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# The role of home country demand in the internationalization of new ventures

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ABSTRACT

International new ventures (INVs) have been documented to exist all around the world, but the literature is silent on the frequency of such companies in different countries. We contend that the propensity of new ventures to internationalize by forming international partnerships is higher in small-domestic demand countries because they have a greater motivation given their limited local demand. After discussing the methodological challenges in testing this hypothesis, we do such a test by studying alliances in the health segment of the biotech industry in relatively small-domestic demand countries (Australia, Israel, and Taiwan) and by comparing the results with five large-domestic demand countries (UK, Germany, France, US, and Japan). We find that young firms in the countries with smaller domestic demand are at least 3 times more likely to enter into international partnerships than their counterparts in countries with larger domestic demand. We further demonstrate that this difference can primarily be explained by the difference in the size of domestic healthcare markets rather than other underlying opportunity structure related factors.



## 1. Introduction

The literature on international new ventures (INV) portrays INVs as a global phenomenon and assumes that new firms around the globe face similar motivations and have experienced a similar improvement in capability to internationalize (Oviatt and McDougall, 1994; Rialp et al., 2005). Hence one would expect a similar internationalization behavior among new ventures from various countries. In this study, we examine this important assumption and ask if the propensity of new ventures to internationalize by forming international partnerships is indeed similar across different countries. Our point of departure is a critical but neglected motivation to internationalize: the size of local demand the new venture experiences in its home country. We argue that in small countries (defined by the size of local demand), young firms have an additional motivation to develop relationships with firms in foreign countries quite early in their lifecycles. This is because accessing additional international demand is more crucial for new ventures in small countries. It helps them to recoup their investment costs and reduces unit costs of production compared to new ventures in large countries, which can achieve similar results through domestic demand alone. Accessing foreign markets also helps young firms overcome local resource constraints by tapping into the resources of other countries. We therefore propose that although international new ventures exist in both small and large countries, small countries will see their young firms internationalize more often than large countries.

We test this proposition by studying international and domestic partnerships between firms in the health segment of the biotech industry. Specifically, we study this knowledge-intensive and high technology industry in a number of small- (Australia, Israel, and Taiwan) and large-domestic demand countries (US, UK, Germany, France, and Japan).

Assessing differences in internationalization behavior across countries in terms of partnership formation patterns, however, is empirically challenging. It is not sufficient to show differences through simple descriptive statistics. This is because large-demand countries also tend to have more firms than small countries. For this reason alone, mere chance may create more international partnerships for small countries. Let us illustrate: For simplicity's sake, assume that the world consists of one small country with 10 firms and one large country with 90 firms. Let us further assume that

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firms find partners through a purely random matching process. In this scenario, firms in the small country would form international partnerships with a probability of 90%, and consequently 9 out of 10 partnerships would be expected to be international. By contrast, firms in the large country would form international partnerships with a probability of 10%, and consequently only 1 out of 10 partnerships would be expected to be international. The key empirical challenge, therefore, is this: One needs to establish that the differences in partnership formation frequencies between large and small countries remain after their specific opportunity structure for internationalization behavior is accounted for.

We use hierarchical linear modeling techniques and employ multi-level logistic regression methodology developed for panel data to address this challenge. This enables us to test hypotheses at the country level while using data at the firm and partnership levels (Peterson et al., 2012; Hofmann, 1997). More specifically through using such a methodology, we are able to introduce various country-level variables that can account for the underlying opportunity structure into a regression that essentially also contains country and year dummies within it. Our empirical analyses yield two findings. First, patterns of partnership formation are different in small- and large-demand countries: Young firms from small countries internationalize more frequently. Second, this difference is due to the size of the local demand rather than what can be explained by taking into account (i) the distribution of potential partner companies domestically and internationally, (ii) the existing science base and capability of the home country within biotechnology, (iii) the global integration of the home country through low trade barriers with potential target countries, or (iv) the underlying propensity of two specific firms to engage in an alliance. By demonstrating the causal role of small home country demand, our findings extend existing arguments regarding why young firms internationalize from early on. This yields important insights regarding the behavior of INVs in different countries.

The paper proceeds as follows: In Section 2, we review the literature on INVs and formulate a proposition about the frequency of INVs in small vs. large countries. Then, with a focus on partnerships among firms, we develop specific hypotheses on how the size of home demand influences the frequency of different types of international and domestic alliances. Section 3 describes the data, the empirical challenges, and the methodology we use to address the challenges and test the hypotheses. Section 4 presents our results. We conclude by discussing the implications of our findings and by proposing avenues for future research.

## 2. Prior literature

In the early 1990s, entrepreneurship researchers started to notice that new firms at the time of their formation or soon thereafter would offer their products in multiple countries (Oviatt and McDougall, 1994). An example is ResMed a world leader in developing and manufacturing products for diagnosis and treatment of sleep-disordered breathing. It was founded in Australia in 1989 but quickly started selling internationally. This phenomenon of ventures going international almost from the beginning was inconsistent with the traditional stage theory of internationalization of companies (e.g., Johanson and Vahlne, 1977).

Intrigued by this inconsistency with traditional theory, scholars tried to understand more systematically the phenomenon of INVs, or "born globals" as they were often dubbed. Oviatt and McDougall (1994, p. 49) define an INV as "a business organization that, from inception, seeks to derive significant competitive advantage from the use of resources and the sale of outputs in multiple countries." Oviatt and McDougall (1994) were careful not to claim that INVs were an entirely new kind of organization. They recognized that firms such as the East India Company, chartered in London in 1600, or the Ford Motor Company, founded in 1903, also operated internationally as start-ups. However, they argued that the frequency of this phenomenon had increased significantly. The literature on INVs has grown substantially in the past two decades and efforts have been made to identify the drivers that have led more entrepreneurs to take their ventures international from the beginning.

### 2.1. The high frequency of international new ventures

We distinguish between two broad sets of factors that contribute to the high frequency of INVs. One set concerns the ability of entrepreneurs to take their young ventures international. The second set explains their motivations to do so.

#### 2.1.1. Ability factors

The primary cause of this enhanced ability to internationalize is technological change. Knight and Cavusgil (1996) highlight the role of advances in communications and digital technology, and Oviatt and McDougall (2005) stress that faster and more efficient transportation of both goods and people decreases the costs of foreign trade and investment. In other words, innovations have dramatically reduced the costs of international communication, plane travel, and the transport of goods and services (Rialp et al., 2005). With email, one can now send virtually unlimited business communications around the world at essentially zero marginal cost and in a matter of seconds. The real cost of air travel has been greatly reduced and video conferencing has become so cheap that any entrepreneur can talk to partners and clients in other countries. Similarly, the cost of accessing information that is created in different parts of the world has been dramatically reduced with the creation of the internet (Bell et al., 2001). In total, technological innovations have dramatically reduced the resource requirements for going international.

A second group of factors enhancing the ability to internationalize arises from the creation of increasingly global markets. The greater connectedness of both the global economy (Herstad et al., 2014) and innovations systems (Carlsson, 2006), and reductions in trade barriers in general, have improved the ability of firms to internationalize. Trade barriers have fallen on average, with many countries entering into global trade pacts (e.g., China joining GATT) or regional trade pacts (e.g., NAFTA combining US, Canada and Mexico, or the European Union removing barriers among member states) (McCann, 2008). Similarly, financial markets have become increasingly internationalized, allowing entrepreneurs to raise financial capital more easily in foreign countries (e.g., Chinese solar and internet companies procuring capital in New York). In addition, the increasing homogenization of tastes enables more companies to sell similar products across multiple countries (e.g., Apple selling the same iPhones around the world). Moreover, because more people have either studied, worked, or simply traveled abroad, more entrepreneurs have established international links that can help them venture into other countries (Rialp et al., 2005). Overall, countries have become increasingly linked, giving entrepreneurs a greater ability to enter international markets.

#### 2.1.2. Motivation factors

Research has identified two causes of increased motivation for entrepreneurs to start a venture in more than one country. One is entrepreneurs' fear that their potential competitors in other countries may quickly imitate and then challenge them in their home country (McDougall et al., 1994). Many entrepreneurs are motivated to protect their home market profits. Such an entrepreneur is concerned that potential competitors in other countries could imitate and introduce the entrepreneur's products in their own

countries, and later on enter the entrepreneur's home market. Entrepreneurs are therefore motivated to internationalize to prevent firms in other countries from imitating the products and building up capabilities that could rival their own resources and capabilities (Oviatt and McDougall, 1994). The idea here is that the entrepreneur may want to fight these potential foreign competitors on their own soil so they do not have to fight them at home.

A related second motivation is the desire of the entrepreneurs to establish their products, services, or processes as a standard in many countries (Oviatt and McDougall, 2005). Given increasingly integrated international markets, an entrepreneur who has developed a new product or service can make more profits by entering more markets at the outset (Rialp et al., 2005), exploiting first mover advantages. As a result, entrepreneurs are motivated to behave proactively and internationalize as quickly as possible. Both mechanisms are especially relevant for new ventures in knowledge-intensive and high-technology industries; hence, while a few studies have investigated INVs in low technology industries (e.g., Bell et al., 2001), the research emphasis has been on internationalization of young firms in high-technology industries.

### 2.2. Where are INVs likely to occur more frequently?

Most scholars studying INVs have identified knowledge-intensive and technology-oriented sectors as a fertile ground for stimulating INVs (Oviatt and McDougall, 1994; Rialp et al., 2005; Bell et al., 2001). For example, Bell et al. (2001) report that knowledge-intensive firms are more likely than other types of firms to go international from the start, internationalize more rapidly, and adopt much more proactive and structured approaches to internationalization.

However, while the existing literature predicts a higher frequency of INVs in knowledge-intensive sectors, it has not investigated whether particular countries or regions are more likely to give rise to INVs in particular sectors. Knight and Cavusgil (2005) report that "born globals have begun to appear worldwide in large numbers" (p. 16). Similarly, Rialp et al. (2005), reviewing the empirical literature from 1993 to 2003, note that, "The emergence of early internationalizing firms has been reported in major trading countries throughout the world, thus demonstrating that this phenomenon is not country-specific. These firms have been found to exist in such diverse places as Australia, the US, Canada, Switzerland, Ireland, New Zealand, the UK, Germany, France, Spain, Israel, and the Nordic Countries" (p. 156).

### 2.3. What is the role of home-country demand in motivating INVs?

Although scholars have identified a variation in the propensity of rapid internationalization among industries, they have neglected to examine the possible variation among countries. Can it be assumed that new ventures in the same sector internationalize with the same frequency across different countries? Below, we theorize on the factors that may generate such a variation. Our starting point is an important but neglected motivation to internationalize: *the size of local demand the firm enjoys in its home country*.

Rialp et al. (2005) in their review, highlighted various factors that researchers have identified as facilitating the emergence of INVs. Although accessing resources in other countries is among the many factors highlighted, none of these concern the demand these firms can or cannot avail themselves of in their home markets. Rugman and Verbeke (1993), for example, observed that firms in Canada are much less focused on forming linkages and competing locally; in fact, increasingly they are forming international linkages to access markets in addition to accessing factors of production. Drawing on this observation, we have systematically reviewed the literature regarding small local demand as a motivation for new ventures to internationalize but have not found articles that empirically examine this motivation. This observation is also consistent with other reviews (see Keupp and Gassman, 2009). Simply put, the size of home-country demand has not been featured prominently as an explanation for early and rapid internationalization of new ventures.

Size of local demand, however, is an important factor that receives a great deal of attention in various strategy, innovation, entrepreneurship, and international business literatures. Demand considerations appear, for example, in discussions of the rise of multinational companies from emerging economies (see Buckley and Hashai, 2014). Demand as a concept has also played a significant role in the discussion of rates of innovation (Mowery and Rosenberg, 1979; Di Stefano et al., 2012). Among the most prominent approaches highlighting the importance of home demand is Porter's (1991) so-called "diamond framework."

Porter's diamond framework features four determinants of success: factor conditions, demand conditions, related and supporting industries, and firm strategy. In his book *The Competitive Advantage of Nations*, Porter stresses that the investment decisions of local firms are driven by the size and rate of growth of home demand, especially early in an industry's development (1990, p. 93). He explains the importance of having access to a large number of local buyers who are demanding and sophisticated (1990, p. 91). For this reason, a crucial question for countries with a much smaller domestic demand is how firms can overcome the fact that their local demand conditions are unfavorable. For example, although KPMG ranks Australia sixth among the top biotech countries in the world, the Australian market is too small to support the commercialization of the opportunities generated by Australian research (Smith and West, 2005; Sparling and Vitale, 2003) and "Australia lacks large internationalized firms in most industries where biotechnology is being applied" (Scott-Kemmis et al., 1990, p. 76).

We argue that new ventures in relatively small countries, where demand may even be quite sophisticated but is nevertheless limited, need to tap international markets from early on if they want to be able to compete with rivals in large countries. In other words, in addition to the various ability- and motivation-related factors of internationalization discussed above, size of the local market is another crucial motivational factor for new ventures to internationalize rapidly.

Similar to other factors highlighted in the INV literature, the size of local market is also particularly important in high-tech industry contexts where firms make substantial investments in R&D that they need to recoup. As the cost of R&D per unit output declines with scale of production (Klepper, 1996), the more a firm sells, the less costly the R&D effort per unit output will be and the more profitable the firm is likely to become. New firms in small countries, of course, quickly realize the competitive danger of small-local demand as they try to amortize the cost of R&D over a larger output. For example, Cochlear, a world leading developer and manufacturer of hearing aid products, was established in Australia in 1982 but rapidly began selling in international markets. We contend that new firms in countries with relatively small domestic demand will focus on international markets much more rapidly and frequently than firms from large-domestic-demand countries. Consequently, the geographic pattern of firm development will look different in small and large countries.

**Proposition.** Although international new ventures exist in both small and large countries, small countries will see their young firms internationalize more often than large countries.

**Table 1**
Types of R&D and business development partnerships.

| Research & development | Business development |
|---|---|
| • R&D partnership with a firm | • Distributorship (Regional/National/International) |
| • R&D partnership with a research institute | • Licensing of technologies |
| • R&D partnership with a university | • Joint development of a product with marketing arrangements (Regional/National/International) to share the revenue |

### 2.4. Partnership formation as an aspect of business development

Starting in the 1980s, formal partnerships have become a cornerstone of firms' strategies for success in the marketplace, especially for the firms in high-technology sectors (Hagedoorn, 2002; Contractor and Lorange, 2002). Due to a continuously evolving and expanding knowledge base, rapidly changing contexts of technological development, and difficulties of acquiring and maintaining sufficient resources to tap into different demand markets, firms typically need to join forces with other organizations by way of formal partnerships (Allen, 1983; Hagedoorn and Schakenraad, 1994; Ahuja, 2000; Zhong and Ozdemir, 2010). The entrepreneurship literature has highlighted the crucial role of partnerships for young ventures (e.g., Baum et al., 2000). Similarly, the international entrepreneurship literature on INVs has particularly emphasized the role of partnerships as a key mechanism for internationalizing a venture. In their seminal article on INVs, Oviatt and McDougall (1994) highlight that "a major feature that distinguishes new ventures from established organizations is the minimal use of internalization and the greater use of alternative transaction governance structures [such as partnerships]" (p. 55). Subsequent research has confirmed partnerships as a primary internationalization strategy of INVs (Keupp and Gassmann, 2009).

Firms enter into these formal partnerships for a variety of reasons that can be broadly classified into two groups: (i) to access and develop knowledge and technologies (R&D partnerships) (Narula and Hagedoorn, 1999; Greis et al., 1995), and (ii) to access and develop markets (business development partnerships) (Mariti and Smiley, 1983; Glaister and Buckley, 1996; Matthews and Zander, 2007). Table 1 shows subcategories of these two groups.

Firms may enter into R&D partnerships to facilitate transfer of knowledge and technologies from one firm to the other or to co-develop knowledge and technology by complementing each other's knowledge bases (Colombo et al., 2009; Gulati et al., 2000). In R&D partnerships, the focal firm usually spends money together with its partner, which can be another firm, a research institute, or a university. In industries where research and development is fast-paced and the risks of committing alone to R&D investments are large, firms frequently use formal partnerships to share the risks of such processes and obtain advantages through the associated learning.

Firms may enter into business development partnerships with other organizations to access the partner's resources and capabilities or to facilitate their own or their partner's entry into a new market and capture additional demand (Mathews and Zander, 2007; Oviatt and McDougall, 1994). These demand markets may be either in a foreign country or in a different industry within the same country as the focal firm. In business development partnerships, the focus is to bring money into the firm in the short and medium term by reaching bigger markets and developing economies of scale. A firm may enter into these business development partnerships for a number of reasons. First, it may simply seek a long-term formal partner to distribute its products at a regional, national or international level. Second, it may license its technology to obtain royalty payments. Third, it may want to co-develop market demand through bundling of both parties' products and services with the aim to jointly market and share revenue. A partnership may even be a requirement dictated by the host country's government (Glaister and Buckley, 1996). These typically entail active collaboration and combination of the resources and capabilities of both firms. In doing so, the focal firm is able to both share the risk and increase the speed of the business development process. In sum, for young firms, which lack both the experience and the slack resources to be used for market development and accessing market demand, a partnership is a very viable alternative, especially for accessing and developing international markets (Contractor and Lorange, 1988).

Researchers examining domestic and international partnerships have identified a sizeable number of international partnerships over the recent decades among low-, mid-, and high-tech industries, and the relative frequency of international partnerships has remained quite stable (Hagedoorn, 2002). In these international partnerships, firms not only try to tap into the potential demand of foreign markets but also seek knowledge and technologies while still aiming to optimize their value chains. In that way, they are following the two broad rationales we have discussed for why firms enter into formal partnerships. Regarding R&D partnerships, Hagedoorn (2002) finds that between 1960 and 1998 more than 50% of the partnerships were international.

INV theory predicts the existence of a significant number of international partnerships. But as we noted earlier, adherents of INV theory have not systematically investigated whether firms from small countries are more likely to internationalize early in order to access resources and demand. Large countries may have all the needed resources within their national borders, allowing firms to form partnerships domestically. In contrast, small countries may lack numerous resources and capabilities (Yetton et al., 1992). Government subsidies and incentives, for example, may not be sufficient to develop the necessary support institutions, such as research universities, or to create all the different resources and capabilities to make a venture successful. This provides young firms with an incentive to gain access to other countries where these resources may exist. A relatively small domestic market also gives firms the incentive to expand to one or more foreign countries in search of greater demand (Gertler and Levitte, 2005; Rugman and Verbeke, 1993). As a result, we expect firms in small countries to engage, on average, in more international than domestic partnerships. Furthermore, we expect this ratio of international to domestic partnerships to be higher in small countries than in large countries.

**H1.** In small- compared with large-home demand countries, firms are more likely to form international rather than domestic partnerships.

Strategy, innovation, and international entrepreneurship researchers have done substantial research on internationalization of partnerships. Most of this research, however, has concentrated on international R&D partnerships (i.e., the first of the two broad rationales for partnerships) (Narula and Santangelo, 2009; Steensma et al., 2000; Narula and Hagedoorn, 1999). In contrast, relatively little research in the strategy and innovation literature has focused on international business development partnerships in high-tech industries (i.e., the second of the two broad rationales for partnerships), although conceptually business development is seen as a key motivation to internationalize quickly in the INV literature (Jones et al., 2011). As stated previously, firms in small countries have a much stronger reason than firms in large

countries to develop international partnerships. These countries primarily lack sufficient domestic demand for the firms' products and, without securing access to sufficiently large markets, firms will not be able to continue their operations or fund the R&D efforts necessary in high-tech industries. Entering into international business development partnerships is therefore crucial for firms in these small countries. On the other hand, even in small countries, governments often fund or subsidize R&D efforts undertaken by domestic research institutes and universities, and there are many small countries with strong science capabilities, such as Taiwan and Israel. For this reason, firms in small countries may be able to carry out research and development via either domestic or international R&D partnerships. Therefore, we expect that firms in small countries are able to access knowledge and technology via domestic R&D partnerships to a larger extent than they can access satisfactory demand via domestic business development partnerships. These considerations lead to the following hypothesis:

**H2.** In small-home demand countries, firms are more likely to form international partnerships for business development purposes than for R&D purposes.

Given the distinction between R&D and business development partnerships, we can revisit Hypothesis 1 with a focus on the distinction between small and large countries in terms of their propensities to form business development partnerships. Firms in large countries already have access to significant potential domestic demand. They may still need to form business development partnerships either to share risks or to augment their resources, but their primary target would continue to be the readily available local market before attending to the demand potential of international markets (Hergert and Morris, 1988). On the other hand, although firms in small countries would continue to tap into domestic demand, since local demand is small and often not adequate to fully support their operations, they would also be keen to tap into international markets. This would direct firms in small countries to form international business development partnerships more often than firms in large countries. Therefore, we expect:

**H3.** In small- compared with large-home demand countries, firms are more likely to form international rather than domestic partnerships for business development.

## 3. Method

### 3.1. Sample and setting

To test our hypotheses regarding the partnership patterns of new ventures in small- vs. large-domestic demand countries in high-tech industries, we have selected the health sector of the biotechnology industry. Biotech is a knowledge-intensive industry with a high frequency of new ventures that regularly enter into both upstream and downstream partnerships (Aggarwal and Hsu, 2009; Audretsch and Feldman, 2003; Stuart et al., 2007). Like those in other knowledge-intensive and high-technology industries, firms in the biotechnology industry have benefited from falling costs of communication and transportation and other reduced production and transaction costs, resulting in an increase in their ability to internationalize rapidly. Moreover, in an attempt to bring cheaper pharmaceuticals to their citizens, a large number of governments around the world have abolished tariff barriers surrounding the importation of pharmaceutical products, although barriers related to regulatory approval still remain strong (European Commission, 2011). This has not only yielded an increase in the ability of young biotechnology firms to engage in international activities, but also increased their motivation to engage in defensive internationalization activities to stave off potential competitors. Furthermore, the motivation to capitalize on the small window of opportunity they have when they invent a new product, service, or process has encouraged firms in the biotechnology industry to actively conduct their business on an international scale from early on. Health is the largest sector of the biotech industry in all developed countries and comprises many sub-segments. We focus our analyses on two major sub-sectors of health biotech – therapeutics (vaccines & diagnostics) and R&D services – rather than a single one, to demonstrate the generalizability of our results.

To investigate whether young firms in small countries differ from their counterparts in large-demand countries in their patterns of domestic and international partnerships, we required a large sample of firms from at least two countries that differ significantly in their local demand for health biotech products. Demand for biotech products was estimated by obtaining data on total healthcare expenditure from the World Health Organization (WHO, 2012). We selected Australia, Israel and Taiwan as small-local demand countries. For large-demand countries we chose the US, Japan, Germany, UK, and France. Using Australia as a point of comparison, the relative size of the health markets according to 2005 WHO total healthcare expenditure data is as follows: Australia = 1, Israel = 0.2, Taiwan = 0.6, UK = 2.7, France = 3.3, Germany = 4.6, Japan = 5.2, all of EU = 20.1, and US = 32.9.

Following Beckman (2006) and Certo et al. (2001), we focused on firms that had been in operation for less than 11 years, as only such firms are deemed as "young" among high technology firms.[1] We performed our original data collection during 2009 and 2010, focusing on all companies established after January 1998 (i.e., firms in operation for no more than 10 years). Given that it takes time to forge partnerships after the start of a company, we have decided to include only firms that were established before December 2004. We have collected information on these firms regarding the partnerships they have forged until December 2009 or the end of their 10th year of existence.

### 3.2. Data sources and data collection procedures

To obtain a comprehensive list of startup biotech firms in our sample countries, we consulted the leading providers of information on the biotech industry: BioScan, Thomson Reuters Cortellis, Internet CM's NewsAnalyzer and IndustryAnalzyer (this service is no longer available but similar information is now provided by Thomson Reuters Cortellis), Biotechgate, and Elsevier Business Intelligence (formerly called Windhover). By comparing the absolute number of firms covered and the overlap in the coverage of different firms between any two databases, we determined that we could achieve the best coverage across our sample countries by using both Biotechgate and Elsevier Business Intelligence to identify new biotech startups. In the case of Australia, we used Elsevier Business Intelligence and information on firms collected by the Australian biotech trade organization (AusBiotech) for two reasons: It provided the most comprehensive coverage of Australian firms and Biotechgate was clearly inferior to both data sources. Data on Israeli and Taiwanese firms were collected later in response to feedback from reviewers, and we followed the same procedure as in the case of Australia in that we also relied on national trade directories to establish a list of relevant firms in addition to relying on Elsevier Business Intelligence.[2] To bring efficiency to our data collection efforts, for the US setting, we focused on two states

[1] Our results remain unchanged when we perform the empirical analyses on firms that had been in operation for less than or equal to 8 years.

[2] The Source on Israel is Israel Science and Technology Directory, section on Biotechnology and Biomedical Companies http://www.science.co.il/Biomedical-Companies.asp. The Source on Taiwan is 2011 Taiwan Biotechnology

that represent key biotech clusters – California and Massachusetts. By combining the two most comprehensive data sources for each country, we have assembled not a small sample of start-ups but what can be regarded as virtually the full sample of relevant biotech start-ups from 1 January 1998 to December 2004. Only those companies formed by nascent entrepreneurs were considered-corporate ventures or companies formed by mergers/acquisitions were not considered. We verified the year of formation and the category of sub-sector by looking into the current objectives of firms and tallying them with their original objectives at the time of establishment or earlier formative years. Based on this search we obtained the following number of new companies formed between January 1998 and December 2004 for the eight countries in the two sectors of the biotech industry: US 151, UK 75, Germany 43, France 27, Israel 24, Australia 19, Japan 11, and Taiwan 10.

Next, we compiled a full list of partnerships formed by each company. We used four databases – NewsAnalyzer, Cortellis, Elsevier Business Intelligence, and Factiva – to identify news items about partnerships and then develop a list of partnerships from them for each company. We also looked into the companies' websites to search for their partnerships. We were primarily interested in the nature of the partnership (e.g., R&D or business development), year of the partnership, and location of the partner (based on the headquarters of the partnering firm). This led to a total list of 1838 partnerships by 360 new ventures in our dataset.

We distinguished between three types of partnerships: research and development (RD), business development (BD), and a residual category (other), which includes partnerships that did not fall clearly into either the RD or BD category. One member of the research team, who is an expert on the biotech industry, developed a coding scheme to distinguish between BD and RD partnerships and other types of partnerships based on the objective of the partnership.

Coded from the perspective of a focal firm, the key distinction between an RD and a BD partnership concerns the flow of financial resources. RD partnerships are typically those where a company is either investing its money to make progress in an ongoing developmental project or is in-licensing/partnering to start a new project. This means money flows out of the focal firm in an RD partnership, although not necessarily to the partner firm. BD partnerships are typically those that have an immediate positive effect on the cash flow of the focal firm. This could be either due to the firm generating new business, accessing demand domestically or internationally, or because the focal firm buys something that has the capability to start generating revenues instantaneously, without investing much into the research and/or development side. This means money flows (or is likely to flow soon) into the focal company in a BD partnership, although not necessarily from the partner firm. A detailed coding scheme with examples of different instances of BD and RD partnerships was developed (see Online Supplement 1). We checked the validity of the coding scheme by asking an independent scholar (who is also an expert in the biotech industry) to code 60 randomly chosen partnerships. In 77% of the cases, the independent coder came up with the same decisions, giving us confidence in the validity of the coding scheme.[3]

We coded a partnership as being either domestic or international from the point of view of the focal firm. In the case of the three European countries, we also coded any partnership as domestic when the partnership was with another firm in the EU. Since 1995, there has been a pan-European agency for drug approval, the European Medicines Agency (EMA). If a firm obtains approval for its pharmaceutical product through this agency, the product is automatically approved in all the EU member countries and the firm can sell its product (or service) freely in any part of the EU (as well as in Norway and Iceland, which accept EMA's approval) (European Medicines Agency, 2013). There are no other trade or tariff barriers within the EU. As a result, a firm in an EU member country experiences no trade barrier at all if it wants to engage in business activity in another EU country. This means that the distinguishing factor between a domestic and international partnership is the lack (or presence) of any regulatory, trade, and tariff barriers between two countries.[4] In our dataset, other than countries within the EU (plus Norway and Iceland), all other country pairs have some form of regulatory, trade, or tariff barriers between them, resulting in partnerships between firms in two such countries being classified international.

### 3.3. Variables and empirical estimation methodology

Hypotheses 1–3 are all concerned with predictions that a focal firm in a small-local demand country would be more likely to form an international rather than a domestic partnership compared to a new firm in a large-demand country. Although a simple odds ratio comparison and two-sample *t*-test may strike one as sufficient to test these predictions, in reality a much more detailed and carefully thought out empirical analysis process needs to be performed in order to control for the underlying distribution of partnership opportunity structure. This is because economic activity is unevenly distributed among these locations and this may systematically influence the likelihood of forming domestic vs. international partnerships.[5]

The literature on geographic concentration and agglomeration sheds light on why such an approach is needed. While a Herfindahl index of company location choices yields a measure of concentration, a true test of concentration of an industry in a geography, as proposed by Krugman (1991) in the form of Gini coefficient or by Ellison and Glaeser (1997) in the form of Ellison–Glaeser index, dictates that one can conclude an industry to be concentrated only if that industry is more concentrated than expected to be under a carefully selected baseline criteria (also see Di Giacinto and Pagnini, 2011 for an alternative index). In Ellison and Glaeser (1997) and Krugman (1991), this baseline is the share of overall manufacturing employment, while in Ellison and Glaeser (1999), share of total population is also included into the baseline criteria. For example, if the industry's share of employment in a specific geography is 20% while that specific geography has on average 15% of overall manufacturing employment, one can conclude that the industry is more concentrated in that geography than otherwise would be expected. On the other hand, if the industry's share of employment in a specific geography is 50% and that geography also has on average 50% of overall manufacturing employment, then the conclusion would be that the industry is not more concentrated in that geography than would be expected.[6]

From this economic geography literature, we adapt the insight that it is crucial to control for underlying distribution of opportunity structure. Only then can one answer if firms in small-local demand countries internationalize more or less often than their

Industry Directory, edited by the "Biotechnology and Pharmaceutical Industry Program Office (BIPO) of the Ministry of Economic Affairs".

[3] Yin and Heald (1975) explain that two-thirds agreement is adequate for internal consistency, much as the Spearman–Brown reliability coefficient of 0.67 is considered adequate.

[4] We thank one of our anonymous reviewers for helping us clarify this important point.

[5] A second reviewer deserves credit for getting us to see this point clearly and improve our methodology considerably to deal with this challenge.

[6] While our example is a very simplified version and in reality both Gini coefficient and Ellison–Glaeser index capture concentration at the industry level, we believe this example serves the purpose of clarifying the essence.

counterparts in large countries compared to what can be expected through pure realization of opportunity structure. In other words, the relevant research question becomes: *Even after accounting for underlying opportunity structure, do small-demand country young ventures internationalize more often than large-demand country counterparts*? A related question, again coming from the economic geography literature, is: Among factors that represent different underlying opportunity structures, which factor(s) best capture the differences observed?[7]

The next task in the empirical methodology, then, would be to identify potential sources of differences in underlying opportunity structure. An immediate one is the size of local demand, as we have hypothesized above. Another may be the distribution of potential alliance partners domestically and internationally. For example, firms in large countries not only have the luxury of a larger domestic demand, but they also enjoy, on average, a larger pool of potential domestic partners. On the other hand, firms in small countries have smaller domestic demand and likely face fewer potential domestic partners. If partnership formations were completely random, for example, then new ventures from small countries would automatically have higher rates of international rather than domestic partnerships. A simple, numerical example illustrates this point. To keep it simple, assume that the world consists of two countries: one small country with 10 firms and one large country with 90 firms. If firms indeed find partners through a completely random matching process, in this model world, firms in the small country would form international partnerships with a probability of 90%. This means that 9 of 10 partnerships would be expected to be international. The situation in the large country would be very different: Firms in the large country would form international partnerships with a probability of 10%. This means that only 1 out of 10 partnerships would be expected to be international.

Although we know that partnership choices are not completely random due to a number of factors such as geographic, cultural, and political distance between potential partners (e.g., Head and Mayer, 2004), a strong test of our hypotheses would evaluate whether new ventures from small countries form international partnerships more often than those from large countries even after accounting for the distribution of potential alliance partners. Similarly, integration of a focal country to the global economy through lower trade barriers may also affect the ability of firms to internationalize. To the extent that firms in a country face higher trade barriers and tariffs as they try to internationalize, they may be less able and inclined to do so. If we are to present support for our hypotheses, we should demonstrate evidence for the explanatory power of size of local demand (as a measure of underlying motivational factor to internationalize) even after accounting for distribution of alliance partners, trade barriers, or other related factors.

Since our dependent variables are binary and we are essentially interested in comparing the odds, we perform logistic regression. Furthermore, our data includes observations for the same firms over many years and we need to account for firm-level effects. Therefore, we use logistic regression procedures developed for cross-sectional time series (panel) data. Altogether, we use two different logistic regression procedures to test the hypotheses.

We start with panel data standard logistic regression, which allows us to set the context and show that there are differences among countries in terms of the internationalization behavior of new ventures. We perform this analysis since most readers would be familiar with it and find it straightforward to interpret its results. Using STATA's xtlogit command, we estimate: $\text{logit}(Y_{ijt}) = b_0 + b_1 \text{FL}_i + b_2 \text{PT}_{ij} + b_3 \text{Age}_i + b_4 \text{Period}_t$, where the dependent variable $Y_{ijt}$ is whether the partnership is international. FL is the location of the focal firm, PT is the partnership type, Age is the age of the focal firm at the time of the partnership, and Period is the period dummies.

Then we use hierarchical linear modeling (also called multi-level modeling methodology) that allows us to explicitly control for underlying factors that may affect the partnership patterns of the companies and perform multi-level mixed-effects logistic regression using STATA's xtmelogit command. We model the data as 3 levels, since partnership-level observations are nested in companies that are in turn nested in countries. The advantage of such modeling is the ability to increase statistical precision in testing hypotheses at a higher level (such as at the country level) while using data at a lower level (such as partnership level) (Peterson et al., 2012; Hofmann, 1997). As such, only with this procedure are we able to truly address the challenges raised above, introduce various variables that account for the underlying factors mentioned earlier, and thoroughly test our hypotheses.

As a result, through using hierarchical linear modeling methodology, we obtain reliable estimates of the country-level variation and show the crucial role the size of the total domestic healthcare expenditure plays in it, while accounting for alternative explanations that may also account for international partnership formation behavior. We control for the distribution of alliance partners (i.e., how many of them are domestic vs. international), trade barriers firms in a given country face when they try to establish international partnerships, the biotechnology science base of the country, and the underlying propensity of an alliance between two firms to exist. Confirming Hypotheses 1 and 3 would mean finding evidence that size of the local market helps explain internationalization behavior beyond what could be explained by the underlying distribution of alliance partners, trade barriers, science base, or other explanatory factors. We would not be able to obtain this by just using panel data specification.

#### 3.3.1. Dependent variables

The dependent variable in all regressions is whether the partnership is domestic or international. *INTERNATIONAL PARTNERSHIP* is measured as a binary variable. From the perspective of the focal company, if the partner firm is located in a different country (or outside the EU region for EU countries), then we code this variable as 1; otherwise, i.e., for domestic partnerships, this variable is coded 0.

#### 3.3.2. Independent variables

To track whether the focal firm resides in a large or small economy, we use two different variables. In the standard panel data logistic regression, our primary independent variable is the *LOCATION OF THE FOCAL FIRM*. We capture this by using 8 different binary variables (country dummies) that represent whether the firm is in Australia or not, in France or not, etc., for each of the 8 countries in our sample. In the multi-level logistic regression, we are able to directly introduce into the analyses the estimated size of the domestic demand for biotechnology products and services in the focal company's country. We capture the *DOMESTIC DEMAND* by using the World Health Organization's total healthcare expenditure data (WHO, 2012) and lag this variable by one year. For a partnership that happens, for example, between a Japanese firm (the focal firm) and a Malaysian firm in 2000, this variable represents the total healthcare expenditure in Japan in 1999. The original data is in billions of dollars, so we log the variable and use the logged version.

Another independent variable we utilize is the *TYPE OF THE PARTNERSHIP*, whether the partnership is BD or RD. We code a binary variable that takes the value 1 when the partnership is for business development and 0 otherwise.

[7] This is similar to how Ellison and Glaeser (1999) model both natural advantages and spillover effects in the concentration index and discuss which one explains how much of the concentration observed.

We also control for the firm's lifecycle and macro-economic conditions. As the company matures and exhausts the local demand over time, it may become more likely to try to tap into demand beyond what is present within the local economy (Johanson and Vahlne, 1977), increasing the likelihood of forming international partnerships. We capture the lifecycle of the firm by measuring the *AGE OF THE FIRM* at the time of the partnership as the difference between the partnership year and the founding year of the firm. The global and local macro-economic conditions may affect the partnership patterns of the companies as well. We constructed 4 different *PERIOD DUMMIES* for the 1998–2009 time period: the period 1998–1999 representing the dot-com boom; 2000–2002 for the dot-com bust; 2003–2007 for the recovery period after the bust; and 2008–2009 for the Global Financial Crisis.

In the hierarchical linear model regressions, we are also able to introduce five additional variables to control for underlying distributions of partnership abilities and motivations: (i) the number of potential alliance partner companies within/outside the focal company's country, (ii) the ratio of potential domestic to international alliance partners, (iii) the average trade barriers firms from a particular country face when they want to form an international alliance, (iv) the science base within the country, and (iv) the underlying propensity of an alliance to exist between the two firms. We capture the *NUMBER OF POTENTIAL DOMESTIC ALLIANCE PARTNERS* by counting the number of active companies in that country in our dataset. Continuing with our example above, this variable would represent the number of Japanese firms that either originated or were targets of an alliance. This number and the *NUMBER OF POTENTIAL INTERNATIONAL ALLIANCE PARTNERS* are essentially the same from a statistical perspective, since the number of international alliance partners is the difference between all potential partners in the world (which is a constant for a given year) and the number of potential domestic partners. The coefficients would just have the reverse sign (one positive and the other one negative). We capture the *RATIO OF POTENTIAL DOMESTIC TO INTERNATIONAL ALLIANCE PARTNERS* by dividing the number of potential domestic partners by the number of potential international alliance partners. We account for the *AVERAGE TRADE BARRIERS FIRMS IN A COUNTRY FACE* by first calculating dyadic trade barriers for all the countries in our dataset. For each country pair, we identify two levels of trade barriers. First, we check whether a firm in the focal country can get immediate approval for its pharmaceutical product in the target country. Second, we investigate whether a firm in the focal country can at least expedite the regulatory approval process in the target country. After these dyadic measures are constructed, we calculate the average trade barriers the focal country faces by calculating the mean trade barrier level among all potential target countries (all countries appearing in our dataset). We use the number of citations biotechnology related academic papers published by authors located in the focal country have received to account for the *SCIENCE BASE IN A COUNTRY*. We obtain this data from the SCImago Journal and Country Science Rank (SCImago, 2014). Finally, we calculate and introduce the *UNDERLYING PROPENSITY OF PARTNERSHIP BETWEEN THE TWO FIRMS* into the empirical analysis. In order to calculate this variable, we have developed a new dataset where for each observed alliance between two firms in our existing data, we have introduced all possible non-realized alliances by forming dyads between the focal firm of the alliance and all other firms in our dataset that entered into an alliance in that year. These essentially represent potential partners with which the firm could have formed an alliance but did not. In other words, we have generated a matched sample of alliance realizations and non-realizations from the perspective of the focal firm. Next, we have done bootstrapped logistics regressions (1000 repetitions, randomly select 5 non-realized and keep the realized at each repetition) on whether the alliance is realized or not with predictor variables that include trade barriers, geographical distance, cultural distance, same official language, target firm's country's total health expenditure, and number of firms in the target firm's country. After obtaining the coefficients of these predictors, we computed the propensity for a realized alliance in our original dataset by summing up the coefficient times variable values and taking the inverse logit of the result. Next, we include this variable as a predictor in the multilevel mixed effects logit model as our fourth alternative way to capture an underlying factor of partnership ability and/or motivation. Table 2 presents the summary statistics for all variables, while Table 3 presents the correlation table. (The Online Supplement 2 presents more detailed descriptive statistics showing age and type distribution of firms across the different countries in our study.)

## 4. Data analysis

Hypothesis 1 predicts that new ventures in small countries are more likely to enter into international rather than domestic partnerships compared to ones in the large countries. We first present the relative frequency of international and domestic partnerships of companies in our sample and then test this hypothesis through econometric estimation techniques.

Panel 1 in Table 4 presents the frequency statistics and the ratio of each type of partnership for the small (Australia, Israel, and Taiwan) and large (France, Germany, Japan, UK, and US) countries. In Australia, Israel, and Taiwan, there are a total of 140, 91, and 23 partnerships, respectively. Among these partnerships, 105 (75%), 62 (68%), and 19 (83%) of them are international. On the other hand, in all large countries, the frequency of international partnerships is much lower than the frequency of domestic partnerships, with the highest percentage for international partnerships out of all partnerships being in the US, with 40%.

Model 1 in Table 5 presents the results of the panel data standard logistic regression investigating the differences in international partnership patterns among countries after controlling for the lifecycle of the firm and macro-economic conditions. We observe that firm age positively affects the likelihood of forming an international partnership (coeff: 0.066, $z$-value = 2.14), while there are no significant differences in international partnership formation patterns among different time periods when compared to the dot-com bust period of 2000–2002. We also find that as the firm gets a year older, the likelihood of it forming an international rather than domestic partnership increases by 6.8%.

We take *Whether the focal firm is in Israel* as our base category among the country-level dummy variables.[8] As a result, the coefficient of the *Is the focal firm in France* variable represents an increase (if the coefficient is positive) or a decrease (if the coefficient is negative) in the likelihood that the partnership would have been international rather than domestic, if an equivalent focal firm in the same time period was in France instead of Israel. While the country dummy variables for the other two small-demand countries are positive but not significant, all of the country dummy variables for large countries are significantly negative, with the coefficients ranging from −1.11 for the US to −1.23 for Japan (at 99% confidence interval, $z$-values range from 3.23 to 4.12). This negative coefficient confirms that biotechnology companies in those 5 large-demand

[8] We use Israel as a base country in order to make the distinction between internationalization patterns of small- and large-local demand countries much clearer. In our empirical analysis, we first used Australia as the base category, since it was our original small-demand country. However, we found that Israel represented a clearer pattern, since its country-level coefficient was the lowest among the small demand countries (i.e., closest to the coefficients of large demand countries). In other words, if the new ventures in the large countries in our dataset have statistically significantly different internationalization patterns than their counterparts in Israel, then they are also significantly different from their counterparts in Australia and Taiwan.

**Table 2**
Summary statistics.

| | Variable | Obs. | Mean | Std. dev. | Min. | Max. |
|---|---|---|---|---|---|---|
| [1] | Is partnership international | 1838 | 0.439 | 0.496 | 0 | 1 |
| [2] | Age of the company | 1838 | 5.425 | 2.330 | 1 | 10 |
| [3] | Period dummy (1998–1999) | 1838 | 0.011 | 0.106 | 0 | 1 |
| [4] | Period dummy (2000–2002) | 1838 | 0.192 | 0.394 | 0 | 1 |
| [5] | Period dummy (2003–2007) | 1838 | 0.629 | 0.483 | 0 | 1 |
| [6] | Period dummy (2008–2009) | 1838 | 0.166 | 0.373 | 0 | 1 |
| [7] | Focal company is in France | 1838 | 0.086 | 0.280 | 0 | 1 |
| [8] | Focal company is in Germany | 1838 | 0.109 | 0.312 | 0 | 1 |
| [9] | Focal company is in UK | 1838 | 0.229 | 0.420 | 0 | 1 |
| [10] | Focal company is in EU | 1838 | 0.424 | 0.494 | 0 | 1 |
| [11] | Focal company is in Japan | 1838 | 0.047 | 0.211 | 0 | 1 |
| [12] | Focal company is in MA, USA | 1838 | 0.127 | 0.333 | 0 | 1 |
| [13] | Focal company is in CA, USA | 1838 | 0.264 | 0.441 | 0 | 1 |
| [14] | Focal company is in USA | 1838 | 0.391 | 0.488 | 0 | 1 |
| [15] | Focal company is in Australia | 1838 | 0.076 | 0.265 | 0 | 1 |
| [16] | Focal company is in Israel | 1838 | 0.050 | 0.217 | 0 | 1 |
| [17] | Focal company is in Taiwan | 1838 | 0.013 | 0.111 | 0 | 1 |
| [18] | Partnership is for business development | 1838 | 0.577 | 0.494 | 0 | 1 |
| [19] | Total health expenditure (logged, lagged by 1 year) | 1838 | 20.448 | 1.369 | 16.204 | 21.580 |
| [20] | Ratio of domestic to international potential partners | 1838 | 0.520 | 0.229 | 0.010 | 0.635 |
| [21] | Number of potential international partners | 1838 | 1417.050 | 282.381 | 1278 | 2069 |
| [22] | Originating country average trade barriers | 1838 | 1.144 | 0.403 | 0.696 | 1.696 |
| [23] | Originating country science base (citable documents, logged, 2 year window) | 1838 | 7.883 | 0.968 | 5.187 | 9.703 |
| [24] | Originating country science base (received citations, logged, 2 year window) | 1838 | 11.357 | 1.027 | 8.523 | 12.547 |
| [25] | Propensity of alliance controlling for underlying decision mechanisms | 1838 | 0.785 | 0.119 | 0.497 | 0.986 |
| | Propensity of alliance (BD alliance only) | 1061 | 0.892 | 0.059 | 0.734 | 0.992 |

**Table 3**
Correlation table.

| | [1] | [2] | [3] | [4] | [5] | [6] | [7] | [8] | [9] | [10] | [11] | [12] | [13] | [14] | [15] | [16] | [17] | [18] | [19] | [20] | [21] | [22] | [23] | [24] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| [1] | 1.00 | | | | | | | | | | | | | | | | | | | | | | | |
| [2] | 0.09 | 1.00 | | | | | | | | | | | | | | | | | | | | | | |
| [3] | −0.02 | −0.18 | 1.00 | | | | | | | | | | | | | | | | | | | | | |
| [4] | −0.03 | −0.52 | −0.05 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| [5] | 0.00 | 0.10 | −0.14 | −0.63 | 1.00 | | | | | | | | | | | | | | | | | | | |
| [6] | 0.04 | 0.48 | −0.05 | −0.22 | −0.58 | 1.00 | | | | | | | | | | | | | | | | | | |
| [7] | −0.04 | 0.02 | 0.04 | 0.02 | 0.01 | −0.05 | 1.00 | | | | | | | | | | | | | | | | | |
| [8] | −0.03 | 0.04 | 0.00 | −0.04 | 0.07 | −0.05 | −0.11 | 1.00 | | | | | | | | | | | | | | | | |
| [9] | −0.05 | −0.03 | −0.01 | −0.01 | −0.03 | 0.06 | −0.17 | −0.19 | 1.00 | | | | | | | | | | | | | | | |
| [10] | −0.08 | 0.02 | 0.01 | −0.02 | 0.03 | −0.01 | 0.36 | 0.41 | 0.63 | 1.00 | | | | | | | | | | | | | | |
| [11] | −0.05 | −0.02 | 0.00 | −0.05 | 0.05 | −0.01 | −0.07 | −0.08 | −0.12 | −0.19 | 1.00 | | | | | | | | | | | | | |
| [12] | −0.05 | −0.06 | −0.04 | 0.00 | 0.03 | −0.03 | −0.12 | −0.13 | −0.21 | −0.33 | −0.08 | 1.00 | | | | | | | | | | | | |
| [13] | −0.04 | −0.05 | 0.04 | 0.10 | −0.09 | 0.01 | −0.18 | −0.21 | −0.33 | −0.51 | −0.13 | −0.23 | 1.00 | | | | | | | | | | | |
| [14] | −0.07 | −0.09 | 0.01 | 0.09 | −0.06 | −0.01 | −0.25 | −0.28 | −0.44 | −0.69 | −0.18 | 0.48 | 0.75 | 1.00 | | | | | | | | | | |
| [15] | 0.18 | 0.07 | −0.01 | 0.01 | 0.04 | −0.06 | −0.09 | −0.10 | −0.16 | −0.25 | −0.06 | −0.11 | −0.17 | −0.23 | 1.00 | | | | | | | | | |
| [16] | 0.11 | 0.09 | −0.02 | −0.10 | 0.01 | 0.09 | −0.07 | −0.08 | −0.12 | −0.20 | −0.05 | −0.09 | −0.14 | −0.18 | −0.07 | 1.00 | | | | | | | | |
| [17] | 0.09 | 0.01 | −0.01 | −0.01 | −0.06 | 0.07 | −0.03 | −0.04 | −0.06 | −0.10 | −0.02 | −0.04 | −0.07 | −0.09 | −0.03 | −0.03 | 1.00 | | | | | | | |
| [18] | 0.05 | 0.15 | −0.04 | −0.11 | 0.04 | 0.08 | 0.06 | 0.01 | 0.04 | 0.07 | −0.05 | −0.04 | 0.01 | −0.02 | 0.01 | −0.06 | −0.02 | 1.00 | | | | | | |
| [19] | −0.20 | −0.02 | 0.00 | 0.00 | −0.02 | 0.03 | 0.07 | 0.09 | 0.15 | 0.23 | −0.15 | 0.24 | 0.36 | 0.49 | −0.55 | −0.68 | −0.25 | 0.07 | 1.00 | | | | | |
| [20] | −0.19 | −0.10 | 0.03 | 0.08 | −0.04 | −0.03 | 0.15 | 0.18 | 0.27 | 0.43 | −0.43 | 0.17 | 0.27 | 0.36 | −0.61 | −0.49 | −0.25 | 0.06 | 0.92 | 1.00 | | | | |
| [21] | 0.19 | 0.10 | −0.03 | −0.08 | 0.04 | 0.03 | −0.15 | −0.17 | −0.27 | −0.42 | 0.42 | −0.17 | −0.27 | −0.37 | 0.61 | 0.50 | 0.26 | −0.06 | −0.92 | −1.00 | 1.00 | | | |
| [22] | 0.04 | −0.03 | −0.01 | 0.01 | -0.04 | 0.04 | −0.34 | −0.39 | −0.60 | −0.95 | 0.27 | 0.34 | 0.53 | 0.71 | −0.04 | 0.29 | 0.15 | −0.08 | −0.15 | −0.34 | 0.33 | 1.00 | | |
| [23] | −0.16 | −0.02 | 0.04 | 0.01 | -0.08 | 0.08 | −0.23 | −0.08 | −0.16 | −0.31 | 0.06 | 0.38 | 0.61 | 0.81 | −0.42 | −0.54 | −0.22 | 0.02 | 0.83 | 0.62 | −0.63 | 0.37 | 1.00 | |
| [24] | −0.16 | −0.11 | 0.00 | 0.10 | -0.05 | −0.04 | −0.22 | −0.05 | −0.18 | −0.31 | −0.07 | 0.41 | 0.64 | 0.86 | −0.42 | −0.50 | −0.27 | 0.01 | 0.83 | 0.68 | −0.69 | 0.36 | 0.97 | 1.00 |
| [25] | −0.80 | −0.08 | 0.01 | 0.01 | 0.00 | 0.00 | −0.01 | −0.02 | 0.14 | 0.10 | 0.10 | 0.05 | −0.02 | 0.01 | −0.17 | −0.10 | −0.07 | −0.07 | 0.17 | 0.15 | −0.15 | −0.06 | 0.13 | 0.11 |

**Table 4**
Tabulated domestic vs. international partnership patterns in small and large local demand countries.

| | | | PANEL 1 All Partnerships | | | PANEL 2 Business development partnerships | | | PANEL 3 Research and development partnerships | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Domestic | International | Total | Domestic | International | Total | Domestic | International | Total |
| Small countries | Australia | Freq. | 35 | 105 | 140 | 15 | 68 | 83 | 15 | 27 | 42 |
| | | Pct. | 25% | 75% | 100% | 18% | 81% | 100% | 36% | 64% | 100% |
| | Israel | Freq. | 29 | 62 | 91 | 11 | 30 | 41 | 16 | 21 | 37 |
| | | Pct. | 32% | 68% | 100% | 27% | 73% | 100% | 43% | 57% | 100% |
| | Taiwan | Freq. | 4 | 19 | 23 | 2 | 9 | 11 | 2 | 8 | 10 |
| | | Pct. | 17% | 83% | 100% | 18% | 82% | 100% | 20% | 80% | 100% |
| | Small country total | Freq. | 68 | 186 | 254 | 28 | 107 | 135 | 33 | 56 | 89 |
| | | Pct. | 27% | 73% | 100% | 21% | 79% | 100% | 37% | 63% | 100% |
| Large countries | France | Freq. | 98 | 60 | 158 | 66 | 40 | 106 | 20 | 15 | 35 |
| | | Pct. | 62% | 38% | 100% | 62% | 38% | 100% | 57% | 43% | 100% |
| | Germany | Freq. | 121 | 80 | 201 | 68 | 50 | 118 | 47 | 25 | 72 |
| | | Pct. | 60% | 40% | 100% | 58% | 42% | 100% | 65% | 35% | 100% |
| | Japan | Freq. | 57 | 29 | 86 | 32 | 8 | 41 | 20 | 19 | 39 |
| | | Pct. | 66% | 34% | 100% | 80% | 20% | 100% | 51% | 49% | 100% |
| | UK | Freq. | 255 | 165 | 420 | 142 | 114 | 256 | 92 | 41 | 133 |
| | | Pct. | 61% | 39% | 100% | 56% | 44% | 100% | 69% | 31% | 100% |
| | US | Freq. | 433 | 286 | 719 | 236 | 170 | 406 | 174 | 101 | 275 |
| | | Pct. | 60% | 40% | 100% | 58% | 42% | 100% | 63% | 37% | 100% |
| | Large country total | Freq. | 964 | 620 | 1584 | 544 | 382 | 926 | 353 | 201 | 554 |
| | | Pct. | 61% | 39% | 100% | 59% | 41% | 100% | 64% | 36% | 100% |
| Overall total | | Freq. | 1032 | 806 | 1838 | 572 | 489 | 1061 | 386 | 257 | 643 |
| | | Pct. | 56% | 44% | 100% | 54% | 46% | 100% | 60% | 40% | 100% |

*Note*: The table includes data for both the frequency and percentages information for all partnerships, business development partnerships, and research development partnerships.

**Table 5**
Panel data standard logistic regression analysis of partnership patterns for Hypotheses 1–3. The models correct for the non-independence of partnership observations from the same firm.

| | Is partnership international | | |
|---|---|---|---|
| Variables | Model 1<br>All partnerships | Model 2<br>Only small country originated partnerships | Model 3<br>Only business development partnerships |
| Age of the company | 0.0662* | −0.0508 | 0.1215** |
| | [2.147] | [−0.627] | [2.963] |
| Period dummy (1998–1999) | −0.1332 | | 0.9096 |
| | [−0.267] | | [1.135] |
| Period dummy (2003–2007) | −0.0716 | 0.2606 | −0.4847* |
| | [−0.453] | [0.533] | [−2.188] |
| Period dummy (2008–2009) | −0.0595 | 0.8973 | −0.5261† |
| | [−0.254] | [1.371] | [−1.672] |
| Focal company is in France | −1.2043*** | | −1.5945*** |
| | [−3.741] | | [−3.567] |
| Focal company is in Germany | −1.1368*** | | −1.3341** |
| | [−3.754] | | [−3.105] |
| Focal company is in Japan | −1.2296** | | −2.2990*** |
| | [−3.226] | | [−3.978] |
| Focal company is in UK | −1.1406*** | | −1.2155** |
| | [−4.083] | | [−3.019] |
| Focal company is in USA | −1.1126*** | | −1.3463*** |
| | [−4.122] | | [−3.423] |
| Focal company is in Australia | 0.3970 | | 0.4221 |
| | [1.165] | | [0.864] |
| Focal company is in Taiwan | 0.8986 | | 0.5811 |
| | [1.431] | | [0.651] |
| Partnership is for business development | | 0.6972* | |
| | | [2.329] | |
| Constant | 0.3847 | 0.6270 | 0.7135† |
| | [1.296] | [1.312] | [1.646] |
| Observations | 1838 | 253 | 1061 |
| Number of unique companies | 360 | 53 | 307 |
| Number of variables | 11.0000 | 4.0000 | 11.0000 |
| Log-likelihood | −1199.1962 | −143.3019 | −683.1775 |
| Wald chi | 81.6910 | 7.3321 | 67.4912 |
| P > chi | 0.0000 | 0.1193 | 0.0000 |

*z*-statistics in brackets.
† $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

countries are significantly less likely to form an international partnership (or significantly more likely to instead form a domestic partnership) when compared to Israeli and other small-demand country counterparts. The companies in France, Germany, Japan, UK, and US are 70%, 67.9%, 70.7%, 68%, and 67.1% less likely, respectively, to form an international rather than a domestic partnership when compared to Israeli companies. In other words, the odds of an international partnership over a domestic partnership in those countries are around 3.15 times lower than the odds of an international partnership over a domestic partnership in Israel. These results lend initial support for Hypothesis 1.

The primary argument behind our theorizing in Hypothesis 1 was that as small countries lack a sufficiently large local demand, new ventures in such countries would be motivated to engage in international rather than domestic partnerships more often than their large country counterparts. While Model 1 in Table 5 shows differences in internationalization behavior between small- and large-demand countries, it is lacking in two dimensions. First, as we explained earlier, an econometric analysis that does not take into account and control for the underlying opportunity structure for partnerships that may differ among countries, such as Model 1 of Table 5, may yield misleading conclusions. Second, it does not enable us to conclude that the size of the domestic health care market is the main driver of this difference. In the second set of analyses presented in Table 6, we employ logistic regression procedures designed for multi-level data that would allow us to introduce size of local demand and other factors affecting opportunity structure into the estimation model.

In what follows, we first replicate Model 1 of Table 5 (i.e., a model without any controls for the underlying opportunity structure) as Model 1 of Table 6 to demonstrate the equivalence of the two approaches. Then, starting with Model 2, we add total domestic health expenditure in the year before the partnership and other factors into the estimation and investigate how, if at all, the country-level variation in internationalization behavior would change and which factors would account for the differences observed.

The results presented in Model 1 of Table 6, which uses hierarchical linear modeling (multi-level modeling), confirm our previous preliminary findings. We compute and present the variation in the country-level estimates[9] (equivalent of the coefficients of the country-level dummies used before) in Fig. 1. The circle for each country represents that country's variation in the constant term, and the bar represents the 95% confidence interval around that estimate. If the bars of two countries intersect, one would conclude that those two countries are not statistically significantly different from each other. In other words, the companies in the first country do

[9] With such a methodology the random effect coefficients of the constant term at the country level (i.e., equivalents of the coefficients of the country dummies above) are not explicitly presented in STATA, although one can produce them through computation.

**Table 6**
Multi-level mixed effects logistic regression modeling of partnership patterns for Hypotheses 1–3 controlling for underlying factors of partnership opportunity structure.

| | Partnership is international | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 | Model 11 | Model 12 |
| Age of the company | 0.067* | 0.083** | 0.072* | 0.082** | 0.077* | 0.072* | 0.075* | 0.086** | 0.069* | 0.085** | 0.050 | 0.055 |
| | [2.158] | [2.638] | [2.249] | [2.605] | [2.408] | [2.219] | [2.395] | [2.741] | [2.197] | [2.722] | [0.884] | [0.950] |
| Period dummy (1998–1999) | −0.145 | −0.191 | −0.156 | −0.189 | −0.168 | −0.149 | −0.203 | −0.180 | −0.143 | −0.191 | −0.602 | −0.601 |
| | [−0.290] | [−0.379] | [−0.309] | [−0.374] | [−0.330] | [−0.294] | [−0.404] | [−0.359] | [−0.285] | [−0.379] | [−0.611] | [−0.604] |
| Period dummy (2003–2007) | −0.073 | −0.051 | −0.096 | −0.080 | −0.113 | −0.099 | −0.112 | −0.037 | −0.077 | −0.064 | 0.266 | 0.388 |
| | [−0.458] | [−0.313] | [−0.587] | [−0.492] | [−0.693] | [−0.605] | [−0.699] | [−0.228] | [−0.483] | [−0.399] | [0.944] | [1.349] |
| Period dummy (2008–2009) | −0.055 | −0.008 | −0.091 | −0.057 | −0.122 | −0.100 | −0.118 | 0.013 | −0.066 | -0.034 | 0.319 | 0.629 |
| | [−0.231] | [−0.033] | [−0.373] | [-0.234] | [−0.503] | [−0.412] | [−0.495] | [0.055] | [−0.278] | [−0.144] | [0.765] | [1.469] |
| Total health expenditure | | **−0.330***** | | **−0.234*** | | **0.031*** | | **−0.403***** | | **−0.317***** | | **−0.610***** |
| (Logged, lagged by 1 year) | | **[−6.250]** | | **[−1.984]** | | **[1.991]** | | **[−4.988]** | | **[−7.017]** | | **[−4.786]** |
| Ratio of domestic to international | | | −1.895*** | −0.583 | | | | | | | | |
| potential partners | | | [−4.576] | [−0.808] | | | | | | | | |
| Number of potential | | | | | −0.002*** | −0.002*** | | | | | | |
| international partners | | | | | [−6.894] | [−4.301] | | | | | | |
| Science base (Number of citations received) | | | | | | | −0.457** | 0.128 | | | | |
| (logged, 2 year window) | | | | | | | [−3.215] | [1.211] | | | | |
| Originating country | | | | | | | | | 0.772 | 0.104 | | |
| average trade barriers | | | | | | | | | [1.414] | [0.703] | | |
| Propensity of alliance – controlling for | | | | | | | | | | | −38.433*** | −38.713*** |
| underlying decision mechanisms | | | | | | | | | | | [−16.971] | [−17.224] |
| Constant | −0.255 | 6.050*** | 0.404 | 4.441* | 0.478* | −0.080 | 4.565** | 6.089*** | −1.175† | 5.701*** | 29.968*** | 41.883*** |
| | [−0.856] | [5.705] | [1.574] | [2.174] | [2.136] | [.] | [2.965] | [6.513] | [−1.689] | [5.849] | [15.809] | [11.960] |
| Observations | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 | 1838 |
| Number of countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Number of variables | 4.0000 | 5.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 |
| Log-likelihood | −1213.810 | −1207.587 | −1209.450 | −1207.368 | −1208.781 | −1209.417 | −1210.917 | −1206.972 | −1212.879 | −1207.454 | −404.175 | −398.449 |
| Wald chi | 8.1330 | 49.5617 | 29.7797 | 62.9224 | 58.4713 | 29.9513 | 18.9744 | 64.5623 | 10.1902 | 63.3371 | 291.9849 | 304.2184 |
| P > chi | 0.0868 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0019 | 0.0000 | 0.0700 | 0.0000 | 0.0000 | 0.0000 |

*z*-statistics in brackets.
† $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

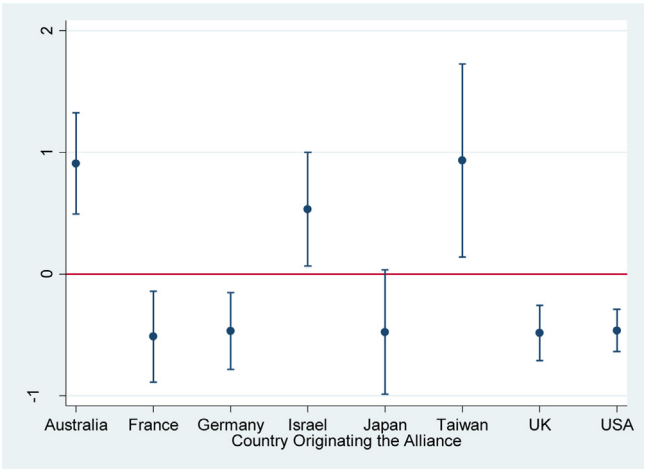


**Fig. 1.** Results of multi-level logistic regression analysis showing country-level variation in partnership patterns of young firms according to whether the partnership is international or domestic.
*Note*: The bar represents the 95% confidence interval around the estimated coefficient (presented as the filled circle).

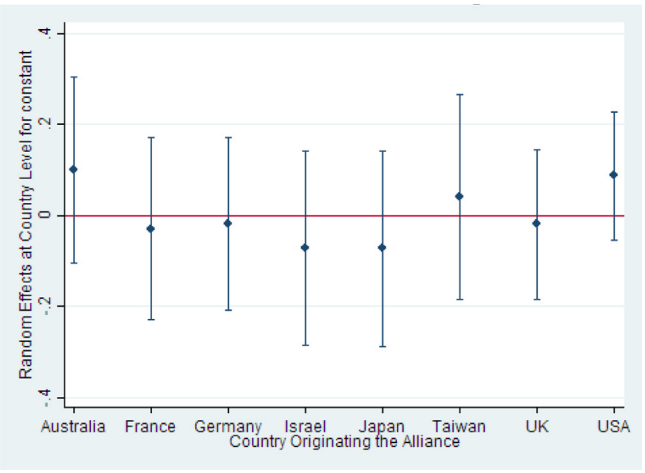


**Fig. 2.** Results of multi-level logistic regression analysis showing country-level variation in partnership patterns of young firms according to whether the partnership is international or domestic when domestic total healthcare expenditure is accounted for.
*Note*: The bar represents the 95% confidence interval around the estimated coefficient (presented as the filled circle).

not significantly differ from those in the second country in terms of their likelihood of forming international rather than domestic partnerships. We observe that Australia's, Israel's, and Taiwan's bars overlap, meaning that the new ventures in these three countries have statistically similar propensities to internationalize. Similarly, the large countries all overlap with each other, meaning they do not differ from each other either. At the same time, the bars of these small countries in our sample do not intersect with any of the large countries', enabling us to conclude that internationalization behavior of new ventures in small countries is significantly different from that in the large countries. Moreover, the coefficient estimates for the three small countries are higher than those for the large countries, meaning that the odds of new ventures forming international rather than domestic partnerships are significantly higher (at 95% confidence interval) for those in small countries compared to those in the large countries, as Hypothesis 1 predicted and our previous analysis lent initial support to.

In Model 2 of Table 6, we introduce total domestic health expenditure (logged) in one year before the partnership as a proxy of the local demand. We find that this variable is negative and significant (coeff: −0.330, at 99% confidence level, $z$-value = 6.25). Each unit increase in this variable decreases the likelihood of an international vs. a domestic partnership by 1.39 times. Australia's logged total healthcare expenditure in 2002 is 17.72 units, Japan's is 19.41, and the US's is 21.18 units. Plugging in the numbers, new ventures in Japan would be 2.35 and the US would be 4.81 times less likely to form international rather than domestic partnerships, based solely on difference in total healthcare expenditure. These observations account for a major portion of what we found by using country dummies to test Hypothesis 1 in Table 5. This supports our argument that a primary driver for the difference in partnership patterns of these young biotech firms among different countries is the strength of the local market demand. If this argument is correct, i.e., if the difference between partnership behaviors of Australian and Japanese biotech firms, for example, depends primarily on the strength of the local demand as we theorized, then when we proxy the local demand by introducing such a variable into the regression, the country-level variation observed in Model 1 should disappear or weaken significantly. Next, we probe this by repeating the procedure employed above to calculate the variation in country-level differences. In Fig. 2, we present the country-level estimates and associated 95% confidence intervals. We observe that all countries' bars intersect with each other. This means that the small- and large-demand countries in our dataset no longer differ from each other in terms of the international partnership patterns of young biotechnology companies within, when the total healthcare expenditure is accounted for in the estimation. This strongly corroborates our argument that one primary cause for variation among partnership patterns of companies in different countries is the size and strength of their local market demand.

There may also be other reasons behind the observed variation we found in Model 1 of Table 6, such as underlying opportunity structure that may affect the motivation or ability of the firms to form international alliances, in addition to the "home market size" factor. The remainder analyses in Table 6 (Models 3–12) introduce four of these other alternative explanations and potential factors. We introduce them by themselves and together with the size of local demand to investigate their possible effects on internationalization patterns and identify which factor might be the primary driver.

In Models 3 and 4, we account for the ratio of potential domestic to international alliance partners. In settings where there are many more such potential partners outside a country and few inside it (i.e., the ratio variable is low), the new ventures in those countries may be less able to engage in business relationships with local firms. Simply for this reason, one would expect to see higher international and lower domestic partnerships in countries with many available international partners. In Model 3, we observe that the coefficient for ratio of domestic to international firms is negative and significant (coeff: −1.895, at 99% confidence interval, $z$-value = 4.58), lending support for such an expectation. However, when we calculate and investigate country-level variation, presented in Fig. 3, we observe that although there is some overlap between countries, there are still bars that do not overlap such as the one between Australia and Japan. In other words, although differences regarding internationalization patterns of new ventures among countries are reduced, the ratio of potential domestic to international partners cannot fully account for the observed variation. In Model 4, we further justify this claim by introducing total domestic health expenditure and ratio of potential domestic to international partners together in the regression. We observe that the size of the domestic health market variable is still negative and significant (at 95% confidence level) in this regression while the ratio variable loses its significance. This result presents a convincing case that between a small health market and abundance of potential inter-

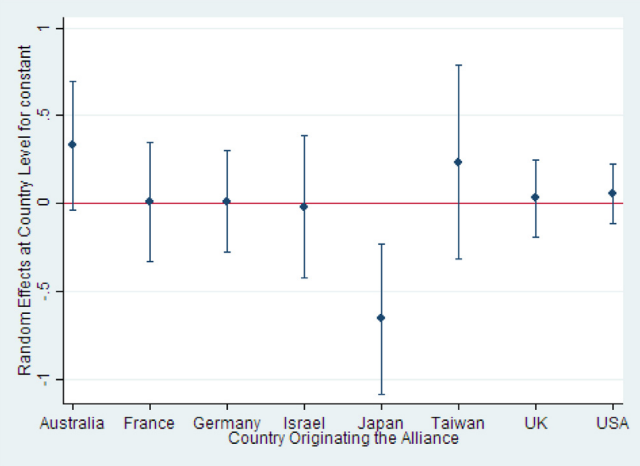


**Fig. 3.** Results of multi-level logistic regression analysis showing country-level variation in partnership patterns of young firms according to whether the partnership is international or domestic when the ratio of number of potential domestic alliance partners to number of potential international alliance partners is accounted for.
*Note*: The bar represents the 95% confidence interval around the estimated coefficient (presented as the filled circle).

national partners, size of domestic market is the primary motivator for new ventures in the country to seek internationalization.

In Models 5 and 6, rather than the ratio of potential domestic to international partners, we introduce the absolute number of potential international alliance partners outside the home country into the model. Similar to the rationale behind introducing the ratio variable, as the number of potential international partners increases, one would expect to see more international alliances. Model 5 confirms this expectation. The coefficient for the number of potential international partners variable is positive and significant (coeff: 0.002, at 99% confidence interval, $z$-value = 6.89). When we introduce this variable together with the size of local demand in Model 6, however, this variable maintains its significance, while the size of local demand is also still remains significant (at 95% confidence level). This once again shows that it is the size of the local demand rather than absolute or relative number of potential alliance partners that drives internationalization behavior differences among small and large countries.

In Models 7 and 8, we introduce biotechnology science base of the home country into the estimation procedure. In countries where there is an established science base, the ability of young firms to find suitable firms, institutions, and entities to partner with within the country might be higher. Because of this reason, one would expect to see higher domestic partnerships in countries with stronger science base. We find that the sign of this variable in Model 7 is negative and it is significant, supporting this expectation. More importantly, however, when we include both science base and size of local demand into the analyses, this variable loses its significance, whereas size of local demand remains significant (at 95% confidence level). In other words, between science base and size of local demand, the magnitude of local demand drives internationalization behavior differences in the sample countries.

In Models 9 and 10, we focus on another potential variation in the *ability* and *motivation* to internationalize: the average international trade barriers faced by companies in the country. To the extent that firms in a country on average need to overcome higher trade barriers and other regulatory hurdles if they want to conduct business in a different country compared to firms in another country, it may be harder for them to engage in international business activities. As a result, one would expect to find higher internationalization propensity among new ventures in those countries that face lower average trade barriers to going abroad. In both Models 9 and 10, we observe that this expectation is not satisfied. The coefficients for the trade barrier variables are not significant. In other words, the average trade barrier a country faces from other countries regarding this industry does not significantly hinder or increase the likelihood of forming international partnerships. More importantly for the primary argument we advance in this study, even after controlling for the average industry-related trade and regulatory barriers a country faces, the size of the domestic market is still statistically significant and negative (at 99% confidence level) as presented in Model 10.

One last alternative explanation we account for in Table 6 is the underlying propensity of alliance formation variable that we introduce in Models 11 and 12. This variable predicts if an alliance is expected to happen or not based on the trade barriers, geographic distance, cultural distance, and language similarity of the two locales, as well as the number of potential partners and size of the market in the target locale. Given that most of the alliances in our dataset happen domestically (such as US to US or EU to EU), it is not surprising to find that this variable has a negative coefficient. More important for testing Hypothesis 1, however, is that the coefficient for size of local demand still remains negative and significant (99.9% confidence level) in Model 12, even after adding this variable that controls for the underlying propensity for an alliance to exist.

All these results, along with the fact that size of local demand retained its significance even when four alternative explanations that account for underlying opportunity structure of alliances were introduced into the model, lend a very strong support for Hypothesis 1. Thus, firms in small countries are more likely to form international rather than domestic partnerships than their counterparts in large countries because of the small home demand they face.

Hypothesis 2 predicts that, in small countries, international BD partnerships occur much more frequently than international RD partnerships. To test this hypothesis, we first count and compare the number of international and domestic BD partnerships and the number of international and domestic RD partnerships in the small-demand countries. Panels 2 and 3 in the first three rows in Table 4 present the relative frequency of partnerships in these two categories. In Australia, Israel, and Taiwan, out of 83, 41, and 11 BD partnerships, 68 (81%), 30 (73%), and 9 (82%), respectively, are international and the rest are domestic. In comparison, out of 42, 37, and 10 RD partnerships, 27 (64%), 21 (57%), and 8 (80%) are international.

Next, we add the partnership type variable into the estimation in Table 5. We perform this analysis when we restrict the sample to biotechnology companies in Australia, Israel, and Taiwan, i.e., the small countries in our dataset. Model 2 in Table 5 presents the results of this panel data logistic regression. We first observe that the age of the firm does not significantly affect the likelihood of a partnership being international rather than domestic. All young ventures seem to emphasize international partnerships with similar likelihood, irrespective of the position in the firm lifecycle. Furthermore, as a baseline effect, companies in small-demand countries are 87.2% (=exp(0.627) −1) more likely to form an international rather than domestic RD partnership. Regarding Hypothesis 2, we find that whether the partnership is for BD purposes positively and significantly (coeff: 0.697, significant at 95% confidence level, $z$-value = 2.33) affects the likelihood of an international partnership. Young biotechnology companies in these small-demand countries are, on average, 2.01 times (101%) more likely to form international rather than domestic partnerships for BD purposes when compared to RD partnerships of the same companies. This result strongly supports Hypothesis 2.

Hypothesis 3 predicts that new ventures in small countries have higher odds of forming international rather than domestic BD part-

nerships when compared to counterparts in large countries. To test this hypothesis, once again we present the relative frequency numbers, perform logistic regression for panel data, and then perform multi-level logistic regression that allows us to account for underlying opportunity structure. Panel 2 in Table 4 presents the frequency statistics and the ratio of international and domestic BD partnerships. As previously noted, there are a total of 83, 41, and 11 BD partnerships in Australia, Israel, and Taiwan, respectively. Among these partnerships, 68 (81%), 30 (73%), and 9 (82%) are international and the remainder is domestic. On the other hand, in all large countries, the frequency of domestic BD partnerships is much higher than the frequency of international BD partnerships. The highest percentages of international partnerships are within the UK with 44% and the US with 42%, while Japan is the lowest with only 20% of BD partnerships being international.

Model 3 in Table 5 shows the results of the logistic regression when we restrict the sample only to BD partnerships rather than all partnerships. We again take Israel as our base country. Among our control variables, we observe that each yearly increase in the age of the company makes it 12.9% more likely for the company to form an international rather than domestic BD partnership (coeff: 0.121, 99% significant, $z$-value = 2.96). Regarding Hypothesis 3, we once again observe that the internationalization patterns of young biotechnology ventures for BD alliances in Australia and Taiwan are not statistically different from those in Israel. At the same time, we find that companies in the large countries (France, Germany, Japan, UK, and US) are 79.7%, 73.7%, 90%, 70.4%, and 74% less likely (significant at 99.% confidence interval, $z$-values range from 3.02 to 3.97) to form international rather than domestic BD partnerships when compared to their counterparts in Israel (coefficients are −1.59, −1.33, −2.30, −1.22, and −1.35, respectively). In other words, the odds of an international BD partnership over a domestic BD partnership in those countries are 4.92, 3.79, 9.96, 3.37, and 3.84 times lower, respectively, than the odds of an international BD partnership vs. a domestic BD partnership in Israel. These results lend an initial support for Hypothesis 3.

Table 7 replicates the analyses we have done in Table 6 and explained in detail above. This time, however, the sample is restricted only to BD partnerships. In the interest of saving space, we note that size of local demand variable is always negative and significant (at 95% or higher confidence levels) even when the other five explanatory factors that we use to account for the underlying distribution of partnership opportunity structure is introduced into the analyses. This strongly supports Hypothesis 3 that firms in small countries are more likely to form international rather than domestic BD partnerships than their counterparts in large countries because of the small domestic demand they face.

## 5. Discussion and implications

The INV literature has not explicitly addressed whether young firms from small countries would be more likely to venture internationally than those from larger countries. Inspired by Porter's (1991) idea on the importance of large and sophisticated local demand, we examined the patterns of forming domestic vs. international partnerships in the early period of a firm's existence.

Our preliminary analysis revealed that there are profound differences between small- and large-demand countries regarding the partnership patterns of young high-tech firms within their borders: Young firms in small countries (Israel, Australia, Taiwan) were more than 3 times more likely to partner with international rather than domestic organizations when compared to young firms in large countries (France, Germany, Japan, UK, and US). These differences were both statistically (at 99% confidence level) and substantively significant. We next turned to explaining the cause of this difference in internationalization behavior.

One of the contributions of our paper was to bring to light the considerable methodological challenges in assessing whether small-country firms have a higher number of international alliances because by mathematical necessity a small country not only has small domestic demand but also contains fewer domestic firms to partner with than its large country counterparts. Firms in large countries both have access to a large domestic demand and have a larger opportunity set of partnerships that are domestic. This meant that in order to determine whether the differences were due to the size of domestic demand or were an "artifact" of underlying partnership opportunities, it would be essential to control for the differences in opportunity structure for international partnerships that large and small countries face. In order to assess whether there is a true effect of smaller home demand on the likelihood of forming an international partnership, we used multi-level logistic regression techniques that allowed us to introduce four different factors that account for underlying partnership opportunity structure. Through a careful econometric analysis, we demonstrated that size of domestic demand was the primary cause for variation in the international partnership formation behavior. We found that each unit increase in the log of the total domestic healthcare expenditure decreased the likelihood of an international vs. a domestic partnership by 1.39 times.

To further substantiate why young high-tech firms in small economies would form international partnerships, we investigated the different reasons why a firm would collaborate. We predicted that young firms in a small country would have relatively more international business development partnerships than international R&D partnerships. In our dataset, 79% of business development partnerships of young ventures in the small-demand countries are international, whereas the number is 63% for their R&D partnerships. In the regression analysis we find that the likelihood of new ventures in Australia, Israel, and Taiwan forming international rather than domestic BD partnerships is 101% higher (i.e., twice as likely) than forming international RD partnerships (significant at 99% level).

Furthermore, to understand the importance of access to demand that business development partnerships can enable for young high-tech firms, we compared the internationalization patterns of the small-demand and large-demand firms with regard to these business development partnerships. We argued that to overcome the liabilities of relatively small local demand, young firms in small countries have substantially greater motivation to enter into international rather than domestic business development partnerships compared to those in large countries. This was strongly supported by the data. We first presented that new ventures in small countries were 3.37–9.96 times more likely than new ventures in large countries to form international rather than domestic business development partnerships (significant at 99% confidence level). Next, we demonstrated that this difference was once again due primarily to difference in size of domestic demand among these countries, rather than differences in underlying partnership opportunity structure. We found that each unit increase in the log of the total domestic healthcare expenditure decreased the likelihood of an international vs. domestic BD partnership by 1.45 times.

In sum, we made a contribution to the INV literature by showing, contrary to what was previously assumed, that the propensity of INVs in the same sector to form international rather than domestic partnerships **is not the same** across different countries. Furthermore, and more importantly, we make a substantive contribution to the theory of internalization by demonstrating that the difference in home demand is underlying the differences in propensity rather than a long list of other factors that differ across countries.

In this study, we especially focused on internationalization for business development purposes and as a result emphasized the role of domestic demand in the process. The primary underlying driver

**Table 7**
Multi-level mixed effects logistic regression modeling of partnership patterns for Hypotheses 1–3 controlling for underlying factors of partnership opportunity structure for BD alliances only.

| | Partnership is international – BD alliances only | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 | Model 7 | Model 8 | Model 9 | Model 10 | Model 11 | Model 12 |
| Age of the company | 0.123** | 0.139** | 0.125** | 0.145*** | 0.125** | 0.144*** | 0.132** | 0.139** | 0.124** | 0.138** | 0.065 | 0.069 |
| | [2.948] | [3.283] | [2.974] | [3.420] | [2.976] | [3.408] | [3.140] | [3.285] | [2.969] | [3.283] | [0.887] | [0.965] |
| Period dummy (1998–1999) | 0.869 | 0.775 | 0.825 | 0.777 | 0.823 | 0.776 | 0.763 | 0.778 | 0.864 | 0.777 | 0.344 | 0.334 |
| | [1.079] | [0.963] | [1.025] | [0.970] | [1.022] | [0.968] | [0.949] | [0.966] | [1.074] | [0.967] | [0.190] | [0.185] |
| Period dummy (2003–2007) | −0.486* | −0.445† | −0.500* | −0.406† | −0.501* | −0.408† | −0.540* | −0.437† | −0.491* | −0.431† | 0.149 | 0.269 |
| | [−2.158] | [−1.953] | [−2.207] | [−1.760] | [−2.211] | [−1.762] | [−2.379] | [−1.870] | [−2.178] | [−1.890] | [0.380] | [0.695] |
| Period dummy (2008–2009) | −0.513 | −0.421 | −0.528 | −0.356 | −0.529 | −0.357 | −0.592† | −0.407 | −0.522 | −0.394 | 0.686 | 0.980† |
| | [−1.600] | [−1.298] | [−1.636] | [−1.077] | [−1.640] | [−1.079] | [−1.833] | [−1.213] | [−1.627] | [−1.211] | [1.247] | [1.812] |
| Total health expenditure | | **−0.373*** ** | | **−0.575*** | | **−0.567*** | | **−0.399*** | | **−0.415*** ** | | **−0.631*** ** |
| (Logged, lagged by 1 year) | | **[−3.892]** | | **[−2.522]** | | **[−2.369]** | | **[−2.155]** | | **[−3.688]** | | **[−3.884]** |
| Ratio of domestic to international potential partners | | | −1.827* | 1.314 | | | | | | | | |
| | | | [−2.276] | [0.972] | | | | | | | | |
| Number of potential international partners | | | | | −0.002* | 0.001 | | | | | | |
| | | | | | [−2.399] | [0.883] | | | | | | |
| Science base (number of citations received) (Logged, 2 year window) | | | | | | | −0.519** | 0.048 | | | | |
| | | | | | | | [−2.577] | [0.164] | | | | |
| Originating country average trade barriers | | | | | | | | | 0.558 | −0.359 | | |
| | | | | | | | | | [0.774] | [−0.777] | | |
| Propensity of alliance – controlling for underlying decision mechanisms | | | | | | | | | | | −81.912*** | −82.051*** |
| | | | | | | | | | | | [−13.568] | [−14.175] |
| Constant | −0.218 | 6.968*** | 0.454 | 10.345** | 0.519 | 10.193* | 5.314* | 6.949*** | −0.871 | 8.185** | 73.212*** | 85.613*** |
| | [−0.571] | [3.677] | [1.022] | [2.629] | [1.153] | [2.488] | [2.426] | [3.699] | [−0.951] | [3.263] | [13.303] | [12.706] |
| Observations | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 | 1061 |
| Number of countries | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| Number of variables | 4.0000 | 5.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 | 5.0000 | 6.0000 |
| Log-likelihood | −697.018 | −693.172 | −695.103 | −692.708 | −694.937 | −692.790 | −694.779 | −693.159 | −696.724 | −692.836 | −238.707 | −232.598 |
| Wald chi | 12.2513 | 27.7290 | 17.3916 | 30.2654 | 17.9769 | 29.9286 | 18.9711 | 28.0707 | 12.8367 | 28.0490 | 188.4011 | 205.3954 |
| P > chi | 0.0156 | 0.0000 | 0.0038 | 0.0000 | 0.0030 | 0.0000 | 0.0019 | 0.0001 | 0.0250 | 0.0001 | 0.0000 | 0.0000 |

z-statistics in brackets.
† $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

of internationalization for research and development purpose may be different. Therefore, future studies that look at internationalization for R&D perspective should instead use a more suitable motivator instead of domestic demand. For example, researchers can examine the size of local science base as a motivator for R&D related international partnership formation.

One avenue for future research is to analyze international partnerships that originate with small-country firms by asking the "where to" question: Which countries do firms in small countries target for their international partnerships? We argued in the development of our Hypothesis 1 that firms in small countries enter into international partnerships to overcome a lack of resources (Rialp et al., 2005) or demand. It follows from this that they would target countries where they can overcome these deficiencies quickly. Furthermore, the primary weak link within small countries, given that they may have considerable innovative capacities, is small local demand. For this reason, one can make a prediction that small-country firms will pursue partnerships in large countries rather than other small countries. Future research ideally would explore this in tandem with other determinants of location selection in alliance formations, such as the role of economic, cultural, political, institutional, and geographic distance between two countries, as well as the existence of trade barriers and a common official language.

A second important avenue for future research is to examine the performance implications of international alliances for firms from small countries. Implicit in many of our arguments for why firms in smaller countries would more frequently make international alliances is the idea that doing this creates a net competitive advantage compared to not doing it. Although Knight and Cavusgil (2005) report "that the earlier the firm internationalizes, the better its ultimate performance in foreign markets" (p. 31), we need more research that tests whether those young ventures in small countries that create international partnerships more frequently and earlier than their domestically oriented counterparts indeed show superior economic performance. The results of such research would also yield robust policy implications about whether governments in small countries should incentivize firms to internationalize early and aid them to do so.

The results of this additional research would also be very useful for policymakers in smaller countries who may presently be guided by Porter's (1991) diamond framework to stimulate economic development and growth. A strict application of the diamond framework would push the governments to invest in order to try to stimulate domestic demand. In light of our findings, future research, however, should explore the potential of substituting the need for large and sophisticated home demand with that of international demand. In other words, further research is needed to investigate whether governments in small countries should instead try to help firms access sophisticated demand in foreign countries more easily rather than invest a disproportionate amount of resources in building this demand locally.

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## Appendix Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.respol.2015.03.002.

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