Will rivals enter or wait outside when faced with litigation risk? Patent litigation in complex product industries and international market entry

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ABSTRACT

A spiral of patent infringement litigation among rival firms is a phenomenon often observed in complex product industries, where products are comprised of numerous separately patentable elements. Theoretically grounded in the awareness–motivation–capability (AMC) framework of competitive dynamics, this paper contributes to the literature on patent strategy and international market entry by looking at how, in a complex product industry, the intensity of patent litigation in a country affects a firm's decision to enter that country. Our results show that the intensity of patent litigation in a country is a deterrent for potential entrants, and has a negative effect on a firm's likelihood of entering that country. We also show that a firm's previous experience with patent litigation (*awareness* component), the share of a firm's current patent applications in a target country (*motivation* component), and the size of a firm's patent stock (*capability* component) moderate the relationship between a country's patent litigation intensity and a firm's likelihood of entering that country. We shed light on the joint effect of macro- and micro-level patent-related variables on a firm's market entry decisions. We test our hypotheses with a comprehensive panel of patenting and entry strategies for 84 mobile phone vendors and country-level patent litigation battles in 45 countries, from 2003 to 2015.

INTRODUCTION

Practical evidence suggests that patent litigation in technology-intense industries, such as consumer electronics, may play a prominent role in a firm's decision to enter a new geographic market. For example, in 2015 Chinese mobile phone vendor[1] Xiaomi's plan to expand into the US market temporarily vanished after the company was served with a lawsuit by Blue Spike LLC, which claimed that Xiaomi had infringed on its patents related to data protection methods in its upcoming mobile phones. Xiaomi had faced a similar situation the previous year in India, when they were sued by rival Ericsson, which claimed Xiaomi's new phones infringed on Ericsson's wireless technology, and the Delhi High Court temporarily blocked Xiaomi from launching its new phone models in India. These and other lawsuits forced Xiaomi to slow its international expansion and to focus on "less litigious" countries where patents were not strictly enforced (Soo, 2015). As Hugo Barra, the former Vice President of Xiaomi, pointed out in an interview (Bloomberg, 2015):

> "We are building our own portfolio of patents for defensive purposes, because you kind of have to have that. Think of it as a war chest of sorts […] This is one of many factors that determines when we are ready to enter certain markets."

As in the mobile phone industry, a firm's decision to enter a geographic market is not trivial in most industries, since firms need to carefully assess the risks and benefits of the target market before moving forward (Alcácer et al., 2013; Brander et al., 2017; Rothaermel et al., 2006). The *competitive environment* in a firm's target market is regarded as one of the most crucial factors in market selection. Prior research on market entry suggests that firms are more likely to enter geographic markets where the intensity of competition and subsequent risk of retaliation from incumbents is low, by examining the risk of being involved in dangerous warfare from multiple angles, such as an incumbent's rate of new product

[1] Mobile phone vendors are those firms that market handsets under their brand name. Notable examples are Samsung and LG of South Korea, the US-based Apple, Huawei and Xiaomi of China.

introduction and R&D spending (Bae, 2002; Cockburn and MacGarvie, 2011), amount of advertising and promotional activity (Kim et al., 2015), likelihood of collusive behaviors (Koçak and Özcan, 2013) and price competition (Kim et al., 2015). Few studies, however, examine whether and how a firm's decision to enter a new geographic market is influenced by battles in that market among firms that aggressively litigate each other's patent rights, which some authors have called *patent wars* (Graham and Vishnubhakat, 2013; Paik and Zhu, 2016). Patent wars have increased as a phenomenon since the mid-2000s especially in complex product industries, where products are comprised of numerous separately patentable elements, thus increasing the likelihood of patent infringements, and the related litigation risk (Cohen et al., 2002; Cohen et al., 2016; Von Graevenitz et al., 2013). This paper addresses this critical gap.

Since firms in many complex product industries frequently infringe on or contest each other's patent rights, their freedom to operate in a market is subject to the risk of patent infringement litigation from their competitors in that market (Lanjouw and Schankerman, 2001). Our study starts from the observation made by various international business scholars that the extent to which an industry becomes a battleground for patent infringement lawsuits, and thus the level of patent litigation risk that a new entrant firm may encounter, is different from country to country, as each country is unique in terms of its intellectual property (IP) rights protection system, and thus patent enforcement strategies have different levels of effectiveness depending on the country (Beukel and Zhao, 2018; Brander et al., 2017; Somaya, 2012). Considering this heterogeneity of *patent litigation intensity* (and litigation risk) across countries our study was guided by the following research questions: In complex product industries, does the intensity of patent litigation cases in a country affect a firm's decision to enter that country? How does it affect that decision? We answer these questions by developing hypotheses that draw from the literature on the strategic management of

patents (Graham and Vishnubhakat, 2013; Lanjouw and Schankerman, 2001; Paik and Zhu, 2016; Polidoro and Toh, 2011; Rudy and Black, 2018) and the awareness–motivation–capability (AMC) framework of competitive dynamics (Chen, 1996; Chen et al., 2007; Uhlenbruck et al., 2017; Yu and Cannella, 2007). We argue that, in complex product industries, a firm's decision to enter a new country, given the level of patent litigation intensity in that country at a specific point in time, is influenced by: (a) the firm's *awareness* of the potential litigation risk it would face if it enters that country, which represents the firm's perception of the competitive environment in that country prior to its entry, (b) the firm's *motivation* to enter that country, which refers to the firm's encouragement and commitment to enter that country, and (c) the firm's *capabilities* to successfully navigate patent litigation in that country, which refers to the firm's resources to successfully mitigate potential litigation risk in that country. Although the previous patent literature has discussed in isolation the independent effect of each of these three patent-related factors on a company's strategy (e.g., Cockburn and MacGarvie, 2011; Lanjouw and Schankerman, 2004; Shapiro, 2001), to the best of our knowledge a framework exploring their joint influence remains unexplored. In fact, to understand how and if a company will respond to a patent litigation risk, it is necessary to *concurrently* assess whether the company is aware of this risk, if it is motivated to react to this risk, and if it is able to respond to this risk. Therefore, the AMC framework appears to be an important lens to employ to develop hypotheses about the drivers of market entry in complex product industries.

The hypotheses we propose complement the competitive dynamics and patent literature in the following ways. First, while there are numerous studies looking at the antecedents of a firm's market entry (e.g., Cockburn and MacGarvie, 2011; Kim et al., 2015; Pettus et al., 2018), to our knowledge there are no studies examining the role played by patent infringement lawsuits in a country in affecting the entry decisions of firms. This is surprising,

given the increasing competition by firms in complex product industries to patent their inventions as a means to either defend themselves from competitor attacks or sue new rivals to expel them from the market (Graham and Vishnubhakat, 2013; Rudy and Black, 2018). Our baseline hypothesis proposes that the intensity of patent litigation in a country is a deterrent to potential entrants. Since fierce patent wars are often observed in countries with strong IP rights protection, like the US (Cohen et al., 2016), with this hypothesis we challenge the assumption that since it can be difficult for firms to protect their knowledge in foreign countries with weak IP protection, firms are more willing to enter (and then invest in) countries with a strong IP right system (Berry, 2017; Khoury and Peng, 2011).

We further complement the extant literature by examining how the effect of patent litigation intensity on market entry decisions is shaped by the three organizational characteristics that affect a firm's strategic actions, as proposed by the AMC framework: awareness, motivation and capability (see Chen and Miller (2012) for a review of studies using the AMC framework). We conceptualize these three micro-level constructs with patent-related variables in our theory. A firm's awareness of the threats and opportunities related to patent litigation intensity in a country is conceptualized in terms of a firm's *previous experience with patent litigation*, and is a function of the previous litigation cases a firm has been involved with. A firm's motivation to enter a country is conceptualized in terms of the *share of a firm's current patent applications* in a target country, and is a function of the number of pending requests to the patent office in the target country relative to the overall number of applications filed by the firm at the global level. A firm's *patent stock*, the extent to which a firm has many (as opposed to few) patents in its portfolio, is used to represent a firm's ability to navigate high patent litigation in a country, a resource endowment protecting the firm from plaintiffs in the host country. Competitive dynamics studies using the AMC framework have examined rivalry among multinationals from multiple angles, including the

antecedents of competitive response speed (Yu and Cannella, 2007), foreign direct investments (Meyer and Sinani, 2009), and foreign-domestic firm rivalry (Chang and Xu, 2008). None of these studies, however, has used the AMC lenses to examine patent litigation, patent strategies or their effect on a firm's entry decision into new countries, which is particularly important to understand competitive dynamics in complex product industries. In exploring how the three patent-related AMC components moderate the relationship between patent litigation intensity in a country and a firm's likelihood of entry, we shed light on the joint effect of macro- (i.e., country/industry) and micro- (i.e., firm) level patent-related variables on market entry decisions. In fact, while prior studies indicate that a firm's entry strategy can be influenced by both macro- and micro-level IP rights variables (e.g., Cockburn and MacGarvie, 2011; Oxley, 1999), most have investigated causal relationships on a single level. Interacting with multiple levels of patent-related variables allows us to build an integrated framework for the underlying mechanisms that affect market entry in complex product industries.

Finally, as noted by Chen and Miller (2012: 177), most of the research that draws on the AMC framework "has been conducted without considering the strategic context." By testing the AMC framework in a context not considered by previous studies (i.e., entry decisions in complex product industries), and by adopting novel measurements to operationalize the three AMC behavioral drivers of interfirm rivalry (i.e., patent-related variables to measure a firm's awareness, motivation and capability), we provide conceptual extension and generalization to this important competitive dynamics framework (Mezias and Regnier, 2007).

Using panel data from 84 mobile phone vendors competing in 45 countries from 2003 to 2015, and the country-level patent litigation battles in which these mobile phone vendors were involved during those years, we find support for all our hypotheses.

THEORETICAL BACKGROUND AND HYPOTHESES

Patent litigation in complex product industries

Our theory starts from the assumption that patent infringement lawsuits are likely to be particularly intense in "complex" product industries as opposed to "discrete" product industries. Cohen et al. (2000) argue that the way products are differentiated depends on the number of patentable elements they incorporate. They distinguish between complex and discrete product industries on the basis of whether a new product is comprised of numerous, as opposed to few, separately patentable elements. Pharmaceutical or chemical industries are examples of discrete industries, and electronic products, which tend to be comprised of a larger number of patentable technologies, may be characterized as complex. Firms in complex product industries, like the mobile phone industry, rarely have proprietary control over all the technologies installed in the products they are developing. This results in a situation in which rivals (as well as suppliers) "hold rights over technologies that others need, and vice versa, creating a condition of mutual dependence that fosters extensive cross-licensing, related negotiations and information sharing" (Cohen et al., 2002: 1356) to reduce the litigation risk. While patents are often used to sustain a differentiation advantage in discrete product industries, rival firms in complex product industries patent inventions mainly to secure market access, thanks to their ability to discourage suits, and countersue if sued (Von Graevenitz et al., 2013).

Extending the AMC framework to market entry decisions in complex product industries with escalating patent litigation

Existing studies in competitive dynamics have offered an integrative model of the three behavioral drivers of interfirm rivalry: the awareness–motivation–capability (AMC) framework (Chen, 1996; Chen et al., 2007). The AMC framework suggests that in order to take a strategic decision, a firm must be aware of the opportunities and risks within the

competitive environment; the firm must also be motivated to act and possess the capabilities to do so. The AMC framework is thus aimed at understanding the "competitive tension" between a focal firm and its rivals, and explaining the conditions under which the focal firm will take a certain strategic decision to attack or respond to rivals in an industry, to reduce a threat or capture an opportunity. More specifically, there are three organizational characteristics that influence strategic actions: factors that affect the *awareness* of the context and signal threats or opportunities for focal firms; factors that induce or impede the *motivation* of firms to undertake a certain competitive action; and the capability-based factors that affect a firm's *ability* to undertake actions. The AMC has guided research in competitive dynamics (e.g., Uhlenbruck et al., 2017) as well as international business (e.g., Chang and Xu, 2008; Cui et al., 2014; Meyer and Sinani, 2009; Yu and Cannella, 2007).

In our theory, incumbent rivals litigating patent rights in a country represent an environment that is sending "competitive signals" (Heil and Robertson, 1991; Smith et al., 1991) about threat or opportunity to a potential entrant firm. We assume that the greater the patent litigation intensity in a country, the greater will be the signal sent to potential entrants. In fact, while previous work has argued that increased patenting in an industry may reduce market entry (Cockburn and MacGarvie, 2011) –for example, because royalties on licensed technologies can be particularly costly for entrants where patents are more numerous– we contend that a high number of patents in a country does not necessarily mean that incumbents will enforce them, which is itself a costly activity (Somaya, 2012). Patent litigation intensity instead signals this potential aggressive behavior by incumbents.

Moreover, it is worth noting that countries with high patent litigation intensity are often those with more efficient, well-designed and balanced IP systems (Cohen et al., 2016). In fact, firms enter and enforce their patents in countries with strong IP systems because they are aware the system will support them against illegal imitators (Berry, 2017). Numerous

studies have documented a positive relationship between the strength of a country IP system and inbound foreign direct investments (e.g., Khoury and Peng, 2011; Ushijima, 2013). However, when competing in countries with a strong IP system, firms in complex product industries also run high litigation risks. We argue that, as patent litigation intensity in a country escalates, a firm's decision to enter that country depends on the trade-off the firm will be able to find between (its perception of) the possibility to enforce its patents and (its perception of) the litigation risk it will have to deal with. The way a potential entrant will solve this trade-off is influenced by AMC patent-related behavioral drivers of interfirm rivalry.

More specifically, we extent the application of the AMC in international business by hypothesizing that in complex product industries, given a certain level of patent litigation intensity in a country, a firm's awareness-motivation-capability organizational characteristics should be considered in a market entry decision. The potential entrant must first be *aware* of the probability of being involved in patent infringement lawsuits in the host country. This means that, for potential entrants to make a decision, patent infringement lawsuits in the host country must not only be sufficiently large and generate signals that are noticeable to potential entrants, but potential entrants must also possess adequate knowledge to be cognizant of the litigation risk they would have to deal with if entering a country. Regardless the magnitude of the competitive signals sent by rivals (i.e., intensity of patent litigation), the level of awareness is important because it affects the extent to which a firm comprehends the consequences of its competitive actions (Chen, 1996). We contend that this awareness of litigation risk is influenced by a firm's previous experience with patent infringement lawsuits, which allows the firm to more accurately interpret the signal (i.e., litigation risk) sent by its target host country rivals. In fact, a signal could be highly visible (i.e., high patent litigation intensity), but the firm could be unaware of the related risks and opportunities (Agarwal et al.,

2009). For example, previous studies examining the awareness component focused most of their empirical work on identifying those factors –like firm size, action volume, and action publicity– that influence whether a firm observes a rival or its actions, and thus affect the competitive response (see Chen and Miller (2012) for a review). As noted in recent studies (Guo et al., 2017), however, observation does not necessarily correspond to interpreting and comprehending. Although Smith et al. (1991) suggested that interpretation is a critical condition that must be met before an effective competitive action can be undertaken, there has still been little attention paid in the competitive dynamics literature to empirically examining the role of competitive signal interpretation in shaping competitive behavior. We advance this literature by considering how the characteristics of a firm's previous experience with certain competitive dynamics –patent litigation in our case– may affect a firm's interpretation of the signal sent by rivals.

The *motivation* of a firm to enter a country depends on the incentives, such as the need to capitalize on the *ad hoc* assets and resources it has already prepared to enter the target country. A firm might be aware of the competitive environment in the target country without necessarily being motivated to enter. Within competitive dynamics research, organizational characteristics such as territorial interests or market dependence (e.g., Gimeno and Woo, 1996; Uhlenbruck et al., 2017) have been used to reflect the motivation to act, however, there is a lack of studies taking into account patent-related assets, such as patent applications, which are asset-specific in the sense that if rejected by a country patent office they will lose their value for the firm, and the firm will have to invest money from scratch to file applications elsewhere (Maekelburger et al., 2012). It is also possible that an invention that results in patent applications in multiple countries will be granted only by one country's patent office and rejected by others (Webster et al., 2007). Since the patent system is territorial and a patent is valid for the country for which it is granted, and firms invest money and time in applying

for a patent if the expected benefits of patenting outweigh the cost of the application, firms are motivated to file patents in countries that are significant for them (Ernst, 2001). The share of a firm's current patent applications in a target country that the firm has not yet entered (relative to its overall filed applications) in a given time period, represents the territorial interest the firm has in that country, given the resources and time it is investing before entering with its products. We argue that a firm's managers will be more motivated to enter a country –and more sensitive to the tension created by patent litigation intensity– the more they have already invested patent-related, transaction-specific assets to navigate the competitive environment in that target country.

Finally, the *capability* of the potential entrant firm depends on its resource endowments, assumed in our theory to be related to the size of a firm's patent stock. In fact, the literature about the strategic management of patents so far has shown that the strength of a firm's patent portfolio not only (1) indicates a firm's innovative capabilities, providing the foundation for its competitive advantage, and (2) deters imitation of its inventions (Lemley and Shapiro, 2005), but also (3) lowers the likelihood that the firm may be involved in patent infringement lawsuits, thanks to the "bargaining chips" (i.e., patents to offer in return) it can exchange with plaintiffs (Shapiro, 2001), and the threat of retaliation it can trigger by countersuing the plaintiffs (i.e., in cases where a firm's patented innovations are used by the plaintiffs without authorization) (Lanjouw and Schankerman, 2004), particularly in complex product industries (Cohen et al., 2002). However, there are no studies examining how the interplay between the size of a firm's patent stock and patent litigation intensity in a country affects the firm's entry decisions. We complement the extant literature by arguing that the larger a potential entrant's patent portfolio, the greater the abilities it perceives as needing to successfully navigate patent litigation in a country.[2]

[2] Paik and Zhu's (2016) study is the only one we found that addresses empirically how firms respond to patent litigation intensity in international markets. Our contribution is different in several respects: (1) their dependent

Figure 1 illustrates our research model, the hypotheses of which will be presented in detail in the following sections.

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Patent litigation intensity in a country and the market entry decisions of firms

In this section, we discuss how, in complex product industries, patent litigation intensity in a country can be a deterrent to potential entrants. Our argument is based on the observation that not all countries have the same level of traffic in patent infringement lawsuits (i.e., patent litigation intensity), which, in turn, affects the visibility of the competitive signals sent by rivals in a country to potential entrants, and in turn a firm's perception of the litigation risk in that country (Beukel and Zhao, 2018; Brander et al., 2017; Somaya, 2012). For instance, contrary to what happens in many emerging economies, in developed economies firms can usually easily enforce the IP rights that their patents specify, as the legal system penalizes illegal imitators through compensation payments (Polidoro and Toh, 2011). In such environments, firms in complex product industries race to assemble patent portfolios so that they can use patents effectively not so much as strategic weapons to maintain a differentiation advantage vis-à-vis competitors, but mainly to trigger aggressive litigation campaigns to enforce IP rights if required (Paik and Zhu, 2016). In the mobile phone industry, a case in point is the impressive sequence of mobile phone patent infringement lawsuits triggered by Apple and Samsung against each other and against other vendors during the first half of the 2010s. These lawsuits and countersuits were filed almost entirely in developed countries, and mostly in the US, a highly lucrative market for handset vendors, where IP law and

variable is not market entry but the percentage of a firm's total sales in a country; (2) they look at the intensity of patent litigation at the global level, not the country level; (3) they only consider the strategic decisions of firms that are not directly involved in litigation, and (4) although they also consider the role of a firm's patent stock in its strategic decisions during intense patent litigation, in our theory patent stock is only one of the three components of the AMC framework that we use to explain market entry.

enforcement procedures function properly and effectively, and where the patent cases usually come with bigger awards for damages than in other countries. In fact, although the US mobile phone market is highly "litigious," it can also be highly profitable for plaintiffs that can sustain costly litigation. This is demonstrated in the stepping back from three years of legal hostilities, when Apple and Samsung agreed in 2014 to end all patent lawsuits between themselves except for those pursued in the US. As an idea of the extent to which Apple used patent litigation as a competitive weapon, in 2011 the US firm spent more money on legal fees than on R&D. At the same time, other rivals that were considering international expansion, were concerned about this escalation of patent litigation cases in certain countries. A case in point is the decision by the Chinese mobile phone vendor Meizu to interrupt its expansion plan outside China in 2011, in countries with stronger IP protection, because of the fierce ongoing patent battles among the big players in these markets. As Hua Hailiang, the Marketing Director of the Chinese vendor said during an interview in 2011 (Lai, 2011):

> "Right now we just want to do well in the Chinese market […] We never wanted to compete with the other big players […] We don't want to clash with anyone, and as a small player, we don't want the trouble […] Lawsuits have been very troubling for these guys."

Especially in complex product industries, entrant firms have reason to fear the cost of defending a lawsuit brought to court by their target country rivals, and these entry costs are likely to increase when there is highly intense patent litigation in the country. These costs include (a) the royalties that would have to be paid if the entrant needed to find licenses from patent holders in the country, (b) R&D expenditures required to inventing around in case the plaintiff contests the entrant product technologies, and (c) a higher probability of having to pay infringement damages (Cockburn and MacGarvie, 2011).

Since firms seek positions in attractive or profit-potential markets where they can defend against their incumbents to minimize the costs and risks of entry, they need to make an assessment of the probability of litigation in these countries prior to their entry, because the

costs of possible patent litigation can greatly outweigh the benefits of launching their new products (Beukel and Zhao, 2018; Brander et al., 2017; Lanjouw and Schankerman, 2001). Accordingly, we would expect that, in complex product industries, all the other things being equal, the higher the intensity of patent litigation in a country, the greater the signal received by the potential entrant about the magnitude of litigation threat, which, in turn, decreases its likelihood of entry into that country. This leads to the following hypothesis:

Hypothesis 1: In complex product industries, there is a negative relationship between the intensity of patent litigation in a country and a firm's likelihood of entry into that country.

The previous experience of firms with patent litigation and their market entry decision

Organizational learning scholars have long contended that firms often learn from their own past experience, experiential learning (e.g., Baum et al., 2000; Pitsakis and Giachetti, 2020; Simon and Lieberman, 2010). We define experience with patent litigation as the degree to which a firm has been involved in previous patent litigation cases. The organizational learning literature on market entry has argued that a lack of knowledge about and experience in a market environment causes internal uncertainty, which may affect entry decisions into a new market (e.g., Zhao et al., 2004; Zahra et al., 2000). The underlying rationale is that firms that are new to –or have not accumulated relevant experience in– a type of competitive environment, such as patent litigation in our framework, have typically not developed methods for gathering and analyzing relevant information, and have not implemented a heuristic for being aware of and then making investment decisions in such environments (Greve, 2000; King and Tucci, 2002). A firm can rely on its experience in previous patent litigation cases to better comprehend the risk it would have to deal with if entering a country with high patent litigation intensity, and at the same time to appreciate the opportunities it would encounter if entering a country where litigation intensity (and then risk) is low.

The competitive dynamics literature suggests that, regardless of the magnitude of the competitive signals sent by rivals in a competitive environment (e.g., intensity of patent litigation in a country), the extent to which a firm is able to understand the likely outcomes of its competitive actions in the competitive environment is influenced by their awareness of the risks related to those competitive signals (Chen, 1996; Guo et al., 2017). We argue that in complex product industries, for a potential entrant to decide whether to enter or not into a new country, not only is the magnitude of the signal sent by the intensity of patent litigation in the country important (Hypothesis 1), but the potential entrant should also be aware of the threats and opportunities resulting from high vs low levels of patent litigation intensity. The greater the knowledge a firm has accumulated over time from its direct experience with patent litigation cases, the more it will be cognizant of the risk it would encounter from being involved in intense patent litigation, thus making it more prudent when entering turbulent litigation environments, and reducing its likelihood of entering a country when patent litigation intensity is escalating in the country. Conversely, a firm that lacks experience of patent infringement lawsuits is less likely to be aware of the risk inherent in very turbulent litigation environments, and will thus be less reluctant to enter such environments.

Hypothesis 2: In complex product industries, the negative relationship between the intensity of patent litigation in a country and a firm's likelihood of entry into that country is strengthened (i.e., more negative) as the firm's previous experience with litigation increases.

Patent applications in a target country and the market entry decisions of firms

In many parts of the world, the examination of patent applications is a lengthy process. Patent applications, on average, are published about 18 months after their filing date, but remain pending, before being formally granted (and then eventually used to sue imitators), on average for some three years (Ernst, 2001; Pitkethly, 2001). Patent applications are also

costly in terms of legal, filing, and maintenance fees, and due to patent specification and language requirements, which vary from country to country. Since patent applications are costly, firms tend to be selective in their patenting decisions to keep costs down, and apply for patents only in countries where they could achieve commercial benefits or threaten technology competition (Park and Lippoldt, 2005). We can thus assume that the share of a firm's current patent applications in a given country indicates the relative importance of that country for the firm.

A firm's reasons for filing patent applications in a country involve preventing potential patent infringement lawsuits, protecting technology from imitation, enhancing R&D collaborations, using patents as negotiation materials for cross-licenses or joint ventures and building technological image or reputation as an innovative firm in order to attract new customers in that specific country (Cockburn and MacGarvie, 2011; Ernst, 2001; Pitkethly, 2001). Accordingly, the higher the number of patent applications submitted in a target country, the more transaction-specific assets (i.e., patents) a firm plans to use in that country, and the higher the incentives to enter that country, in order to use and capitalize on these assets, which, if rejected by the target country patent office, cannot be easily redeployed elsewhere without incurring in additional costs for the firm. Hence we posit:

Hypothesis 3a: In complex product industries, with the intensity of patent litigation in a country held constant, there is a positive relationship between the share of a firm's current patent applications in that country and the firm's likelihood of entry into that country.

Returning to our main argument, since in complex product industries a firm's decision to enter a country should be made by considering the magnitude of the competitive signals sent by the level of litigation intensity in that country, we contend that the deterrent effect of patent litigation intensity in a country is weakened (made less negative) by the relative

amount of patent-related assets a potential entrant has invested in that country (as opposed to other countries). In particular, if patent litigation intensity in a target country is high, then the greater the share of a firm's current patent applications in that country, the greater the firm's incentives to capitalize on the patent-related assets, by entering that country. A firm with several pending patents (applications) in a target country may discourage aggressive plaintiffs, and instead foster tacit collusion or cross-licensing agreements (OECD, 2009). For example, in complex product industries, the uncertainty associated with pending patents in a target country can be used strategically in cross-licensing contexts by new entrants in ways that harm competition with host country rivals. In fact, there are various ways in which a potential entrant can use patent applications to its advantage prior to its entry into countries with high litigation intensity. A potential entrant firm may file a large number of patent applications in a target country, some at the margins of the original company's patents, with the aim of deterring potential rivals from working with the inventions to which the applications relate for fear of a potential litigation case. Furthermore, the firm may file patent applications with the intention of either keeping its competitors out of the target country or forcing them to cross-license valuable technology, generally on a royalty free basis, as a form of negotiation tool to avoid litigation battles in the target country (Harhoff et al., 2007; OECD, 2009). Even weak pending patent applications can be used by a potential entrant firm as an effective weapon against its competitors when faced with a litigation risk, because once a potential entrant firm files many patent applications, its potential competitors in the target country will probably not have the time or resources to determine the quality and validity of a large number of pending patents.

Based on the arguments above, we would expect that a firm's motivation to enter a target country is contingent upon the number of its current patent applications in that country, especially when patent litigation intensity in that country is high. Hence we posit:

Hypothesis 3b: In complex product industries, the negative relationship between the intensity of patent litigation in a country and a firm's likelihood of entry into that country is weakened (i.e., less negative) as the share of a firm's current patent applications in that country increases.

Patent stock and the market entry decisions of firms

Many complex product industries, such as consumer electronics, are characterized by products that are made by several high-tech components, most of them protected by patents, with these patents owned by competing firms (Von Graevenitz et al., 2013). This leads to a "patent thicket," "an overlapping set of patent rights requiring that those seeking to commercialize new technology obtain licenses from multiple patentees" (Shapiro, 2001: 119). Firms with extensive patent portfolios may be perceived as possessing adequate *capabilities* to tackle this situation in two main ways.

First, they have the option to enter into broad patent cross-licensing agreements with their rivals (contracts where parties grant licenses to each other for the exploitation of the patents each owns) as a way to settle patent disputes or offset their litigation risks (Cohen et al., 2002; Lemley and Shapiro, 2005). Such agreements are particularly useful because, since the structure of high-tech products is usually comprised of a complex web of patents, it is impossible for a firm to predict all relevant patent holders and determine whether it is infringing on their patents. Accordingly, a firm with a broader patent portfolio can better defend itself from plaintiffs, as it can offer more bargaining chips (Lemley and Shapiro, 2005). For example, in 2014 Samsung and Google, agreed not to litigate against each other's patent rights and to fend off intense competition from rivals such as Apple and Nokia, and signed a broad cross-licensing deal on mobile technology patents, which covers the two firms' existing patents, as well as those filed over the following 10 years (Grush, 2014).

Firms with a large stock of patents can confidently threaten their rivals with "weapons" to countersue (Shapiro, 2001), because if the firm has many patents, some are likely to be used in the products of a rival that considers suing the firm; the firm might therefore alert the potential plaintiff that claims will probably be followed by counterclaims. For example, although Samsung's new line of smartphones introduced in 2009 resembled Apple's iPhones in many ways, Apple waited nearly two years before suing Samsung. When Apple first sued Samsung in 2011 for infringing on a number of design and utility patents for basic functions of the iPhone, Samsung responded after a few months by countersuing Apple, saying that the vendor had infringed on Samsung patents regarding wireless communications and camera phones. The legal battle between the two tech giants continued for years. We expect the strength of firms with such large patent stocks to make them more self-confident that they will be able to pursue the "safer" utilization and exploitation of their patented inventions in foreign locations, thus increasing their likelihood of entry. Thus, we posit:

Hypothesis 4a: In complex product industries, with the intensity of patent litigation in a country held constant, there is a positive relationship between the size of a firm's patent stock and the firm's likelihood of entry into that country.

Returning to our main argument, it is important to recall that a country's competitive environment is the context in which entry will take place or not. The influence that a firm's patenting activity exerts on its likelihood to enter new countries will therefore take place in a context in which the intensity of patent litigation varies over time and among potential target countries. This means that in addition to the independent effect of patent litigation intensity on the likelihood of entry that we presented in Hypothesis 1, it is important to examine the moderating effect of the size of a firm's patent stock on the relationship between patent litigation intensity in a potential target country and the likelihood of entry into that country.

We expect the relationship between the intensity of patent litigation in a firm's potential target country and the firm's likelihood of entry into that country to be less negative the more patent stock it owns, because if the intensity of patent litigation in a country a firm plans to enter is high, then if the firm owns a large amount of patent stock, it will perceive itself as being able to rely on patents for use as bargaining chips with potential plaintiffs or as a weapon to countersue. In fact, if patent litigation intensity in a country is high, entering that country with few patents means that the firm potentially exposes itself to the risk of costly litigation and injunctions (Beukel and Zhao, 2018; Lanjouw and Schankerman, 2004). An example in complex product industries, is the decision by the Chinese mobile phone vendor Lenovo, which after rapid growth in the Chinese mobile phone market in the early 2000s, (at that time) characterized by weak IP right protection and few patent-enforcement lawsuits, at the end of the 2000s decided to postpone its geographic expansion strategy in developed economies because of the aggressive patent battles that exploded in those years, and focused its international expansion in developing economies such as Indonesia and the Philippines, characterized by weaker IP rights protection. Lenovo has only expanded across the global mobile phone market since 2014, after having significantly enlarged its portfolio of mobile phone-related patents, both by patenting its own inventions and purchasing patents from rival vendors. When commenting on Lenovo's acquisition of more than 3,800 patent families from the Japanese vendor NEC in 2014, the Vice President of Litigation and Intellectual Property at Lenovo stated that (Ranii, 2014):

> "Lenovo decided that expanding its smartphone patent portfolio further makes a lot of sense […] We see there is plenty of litigation in the mobile phone space between and among competitors and recently departed competitors […] It's a space where it's very important to have solid patent support. […] The NEC agreement and a $100 million patent deal that Lenovo announced last month are strategic moves designed to deter patent lawsuits from competitors as the company ramps up its smartphone business […] We want to be free to innovate, not litigate."

From an AMC perspective, we contend that the larger a potential entrant's patent portfolio, the greater the capabilities it perceives possessing to navigate escalating patent litigation in a target country. If on the one hand increasing patent litigation intensity in a country reduces the motivation of a firm to enter that country, on the other hand, since its perceived capabilities to obtain certain rewards in a host country reinforce its motivation to pursue those rewards (Cui et al., 2014), we expect that the firms most likely to enter countries with escalating patent infringement lawsuits are those with larger patent portfolios. Therefore, we posit:

Hypothesis 4b: In complex product industries, the negative relationship between the intensity of patent litigation in a country and a firm's likelihood of entry into that country is weakened (i.e., less negative) as the firm's patent stock increases.

METHODS

Research setting and sample

To test our hypotheses, we examined the patent strategies of 84 mobile phone vendors in 45 countries from 2003 to 2015. Mobile phones are convergent portable devices that come loaded with several software and hardware components. They are "convergent" in the sense that they combine technologies originating in other product categories offering new functionalities to the base product (e.g., email, text messaging, web browsing, a camera, a voice recorder, a Bluetooth, a music player) (Giachetti et al., 2017). Most of these technologies as well as other hardware and software components, are patented, either by the vendors themselves or by firms from other industries. Without patents, mobile phone firms may both fail to protect their inventions from imitation and be the target of patent litigation (Graham and Vishnubhakat, 2013). The numerous separately patentable elements we find in a mobile phone make this product category particularly "complex", and thus an ideal setting for our analysis.

Mobile phones have been commonly distinguished according to two categories: (1) "feature phones," offering mainly basic phone and multimedia functionalities, and (2) "smartphones," which are handsets equipped with advanced operating systems offering PC-like functionalities. The first smartphones were introduced at the end of the 1990s by Nokia, and competing vendors such as Motorola and Ericsson began entering this category in the early 2000s (Giachetti and Marchi, 2017). Although we consider the mobile phone industry as a whole in this study, including any type of mobile phone vendor and thus patents related to any type of mobile phone technology, most patent lawsuits have centered on smartphone-related technologies. Our analysis starts in 2003 because smartphones and their related technologies began diffusing from this year, and mobile phone vendors began patenting more intensely across many countries to expand their patent portfolio in an effort to protect their innovations against possible infringements. Although patents have always played an important role in the mobile phone industry in order for vendors to protect their inventions, patent litigation cases exploded at the end of the 2000s, reflecting a trend, especially for large mobile phone vendors, of using patents as a defensive business strategy. Steve Jobs, the former CEO of Apple, made a point of this when he announced the first iPhone in January 2007, by stating that they had "patented the hell out of it" (Guglielmo, 2012).

Figure 2 shows the exponential growth of mobile phone-related patents granted to the mobile phone vendors considered in our sample. The time frame of our study, from 2003 to 2015, allows us to capture how patent infringement lawsuits evolved dynamically over time in multiple countries, thereby giving great variance to our patent litigation intensity variable (as we will discuss below in greater detail).

Please insert Figure 2 about here.

We constructed our dataset using multiple data sources. We collected information about the annual market shares of mobile phone vendors and units sold in the various countries from *Euromonitor International* (2003–2015). We obtained firms' patent data from Questel's *Orbit Intelligence*, a patent search engine aggregating data from over 100 patent offices worldwide. Finally, we used *LexisNexis* to collect firm- and country-level litigation data within the mobile phone industry. In the next section, we explain in detail how we used this information to operationalize variables in our analysis.

Measures

Market entry. A firm's *entry* into a new country was measured with an indicator variable coded as 1 if the firm began operating (started selling its products) in a given country within a given year, and 0 otherwise. Market entry could be a repeated event, as firms can enter a market, exit from the country, and afterwards re-enter the country (Haveman and Nonnemaker, 2000). After checking our dataset, we found no firms committing re-entry throughout our observation period.

Patent litigation intensity. Ideally, we would need a composite index weighting multiple factors to measure patent litigation intensity, such as the number of patent infringement lawsuits for all vendors in every country, the royalties paid by infringers when disputes are settled, the amount of penalties that infringers had to pay plaintiffs in each country, and legal fees. Some of this information is not readily available, however, making it difficult to compute composite indices of this type, and vendors are unlikely to possess all this knowledge about litigation cases, unless it is publicized. Based on Tan (2016), who noted that the level of media coverage can influence the level of a firm's awareness of patent enforcement strategies used by other firms, and Paik and Zhu (2016), who argued that the level of media coverage of mobile phone conflicts increases as patent litigation intensifies, we

constructed a country-level measure of *patent litigation intensity* by counting the total number of media articles related to mobile phone lawsuits in each country for a given year.

We tracked media articles discussing the court cases of mobile phone vendors and related events (e.g., patent acquisition, cross-licensing and settlement agreements, damages awarded) in a specific country in a given year using *LexisNexis*, a commercially compiled source that searches thousands of newspaper articles published in the major world publications (e.g., *The Times*, *The Guardian*, *The New York Times*, *The Wall Street Journal*, and *The Korea Times*).[3] More specifically, we counted the total number of articles for each year containing different combinations of "mobile phone"-related keywords (e.g., cell phone, cellular handset, mobile phone, mobile handset, smartphone), "patent" keywords, and various combinations of keywords associated with a "court action" (e.g., infringement, lawsuit, dispute, case, litigation). In addition to these keywords, in order to track mobile phone-related court cases in each country, we used multiple combinations of keywords related to a specific country's legal institution (e.g., Chinese court, Chinese judge, court in China). The logic of this measure is that we consider repeated counts for the discussed court cases, assuming that cases which received greater media attention were also those signaling greater litigation risk.

Finally, it is worth noting that our study considers media discussing both actual cases (i.e., ongoing cases at a given year *t*, which we call also *live* litigation cases) and settled cases. We also included articles discussing terminations of cases because they often included information about the royalties paid by infringers when disputes are settled, the amount of penalties infringers had to pay to plaintiffs in each country, and legal fees, all of which is important information signaling that there are litigation activities in a country, and then litigation risk for potential entrants. We can reasonably assume that in those countries with a

[3] Our LexisNexis analysis takes into account both English and non-English media articles in all major world publications. Although the majority of these articles are in English, non-English articles were found by Lexis Nexis using the English keywords that we employed, and they were translated into English using LexisNexis's automated translation feature.

high number of settled cases there is also high number of cases filed, so removing articles discussing cessations would not change the results.

To give an idea of how patent litigation in the mobile phone industry has evolved over time, Figure 3 shows patent litigation intensity at the global level, measured in terms of the number of media articles on mobile phone patent litigation cases on a yearly basis (solid line), and highlights notable events. Figure 3 also reports the number of actual litigation cases, i.e. the number of *live* patent infringement lawsuits per year (dotted line), an alternative measure of patent litigation intensity we will present in the robustness checks section.

Please insert Figure 3 about here.

Experience with patent litigation. A firm's experience with patent litigation was measured using the cumulative number of patent infringement lawsuits a firm was involved with since 2003, in a given year. To build this measure we hand collected litigation data from several secondary sources, as follows: (1) we went back to the media articles we had initially collected from LexisNexis, and we did further searches for each identified litigation case; (2) we cross-checked the litigation found in LexisNexis with each country/region patent office, including the United States Patent and Trademark Office (USPTO), the European Patent Office (EPO) and the State Intellectual Property Office of the People's Republic of China, and from these we extracted other patent lawsuits; (3) we used multiple keywords to search mobile phone-related patent infringement lawsuits on online web portals for international patent litigation cases, such as the Word Legal Information Institute (worldlii.org/databases.html), MaxVal database (litigation.maxval-ip.com), Orbit Intelligence (orbit.com), FOSS Patents (fosspatents.com), and Telecompaper (telecompaper.com). This search resulted in a total of 580 litigation cases with which firms in our sample were involved from 2003 to 2015. We also collected information on the names of the plaintiff (patent

holders) and defendants (alleged infringers), the filing date of the complaint, the district court at which the complaint was filed, whether or not the case was settled, whether or not the case proceeded to trial and the resulting outcome if it did, as well as the duration of the lawsuit for all these litigation cases. Using this information, we counted the number of new litigation cases in each country, each year, for each firm, and for each year we computed the cumulative number of cases that a firm was involved with until that year.

Patent applications in the target country. To construct our measure, we initially identified mobile phone-related international patent classification (IPC) codes using *Espacenet* (an online service for searching codes related to patents and patent applications provided by the European Patent Office).[4] Next, following the approach used in previous studies (Hall and MacGarvie, 2010; Xie and Miyazaki, 2013), for each firm, together with the IPC codes identified, we performed a search in *Orbit Intelligence* using the mobile phone-related multiple keywords (e.g., "cell phone," "mobile phone," "smartphone") that appeared in a patent's title, abstract, and claims.[5] Lastly, after having carefully checked each patent for accuracy, we computed the *share of a firm's current patent applications in the target country* by dividing a firm's past three years (*t*-2 to *t*) of patent applications in a given country by the firm's total number of patent applications at the global level for the past three years. The three-year window was used to take into account patent applications that are likely to be still pending (Ernst, 2001; Pitkethly, 2001). The higher the share of a firm's current patent applications in a target country, the higher the relative importance of that country for the firm.

Patent stock. Using the patent search criteria described above, the size of a firm's *patent stock*, consistent with prior studies (Hall and MacGarvie, 2010), was measured by counting the number of mobile phone-related patents granted to each firm and published in

[4] According to our search in *Espacenet*, the following IPC codes were related to the mobile phone technology: A63, B22, B29, C03, C23, G01, G02, G03, G06, G08, G09, G10, G11, H01, H02, H03, H04, and H05.
[5] Patent information that includes title, abstract, and claims is the most effective strategy to identify patents through a keyword search (Xie and Miyazaki, 2013).

each country. In order to build our measure of patent stock, we took into consideration the firm's overall patent holdings at the global level (and thus regardless of the countries where these patents were granted to the firm), which was measured as the count of patents granted to a firm at the global level within a five-year period, including the current year (*t*-4 to *t*). In fact, as suggested by various authors, recent patents provide the most current information concerning a firm's ability to defend its products from a rival's patent enforcement strategy in a given product category (Tyler and Caner, 2016).

Control variables. Various country- and firm-level control variables were used in our analysis. As country-level controls, we first controlled for the strength of IP rights protection (*IP index*) using the Park's (2008) updated index of patent protection, since firms may prefer to enter countries where they can enforce their IP rights (Berry, 2017). Second, we controlled for the concentration of granted patents across firms in a country, using the Herfindahl index (i.e., squaring the share of patents granted to each firm competing in a country and then summing the resulting numbers) (*granted patent concentration*) (Calabrese et al., 2000). Third, we controlled for a country's *institutional quality*, by averaging the World Bank's Worldwide Governance Indicators, since the strength of local institutions of a country is likely to influence the market entry decisions made by firms (Oxley, 1999). Furthermore, we controlled for *product diffusion growth*, measured using the annual mobile phone subscribers (per 100 people) growth rate, since it might be perceived by new entrants as a window of opportunity related to consumer demand (Giachetti and Marchi, 2017). Since online retailing is increasingly important for handset vendors given the limited space that physical outlets have on their shelves, market entry decisions may also be influenced by the growth of e-commerce channels relative to store-based retailers in a country. Therefore, with data gathered from *Euromonitor International*, we controlled for the *non-store-based retailing*

growth rate, which is calculated as the rate of change in aggregate shares of mobile phone e-commerce channels in a country relative to the previous year.

Additionally, we controlled for *exit rate* (number of firms exiting a country in a given year), as this can be a sign of increasing competitive intensity in the target country. We also controlled for *market size*, the total number of mobile phone vendors' units sold in a given country, as larger host country markets might offer a larger customer base to new entrants (Agarwal and Ramaswami, 1992). Since the instability of market shares is a sign of active competition in a given market which is likely to influence the market entry decisions of firms, we controlled for *market share instability*, which is calculated as the summation of the absolute value of the annual percentage point market share changes of all firms in a given country (Hymer and Pashigian, 1962). The point at which a market share leader is dethroned in an industry may be a sign that competition is changing, offering new opportunities for challengers (Giachetti and Marchi, 2017), and in turn also for new entrants, and so we controlled for the *market leader dethronement*, which was a dummy coded 1 for the country-year in which a market share leader in a country was dethroned and 0 for a country-year in which there was no dethronement. Several industry reports published by mobile phone consulting companies (e.g., counterpointresearch.com; idc.com; strategyanalytics.com) showed that geographic markets mainly populated by developing country-based handset vendors tend to be characterized by aggressive price competition, and are thus a higher deterrent for potential entrants. By borrowing from previous studies, we thus controlled for the *number of developing country-based firms* (Petrou, 2007). Finally, we controlled for the *growth rate of the Android operating system* (OS), an OS for smartphones introduced by Google in 2008, offered for free to handset vendors, thereby lowering barriers to entry into the smartphone segment (in 2011, only four years after its introduction, Android became the highest-selling smartphone operating system, with nearly 50% of the global market share).

As firm-level controls, first, we included a firm's *rate of success in patent litigation*, which was measured by dividing the cumulative number of litigation cases that a firm had won at the global level since 2003 until year *t* by the cumulative number of litigation cases the firm was involved in at the global level since 2003 until year *t*. Since past success gives firms the confidence (and often overconfidence) to explore new opportunities and take more risks (Hayward et al., 2006), a firm's rate of success in litigation may positively affect their likelihood of entry into a new country.[6] Since nearly 38 percent of litigation cases had no clear winner or loser because they were either (a) settled before trial with no indication about whether the plaintiff or defendant accepted to pay damages, royalties, or stop infringing, or (b) were still ongoing in 2015, they were not included at the numerator of this control variable. We also controlled for a firm's *number of patent litigation cases as plaintiff* by counting the total number of litigation cases where each firm was plaintiff in a given year, since firms that are more aggressive in initiating patent litigation may have a greater ability to protect their knowledge-based resources, and then be more confident about entering new markets (Theeke and Lee, 2017). We also controlled for firms that were involved in *acquisitions* with other firms during our observation period, and compared the pre-acquisition to post-acquisition main effect on market entry, using a dummy variable taking the value of 1 for the year of the acquisition onwards, and 0 for the years before the acquisition (Gimeno and Woo, 1996).[7]

Finally, *time period dummies* for three-time periods (2003-06, 2007-10, 2011-15) were added to capture year effects. Drawing on the longitudinal analysis of Hall and Ziedonis

[6] For this variable, which is a ratio ranging from 0 to 1, firms that were never involved in any litigation case were coded with 0, meaning that they were treated in the same way as firms that never won a litigation case. Our assumption is that, for both types of firms, their propensity to run the risk of entering a new market is lower than firms that won at least one litigation.

[7] "Firm size" is a very common control at the firm-level. Although we tried to include this variable measured with a firm's number of units sold, we found it to be closely correlated with a firm's patent stock, creating serious problems of multicollinearity, and therefore, we decided not to use it in our model.

(2007) on litigation cases in the U.S. semiconductor industry, we grouped the years for greater precision in the estimates because of the volatility of patent litigation intensity over our observation period, as reported in Table 1 (mean = 5.046; SD = 29.681).

RESULTS

Since our dependent variable is the hazard (the instantaneous probability) of a potential entrant firm entering a given country (i.e., market entry), we used survival techniques to model the hazards of market entry. Entry is thus not modelled as a one-time behavioral choice in our study, but as a process of choice regrading when to enter a country. We constructed a longitudinal dataset of the timing and duration of market entry by potential entrants. We observed each potential entrant until 2015, leading to right-censoring of observations (not all firms entered all countries). Consistent with previous market entry studies (e.g., Fuentelsaz and Gómez, 2006; Guo et al., 2017) we used the Cox proportional hazards model, a robust estimation technique for hazard rate analysis that gives no parametrization and makes no assumptions about the shape of the hazard over time.

In order to prevent multicollinearity, we standardized all independent variables before entering them into Cox proportional hazard models. All independent variables were lagged by 1 year (*t*-1) to establish causal relationships, although formal tests for endogeneity are presented later in the robustness checks section. We calculated variance inflation factors (VIFs) for all regressions to determine if there was a multicollinearity issue in our analysis. Among all regressions, the range of VIF scores was 1.02 to 3.46, less than the recommended threshold of 10 (Chatterjee and Hadi, 2006). Table 1 reports the descriptive statistics of variables included in our analysis.

Please insert Table 1 about here.

Table 2 presents a set of regressions with market entry as the dependent variable. Model 1 in Table 2 includes controls, and in the remaining models we added our key

regressors to test Hypotheses 1, 3a and 4a, and the interactions between patent litigation intensity and patent litigation experience, patent applications in the target country and patent stock to test Hypotheses 2, 3b and 4b, respectively.

Hypothesis 1 proposes that patent litigation intensity in a country would be negatively associated with the firm's likelihood of entry into that country. As shown in Model 6, the coefficient for patent litigation intensity is negative and significant (β = -0.617, p < .05), thereby supporting Hypothesis 1.

Please insert Table 2 about here.

Hypothesis 2 states that the negative relationship between the intensity of patent litigation in a country and a firm's likelihood of entry into that country is strengthened as the firm's previous experience with litigation increases. As evident in Model 6, Hypothesis 2 is supported, as the coefficient for the interaction between patent litigation intensity and patent litigation experience is negative and statistically significant (β = -1.237, p < .05).

Hypothesis 3a proposes that with the intensity of patent litigation in a country held constant, there is a positive relationship between the share of a firm's current patent applications in a country and the firm's likelihood of entry into that country. As can be seen in Model 6, the coefficient for the current share of a firm's current patent applications is positive and statistically highly significant (β = 0.181, p < .001), thereby supporting Hypothesis 3a.

According to Hypothesis 3b, the negative relationship between the intensity of patent litigation in a country and a firm's likelihood of entry into that country is weakened as the share of a firm's current patent applications in that country increases. The coefficient of the interaction, as can be seen in Model 6, is positive and significant (β = 0.089, p < .05), indicating support for Hypothesis 3b.

Hypothesis 4a states that the stronger a firm's patent stock, the more likely the firm will enter new countries. As evident in Model 6, Hypothesis 4a is supported, as patent stock shows a positive and significant association with entry ($\beta = 0.213$, $p < .05$).

Finally, Hypothesis 4b proposes that the size of a firm's patent stock will positively moderate the negative relationship between the intensity of patent litigation in a country and the firm's likelihood of entry into that country. As can be seen in Model 6, the coefficient for the interaction between patent litigation intensity and patent stock is positive and statistically significant ($\beta = 0.135$, $p < .05$), thereby supporting Hypothesis 3.

Figures 4-6 show the plots of the estimated hazard functions of the interaction effects, as well as the margins plots of probit models, which we will discuss later in the robustness checks section.

Please insert Figures 4, 5 and 6 about here.

Robustness checks

We performed several robustness checks, presented in Tables 3 and 4. First, we repeated the analysis, building an alternative measure of patent litigation intensity, based on the *actual* number of patent infringement lawsuits taking place in a country. More specifically, we used the database we created to compute the patent litigation experience variable, and we counted the number of *live* litigation cases in each country, meaning that for each mobile phone-related litigation case we identified the filing and ending dates. For each litigation case in a given country, we created a dummy variable taking the value of 1 in all years since the litigation was filed until it was closed, and 0 otherwise. Next, we summed the dummy variables of each litigation in a country to obtain the total number of live litigation cases in that country. We found this alternative measure of patent litigation intensity to be highly correlated with that based on media articles ($\rho = 0.767$, $p < .001$). The evolution of this

variable computed at the global level is illustrated in Figure 3. As can be seen in Table 3 (Model 7), the results are consistent with those of the full model in Table 2.

Second, we proposed five alternative measures of a firm's patent litigation experience and repeated the analyses. The first alternative measure of a firm's patent litigation experience is based on the cumulative number of live litigation cases that a firm was involved with from 2003 until year *t* at the global level (Model 8), the second measure considers the cumulative number of the media articles discussing the court cases a firm was involved with from 2003 until year *t* at the global level (Model 9), the third considers the cumulative number of litigation cases where a firm was plaintiff (Model 10), the fourth considers the cumulative number of litigation cases where a firm was defendant (Model 11), while the fifth measure discounts prior litigation experience by using the perpetual inventory method with an assumed depreciation rate of 15 percent (Model 12), often used to depreciate a firm's technological knowledge (Griliches and Mairesse, 1984).[8] The results, as shown in Table 3 (Models 8-12), are robust across the full model in Table 2.

Third, since previous studies have proposed alternative measures for a firm's patent stock, we repeated the analysis by measuring a firm's patent stock with the cumulative number of mobile phone-related patents granted from the year of its establishment using the perpetual inventory method with an assumed depreciation rate of 15 percent (Griliches and Mairesse, 1984).[9] As shown in Table 3 (Model 13), the results also remained consistent with those presented in Table 2.

Please insert Table 3 about here.

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[8] The experience depreciation formula is as follows: $EXP_{i,t} = (1-\delta)EXP_{i,t-1}+LC_{i,t}$, where $EXP_{i,t}$ is the cumulative number of patent litigation cases firm *i* had been involved with at time *t* (i.e. litigation experience), $LC_{i,t}$ is the number of litigation cases firm *i* was involved with at time *t*, while δ is the depreciation rate. We tried also with 5, 10, 20, 25, and 30 percent depreciation rates, and results remained consistent.

[9] A firm's patent stock since its establishment was measured by: $PATSTOCK_{i,t} = (1-\delta)PATSTOCK_{i,t-1} + PATGRANTS_{i,t}$, where $PATSTOCK_{i,t}$ is the cumulative number of patents firm *i* granted at time *t*. $PATGRANTS_{i,t}$ is the number of patents the firm *i* granted at time *t,* where δ is the depreciation rate.

Fourth, we checked if the model was robust to a winsorized approach. More specifically, we winsorized all variables at the 1 percent and 99 percent levels (i.e., the values at the tails of the distribution were not removed, but were recoded to less extreme values) to minimize the potential bias of outliers (Barnett and Lewis, 1994). As shown in Model 14 of Table 4, results remained consistent.

Fifth, since most of patent infringement lawsuits were filed in the US, we wanted to be sure that firm-US level observations (i.e., all observations related to a firm entry in the US market) did not alter the results. As shown in Table 4 (Model 15), even when removing these observations, except the interaction between patent litigation intensity and the share of a firm's current patent applications in the target country, the results remained consistent with the full model in Table 2.

Similarly, since there is a positive and highly significant correlation between patent litigation intensity and the strength of the IP system in a country (Table 1: $\rho = 0.212$, $p < .001$), we wanted to check if results hold also removing observations of firms entering host countries with very high levels of *IP index*. In Model 16 the regression analysis was repeated by removing observations with host country Park index in the first decile. As can be observed, results remained consistent, with the only exception of the interaction between patent litigation intensity and the share of a firm's current patent applications in the target country.

Moreover, we wanted to check how independent results are from observations of Apple and Samsung, the two handset vendors more discussed in the media, and those involved in more patent litigation cases. As shown in Model 17, when removing observations of Apple and Samsung, results remained consistent with the full model in Table 2.

Likewise, in Model 18 we repeated the analysis by removing larger firms, to check whether results were consistent. To do this, in each year we ranked firms in terms of their global units sold, and we repeated the analysis by removing the five largest firms. Results

were again consistent (with only the interaction between litigation intensity and litigation experience that was marginally insignificant).[10]

A key assumption of the Cox hazards model is that the shape of the hazard function is the same (proportional) for cases at different levels of each covariate (Box-Steffensmeier and Jones, 2004). We tested the hazards proportionality assumption with a test of Schoenfeld (1982) residuals. More specifically, we tested interactions between our predictors and time according to the procedure recommended by Ruhe (2016). If the interactions are not significant by this criterion, then the assumption of proportionality of hazards has been met. We found that none of our key regressors of interest (i.e., patent litigation intensity and the moderators) exhibited relationship with time, which conformed to the proportional hazards assumption, with the only exception of previous experience with patent litigation. Therefore, consistent with previous market entry studies (e.g., Guo et al., 2017; King and Tucci, 2002), to further check the use of the Cox hazards model, we estimated a complementary loglog model in Model 19 and a probit model in Model 20. In fact, when the dependent variable is considered a rare event with a large number of zeros, the complementary loglog and probit models are particularly appropriate because they provide consistent estimates of the continuous time and proportional hazards parameters, regardless of the interval length or the size of the failure rate (Jenkins, 1995). As can be noted in Table 4, Models 19 and 20, coefficient signs and significances of our key regressors are highly consistent with the estimates of Cox proportional hazards in Model 6 (Table 2).

Finally, we tested whether our results were biased by potential problems of endogeneity. In fact, while two our hypotheses posit that patent litigation intensity in a country and a firm's patent stock affect the firm market entry, it could be argued that a firm

[10] We chose the five largest firms because mobile phone consulting companies (e.g., counterpointresearch.com; idc.com; strategyanalytics.com) often consider these as the dominant players. However, we tried also excluding the largest 3 up to 10 firms, and results were consistent.

increases its stock of patents to cope with patent litigation intensity. Accordingly, in our model, the independent variable firm patent stock would be determined endogenously. We checked for endogeneity concerns by instrumenting the endogenous variable in the probit model (Bascle, 2008). More specifically, we dealt with this issue by identifying instrumental variables, that is, variables not included in our model that were correlated with our potentially endogenous variable (i.e., patent stock), but not with the dependent (i.e., market entry). More specifically, the premise of instrumental variables is that they affect the dependent variable *market entry* only through the potentially endogenous independent variable *patent stock*. We selected the following three instruments: (1) *institutional quality of a firm's home country*; (2) *IP index of a firm's home country* (previous studies have noted that the greater the strength of market institutions and the stronger the protection of IP rights in a firm's home country, the more the firm is likely to patent its inventions; and home countries with strong institutions and IP systems are not necessarily an incentive for firms to expand abroad (e.g., Khoury et al., 2014)); (3) *competitive intensity in a firm's home country*, measured with 1 - Herfindahl concentration index of a firm's home country (previous studies have shown that the greater the competition in a firm's home country, the more likely the firm is to innovate (e.g., Blazsek and Escribano, 2016)), but competitive intensity in a firm's home country is not necessarily a motive for international expansion). We tested for the presence of endogeneity using the *instrumental variables (IV) probit* estimation which fits probit models where one or more of the regressors are endogenously determined, and generates a Wald exogeneity test statistic that assesses how endogeneity might affect our results (Wooldridge, 2002). As can be seen in Table 4 (Model 21), the Wald test statistic is insignificant, and therefore, the null hypothesis that the patent stock may be treated as exogenous cannot be rejected, thus suggesting that endogeneity is not a problem in our model.

Please insert Table 4 about here.

DISCUSSION AND CONCLUSIONS

Implications for theory and practice

Grounded in research into the strategic management of patents, market entry and interfirm rivalry, our central hypothesis in this article was that firms in a complex product industry are less likely to enter a country in which rivals fight each other aggressively through patent infringement lawsuits — where patent litigation intensity is high. We found support for this hypothesis in the global mobile phone industry in the 2003–2015 observation period. We used the same empirical setting to examine how the patent litigation intensity-market entry relationship is moderated by three firm-level, patent-related AMC components: a firm's previous experience with patent litigation (*awareness*), the share of a firm's current patent applications in a target country (*motivation*), and the size of a firm's patent stock (*capabilities*). Consistent with our hypotheses, a firm's previous experience with patent litigation was found to negatively moderate the patent litigation intensity-market entry relationship, while the share of a firm's current patent applications in a target country and the size of a firm patent stock, in addition to having a positive effect on market entry, both moderate the relationship positively. Together, these hypotheses and findings elucidate how firms manage the tension between (1) entering a new geographic market given their patent-related resources and capabilities, and (2) reducing the risk of being involved in bloody patent infringement lawsuits with rivals in the target country.

Our study has a number of implications for theory. It contributes to the literature on patent enforcement strategies (Lanjouw and Schankerman, 2001; Paik and Zhu, 2016; Polidoro and Toh, 2011; Rudy and Black, 2018) and antecedents of market entry decisions (Bae, 2002; Kim et al., 2015; Koçak and Özcan, 2013) by highlighting the crucial role that patent litigation intensity in a country plays in deterring potential entrants. In fact, given the

enormous costs that a firm which remains involved in patent infringement lawsuits may have to bear, it is reasonable to expect firms to *ex ante* behave strategically to mitigate this threat. Examining whether and how firms are likely to avoid patent litigation leads to a more comprehensive understanding of how they can strategize in complex product industries, often the theater of patent battles among firms in multiple countries, with countries greatly differing in terms of patent system and IP protection legislations. As this study shows, an important way in which firms respond to patent litigation intensity in a country is by reducing the likelihood of their entry to that country. In this way we respond to recent calls in the patent enforcement strategy literature to empirically "examine patent litigation in [different] institutional contexts [and] increase the time frame to understand how patent litigation strategies evolve", since "patent law varies from country to country" (Rudy and Black, 2018: 1245), as well as the country-level litigation intensity.

Second, by applying the AMC framework of competitive dynamics to assess the joint influence of patent litigation intensity and our three firm-level, patent-related variables on foreign market entry, our study builds on the emerging body of research on patent enforcement strategies in international markets (e.g., Alcácer et al., 2013; Brander et al., 2017; Rothaermel et al., 2006) and rivalry among multinational firms (Chen et al., 2007; Yu and Cannella, 2007), thereby complementing the literature on the strategic management of patents, particularly that centered on complex product industries (Cohen et al., 2002; Von Graevenitz et al., 2013). The moderating effects of each of our three firm-level, patent-related AMC components provides additional support for the AMC framework and highlights the value and generalizability of previous findings by studies in competitive dynamics to the domain of patent strategies.

We suggest that a firm's *awareness* of litigation risk in a target country is a function of its previous experience with patent infringement lawsuits, and that this experience allows

the firm to more accurately interpret the signal of litigation risk sent by host country rivals. In fact, there is a shortage of competitive dynamics studies that have examined empirically how competitive signal interpretation can shape competitive behaviors (Guo et al., 2017; Smith et al., 1991). Our study is the first that theorizes about how characteristics of a firm's previous experience with patent-related competitive dynamics in a complex product industry may affect a firm's interpretation of the litigation risk sent by rivals in a country, and then affect its intention to enter a country.

We suggest that a firm's likelihood of entry into a country depends on the firm's willingness to capitalize the *ad hoc* patent-related assets it has already prepared to enter the target country. Unlike previous competitive dynamics studies, which measured a firm's *motivation* to act with variables such as market correspondence and resource similarity among competitors, past performance, perceived market potential, and industry growth (Chen and Miller, 2012), we conceptualize a firm's territorial interest, which reflects its motivation to act, with the share of a firm's current applications in a target country. In fact, although the motivation component has been examined in previous studies, few competitive dynamics studies take into account patent-related assets, such as patent applications, as a factor influencing a firm's motivation to take competitive actions. We advance the literature by showing that, in complex product industries, the share of a firm's current patent applications in a target country that the firm has yet not entered (relative to its overall filed applications), is an important component of motivation.

As far as the *capability* component is concerned, by drawing on the literature on strategic management of patents (Cockburn and MacGarvie, 2011; Shapiro, 2001), this study highlights the role of the strength of a firm's patent stock (a) in fostering the firm's entry into a new country, and (b) in weakening the negative effect of patent litigation intensity on market entry (i.e., making it less negative). In fact, a static interpretation of the link between

the size of a firm's patent stock and the likelihood of entry into a new country may lead to the somewhat simplistic view that firms can attain omnipotent incentives to entry, especially in complex product industries. Considering the competition that unfolds as patent litigation intensity in a country escalates, however, helps us to realize that, in reality, the strength of a firm's patent stock and patent litigation intensity in a country are interdependent, and that the firm balances one against the other when making an entry decision. Without recognizing how firms manage this interdependence, scholars may have underestimated the true difficulties that firms with a weak patent portfolio in complex product industries face when deciding whether to enter a new geographic market.

Finally, by employing the AMC framework, our study sheds light on how firms solve the dilemma of entering (and then investing in) countries with strong IP systems to have their patents more easily enforced (Khoury and Peng, 2011), or waiting outside because fearing to run high litigation risks (Cockburn and MacGarvie, 2011). Since previous studies have noted that "it can be difficult for firms to protect their knowledge in foreign countries – especially countries with weak intellectual property (IP) protection" (Berry, 2017: 787), we should expect the managers of firms to be more willing to enter countries with a strong IP right system. However, in complex product industries, we believe this assumption works with the level of patent litigation intensity in a country held constant. In fact, on the one hand our control variable *IP index* (Model 6: $\beta = 0.101$, $p > .1$) is insignificant, meaning that countries with strong IP rights protection are not necessarily those that firms are more likely to enter; on the other hand our results also show that a high-tech firm's decision to enter a new country is negatively affected by the level of patent litigation intensity in that country (although this deterrent effect can be weakened by an entrant firm's patent stock). Interestingly, patent litigation is usually more intense in countries with strong IP right systems, typically developed economies with strong market-supporting institutions (with notable exceptions,

like China, which has experienced an increasing number of litigation cases over the last decade; see Brander et al., 2017), as can also be seen in Table 1 from the positive and significant correlation between a country's IP index and patent litigation intensity ($\rho = 0.212$, $p < .001$), and between a country's institutional quality and patent litigation intensity ($\rho = 0.137$, $p < .001$). If, on the one hand, highly innovative firms often believe they have more to lose when entering in countries with weak IP protection systems, then on the other hand, in times of patent wars, it is usually in these countries that they will encounter lower levels of patent litigation risk. The way a potential entrant will solve the dilemma of entering a country or waiting outside as patent litigation intensity escalates, is influenced by the three AMC patent-related components we have presented in our theory. An appreciation of the role played by patent litigation intensity in a country as deterrent to new entrants should help managers not only to be mindful when planning the resources to invest to compete in new countries, but also to estimate in advance the resources needed to compete in different countries with different levels of litigation risk.

Limitations and suggestions for future research

A potential limitation of this study is the generalizability of the findings. We chose the global mobile phone industry because it allowed us to test our theory in a setting where patent enforcement strategies have been regarded as a tremendous competitive weapon to deter imitation (Graham and Vishnubhakat, 2013). Imitation deterrence is important in this setting, as the mobile phone development process may be very costly and span from a few months to years, as in the case of high-end smartphones, even though new technologies equipped with these products are often affected by technological obsolescence. First movers therefore often struggle to defend their inventions with legal battles to safeguard returns on investments in the short term. The corresponding shortcoming may be that our hypotheses are less applicable to settings where complex products and related technologies have a longer life cycle, because

product features are less subject to technological obsolescence, such as in the automotive industry. Similarly, although our theory is centered on complex product industry, similar (or opposite) patterns could be observed in discrete product industries like the pharmaceutical industry (Polidoro and Toh, 2011), or in industries where patent-enforcement strategies are ineffective or inconvenient (Cohen et al., 2002), such as in the garment industry (Brander et al., 2017). We therefore hope that future research will test and extend our theory in empirical settings with specific peculiarities.

Another limitation relates to the lack of firm-level data included in our model about the possible relationships that mobile phone vendors have with actors upstream and downstream on the value chain, such as telecom companies and semiconductor manufacturers. For example, these actors may have licensing and cross-licensing agreements with handset vendors in certain countries, and this may affect a vendor's likelihood of being involved in litigation cases in those countries, and in turn their likelihood of market entry. Future research could collect additional data on vendors' partnerships at all levels of the value chain, and explore the resulting implications for patent litigation intensity and market entry decisions.

Finally, although to build our argument on the *awareness* component we drew mainly on the experiential learning literature, various authors have noted that the learning process may be both *experiential*, i.e. when the stock of information and knowledge is obtained from the firm's own prior experience, and *vicarious*, i.e. when the stock of information and knowledge is acquired from the observation of others, like industry peers or market leaders (e.g., Baum et al., 2000; Pitsakis and Giachetti, 2020). For example, scholars in the international business literature have shown that a firm's propensity to enter a country is influenced by entry decisions of peers that have entered that country (e.g., Chan et al., 2006; Henisz and Delios, 2001). Therefore, an interesting avenue for future research would be to

extend our patent-related AMC framework by exploring different ways a firm can learn from patent litigation, and how these different learning processes affect its likelihood of entering a country, as patent litigation intensity in that country escalates.

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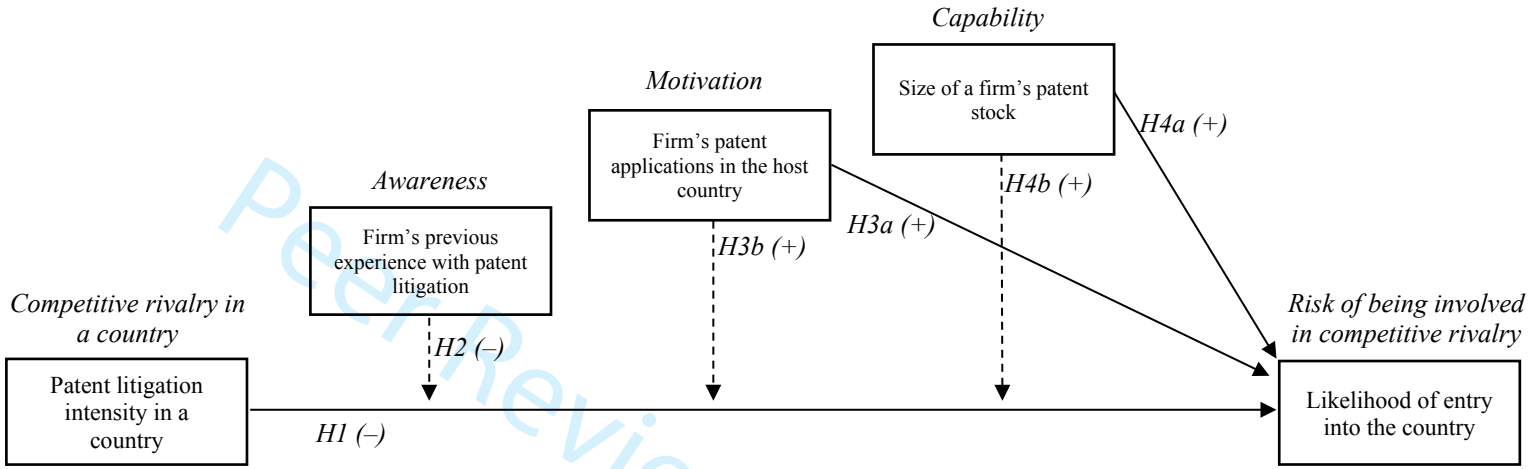
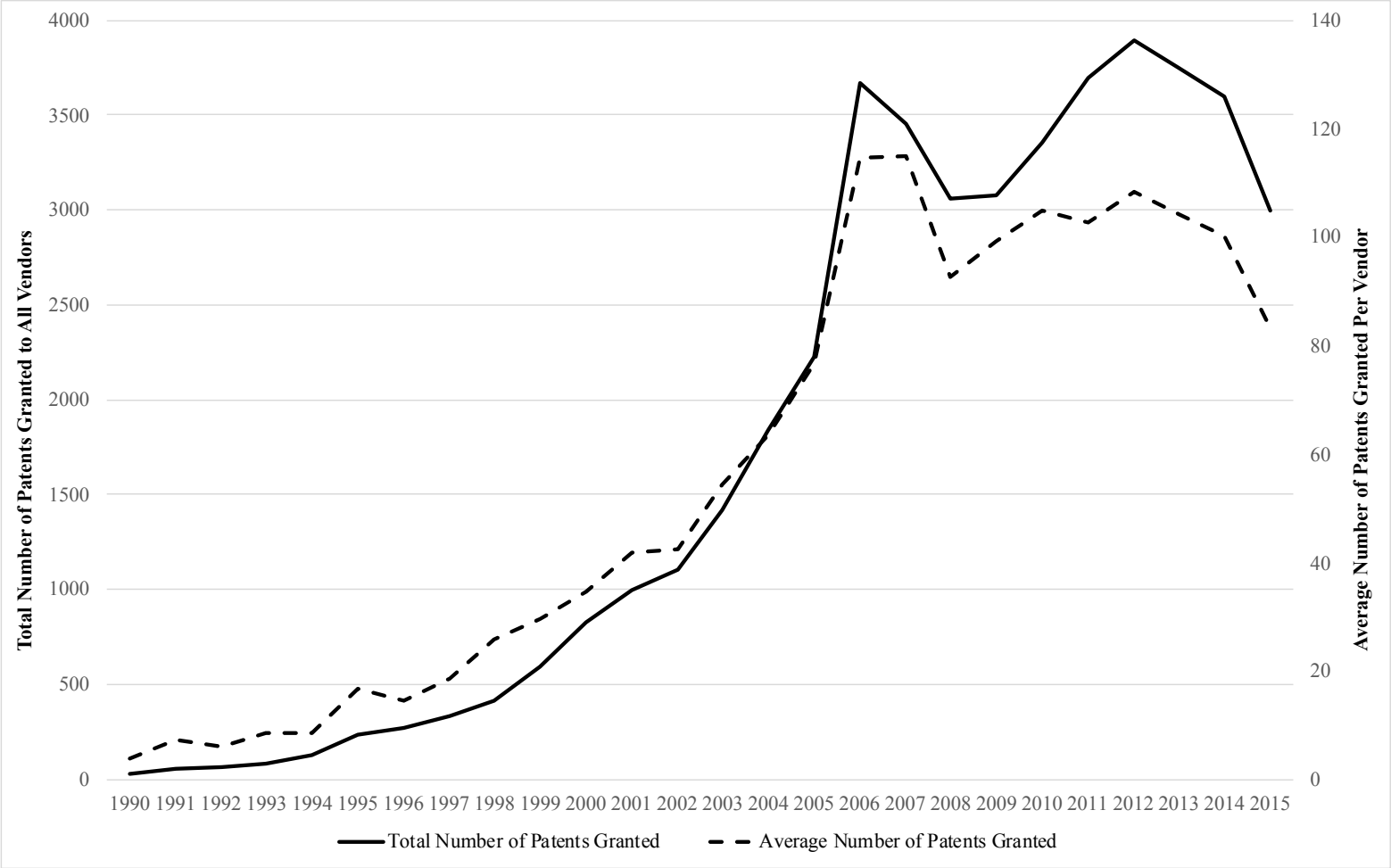
Figure 1. An awareness-motivation-capability framework to explain the relationship between patent litigation intensity in complex product industries and international market entry



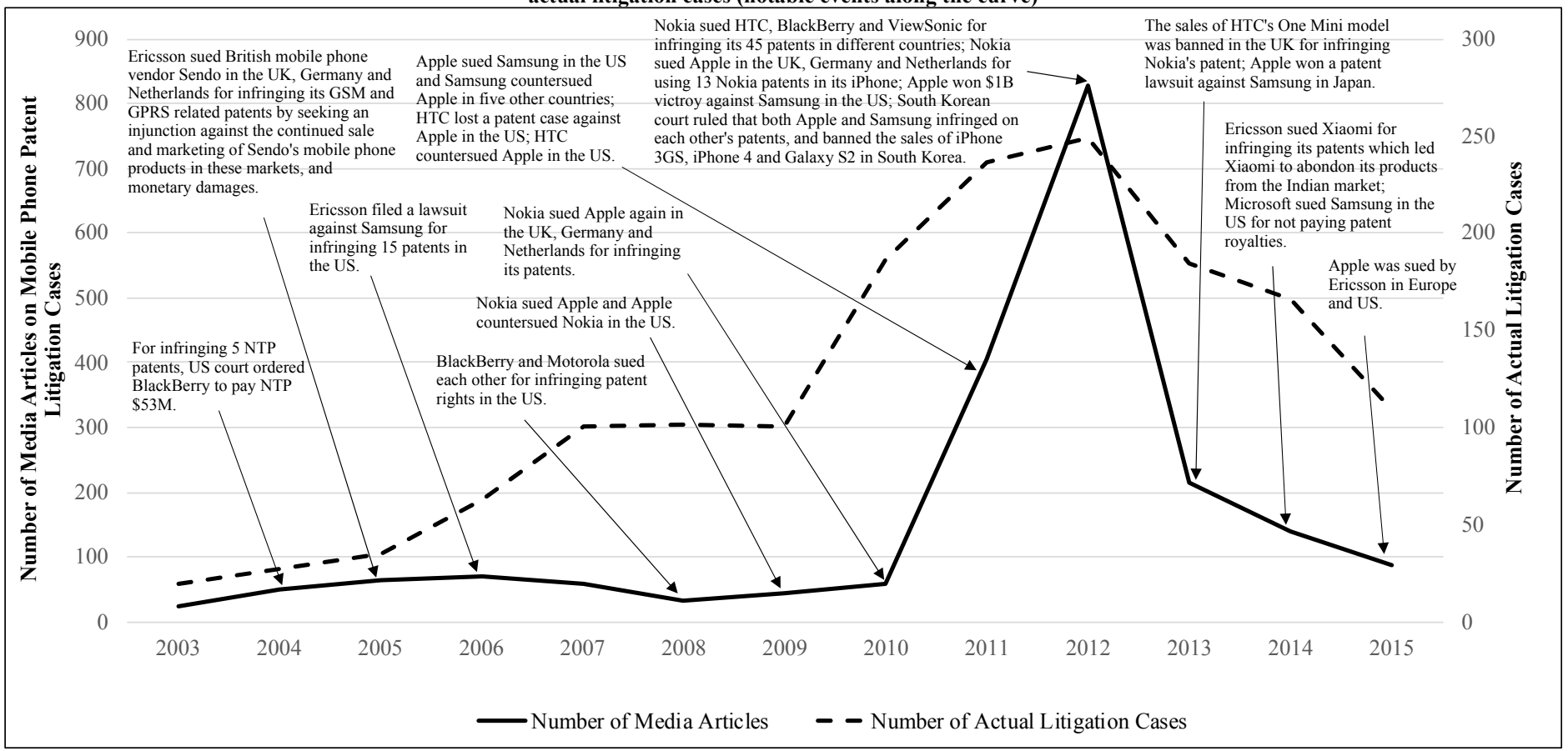
Note: Continuous lines for main effects, dotted lines for moderating effects; expected signs in parentheses.

Figure 2. Total and average number of mobile phone-related patents granted to vendors (1990–2015)



Source: Our elaboration of data collected from *Orbit Intelligence*, based on mobile phone vendors included in our sample.
Note: "Average number of patents granted per vendor" is based only on firms granted patents in a given year.

Figure 3. Patent litigation intensity at the global level, measured in terms of (1) number of media articles on mobile phone patent litigation cases, and (2) number of actual litigation cases (notable events along the curve)



Note: Media articles were counted more than once in this figure when they discussed court cases in multiple countries.

Figure 4. Hazard and marginal effects plots of entry: Patent litigation intensity × patent litigation experience

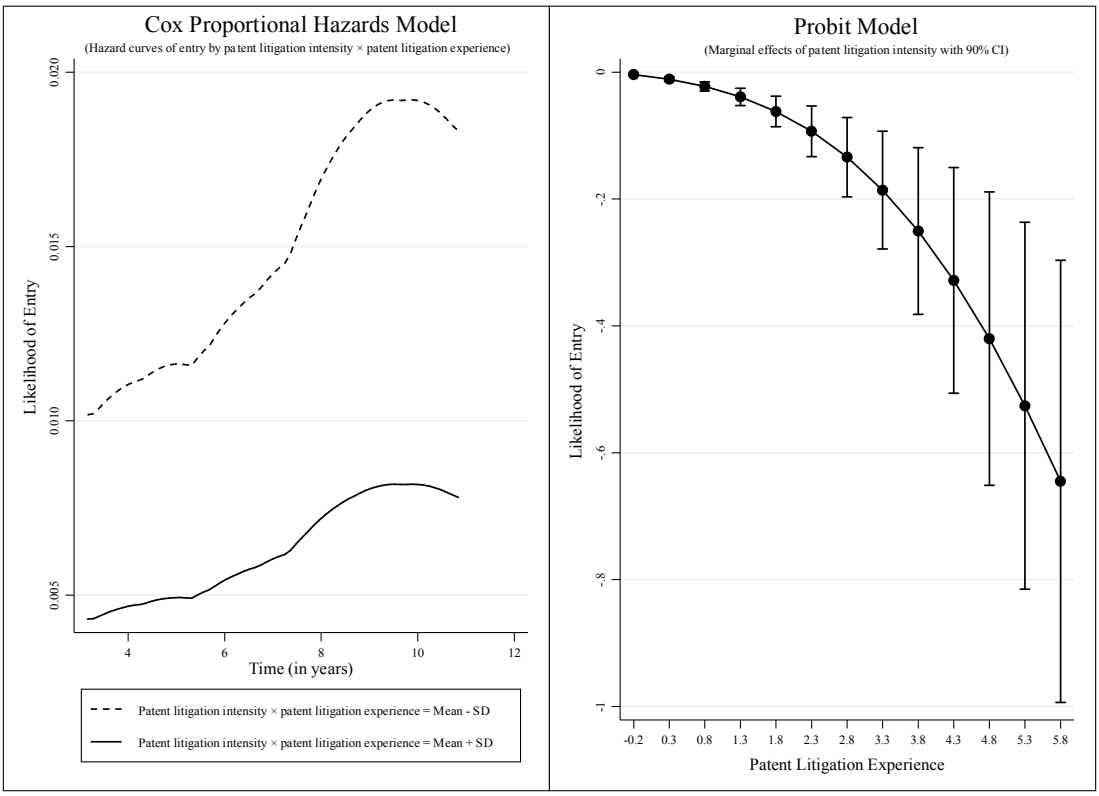


Figure 5. Hazard and marginal effects plots of entry: Patent litigation intensity × patent applications in the target country

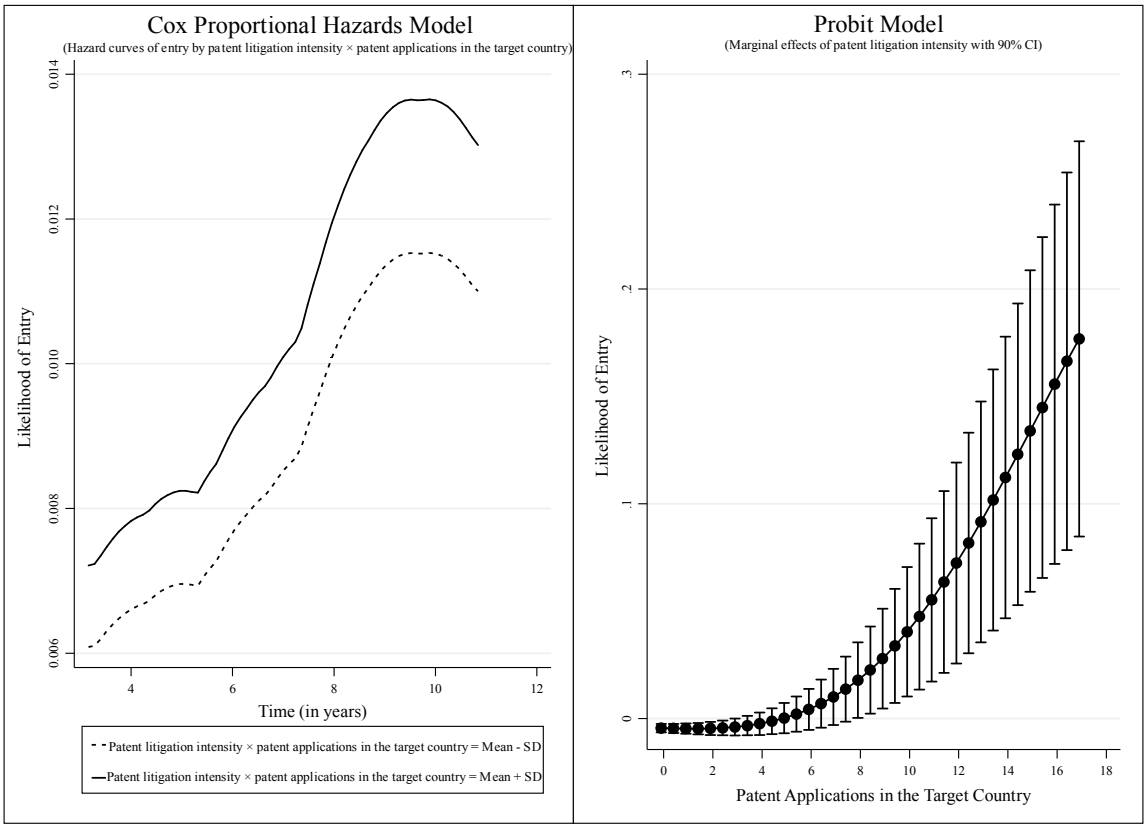


Figure 6. Hazard and marginal effects plots of entry: Patent litigation intensity × patent stock

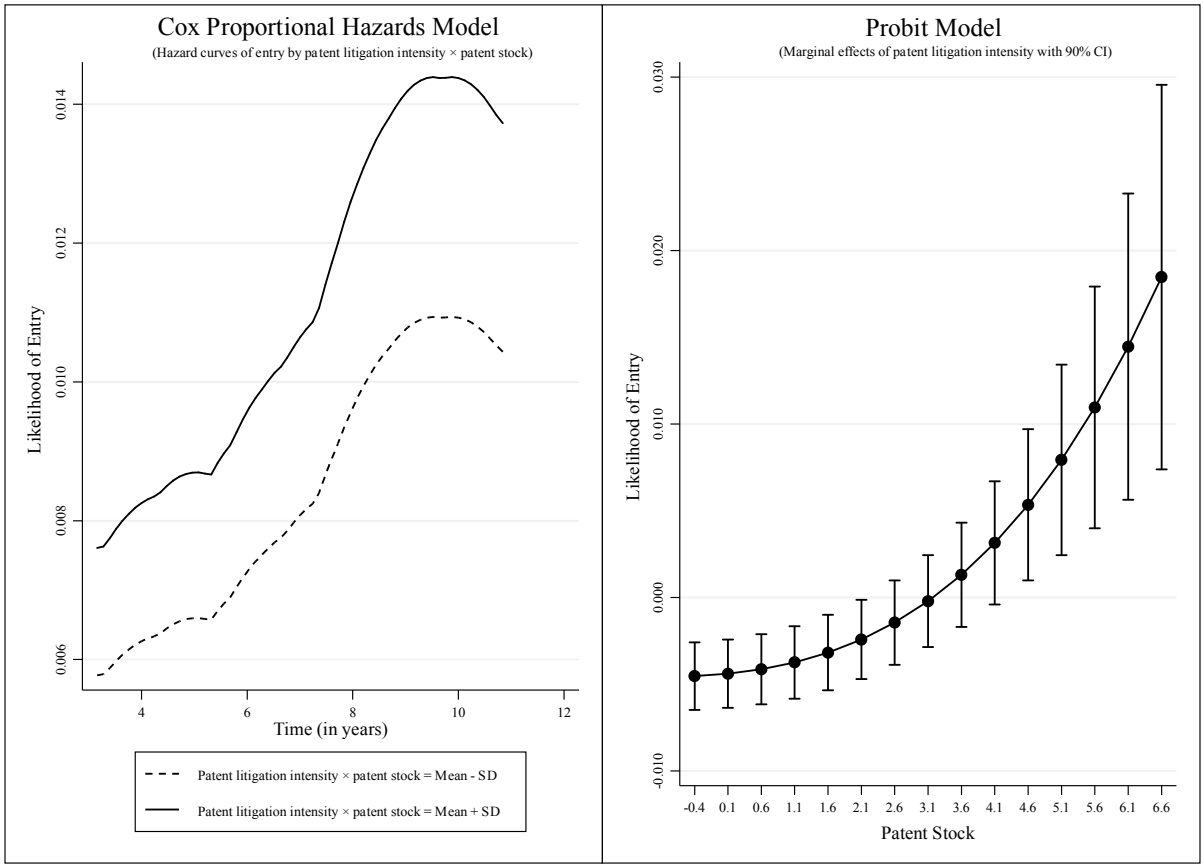


Table 1. Descriptive statistics and correlations

		Mean	Sd	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	Entry	0.013	0.111	0.000	1.000	1.000																					
2	Patent litigation intensity	5.046	29.681	0.000	481.000	-0.011 [0.104]	1.000																				
3	Patent litigation experience	0.848	3.092	0.000	77.000	0.068 [0.000]	-0.004 [0.535]	1.000																			
4	Patent applications in the target country	0.002	0.033	0.000	1.000	0.129 [0.000]	0.017 [0.008]	-0.002 [0.802]	1.000																		
5	Patent stock	119.651	246.431	0.000	2498.000	0.031 [0.000]	-0.007 [0.249]	0.318 [0.000]	-0.006 [0.319]	1.000																	
6	IP index	4.025	0.551	2.398	4.880	0.002 [0.750]	0.212 [0.000]	-0.019 [0.003]	0.028 [0.000]	-0.012 [0.073]	1.000																
7	Granted patent concentration	0.208	0.319	0.000	1.000	-0.000 [0.969]	0.028 [0.000]	-0.008 [0.215]	-0.003 [0.601]	0.013 [0.048]	0.151 [0.000]	1.000															
8	Institutional quality	65.983	23.203	8.935	97.948	-0.008 [0.198]	0.137 [0.000]	-0.024 [0.000]	-0.020 [0.002]	-0.005 [0.435]	0.779 [0.000]	0.279 [0.000]	1.000														
9	Product diffusion growth	0.070	0.115	-0.161	1.069	0.028 [0.000]	-0.051 [0.000]	-0.032 [0.000]	0.023 [0.000]	0.013 [0.037]	-0.295 [0.000]	-0.013 [0.047]	-0.300 [0.000]	1.000													
10	Non-store-based retailing growth rate	0.259	1.069	-0.643	27.000	0.007 [0.297]	-0.028 [0.000]	-0.003 [0.602]	0.013 [0.042]	0.001 [0.901]	-0.111 [0.000]	-0.068 [0.000]	-0.133 [0.000]	0.139 [0.000]	1.000												
11	Exit rate	0.189	0.431	0.000	2.000	0.002 [0.767]	0.028 [0.000]	0.007 [0.292]	0.000 [0.987]	-0.021 [0.001]	0.036 [0.000]	-0.047 [0.000]	0.001 [0.933]	-0.068 [0.000]	-0.051 [0.000]	1.000											
12	Market size	23080.415	46533.354	450.100	435445.906	0.013 [0.045]	0.298 [0.000]	0.001 [0.900]	0.100 [0.000]	-0.010 [0.139]	0.089 [0.000]	-0.015 [0.022]	-0.180 [0.000]	0.071 [0.000]	0.033 [0.000]	0.128 [0.000]	1.000										
13	Market share instability	0.072	0.885	0.000	24.588	-0.004 [0.544]	-0.009 [0.179]	-0.007 [0.249]	-0.002 [0.739]	-0.000 [0.967]	-0.031 [0.000]	-0.026 [0.000]	-0.035 [0.000]	0.187 [0.000]	0.007 [0.271]	-0.011 [0.102]	-0.009 [0.158]	1.000									
14	Market leader dethronement	0.148	0.355	0.000	1.000	-0.022 [0.001]	0.018 [0.006]	0.007 [0.307]	-0.016 [0.014]	-0.013 [0.046]	-0.007 [0.255]	-0.045 [0.000]	0.015 [0.018]	-0.075 [0.000]	-0.019 [0.004]	0.042 [0.000]	0.089 [0.000]	-0.012 [0.054]	1.000								
15	Number of developing country-based firms	4.368	2.437	0.000	17.000	-0.022 [0.001]	0.058 [0.000]	0.018 [0.006]	0.037 [0.000]	-0.034 [0.000]	-0.021 [0.001]	-0.066 [0.000]	-0.198 [0.000]	-0.175 [0.000]	0.011 [0.082]	0.182 [0.000]	0.605 [0.000]	-0.043 [0.000]	0.159 [0.000]	1.000							
16	Growth rate of the Android OS	1.287	2.213	0.000	6.800	-0.009 [0.178]	-0.047 [0.000]	-0.019 [0.004]	0.005 [0.479]	0.034 [0.000]	-0.032 [0.000]	-0.021 [0.001]	-0.021 [0.001]	-0.079 [0.000]	-0.011 [0.087]	-0.123 [0.000]	-0.018 [0.006]	-0.021 [0.001]	-0.089 [0.000]	-0.064 [0.000]	1.000						
17	Success in patent litigation	0.045	0.159	0.000	1.000	0.006 [0.350]	-0.018 [0.006]	0.306 [0.000]	0.004 [0.582]	0.247 [0.000]	-0.008 [0.204]	0.011 [0.104]	-0.001 [0.857]	0.044 [0.000]	0.007 [0.252]	-0.024 [0.000]	-0.013 [0.039]	0.008 [0.236]	-0.018 [0.005]	-0.039 [0.000]	-0.013 [0.040]	1.000					
18	Number of patent litigation cases as plaintiff	0.035	0.327	0.000	19.000	0.082 [0.000]	-0.002 [0.816]	0.455 [0.000]	0.000 [0.993]	0.111 [0.000]	-0.005 [0.406]	0.007 [0.285]	-0.005 [0.451]	0.025 [0.000]	-0.004 [0.562]	-0.010 [0.126]	-0.008 [0.220]	-0.003 [0.610]	-0.011 [0.091]	-0.042 [0.000]	-0.031 [0.000]	0.024 [0.000]	1.000				
19	Acquisitions	0.053	0.224	0.000	1.000	-0.010 [0.124]	0.002 [0.800]	0.273 [0.000]	-0.011 [0.088]	0.376 [0.000]	-0.010 [0.116]	0.004 [0.572]	-0.000 [0.959]	-0.024 [0.000]	0.003 [0.597]	0.000 [0.971]	0.000 [0.971]	0.000 [0.962]	0.013 [0.049]	0.021 [0.001]	0.006 [0.343]	0.120 [0.000]	0.041 [0.000]	1.000			
20	Time period 2003-2006	0.148	0.355	0.000	1.000	0.013 [0.042]	-0.049 [0.000]	-0.056 [0.000]	0.028 [0.000]	-0.003 [0.590]	0.041 [0.000]	0.053 [0.000]	0.072 [0.000]	0.401 [0.000]	0.071 [0.000]	-0.133 [0.000]	-0.086 [0.000]	0.098 [0.000]	-0.118 [0.000]	-0.346 [0.000]	-0.242 [0.000]	0.069 [0.000]	0.038 [0.000]	-0.033 [0.000]	1.000		
21	Time period 2007-2010	0.331	0.471	0.000	1.000	0.039 [0.000]	-0.094 [0.000]	-0.028 [0.000]	0.022 [0.001]	0.062 [0.000]	-0.015 [0.021]	0.055 [0.000]	-0.001 [0.913]	0.074 [0.000]	-0.007 [0.297]	-0.158 [0.000]	-0.043 [0.000]	-0.023 [0.000]	-0.150 [0.000]	-0.224 [0.000]	0.628 [0.000]	0.027 [0.000]	-0.013 [0.043]	-0.015 [0.019]	-0.293 [0.000]	1.000	

22	Time period 2011-2015	0.521	0.500	0.000	1.000	-0.046 [0.000]	0.123 [0.000]	0.065 [0.000]	-0.041 [0.000]	-0.055 [0.000]	-0.015 [0.021]	-0.089 [0.000]	-0.051 [0.000]	-0.355 [0.000]	-0.044 [0.000]	0.243 [0.000]	0.102 [0.000]	-0.049 [0.000]	0.225 [0.000]	0.457 [0.000]	-0.419 [0.000]	-0.075 [0.000]	-0.015 [0.021]	0.038 [0.000]	-0.435 [0.000]	-0.734 [0.000]	1.000

Descriptive statistics are based on unstandardized variables. All variables are lagged by one year, except Entry; *p*-values in square brackets.
N =23,954

Table 2. Cox proportional hazard regression for the effect of patent litigation intensity and patent-related AMC components on entry

		Model 1 Entry	Model 2 Entry	Model 3 Entry	Model 4 Entry	Model 5 Entry	Model 6 Entry
Independent Variables							
Patent litigation intensity	**H1**		-0.314	-0.273	-0.390	-0.557	-0.617
			(0.172)	(0.148)	(0.177)	(0.192)	(0.203)
			[0.068]	[0.065]	[0.028]	[0.004]	[0.002]
Patent litigation experience				0.520	0.433	0.423	0.412
				(0.125)	(0.120)	(0.118)	(0.118)
				[0.000]	[0.000]	[0.000]	[0.000]
Patent applications in the target country	**H3a**			0.180	0.181	0.180	0.181
				(0.019)	(0.020)	(0.019)	(0.019)
				[0.000]	[0.000]	[0.000]	[0.000]
Patent stock	**H4a**			0.179	0.199	0.203	0.213
				(0.068)	(0.066)	(0.066)	(0.066)
				[0.008]	[0.002]	[0.002]	[0.001]
Interactions							
Patent litigation intensity × patent litigation experience	**H2**				-0.975	-1.112	-1.237
					(0.495)	(0.500)	(0.517)
					[0.049]	[0.026]	[0.017]
Patent litigation intensity × patent applications in the target country	**H3b**					0.084	0.089
						(0.029)	(0.030)
						[0.004]	[0.003]
Patent litigation intensity × patent stock	**H4b**						0.135
							(0.054)
							[0.013]
Controls							
IP index		0.144	0.167	0.102	0.094	0.100	0.101
		(0.114)	(0.117)	(0.117)	(0.118)	(0.118)	(0.118)
		[0.208]	[0.153]	[0.384]	[0.426]	[0.397]	[0.391]
Granted patent concentration		-0.029	-0.030	-0.034	-0.032	-0.029	-0.029
		(0.061)	(0.061)	(0.063)	(0.063)	(0.063)	(0.063)
		[0.642]	[0.629]	[0.590]	[0.615]	[0.643]	[0.649]
Institutional quality		-0.150	-0.126	-0.063	-0.055	-0.056	-0.055
		(0.110)	(0.110)	(0.113)	(0.115)	(0.114)	(0.114)
		[0.171]	[0.255]	[0.577]	[0.630]	[0.624]	[0.628]
Product diffusion growth		0.078	0.089	0.080	0.081	0.090	0.090
		(0.105)	(0.105)	(0.110)	(0.110)	(0.109)	(0.109)
		[0.457]	[0.393]	[0.468]	[0.460]	[0.411]	[0.408]
Non-store-based retailing growth rate		0.024	0.022	0.008	0.009	0.013	0.012
		(0.025)	(0.027)	(0.031)	(0.031)	(0.029)	(0.029)
		[0.339]	[0.416]	[0.804]	[0.772]	[0.666]	[0.672]
Exit rate		0.013	0.017	-0.010	0.018	0.024	0.025
		(0.053)	(0.053)	(0.054)	(0.052)	(0.052)	(0.052)
		[0.811]	[0.745]	[0.856]	[0.730]	[0.647]	[0.636]
Market size		0.174	0.254	0.197	0.184	0.186	0.189
		(0.068)	(0.072)	(0.078)	(0.079)	(0.079)	(0.079)
		[0.011]	[0.000]	[0.012]	[0.020]	[0.018]	[0.017]
Market share instability		-0.970	-1.086	-0.756	-0.795	-0.807	-0.812
		(1.081)	(1.099)	(1.045)	(1.047)	(1.050)	(1.051)
		[0.370]	[0.323]	[0.470]	[0.448]	[0.442]	[0.440]
Market leader dethronement		-0.116	-0.115	-0.097	-0.099	-0.097	-0.098
		(0.068)	(0.068)	(0.068)	(0.068)	(0.068)	(0.068)
		[0.089]	[0.093]	[0.153]	[0.147]	[0.153]	[0.152]
Number of developing country-based firms		-0.117	-0.189	-0.201	-0.190	-0.182	-0.185
		(0.092)	(0.096)	(0.100)	(0.100)	(0.098)	(0.098)

	[0.205]	[0.050]	[0.045]	[0.057]	[0.063]	[0.060]
Growth rate of the Android OS	-0.458	-0.446	-0.446	-0.446	-0.446	-0.445
	(0.071)	(0.072)	(0.073)	(0.073)	(0.073)	(0.073)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Success in patent litigation	-0.013	-0.013	-0.059	-0.048	-0.050	-0.049
	(0.036)	(0.036)	(0.040)	(0.039)	(0.039)	(0.039)
	[0.721]	[0.722]	[0.139]	[0.222]	[0.194]	[0.204]
Number of patent litigation cases as plaintiff	0.467	0.487	0.232	0.334	0.335	0.336
	(0.079)	(0.072)	(0.079)	(0.085)	(0.084)	(0.083)
	[0.000]	[0.000]	[0.003]	[0.000]	[0.000]	[0.000]
Acquisitions	-0.123	-0.123	-0.183	-0.198	-0.199	-0.199
	(0.068)	(0.068)	(0.072)	(0.074)	(0.075)	(0.075)
	[0.071]	[0.071]	[0.011]	[0.008]	[0.008]	[0.008]
Time period 2003-2006	0.542	0.486	0.435	0.438	0.422	0.418
	(0.111)	(0.114)	(0.113)	(0.113)	(0.114)	(0.114)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time period 2007-2010	0.780	0.726	0.657	0.662	0.659	0.654
	(0.098)	(0.101)	(0.104)	(0.104)	(0.103)	(0.103)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Time period 2011-2015	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
N	23,954	23,954	23,954	23,954	23,954	23,954
Log pseudolikelihood	-2189.207	-2185.980	-2153.192	-2149.313	-2146.484	-2145.927
Pseudo *R-sq*	0.038	0.040	0.054	0.056	0.057	0.057
Wald *Chi-sq*	163.942	185.053	335.795	380.343	376.590	379.431
Prob > *Chi-sq*	0.000	0.000	0.000	0.000	0.000	0.000
Log-likelihood ratio *Chi-sq* vs. 1		6.454	72.029	79.788	85.447	86.559
		[0.011]	[0.000]	[0.000]	[0.000]	[0.000]
Log-likelihood ratio *Chi-sq* vs. 2			65.576	73.335	78.993	80.106
			[0.000]	[0.000]	[0.000]	[0.000]
Log-likelihood ratio *Chi-sq* vs. 3				7.759	13.417	14.530
				[0.005]	[0.001]	[0.002]
Log-likelihood ratio *Chi-sq* vs. 4					5.659	6.771
					[0.017]	[0.034]
Log-likelihood ratio *Chi-sq* vs. 5						1.112
						[0.292]

Estimates are based on standardized variables; robust standard errors are reported in parentheses; *p*-values are reported in square brackets.

Table 3. Robustness tests: alternative measures for patent litigation intensity, patent litigation experience, and patent stock

	Patent litigation intensity (number of live patent litigations)	**Patent litigation experience (1)** (cumulative number of a firm's live patent litigations)	**Patent litigation experience (2)** (cumulative number of media articles discussing a firm's litigations)	**Patent litigation experience (3)** (cumulative number of litigations where a firm was plaintiff)	**Patent litigation experience (4)** (cumulative number of litigations where a firm was defendant)	**Patent litigation experience (5)** (cumulative number of litigations with depreciation rate of 15 percent)	**Patent stock** (stock of patents since a firm's establishment)
	Model 7 Entry	**Model 8** Entry	**Model 9** Entry	**Model 10** Entry	**Model 11** Entry	**Model 12** Entry	**Model 13** Entry
Independent Variables							
Patent litigation intensity	-0.411	-0.674	-0.664	-0.439	-0.486	-0.609	-0.595
	(0.190)	(0.227)	(0.196)	(0.149)	(0.181)	(0.201)	(0.199)
	[0.031]	[0.003]	[0.001]	[0.003]	[0.007]	[0.002]	[0.003]
Patent litigation experience	0.362	0.447	0.429	-1.208	0.601	0.468	0.429
	(0.160)	(0.129)	(0.163)	(0.482)	(0.113)	(0.119)	(0.117)
	[0.023]	[0.001]	[0.008]	[0.012]	[0.000]	[0.000]	[0.000]
Patent applications in the target country	0.177	0.181	0.181	0.181	0.181	0.181	0.180
	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Patent stock	0.194	0.208	0.218	0.273	0.193	0.210	0.158
	(0.068)	(0.067)	(0.063)	(0.058)	(0.071)	(0.066)	(0.068)
	[0.004]	[0.002]	[0.001]	[0.000]	[0.006]	[0.002]	[0.021]
Interactions							
Patent litigation intensity × patent litigation experience	-1.418	-1.523	-1.642	-0.256	-0.623	-1.192	-1.194
	(0.749)	(0.608)	(0.716)	(0.098)	(0.359)	(0.514)	(0.527)
	[0.058]	[0.012]	[0.022]	[0.009]	[0.082]	[0.020]	[0.023]
Patent litigation intensity × patent applications in the target country	0.043	0.095	0.078	0.074	0.085	0.089	0.087
	(0.021)	(0.035)	(0.028)	(0.026)	(0.031)	(0.030)	(0.030)
	[0.041]	[0.006]	[0.006]	[0.004]	[0.005]	[0.003]	[0.003]
Patent litigation intensity × patent stock	0.080	0.134	0.115	0.102	0.125	0.134	0.104
	(0.035)	(0.056)	(0.059)	(0.056)	(0.061)	(0.054)	(0.046)
	[0.022]	[0.016]	[0.051]	[0.068]	[0.041]	[0.013]	[0.024]
Controls							
IP index	0.088	0.098	0.103	0.114	0.092	0.101	0.103
	(0.116)	(0.118)	(0.119)	(0.117)	(0.118)	(0.118)	(0.118)
	[0.450]	[0.402]	[0.383]	[0.329]	[0.437]	[0.393]	[0.382]
Granted patent concentration	-0.033	-0.029	-0.027	0.022	-0.029	-0.028	-0.026
	(0.063)	(0.063)	(0.062)	(0.062)	(0.063)	(0.063)	(0.062)
	[0.600]	[0.642]	[0.666]	[0.725]	[0.642]	[0.650]	[0.674]
Institutional quality	-0.061	-0.053	-0.051	-0.075	-0.041	-0.054	-0.057
	(0.114)	(0.114)	(0.116)	(0.113)	(0.115)	(0.114)	(0.114)
	[0.593]	[0.642]	[0.658]	[0.508]	[0.724]	[0.639]	[0.615]
Product diffusion growth	0.085	0.091	0.096	0.079	0.092	0.091	0.090
	(0.109)	(0.109)	(0.108)	(0.110)	(0.109)	(0.109)	(0.109)
	[0.438]	[0.403]	[0.371]	[0.471]	[0.400]	[0.404]	[0.408]
Non-store-based retailing growth rate	0.013	0.013	0.011	0.012	0.013	0.012	0.012
	(0.029)	(0.029)	(0.030)	(0.030)	(0.029)	(0.029)	(0.029)
	[0.655]	[0.666]	[0.716]	[0.678]	[0.663]	[0.675]	[0.674]
Exit rate	0.014	0.027	0.045	0.026	0.021	0.024	0.025
	(0.052)	(0.052)	(0.050)	(0.052)	(0.052)	(0.053)	(0.053)
	[0.782]	[0.611]	[0.373]	[0.618]	[0.684]	[0.648]	[0.639]

Market size	0.164 (0.084) [0.050]	0.189 (0.079) [0.017]	0.207 (0.079) [0.009]	0.184 (0.077) [0.017]	0.182 (0.080) [0.023]	0.189 (0.079) [0.017]	0.189 (0.079) [0.016]
Market share instability	-0.793 (1.052) [0.451]	-0.821 (1.052) [0.435]	-0.859 (1.045) [0.411]	-0.923 (1.069) [0.388]	-0.857 (1.066) [0.421]	-0.810 (1.050) [0.441]	-0.813 (1.051) [0.440]
Market leader dethronement	-0.095 (0.068) [0.163]	-0.098 (0.068) [0.153]	-0.103 (0.069) [0.135]	-0.099 (0.067) [0.144]	-0.092 (0.068) [0.176]	-0.097 (0.068) [0.155]	-0.098 (0.068) [0.152]
Number of developing country-based firms	-0.162 (0.100) [0.104]	-0.186 (0.099) [0.060]	-0.216 (0.098) [0.028]	-0.187 (0.097) [0.055]	-0.169 (0.099) [0.089]	-0.184 (0.098) [0.061]	-0.188 (0.099) [0.057]
Growth rate of the Android OS	-0.449 (0.073) [0.000]	-0.445 (0.073) [0.000]	-0.437 (0.072) [0.000]	-0.441 (0.073) [0.000]	-0.443 (0.072) [0.000]	-0.444 (0.073) [0.000]	-0.444 (0.072) [0.000]
Success in patent litigation	-0.050 (0.039) [0.205]	-0.057 (0.039) [0.146]	-0.035 (0.037) [0.344]	0.028 (0.037) [0.454]	-0.059 (0.040) [0.143]	-0.052 (0.039) [0.182]	-0.046 (0.039) [0.233]
Number of patent litigation cases as plaintiff	0.289 (0.075) [0.000]	0.378 (0.079) [0.000]	0.429 (0.074) [0.000]	1.015 (0.179) [0.000]	0.308 (0.078) [0.000]	0.296 (0.085) [0.001]	0.337 (0.081) [0.000]
Acquisitions	-0.194 (0.074) [0.008]	-0.219 (0.077) [0.004]	-0.286 (0.122) [0.019]	-0.139 (0.069) [0.044]	-0.190 (0.072) [0.009]	-0.203 (0.075) [0.007]	-0.195 (0.075) [0.010]
Time period 2003-2006	0.455 (0.112) [0.000]	0.419 (0.114) [0.000]	0.406 (0.114) [0.000]	0.394 (0.114) [0.001]	0.431 (0.114) [0.000]	0.420 (0.114) [0.000]	0.429 (0.114) [0.000]
Time period 2007-2010	0.688 (0.101) [0.000]	0.653 (0.103) [0.000]	0.646 (0.103) [0.000]	0.653 (0.104) [0.000]	0.657 (0.103) [0.000]	0.654 (0.103) [0.000]	0.661 (0.103) [0.000]
Time period 2011-2015	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
N	23,954	23,954	23,954	23,954	23,954	23,954	23,954
Log pseudolikelihood	-2150.506	-2144.450	-2141.381	-2147.629	-2136.858	-2144.492	-2147.913
Pseudo *R-sq*	0.055	0.058	0.059	0.056	0.061	0.058	0.056
Wald *Chi-sq*	353.114	367.008	396.952	468.472	381.670	380.697	379.362
Prob > *Chi-sq*	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Estimates are based on standardized variables; robust standard errors are reported in parentheses; *p*-values are reported in square brackets.

Table 4. Robustness tests: winsorization, sub-sample analyses, complementary log-log, and probit

	Cox proportional hazard					*Complementary log-log*	*Probit*	
	Winsorization	**No US-level obs.**	**No high IP index obs.**	**No Apple and Samsung obs.**	**No 5 largest firms obs.**	**Full (Model 6, Table 2)**	**Full (Model 6, Table 2)**	**Instrumental variables [a]**
	Model 14 Entry	**Model 15** Entry	**Model 16** Entry	**Model 17** Entry	**Model 18** Entry	**Model 19** Entry	**Model 20** Entry	**Model 21** Entry
Independent Variables								
Patent litigation intensity	-0.421	-0.739	-0.515	-0.441	-0.532	-0.610	-0.248	-0.198
	(0.105)	(0.254)	(0.302)	(0.145)	(0.159)	(0.170)	(0.056)	(0.054)
	[0.000]	[0.004]	[0.088]	[0.002]	[0.001]	[0.000]	[0.000]	[0.000]
Patent litigation experience	0.263	0.399	0.349	-0.186	1.585	0.474	0.260	0.241
	(0.101)	(0.118)	(0.122)	(0.221)	(0.504)	(0.120)	(0.060)	(0.059)
	[0.009]	[0.001]	[0.004]	[0.399]	[0.002]	[0.000]	[0.000]	[0.000]
Patent applications in the target country	0.337	0.189	0.174	0.200	0.180	0.199	0.122	0.123
	(0.028)	(0.027)	(0.021)	(0.021)	(0.019)	(0.021)	(0.016)	(0.016)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Patent stock	0.172	0.224	0.200	0.252	0.142	0.217	0.097	0.250
	(0.059)	(0.066)	(0.074)	(0.062)	(0.077)	(0.063)	(0.025)	(0.090)
	[0.003]	[0.001]	[0.007]	[0.000]	[0.065]	[0.001]	[0.000]	[0.006]
Interactions								
Patent litigation intensity × patent litigation experience	-0.502	-1.480	-1.463	-0.537	-0.365	-0.962	-0.416	-0.151
	(0.206)	(0.523)	(0.546)	(0.126)	(0.251)	(0.503)	(0.118)	(0.115)
	[0.015]	[0.005]	[0.007]	[0.000]	[0.147]	[0.056]	[0.000]	[0.191]
Patent litigation intensity × patent applications in the target country	0.033	0.183	0.191	0.065	0.077	0.087	0.038	0.033
	(0.013)	(0.262)	(0.219)	(0.026)	(0.033)	(0.021)	(0.010)	(0.010)
	[0.013]	[0.485]	[0.383]	[0.011]	[0.020]	[0.000]	[0.000]	[0.000]
Patent litigation intensity × patent stock	0.116	0.208	0.255	0.097	0.181	0.143	0.058	0.046
	(0.040)	(0.094)	(0.119)	(0.055)	(0.053)	(0.037)	(0.014)	(0.016)
	[0.004]	[0.027]	[0.032]	[0.078]	[0.001]	[0.000]	[0.000]	[0.004]
Controls								
IP index	0.070	0.105	0.109	0.118	0.091	0.081	0.046	0.042
	(0.117)	(0.118)	(0.121)	(0.126)	(0.130)	(0.116)	(0.045)	(0.045)
	[0.549]	[0.371]	[0.367]	[0.353]	[0.486]	[0.484]	[0.307]	[0.356]
Granted patent concentration	-0.016	-0.025	-0.040	-0.049	-0.031	-0.043	-0.012	-0.012
	(0.064)	(0.062)	(0.067)	(0.070)	(0.065)	(0.064)	(0.025)	(0.025)
	[0.797]	[0.690]	[0.557]	[0.486]	[0.626]	[0.503]	[0.614]	[0.626]
Institutional quality	-0.023	-0.056	-0.046	-0.093	0.026	-0.042	-0.032	-0.025
	(0.117)	(0.115)	(0.115)	(0.121)	(0.130)	(0.114)	(0.044)	(0.044)
	[0.846]	[0.623]	[0.689]	[0.444]	[0.844]	[0.709]	[0.463]	[0.572]
Product diffusion growth	0.087	0.093	0.137	0.050	0.094	0.105	0.042	0.043
	(0.107)	(0.109)	(0.110)	(0.121)	(0.119)	(0.106)	(0.043)	(0.043)
	[0.412]	[0.396]	[0.215]	[0.677]	[0.428]	[0.321]	[0.323]	[0.320]
Non-store-based retailing growth rate	0.080	0.014	0.017	0.023	0.017	0.015	0.004	0.005
	(0.051)	(0.029)	(0.031)	(0.025)	(0.030)	(0.026)	(0.012)	(0.012)
	[0.120]	[0.642]	[0.571]	[0.375]	[0.570]	[0.564]	[0.731]	[0.669]
Exit rate	0.026	0.033	0.026	0.061	-0.033	0.101	0.050	0.054
	(0.052)	(0.053)	(0.059)	(0.053)	(0.071)	(0.051)	(0.020)	(0.020)
	[0.617]	[0.530]	[0.654]	[0.248]	[0.641]	[0.046]	[0.011]	[0.006]
Market size	0.126	0.179	0.150	0.179	0.197	0.230	0.069	0.070
	(0.089)	(0.082)	(0.084)	(0.080)	(0.089)	(0.074)	(0.032)	(0.032)
	[0.157]	[0.029]	[0.073]	[0.026]	[0.028]	[0.002]	[0.028]	[0.026]

Market share instability	-0.058 (0.066) [0.381]	-0.778 (1.045) [0.456]	-0.787 (1.102) [0.475]	-1.078 (1.218) [0.376]	-1.279 (1.200) [0.287]	-0.752 (1.070) [0.482]	-0.399 (0.413) [0.334]	-0.405 (0.412) [0.325]
Market leader dethronement	-0.100 (0.067) [0.135]	-0.109 (0.072) [0.130]	-0.107 (0.074) [0.150]	-0.091 (0.071) [0.200]	-0.093 (0.076) [0.221]	-0.123 (0.069) [0.074]	-0.047 (0.026) [0.068]	-0.047 (0.026) [0.066]
Number of developing country-based firms	-0.174 (0.094) [0.064]	-0.176 (0.100) [0.079]	-0.121 (0.106) [0.255]	-0.176 (0.104) [0.092]	-0.127 (0.111) [0.253]	-0.259 (0.099) [0.009]	-0.080 (0.038) [0.036]	-0.077 (0.038) [0.045]
Growth rate of the Android OS	-0.437 (0.074) [0.000]	-0.444 (0.073) [0.000]	-0.418 (0.075) [0.000]	-0.117 (0.071) [0.099]	-0.442 (0.072) [0.000]	-0.276 (0.065) [0.000]	-0.108 (0.026) [0.000]	-0.105 (0.025) [0.000]
Success in patent litigation	-0.046 (0.039) [0.238]	-0.058 (0.041) [0.151]	-0.071 (0.041) [0.086]	-0.133 (0.061) [0.029]	-0.016 (0.040) [0.685]	-0.042 (0.034) [0.219]	-0.030 (0.015) [0.048]	-0.045 (0.017) [0.008]
Number of patent litigation cases as plaintiff	0.298 (0.056) [0.000]	0.339 (0.082) [0.000]	0.383 (0.081) [0.000]	0.641 (0.100) [0.000]	0.167 (0.178) [0.348]	0.357 (0.091) [0.000]	0.248 (0.058) [0.000]	0.270 (0.056) [0.000]
Acquisitions	-0.185 (0.075) [0.013]	-0.196 (0.075) [0.009]	-0.164 (0.076) [0.032]	-0.142 (0.069) [0.041]	-0.230 (0.092) [0.012]	-0.198 (0.079) [0.012]	-0.077 (0.031) [0.013]	-0.111 (0.038) [0.003]
Time period 2003-2006	0.356 (0.111) [0.001]	0.414 (0.115) [0.000]	0.383 (0.122) [0.002]	0.511 (0.119) [0.000]	0.382 (0.116) [0.001]	0.183 (0.103) [0.076]	0.084 (0.040) [0.035]	0.081 (0.040) [0.041]
Time period 2007-2010	0.622 (0.102) [0.000]	0.653 (0.104) [0.000]	0.658 (0.107) [0.000]	0.310 (0.102) [0.002]	0.638 (0.102) [0.000]	0.433 (0.084) [0.000]	0.183 (0.031) [0.000]	0.174 (0.030) [0.000]
Time period 2011-2015	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted	Omitted
Constant	-	-	-	-	-	-4.384 (0.081) [0.000]	-2.222 (0.031) [0.000]	-2.199 (0.034) [0.000]
N	23,954	23,423	21,255	23,861	23,784	23,954	23,954	23,587
Log pseudolikelihood	-2117.288	-2094.906	-1878.026	-1845.059	-1853.993	-1489.626	-1476.439	-22250.942
Pseudo *R-sq*	0.070	0.055	0.051	0.049	0.070	-	0.087	-
Wald *Chi-sq*	654.693	406.604	420.629	421.523	463.114	466.001	339.948	356.282
Prob > *Chi-sq*	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chi-sq (Wald test of exogeneity)	-	-	-	-	-	-	-	2.21
Prob > *Chi-sq* (Wald test of exogeneity)	-	-	-	-	-	-	-	0.1368

Estimates are based on standardized variables; robust standard errors are reported in parentheses; *p*-values are reported in square brackets.

[a] Instruments are the following: institutional quality of a firm's home country, IP index of a firm's home country, and competitive intensity in a firm's home country. Model 21 with instrumental variables has fewer observations because data about instrumental variables in a couple of home countries was not available in our database.