

Do Institutional Reforms Perpetuate or Mitigate Matthew Effects? Intellectual Property Rights and Access to International Alliances

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Provisionally accepted, Strategy Science

Draft: 5 September 2018

Comments are welcome

Abstract: Institutional reforms can profoundly alter the competitive positions of firms. Yet there has been limited research on *which* firms benefit most from these reforms: are the opportunities they create seized primarily by the most prominent firms, thus perpetuating a ‘rich get richer’ dynamic, or by previously peripheral firms, thus leveling the playing field? We address this question by exploring how intellectual property rights (IPR) reforms affect firms’ access to international alliances, a valuable channel of resources for firms in emerging markets. We find a significant increase in the number of international alliances formed by firms from the reforming countries corresponding precisely with the timing of IPR law improvements. This increase is strongest for firms that were ‘peripheral’ pre-reform: those that were of low status in the global alliance network and those located outside major cities in the reforming countries. Peripheral firms also benefitted the most from IPR improvements in terms of the quality of their alliance portfolios, gaining partners of higher status, from technologically stronger countries, and from a wider diversity of countries. Our study suggests that institutions play a role in mitigating Matthew effects in global alliance networks.

Acknowledgments: We thank the Strategy Science editors and reviewers for their feedback. We received constructive ideas from Matthew Bidwell, Adam Cobb, Julien Clement, Todd Gormley, Mauro Guillen, Witold Henisz, Lori Rosenkopf, Myles Shaver, Keyvan Vakili, and Todd Zenger; from participants in seminars at Baruch College, Bocconi University, George Washington University, University of Michigan, and Wharton; and from participants in the Global Strategy and Emerging Markets Conference, the Wharton Technology and Innovation Conference, the Wharton Undergraduate Research Seminar, the Trans-Atlantic Doctoral Conference, the Sumantra Ghoshal Conference hosted by London Business School, the INSEAD Networks conference, the Academy of International Business conference, and the SMS Rome Special Conference. The Mack Institute for Innovation Management provided generous financial support. The usual disclaimers apply.

Have the institutional changes that enabled globalization alleviated or exacerbated inequities in access to economic resources? Recent events have brought this question to the forefront of popular and academic discourse (Antras et al. 2017, Garlock 2015). The fundamental issue is whether the opportunities enabled by globalization-focused institutional reforms largely accrue to those with pre-existing advantages, thus exacerbating inequality, or whether they accrue to previously disadvantaged actors, bringing about a more equitable distribution of access to resources. Much of the focus has been on examining this question at the level of individuals. Yet how institutions influence disparity in resource access between firms is also an important issue, particularly for strategy scholars, because it affects which firms gain competitive advantage, the intensity of competition in industries, and the competitiveness of the economy as a whole. Which firms capture the benefits of institutional reforms is therefore a critical yet under-investigated question.

We address one aspect of this broad question by examining how reforms that strengthen intellectual property rights (IPR) laws affect the ability of firms from the reforming country to access international alliance partners. Alliances with foreign firms are an important resource for firms because they serve as a channel to access new markets, technologies, and knowledge (Lavie and Miller 2008). These partnerships are particularly important for firms in emerging economies, for whom they are a critical channel for learning and upgrading capabilities (Siegel 2007). While the value creation potential of international alliances is clear, the institutional environment in emerging economies raises value appropriation concerns that act as barriers to access foreign alliance partners. Perhaps the most salient of these barriers is weak IPR, which makes foreign firms unwilling to partner with local firms for fear of exposing their intangible assets without any assurance of appropriating the value of such assets (Shih and Wang 2013). Consequently, efforts to promote international exchange and link firms to global markets (such as trade agreements) typically include significant provisions to improve IPR protection around the world (Braga 2016). We ask whether enhanced access to international alliances after countries strengthen IPR institutions accrues primarily to firms that were already able to participate in international alliances in the pre-reform regime, or whether these reforms “level the playing field” by benefitting firms with few opportunities to access international partners pre-reform.

In particular, we focus on how improvements in IPR laws affect the impact that a firm's status in the global alliance network has on its opportunities to access international alliance partners. High-status firms, or those most centrally located in a network, tend to disproportionately attract new partners (Gulati and Gargiulo 1999). This empirical regularity is often labeled 'the Matthew Effect': the rich get richer because those seeking new partners prefer to attach themselves to firms that are highly visible and reputable in the network (Bothner et al. 2011, Merton 1968). This dynamic is likely to play out with respect to international alliance formation in weak IPR regimes because, in the absence of formal institutional protection against expropriation, foreign firms are forced to rely on informal, reputational means of governing alliances with local partners (Gao et al. 2017). In this situation, foreign firms should gravitate towards high-status local firms for two reasons: they are more visible, and their status functions as a signal of trustworthiness (Sauder, Lynn and Podolny 2012). Indeed, research shows that the potential loss of status firms would suffer by behaving opportunistically serves as a credible deterrent (Phillips et al. 2013). These considerations suggest that, when IPR laws are weak, the Matthew Effect will prevail because firms of high-status will disproportionately accrue alliances with foreign partners. However, we have little understanding of whether and how this dynamic changes when formal institutional protections (like IPR laws) are strengthened. On the one hand, we may expect the importance of status in attracting foreign partners to diminish since there is now an alternative means of assurance. On the other hand, the high-status firms may be best positioned to seize on the new foreign partnering opportunities enabled by institutional improvements because they are seen as more desirable partners by foreign firms.

We examine this issue by studying quantity and quality of alliances formed by firms from thirteen countries that passed substantial patent protection reforms during 1991-1999 (Branstetter et al. 2006). We exploit variations in the timing of the passage of these reforms across countries to set up a difference-in-differences design. Our findings reveal a significant increase in the number of international alliances formed by firms from the reforming countries corresponding precisely with the timing of the passage of IPR laws. Most central to our purposes, the increase was strongest for firms that were previously disadvantaged in access to international alliances: those that were of lower status in the alliance network pre-reform. The strengthening of the formal institutions diminished the importance of status as a driver of

international alliance formation. In further support of the broader notion that the reforms were particularly beneficial to firms that were previously peripheral, we also found that the increase in international alliances post-reform was more pronounced for firms that were located outside the political and commercial capitals of the reforming countries. Beyond quantity, we also found that the reforms also disproportionately enhanced the quality of peripheral firms' alliance partners: they were able to access partners of higher status, from more technologically advanced contexts, and from a greater variety of foreign countries. Hence, IPR reforms allowed disadvantaged firms to enhance both the size and quality of their global alliance portfolios, in effect weakening the Matthew Effect as it pertains to accessing international alliances.

Our research contributes to the literatures on global strategy, alliances, and institutions. Empirical work on whether globalization-focused institutional changes affect the relative distribution of resources across firms is scarce (e.g. Acemoglu and Robinson 2012). Yet it is central to the mission of strategy scholars because institutions help explain how context can shape who accrues differential advantages, getting at the heart of heterogeneity in competitiveness and firm performance. Our findings suggest that the strengthening of IPR institutions may be helpful in leveling the playing field, serving as an important fillip to disadvantaged firms in an economy. Further, we document an aspect of firms' strategic activities that has not previously been examined in relation to IPR reforms: their external partnering. Most prior research has focused on how firms respond to IPR reforms via internal resource allocation, such as R&D investments (e.g. Branstetter et al. 2006, Vakili and McGahan 2016). Yet because collaborative relationships are increasingly central to firms' global strategies, understanding the institutional antecedents of these relationships is increasingly important but understudied (Ahuja et al. 2012). Finally, in an environment in which the narrative of globalization is increasingly stressing its propensity to exacerbate inequality (e.g. Keller and Olney 2018), our findings offer an important counterpoint and are timely given the topic of this special issue. By addressing these issues, this paper offers insights useful to strategy scholars, managers, and policy makers.

BACKGROUND

Value Creation and International Alliances

Research has documented a range of benefits for firms that participate in international alliances, including knowledge acquisition, innovation, capability development, market expansion, and profitability (Balachandran and Hernandez 2018, Grigoriou and Rothaermel 2017, Lavie and Miller 2008). In terms of knowledge-related benefits, which are most germane to IPR issues, alliances that span national boundaries can facilitate access to knowledge and other resources that are distinct from those already possessed by the firm (Kogut and Zander 1993, Lavie and Miller 2008, Zaheer and Hernandez 2011). The meaning of knowledge and organizational practices reflects the institutional environment within which they are embedded, and plays a determining role in the trajectory along which knowledge evolves (Meyer and Rowan 1977). National institutions imprint firms with norms of behavior, as well as influencing the development of their search behavior in fundamental ways (Marquis and Tilcsik 2013). Given differences in institutional environments, firms from different countries are likely to develop distinct approaches and routines towards problem solving and innovation—to the point where the innovation system becomes a distinguishing feature of nations and the economic actors within them (Nelson 1993). Partnering with a firm from a different country therefore brings something more unique than partnering with a firm from the same country, all else equal (Hitt et al. 2000). Hence, complementarities in capabilities between firms from different countries are an important source of value creation (Kale et al. 2002), which increases the motivation to form alliances (Dacin et al. 1997, Heimeriks and Duysters 2007, Mindruta et al. 2016).

These alliances are particularly valuable to firms from emerging markets, for which there are few alternate avenues to access these benefits (Siegel 2007). International partnerships can be a crucial channel for learning, allowing these firms to gradually upgrade their knowledge and capabilities. A range of studies have demonstrated how international alliances can bring about these improvements for these firms. For instance, Alcacer and Oxley (2013) show that firms from emerging markets in the telecommunications handset industry substantially improved their technological capabilities via their OEM partnerships with foreign firms. The potential for this type of improvement has led many firms from emerging economies to adopt strategies focusing on ‘moving up the value curve’, which involves

gradually engaging in more technologically complex (and profitable) activities by learning from their partners (Bartlett and Ghoshal 2000). In addition to facilitating learning about technology, these partnerships can also open up new markets where these firms can deploy the unique capabilities they possess (Brandl et al. 2015).

Value Appropriation Concerns, IPR, and International Alliances

The research mentioned so far makes a strong case for the value creation potential of alliances with foreign partners. Our primary interest lies in how IPR institutions affect value appropriation in such alliances. Despite a strong rationale for participating in international alliances, these are unlikely to be formed in the first place if their value creation potential is outweighed by the participants' concerns about exposing their intangible assets without any assurance of capturing the value created (Dushnitsky and Shaver 2009, North 1990, Oxley 1999, Teece 1986). In particular, concerns stemming from inadequate IPR protections have become one of the most serious impediments to doing business internationally (Economist Intelligence Unit 2004, Fang et al. 2017). This has become a particularly salient issue in emerging markets, which are often characterized by weaker IPR laws compared to more developed markets.

Yet the extant work on firms' responses to weak IPR emphasizes internal resource allocation decisions rather than its effects on external ties such as alliances. For example, Zhao (2006) demonstrated that the complexity and complementarity of internal linkages between technologies within the firm serve as a barrier to undesired knowledge spillovers in countries with weak IPR. Alcacer and Zhao (2012) further showed how such internal linkages allow firms to protect their IP from imitation in industry clusters where knowledge spillovers are likely. Other research focuses on different actions or strategies firms can follow to safeguard their knowledge in weak IPR settings (Agarwal et al. 2009, Schotter and Teagarden 2014). And some work has focused on how improvements in IPR laws affect the knowledge-related activities of firms. For example, Branstetter, Fisman, and Foley (2006) demonstrated that multinational firms were more willing to transfer technological activities to their subsidiaries in the reforming countries. Others have focused on whether reforms increased the innovative output of firms from the reforming countries, showing mixed results (Lerner 2009, Qian 2007). More recently, Vakili and

McGahan (2016) show that firms change the focus of their R&D investments to develop capabilities that pertain to particular environments when the IPR protection in those environments is improved.

However, given the appropriability concerns raised by weak IPR institutions for cross-border alliances, it is surprising that there is only one study on external responses to IPR (that we know of). Oxley (1999) showed that firms adjust the alliance governance mode (equity vs. non-equity) to the strength of IPR laws in their partners' country. But research has not explored how changes in IPR institutions affect the ability of firms to access global alliance partners in the first place, nor looked at how IPR affects the quality of partners firms can access. And most crucially for our main question, prior work has also not addressed *which firms* obtain these alliance benefits as a result of IPR reforms. We attempt to fill these gaps in prior research.

Status and Matthew Effects

Research on reforms that improve the quality of formal institutions in general (not just IPR) is equivocal about which types of firms benefit from such improvements: some globalization-focused reforms appear to reinforce the preexisting advantages of the largest, most powerful firms and economic actors, while others seem provide benefits to a more inclusive set of actors (See Acemoglu and Robinson 2012 for a review). Existing research on IPR reforms in particular does not address these distributional issues. We will first review relevant considerations from extant theories on mechanisms that may drive international alliance formation in a regime with weak IPR institutions vs. a regime with stronger IPR institutions. From these, we develop a few plausible expectations about how the value of status in the global alliance network may shift across the two types of regimes.

When IPR laws (and formal institutions more generally) are weak, firms need to rely on informal relational mechanisms of exchange to mitigate concerns of partner misbehavior (Granovetter 1985). Among other mechanisms, research has shown that the status of a firm can be a significant enabler of exchange in these contexts (e.g. Gao et al. 2017). Status is defined as a hierarchical position in a pecking order, and networks are a good forum in which to observe it because high status actors sort into central positions and low status actors into peripheral positions (Sauder et al. 2012). Status has economic value in the context of interfirm relations (of which international alliances are a subset) because it is a signal of

unobservable firm quality and reliability as an exchange partner. Organizations can experience a loss of status when they engage in behavior perceived to be inappropriate (Phillips et al. 2013, Rhee and Haunschild 2006), so the reputational fallout from behaving badly can serve as a credible deterrent to opportunistic behavior by high status actors (Jensen and Roy 2008). Hence partnering with a high status actor can lower the risk of expropriation since the cost of behaving opportunistically goes up as status in the network increases (Graffin et al. 2013, Rhee and Haunschild 2006). Further, high status firms tend to be visible or prominent in networks, lowering the cost of searching for exchange partners. These various status signals are of particular value when uncertainty makes it difficult to ascertain the true quality and reliability of a potential partner, so that status becomes a particularly valuable means of attracting partners when uncertainty is high (Podolny 1994, 2001).

While these ideas have not been empirically applied to a scenario in which one firm is considering an alliance with another firm from a weak IPR country, they are likely to be relevant. When formal IPR laws are weak, foreign firms are particularly likely to seek high status local firms to partner with: those that already have a degree of centrality or connections to other firms in the global alliance network. As just mentioned, these firms should be more visible and reputable, with status signals mitigating the appropriability concerns resulting from weak IPR. This results in a dynamic of partnership formation driven by ‘preferential attachment’: firms from weak IPR countries that are of high status (in the eyes of foreign partners) in one period disproportionately accrue new foreign partnerships in the next period (Schilling and Fang 2013).¹ Over many periods, a regime dominated by preferential attachment leads to a highly skewed distribution of network size and quality: firms with initial status advantages have disproportionately larger and better networks.

This dynamic conforms to patterns of increasing returns to centrality known as the ‘Matthew effect’: the rich get richer and the poor get poorer (Bothner et al. 2011, Merton 1968). Indeed, this is

¹ Our theoretical concern is in alliances with foreign partners for two reasons. First, these are the most desirable for firms from emerging markets because they are the most useful to upgrade capabilities and access new markets, as explained earlier. Second, foreign partners are the most likely to have appropriability concerns due to weak IPR in the country of the focal firm because they are outsiders with little recourse to other mechanisms of protection. Other domestic firms are insiders that likely have developed alternative means of overcoming IPR concerns. In short, IPR is a greater barrier to cross-border than to domestic alliances. In additional analysis later, we will explore how IPR reforms affect domestic alliances as well.

among the most universal empirical patterns observed across a wide variety of networks (Barabási and Albert 1999). In our context, Matthew effects are manifested in foreign firms exhibiting a preference to form partnerships with firms from weak IPR regimes that are already involved in alliances. This preference is reinforced over time, resulting in an uneven distribution of access to global alliances that gives some firms resource advantages over others. Empirical studies of emerging markets are consistent with this dynamic, showing that a handful of firms affiliated with business groups, powerful families, or dominant political parties accrue most foreign partnerships and access to global markets (Gao et al. 2017, Khanna and Palepu 2000, Siegel 2007).

The main question we ask is whether institutional reforms perpetuate or mitigate the Matthew effect as it pertains to international alliances. On the one hand, evidence from some studies of institutional reform would suggest a perpetuation (though none of these studies is about alliances). While credible reforms may generate greater interest and willingness to partner with firms from the reforming country, the most prominent of these firms, having prior experience with partnering and often superior resources, are likely to be best positioned to cater to the needs of foreign partners. For instance, research has shown that as institutions improve in emerging markets, the advantages enjoyed by prominent business groups or large firms often grow rather than shrink (e.g. Chittoor et al. 2015, Siegel and Choudhury 2012). More generally, prior research has shown that actors with the most social capital or the greatest reputation and visibility are best positioned to seize the opportunities precipitated by institutional reform (Aven 2013, Stiglitz 2002). Firms that are already connected to global alliance partners in these weak IPR economies are typically the ones that possess these qualities, and preferential attachment would simply reinforce their advantages when it comes to forming additional international partnerships.

On the other hand, classic institutional theories suggest a mitigation of inequality in access to global alliances after IPR laws improve. The transition to stronger IPR represents a change from a regime dominated by interpersonal enforcement to one in which third-party enforcement is more prevalent (Zucker 1986). Rather than relying on cues of trustworthiness centered on the potential partner itself, foreign and domestic firms can now rely on an impersonal and universal platform of governance (Fang et al. 2017). This means that a potential foreign partner can rely on the quality and strength of the law rather

than solely on attributes of the focal partner. The problems of search costs and ascertaining trustworthiness are significantly mitigated. Consequently, foreign firms should be able to choose from a wider pool of potential partners. This does not imply that informal mechanisms such as status and reputation cease to function as means of ascertaining the quality and reliability of potential alliance partners—but it does mean that firms are less reliant on those informal mechanisms. Consequently, a greater number of firms that were previously shut out of international alliancing opportunities can access foreign partners.

Given the competing theoretical possibilities, which of these outcomes plays out after strengthening IPR is an empirical question. Instead of presenting hypotheses, we progressively develop an account of the distributional effects of institutional reforms on firms in three stages. In each stage, we present empirical results and, informed by theory, probe the underlying mechanisms and develop theoretical arguments to resolve the tension. Unlike in traditional empirical papers, theoretical concepts will be interspersed with the empirical results and developed inductively rather than presented ex-ante. First, before delving into distributional effects, we establish a necessary baseline: do IPR reforms have any effect on the international alliance formation of the firms from the reforming country? Surprisingly, there is no empirical evidence of this relationship despite the importance of foreign alliances for emerging-market firms. Second, we get into our primary question: who benefits most from this increased rate of international alliance formation facilitated by IPR improvements: firms with pre-existing status advantages or those with previously limited opportunities due to low status? Third, we attempt to distinguish quantity from quality: do those firms that benefit from IPR reforms simply get more foreign alliance partners, but perhaps not the ‘good’ partners? Or does the reform allow them to also assemble a higher quality portfolio of foreign partners?

Clearly, a firm’s ability to form partnerships is closely related to its own capabilities or quality, i.e. how good it is at what it does (Dyer and Singh, 1997; Kale et al., 2002). Our objective in this study is to examine, for a given level of resources and capabilities, how the institutional environment influences the ability of that firm to form partnerships, and how that change is moderated by the firm’s status. In other words, we hold fixed (both conceptually and empirically) the level of the firm’s actual capabilities,

i.e. its underlying quality or how good it is at managing alliances. As we will now describe, the design of our study (a diff-in-diffs with firm fixed effects) is chosen so as to enable us to hold many of the firm specific characteristics fixed. We will also examine changes that happen over relatively brief windows around the reforms to facilitate this, since it is unlikely a particular firm's capabilities will have changed dramatically within these brief windows.

DATA AND METHODS

Our sampling frame consists of firms from thirteen countries that passed substantial and credible laws to strengthen patent protection during the 1990's. We drew information about these IPR changes and their timing from Branstetter et al. (2006). They identify governmental interventions that lead to expansions or improvements in (i) eligible inventions, (ii) effective scope of patent protection, (iii) duration of patent protection, (iv) enforcement of patent rights and (v) administration of the patent system. The reforms in each of the 13 countries in our analyses exhibited improvements on at least four of these five dimensions. Other countries engaged in IPR reforms during this period too, but the changes in the law and its enforcement were not strong or credible enough to be considered meaningful. We refer the reader to the appendix of Branstetter et al. (2006) for an explanation of the reforms in each country. Table 1 shows the countries in our analyses and the year of reform in each case. We further investigated the circumstances leading to the reforms in each of these countries, and a summary of these is presented in table 2. We discuss later how we deal with any empirical concerns arising from these reform processes.

We drew information on interfirm alliances from SDC Platinum, the most comprehensive source of global alliances across multiple industries (Schilling 2009). Alliance data of a reasonable quality in SDC Platinum is only available starting in 1988. We were thus forced to drop firms from some of the original sixteen countries identified by Branstetter et al. (2006) because the reforms in these countries occurred prior to 1988: Japan (1983), South Korea (1987), Spain (1986) and Taiwan (1986). In addition to the remaining twelve countries in their original study, our sample also includes India (1999), which was identified by Branstetter et al. (2006) as passing a significant IPR reform but not included in their analysis as 1999 was the last year in their sample. While the IPR systems of these countries remain imperfect to this day, our study relies on the significance of the change rather than on them reaching an

ideal level. We do not assess differences in the strength or quality of reforms across countries because distinctions in the legal procedures and systems of countries make such comparisons infeasible—we focus only on whether and when there was a significant change (in a binary sense).

INSERT TABLES 1 AND 2 HERE

Our sample includes 11,072 firms from the thirteen IPR-changing countries that participated in alliances between 1988 and 2004. Though our focal firms are only from the countries in which we observe the legal changes, their alliances could be with firms from anywhere in the world. While we focus on international alliances, we account for domestic alliances in all our models. Research shows that any type of alliance can provide a path for knowledge diffusion, and that the actual breadth of an alliance's activity is typically much greater than what is formally reported as the purpose of the collaboration (Alcacer and Oxley 2014, Powell et al. 1996). Hence, we include alliances of all types in our sample. However, the results are robust to dropping alliances that have no explicitly mentioned knowledge component, as discussed later.

Research Design and Estimation

Our objective is to estimate how a firm's cross border alliance activity changes when IPR institutions in its home country experience a marked improvement. The 'treatments' are changes in laws, where the treated group consists of the firms in the country that passed IPR reforms and the control group consists of firms from countries that did not pass reforms in the same period. We examine how the treated firms' international alliance activity changes after the reforms are passed, compared to before (the first difference). Further, we compare these before vs. after changes with changes over the same period by firms whose countries had not modified their IPR laws (the second difference). This difference-in-differences setup allows us to separate the specific effect of the reforms from broader changes occurring during the period (Angrist and Pischke 2008). To capture the distributional effects of these reforms, we explore whether there are further differences in the effect of IPR reforms across firms of different status (the third difference). We measure status based on a firm's centrality, as we will describe later.

For the estimates to be biased, the underlying data generation process would need to violate the parallel trends assumption, i.e. the changes in cross border alliance activity would have to be varying in

systematically different ways between the treatment and control groups for reasons that are unrelated to the IPR reforms (Bertrand et al. 2004). Since our identification relies on multiple events rather than just one, this systematic difference would have to be consistent and in the same direction across many events to bias the results. An additional factor that makes the estimation stringent is that we do not include firms from countries that made no IPR reforms during the sample period (say, the U.S. or Japan). The alliance activity of firms in these countries is likely to be systematically distinct to that of firms from the treated countries, which would increase the potential for selection bias. Hence, our sample only consists of firms from countries that made reforms over the sample period, just at different times.

Our identification strategy therefore relies on the timing of the various IPR changes not being systematically endogenous to alliance activity by firms from the reforming countries. While we cannot perfectly verify such exogeneity, we have tried to be as thorough as possible. As Table 2 shows, the process leading to a reform within any given country is driven by distinct factors, some measurable and some not. Further, virtually all the countries reformed due to external pressures rather than internal factors correlated to the alliance formation decisions of local or foreign firms. These considerations make it unlikely that differences in the timing of IPR reforms across countries systematically coincide with factors endogenous to the changes in the alliance network. Nevertheless, to examine whether the changes in alliance activity coincide with the reforms (rather than just being part of a broader secular trend), we will estimate the difference in alliance activity between the treated and control groups year by year (see Branstetter et al. 2011 for a similar approach). We estimate the following equation:

$$Alliances_{ict} = \beta_0 + \beta_1 Post Reform_{ct} + \beta_2 Post Reform_{ct} * Status_{ict} + \beta_3 Controls_{ict} + Firm_i + Year_t + \varepsilon_{ict}$$

where $alliances_{ict}$ represents an alliance outcome of interest (quantity or quality) for firm i from country c at time t . The variable $post reform_{ct}$ indicates whether country c has strengthened its IPR laws as of year t . The coefficient of $post reform_{ct}$ gives the difference-in-differences estimate, i.e. the average difference between the treated and control groups in the pre- vs. post-treatment change in *international alliances*. To explore our main question, we estimate a further specification in which we interact $post reform$ with a $status$, as explained more later. We employ OLS regressions with firm fixed effects in all models ($firm_i$)

to partial out time invariant unobserved heterogeneity between firms. These fixed effects are crucial to rule out the alternative explanation that central vs. peripheral firms have distinct quality or capability differences that justify the preferential attachment to central firms, particularly during the pre-reform regime. We also include year fixed effects ($year_t$) to account for macroeconomic effects that may cause fluctuations in global alliance activity. All our models contain the controls summarized in table 3.

Table 4 shows the summary statistics and correlations for the variables involved in the estimation. Note that the mean of new international alliances is very low (0.05), and is also highly skewed (s.d. of 0.2). This is not too surprising, since this variable is the mean of the number of new international alliances formed per firm-year across all the firms in the sample and the entire study period. Furthermore, the skewness confirms the fact that a relatively small proportion of these firms are likely to be responsible for a lot of the alliance activity. We will log this variable in our linear models, and also present it broken down in different ways by period and by country throughout our analysis.

INSERT TABLES 3 AND 4 HERE

RESULTS

1. Baseline: Effect of IPR Reforms on International Alliance Formation

Based on canonical institutional theory (Teece, 1986; Zucker, 1986; North, 1990; Acemoglu and Johnson, 2012), we would expect that firms establish more alliances with international partners after IPR reforms in their countries. The conceptual explanation is simple: an improved appropriability regime allays the IP loss concerns of foreign partners (Teece, 1986), making firms from the reforming country relatively more attractive than before. However, this important effect on alliances has not been documented previously. With the exception of Oxley (1999), who assessed the effects of IPR strength on alliance governance mode choice, prior research has largely focused on how firms adjust their internal activities in response to the strengthening of IPR protection (e.g. Vakili and McGahan 2016; Branstetter et al., 2006; 2011). Documenting the main effect of IPR reforms on the international alliance formation of firms in the reforming countries is thus a necessary first step to later explore the distributional effects of IPR on access to international alliances.

INSERT TABLE 5 HERE

We start by examining the raw data for any trends in international alliance formation around the reforms. Table 5 shows the average number of new international alliances formed by the firms from each country in the three-year windows before and after the reforms. We see that this number goes up in each case except that of the Philippines. Next, we statistically test this in a regression model including a range of controls as well as firm and year fixed effects. We measure *international alliances* as the natural log of one plus the number of new alliances that the focal firm establishes in a given year with partners that are based in a country different than its own, as classified by SDC's alliance participant location. We add one to the original count for logging purposes because many firms do not form ties every year. Model 1 of table 6 shows the estimate of the difference-in-differences in the *post reform* variable. The positive and significant coefficient ($p < 0.01$) indicates that IPR reforms are associated with an increase in the rate of international alliance formation. The partial elasticity, holding other variables at their mean, reveals that IPR reforms increased *international alliances* by 45% for the treated group compared to the change over the same time period for the control group.

INSERT TABLE 6 AND FIGURE 1 HERE

Mechanisms driving the main effect. One potential alternative explanation for the main effect of IPR reforms on *international alliances* may be that the reforms proxy for a general process of globalization and liberalization (this was the time of the Washington consensus), and therefore the underlying mechanism may not have anything specifically to do with the IPR laws per se. If that were the case, we would observe the increase in international alliances as a secular trend, regardless of when or whether these laws were passed. Note that we controlled for several indicators of globalization: an indicator of liberalization, a measure of capital flow openness, and a count of reforms enacted by neighboring countries (see table 3). Also, as table 2 shows, IPR reforms in each of our sample countries displayed substantial idiosyncrasies and it was not the case that these coincided precisely with other liberalizing reforms in each country.

Nevertheless, to verify if the IPR laws were driving the observed changes we break down the difference-in-differences estimate by year. This allows us to observe the difference in *international alliances* between the treated and control groups in the years leading up to and following the reforms. In

Model 2, we break down *post-reform* into a series of year-by-year indicators, with the year before the reform (*reform(t-1)*) as the baseline. The coefficients of these indicators are plotted in figure 1 (with vertical lines indicating the 95% confidence intervals). We observe a clear jump in the coefficient corresponding with the year of the reforms. The rate at which firms form international alliances is then largely sustained at this higher level well into the future.² These yearly results significantly strengthen our ability to infer that the observed changes are caused by the IPR reforms. We observe no pre-trend, i.e. the rate of international alliance formation was not steadily increasing in the years leading up to the reforms. And the ‘jump’ corresponds *precisely* with the year of the reforms. It is unlikely that alternative factors driving international alliance formation would also correspond so precisely in time with the law changes across thirteen different countries. This test offers us confidence that the results we observe are have something to do with the strengthening of IPR protections. Even if other liberalizing institutional changes were occurring over roughly the same period, it is extremely unlikely that these coincided precisely with the IPR law changes across all of these different countries in such a way as to be responsible for the substantial ‘jump’ we see exactly at the time when these law changes occurred.

As a further test of this, we also probed whether the baseline results are driven by knowledge-related mechanisms, as we would expect if the effects are a product of easing concerns regarding IP appropriability. If this were the case, the increase in international alliances should be most pronounced for firms in industries where IP-related concerns are greatest. Since the laws in our sample were related to patent protection, we estimate a ‘triple difference’ (a difference in the difference-in-differences) between firms in patent intensive and non-patent intensive industries. We interacted the *post reform* variable with a binary indicator of *patent intensity*, which takes the value of 1 if the firm is in a patent intensive industry, and 0 otherwise, as defined by the US patent and trademark office (USPTO 2012). Model 3 of table 7 shows these estimates. We observe a positive and significant coefficient of the triple difference term ($p < 0.05$). The positive effect of IPR reforms on the rate of international alliance formation is more pronounced for firms in patent intensive industries—approximately 35% greater than that experienced by

² Note that the post-reform yearly coefficients need not be significant in every year to conclude that IPR reforms caused a significant increase in *international alliances*. The timing and the overall pattern are more important, as there will be natural variability across individual years (Wooldridge 2010).

firms from non-patent-intensive industries. It is less plausible that this distinction between firms in patent intensive and non-patent intensive industries would exist if they were being driven by other events unrelated to IPR protection.

INSERT TABLE 7 HERE

In combination, the results so far demonstrate that IPR reforms had an important effect on the opportunity of firms from the reforming countries to access international partners. This is a significant result given the demonstrated value of these cross-border partnerships for capability development and innovation (e.g. Grigoriou and Rothaermel 2017; Balachandran and Hernandez 2018). It is also important given that prior research has found that in many cases these laws do not elicit the internal resource allocation changes they were intended to (e.g. Kyle and McGahan 2012). The fact that these reforms facilitate benefits in terms of interfirm partnerships is therefore an important and, to the best of our knowledge, thus far undocumented result.

2. Who Benefits from IPR Reforms?

While the results thus far show an average increase in alliance formation, we still have a limited understanding of which firms are most likely to accrue this increase. An important question is whether these increases are driven by a growth in the number of alliances per firm or a growth in the number of firms forming alliances, or indeed both of these. To probe this, we will first examine some descriptive statistics. Table 8 shows the average number of new international alliances formed by the firms that formed at least one international alliance in the *pre and post* reform periods, in the three-year window around the reforms. The uniform increases we observe here suggest that there was a widespread increase in the number of alliances formed by the firms that were already participating in international alliances. Table 9 shows the number of firms from each country in our sample that form international alliances in the three-year windows before and after the reforms. The increases we see across the board in this table suggest that the reform also had the effect of broadening the base of participating firms.³ On average, across the countries in the sample only 9.4% of firms had at least one foreign alliance partner in the three

³ The increase in the number of firms is particularly stark in China. As described later, the results hold if we drop Chinese firms from the sample.

years leading up to the reform. In contrast, 26.6% of the firms in the average country had one or more foreign partners post-reform. A t-test shows that this increase is statistically significant ($p < 0.01$). While only indicative, this is a powerful clue that the distribution of international alliancing opportunities became much more even across firms within countries. In combination, these figures suggest that the effects of the reforms were reflected in an increase in both the intensive margin (number of alliances formed) as well as the extensive margin (number of firms forming alliances). We will now focus our attention on the latter because we are interested in understanding whether the benefits associated with the reforms principally accrue to the most prominent firms in the economy or whether they are more equitably distributed.

INSERT TABLES 8 AND 9 HERE

We turn to results at the firm level to more systematically explore this question. Our primary test is based on a measure of the firm's status in the global alliance network, based on the well-documented benefits of preferential attachment we discussed earlier. Drawing on prior research, we capture a firm's status in each year using its *eigenvector centrality*, which is a measure that weights each of the firm's ties by the centrality of the actor to which it is associated (Bonacich 1987, Sauder et al. 2012). This is the most frequently used indicator of status because it accounts not just for how extensively connected a firm is, but also the connectedness of its partners (e.g. Podolny 1994, 2001, Bothner et al. 2011). We will interact *eigenvector centrality* in the year prior to the reform with the *post reform* indicator to examine if the effect of the reforms on *international alliances* increases or decreases with a firm's pre-reform centrality. In addition to being a good indicator of a firm's position of advantage in the pre-IPR reform regime, measuring centrality before the reform (but not afterward) has an empirical advantage. A firm's centrality may be affected by the reform; so measuring centrality year-by-year after the reform can lead to biased estimates due to the "bad control" problem (Angrist and Pischke 2008). To avoid this, and because it better captures our conceptual interest, we measure centrality in the year preceding the reform and interact it with the *post reform* indicator.

INSERT TABLES 10 AND 11 HERE

Model 4 of table 10 shows these results. Note that we cannot estimate a direct effect of *eigenvector centrality* on international alliances because it has a single value for each firm (the value from the year prior to the reform) and is therefore collinear with the firm fixed effects. However, we can estimate its interaction with *post reform*. The coefficient of this interaction term is negative and significant ($p < 0.001$): the positive effect of the reforms on international alliances is more pronounced for firms that were of lower centrality prior to the reforms. The substantive significance of these coefficients is somewhat tricky to interpret given that centrality values are time-invariant. But an approximation indicates that the effect of IPR reforms on international alliance formation is about 40% lower for firms with eigenvector centrality one-standard deviation above the mean in the pre-reform period. These results suggest that IPR reforms bring about a softening of the Matthew effect. In other words, the reforms serve to diminish the degree to which a firm's status predicts its future international alliance formation.

Alternative measure of initial advantage. Firm status is our preferred indicator of initial advantage because it relates directly to the ability to obtain international alliances. Nevertheless, we want to examine whether the basic mechanism we are proposing, i.e. that the benefits of the reforms favor those firms that were peripheral in the pre-reform regime hold using a different conceptualization of initial advantage altogether. As an additional measure of this, we look at whether the firm is located in the political or financial capital of the reforming country. Being located in the most prominent cities in the economy can be advantageous in terms of visibility to foreign partners since these cities tend to be the best connected to the outside world (Parnreiter 2017). In addition, these locations may also make it easier to access valuable resources—ideas, production inputs, social and political capital—which can be valuable in facilitating access to foreign partners (Nanda and Khanna 2010). In contrast, being located in a more provincial part of the country can be a disadvantage in these respects. Firms in smaller cities may be both harder to find, and in a regime viewed as having weak institutions the location of the firm may also be used as a heuristic for its quality or reliability (Porter and Stern 2001). In short, location in a political or economic capital could be another driver of preferential attachment—albeit less because of the firm's status or reputation and more because of indirect attributions made about the firm. We will

therefore examine how the effect of the reforms differs for firms located in the prominent cities compared to firms located elsewhere.

To carry out this analysis, we first obtained data on the location of the firms in the reforming countries (the ‘participant location’ in SDC Platinum). This information is only available for roughly 50% of the firms in our sample. Subsequently, we identified the political and commercial capitals for each of the countries in our sample. For most countries, the same city serves as both the political and commercial center of the country (e.g. Buenos Aires in Argentina). The exceptions are India, China, and Brazil. Table 11 shows the cities classified as ‘capitals’ in each of the countries in our sample. We define the variable *major city* as being equal to 1 if the firm is located in one of these cities and 0 otherwise.

Model 5 of table 10 shows the baseline (main effect) result for the subsample of firms for which we have location data. The results are not materially altered from those in model 1. In model 6 we introduce the interaction of *major city* with the *post reform* indicator, which has a negative and significant coefficient ($p < 0.01$). This indicates that the alliance-enhancing benefits of the reforms are more pronounced for firms located outside major cities, in line with the narrative supported by our previous results: institutional improvements disproportionately helped initially disadvantaged firms access international partnerships.

3. Quality vs. Quantity of International Alliances

So far, we have shown that IPR reforms allow firms from reforming countries to access more international partners, and that this benefit is particularly pronounced for firms that were in a less advantageous position to access these alliances in the pre-reform regime. But a greater number/quantity of foreign partners may not equate to improved quality in firms’ alliance portfolios. If previously disadvantaged firms simply get more of the ‘bad’ partnerships due to adverse selection, perhaps IPR reforms are not as helpful in leveling the playing field as we have suggested. We thus focus our analysis on assessing if reforms help improve firms’ alliance portfolio quality and, if they do, who obtains such a benefit.

Technological Sophistication of Partner Country: As we outlined previously, a significant part of the benefits from international alliances arise from being able to update their technological capabilities

by learning from their partners (Alcacer and Oxley 2013). This benefit would only be realized if the increase in the rate of alliance formation we observe (especially among the previously disadvantaged firms) also incorporates more partnering with firms with better knowledge resources. We will use two different variables to proxy for technological sophistication, both based on the characteristics of the partners' countries. First, we will use the volume of high technology exports made by the partner country as of the year in which the partnership is formed. As an alternative, we will use the number of articles in science and technology journals published by individuals located in these countries. We obtain data for both these measures from the World Bank's country indicators database.

Models 7 and 8 of table 12 show the results using the average high technology exports (measures in billions of USD) of the firm's partners' countries. Model 7 shows that the reforms bring about an increase in this measure of about \$1.9B USD ($p < 0.001$). In model 8, we see from the interaction term that this increase is lower as the eigenvector pre-reform centrality of the firm increases ($p < 0.001$). Models 9 and 10 show the analogous results using the average number of science and technology journal articles authored by individuals from the firm's partner country (in hundreds). We observe a positive and significant effect of the reforms on average, but one that is most pronounced for firms that were peripheral prior to the reforms ($p < 0.001$ in both cases). In combination, these results support the idea that the reforms served to level the playing field in terms of the quality of international partners that the firms from the reforming country were able to access.

INSERT TABLE 12 HERE

Partner Status: A second measure of quality we employ is based on the status of the foreign partner. One possibility may be that the high-status domestic firms continue to accrue partnerships to the high-status foreign firms after the reforms, while peripheral firms can only ally with the lower status foreign partners. To test whether this is the case, we formulate a DV based on partner status, measured as the average eigenvector centrality of the focal firm's partners as of the focal year. We then test how this measure is affected by the reforms, and whether the change in this measure brought about by the reforms varies depending on the status of the firms from the reforming country. Models 11 and 12 of table 12 show these results. We observe that the average effect of the reforms on partner status is positive and

significant ($p = 0.057$). On average, the reforms are associated with a 27% increase in partner status for firms from the reforming country. Furthermore, the increase in partner status is significantly more pronounced for firms from the reforming country that were of low status pre-reform ($p < 0.001$).

International Diversity of Alliance Partners. As a final indicator of quality, we focus on the international diversity of firms' alliance portfolios. Exposure to partners from distinct national jurisdictions is a source of resource and knowledge diversity. The persistent differences across countries along many dimensions—institutional, cultural, or economic—create pockets of idiosyncratic knowledge, technologies, practices, and other resources. Countries have unique national innovation systems (Nelson 1993), and firms with alliances that span various countries derive greater innovation, profitability, and other types of performance benefits (Balachandran and Hernandez 2018, Vasudeva et al. 2013). To examine this, we generate *partner diversity*, which captures the degree to which a firm's partners are dispersed across countries. The measure is based on a Herfindahl index and is defined as $1 - \sum_i s_i^2$ where s_i is the fraction of the firm's partners that are from country i . High values of this measure indicate that a firm's partners are spread out geographically whereas low values indicate that they are concentrated in fewer countries.

Models 13 and 14 of table 12 show the results of our analyses using *partner diversity* as the dependent variable. The reforms bring about an increase in the diversity of partners for firms from the reforming country ($p < 0.05$). The magnitude is substantial: the partial elasticity, holding other variables at their means, suggests that partner diversity increases by about 44% after the reforms for the treated firms compared to the control group. But most germane to our interest in Matthew effects, Model 14 shows that the increase in diversity of partners is most pronounced for firms that were of lower centrality in the alliance network prior to the reforms ($p < 0.001$).

Type of Alliance. So far we have not distinguished among different types of alliances because any international partnership can involve exchanges of IP and knowledge that are valuable for firms from emerging economies, even if the alliance does not explicitly state a knowledge-related objective (Alcacer and Oxley 2014, Schilling and Phelps 2007). However, it may be that alliances classified as having more explicit knowledge-related components are more desirable or of better quality than other types,

particularly for firms from emerging economies seeking to upgrade their capabilities. As a first step towards getting at this, we estimated the results after dropping alliances whose description in SDC Platinum appears to be the least likely to involve knowledge exchange (e.g. retail and wholesale, financial services, advertising, shipping, etc.). This removed about 30% of the alliances in our sample. The results using only the remaining ‘knowledge’ alliances are summarized in models 15 and 16 of table 13. The IPR reforms continue to exhibit a positive effect on the formation of international knowledge alliances and the benefit is strongest for firms that were peripheral in the pre-reform period.

INSERT TABLE 13 HERE

We probed further into specific alliance types by partitioning the ‘knowledge’ alliances formed by firms into specific types. The most common alliance type in our sample, as classified by SDC, is ‘manufacturing’, which composes 40% of the total sample (knowledge plus non-knowledge). ‘Marketing’ alliances make up 18%, whereas ‘R&D’ alliances make up around 5% of the sample. It could be that some alliance types are more desirable than others. For instance, R&D collaborations may help firms develop new technologies to upgrade capabilities, or marketing alliances may help firms learn how to manage valuable brands. If central firms disproportionately gain one or more of these desirable alliances post IPR reform, the playing field may not be leveled as much as our narrative suggests. To explore this, we re-ran our analysis using separate counts of the three alliance types as dependent variables.

The results are shown in models 17-22 of table 13. In terms of the main effect of *post reform*, we find that the rate at which firms establish manufacturing and marketing alliances increases significantly following reforms. We find no main effect of *post reform* in the case of R&D alliances. Most importantly, however, we observe firms that with lower centrality in the network prior to the reforms establish significantly more of each of the three alliance types post-reform compared to firms with higher centrality pre-reform. This conforms to our prior that any kind of international alliance can be beneficial (for different reasons), and also validates the narrative that IPR reforms allow firms with initial disadvantages to improve both the quantity and quality of their alliance portfolios.

Domestic Alliances

The focus of this paper is on how reforms that strengthen IPR affect the ability of firms from the reforming country to form international partnerships. As we have argued, this is interesting and exceedingly important given the value of international partnerships for firms from emerging economies. However, a related question that can also help us understand more about the way these reforms work is whether and how they affect domestic partnering behavior among firms from the reforming country. While IPR concerns are still likely to play some role, these are likely to be less pronounced than in the case of international alliances given that firms within these countries have developed their knowledge assets within the same environments in which they are forming alliances and that all firms are subject to the same institutional limitations. Also, these firms may have developed alternative means of protecting their IP that are well suited to their home environments. We examine this using an identical setup to our preceding analyses in table 14, except that the dependent variable is now the count of domestic alliances. Model 23 shows the average effect of the reforms on new domestic alliances. We observe a positive coefficient on the post reform variable, though it is only statistically significant at the $p < 0.1$ level. Hence, we have some evidence that the reforms have a positive, though noisy, effect on domestic alliance formation.

INSERT TABLE 14 HERE

To probe this further, we make a distinction that is particularly important to our question: whether the domestic alliance is with a locally owned firm vs, with the local affiliate of a foreign firm (partially or fully owned, though we do not know the ownership level). Of the firms in our sample, 9% belong to this category, i.e. their ‘ultimate parent’ as classified by SDC is from a different country.⁴ We break down the ‘domestic alliances’ count into two parts—alliances with affiliates of foreign firms, and alliances with other local firms. The results using each of these as the DV are shown in models 25 and 27, respectively. While the reforms have a positive and significant effect on the number of domestic alliances with foreign

⁴ This may provoke the question of whether affiliates of foreign firms should be counted as part of *international alliances*, or whether they should be included in our data at all. As mentioned, these firms only compose a relatively small part of our sample. We re-ran all our analyses after trying both (counting ties to affiliates as international alliances, and dropping affiliates from the data) and found all our estimates to be materially unaltered, both in terms of magnitude and statistical significance.

subsidiaries ($p < 0.01$), we observe no effect in relation to domestic alliances with other local firms. This suggests that the effect we observed on domestic alliances in aggregate is driven primarily by affiliates of foreign firms. It is also in line with our earlier expectation that foreign firms are the most sensitive to changes in these formal institutions, whereas local firms are likely to have developed alternative means of assurance that are well suited to their home environments.

We also examine how the main effect of IPR reforms on domestic alliances varies based on the status of the firm. Interestingly, we find no significant interaction effect regardless of whether the dependent variable is aggregate domestic alliances (model 24), alliances with local affiliates of foreign firms (model 26), or alliances with purely local firms (model 28). The lack of a status effects for domestic alliances suggests that status-based assurance mechanisms are not as relevant when indigenous firms ally with each other. This could happen because local firms develop alternative informal means of reducing transaction hazards that are customized to their native environments. In any case, these findings validate our choice to focus on international alliances when studying the impact of IPR on Matthew effects in alliance networks.

Additional Considerations and Robustness Tests

We considered a variety of alternative specifications to address potential sources of bias. We ran additional tests to ensure that our findings are not sensitive to measurement choices. In our primary models, we logged the count of international alliances to improve the linear fit. We ran other models using the non-logged measure and the results were similar (see model 29 and 30 in table 15). Instead of measuring *eigenvector centrality* in the year before the passage of the laws, we used measures from 2 and 3 years before and the results were robust (results available from the authors). We also included country-year fixed effects rather than year fixed effects in the models with triple differences (country-year dummies are collinear with the *post reform* indicator and therefore cannot be used in the other models) and the results were materially unchanged. Given the correlation between *domestic alliances* and *international alliances*, we dropped the former as a control variable from all the models and found our results to be materially unaltered.

We also carried out various tests to ensure that our findings were not driven by a particular subset of the observations in the sample. We replicated all our analyses after separately dropping firms from the two largest countries in our sample, China and India, and the results were not materially altered (see models 31 – 34 in table 15). Indeed, our results were robust to dropping the firms from any individual country. As table 2 shows, pressure from the United States government appears to have played an important role in driving several of the IPR reforms. If U.S. firms were instrumental in bringing about this pressure, in part to further their interests through alliances with firms from the reforming markets, the increased alliance formation could be endogenous to the timing of the legal changes. To rule this out, we recalculated the *international alliances* variable to include ties to firms from every foreign country *except the United States*. The results remained materially unaltered (models 35 and 36 of table 15).

In addition, to rule out the concern that the results are driven by a small set of firms that are very active in alliance formation, we dropped the 10% of firms in each country that form the most alliances over the sample period. We did not find any material differences in the results due to these changes (results available from the authors).

INSERT TABLE 15 HERE

Despite the robustness of the results, our approach has limitations. Regulatory changes do not occur in isolation: they are often accompanied by other events that could make the climate in the country more favorable for foreign firms or increase exposure to global collaboration in general. Despite our efforts to account for a myriad of issues unrelated to IPR (see Table 2 and the year-by-year estimates), the effects we find could still be influenced by unobserved factors. But the fact that we observe no pre-trends and that changes in firms' alliance coincide with the years in which laws are passed alleviates the concern of reverse causality, i.e. the possibility that increased alliance activity could somehow be driving the passage of the laws. The observed effects could still be consistent with firms 'preparing the groundwork' for international ties in anticipation of IPR changes and then signing alliance contracts as soon as the laws are passed. If that were the case, it still underscores the importance of actual reform as the source of the effect because it shows that firms do not establish ties until better formal institutions are in place.

DISCUSSION

Institutional reforms can profoundly alter the competitive positions of firms. Yet there has been limited research on *which* firms benefit most from these reforms: are the opportunities they create seized primarily by the most prominent firms, thus perpetuating Matthew effects; or by previously peripheral firms, thus leveling the playing field? This forms the overarching motivation for this study, which examines how the strengthening of IPR laws affects the distribution of access to international partnerships among the firms in the reforming country. Specifically, we investigate whether the international alliancing benefits of IPR reforms are predominantly captured by central firms or whether they accrue to firms that were peripheral during the pre-reform regime. We find that institutional improvements lead to a democratization in foreign alliance opportunities, by disproportionately enhancing the quantity and the quality of the global alliance portfolios of firms that had limited access to the global network of alliances before the reforms.

Figure 2 depicts an example from our data that illustrates our findings. The figure shows the alliances of two firms from Thailand before and after the 1992 IPR reforms in that country. One of these firms, the C.P. Group, was and still is the most prominent business group in the country, whereas the other, Shin Corporation, was a much younger and less prominent firm at the time. The alliances in the pre-reform period reflect this, with Shin having only two partnerships with other Thai firms, whereas the C.P. Group had several international partnerships. Following the IPR reform, both firms increased their number of international alliances. However, the difference is most marked for Shin, which was able to access many foreign partners and participate in the global alliance networks for the first time. Further, Shin was able to assemble a much more globally diversified portfolio of alliance partners, whereas C.P. Group exhibited a much less drastic change in alliance partner diversity. Note that C.P. was not necessarily harmed by the IPR reform—it was simply that the inequality in the size and quality of its global alliance portfolio relative to Shin diminished.

This suggests that the distributional benefits of IPR reforms do not come from taking away from the advantaged firms but rather from elevating the ones that were previously prevented from participating. Our findings in tables 8 and 9, as well as the fact that the rate of participation in foreign alliances jumped

from 9.4% to 26.6%, is consistent with the conclusion that the benefit to the weak came through enhanced access for all firms rather than from taking away from those with pre-existing advantages. These findings go against the current narrative that globalization-focused reforms that open an economy to international exchange are detrimental to local firms on average, particularly the weaker ones. Of course, we capture benefits in a relatively narrow sense by focusing on alliances, and we lack data to assess the effects of reforms on the financial performance of firms.

INSERT FIGURE 2 HERE

Before the empirical analysis, we developed competing empirical expectations. On the one hand, the concept of preferential attachment would suggest that central firms would benefit the most from IPR reforms. On the other hand, classic institutional theories would suggest that peripheral firms would see enhanced opportunities to participate in the global alliance network thanks to IPR improvements. We did not offer a theoretical resolution *ex-ante*, but with the benefit of a consistent pattern of empirical results we now offer a potential explanation. The core of our answer has to do with the scalability of informal (relational) vs. formal (legal) institutions. Prior literature has tended to ask whether these different types of mechanisms (formal or relational) are effective at the dyadic level (e.g. Poppo and Zenger 2002). In other words, do they facilitate collaboration between a particular pair of partners? The answer of prior work, by and large, is that both mechanisms work at the dyadic level—that is, they can both reduce appropriability concerns.

But we address a different issue: What are the implications of these two different modes of governing interfirm alliances for the preferential attachment mechanism that leads to Matthew effects? Note that this is not a *functional* question (do the governance modes work?), but a *distributional* one (how do they affect the relative distribution of partnering opportunities?). In terms of that question, formal vs. informal governance are not equivalent. While effective to govern individual dyads, informal governance is inherently hard to port across many alliances or partners. For example, the status of a specific local firm with which a foreign firm wishes to partner cannot transfer to another local firm. Similarly, the trust developed over time with a specific partner (another informal governance mechanism) does not apply to a different partner. This lack of portability places a ceiling on the number of international alliance partners

that a firm can access based on relational governance mechanisms. At an aggregate level, this is manifested in an unequal distribution of access to foreign partners because only a few firms can develop distinctive attributes such as status—as the Matthew effect predicts. In contrast, formal institutions (e.g. IPR laws) are by design meant to offer a universally applicable platform to govern collaborations within a jurisdiction. Hence, transitions to significantly stronger IPR laws allow for much wider participation in alliances for firms from the reforming jurisdiction. Now, a foreign firm wishing to partner with a local firm does not need to screen only for a select few that have ‘relational’ attributes such as status. This permits more value-creating partnerships to form, and results in the more equitable distribution we document in this study. We believe this is a relatively novel theoretical explanation, and that it offers an intriguing link between institutions and the widely documented phenomenon of the Matthew effect in interfirm networks.

The other major finding of this study is that IPR changes also allow firms—particularly peripheral ones—to increase the quality of the firms in their alliance portfolios. The results show quality improvements along three dimensions: technological capability, network status, and diversity. Prior research shows each of these to be valuable benefits from participation in alliances. In the first case, studies demonstrate that partnerships with technologically stronger firms are crucial means of upgrading technological capabilities for firms. This is especially the case for firms from emerging markets (Alcacer and Oxley, 2014). In the literature on network structure, being able to partner with other firms of high status is the means by which a focal firm’s status increases. In a circular way, the status of a firm’s partners reflects upon the focal actor, enhancing its status and thus leading to several documented benefits (e.g. revenues, funding, etc.) (Podolny, 2001; Stuart et al. 1999). Finally, alliance partner diversity is one of the most commonly referenced motives for cross-national collaboration, particularly those involving R&D or other knowledge activities (Lavie and Miller 2008, Penner-Hahn and Shaver 2005). Diversity of national backgrounds is valuable because it is an ingredient in the process of recombination of ideas central to innovation (Fleming, 2001; Balachandran and Hernandez, 2018). Our contribution is to show that institutions are precursors to these known benefits from participating in cross-border alliances.

Our study is not without limitations. Because we do not have much data on the firms in the sample, we are unable to examine outcomes such as financial performance, or other indicators of advantage or prominence used in prior literature such as affiliation to a business group or political connections (Khanna and Palepu 2000, Siegel 2007). Another mechanism we are unable to observe, due to lack of data, is whether the increase in alliances we observe is driven by foreign firms switching governance modes due IPR improvements, for instance from wholly owned subsidiaries to alliances (e.g. Oxley 1999). Also, it may be the case that limits to the number of alliances that high-status firms can handle naturally drive some of the foreign partners towards allying with low-status firms. This mechanism is still consistent with our reasoning, because partnerships with low-status firms are only observed after IPR improvements. However, we are unable to distinguish this precisely in our data.

We are limited in our ability to delve into the variance in IPR reforms across countries. This variance exists along two dimensions. One is the strength or quality of reform. Exploring it would allow scholars to assess if there are thresholds of reform strength necessary for the effects we observe to manifest. A second dimension of variance comes from the different motivations countries have to reform IPR. While Table 2 summarizes some of those, in our sample we lacked sufficient variance across only 13 countries to explore this. It could be that some motivations are more credible than others, or that different motivations lead to distinct outcomes for alliance formation. Finally, though we are seeking to broadly highlight the importance of institutional changes on firms' strategic decisions and outcomes, as well as the paucity of research on these topics, the scope of our study covers only a particular type of institutional change: the strengthening of IPR protections. We hope future research will be able to examine whether similar mechanisms operate with respect to other kinds of institutional reforms.

This study identifies important consequences of institutional improvements in IPR, namely that they facilitate improved access to and quality of international alliances for firms from the reforming country—particularly for those that were previously disadvantaged in accessing foreign partners. Given the increasing importance of collaborative arrangements between firms in the global economy, and the growing chorus of concerns about the distributional effects of globalization, these findings are noteworthy for those with an interest in global strategy, institutions, and international exchange.

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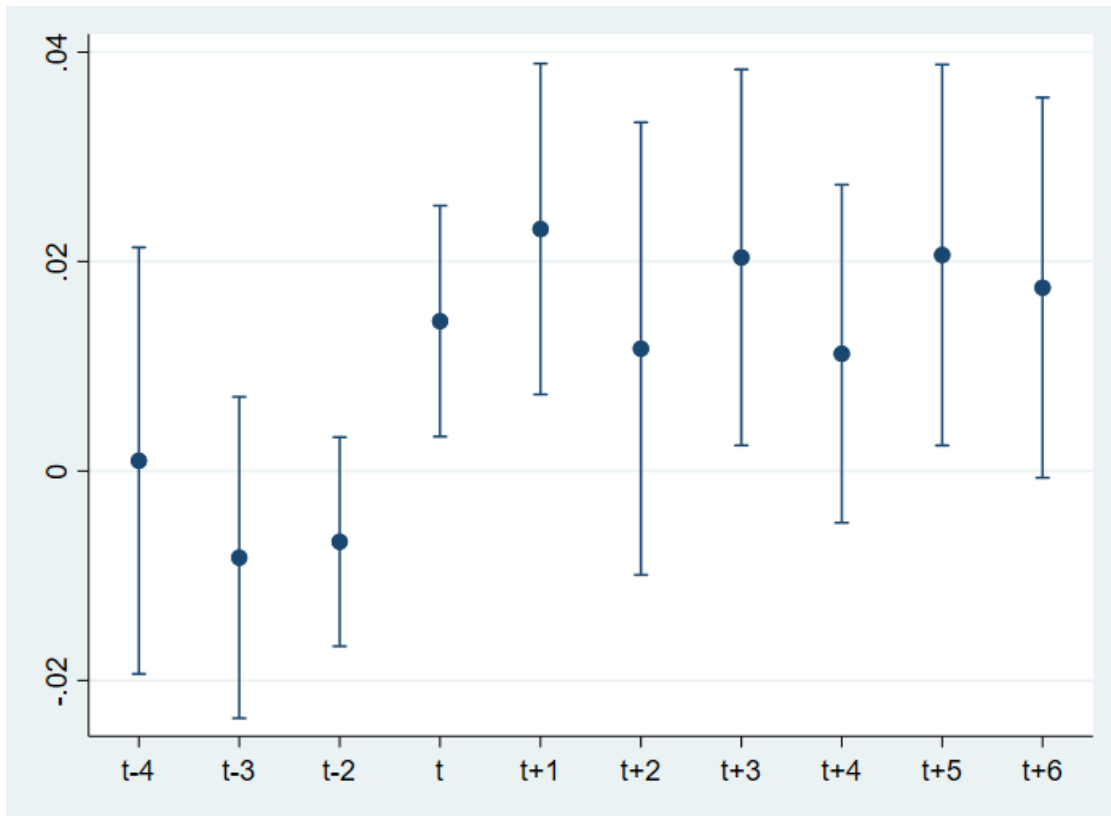
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FIGURES AND TABLES

Figure 1: Effects of IPR reforms on the number of international alliances (Model 2)



Graph shows the point estimates and 95% confidence intervals for the coefficients associated with the corresponding variable in model 2 of table 5. Variables indicate the specific year in relation to the year of reform. 't-1' is the omitted year. DV is log of 1 + the number of international alliances formed by the firm in a given year

Figure 2: Example of Effect of IPR Reforms on International Alliance Formation

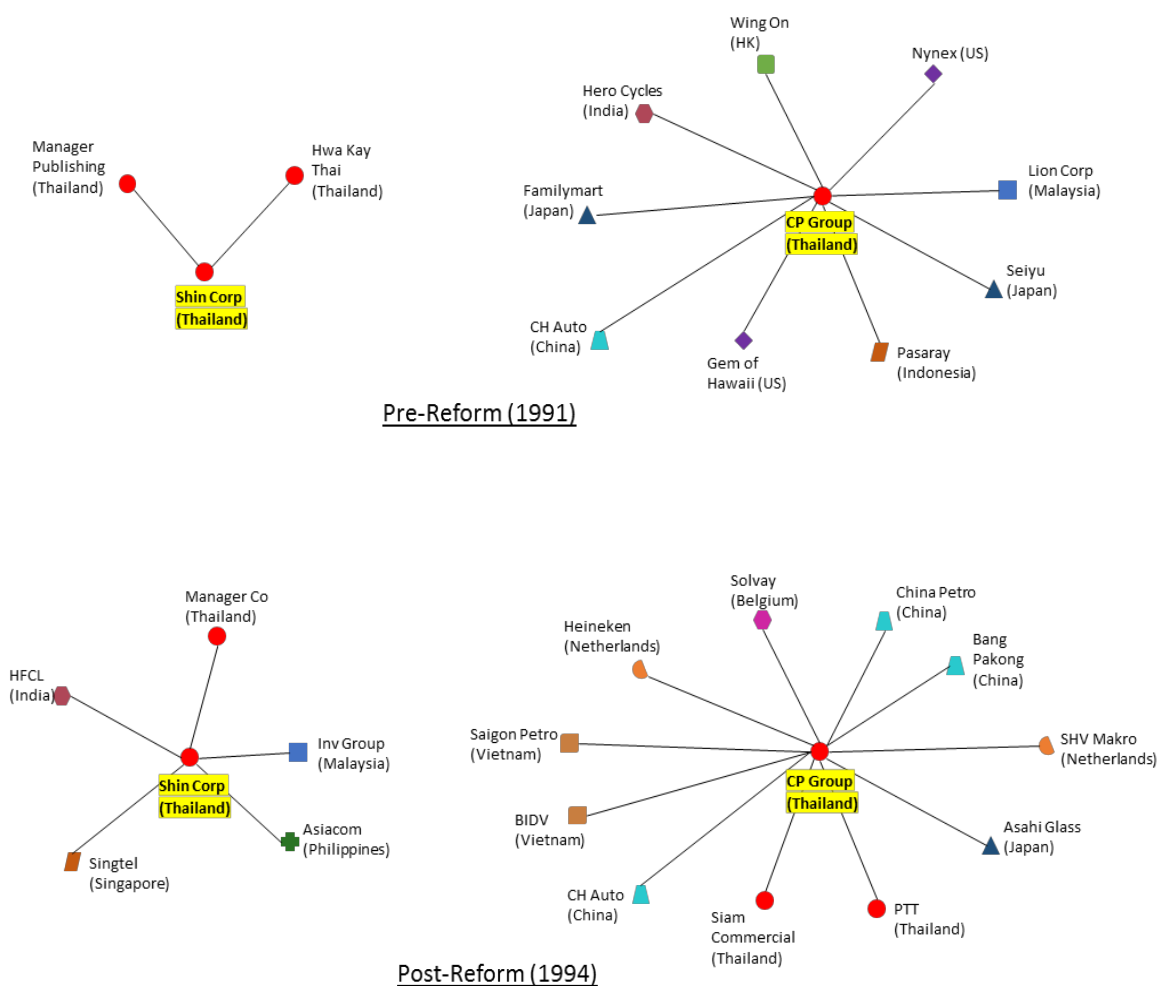


Table 1: Countries in sample and year of reform

Country	Year of reform
Argentina	1996
Brazil	1997
Chile	1991
China	1993
Colombia	1994
India	1999
Indonesia	1991
Mexico	1991
Philippines	1997
Portugal	1992
Thailand	1992
Turkey	1995
Venezuela	1994

Table 2: Process Leading to IPR Reforms in Different Countries

Path to Reform	Issue Description	Empirical Implications
Pressure from the U.S.	<p>The U.S. Trade Representative (USTR) placed some countries on its “priority watch list” and threatened to impose trade sanctions if they did not reform IP laws (e.g. China, Indonesia, Mexico). The U.S. also made IP reform a precondition for negotiating bilateral trade agreements (Chile and Mexico in late 1980’s). Typically, countries gave the U.S. a credible signal that they would modify their laws and were dropped from the watch list. Actual reforms became effective 1-3 years after the initial intent to reform.</p> <p>Sources: Platikanova-Gross 2006, Yu 2001, Kusumadara 2000, Goldstein & Strauss 2009, Hufbauer & Schott 1992, Baca 1994, Shadlen 2009</p>	<p>1) If U.S. pressure instead of actual IPR reform drives the effects, we should observe a pre-reform trend by which network changes occur in the window between U.S. pressure and actual IPR reform.</p> <p>2) Changes in global network participation could be driven only by alliances with U.S. firms, not from ties to firms from other foreign countries.</p> <p>SOLUTION: 1) We observe year-by-year trends leading up to the actual IPR reform and find no pre-trends. 2) We drop U.S. firms as potential international partners and the results remain consistent.</p>
Compliance with TRIPS to enter the WTO	<p>When it became clear that compliance with the Trade-Related Aspects of Intellectual Property Rights (TRIPS) would be required to join the WTO in the early 1990’s, some countries demonstrated willingness to reform IPR relatively quickly but the legal changes weren’t always immediate. Turkey signed the WTO agreement in 1994 and reformed IP in 1995. The Philippines was open to IP reform but the circuitous legislative process delayed the law until 1997.</p> <p>Sources: Goldstein & Strauss 2009; Ozkan 2010</p>	<p>If the intent to comply with TRIPS instead of actual IPR reform drives the effects, we should observe a pre-reform trend by which network changes occur in the window between expressed intent and the passage of the law.</p> <p>SOLUTION: We observe year-by-year trends leading up to the actual IPR reform and find no pre-trends.</p>
Broad neo-liberalization during the 1980’s and 1990’s	<p>The 1980’s and 1990’s were a period of significant economic liberalization across the world. Many developing countries adopted several of the reforms suggested by the Washington Consensus. Reforms focused on fiscal policy, tax reform, trade liberalization, and deregulation. While property rights were considered part of the reform package, IPR tended to be part of a later, “second wave” of liberalization that came 5-10 years after the first set of neoliberal reforms.</p> <p>Sources: Fukuyama 1992, Williamson 2000, Helfer et al. 2009</p>	<p>Broad neo-liberalization could be confounding the effects of IP-specific reforms in our study. The effects we observe could be driven by a more general opening of these countries to foreign exchange, which is unrelated to IP or knowledge mechanisms.</p> <p>SOLUTION: We control for trade neo-liberalization (Wacziarg & Welch 2003) and openness to capital flows (Quinn & Toyoda 2008) as well as a host of country-level indicators such as FDI inflows, exports, infrastructure changes, etc.</p>
Compliance with regional treaties	<p>Some countries reformed in unison as part of a regional agreement. For example, Colombia and Venezuela reformed IPR as part of the Andean Community while Portugal reformed</p>	<p>If the expectation of reform instead of actual IPR reform drives the effects, we should observe a pre-reform trend by which network changes occur in the window between</p>

	<p>to comply with the expectations of the European Single Market. In both cases the regional agreement to reform preceded actual reform by at least 2-3 years.</p> <p>Sources: Maskus 2000; Helfer et al. 2009; Branstetter et al. 2006</p>	<p>pressure or change in regime and the passage of the law.</p> <p>SOLUTION: We observe year-by-year trends leading up to the actual IPR reform and find no pre-trends.</p>
Internal government changes	<p>While external pressure from the WTO or the U.S. “watch list” was common among many countries, not all responded as quickly or willingly. Some countries resisted international demands for a few years until a new government with favorable views on IPR reform was elected. For example, India was unwilling to reform IP until a new party was elected in 1998 (reform was in 1999). Argentina and Brazil had similarly contentious internal processes.</p> <p>Sources: Correa 2000, Branstetter et al. 2006, Ryan 2010, Ramanna 2012</p>	<p>1) If external pressure or the change in the government’s willingness to reform instead of actual IPR reform drives the effects, we should observe a pre-reform trend by which network changes occur in the window between pressure or change in regime and the passage of the law.</p> <p>2) Internal processes idiosyncratic to certain countries could drive the results</p> <p>SOLUTION: 1) We observe year-by-year trends leading up to the actual IPR reform and find no pre-trends. 2) We drop each of these countries from the analysis and find the results to be consistent.</p>
Regional spillovers	<p>Given the rise of regional treaties and broader liberalization during the period of study, there could be regional contagion in the timing of IPR reforms.</p> <p>Source: Peck & Tickell 2002</p>	<p>If geographic spillovers affect the timing of reform, the timing of neighboring countries’ reforms may create anticipated changes in the network.</p> <p>SOLUTION: We control for the year in which neighboring countries in the region adopted IPR reform. We also observe year-by-year trends leading up to the actual IPR reform and find no pre-trends.</p>

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Table 3: Control Variables

Control Variable	Measure	Source	Reason for inclusion
<i>liberalization</i>	Dummy variable to indicate the year in which major economic liberalization occurred in each country	Wacziarg and Welch (2008)	Countries that pass IPR reforms may simultaneously be undergoing other changes that could influence alliance activity (see Table 2 and Henisz et al. 2005). Broader economic liberalization could lead to greater interaction with the outside world, which may manifest itself in terms of more cross-border alliances for reasons unrelated to IPR reform.
<i>capital flows openness</i>	0-100 scale, with 100 representing an economy that is fully open	Quinn and Toyoda (2008)	The opening up of the economy to foreign capital may be correlated with IPR reforms, as these could be part of a suite of wider changes. Increased ease of capital flows may also make foreign firms more interested in partnering with firms from the reforming country.
<i>reformed neighbors</i>	Running count of the other countries in the same continent that already passed patent reforms	Branstetter et al. (2006)	IPR reform in a proximate country may lead the focal country to pass reforms, and potentially also create opportunities for firms from the focal country to access foreign partners but not due to the IPR reform per se.
<i>domestic alliances</i>	Logged count of number of alliances formed with firms from the same country	SDC Platinum	While our interest is on the formation of international alliances, the investment made in domestic alliances can enable or constrain firms in establishing foreign ties and it could be correlated with changes in IPR laws.
<i>political constraints (polcon)</i>	Number of veto players present in the country's governing structure	Henisz (2000)	Level of political constraints could influence the timing and nature of the laws passed as well as the degree to which firms are able to influence the government to accelerate or delay laws according to business interests—including pressures for politicians to facilitate international alliances.

Table 3: Control Variables (continued)

Control Variable	Measure	Source	Reason for inclusion
<i>FDI inflows</i>	Dollar value (in billions) of total foreign direct investment into the country	World Bank	Indicative of the level of interest in the country from foreign investors. Could be correlated with a desire for, or a propensity to, pass institutional reforms as well as the likelihood in international alliances.
<i>hi-tech exports</i>	Dollar value (in billions) of the country's exports in products with high R&D intensity	World Bank	Captures the ability of the country's firms to produce products that are competitive with respect to the outside world. Could be a spur to pass reforms that promote trade. Could also be related to the attractiveness of firms from the focal country as alliance partners.
<i>flight takeoffs</i>	Number of commercial flight takeoffs from the country's airports	World Bank	Proxy for connectedness of focal country, both internally and with international markets. Could be indicative of degree of access to the outside world, which could be related to cross border alliance formation and propensity of country to pass reforms.
<i>cellphone connections</i>	Number of cellphone connections per 100 people in the country	World Bank	Similar reasoning to above
<i>internet connectivity</i>	Number of Internet users per 100 people in the country	World Bank	Similar reasoning to above
<i>GNI per capita</i>	Gross National Income divided by the total population	World Bank	Improved economic growth could be correlated to economic reforms, but also a spur for foreign firms' interest in partnerships with local firms.
<i>urban population fraction</i>	Fraction of the country's population in urban areas	World Bank	Ease of access to labor, which may influence the interest of foreign firms in forming alliances with local firms and transferring IP-intensive operations to the local market.

Table 4: Summary Statistics and Correlations

SI Variable	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
1 New International Alliances _b	0.05	0.20	0	3.40	1																	
2 Av Ptn Cty High Tech Exports	0.39	2.01	0	19.75	0.68	1																
3 Av Ptn Status	0.01	0.10	0	4.68	0.16	0.17	1															
4 Partner International Diversity	0.03	0.12	0	0.93	0.44	0.22	0.14	1														
5 Eigenvector	0.01	0.08	0	3.83	0.08	0.05	0.49	0.24	1													
6 New domestic alliances _b	0.02	0.14	0	2.56	0.33	0.19	0.04	0.32	0.04	1												
7 Liberalization dummy	0.35	0.48	0	1	0.02	0.01	-0.01	0.02	0.00	0.02	1											
8 Cap Flows openness	50.21	14.26	25	100	0.03	0.03	0.00	0.03	0.01	0.04	0.58	1										
9 Reformed Neighbors	5.13	1.97	0	7	-0.01	0.01	0.01	0.03	0.03	0.02	-0.42	-0.16	1									
10 PolCon	0.32	0.34	0	0.89	0.01	0.01	-0.01	0.01	-0.01	0.02	0.47	0.32	-0.17	1								
11 FDI Inflows	0.19	0.19	-0.05	0.62	0.00	0.03	0.02	0.01	0.03	0.00	-0.49	-0.23	0.39	-0.67	1							
12 Hi-Tech Exports	0.35	0.64	0	2.73	-0.04	0.01	0.00	-0.03	0.01	-0.01	-0.31	-0.03	0.41	-0.43	0.75	1						
13 Cellphone Connections	6.19	10.89	0	100.89	-0.06	-0.02	-0.02	-0.06	0.00	-0.03	0.23	0.28	0.07	0.02	0.23	0.45	1					
14 GNI per capita	1.53	1.87	0.33	16.12	0.00	0.01	-0.02	-0.02	-0.01	0.00	0.60	0.57	-0.56	0.37	-0.15	-0.08	0.48	1				
15 Internet connectivity	2.37	4.30	0	34.50	-0.05	-0.02	-0.02	-0.05	0.00	-0.03	0.33	0.35	-0.01	0.16	0.06	0.26	0.88	0.49	1			
16 Flight takeoffs	3.50	2.88	0.37	12.10	-0.03	0.02	0.01	-0.02	0.02	-0.01	-0.42	-0.15	0.38	-0.52	0.89	0.89	0.34	-0.11	0.15	1		
17 Urban Pop. Fraction	40.66	17.86	25.55	89.90	-0.01	0.01	-0.01	-0.03	-0.01	-0.02	0.62	0.46	-0.57	0.33	-0.12	-0.06	0.33	0.73	0.45	-0.01	1	

b – Logged Variable, Based on 11,072 firms

Table 5: Average Number of New International Alliances Formed by Firms in the 3 Year Window Pre and Post Reform (by Country)

Country	Pre-Reform	Post-Reform
Argentina	0.30	0.49
Brazil	0.26	0.49
Chile	0.01	0.30
China	0.09	0.64
Colombia	0.18	0.72
India	0.21	0.32
Indonesia	0.09	0.54
Mexico	0.02	0.50
Philippines	0.61	0.35
Portugal	0.12	0.43
Thailand	0.08	0.81
Turkey	0.47	0.49
Venezuela	0.63	0.95

Table 6: Baseline Effect of IPR Reforms on International Alliance Formation

DV: New International Alliances		Variable	Model 2
Variable	Model 1	Reform (t-5) or further	-0.026* (0.011)
Post Reform	0.019** (0.004)	Reform (t-4)	0.001 (0.009)
New domestic alliances	0.424*** (0.029)	Reform (t-3)	-0.008 (0.007)
Liberalization dummy	-0.000 (0.006)	Reform (t-2)	-0.007 (0.005)
Cap Flows openness	0.000 (0.000)	Reform (t)	0.014* (0.005)
Reformed Neighbors	0.004+ (0.002)	Reform (t+1)	0.023** (0.007)
PolCon	0.017 (0.014)	Reform (t+2)	0.012 (0.010)
FDI Inflows	0.014 (0.029)	Reform (t+3)	0.020* (0.008)
Hi-Tech Exports	0.001 (0.008)	Reform (t+4)	0.011 (0.007)
Cellphone Connections	0.000 (0.000)	Reform (t+5)	0.021* (0.008)
GNI per capita	0.001 (0.002)	Reform (t+6)	0.018+ (0.008)
Internet connectivity	0.001 (0.001)	Reform (t+7) or further	0.018 (0.012)
Flight takeoffs	0.004 (0.003)	Controls	Y
Urban Pop. Fraction	-0.003* (0.001)	Firm Fixed Effects	Y
Constant	0.097* (0.038)	Year Fixed Effects	Y
Firm Fixed Effects	Y	Number of Firms	11,072
Year Fixed Effects	Y	R2 (Within)	0.121
Number of Firms	11,072		
R2 (Within)	0.121		

*** p<0.001 ** p<0.01 * p<0.05 + p<0.1; Standard errors reported in parentheses are heteroscedasticity robust and clustered by country

Table 7: Patent Intensive Industries

Variable	Model 3
Post Reform	0.018** (0.004)
Post Reform x Patent Intensive	0.006* (0.003)
New domestic ties	0.424*** (0.029)
Liberalization dummy	-0.000 (0.006)
Cap Flows openness	0.000 (0.000)
Reformed Neighbors	0.004+ (0.002)
PolCon	0.017 (0.014)
FDI Inflows	0.013 (0.030)
Hi-Tech Exports	0.001 (0.008)
Cellphone Connections	0.000 (0.000)
GNI per capita	0.001 (0.002)
Internet connectivity	0.001 (0.001)
Flight takeoffs	0.004 (0.003)
Urban Pop. Fraction	-0.003* (0.001)
Constant	0.098* (0.038)
Firm Fixed Effects	Y
Year Fixed Effects	Y
Number of Firms	11,072
R2 (Within)	0.121

*** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$ + $p < 0.1$;
Standard errors reported in parentheses are
heteroscedasticity robust and clustered by
country.

Table 8: Average Number of New International Alliances for Firms that Form at least One International Alliance in the 3 Year Window pre and post Reform

Country	Pre-Reform	Post-Reform
Argentina	1.50	4.17
Brazil	2.32	3.58
China	2.13	4.02
Colombia	3.50	4.00
India	1.98	2.58
Indonesia	1.67	4.33
Mexico	1.00	2.00
Philippines	3.06	2.55
Portugal	1.25	2.25
Thailand	2.91	6.91
Turkey	2.41	2.65
Venezuela	6.29	3.43

Table 9: Number of Firms Forming International Alliances in the 3 Year Window pre and post Reform

Country	Pre-Reform	Post-Reform
Argentina	47	64
Brazil	96	178
China	281	1997
Colombia	6	31
India	271	397
Indonesia	34	195
Mexico	10	162
Philippines	169	115
Portugal	14	35
Thailand	38	329
Turkey	58	62
Venezuela	20	44

Table 10: Distribution of Benefits from IPR Reforms

DV: New International Alliances

Variable	Model 4	Model 5	Model 6
Post Reform	0.023*** (0.004)	0.029*** (0.006)	0.035*** (0.006)
Eigenvector x Post Reform	-0.288*** (0.044)		
Major City x Post Reform			-0.008** (0.002)
New domestic ties	0.423*** (0.030)	0.430*** (0.031)	0.430*** (0.031)
Liberalization dummy	0.002 (0.006)	-0.001 (0.011)	-0.001 (0.010)
Cap Flows openness	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Reformed Neighbors	0.004+ (0.002)	0.005 (0.004)	0.005 (0.004)
PolCon	0.019 (0.015)	0.031 (0.019)	0.031 (0.018)
FDI Inflows	0.012 (0.029)	-0.009 (0.037)	-0.013 (0.037)
Hi-Tech Exports	0.001 (0.009)	0.007 (0.012)	0.008 (0.011)
Cellphone Connections	0.000 (0.000)	0.000 (0.001)	0.000 (0.000)
GNI per capita	0.001 (0.002)	0.001 (0.004)	0.001 (0.004)
Internet connectivity	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Flight takeoffs	0.004 (0.003)	0.006 (0.004)	0.006 (0.004)
Urban Pop. Fraction	-0.003* (0.001)	-0.005* (0.002)	-0.005* (0.002)
Constant	0.105* (0.039)	0.137+ (0.064)	0.140* (0.064)
Firm Fixed Effects	Y	Y	Y
Year Fixed Effects	Y	Y	Y
Number of Firms	11,072	4508	4508
R2 (Within)	0.123	0.125	0.125

Table 11: Major Cities

Country	Major Cities
Argentina	Buenos Aires
Brazil	Brasilia, Sao Paulo
Chile	Santiago
China	Beijing, Shanghai
Colombia	Bogota
India	New Delhi, Mumbai
Indonesia	Jakarta
Mexico	Mexico City
Philippines	Manila
Portugal	Lisbon
Thailand	Bangkok
Turkey	Istanbul
Venezuela	Caracas

*** p<0.001 ** p<0.01 * p<0.05 + p<0.1; Standard errors reported in parentheses are heteroscedasticity robust and clustered by country. *Eigenvector* is measured in the year prior to the reforms. *Major City* is a binary variable that is equal to 1 if the firm is located in its county's political or commercial capital.

Table 12: Effect of IPR Reforms on Quality of International Alliances

Dependent Variable - Variable	Avg. Partner Country High Tech Exports		Avg. Partner Country Sci Tech Journal Articles		Avg. Partner Status		Partner Diversity	
	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12	Model 13	Model 14
Post Reform	0.191*** (0.032)	0.220*** (0.034)	0.248*** (0.053)	0.290*** (0.052)	0.003+ (0.001)	0.009*** (0.002)	0.011* (0.004)	0.012** (0.004)
Eigenvector x Post Reform		-2.122*** (0.216)		-3.054*** (0.338)		-0.452** (0.128)		-0.143*** (0.016)
New domestic ties	2.567** (0.688)	2.559** (0.690)	1.739*** (0.333)	1.729*** (0.334)	0.021** (0.005)	0.019** (0.005)	0.203*** (0.017)	0.202*** (0.017)
Liberalization dummy	0.012 (0.045)	0.027 (0.049)	-0.051 (0.069)	-0.030 (0.077)	-0.004* (0.001)	-0.000 (0.003)	0.004 (0.005)	0.005 (0.005)
Cap Flows openness	0.000 (0.001)	0.000 (0.001)	0.000 (0.001)	0.001 (0.001)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Reformed Neighbors	0.011 (0.023)	0.013 (0.024)	0.060*** (0.010)	0.062*** (0.012)	-0.003* (0.001)	-0.002* (0.001)	-0.004+ (0.002)	-0.004+ (0.002)
PolCon	0.103 (0.104)	0.115 (0.106)	0.126 (0.122)	0.144 (0.124)	0.007+ (0.004)	0.010+ (0.005)	0.018 (0.015)	0.018 (0.015)
FDI Inflows	-0.458 (0.351)	-0.478 (0.352)	-0.621 (0.557)	-0.650 (0.558)	0.021+ (0.011)	0.016 (0.010)	-0.009 (0.032)	-0.011 (0.032)
Hi-Tech Exports	0.007 (0.056)	0.006 (0.059)	-0.066 (0.093)	-0.068 (0.096)	0.004* (0.002)	0.004 (0.002)	0.003 (0.006)	0.003 (0.006)
Cellphone Connections	-0.000 (0.003)	-0.000 (0.003)	0.001 (0.003)	0.001 (0.003)	0.000+ (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
GNI per capita	0.012 (0.022)	0.012 (0.022)	0.005 (0.023)	0.004 (0.024)	-0.003*** (0.000)	-0.003*** (0.000)	-0.002 (0.002)	-0.002 (0.002)
Internet connectivity	0.003 (0.005)	0.002 (0.005)	-0.004 (0.006)	-0.005 (0.006)	0.000 (0.000)	-0.000 (0.000)	0.001 (0.001)	0.001 (0.001)
Flight takeoffs	0.075* (0.029)	0.076* (0.029)	0.083 (0.048)	0.084 (0.048)	-0.000 (0.001)	-0.000 (0.001)	0.003 (0.002)	0.003 (0.002)
Urban Pop. Fraction	-0.021+ (0.011)	-0.023+ (0.011)	-0.013 (0.010)	-0.016 (0.010)	-0.001+ (0.001)	-0.001* (0.001)	-0.002 (0.001)	-0.002+ (0.001)
Constant	0.644 (0.368)	0.697+ (0.374)	0.274 (0.338)	0.351 (0.339)	0.047* (0.018)	0.058* (0.020)	0.060+ (0.032)	0.064+ (0.032)
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of Firms	11,072	11,072	11,072	11,072	11,072	11,072	11,072	11,072
R2 (Within)	0.045	0.046	0.020	0.022	0.007	0.033	0.110	0.112

*** p<0.001 ** p<0.01 * p<0.05 + p<0.1; Standard errors reported in parentheses are heteroscedasticity robust and clustered by country. The DV in Models 11 and 12 is the average eigenvector centrality of the focal firm's partners. The coefficient on the Post Reform variable in model 11 has a p value of 0.057.

Table 13: Effect of IPR Reforms on Different Types of Alliances

Dependent Variable - Variable	Knowledge alliances		Manufacturing Alliances		Marketing Alliances		R&D Alliances	
	Model 15	Model 16	Model 17	Model 18	Model 19	Model 20	Model 21	Model 22
Post Reform	0.018*** (0.002)	0.021*** (0.002)	0.008** (0.003)	0.010** (0.003)	0.006*** (0.001)	0.007*** (0.001)	-0.000 (0.001)	0.000 (0.001)
Eigenvector x Post Reform		-0.233*** (0.029)		-0.114*** (0.015)		-0.099*** (0.023)		-0.045** (0.011)
New domestic ties	0.310*** (0.032)	0.309*** (0.032)	0.555*** (0.026)	0.554*** (0.026)	0.504*** (0.085)	0.503*** (0.085)	0.480*** (0.028)	0.480*** (0.029)
Liberalization dummy	0.001 (0.005)	0.002 (0.005)	-0.003 (0.002)	-0.002 (0.002)	-0.004* (0.001)	-0.003+ (0.002)	-0.002 (0.001)	-0.002 (0.001)
Cap Flows openness	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)
Reformed Neighbors	0.002 (0.001)	0.002 (0.001)	0.001 (0.001)	0.001 (0.001)	0.001* (0.000)	0.001** (0.000)	0.000 (0.000)	0.000 (0.000)
PolCon	0.016 (0.010)	0.017 (0.011)	0.001 (0.008)	0.002 (0.008)	0.007* (0.003)	0.008* (0.003)	-0.002+ (0.001)	-0.002+ (0.001)
FDI Inflows	0.010 (0.020)	0.008 (0.021)	0.041** (0.011)	0.040** (0.011)	-0.003 (0.007)	-0.004 (0.007)	0.002 (0.002)	0.001 (0.002)
Hi-Tech Exports	0.001 (0.006)	0.000 (0.007)	0.003 (0.004)	0.003 (0.004)	0.001 (0.002)	0.001 (0.003)	-0.001 (0.001)	-0.001 (0.001)
Cellphone Connections	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
GNI per capita	0.001 (0.002)	0.000 (0.002)	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)	0.000 (0.000)
Internet connectivity	0.000 (0.000)	0.000 (0.000)	0.001* (0.000)	0.001* (0.000)	0.000* (0.000)	0.000* (0.000)	0.000 (0.000)	0.000 (0.000)
Flight takeoffs	0.002 (0.002)	0.002 (0.002)	-0.001 (0.001)	-0.001 (0.001)	0.000 (0.001)	0.000 (0.001)	0.000 (0.000)	0.000 (0.000)
Urban Pop. Fraction	-0.002+ (0.001)	-0.002+ (0.001)	-0.002* (0.001)	-0.002* (0.001)	-0.000+ (0.000)	-0.001* (0.000)	0.000 (0.000)	-0.000 (0.000)
Constant	0.055 (0.034)	0.061+ (0.034)	0.058* (0.021)	0.061* (0.021)	0.013 (0.007)	0.015+ (0.007)	-0.001 (0.003)	0.000 (0.002)
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of Firms	11,072	11,072	11,072	11,072	11,072	11,072	11,072	11,072
R2 (Within)	0.086	0.088	0.141	0.142	0.109	0.110	0.117	0.119

*** p<0.001 ** p<0.01 * p<0.05 + p<0.1; Standard errors reported in parentheses are heteroscedasticity robust and clustered by country

Table 14: Effect of IPR Reforms on Domestic Alliances

Dependent Variable - Variable	New Domestic Alliances		New Domestic Alliances with local affiliates of Foreign Firms		New Domestic Alliances with local firms	
	Model 23	Model 24	Model 25	Model 26	Model 27	Model 28
Post Reform	0.014+ (0.007)	0.014+ (0.007)	0.002** (0.001)	0.002** (0.001)	0.012 (0.007)	0.012 (0.007)
Eigenvector x Post Reform		0.009 (0.014)		-0.003 (0.004)		0.010 (0.013)
New international ties	0.226*** (0.022)	0.226*** (0.023)	0.015*** (0.001)	0.014*** (0.001)	0.215*** (0.022)	0.215*** (0.022)
Liberalization dummy	0.003 (0.006)	0.003 (0.006)	0.001 (0.001)	0.001 (0.001)	0.003 (0.006)	0.003 (0.006)
Cap Flows openness	0.000** (0.000)	0.000** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000** (0.000)
Reformed Neighbors	-0.002 (0.002)	-0.002 (0.002)	0.000 (0.000)	0.000 (0.000)	-0.002 (0.002)	-0.002 (0.002)
PolCon	0.027 (0.017)	0.027 (0.017)	0.005*** (0.001)	0.005*** (0.001)	0.023 (0.017)	0.023 (0.016)
FDI Inflows	-0.004 (0.030)	-0.004 (0.030)	0.008+ (0.004)	0.008+ (0.004)	-0.009 (0.031)	-0.009 (0.031)
Hi-Tech Exports	0.001 (0.003)	0.001 (0.003)	-0.000 (0.000)	-0.000 (0.000)	0.002 (0.003)	0.002 (0.003)
Cellphone Connections	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)
GNI per capita	0.001 (0.003)	0.001 (0.003)	0.000 (0.000)	0.000 (0.000)	0.001 (0.003)	0.001 (0.003)
Internet connectivity	0.000 (0.000)	0.000 (0.000)	-0.000 (0.000)	-0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Flight takeoffs	0.001 (0.001)	0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)	0.001 (0.001)	0.001 (0.001)
Urban Pop. Fraction	-0.001 (0.001)	-0.001 (0.001)	-0.000 (0.000)	-0.000 (0.000)	-0.000 (0.001)	-0.000 (0.001)
Constant	0.001 (0.030)	0.000 (0.030)	0.004 (0.006)	0.004 (0.006)	-0.004 (0.029)	-0.004 (0.029)
Firm Fixed Effects	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y
Number of Firms	10,033	10,033	10,033	10,033	10,033	10,033
R2 (Within)	0.113	0.113	0.006	0.006	0.114	0.114

*** p<0.001 ** p<0.01 * p<0.05 + p<0.1; Standard errors reported in parentheses are heteroscedasticity robust and clustered by country

Table 15: Robustness

DV: New International Alliances	Unlogged DV		No China		No India		No Alliances with US firms	
	Model 29	Model 30	Model 31	Model 32	Model 33	Model 34	Model 35	Model 36
Post Reform	0.031** (0.008)	0.039*** (0.008)	0.013* (0.006)	0.017** (0.005)	0.017* (0.007)	0.021* (0.007)	0.010* (0.004)	0.012* (0.004)
Eigenvector x Post Reform		-0.601*** (0.128)		-0.282*** (0.041)		-0.354** (0.087)		-0.165*** (0.035)
New domestic alliances	0.803*** (0.061)	0.801*** (0.062)	0.383*** (0.029)	0.382*** (0.030)	0.440*** (0.023)	0.439*** (0.023)	0.336*** (0.032)	0.336*** (0.032)
Liberalization dummy	-0.001 (0.011)	0.003 (0.011)	-0.005 (0.006)	-0.003 (0.005)	0.001 (0.005)	0.004 (0.005)	-0.001 (0.005)	-0.000 (0.005)
Cap Flows openness	0.000 (0.000)	0.000 (0.000)	0.000** (0.000)	0.000** (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
Reformed Neighbors	0.005 (0.004)	0.005 (0.004)	-0.000 (0.003)	-0.000 (0.003)	0.005* (0.002)	0.005* (0.002)	0.001 (0.002)	0.001 (0.002)
PolCon	0.030 (0.027)	0.034 (0.028)	0.015 (0.012)	0.016 (0.012)	0.013 (0.013)	0.014 (0.013)	0.012 (0.014)	0.013 (0.014)
FDI Inflows	0.016 (0.057)	0.010 (0.057)	0.079 (0.074)	0.085 (0.074)	0.025 (0.031)	0.024 (0.031)	0.040 (0.025)	0.039 (0.025)
Hi-Tech Exports	0.003 (0.016)	0.003 (0.017)	-0.047 (0.042)	-0.053 (0.042)	0.006 (0.007)	0.006 (0.007)	0.002 (0.007)	0.002 (0.007)
Cellphone Connections	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000+ (0.000)	-0.000 (0.000)	-0.000 (0.000)
GNI per capita	0.003 (0.004)	0.003 (0.004)	-0.002 (0.002)	-0.003 (0.002)	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	0.001 (0.002)
Internet connectivity	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)	0.001+ (0.000)	0.001+ (0.000)	0.001+ (0.001)	0.001+ (0.001)
Flight takeoffs	0.007 (0.005)	0.007 (0.006)	0.009 (0.008)	0.009 (0.008)	0.002 (0.003)	0.002 (0.003)	0.002 (0.002)	0.002 (0.002)
Urban Pop. Fraction	-0.005* (0.002)	-0.006* (0.002)	-0.002* (0.001)	-0.002* (0.001)	-0.002+ (0.001)	-0.002* (0.001)	-0.003** (0.001)	-0.003** (0.001)
Constant	0.159* (0.065)	0.174* (0.067)	0.067 (0.041)	0.072 (0.040)	0.059+ (0.031)	0.065+ (0.031)	0.103** (0.033)	0.107** (0.034)
Firm Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of Firms	11,072	11,072	5,926	5,926	9,143	9,143	11,072	11,072
R2 (Within)	0.101	0.103	0.106	0.109	0.130	0.132	0.103	0.104

*** p<0.001 ** p<0.01 * p<0.05 + p<0.1; Standard errors reported in parentheses are heteroscedasticity robust and clustered by country