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Persistence and Interrelation in European Firms' Alliance Formation

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ABSTRACT

We analyse patterns and determinants of technology alliance formation with partner firms from emerging economies, with a focus on European firms' alliance strategies. We examine to what extent European firms' alliance formation with partners based in emerging economies is persistent, that is: to what extent prior collaborative experience determines new alliance formation, and we compare this pattern with alliance formation with developed country partners. Second, we examine to what extent prior engagement in international alliances with partners from developed countries increases the propensity to form technology alliances with partners based in emerging economies and vice versa (interrelation). We find that both persistence and interrelation effects are present, and that they are generally not weaker for emerging economy alliances. Alliance formation with Indian and Chinese firms is significantly more likely if firms have prior alliance experience with Japanese firms. The findings suggest that firms extend their alliance portfolio from developed to emerging economies, increasing the geographic diversity of their alliance portfolio and building on their prior international alliance experience.

Keywords: Alliances, Persistence, Interrelation, Emerging economies

1. Introduction

In recent years, the innovation strategies of firms are characterised by an increasing importance attached to external sources of knowledge (Archibugi and Coco 2004; OECD 2007; Patel and Pavitt 1991; Belderbos, Lykogianni and Veugelers 2008; Kang and Kang 2010; Lokshin et al. 2008) and a parallel decline in internal R&D departments (Chesbrough 2003; Howells, James and Malik 2004). This trend is especially pronounced in research intensive industries (Bönte 2003) and is accelerating due to technological convergence, declining transaction costs of acquiring external R&D inputs, and shortening product cycle times (Granstrand et al. 1992; Narula 2001). Strategic technology alliances are increasingly recognized as an important (quasi-market) mechanism to access such external knowledge (Narula and Hagedoorn 1999; Hagedoorn 2002; Schilling 2008), and there is an expanding literature in innovation management on alliance strategies and their impacts on performance (e.g. Powell, Koput and Smith-Doerr 1996; Gulati 1999; Gilsing et al. 2007; Vanhaverbeke et al. 2009; Belderbos et al. 2004; 2006).

One of the findings in the literature on strategic alliances is that cross-border alliances are important and that geographic diversity of alliance portfolios can improve alliance performance (Lavie and Miller 2008; Duysters and Lokshin 2007). Recently, important drivers of such internationalization of alliance activities have been the intensified global innovation competition and increasing R&D costs that push firms to search for lower cost technology development options abroad, the rapid development of science and engineering talent pools at low cost in emerging economies such as China and India, and the improved climate in emerging economies for multinational firms' R&D activities due to reforms in intellectual property right regimes (e.g. OECD 2007; Erken and Gilsing 2005). As a result, emerging economies have become increasingly important in multinational firms' R&D activities in general and in their international alliance activity in particular. As our

calculations show, during 2004-2008 more than a third of global technology alliance formation involved firms from emerging economies.

Against this background, it is surprising that the alliance literature has primarily focused on alliances between partners from developed countries. We still have only a limited understanding of the pattern of technology alliances between developed-country and emerging-economy firms. A number of case studies has suggested that technology alliances with Western multinationals were instrumental in the global emergence of such well known companies as China's Haier (Duysters et al. 2009) and Huawei Technologies (Zhang 2009) or India's Tata (Duysters et al. 2009). However, the factors driving Western firms to form technology alliances with emerging-economy firms have not received due attention in the literature.

In this study, we conduct an analysis of technology alliance formation with partner firms from emerging economies, with a focus on European firms' technology alliance strategies. We empirically analyse the drivers of European firms' technology alliance formation (1999-2008) with emerging economy firms, in comparison with the drivers of alliance formation with firms based in developed countries. Specifically, we examine to what extent European firms' alliance formation is influenced by patterns of prior alliance experience. Our multivariate empirical analysis of technology alliance formation by European firms draws on data of close to 2500 firms engaged in such alliance activity during 1999-2008.

Studies on alliance experience distinguish between 'general partnering experience' which reflect all of a firm's prior alliances, and 'partner-specific experience' which refers to alliance experience with a specific partner (Gulati et al. 2009). Our analysis focuses on another dimension of alliance experience, namely 'region-specific partnering experience', which is based on partnering experience in a particular region. Region-specific partnering

experience may positively influence alliance formation with new and/or existing partners from a region (persistence), but also with partners from other regions (interrelation). Patterns of persistence in, and interrelation between, different types of alliances have been examined for different types of alliances partners, such as customers, suppliers, or competitors (Belderbos, Gilsing and Lokshin 2012). In this paper, we build on this idea and study two key issues. First, we consider to what extent prior collaborative experience with partners based in developed countries or emerging economies influences alliance formation with partners based in these same regions. This is indicative of a *persistence* effect of prior collaborative experience. Second, we examine to what extent prior engagement in international alliances with partners from developed countries increases the propensity to form technology alliances with partners based in emerging economies and vice versa. This would be indicative of an *interrelationship* between alliance formation with partners from emerging and developed economies, suggesting that international alliances in developed countries reinforce incentives to establish alliances in emerging economies and vice versa, leading to an increase of the geographical diversity of alliance portfolios. In an extension, we examine alliance formation with partner firms in the two most important emerging economies in terms of their involvement in international technology networks: China and India.

By considering the degree of persistence and interrelationship among international alliances, we contribute to a deeper understanding of the development of global alliance portfolios in general, and to the structure and evolution of the geographical portfolio of technology alliances of European firms in particular. We thus extend the literature on the geographical dimension of technology collaboration and alliance portfolios, which has so far focused mainly on the performance effects of portfolios (Wassmer 2010).

Our study informs R&D managers of Western companies by considering the understudied phenomenon of alliances with partners from emerging economies. We

demonstrate the key role of region-specific partnering experience that is critical for dealing with elevated risks and cultural differences associated with alliances in emerging economies. Region-specific partnering experience may not only be useful for knowledge exploitation purposes but also for knowledge augmenting purposes as emerging economy alliances may potentially also help Western firms to become more innovative in their home markets.

The following section describes the theoretical background to our empirical study. In Section 3 we describe the database, the variables and the empirical model, and in Section 4 we present the results of the multivariate analysis. We conclude in Section 5.

2. Theoretical background

In the literature on alliances it has been established that alliances may contribute to the development of dynamic capabilities and, in this way, can support firms in strengthening and renewing their competitive advantage over time (Teece, Pisano and Shuen 1997; Eisenhardt and Martin 2000). More specifically, recent studies on alliances suggest that they can serve a "radar function" by linking firms to diverse partners and accessing novel information in a world which is dynamic and lacks transparency (Faems, Van Looy and Debackere 2005). Alliances offer flexibility to the firm in that it can ‘cherry pick’ the most desired knowledge available with a partner (Gilsing and Duysters 2008). Persistent use of alliance strategies may allow companies to maintain a focus on their core domains through in-house specialization while external collaboration may provide them with a window on newly emerging (technological) opportunities that fall beyond their core areas of expertise (Ahuja 2000).

Although in alliance studies the empirical focus has included international alliances (e.g. Hagedoorn 1993; 2002; Ahuja 2000), the role and importance of geographic heterogeneity among international alliance partners have received only limited attention until

now, especially with regard to partners from emerging economies. Duysters and Lokshin (2011) argue that diverse sources of knowledge offer flexibility and reduce risk in an uncertain technological and market environment, and find that broad international alliance portfolios are associated with strong innovation performance. Lavie and Miller (2008) show that moderate levels of international partner diversity - measured as a composite of several national-level differences like geographical, cultural, institutional and economic diversity - contribute to improved firm performance.

Too much diversity, however, may reduce firms' ability to understand partners' backgrounds (Lavie and Miller 2008). Therefore, international alliances may engender significant uncertainties as the risk of opportunistic behaviour by partners may be higher, especially in case of alliances with partners from emerging companies (Hoskisson et al. 2000). Tackling these challenges require a strong ability to find and screen information on potential partners. The ability to find and interpret information on potential partners, and to carefully discriminate among them, is strongly enhanced by alliance experience (Gulati 1999). Studies on alliance experience distinguish between 'general partnering experience' and 'partner-specific experience' (Gulati et al. 2009). Whereas partner-specific experience refers to alliance experience that is specific to a particular partner, general partnering experience points to the totality of partnering experience stemming from all of a firm's prior alliances. It has been demonstrated that the more alliance experience a firm has, the more capable it may become in dealing with inter-firm differences as well as in mitigating the risks of opportunistic behaviour (Kale and Singh 2007). At the same time, there is also an argument that prior experience with the same specific partner is much more important than general partnering experience for generating better outcomes from future partnerships with that partner (Gulati et al. 2009). Specific to international alliances, the literature suggests that the more experience a firm has with engaging in international alliances, the more it may

develop collaborative routines and capabilities that help it to overcome cross-cultural differences and to mitigate the associated higher risks of opportunism (Barkema et al. 1997). In this paper, we extend this logic and argue that a firm can build up 'region-specific' alliance experience that makes it become familiar and sensitive to key institutional and cultural issues that pertain to a certain region. Such regional specificities pertaining to emerging economies in Asia include the generally more collectivistic orientation of most Asian cultures (Hofstede, 1980; Xiao, 2007), or the elevated risks of knowledge spillovers in many emerging economies due to the generally weak institutions for IP protection in those economies. To the extent that a firm has some alliance experience in emerging economies, it may be better able to anticipate these issues and hence obtain more value from their later alliances there.

The more international alliance experience a firm has in a certain region, the more it may be able to generate value from partnerships in that region (Krishnan, Martin and Noorderhaven 2006). Prior international alliance experience within a region not only contributes to the ability of extracting value from international alliances but also helps generating new international partnering opportunities. The more alliance experience in a region a firm has, the more it becomes structurally embedded in an alliance network within that region, providing it with network-level information on new partnering opportunities, beyond its direct partners (Granovetter 1985). In a similar vein, this mechanism brings information regarding a firm's capabilities and reputation to potential partners, enhancing their ability to assess the firm's attractiveness. In this way, alliance experience, through regional embeddedness in alliance networks, contributes to a persistent pattern of collaboration between partners that are connected, directly and/or indirectly (Gulati and Garguilo 1999).

Taken together, these arguments suggest that a firm's specific regional pattern of international alliance experience contributes to persistence of its international alliance strategy. Hence, we propose that:

Proposition 1: *Firms with prior experience in dealing with alliance partners from a specific region (developing or emerging economies) are more likely to form new alliances with partners from that region.*

A second, related issue is that the more a firm has built up alliance experience within developed economies or emerging economies, the higher the likelihood that it may increasingly receive redundant information, yielding diminishing novelty value. To address this, a firm may decide to broaden the geographic scope of its alliance portfolio (Lavie and Miller 2008). This would suggest that the more a firm has alliance experience with partners from developed economies, the more likely that it forms alliances with firms from emerging economies, and vice versa. Another factor driving the geographic diversification of a firm's alliance portfolio is the differences in the innovation goals of alliances in developed countries and those in emerging economies. Li et al. (2008) have shown that when an alliance's innovation goals are more radical, it is the more likely that the alliance partners are familiar rather than distant partners. In the context of regional alliance experience, firms from developed countries are arguably more familiar with firms from the same region, given their relative homogeneity in technological, institutional and cultural characteristics, than with firms from emerging economies. Therefore, they are able to better understand the background and motives of partners from developed countries, than those from emerging economies, and take suitable precautions against risks. This suggests that while developed-country firms may aim to develop new and novel technologies through their alliances in developed countries,

they may aim to adapt their existing technologies to meet local preferences through their alliances in emerging economies. To be successful in emerging economies requires adaptations of the western 'dominant design' in such a way that it fits into the different cultural and institutional context. The differential innovation goals of alliances in developed countries and emerging economies are analogous to the two well known motives driving R&D internationalization, namely 'knowledge augmentation' and 'knowledge exploitation' (e.g. Kuemmerle 1999). Studies in this tradition demonstrate that in general Western firms' R&D investments in developed regions are driven by the need for augmenting their existing knowledge, while those investments in emerging economies are often aimed at exploiting their existing knowledge and technologies (e.g. Kuemmerle 1999; Ambos and Ambos 2009; Schmiele 2011).

Extending alliance activities from developed countries to emerging economies may also reflect that a firm is leveraging its knowledge-augmenting alliances in the former by engaging in knowledge exploitation alliances in the latter. Such a geographic diversification strategy increases the degree of diversity in a firm's technology alliance portfolio, and expands its alliance portfolio through increasing internationalization (Lavie and Miller 2008). This also enables a firm to connect with the growing technological capability levels in emerging economies and to combine this with technological expertise in developed countries (Erken and Gilsing 2005).

Knowledge-augmenting alliances in developed regions may also spur similar knowledge augmenting alliances in emerging economies. Although incremental adaptations of technologies in emerging economies may suffice in some cases, these may turn out to be insufficient in other cases, as more profound changes in western firms' core technological expertise and capabilities are required (Giarratana and Torrisi 2010). For example, to the extent that technology is more systemic, these adaptations can become complex, especially

when complementary (non-) technological processes also need to be adjusted in order to make Western technology fit well into the local context. At this point, insights into the technological and/or cultural-institutional limitations of the Western 'dominant design' are factored in, which may possibly lead to a new path of exploration and innovation (Gilsing and Nooteboom 2006). Knowledge augmenting alliances with partners from emerging economies will be instrumental in such enhanced adaptation of dominant designs, implying two-way knowledge flows within these alliances (Giarratana and Torrisi 2010). An example here is formed by Unilever's experiences in the market for hair care products in Southeast Asia in the 1990s. In collaboration with its local partners in Thailand, Unilever found out that its hair care products did not really entice local demand. Women in this country were generally far more critical regarding the quality of hair care products than most Western women, especially with respect to the degree to which it enhanced 'shiny' hair. This experience and insight ultimately led Unilever to reconsider its hair care products also within Europe, and to develop a 'next generation' hair care product range that it developed in collaboration with partners in Thailand and in Europe (France). This has ultimately led to the launch of its 'Organics' brand of hair care in 1995 in Europe, although the first launch occurred in Thailand already in 1993.[1]

These argument suggests a two-way interrelationship between international alliance activities in developed countries and alliances with firms based in emerging economies: the more a firm has alliance experience with partners from developed economies, the more it may also engage in alliances with firms from emerging economies, and vice versa. While developed country alliance experience is likely to drive complementary alliance formation in emerging economies to exploit and adapt technologies, this exploitation of a firm's capabilities may bring new innovative ideas and solutions that may fuel the need for further

[1] See also "Unilever and P&G begin Haircare world war; Rivals each claim similar innovative formulas", by Dagmar Mussey, 19th June 1995, *Advertising Age*.

augmentation or renewal of core capabilities through establishing new ties in developed countries. This leads to the following proposition:

Proposition 2: *Prior experience in international alliances with partners from developed countries increases the propensity to form technology alliances with partners based in emerging economies and vice versa.*

3. Data and Model

For our empirical study, we make use of the SDC (Securities Data Company) Platinum databases - a well-known data source for empirical studies on strategic alliances (Schilling 2008). This database is richer than the MERIT-CATI database, as it codes more information on alliances. We select only those alliances in the SDC database that have explicit technology development or technology sharing objectives, or that have a broad functional scope of activities (joint ventures; Schilling 2008). Hence, we do not include simple one-way technology licensing, as this is essentially a market-based mode of technology acquisition.

We then differentiate the alliances with respect to the country of incorporation of the participants. In our analysis of the determinants of technology alliance formation with firms based in emerging economies as compared to alliance formation with developed country firms, we focus on alliance strategies of European firms. We identify the alliance activities of the focal firms in the following destinations: Europe (all current Europe-27 countries plus Iceland, Lichtenstein, Norway and Switzerland), the US, Japan, emerging economies and the most alliance-active emerging economies, China and India. The data reveals that technology alliance activity by European firms is distinctly international and externally oriented, with on average around 50% of alliances formed with partner firms outside of the Europe and about

75% outside of the home country. Since the early 1990s, emerging-economy firms led by Chinese firms have become important partners of European firms' alliance activity with their share as partners rising to more than a quarter in 2004-2008, the latest period for which data are available. During this period (2004-2008), the number of alliances with Indian firms increased rapidly, surpassing the number of alliances established with Chinese firms. We limit the analysis to alliances established in the most recent 10-year period 1999-2008, the period during which alliance activity in emerging economies became more widespread. The sample consists of a panel data set of 2,488 European firms for which information is available on firm size and prior alliance activity, and of which about 78 percent are engaged in international alliances.

Dependent variable

In our analysis of alliance formation by European firms, the dependent variable is measured as the total number of technology alliances per year established with partner firms based in emerging economies and developed countries. We estimate similar models for alliance formation in emerging economies and developed countries in order to examine differences and similarities. In an extension, we focus more specifically on alliance formation with firms based in China and India.

Key Explanatory variables

The key explanatory variables relate to persistence (prior alliance formation with firms based in the same region) and interrelation (prior alliance formation with firms based in a different region). We include two dummy variables to examine these influences. The variable *alliance experience - developed countries* take the value 1 if the firm had formed technology alliances with firms based in developed countries in the prior 5-year period, and

zero otherwise. Similarly, the variable *alliance experience - emerging economies* takes the value 1 if the firm engaged in alliance formation with firms based in emerging economies in the prior 5-year period. We also include a proxy variable for absorptive capacity. As data on R&D expenditures are missing in our large sample of (unlisted) firms, we measure R&D capabilities by calculating the frequency at which the firms are recorded to have been engaged in (collaborative) R&D activities in the SDC data in the prior 5-year period. We term this variable *R&D capability.* We also employ a dummy variable measuring whether the firm had prior domestic alliance formation (*alliance experience - home country*). In the analysis of alliance formation with firms based in the most important emerging economies, India and China, we examine the role of prior alliance formation in these countries (*alliance experience - India, China*) and we differentiate between the US and Japan as partner countries in prior alliance formation *(alliance experience- US, Japan)*.

Control variables

The analysis includes a range of control variables. First, the European firms could be independently owned, or part of a larger group and ultimately owned by a (multinational) parent firm. We make a distinction between European and non-European parent firms. This distinction is possible because the SDC database allows examining the country of the ultimate owner of the participants in alliances. *Non-European MNC* takes the value 1 if the firm belongs to a non-European parent; *European MNC* takes the value 1 if the firm belongs to a European parent based in another European country. Since alliance activity may be concentrated and centralized in the headquarters, the affiliates of EU and non-EU MNCs may show systematically different propensities to engage in cross-border alliances. EU firms may be different from US firms as EU firms' European operations are likely to be more integrated, whereas EU affiliates of US firms may act in a more autonomous way. Third, we include the

logarithm of the number of employees of the firm to control for firm size. Fourth, the analysis takes into account home country, year and industry-specific factors that influence the propensity to engage in technology alliances, by including dummy variables representing the home country, year of operation and sector of each European firm.

INSERT TABLE 1

Table 1 provides summary statistics of the variables. The number of European alliances with partners based in developed economies is larger than the number of alliances with emerging economy firms (3320 versus 1187, under 'Sum' in Table 1). The descriptives also confirm that alliances with Chinese firms are more frequent than alliances with Indian firms in the sample period. The alliance experience variables show a similar pattern: for about 42 percent of the firm observations there is alliance experience in developed countries, but this is limited to just over 19 percent of the sample in case of emerging economy alliances. The dependent variables show considerable dispersion with a preponderance of zero outcomes because many firms engage in one or a limited number of alliances with a specific target region while some engage in only domestic alliances. Since many zero outcomes are the result of the fact that some firms simply do not undertake international alliance activities, we employ a Zero Inflated Poisson (ZIP) model which combines a Logit model (the so-called inflate model) predicting whether there are 'certain' cases of zero alliances and a Poisson model that predicts the number of alliances in a region for the remainder of the sample.[2] The Poisson model is estimated with clustered and robust standard errors that corrects for overdispersion and allows for correlation between observations for the same firms (Cameron and Trivedi 2008).

[2] In the inflate model we included a dummy variable representing international technology alliance experience during the prior 5- year period, as well as a constant term.

4. Empirical results

The estimation results on alliances with developed countries and emerging economies are reported in table 2. A significantly positive Vuong statistics confirms the preference for ZIP over the standard Poisson model in all model specifications (Tables 2, last line).The first and third columns report estimations with the control variables only, and the second and fourth columns add the prior alliance variables. Both for alliance formation with firms based in developed countries and for alliances with firms from emerging economies, the effect of firm size, captured by *log(employment)*, is broadly in line with the understanding that smaller firms have a much stronger 'local' orientation in alliance formation or a smaller propensity to form technology alliances in general. Affiliates of EU multinationals are less likely to establish alliances with developed country firms, perhaps because alliance formation is centralized at EU headquarters. Both the set of home country dummies and industry dummies (not shown) are jointly significant, indicating systematic country and industry variation in the propensity to form alliances.

INSERT TABLE 2

If we examine the effects of prior alliance engagement (columns 2 and 4 in Table 2) we see that alliance experience in a given region, in both emerging and developed countries, has a strong positive impact on alliance formation with that region. This is indicative of a *persistence effect* of prior collaboration and collaborative experience that is similar across the two regions. The results also show a strong pattern of *interrelation*: prior alliance formation with partners from developed economies increases the propensity to engage in technology alliances with partners from emerging economies, and vice versa. The coefficients are smaller than the coefficients of the persistence effects, but they are of a comparable magnitude for both emerging economy and developed country alliance formation. These results suggest that firms increase the geographical diversity of alliance portfolios driven by a broadening of

alliances portfolios to involve both developed countries and emerging economies. R&D capabilities have a positive impact on both types of new alliance formation, with the effects being slightly larger for alliance formation with developed country partners, which is in line with the notion that technology alliances are more effective for firms with sufficient absorptive capacity. In contrast, home country alliance experience does not exert a significant impact, suggesting that it is cross-border alliance experience that is the most relevant for expansion of alliance portfolios into emerging economies. Chi square tests comparing the explanatory power of models (1)-(2) and (3)-(4) indicate that the inclusion of the prior alliance variables significantly improves the fit of the model.

In an extension of the analysis, we examine the determinants of alliance formation with partner firms based in the two most important emerging economies with the most frequent involvement in international technology alliances: India and China. The results are presented in Table 3. The preference for ZIP over the standard Poisson model is confirmed in all specifications by the significantly positive Vuong statistics (Tables 3, last line).The results show that larger firms have a greater propensity to form technology alliances with partners from both China and India. The persistence effect (columns 3and 5 respectively) is strong and significantly positive for both China and India.

INSERT TABLE 3

As to the evidence on interrelationships, the results show no significant effect of experience in developed countries in general. On the other hand, when we apply a more fine-grained decomposition of alliance experience (columns 3 and 5), we observe that past alliances with Japanese firms significantly increase the propensity to form alliances with both Chinese and Indian firms, while those with American firms increase the propensity to form new alliances with Chinese but not with Indian firms. In addition, emerging economy

experience (excluding China and India) increases the propensity to engage in alliances with both Chinese and Indian firms. Chi square tests comparing the explanatory power of models (1)-(3) and (4)-(5) indicate that the inclusion of the (fine-grained) prior alliance variables significantly improves the fit of the model.

While alliance diversification into emerging economies offers new opportunities for European firms, such a strategy involves considerable risk due to unfamiliarity with the region and the business practices of local firm. As a result, firms most prepared to form alliances with firms from emerging economies like China or India are those that have international alliance experience in the developed country located in Asia (Japan), from which Asian investment strategies can be implemented. Similarly, earlier alliance experience in emerging economies in the Asian region facilitates alliance formation in India and China.

Robustness checks

We examined the robustness of the empirical results to alternative estimation methods. An alternative to the ZIP model is the Zero Inflated Negative Binomial model (ZINB). ZINB models did not convergence for all specifications but produced rather similar results in the cases where estimates were obtained (emerging economies, and China). Evidence on model fit was mixed: the Bayesian Information Criterion (BIC) indicated a preference for ZINB in the model for alliances in emerging economies, while for ZIP in the model for alliances in China. We preferred ZIP models as they provided estimates for all of our four specifications.

Given the absence of information on R&D expenditures for a major proportion of our firms, we used information on prior (collaborative) R&D activities of focal firms as a proxy for R&D capabilities. We explored the accuracy of this proxy for a subsample of firms for which we could obtain information on R&D expenditures. For 50 firms in our sample we

found a substantial correlation of 76 percent between the R&D capability measure and R&D expenditures. As a further robustness check we excluded the R&D capability variable from our models, and the results remained very similar.

5. Conclusion and discussion

Rapidly rising competitive pressures from globalization and the ensuing search for broader sources of new knowledge have increased the internationalization of R&D and external knowledge acquisition, directed, in particular, towards emerging economies. While international technology alliances are a well known (quasi-market) mechanism to gain such external knowledge, very little is known about its application by Western firms in emerging economies.

In this paper, we analysed the factors driving technology alliance formation with partner firms in emerging economies. We draw on the extensive database on technology alliances by European firms available from SDC. In a multivariate analysis, we examined the determinants of alliance formation with firms based in emerging economies, and compared these to the determinants of alliance formation with firms from developed countries. We focused on the role of alliance experience in the same region (persistence) and alliance experience in other regions (interrelationship) in alliance formation. Our sample consists of close to 2500 European firms of which more than 1900 firms engaged in international technology alliance activities. We analysed the number of yearly technology alliances established during 1999-2008, taking into account factors such as firms' R&D capability, sector, size, ownership and country of origin.

The results of the multivariate analyses confirmed our expectations about the influence of persistence and interrelation in international alliance activities. First, there is evidence of persistence in alliance strategies with partners from both emerging economies

and developed countries, with a comparable magnitude. This is indicative of 'region-specific partnering experience', which positively influences alliance formation with new and/or existing partners from that region. Second, prior alliance activity in developed countries increases the propensity to engage in alliance activity in emerging economies, and this effect is also observed vice versa. Hence, firms extend their alliance portfolio across both developed and emerging economies, increasing the geographic diversity of their alliance portfolio and building on their prior international alliances in other regions. In an extension of the analysis focusing on alliance formation with Chinese and Indian firms, we find persistence effects in relation to alliances with both Chinese and Indian firms. Results on interrelationships are more nuanced, in the sense that not all developed-country alliance experience, but only prior alliance engagement with Japanese firms enhances the alliance propensity with Chinese and Indian firms, while alliance experience with American firms contribute to alliance formation with Chinese firms.

The persistence effect indicates that prior international alliances activities lead to improved understanding of foreign partners and their specific characteristics, and this raises the likelihood of subsequent alliance activities involving an already established inter-firm network (Gulati 1995). The results on the interrelationship between developed country and emerging economy alliances are indicative that firms see the diversity benefits of broader alliance portfolios as superseding any conflict in alliance portfolios (Wassmer 2010).

The R&D internationalization literature provides another rationale for the persistence and interrelationship hypotheses in the context of firms' knowledge sourcing activities in the developed and emerging economies. Following this perspective (Kuemmerle 1999; Ambos and Ambos 2009; Schmiele 2011), alliances with developed country firms facilitate knowledge augmentation, while those with emerging economy firms provide opportunities for knowledge exploitation as emerging economy firms are less often at the frontier of

technology development. Our study contributes to this literature by demonstrating that knowledge augmentation and exploitation reinforce each other. In other words, the results suggest that there is no substitution of technological collaboration within developed economies by technological collaboration with partners from emerging economies – an issue that may reassure policymakers in Europe emphasizing the importance of intra-EU partnerships.

The findings on the specific role of prior alliance experience with Japanese partners in alliance formation with Indian and Chinese firms are consistent with the recognition in the alliance literature that region-specific experience and knowledge exert an important influence in the choice of partners (Geringer 1991; Dacin, Hitt and Levitas 1997; Zutshi and Tan 2009). More generally, our findings are in line with the idea that there is persistence in, and interrelation between, alliance strategies with different partner types. Whereas this has been demonstrated for vertical collaboration (i.e. with customers and suppliers) and for horizontal collaboration (i.e. with competitors) (Belderbos, Gilsing and Lokshin 2012), our findings indicate that this also applies when distinguishing between partners from developed and emerging economies. In this way, we contribute to the literature by shedding some more light on how diversity in alliance portfolios comes into being. While there is growing agreement in the alliance portfolio literature that diversity carries positive performance effects (e.g. Lavie and Miller 2008), how such portfolio diversity originates remains an under addressed issue in the literature thus far (Wassmer 2010). Here, our study demonstrates that prior international alliance experience, be it in either developed economies or emerging economies, forms an important antecedent of growing diversity in a firm's alliance portfolio.

There are a number of implications for (R&D) managers that follow from our study. Our findings show that technology-based collaboration is not something that is only, or largely, confined to partnerships within developed countries. Our findings clearly indicate

that collaboration with partners from emerging economies has become a major phenomenon– a phenomenon that has been overlooked in the alliance literature with its primary focus on alliances between partners from developed countries. Our study suggests that Western firms should closely examine alliance opportunities with emerging economy partners, as foregoing such opportunities may put future innovation performance and competitiveness at risk. First, firms will miss out on the increasing pools of high quality science and engineering talent at low(er) costs in emerging economies, such as China and India. Apart from cost advantages, firms may also lack access to new technological developments that will increasingly originate in these countries. In the short term, Western companies may not be affected so much by Asian companies yet, but much more by those western competitors who do collaborate with partners from emerging economies and hence enjoy access to local talent and expertise. Furthermore, such collaboration contributes to the build up of region-specific partnering experience that may help to alleviate concerns about cultural and/or institutional risks, and hence to obtain more value from alliances in the region. In addition, engaging in alliances with partners in emerging economies should also be seen in the light of building up a reputation as a reliable and attractive collaboration partner. This is something that may pay off well for western companies in the longer term, given the generally long term orientation of Asian companies (Hofstede 1980). Finally, collaboration in emerging economies may unexpectedly lead to insights into the technological and/or cultural-institutional limitations of their core technology that may help a firm to develop new technologies for their home markets in developed countries.

The findings of the study also provide interesting suggestions for further research. First, the analysis can be expanded to include a wider range of firm characteristics and host and home country factors. Expansions of the analysis to a broader set of individual partner countries would allow studying the role of home and host country characteristics in alliance

formation, such as relative technological capabilities and market opportunities. Second, future work should examine the performance consequences of alliance formation with emerging economy partners, and the increased diversity of alliance portfolios. Prior work has related innovativeness to a more diverse portfolio of international alliance partners (Duysters and Lokshin 2011; Lavie and Miller 2008). Given that technology alliances with firms based in emerging economies is potentially of a specific nature, related to the relatively lower level of technological capabilities of such partner firms, the impact on innovative performance is an interesting subject of research. Third, the relationship with other external technology sourcing strategies, in particular M&A activity, as a possible complement or substitute for technology alliance activity would be a fruitful subject of examination. We envisage further analysis to examine the complex impact of this portfolio of (international) technology sourcing strategies in terms of instruments and partners, on effective innovation and market outcomes.

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Table 1 Descriptive statistics

Variables	Mean	Std.Dev	Min	Max	Sum	Firms
Dependent Variables						
Developed Economies	0.233	0.632	0	12	3,320	1622
Emerging Economies	0.083	0.340	0	6	1,187	691
China	0.023	0.167	0	3	327	216
India	0.014	0.125	0	3	195	161
Explanatory Variables						
Alliance Experience in:						
Developed economies	0.416	0.493	0	1	5,932	1552
Home country	0.294	0.455	0	1	4,188	1122
Intra-Europe	0.274	0.446	0	1	3,905	1047
USA	0.201	0.400	0	1	2,861	771
Japan	0.071	0.257	0	1	1,013	262
Excl. Europe, US & Japan	0.057	0.232	0	1	815	231
Emerging Economies	0.186	0.389	0	1	2,646	702
China	0.068	0.251	0	1	966	257
Excl. China	0.152	0.359	0	1	2,165	597
India	0.033	0.178	0	1	469	164
Excl. India	0.168	0.374	0	1	2,393	626
Excl. India & China	0.132	0.339	0	1	1,883	512
Control Variables						
R&D Capability	0.316	1.453	0	35	4,507	495
International Experience	0.485	0.500	0	1	6,918	1789
EU MNC	0.056	0.230	0	1	796	162
Non-EU MNC	0.031	0.174	0	1	445	92
Log(Employment)	8.220	2.315	0	13.13	117,221	2488

Table 2. Zero Inflated Poisson Regression Analysis of the Drivers of EU firms' alliances with partners from Developed and Emerging economies

	(1)	(2)	(3)	(4)
Dependent Variable	Developed	Developed	Emerging	Emerging
Constant	-1.974***	-2.183***	-3.024***	-3.295***
	(0.302)	(0.232)	(0.318)	(0.311)
Non-EU MNC	-0.131	-0.00239	-0.0889	0.0284
	(0.172)	(0.152)	(0.185)	(0.172)
EU MNC	-0.330***	-0.221***	-0.225	-0.141
	(0.0786)	(0.0787)	(0.173)	(0.166)
log(Employment)	0.173***	0.111***	0.241***	0.189***
	(0.0166)	(0.0122)	(0.0202)	(0.0203)
R&D capability		0.0579***		0.0504***
		(0.00783)		(0.0144)
Alliance Experience in:				
Developed economies		0.680***		0.377***
		(0.0602)		(0.129)
Emerging economies		0.422***		0.671***
		(0.0628)		(0.112)
Home country		-0.0415		-0.107
		(0.0529)		(0.0799)
Home country dummies	included	Included	included	included
Industry dummies	included	Included	included	included
Year dummies	included	Included	included	included
Inflation model				
Constant	-0.254***	-15.63***	0.181	-1.634
	(0.0984)	(2.542)	(0.166)	(1.102)
International Experience	0.111	15.53***	-0.0951	1.682
	(0.0952)	(2.531)	(0.135)	(1.025)
Observations	14,260	14,260	14,260	14,260
Log likelihood	-7909	-7726	-3731	-3685
Chi-2	1392*	1759*	799.7*	891.7*
Vuong test	7.094*	6.913*	4.053*	4.177*

Notes: Cluster-robust standard errors in parentheses.
* p<0.1, ** p<0.05, *** p<0.01

Table 3. Zero Inflated Poisson Regression Analysis of the Drivers of EU firms' alliances with partners from China and India

	(1)	(2)	(3)	(4)	(5)
Dependent Variable	China	China	China	India	India
Constant	-5.671***	-5.802***	-5.687***	-5.108***	-5.226***
	(0.684)	(0.713)	(0.655)	(0.821)	(0.799)
Non-EU MNC	-0.224	-0.0701	0.00200	-0.0279	-0.00179
	(0.386)	(0.360)	(0.358)	(0.408)	(0.404)
EU MNC	-0.250	-0.168	-0.147	0.288	0.310
	(0.337)	(0.326)	(0.321)	(0.367)	(0.371)
log(Employment)	0.348***	0.277***	0.270***	0.136***	0.127***
	(0.0399)	(0.0385)	(0.0377)	(0.0400)	(0.0406)
R&D capability		0.0417***	0.0158	0.0538***	0.0326
		(0.0149)	(0.0170)	(0.0209)	(0.0258)
Alliance Experience in:					
Developed economies		0.193		0.295	
		(0.239)		(0.278)	
Intra-Europe			-0.216		0.293
			(0.167)		(0.209)
USA			0.448**		0.178
			(0.179)		(0.218)
Japan			0.401**		0.731***
			(0.202)		(0.237)
Developed excl. Europe, US & Japan			0.320*		0.184
			(0.187)		(0.335)
China		0.658***	0.516**		-0.0539
		(0.193)	(0.204)		(0.252)
Emerging excl. China		0.419**			
		(0.174)			
India			0.277	0.710**	0.545**
			(0.205)	(0.284)	(0.278)
Emerging excl. India				0.573**	
				(0.248)	
Emerging excl. India & China			0.318*		0.591**
			(0.180)		(0.230)
Home country		-0.0781	-0.131	-0.353*	-0.436**
		(0.144)	(0.153)	(0.182)	(0.183)
Home country dummies	included	included	included	included	included
Industry dummies	included	included	included	included	included
Year dummies	included	included	included	included	included
Inflation Model					
Constant	0.520	-1.114	-1.347	-1.397	-2.667
	(0.390)	(1.690)	(1.789)	(2.642)	(7.409)
International Experience	-0.349	0.923	0.992	2.040	3.135
	(0.234)	(1.309)	(1.297)	(2.244)	(6.874)
Observations	14,260	14,260	14,260	14,260	14,260
Log likelihood	-1314	-1295	-1285	-878.9	-871.9
Chi-2	416.7*	454.6*	475.5*	284.2*	298.2*
Vuong test	1.831**	1.334*	1.342*	1.955**	2.392***

Notes: Cluster-robust standard errors in parentheses. The basic model for India in which only the control variables are included did not converge because of the preponderance of zero outcomes, and hence is not reported.* p<0.1, ** p<0.05, *** p<0.01

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