated with certain stereotypes, and such stereotypes carry expectations about beliefs and behaviors. These expectations, we claim, shape infringement-litigation decisions. We develop this logic in the following sections.

2.1. Roles, stereotypes, and expectations

Roles are specific functions or parts played by individuals or organizations in a particular situation, e.g., an individual chairing a board meeting or a start-up in a venture capitalist's portfolio (Eagly and Karau, 2002). It is often the case that roles are associated with particular stereotypes, which creates expectations about what kind of attitudes, beliefs, and behavior those playing such roles should exhibit (Diekman and Goofriend, 2006; Eagly and Karau, 2002; Um et al., 2022). For instance, stereotypes about corporate leaders lead to the expectation that individuals chairing a board will be assertive and confident (Chen et al., 2018; Shi et al., 2019). Similarly, at the organizational level, stereotypes about start-ups that rely intensively on basic science lead to the expectation that such start-ups are not sufficiently motivated to maximize economic profits and need special competence addition (Wry et al., 2014).

Role congruity theory suggests that when these stereotypical expectations are strong enough, they are likely to guide actors' interpretation of others' behavior (Bechky, 2006). Therefore, such stereotypes are likely to determine normative expectations and perceived obligations, thus shaping the behavior of both those interacting with stereotyped subjects and those stereotyped subjects themselves (Cuddy et al., 2008). First, the presence of a strong stereotype around a particular role is likely to shape the behavior of those interacting with the agent playing that role. In particular, role congruity theory states that people are likely to react negatively when others behave in a way that is incongruent with the stereotype associated with their role (Eagly and Karau, 2002). For example, prior studies found that females accepting leadership roles are viewed negatively because they are seen as play-acting a role tailored for and defined by men (Carli et al., 2016; Eagly and Karau, 2002; Heilman et al., 2004; Parker et al., 2020). Analogously, at the organizational level, Carroll and Swaminathan's (2000) study on the microbrewery movement shows how microbreweries whose activities were inconsistent with the expectations associated with the existing stereotype (e.g., used mass-production techniques rather than handcrafted methods on traditional ingredients) experienced a negative reaction from consumers.

Second, the presence of strong stereotypes around particular roles is likely to shape the behavior of those playing such roles as well (Eagly and Karau, 2002). Basically, role congruity theory argues that those who are subject to role stereotypes are likely to conform to the expectations that these stereotypes carry to avoid the punishments that follow expectancy violation (Jourdan et al., 2017; Spencer et al., 1999). Prior work, for instance, has found that women are likely to conform to expectations when gender stereotypes are highly salient (Spencer et al., 1999). Similarly, at the organizational level, Carlos and Lewis (2018) show how firms that are stereotyped as non-sustainable are less likely to make their environmental certifications visible. The reason is that such firms are likely to be punished because having a certification is inconsistent with these firms' stereotypes; thus, external audiences are likely to perceive it as hypocritical and react negatively.

In sum, role congruity theory states that when the role played by an agent carries a stereotype, others behave assuming that this organization's actions will be consistent with the stereotype and react negatively if this is not the case. Therefore, this expectation is likely to create pressure on the stereotyped agent to conform with the expectations associated with such stereotypes, strengthening such stereotypes even further. We apply this logic in the context of IP infringement to argue that the roles played in shared markets by both firms (focal and rival) are associated with stereotypical expectations. Accordingly, we propose that both firms' behavior is shaped by those expectations, thus affecting infringement-litigation decisions.

2.2. Roles and stereotypes in innovation: innovators vs imitators

The literature on industry evolution and competitive dynamics has distinguished between two main roles of firms in the innovation arena: innovators and imitators (Nelson and Winter, 1982; Chen, 1996; Haleblian et al., 2012). Innovators are firms that compete by pursuing novel and unexplored technological trajectories to open new markets, whereas imitators are firms that compete through slight modifications or even direct replications of existing products and technologies (Lieberman and Montgomery, 1998; Tripsas and Gavetti, 2000). We propose that each of these two roles carries its own stereotypes about how they perceive IP rights, and thus, firms playing these roles are expected to approach IP rights in different ways.

Innovators see IP rights as resources that need to be respected (Suarez and Utterback, 1995). Opening up new technological trajectories is a risky and costly endeavor, where the reward is the development of new IP and the creation of dominant designs or categories (Suarez et al., 2015). Therefore, those playing the role of innovators are expected to believe that novelty and creativity are the only legitimate drivers of competitive advantage and thus should be the main determinants of firm success (Nelson and Winter, 1982). Accordingly, innovators are expected to perceive that free-riding on others' IP efforts is a clear inappropriate behavior and thus to be protective of their innovations. Instead, the appropriate behavior is to follow diverging technological trajectories to maintain a healthy distance between the two firms' IP rights and to let the competition designate the best technology. Gilead Sciences provides a good example of the kind of stereotype that is typically associated with an innovative firm. This firm holds a reputation for both its success in developing breakthrough drugs for the hepatitis market as well as its public stance in support of strong IP rights for innovators (Gilead, 2014). Similar cases to the one of Gilead Sciences have led to the emergence of a strong stereotype around innovators, and thus, strengthened the expectation that innovators see IP infringement as an inappropriate and anti-competitive behavior.

Imitators, conversely, are subject to a very different stereotype. Imitators see IP rights as resources that can be replicated. These firms are expected to seek technological convergence as a logical and appropriate

strategy to cope with the uncertainties inherent in innovation activities (Nelson and Winter, 1982; Roberts, 1999). Competition, therefore, consists of picking the right trajectory to avoid being stuck in a dead end. That is, those playing the role of imitators are expected to see new IP as an indication of where they should be heading in their technological trajectory. Therefore, for imitators, infringing another firm's IP is perceived as an acceptable behavior in that it is nothing more than an attempt to join and reinforce a technological trajectory. Teva Pharmaceuticals exemplifies a company that exhibits such stereotypes. Teva holds a strong reputation for developing imitations (i.e., generics) of existing drugs, and it is known for its view of patents as IP rights that ought to be challenged (Singer, 2010). Therefore, the behavior of firms such as Teva has led to the emergence of a strong stereotype around imitators as firms who perceive that infringing on another firm's IP rights is an appropriate behavior.

We propose that the greater the level of MMC, the more likely firms are to stereotype their rivals and form expectations about each other. Notably, this means that as MMC increases, each firm in a given dyad develops stronger expectations about each other's beliefs with respect to IP rights. The nature of these expectations, then, depends on the role played by the other member of the dyad, i.e., whether firms associate one another with the stereotype of an innovator or an imitator. Hence, we look at how the role played by the rival firm (the one that decides whether to infringe on the focal firm's IP) and the focal firm (the one that decides whether to litigate after infringement) in the markets they share explains what competitive dynamics emerge. We first focus on the rival's role as explaining infringement-litigation dynamics (keeping a focal firm's characteristics constant), and second, we focus on the focal firm's role in explaining infringement-litigation dynamics (keeping a rival's characteristics constant).

2.3. MMC and Infringement-litigation decisions as a function of the rival's role

In this section, we look at what infringement-litigation dynamics arise when MMC increases, depending on whether the *rival firm* plays an innovator or an imitator role in shared markets. We propose that greater levels of MMC imply a stronger interaction between firms, which is likely to increase the probability that the rival firm is associated with a stereotype based on the role it plays in those shared markets. Building on the logic outlined above, we propose that the focal firm develops its expectations about how the rival firm sees IP rights depending on the role the rival plays in the markets they share. These expectations consequently affect both the rival's decision on whether to infringe and the way the focal firm interprets and reacts to the rival's infringement decision.

On the one hand, if the rival plays the role of an *innovator* in shared markets, the focal firm will expect that the rival holds values and beliefs that are consistent with that role's stereotype (Eagly and Karau, 2002; Hsu et al., 2009). In particular, the focal firm expects the rival to believe that IP rights are key resources that need to be respected by other firms. For such a rival, the appropriate competitive behavior is to follow diverging technological trajectories in order to avoid infringing IP rights and to let the competition determine which one is more successful. Accordingly, the focal firm is likely to react negatively and with disbelief if the rival behaves in a way that is inconsistent with such expectations (Durand and Vergne, 2015). In other words, if the rival firm decides to infringe the focal firm's IP rights, this action will be deeply incongruent with the kind of behavior the focal firm expects from an innovator, and the focal firm thus is likely to react negatively by litigating against such infringement. The punishment that would follow a violation of the focal firm's expectations (i.e., litigation) is likely to translate into strong pressures on the rival firm to conform to expectations associated with its stereotype (i.e., not infringe) (Jourdan et al., 2017). As suggested by role congruity theory, the expectations others have about one's behavior may actually become powerful constraints that shape one's future behavior (Eagly and Karau, 2002). We therefore propose that the rival firm is less likely to infringe the focal firm's IP rights and more likely to (re)direct its innovative resources to pursue projects that involve a diverging technological trajectory, a behavior that is more consistent with both the rival's identity and the focal firm's expectations.

On the other hand, if the rival plays the role of an *imitator* in the markets it shares with the focal firm, then the focal firm will expect the rival's beliefs to be consistent with those defined by this role's stereotype (Fiske et al., 2002). This means that the focal firm expects the rival to see technological convergence as an appropriate competitive strategy to cope with uncertainty and to see the infringement of IP rights as a natural and acceptable consequence of such behavior. Accordingly, the focal firm is less likely to react negatively (i.e., litigate) if the rival decides to infringe on the focal firm's IP (Polidoro and Toh, 2011; Tan, 2016). Such behavior is consistent with the focal firm's expectations associated with the stereotype linked to the rival's role as an imitator (Cuddy et al., 2008). These expectations, as explained above, are also likely to shape the rival's behavior (Carlos and Lewis, 2018). The pressures to conform to the focal firm's expectation that the rival sees technological convergence (and thus the replication of IP rights) as an appropriate behavior shape the rival's infringement decision. Accordingly, we propose that the rival is more likely to infringe on the focal firm's IP to the extent that such behavior is consistent with the focal firm's expectations and will not trigger punishment (i.e., litigation).

In sum, we suggest that greater levels of MMC between the focal firm and the rival lead to a lower probability of infringement and a greater probability of litigation when the rival plays the role of an innovator in shared markets. Conversely, we predict that greater levels of MMC lead to a greater probability of infringement and a lower probability of litigation when the rival plays the role of an imitator.

Hypothesis (H1a). Greater levels of MMC increase the probability that a rival infringes on a focal firm's IP rights when the rival plays the role of an imitator but decrease the probability that a rival infringes on a focal firm's IP rights when the rival plays the role of an innovator.

Hypothesis (H1b). Greater levels of MMC decrease the probability that the focal firm litigates against a rival after IP infringement when the rival plays the role of an imitator but increase the probability that a focal firm litigates against a rival after IP infringement when the rival plays the role of an innovator.

2.4. MMC and infringement-litigation decisions as a function of the focal firm's role

In this second section, we examine how infringement-litigation decisions depend on whether the *focal firm* plays the role of an innovator or an imitator in shared markets. As before, we argue that greater MMC implies stronger and more frequent interactions, thus increasing the probability that the focal firm is linked to a particular stereotype. The stereotypical expectations the rival has about the focal firm differ depending on the role the focal firm plays in the markets the firms share (Merton, 1957; Biddle, 1986). These expectations, as proposed in the previous section, affect both the rival's decision on whether to infringe on IPs *and* the way the focal firm interprets and reacts to the rival's infringement decision.

On the one hand, when the focal firm plays the role of an *innovator* in shared markets, the rival is likely to expect that the focal firm's values and beliefs are consistent with this role's stereotype (Thomas and Biddle, 1966; Solomon et al., 1985). Specifically, we claim that the rival expects the focal firm to see IP rights as key resources that should not be infringed, leading to diverging technological trajectories between the two firms. Accordingly, the rival is likely to expect the focal firm to interpret an infringement as a flagrant violation and thus to respond aggressively when it happens. Hence, based on these stereotypical expectations, we claim that the rival is less likely to infringe on the focal firm's IP and that the focal firm is more likely to react aggressively to the

rival's infringement of its IP rights, i.e., to litigate. Such behavior is consistent with the expectations the rival holds about the focal firm based on the particular role the latter plays in shared markets, i.e., innovators.

On the other hand, if the focal firm's role in shared markets is that of an *imitator*, the rival is likely to expect that the focal firm's beliefs are consistent with those defined by stereotypes of that role (Biddle, 1986). In other words, the rival is likely to expect the focal firm to see IP rights as indicative of a technological trajectory along which competitors cluster as a way to cope with uncertainty (Suarez et al., 2015). Hence, if the rival expects the focal firm to tolerate IP infringement, the rival is more likely to infringe on the focal firm's IP. Moreover, the focal firm's litigation decision is also shaped by the rival's expectations about the focal firm's behavior. Since the focal firm plays the role of an imitator, the rival firm (as well as others in the same market) expects the focal firm to behave in a way that is consistent with the associated stereotype, i.e., see IP infringement as a behavior that may not compromise competition and the focal firm's competitive edge. Thus, the expectation is of a low probability that the focal firm will litigate if its IP rights are infringed. That the focal firm would exhibit a different behavior from the expected one (i.e., litigating) would likely trigger a negative reaction from external players to the extent that it is not congruent with the expectations the focal firm's role carries. Therefore, the pressures to conform to such expectations are likely to mitigate the focal firm's likelihood of responding to the rival's infringement. Hence, we claim that the focal firm will be less likely to litigate after the rival infringes on its IP rights.

Overall, we propose that greater levels of MMC between the focal firm and the rival lead to a lower probability of infringement and a greater probability of litigation when the focal firm plays the role of an innovator in shared markets. However, we predict that increases in MMC lead to a greater probability of infringement and a lower probability of litigation when the focal firm plays the role of an imitator. This leads to our last two hypotheses:

Hypothesis (H2a). Greater levels of MMC increase the probability that a rival infringes on the focal firm's IP rights when the focal firm plays the role of an imitator but decrease the probability that a rival infringes on the focal firm's IP rights when the focal firm plays the role of an innovator.

Hypothesis (H2b). Greater levels of MMC decrease the probability that a focal firm litigates against a rival after IP infringement when the focal firm plays the role of an imitator but increase the probability that a focal firm litigates against a rival after IP infringement when the focal firm plays the role of an innovator.

3. Methods

3.1. Empirical context

To test our predictions, we need a context where the following conditions are met. First, we need to be able to identify IP infringements. Second, the infringement must be intentional since a violation of an agreement leads to punishment mainly when observers perceive intentionality on the part of the actor (Bachman and Guerrero, 2006). Third, the infringed firm must be aware of the infringement. This is critical so that we do not confound the lack of litigation with the fact that the focal firm was simply not aware that an infringement had occurred. Fourth, we need to be able to identify the moment when the focal firm becomes aware of the infringement and decides whether to litigate or not. In this way, we can be sure that the lack of litigation against a rival is not because the infringed firm is still deciding whether to litigate or not.

We select a context in which all of these conditions are met (Branstetter et al., 2016; Conti et al., 2022): the introduction of generic versions of branded drugs still under patent protection in the biopharmaceutical industry.[1] First, for a generic to be introduced into the market, a firm needs to obtain approval by the regulatory agency (the FDA in the U.S.). The approval processes for generics vary depending on the presence of patent protection behind the branded drug (Hatch-Waxman Act of 1984). Generic applications where the branded drug has no patents, the patents have expired, or the generic firm specifically declares that it is willing to delay approval until the patents have expired fall under Paragraph I, Paragraph II, and Paragraph III certifications, respectively. In all these cases, there is no infringement of the branded drug's patents. However, applications where the generic firm expresses its desire to market its drug *before* the branded drug's patents have expired fall under Paragraph IV certification. These are cases where the introduction of the generic does represent an infringement and opens up the option for the branded drug's owner to litigate for patent infringement. Thus, we examine generic drug introductions that fall under Paragraph IV certification since the first and second conditions hold: there is an infringement of the focal firm's IP (patents in our context), and the rival is infringing intentionally.

In addition, in attending to the FDA's regulatory requirements, during the application review process of the generic, the applying firm must communicate to the owner of the branded drug its intention to introduce a generic version of the drug. This means that the focal firm is always aware of the fact that the rival is infringing on its patents, which is our third condition. Finally, the FDA states that once the branded drug's owner is informed about the infringement, it has 45 days to decide whether to sue the generic firm for patent infringement or not. If the branded drug's owner chooses not to litigate, it waives its right to litigate in the future based on the equitable estoppel doctrine.[2] This means that we can perfectly identify firms' decision to litigate or not in this context since the lack of litigation after 45 days of infringement automatically implies that litigation does not occur.

In sum, as recent studies have shown, the regulatory environment in this industry makes it an ideal setting to identify infringement-litigation dynamics (Branstetter et al., 2016, Conti et al., 2022). Unlike other industries where infringement decisions are not made public and are hard to identify, the pharmaceutical industry provides the level of transparency that we need to test our conceptual model.

3.2. Data

To identify Paragraph IV certification generic applications (i.e., infringement that can lead to litigation), we rely on two different data sources. First, consistent with prior work (Branstetter et al., 2016; Conti et al., 2022; Higgins and Graham, 2009; Panattoni, 2011), we obtain Paragraph IV cases from the FDA's repository of files on Abbreviated New Drug Applications (ANDA) provided on the FDA's website (drugs@FDA database). We identify ANDAs that refer to Paragraph IV certification by looking at the approval letters available in the FDA application files. In these letters, we can identify the generic drug, the company that submitted the application, the branded drug based on which a generic is to be developed, the firm that owns that branded drug, the infringed patents that are behind the branded drug, and the date on which the infringement took place. More importantly, these letters provide information about the infringed firm's response

[1] Generic drugs are nonbranded versions of branded drugs that are already in the market. These generics are pure imitations of a branded drug that include the exact same active ingredients and in the same amount.

[2] A patentee cannot sue a potential infringer if misleading conduct (or silence) leads the alleged infringer to reasonably infer that the patentee does not intend to enforce its patent (Rockman, 2004).

(litigation or not). It is important to note, however, that the FDA's repository of files includes only approved generic applications. This means that we can identify only Paragraph IV applications where the branded drug's owner decided not to litigate (so the generic was automatically approved and introduced into the market) or Paragraph IV applications where the branded drug's owner decided to litigate but the infringing company won the patent infringement case (so the generic was finally approved and introduced into the market). Cases where the branded drug's owner decided to litigate and won the patent infringement case are not included in the FDA's repository files since those applications were never approved.

To identify cases where litigation took place and the infringed firm won the case, we follow prior studies and look at court decisions data (Branstetter et al., 2016, Conti et al., 2022, Higgins and Graham, 2009, Panattoni, 2011). Specifically, we look directly at data from publicly available litigation databases (e.g., Panattoni, 2011; Sytch and Tatarynowicz, 2014). We download all patent infringement cases that referred to Paragraph IV certification applications from the Public Access to Court Electronic Records (PACER). We retain records where we can identify the generic drug application involved in the infringement (ANDA), the branded drug being infringed, and the infringed patents. Note that in this data source, we also obtain cases where litigation took place and the generic firm won the case (these cases are available in both data sources). Overall, then, combining the two data sources, we create a comprehensive sample of infringement cases, where some lead to litigation and others do not.

3.3. Sample

Ultimately, we are able to identify 813 patent infringement cases during the 1997–2013 period.[3] Out of these 813 cases, in 533 (65.6 %), the branded firm decided to litigate, and in 280 (34.4 %), it decided not to litigate. Thus, we use this sample of 813 cases to test the predictions on the probability of litigation (H1b and H2b). To test the predictions on the probability of infringement (H1a and H2a), we also need cases where infringement *did not* occur. That is, in addition to these 813 cases, we need to incorporate cases where a rival could have infringed a focal firm's patents but did not. To that end, we consider all companies that had introduced at least one drug in their lifespan as potential infringers, i.e., rivals. Then, for each focal firm whose patents were infringed in our 813 cases, we create dyads with all possible rivals throughout the 1997–2013 period. We end up with 4,920,276 dyad-year observations (813 focal firms, times an average of 356 rivals for each focal firm, times 17 years where the infringement might have occurred), which include 813 dyad-year observations where the rival did infringe on the focal firm's patents and 4,919,463 dyad-year observations where it did not.

3.4. Measures

Infringement. Our first dependent variable takes the value of 1 if the focal firm's patents were infringed on by a specific rival in time t and 0 otherwise.

Litigation. Our second dependent variable takes the value of 1 if the focal firm whose patents were infringed on decided to litigate against the rival and 0 otherwise.

MMC. To create our measure of MMC between the focal firm and the rival, we look at the number of markets where both firms are active (Anand et al., 2009; Gimeno and Woo, 1996; Theeke and Lee, 2017). First, it is important to note that we define markets based on pharmacological classes (e.g., antiarrhythmic, anti-coagulant) (Polidoro and Toh, 2011), a classification that is available in the RxClass database provided by the U.S. Library of Medicine. Next, we count the number of markets where both firms have introduced at least one drug in the previous 5 years (Anand et al., 2009; Theeke and Lee, 2017). We calculate the natural logarithm of this measure to account for its skewed nature.[4]

Rival Imitator. To capture the role played by the rival in shared markets, we look at the type of drugs the rival has developed in the previous 5 years. There are two types of drugs approved by the FDA: generic drugs (replications of existing drugs) and branded drugs (products that demonstrate substantial improvement over available therapy). We claim that firms developing generics are more likely to be perceived as imitators, whereas firms developing branded drugs are likely to be perceived as innovators. Thus, to capture the role a rival plays in shared markets, we look at the percentage of generics the rival has developed in the previous 5 years in the markets it shares with the focal firm. Therefore, a score close to one in this measure means that the rival is likely to play the role of an imitator in shared markets, while a score close to zero means that the rival is likely to play the role of an innovator in shared markets.[5]

Focal Firm Imitator. Analogously, we capture the role a focal firm plays in shared markets by looking at the percentage of generics the focal firm has developed in the previous 5 years in the markets it shares with the rival.

Controls. First, we control for the total number of markets in which the rival is active (*total markets rival*) and the total number of markets in which the focal firm is active (*total markets focal firm*) (Theeke and Lee, 2017). Second, we include the natural logarithm of the total number of drugs the rival has introduced in the last five years (*total drugs rival*) and the natural logarithm of the total number of drugs the focal firm has introduced in the last five years (*total drugs focal firm*) to control for the overall size of both firms' portfolios (Polidoro and Toh, 2011; Tan, 2016). Third, we include the number of other competing drugs in the focal market (*other drugs in market*) to capture the degree of competition and attractiveness of that market (Polidoro and Toh, 2011). Fourth, we add the natural logarithm of the number of years left of patent protection (*patent time left*) (Polidoro and Toh, 2011). Fifth, we include a measure of the number of times the rival has been sued for patent infringement (*prior litigations rival*) and the number of times the focal firm has litigated against rivals (*prior litigations focal firm*) (Polidoro and Toh, 2011; Theeke and Lee, 2017). Finally, we add a control for the *number of patents* behind the drug at risk of infringement, which should influence the rival's motivation to infringe and the focal firm's predisposition to litigate (Polidoro and Toh, 2011, Tan, 2016).

3.5. Analysis

Given the binary nature of our two dependent variables (*infringement* and *litigation*), we rely on probit estimations. We include year fixed effects to control for temporal dynamics in the reaction to patent infringement and cluster standard errors at the rival and focal firm levels to address the potential nonindependence of residuals. The tests for the first dependent variable, however, rely on a very large sample (4,920,276 observations), with only 813 cases in which infringement took place. We thus follow prior research (Cockburn and MacGarvie, 2011; Diestre and Rajagopalan, 2011; Diestre et al., 2015; Silverman, 1999) and use a state-based sampling technique that consists of selecting all cases in which the dependent variable takes a value of 1 (infringement took place) and only a random sample of noninfringement cases

[3] We look up to 2013 to avoid incurring in sample selection bias, since those patent infringement cases where litigation takes place will not appear in the FDA data until they are resolved in court and the FDA goes through the review process afterwards (something that may take up to 8 years).

[4] We also tried using a lagged measure of MMC and the results provide similar support to our hypotheses (available upon request).

[5] We also try an alternative measure consisting of a binary variable that takes the value of 1 if the majority of the drugs developed by a firm are generics and takes the value of 0 otherwise (see the robustness test section below).

(where the dependent variable is 0). This technique has been shown to provide unbiased coefficients for all variables except for the intercept,[6] and to provide a more efficient estimation than using the whole sample in situations in which one state is extraordinarily more frequent than the other (Manski and McFadden, 1981). Accordingly, we use SAS's random number generator function and select approximately 0.2 % of non-infringements, obtaining a final sample of 9856 dyad-year observations (813 where infringement took place and 9043 where it did not).[7]

In addition, it is important to acknowledge that there might be endogeneity in our estimations on the probability of *litigation*. It is possible that rivals' decision to infringe is affected by the expectations that the focal firm will litigate. This means that the estimations with our second dependent variable (*litigation*) may suffer from self-selection bias. For this reason, we perform a Heckman two-step procedure (Heckman, 1979). In the first step, we estimate the probability of *infringement* including the same controls we use in our main models together with the following instrumental variable: a dummy variable that takes the value of 1 after 2006 and 0 before 2006 (*regulatory change*). On January 1st, 2006, the Medicare Prescription Drug, Improvement, and Modernization Act of 2003 (MMA) enacted by Congress became effective. This act substantially revised certain statutory provisions related to the exclusivity benefits of the first generics to challenge branded drugs and end up being introduced into the market. We believe that these changes should affect rivals' motivation to infringe on a focal firm's patents under Paragraph IV but not focal firms' decision on whether to litigate or not after infringement has already taken place. Thus, using the first step estimations, we calculate the inverse Mills ratio (IMR), which we later introduce in the second-step estimations (i.e., probability of litigation) to correct for potential selection bias (Hamilton et al., 2003).[8]

4. Results

Table 1a and b report descriptive statistics and correlations of all our main variables for both samples. The correlation tables show that there are some correlations above the 60 % level (e.g., between *total drugs rival* and *total markets rival* or between *total drugs focal firm* and *total markets focal firm*). While all variables and interaction terms have a VIF lower than 10 (Belsley et al., 1980), we still try removing those control variables that exhibit high correlations, and the results remain substantially the same (available upon request).

In Table 2, we report the main estimations of the Heckman two-step procedure. In Models 1 and 5 of Table 2, we estimate the probability of infringement and litigation as a function of *MMC*. We find that *MMC* has a positive and significant effect on the probability of *infringement* ($\beta = 0.19$, $p = 0.0001$) and a negative and nonsignificant effect on the probability of *litigation* ($\beta = -0.03$, $p = 0.707$). These results show, consistent with mixed findings in the extant literature, that neither the mutual forbearance nor the mimetic behavior perspectives receive full support. While the signs of the coefficients are more consistent with the mimetic behavior perspective (*MMC* increases the probability of *infringement* but decreases the probability of *litigation*), only one of these coefficients is statistically significant. This supports our claim that there is no single perspective that fully explains infringement-litigation dynamics and that each perspective is likely to apply under different circumstances.

In the remaining models, we test our four hypotheses. In Model 2, we test Hypothesis 1a, which predicts that the effect of *MMC* on the probability of *infringement* is positively moderated by the variable *rival imitator*: the effect of *MMC* on *infringement* becomes more positive as the rival shifts from being an innovator (low values of *rival imitator*) to an imitator (high values of *rival imitator*). We add the interaction between *MMC* and *rival imitator* and find a positive and significant coefficient ($\beta = 0.40$, $p = 0.001$), providing support for Hypothesis 1a.

In Model 6, we test Hypothesis 1b, which predicts that the effect of *MMC* on the probability of *litigation* is negatively moderated by the variable *rival imitator*: the effect of *MMC* on *litigation* becomes more negative as the rival shifts from being an innovator (low values of *rival imitator*) to an imitator (high values of *rival imitator*). We include the interaction between *MMC* and *rival imitator* and find a negative and significant coefficient ($\beta = -0.68$, $p = 0.011$), as predicted by Hypothesis 1b.

In Model 3, we test Hypothesis 2a. This hypothesis predicts that the effect of *MMC* on the probability of *infringement* is positively moderated by the variable *focal firm imitator*: the effect of *MMC* on *infringement* becomes more positive as the focal firm shifts from being an innovator (low values of *focal firm imitator*) to an imitator (high values of *focal imitator*). Consistent with Hypothesis 2, we find a positive coefficient for the interaction between *MMC* and *focal firm imitator*, but the effect is not statistically significant ($\beta = 0.06$, $p = 0.708$), failing to support Hypothesis 2a.

In Model 7, we test Hypothesis 2b, which predicts that the effect of *MMC* on the probability of *litigation* is negatively moderated by the variable *focal firm imitator*: the effect of *MMC* on *litigation* becomes more negative as the focal firm shifts from being an innovator (low values of *focal firm imitator*) to an imitator (high values of *focal firm imitator*). As expected, the interaction between *MMC* and *focal firm imitator* is negative and significant ($\beta = -1.13$, $p = 0.003$), providing support for Hypothesis 2b.

Finally, in Models 4 and 8, we test all four hypotheses together, so we include interactions between *MMC* and both the *rival imitator* and *focal firm imitator*. In regard to *infringement*, we still find a positive and significant interaction between *MMC* and *rival imitator* ($\beta = 0.39$, $p = 0.001$) and a positive but not significant interaction between *MMC* and *focal firm imitator* ($\beta = 0.05$, $p = 0.745$). As before, this finding supports Hypothesis 1a but not Hypothesis 2a. In addition, with respect to the probability of *litigation*, we still find a negative and significant interaction between *MMC* and *rival imitator* ($\beta = -0.61$, $p = 0.019$) and a negative and significant interaction between *MMC* and *focal firm imitator* ($\beta = -1.08$, $p = 0.005$), providing support for Hypothesis 1b and Hypothesis 2b.

4.1. Interpretation of results

It is important to highlight that our hypotheses make very particular predictions about the nature of the moderating effects of *rival imitator* and *focal firm imitator* on the impact of *MMC* on both *infringement* and *litigation*. Our hypotheses do not simply predict a moderating effect but an actual change in sign. For instance, Hypothesis 1 predicts that the effect of *MMC* on *infringement* will be negative when the rival plays the role of an innovator (low values of *rival imitator*) but positive when the rival plays the role of an imitator (high values of *rival imitator*). Thus, to truly assess whether our estimations provide support for our predictions, we need to explore whether the effect of *MMC* on both *infringement* and *litigation* changes in sign for different values of our proposed moderating variables (*rival imitator* and *focal firm imitator*).

Looking at the size and statistical significance of the main and interaction coefficients is not the appropriate approach since we use nonlinear estimations, and in these cases, the relationship between independent and dependent variables also depends on the values of the other variables included in the model (Ai and Norton, 2003; Hoetker, 2007). Therefore, to assess the nature of the moderating effects implied

[6] To obtain an unbiased coefficient for the intercept, we need to subtract from the reported coefficient the natural logarithm of the division between the proportions of 1 s and 0 s included.

[7] We also tried selecting 0.1 % and 0.3 % of non-imitations and found similar support for our theory with these alternative samples (available upon request).

[8] The inverse Mills ratio, λ, was calculated as $\lambda = (\phi(\beta X))/(\Phi(\beta X))$, where $\phi(\cdot)$ is the standard normal probability density function and $\Phi(\cdot)$ is the standard normal cumulative density function.

Table 1
a and b. Descriptive statistics and correlations.

$N = 9856$	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13
Infringement	0.08	0.28	1.00												
MMC	0.25	0.67	0.47	1.00											
Rival imitator	0.12	0.32	0.49	0.80	1.00										
Focal imitator	0.02	0.13	0.05	0.35	0.27	1.00									
Total markets rival	7.02	17.58	0.65	0.68	0.65	0.11	1.00								
Total markets focal firm	16.52	18.70	−0.01	0.24	0.15	0.29	−0.02	1.00							
Total drugs rival	0.92	1.60	0.57	0.71	0.68	0.18	0.89	−0.02	1.00						
Total drugs focal firm	2.48	1.56	0.01	0.26	0.19	0.20	0.00	0.86	0.00	1.00					
Other drugs in market	9.35	14.98	0.00	0.03	0.02	0.01	−0.01	0.10	−0.01	0.12	1.00				
Patent time left	2.50	0.52	−0.01	0.00	−0.01	0.02	−0.01	0.04	−0.02	0.03	−0.05	1.00			
Prior litigations rival	0.11	0.44	0.62	0.45	0.47	0.05	0.77	−0.03	0.61	−0.02	−0.01	−0.02	1.00		
Prior litigations focal firm	0.14	0.40	0.04	0.01	0.01	−0.01	0.03	−0.01	0.02	0.01	0.03	−0.23	0.04	1.00	
Number of patents	2.97	3.05	0.07	0.00	0.02	−0.01	0.06	−0.10	0.06	−0.08	−0.05	0.24	0.08	0.00	1.00

$N = 813$	Mean	s.d.	1	2	3	4	5	6	7	8	9	10	11	12	13
Litigation	0.66	0.48	1.00												
MMC	1.30	1.17	0.09	1.00											
Rival imitator	0.63	0.46	0.10	0.76	1.00										
Focal imitator	0.04	0.19	0.06	0.32	0.16	1.00									
Total markets rival	44.91	31.26	0.18	0.45	0.47	0.03	1.00								
Total markets focal firm	15.84	16.31	−0.03	0.65	0.32	0.52	−0.03	1.00							
Total drugs rival	3.97	1.84	0.21	0.52	0.58	0.08	0.86	0.01	1.00						
Total drugs focal firm	2.55	1.41	−0.05	0.68	0.46	0.33	−0.04	0.86	−0.02	1.00					
Other drugs in market	9.32	15.17	0.03	0.06	0.10	−0.02	−0.04	0.05	−0.04	0.10	1.00				
Patent time left	2.47	0.45	0.17	0.00	0.03	−0.05	0.03	−0.09	0.08	−0.08	−0.05	1.00			
Prior litigations rival	1.02	0.97	0.26	0.24	0.30	0.02	0.70	−0.07	0.59	−0.07	−0.04	0.04	1.00		
Prior litigations focal firm	0.19	0.45	0.12	−0.01	0.02	−0.06	0.03	−0.06	−0.01	−0.01	0.03	−0.10	0.05	1.00	
Number of patents	0.66	0.48	0.22	−0.05	0.01	−0.06	0.06	−0.15	0.09	−0.13	0.10	0.34	0.13	0.03	1.00

by our estimations, we need to rely on graphical interpretation (Zelner, 2009). Thus, we graph the probability of *infringement* and *litigation* as a function of *MMC* (including 95 % confidence intervals) for different values of *rival imitator* and *focal firm imitator* while keeping all of the remaining variables at their mean values.

Fig. 1a and b show the effect of *MMC* on the probability of *infringement* and *litigation* for two different values of *rival imitator*, 0 and 1. These graphs are consistent with our predictions: when the rival plays the role of an innovator (*rival imitator* equals 0), *MMC* decreases the probability of *infringement* but increases the probability of *litigation*. Conversely, when the rival plays the role of an imitator (*rival imitator* equals 1), *MMC* increases the probability of *infringement* but reduces the probability of *litigation*. These graphs provide further support for Hypotheses 1a and 1b.

Fig. 2a and b show the effect of *MMC* on the probability of *infringement* and *litigation* for different values of the *focal firm imitator*, 0 and 1. Consistent with our theory, we see that when the focal firm plays the role of an innovator (*focal firm imitator* equals 0), *MMC* decreases the probability of *infringement* but increases the probability of *litigation*. Conversely, when the focal firm plays the role of an imitator (*focal firm imitator* equals 1), *MMC* decreases the probability of *litigation*. However, as was the case in our estimations, we do not find that *MMC* increases the probability of *infringement* when the focal firm plays the role of an imitator. Thus, these graphs provide partial support for H2a and full support for Hypothesis 2b.

We also estimate the magnitude of these effects to assess their practical significance (Ai and Norton, 2003, Hoetker, 2007). We find that moving from one standard deviation below to one standard deviation above the mean value of *MMC* leads to a 21.6 % decrease in the probability of *infringement* and a 22.7 % increase in the probability of *litigation* when the rival is an innovator (*rival imitator* equals 0). However, it leads to a 14.3 % increase in the probability of *infringement* and a 5.2 % decrease in the probability of *litigation* when the rival is an imitator (*rival imitator* equals 1). Moreover, this increase in *MMC* leads to a 20.6 % decrease in the probability of *infringement* and a 65.1 % increase in the probability of *litigation* when the focal firm is an innovator (*focal firm imitator* equals 0), but it leads to no increase in the probability of infringement and to a 16.4 % decrease in the probability of litigation when the focal firm is an imitator (*focal firm imitator* equals 1).

4.2. Robustness tests

We perform the following robustness tests. First, while we try to account for the endogeneity inherent in the two decisions we explore (i.e., the decision to infringe depends on the expectation that the other firm will litigate), there is another type of endogeneity that could be biasing our estimations that is not accounted for in our main regressions. It may be the case that the level of MMC is not exogenous to the decision to infringe in the first place. That is, there may be self-selection bias in our estimations in that firms who are expecting to infringe on each other increase their level of market overlap beforehand. To rule out this potential self-selection bias, we perform a Heckman 2-step procedure where we first estimate whether a pair of firms will have multimarket contact (dummy equal to 1 if two firms face each other and 0 otherwise) and then introduce the inverse Mills ratio calculated from this first step into our estimation of the probability of infringement. We add the following two instrumental variables in the first step: (1) *market recombination potential* and *anti-trust pressures*. The first instrument (*market recombination potential*) captures the extent to which firms active in the focal market are diversified into other markets (average number of other markets in which these firms were present). We believe this variable meets both relevance and exogeneity requirements for a valid instrument. On the one hand, this instrument is relevant in that it is likely to capture the extent to which both the rival and the focal firm will try to be active in other markets as well, which should have a positive effect on the probability that both firms have multimarket contact. On the other hand, we believe that the fact that firms active in the focal market frequently have activities in other markets should not affect the probability that the rival infringes the focal firm's patents. The second instrument (*anti-trust pressures*) is calculated as the natural logarithm of the total number of anti-competitive violations enforced by the Federal

Table 2
Main results[a].

Dependent variable		Infringement					Litigation			
Model		1	2	3	4		5	6	7	8
Intercept		−1.71**	−1.69**	−1.72**	−1.70**		0.82	0.69	0.79	0.61
		(0.19)	(0.19)	(0.19)	(0.19)		(0.74)	(0.76)	(0.78)	(0.82)
MMC		0.19**	−0.22*	0.20**	−0.21+		−0.03	0.64*	−0.04	0.58*
		(0.04)	(0.11)	(0.04)	(0.11)		(0.09)	(0.26)	(0.09)	(0.25)
Rival imitator		–	0.22+	–	0.23+		–	−0.10	–	−0.17
			(0.12)		(0.12)			(0.19)		(0.19)
MMC x Rival imitator	H1a +	**–**	**0.40****	**–**	**0.39****	H1b −	**–**	**−0.68***	**–**	**−0.61***
			(0.12)		**(0.12)**			**(0.27)**		**(0.25)**
Focal firm imitator		–	–	−0.42	−0.44		–	–	3.72**	3.56**
				(0.38)	(0.39)				(1.26)	(1.28)
MMC x Focal firm imitator	H2a +	**–**	**–**	**0.06**	**0.05**	H2b −	**–**	**–**	**−1.13****	**−1.08****
				(0.16)	**(0.16)**				**(0.38)**	**(0.38)**
Total markets rival		0.01	0.01	0.01	0.01		−0.01	−0.01	−0.01	−0.01
		(0.01)	(0.01)	(0.01)	(0.01)		(0.01)	(0.01)	(0.01)	(0.01)
Total markets focal firm		−0.01**	−0.01**	−0.01**	−0.01*		0.02**	0.02*	0.02**	0.02*
		(0.003)	(0.003)	(0.003)	(0.003)		(0.01)	(0.01)	(0.01)	(0.01)
Total drugs rival		0.25**	0.25**	0.26**	0.25**		−0.05	−0.02	−0.06	−0.02
		(0.03)	(0.03)	(0.03)	(0.03)		(0.11)	(0.11)	(0.12)	(0.12)
Total drugs focal firm		0.08*	0.06+	0.07*	0.05		−0.13	−0.12	−0.14+	−0.12
		(0.03)	(0.03)	(0.03)	(0.03)		(0.08)	(0.08)	(0.08)	(0.09)
Other drugs in market		0.01	0.01	0.01	0.01		0.01*	0.01*	0.01*	0.01*
		(0.01)	(0.01)	(0.01)	(0.01)		(0.004)	(0.003)	(0.004)	(0.004)
Patent time left		−0.16**	−0.16**	−0.16**	−0.16**		0.43**	0.43**	0.44**	0.44**
		(0.05)	(0.05)	(0.05)	(0.05)		(0.11)	(0.11)	(0.11)	(0.11)
Prior litigations rival		0.71**	0.68**	0.71**	0.68**		0.10	0.13	0.11	0.14
		(0.07)	(0.07)	(0.07)	(0.07)		(0.14)	(0.13)	(0.14)	(0.14)
Prior litigations focal firm		0.12+	0.12*	0.12+	0.12*		0.25*	0.27*	0.26*	0.27*
		(0.06)	(0.06)	(0.06)	(0.06)		(0.13)	(0.13)	(0.13)	(0.13)
Number of patents		0.04**	0.04**	0.04**	0.04**		0.03	0.03	0.03	0.03
		(0.01)	(0.01)	(0.01)	(0.01)		(0.02)	(0.02)	(0.02)	(0.02)
Regulatory change		−0.40**	−0.41**	−0.39**	−0.41**		–	–	–	
		(0.13)	(0.13)	(0.13)	(0.13)					
Inverse Mills ratio		–	–	–	–		−0.47	−0.42	−0.47	−0.41
							(0.32)	(0.32)	(0.34)	(0.35)
N		9856	9856	9856	9856		813	813	813	813

[a] Significance levels: ** $p < 0.01$, * $p < 0.05$, + $p < 0.10$. All models include year fixed effects and two-way clustered standard errors at the rival and focal firm levels. The hypothesized signs of the interaction effects for each dependent variable are shown in the respective columns.

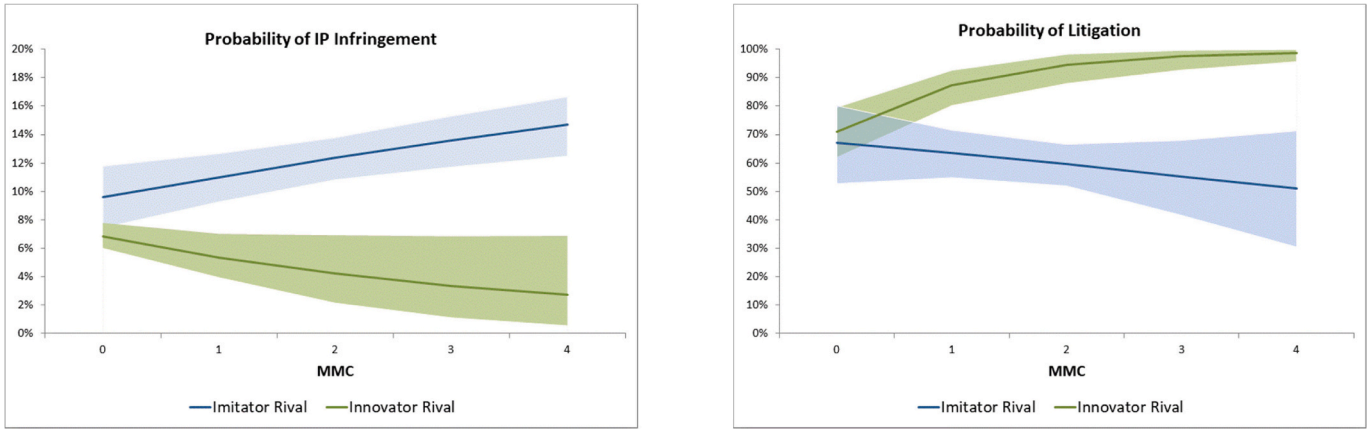

Fig. 1. a. Effect of *MMC* on the Probability of *Infringement* for Imitator Rivals (*rival imitator* = 1) and Innovator Rivals (*rival imitator* = 0).
b. Effect of *MMC* on the Probability of *Litigation* for Imitator Rivals (*rival imitator* = 1) and Innovator Rivals (*rival imitator* = 0).

Trade Commission in the previous three years in the pharmaceutical industry. Again, we believe this instrument is both relevant and exogenous. On the one hand, we expect *anti-trust pressures* to reduce the rival and focal firms' willingness to have MMC since that could signal the FTC the presence of price collusion or other anti-competitive practices and thus increase the risk of being investigated (Gimeno, 1999). On the other hand, greater *anti-trust pressures* should not explain why a certain rival, and not another one, decides to infringe on the focal firm's patents. To assess the exogeneity of our instruments, we take advantage of the fact that we have two instruments and estimate the Hansen J-statistic implementing the overidentification restrictions test (Hansen, 1982). The null is rejected, supporting the hypothesis that the instruments are uncorrelated with the error term of our main equation. We show the results of our Heckman 2-step estimation in Table 3, which still provide

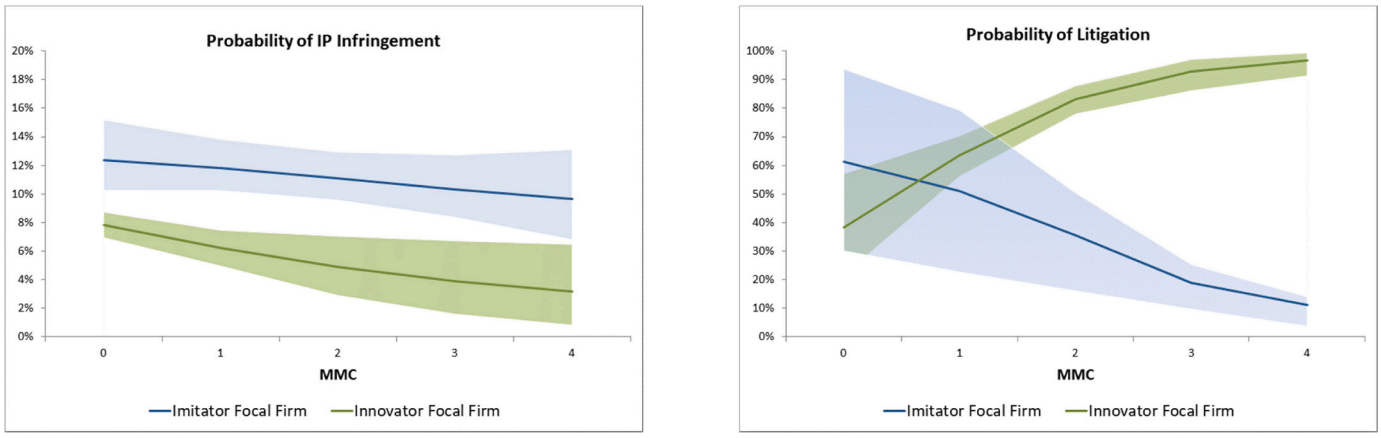

Fig. 2. a. Effect of *MMC* on the Probability of *Infringement* for Imitator Focal Firms (*focal firm imitator* = 1) and Innovator Focal Firms (*focal firm imitator* = 0). b. Effect of *MMC* on the Probability of *Litigation* for Imitator Focal Firms (*focal firm imitator* = 1) and Innovator Focal Firms (*focal firm imitator* = 0).

Table 3
Robustness tests. Hypotheses testing in bold.

Robustness test	Heckman 2-steps		Role in other markets		Number of products		Dummy variables	
Dependent Variable	MMC > 0	Infringement	Infringement	Litigation	Infringement	Litigation	Infringement	Litigation
Intercept	−2.90*	−2.10**	−1.73**	0.83	−1.69**	0.58	−1.67**	0.70
	(1.41)	(0.14)	(0.19)	(0.73)	(0.19)	(0.84)	(0.19)	(0.82)
MMC	–	−0.22*	−0.05	0.63*	−0.16+	0.42*	−0.23*	0.35+
		(0.11)	(0.11)	(0.29)	(0.09)	(0.18)	(0.11)	(0.20)
Rival imitator	–	0.22+	0.12	−0.13	0.23*	−0.17	0.22+	−0.18
		(0.12)	(0.12)	(0.19)	(0.12)	(0.20)	(0.12)	(0.19)
MMC x Rival imitator	–	**0.40****	**0.41***	**−0.45+**	**0.31****	**−0.45***	**0.40****	**−0.35+**
		(0.12)	**(0.17)**	**(0.26)**	**(0.09)**	**(0.18)**	**(0.12)**	**(0.21)**
Focal firm imitator	–	−0.45	−0.12	3.49*	−0.49	3.37*	−0.44	3.35**
		(0.38)	(0.42)	(1.40)	(0.38)	(1.42)	(0.40)	(1.23)
MMC x Focal firm imitator	–	**0.05**	**0.12**	**−0.89+**	**0.06**	**−0.76***	**0.06**	**−1.00****
		(0.16)	**(0.24)**	**(0.46)**	**(0.12)**	**(0.31)**	**(0.16)**	**(0.37)**
Rival imitator other	–	–	0.46**	−0.29	–	–	–	–
			(0.08)	(0.31)				
MMC x Rival imitator other	–	–	**−0.18**	**−0.21**	–	–	–	–
			(0.14)	**(0.27)**				
Focal firm imitator other	–	–	−0.44*	0.12	–	–	–	–
			(0.23)	(0.53)				
MMC x Focal firm imitator other	–	–	**−0.08**	**−0.26**	–	–	–	–
			(0.21)	**(0.32)**				
Total markets rival	−0.026**	0.01	0.01	−0.01	0.01	−0.01	0.01	−0.01
	(0.003)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Total markets focal firm	−0.016**	−0.01*	−0.01+	0.02**	−0.01*	0.02**	−0.01*	0.02**
	(0.002)	(0.003)	(0.003)	(0.01)	(0.003)	(0.01)	(0.003)	(0.01)
Total drugs rival	1.28**	0.26**	0.13**	0.03	0.25**	−0.01	0.26**	−0.04
	(0.040)	(0.03)	(0.04)	(0.12)	(0.03)	(0.12)	(0.03)	(0.12)
Total drugs focal firm	1.00**	0.05	0.05	−0.14	0.05	−0.11	0.05	−0.11
	(0.046)	(0.03)	(0.04)	(0.09)	(0.03)	(0.09)	(0.03)	(0.09)
Other drugs in market	0.005**	0.01	0.01	0.01*	0.01	0.01*	0.01	0.01*
	(0.002)	(0.01)	(0.01)	(0.004)	(0.01)	(0.004)	(0.01)	(0.004)
Patent time left	0.038	−0.16**	−0.15**	0.43**	−0.16**	0.44**	−0.16**	0.44**
	(0.068)	(0.05)	(0.05)	(0.11)	(0.05)	(0.11)	(0.05)	(0.11)
Prior litigations rival	−0.048	0.68**	0.67**	0.12	0.68**	0.13	0.68**	0.12
	(0.079)	(0.06)	(0.07)	(0.13)	(0.07)	(0.14)	(0.07)	(0.14)
Prior litigations focal firm	−0.024	0.13*	0.12*	0.26*	0.12*	0.28*	0.13*	0.25+
	(0.074)	(0.06)	(0.06)	(0.13)	(0.06)	(0.13)	(0.06)	(0.13)
Number of patents	−0.013	0.04**	0.04**	0.03	0.04**	0.03	0.04**	0.03
	(0.010)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.01)	(0.02)
Regulatory change	–	–	−0.43**	–	−0.40**	–	−0.43**	–
			(0.13)		(0.13)		(0.13)	
Market combination potential	0.006**	–	–	–	–	–	–	–
	(0.002)							
Anti-trust pressures	−0.831*							
	(0.407)							
Inverse Mills ratio	–	−0.003	–	−0.47	–	−0.38	–	−0.44
		(0.003)		(0.31)		(0.31)		(0.36)
N	9856	9856	9856	813	9856	813	9856	813

the same support for our theory.[9]

Second, our theory suggests that dyads develop different expectations depending on the role each firm plays in the markets they share. This suggests that the role played in the markets they *do not* share should not drive the same dynamics we propose in our theory. We test this by implementing a placebo test where we create an alternative set of contingency variables, *rival imitator other* and *focal firm imitator other*, examining the role of these firms in the markets they do not share. Interestingly, the interactions between these alternative variables and *MMC* do not show the same effects as those reported in our main tests (see Table 3). This evidence is consistent with our theoretical proposition that firms stereotype other firms and thus develop expectations of other firms through close interactions with them in shared markets. In addition, not finding support with these alternative measures rules out the alternative explanation that our findings are driven by innovators and imitators behaving differently in general. If that were the case, we should have found the same patterns when looking at the role played by firms in nonshared markets.

Third, instead of using the number of markets shared by firms as our measure of *MMC*, we create an alternative measure: the *number of products* that both firms have in shared markets (Chen, 1996). Our findings with this alternative measure provide further support for our theory (see Table 3). Alternatively, we create dummy variables to capture a firm's imitator/innovator identity assuming that such a construct is binary in nature, i.e., firms are perceived to be either innovators or imitators. Thus, we give a value of 1 if the majority of the products a firm has developed in shared markets are generics and give a value of 0 otherwise. The results with these alternative measures are presented in Table 3 and provide similar support to our theoretical predictions.

5. Discussion

In this study, we explore how MMC explains the kind of infringement-litigation dynamics that arise within a firm dyad. We propose that the role played by both the focal firm and the rival firm in shared markets determines which of two possible dynamics arise: mutual forbearance (low infringement and high litigation) or mimetic behavior (high infringement and low litigation). We claim that as MMC increases, firms rely more on stereotyped roles to form expectations about each other. As a result, the behavioral expectations about each dyad member (i.e., focal or rival firm) determine which of these two dynamics arises. These expectations, we argue, are determined by the role each firm plays—innovator or imitator—in the markets they share. Specifically, we propose and find that the mimetic behavior dynamic is more likely to arise when the focal firm and the rival are seen as imitators, whereas the mutual forbearance dynamic is more likely to arise when the focal firm and the rival are seen as innovators.

5.1. Theoretical contributions and practical implications

We believe that our study contributes to several bodies of literature. First, we contribute to the MMC and competitive dynamics literature by developing a conceptual model that explains the presence of different types of competitive dynamics in the same context. Prior studies have found support either for the mutual forbearance rationale or for the mimetic behavior logic in a particular context (e.g., Anand et al., 2009; Theeke and Lee, 2017). One single study, Anand et al. (2009), proposed a contingency model, suggesting that mutual forbearance dynamics are more likely to arise in less uncertain contexts (exploitation), whereas mimetic behavior arises in more uncertain contexts (exploration). Our approach argues and shows how both dynamics may be present even under the same market conditions. This contribution arises from an important departure from prior research: our model acknowledges heterogeneity in MMC. We build on the assumption that firms across different dyads play different roles and thus trigger distinct expectations (Diekman and Goofriend, 2006; Eagly and Karau, 2002). Accordingly, we argue that a firm may react differently to the same action depending on which rival performed that action. This broader perspective, we believe, provides the opportunity to explore rivalry dynamics in a richer and more nuanced manner. In addition, our conceptual model joins the debate about why firms decide not to respond to strategic attacks, a phenomenon that is still not well understood by competitive dynamics scholars (Andrevski and Miller, 2022; Hughes-Morgan et al., 2018).

Second, we believe our study contributes to the literature on litigation (Clarkson and Toh, 2010; Lanjouw and Schankerman, 2001; Somaya, 2003). Extant research has paid little attention to the factors explaining firms' decisions on whether to litigate or not after an infringement of their IP rights (Polidoro and Toh, 2011; Tan, 2016). In fact, as scholars have pointed out, it is still unclear why certain firms are very aggressive in enforcing their IP rights, whereas others are continuously letting rivals enter their IP space (Polidoro and Toh, 2011, Tan, 2016). Understanding this has also clear policy implications when it comes to designing intellectual property rights. Our study provides some insights into this issue by proposing a rationale that may explain firms' distinct behavior: different firms develop very different implicit agreements pertaining to infringement; in some cases, infringement is expected, whereas in others, it is a clear violation of an agreement.

Moreover, to our knowledge, our study is the first to explore firms' litigation decisions when they know that IP infringement has taken place. Prior research assumes that all dyads are at risk of litigating each other and explores the probability of litigation as if all dyads are at risk of such an action occurring (Polidoro and Toh, 2011; Tan, 2016; Theeke and Lee, 2017). However, this is unlikely to be the case because litigation can occur only if the focal firm believes infringement has occurred in the first place. Thus, prior studies have captured litigation in such a way that they could in reality be capturing infringement; i.e., the difference between cases with and without litigation could be the presence vs. absence of infringement. This means that prior studies' finding that MMC increases litigation (e.g., Theeke and Lee, 2017) could be driven by the fact that MMC increases infringement. Without a clear way to identify whether infringement took place or a test that estimates litigation *conditional* on infringement, it is not possible to disentangle these two confounding actions. Our study addresses this limitation by taking advantage of our unique context, where we can clearly assess whether and when an IP infringement has taken place and observe the decision to litigate in response. We believe that this allows us to provide more reliable evidence on infringement-litigation dynamics, especially given that our empirical estimations account for the endogenous nature of these two interdependent strategies.

Third, by applying role congruity theory to the context of competitive dynamics, our study joins extant efforts to increase our understanding of the extent to which the role played by an organization can have a significant impact on the behavior of that organization and its competitors (e.g., Bechky, 2006). In particular, we show how a firm's prior activity in the innovation arena leads to the assignment of strong and salient stereotypes to that firm. The role a firm plays in the innovation competitive arena triggers very particular normative expectations with respect to the value of IP rights, which shape the way others interpret its behavior. Moreover, our study shows how these stereotypes force firms to behave in a way that is consistent with the expectations that those roles carry, which explains why stereotypes can be so pervasive and enduring.

Fourth, we believe that our study may enrich social categorization theories used in management research. While market categories are mostly seen as frames that guide and sanction firm positioning (Hsu et al., 2009; Paolella and Durand, 2016), no study to our knowledge connects expected strategic behaviors from a rival based on its role, as

[9] We also tried using a 2SLS estimation instead of the Heckman analysis to address potential endogeneity of our MMC measure and the results provide similar support to our hypotheses (available upon request).

defined by its copresence in product categories. Beyond using measures of similarity and difference that account for appeal, valuation, or performance in most studies in market category research (Cattani et al., 2017), this study associates the roles of product categories and producers directly with competitive behaviors (IP infringement and litigation). Moreover, it bridges categorization models with stereotypes, although the linkage is not yet fully developed. This study claims and provides evidence that actors infer a role of their rivals from the presence of identifiable features (i.e., being an imitator or an innovator in the product categories where a rival is copresent), formulate corresponding behavioral expectations, and react accordingly. The findings are representative of the proximity between causal model-based categorization (Rehder, 2003; Durand and Paolella, 2013) and stereotyping (Fiske et al., 2002). Moreover, the findings contextualize these research streams in competitive dynamics whereby expectations at both the focal- and rival-firm levels lead to consequential decisions—those that we observed, i.e., infringement and litigation, and those we did not, i.e., fines and settlements, which often amount to hundreds of millions of dollars, as per the examples mentioned in this paper's introduction.

Finally, our study has highly relevant practical implications both for firms and policy makers. From an organizational viewpoint, it shows how different dynamics arise as a function of how firms see each other. These implications could prove useful for managers trying to understand rivals' behavior; managers could use this information strategically as a way to take advantage of their rivals' IP rights. Similarly, it may inform their decision about how to manage their own IP rights. The study shows how decisions that may affect a firm's level of MMC with its rivals should factor in the risks and opportunities associated with maintaining its IP rights protection. More broadly, a better understanding of infringement-litigation dynamics is important to protect firms' intellectual property and innovation strategy. From a public policy viewpoint, our study suggests that policy makers should develop anti-trust regulations which both mitigate collusion and prevent IP infringement. Finding such a balance is a condition to promote the dissemination and transfer of technology.

5.2. Limitations

There are several limitations in our study that must be acknowledged. First, our study does not cover the outcomes of IP infringements. In some cases, the involved parties settle an agreement (Lumineau and Oxley, 2012), while in others, court decisions take various sanctions. To the extent that multi-market contact and firms' roles could shape expectations about competitors' behavior within the litigation process as well, our theory could also be used to explain variance in litigation outcomes. It would be interesting to consider whether the different outcomes depend on the role-based dynamics we evidenced in this paper.

Second, our theory is tested in the pharmaceutical industry because the regulatory context in this industry allows to identify infringement events. The question is whether our conceptual model applies to other settings. We believe this is likely to be the case because the kind of competitive dynamics we explore in our study have already been identified in other industries such as medical devices (Theeke and Lee, 2017), car manufacturing (Yu et al., 2009), and shipbuilding (Greve and Mitsuhashi, 2004). While innovation is of very different nature in each of these industries and the effectiveness of patents in preventing imitation may vary, the logic we propose could still apply as long as different players within these industries play different roles in the innovation arena. We hope future studies explore the applicability of our theoretical model into other empirical settings.

Finally, our empirical analysis examines one kind of IP rights—i.e., patents— in one particular country—the U.S. Given that different IP rights represent different infringement challenges, and that the ability to enforce IP rights varies substantially across countries, it is not clear whether our theory would apply into other settings. Thus, we hope future research explores the generalizability of our findings to other types of IP rights (e.g., copyright or trademarks) and other geographical areas.

Overall, we believe our study has taken important steps in understanding how MMC explains infringement-litigation dynamics. We hope that it will spur more research efforts to explore this relevant issue and the broader topic of how firms develop distinct dynamics as a function of how they perceive each other.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

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