# Commercialization strategy and internationalization outcomes in technology-based new ventures


## Abstract

We investigate effects of intellectual property (IP)-based, product-based and hybrid (both product and IP) commercialization strategies on internationalization propensity and intensity in technology-based new ventures. Using the Kauffman Firm Survey, after correcting for endogeneity, we find that new ventures adopting a product-based commercialization strategy are less likely to internationalize than those with hybrid or IP-based strategies. In addition, new ventures using IP-based commercialization strategies exhibit higher international intensity after foreign market entry than those with hybrid and product-based strategies. These findings provide novel insights into the dependence on external resources associated with different types of commercialization strategy.



**Keywords:** Liability of outsidership; international new venture; IP-based commercialization strategy; product-based commercialization strategy; market for technology

## 1 Introduction

New ventures seeking to internationalize face many well-studied choices, such as at what age to internationalize, which country markets to enter and in what order, and which entry modes to employ (Autio et al., 2000; Brouthers, 2002; Brouthers and Nakos, 2004; Burgel and Murray, 2000; Zahra et al., 2000). However, because internationalization has typically been defined as the expansion of a firm's *current* or at least *preconceived* business operations abroad, one consequential choice has been hitherto overlooked, namely the effect of *alternative* commercialization strategies on internationalization outcomes (Laufs and Schwens, 2014). This is an important gap because different commercialization strategies imply different costs, different external resource dependencies, and different value chain positions, all of which may significantly influence internationalization outcomes (Coviello and Cox, 2006; Gans and Stern, 2003; Lu and Beamish, 2006; Schweizer, 2013). The objective of this paper is to explore the effect on internationalization propensity and intensity of one increasingly common commercialization strategy choice: the choice between a product-based, intellectual property (IP)-based, or hybrid (both product and IP) commercialization strategy (Arora and Fosfuri, 2003).

Advances in business process outsourcing and open innovation practices have made the choice of technology commercialization strategy increasingly real for technology-based new ventures (Di Gregorio et al., 2008; Marx and Hsu, 2015; Roza et al., 2011). They may choose to integrate their technologies into their products and services or to sell or license their IP for integration into the products and services of others. Those adopting a hybrid commercialization strategy may sell their knowledge through products as well as IP. Whether chosen consciously or not, these commercialization strategies require very different business models, or "system[s] of interconnected and interdependent activities that determine the way

the company does business" (Amit and Zott, 2012: 42), emphasizing the importance of resource configurations in use (Demil et al., 2015).

Firms choosing to compete in product markets operate in the context of a manufacturing chain: they need to acquire or access raw materials and components, manufacturing capacity, and distribution channels to operationalize their business model. In contrast, firms selling licenses, copyrights, and other forms of IP typically rely on strong internal R&D capacity and technology insourcing and sell their IP to manufacturers and service providers for integration into the purchasers' products and services. Thus, firms adopting an IP-based commercialization strategy are usually removed from direct product market competition and have less need to access and build value chain resources abroad when internationalizing. Such differences mean that different commercialization strategies may have important, yet hitherto little studied, implications for the fixed and variable costs of international entry and performance, for external resource dependencies in foreign markets, and consequently for the venture's exposure to liabilities of foreignness (Denk et al., 2012) and liabilities of outsidership (Johanson and Vahlne, 2009). We argue that these differences will impact on the propensity for and intensity of internationalization in internationalizing new ventures.

As companies become increasingly adept at technology outsourcing, the choice of commercialization strategy is becoming accessible to ever smaller and newer firms (Afuah, 2003; Autio and Acs, 2010; Brouthers and Hennart, 2007; Fiedler and Welpe, 2010; Kasch and Dowling, 2008; Kollmer and Dowling, 2004; Marx and Hsu, 2015). There has been a rapid growth in exchanges in technology markets, including sales of patents, licenses, and other forms of IP, particularly in technology-based sectors such as chemicals, electronics, and software (Arora et al., 2013; Kasch and Dowling, 2008). The choice between a product-based, IP-based, or hybrid commercialization strategy is particularly relevant for technology-

based new ventures, whose business is based on creating and exploiting intellectual property (Onetti et al., 2012). Given that the adopted commercialization strategy and associated business model may significantly affect performance (Zott and Amit, 2007), and since internationalization tends to exacerbate both positive and negative performance outcomes in new ventures (Sapienza et al., 2006), empirical research is urgently needed that explores the implications of commercialization strategy for internationalization performance. To address this gap, we use the Kauffman Firm Survey (DesRoches et al., 2010) to compare the international propensity for and intensity of internationalization by US new ventures employing an IP-based commercialization strategy with those adopting a product-based or hybrid commercialization strategy.[1]

We argue that new ventures adopting a product-based commercialization strategy will experience different fixed and variable costs and greater external resource dependencies compared with those adopting an IP-based or hybrid commercialization strategy.[2] Greater resource dependencies and the consequent liabilities of outsidership will reduce both the propensity to internationalize and the subsequent international performance of product-commercializing firms, while the internationalization performance of new ventures following a hybrid strategy (i.e., combining product- and IP-based commercialization strategies) will fall between these two extremes. We find broad support for our hypotheses.

This study makes several conceptual and empirical contributions to the international entrepreneurship literature. First, we open the black box with regard to the effect of commercialization strategies on internationalization outcomes in new ventures. Previous

1 "New ventures with IP-based commercialization strategies" and "IP-based new ventures" are used interchangeably. Similarly, we use the term "product-based new ventures" to refer to new ventures with product-based commercialization strategies, and "hybrid new ventures" to refer to new ventures with hybrid commercialization strategies.

[2] In our empirical design, we use "hybrid" ventures as the reference group, and compare pure product-based ventures and pure IP-based ventures with ventures that adopt a mix of both strategies. We thank an anonymous reviewer for raising this point.

research on liabilities of foreignness and outsidership has treated commercialization strategy as a given, thereby assuming that all internationalizing firms are similarly affected by these liabilities. We show how a venture's choice of commercialization strategy may significantly affect its exposure to such liabilities, with consequent implications for internationalization outcomes. Our findings suggest that hybrid new ventures are not disadvantaged compared with IP-based new ventures when entering foreign markets, but they do face a disadvantage when scaling up their operations in those foreign markets. This provides a more nuanced perspective on how resource dependencies manifest themselves in internationalizing technology ventures, and also advances an understanding of how the fixed costs of foreign market entry and the operating costs of exploiting international opportunities differ across technology commercialization strategies.

Second, we contribute to a growing body of research on the internationalization of intangible resources (Knight and Kim, 2008). Thus far, international entrepreneurship research has focused predominantly on product- and service-based new ventures, paying little attention to ventures that sell intellectual property rights (IPRs) in foreign markets (Gassmann and Keupp, 2007). This study contributes to a better understanding of the benefits of intangible resources in new venture internationalization – benefits which are reduced when IP-based new ventures simultaneously sell products in the foreign market. We extend extant theory on the role of foreign market knowledge to show that technology commercialization strategy regulates the firm's dependence on such knowledge for internationalization.

Third, we extend the literature on the commercialization strategies of new ventures, which until now has focused primarily on explaining the choice between technology markets and product markets (Gans et al., 2002; Marx and Hsu, 2015), with limited understanding of its implications from the perspective of internationalization. Finally, we extend this literature

by considering hybrid commercialization as a distinct strategy in between product- and IP-based commercialization strategies (Gans and Stern, 2003).

This paper is organized as follows. In Section 2, we discuss new venture internationalization challenges in the light of resource dependence theory, and develop a model that demonstrates how different commercialization strategies expose a new venture to different resource dependencies and consequent liabilities. In Section 3 we describe our methodological choices; our results and findings are presented in Section 4; and Section 5 concludes with a discussion of our contributions to theory and practice.

## 2 Theoretical background and hypotheses

### *2.1 Challenges of network entry and resource dependence in foreign markets*

In seeking to establish itself in foreign markets, a new venture must contend with numerous challenges, arising from the need to access resources, knowledge, and network relationships abroad in order to implement its business model (Denk et al., 2012; Johanson and Vahlne, 2009). While the consequent costs and resource dependencies give rise to liabilities of newness in general, such liabilities may be exacerbated in foreign markets, where the new venture may have few previous contacts, and where a lack of local reputation and knowledge makes it particularly challenging to access and mobilize resources controlled by others (Johanson and Vahlne, 2009; Stinchcombe, 1965).

More tangibly, the need to access or build resources abroad when internationalizing exposes new ventures to various hazards that may adversely impact on their internationalization performance, including unfamiliarity hazards, relational hazards, and discrimination hazards (Denk et al., 2012). Unfamiliarity hazards arise from a lack of foreign market knowledge about a) the foreign culture, institutions, rules, and regulations; and b) the resources, capabilities, and behaviors of suppliers, competitors, and customers (Fletcher and Harris, 2011; Johanson and Vahlne, 1977). Learning about foreign markets occurs primarily

through collaboration with other firms (Chetty and Blankenburg-Holm, 2000), which requires internationalizing firms to build a diverse network of relationships in foreign markets with customers, suppliers, competitors, and governments (Musteen et al., 2014). Lack of foreign market knowledge and lack of business relationship networks abroad are therefore intertwined (Johanson and Vahlne, 1990). Relational hazards push up the transaction costs of both internal relations, due to increased distance and organizational complexity, and external relations, due to lack of network embeddedness and social capital (Miller and Eden, 2006; Yli-Renko et al., 2002). Discrimination hazards relate to the treatment of the non-domestic market entrant by local authorities and business partners (Denk et al., 2012). The degree to which the venture is exposed to different hazards is likely to impact on its internationalization performance: greater exposure to internationalization hazards may hamper internationalization outcomes, whereas business models that limit exposure to internationalization hazards may be associated with better internationalization outcomes. Internationalizing new ventures are well aware of such hazards; for example, there is evidence that the anticipated costs of internationalization influence international entry decisions by new firms (Eriksson et al., 1997).

Internationalization hazards are related to the process of network creation and expansion in foreign markets. New venture internationalization is widely conceptualized as a network entry and network development process conditioned by the gradual development of relationship-specific social capital and learning and mutual commitments (Coviello, 2006; Coviello and Cox, 2006; Ellis, 2011; Fernhaber and Li, 2013; Hohenthal et al., 2014; Johanson and Vahlne, 2009; Prashantham and Dhanaraj, 2010). According to Johanson and Vahlne (2009: 1415), "*if a firm attempts to enter a foreign market where it has no relevant network position, it will suffer from a liability of outsidership and foreignness, and foreignness presumably complicates the process of becoming an insider*." This network view

emphasizes the importance of building mutual trust and commitment that induce reciprocity and facilitate learning about foreign markets (Brouthers, 2002; Brouthers and Nakos, 2004; Hilmersson and Jansson, 2012). Entering into networks and then expanding them is no trivial process, since business relationships tend to be characterized by mutual dependence resulting from the gradual development of co-specialized relationship knowledge and the co-specialization of assets in repeated transactions (Yli-Renko et al., 2001). Such mutuality will naturally make potential partners wary of committing to relationships, especially with "outsiders" who have little or no established reputation in the relevant market context. The constrained transferability of reputation and referrals across national borders makes it more difficult to expand networks outside the domestic market than within it.

To date, the network perspective on internationalization has focused mainly on the difficulties and constraints associated with network creation and expansion into foreign markets (e.g., Johanson and Vahlne, 2009; Schweizer, 2013). It has explored patterns of international network expansion (e.g., Coviello, 2006; Coviello and Cox, 2006; Fernhaber and Li, 2013), the effects of network structural characteristics on firm-level internationalization outcomes (e.g., Al-Laham and Souitaris, 2008; Fernhaber and Li, 2013), and different kinds of firm-level outcomes derived from network relationships (e.g., Hohenthal et al., 2014; Prashantham and Dhanaraj, 2010; Yli-Renko et al., 2002). The dominant approach has been to consider network structures and difficulties in network creation as exogenous influences that are mostly beyond the control of the focal firm. Although the firm may leverage firm-specific strengths for international network expansion, such as founders' pre-firm social capital (e.g., Manolova et al., 2010; Oviatt and McDougall, 2005), the need for network relationships is seldom questioned, nor are alternative network structures considered. Importantly, the international entrepreneurship literature has hitherto overlooked the possibility that the degree to which an internationalizing venture needs to create network

relationships abroad may depend partly on the firm's endogenous strategic choices. Although we know that new ventures may endogenously regulate their dependence on network relationships through their choice of commercialization strategy (Marx and Hsu, 2015), the theoretical and empirical implications of such endogenous choices for internationalization outcomes remain unexplored in the international entrepreneurship literature. We address this gap.

### *2.2 Product-based, IP-based and hybrid commercialization strategies and new venture internationalization*

In this section, we develop hypotheses regarding the effect of product-based, IP-based and hybrid commercialization strategies on new venture internationalization outcomes. We use new ventures with a hybrid commercialization strategy as the reference group and compare "pure" product-based and "pure" IP-based commercialization strategies with ventures that adopt both strategies. First, we hypothesize that the cost and difficulty of accessing value chain resources abroad mean that new ventures that choose a product-based commercialization strategy are less likely to internationalize their operations than those that choose an IP-based strategy. Second, we argue that greater dependence on external resources abroad also pushes up the variable costs of the international operations of product-based new ventures relative to IP-based ones. This makes product-based new ventures less likely than IP-based firms to successfully exploit international opportunities after initial entry. New ventures following a hybrid strategy will lie in between product- and IP-based strategies, as they share characteristics with both strategies. In common with product-based firms, hybrid firms need to invest in building or accessing value chain resources such as production facilities, distribution channels, and after-sales services. Similarly to IP-based firms, hybrid firms also enjoy the benefits of selling IPRs, which may give them an advantage over pure-play product-based firms. However, in contrast to IP-based firms, hybrid firms cannot

allocate 100% of their resources to selling IPRs to foreign markets. Thus, all else being equal, IP-based firms should be able to allocate more resources than hybrid and product-based firms to 1) entering foreign markets and 2) exploiting international opportunities.

### *2.2.1 International propensity*

We suggest that new ventures that choose or adopt a product-based commercialization strategy will be less likely to internationalize than those that choose a hybrid or an IP-based commercialization strategy, for three reasons. First, "pure" product-based commercialization strategies are more likely to be inhibited by location specificity, or the degree to which products and services are subject to idiosyncratic demands in local markets (Anand and Delios, 1997). Consequently, a product-based commercialization strategy may require significant customization to comply with local cultures and social norms abroad (Buckley and Casson, 1998; Cavusgil et al., 1993; Fan and Phan, 2007). In contrast, an IP-based commercialization strategy is less likely to be inhibited by location specificity, as customers of IP-selling businesses integrate the IP into the products and services they sell locally. This should reduce the anticipated cost of internationalization for IP-based new ventures relative to hybrid or product-based ones, making IP-based new ventures more likely to internationalize (Eriksson et al., 1997).

Second, in order to produce and deliver their products and services to customers abroad, product-based new ventures must either access or build the necessary value chain resources, including production facilities, distribution channels, and after-sales service and maintenance functions (Gans and Stern, 2003; Katila and Shane, 2005). This is costly and means that product-based ventures are more likely than IP-based ventures to face higher costs at the point of international market entry (Ganotakis and Love, 2012). In contrast, new ventures that choose an IP-based commercialization strategy have less need to access

downstream value chain assets (Gans & Stern, 2003).[3] Although IP-based ventures may incur search costs[4] in looking for licensees, and although they may be fearful of opportunism in negotiations, the protection offered through IPRs, such as patents, trademarks and copyrights, should mitigate these costs (Arora and Gambardella, 2010). Furthermore, because IP-based firms sell IP that they have already developed, they are motivated to recoup this fixed cost by actively searching for customers abroad. The anticipated cost of accessing value chain resources will deter product-based new ventures from internationalizing more than it will deter hybrid or IP-based new ventures.

Finally, new ventures that choose an IP-based commercialization strategy face less significant legitimacy challenges abroad than those that choose a product-based commercialization strategy. IP-based new ventures may signal their quality by securing exclusive rights to their inventions through an accreditation agency (Hsu and Ziedonis, 2013). For example, the US Patent and Trademark Office effectively functions as a certification agency for IP-based ventures by granting enforceable patent rights and by disseminating information about the invention (Lamoreaux and Sokoloff, 1999).[5] In contrast, new ventures adopting a product-based commercialization strategy do not usually have access to an acknowledged accreditation agency to validate their products, and they will consequently face a greater challenge in establishing legitimacy in foreign markets (Hymer, 1960; Miller and Parkhe, 2002; Xu and Shenkar, 2002). In summary, new ventures choosing a product-based commercialization strategy will find it more difficult to access value chain resources abroad than those choosing an IP-based commercialization strategy (Shaw and Darroch,

3 Transactions in the market for ideas allow new-venture innovators to avoid sunk investments in complementary assets necessary for commercialization (Gans and Stern, 2003: 338).
4 We thank an anonymous reviewer for commenting on this.
5 The federal courts are responsible for patent enforcement and protection of the rights of patentees, as well as the rights of people who purchase licensed patented technologies. The provisions under US law allow inventors to reveal some information about their technologies, yet still be protected against uncompensated exploitation of their ideas by others (Lamoreaux and Sokoloff, 1999).

2004), pushing up the anticipated cost of internationalization. Ventures pursuing a hybrid strategy should fall somewhere in between the two "pure" commercialization strategies.

Summarizing, we hypothesize that product-based new ventures will anticipate a greater cost of international entry, making them less likely to internationalize than hybrid or IP-based new ventures. Conversely, IP-based new ventures, having already spent the money to develop their IP, will anticipate a smaller variable cost to internationalization than hybrid or product-based new ventures, and consequently, they will be more keen to internationalize so as to recoup the fixed costs of IP development. We hypothesize:

**Hypothesis 1a** *New ventures that choose a product-based commercialization strategy will exhibit a lower propensity for internationalization than those that choose a hybrid commercialization strategy.*

**Hypothesis 1b** *New ventures that choose an IP-based commercialization strategy will exhibit a higher propensity for internationalization than those that choose a hybrid commercialization strategy.*

### *2.2.2 International intensity*

We also argue that an IP-based commercialization strategy will lead to greater international intensity post-internationalization, for four reasons. First, as stated by Johanson and Vahlne (2009) and demonstrated empirically by Coviello (2006), achieving better international performance requires continued expansion of network relationships in foreign markets. As IP-based new ventures are less reliant than product-based firms on network relationships abroad, they are less constrained by liabilities of outsidership.

Second, IP-based new ventures license knowledge-based assets such as patents, trademarks, and copyrights. Owing to the low location specificity of generic technologies and IP, such assets tend to be fungible across geographic distance and country markets, in the sense that such assets can be flexibly reallocated from servicing one country market to

servicing another (Anand and Delios, 2002). This fungibility allows new ventures with IP-based commercialization strategies to increase their international sales at a lower cost than product-based new ventures, allowing the pursuit of multiple growth opportunities at lower cost (Sapienza et al., 2006). Knowledge-intensive outputs, such as IPRs, may be easily redirected from one foreign market to another, since adaptation costs are lower and codified knowledge easier to transfer (Autio, 2005; Kylaheiko et al., 2011). In contrast, downstream assets such as distribution channels are less fungible across different country markets, which may inhibit the international performance of product-based relative to IP-based new ventures (Anand and Delios, 2002).

Third, product-based new ventures are likely to need more units abroad performing tasks in various geographic locations (Mudambi and Zahra, 2007). As the associated coordination costs may be high, the variable costs of exploiting international opportunities tend to be steep for product-based new ventures (Ganotakis and Love, 2012; Zaheer, 1995). In contrast, IP-based firms incur lower variable costs in foreign operations, as such operations do not require extensions to manufacturing and distribution capacity like those of product-based firms. Furthermore, IP-based ventures can scale their operations more cheaply than product-based ones which also require significant scale economies (Andersson et al., 2004).

Finally, IP-based new ventures are less dependent on building networks of relationships with customers, suppliers and competitors to access and build foreign market knowledge in order to increase international performance. Such firms are further removed from downstream product markets because their IPRs are incorporated into the licensor's products and services (Gans and Stern, 2003). This implies that accessing and building foreign market knowledge is the concern primarily of buyers rather than sellers of IPRs. In contrast, product firms are more dependent on a deep understanding of local market needs and customer preferences (Johanson & Vahlne, 1977). Firms selling products abroad must

also gain a very good understanding of how to operate in the foreign market and must learn about the new institutional environment (Cuervo-Cazurra et al., 2007). Product-based new ventures therefore need to develop a network of relationships to acquire such knowledge. This process is characterized by a time- and resource-intensive learning-by-doing process, which increases the variable costs for product firms seeking to improve their international performance.

In summary, the lower variable costs faced by IP-based ventures in foreign operations, aided by their lower reliance on downstream assets and foreign market knowledge as well as the greater fungibility of IPRs, should make IP-based new ventures better equipped than product-based new ventures to increase the international intensity of their operations. Ventures pursuing a hybrid commercialization strategy should fall somewhere in between the two "pure" commercialization strategies. We hypothesize that:

**Hypothesis 2a** *New ventures that choose a product-based commercialization strategy will exhibit a lower intensity of internationalization than those that choose a hybrid commercialization strategy.*

**Hypothesis 2b** *New ventures that choose an IP-based commercialization strategy will exhibit a higher intensity of internationalization than those that choose a hybrid commercialization strategy.*

## 3 Methodology

### *3.1 Sample*

We used the Kauffman Firm Survey (KFS) to test our hypotheses. This dataset was formed from a random sample of 32,469 firms from Dunn and Bradstreet's database of all start-ups formed in 2004 in the US, excluding non-profit firms, those owned by an existing business, and firms inherited by someone else (DesRoches et al., 2010). The KFS team

interviewed the founders of about 5,000 new ventures and surveyed them annually for a period of six years (DesRoches et al., 2010).[6]

Our sample included all technology-based new ventures surveyed by the KFS team. We selected new ventures operating in high-technology areas (Hecker, 2005).[7] Due to data limitations, we had information on the internationalization activities of new ventures only from their fourth year of operation up to and including their seventh year of operation (four years of data), as the question of internationalization was introduced in the fourth year. This resulted in an unbalanced panel of 623 observations representing 232 firms. Table 1 displays the industry distribution in our sample.

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### *3.2 Measures*

#### *3.2.1 International propensity and internationalization intensity*

Our main dependent variables were internationalization propensity and internationalization intensity. Internationalization propensity was equal to 1 if the new venture engaged in international sales and 0 if it did not**.** International intensity was an ordinal categorical variable recording the percentage of firms' total sales generated outside the US as either below 5%, 5–25%, 26–50%, 51–75% or 76–100% (Westhead et al., 2001).

#### *3.2.2 Product-based, IP-based, and hybrid strategies*

We created three dummy variables to operationalize the commercialization strategies of technology ventures, building on Gans et al.'s (2002) definition. First, we created a "product strategy" dummy variable that equaled 0 when the firm licensed out IPRs (patents, copyrights or trademarks), and 1 when it did not. To operationalize an IP-based strategy, we

6 There are six follow-up surveys (after the baseline survey of 2004), covering the period 2005–2010. To be eligible for the KFS, businesses had to indicate whether they: 1) had used an EIN; 2) had paid schedule C income tax; 3) had paid state unemployment taxes; 4) had paid Federal Insurance Contributions Act taxes; and 5) had a legal status. To be eligible for inclusion, at least one of these activities must have been present during 2004, and none prior to 2004.

7 See Table 1 for a list of industry codes included within high-technology areas.

created a dummy variable which equaled 1 when the firm licensed out IPRs but did not sell products and 0 otherwise. Finally, we created a dummy variable to denote a hybrid strategy that equaled 1 when firms licensed out IPRs and provided a product and 0 otherwise. This hybrid strategy constituted the reference category for the empirical analysis. We thus created three mutually exclusive groups of technology ventures that adopted either a product-based, IP-based, or hybrid commercialization strategy.

### *3.2.3 Control variables*

We set controls for founder, firm, and industry characteristics. As previous studies have shown that the founder's education level may boost internationalization (Nummela et al., 2004) and new venture performance (Gimeno et al., 1997), we controlled for the entrepreneur's level of education with a dummy that equaled 1 if the entrepreneur had a college degree and 0 otherwise. We measured prior entrepreneurial experience by summing the number of previous businesses created across owners and taking the log of this number (Eesley and Roberts, 2012). The founder's previous work experience may have a positive influence on a new venture's performance, endowing it with a wider range of skills (Gimeno et al., 1997), and valuable contacts with customers, suppliers, and investors (Shane and Stuart, 2002).

The size of the firm has been found to affect internationalization. We controlled for firm size by taking the log of the number of employees (Reuber and Fischer, 1997). We controlled for the age of the new venture with a continuous variable that measured the number of years the firm had been in existence (Zahra and Hayton, 2008). We controlled for the legal form of the firm with a binary variable, as this factor may influence the extent of internationalization (Mata and Portugal, 2002). Research and development (R&D) intensity is frequently related to internationalization (Kumar, 2009): we measured firms' R&D intensity by taking the number of R&D employees as a percentage of their total number of employees.

We also included a dummy that captured whether the firm had raised venture capital, as this may influence firm internationalization (Westhead et al., 2001). We used a continuous variable to measure a new venture's liquidity by taking the log of the amount of cash held by the new venture (Das and Teng, 2000; Hilmersson and Jansson, 2012; Schweizer, 2013). Finally, we included industry dummies to account for differences in industry characteristics.

### *3.3 Model and econometric approach*

We estimated a technology-based new venture's propensity to internationalize given its commercialization strategy (i.e., product-based, IP-based, or hybrid) using a logistic regression model with robust standard errors clustered on the firm (Miranda and Rabe-Hesketh, 2006). To enhance the accuracy of our predictions, we lagged all our independent variables by one year (t-1). A common empirical challenge is that endogeneity of independent variables may distort the results (Hamilton and Nickerson, 2003). Our dataset provided detailed information on the entrepreneurs, the ventures themselves, and the industries in which they operated, enabling us to control for many key correlates and to address endogeneity using the instrumental variable (IV) method.

To address the potential endogeneity of the product strategy variable, we used the Durbin-Wu Hausman test, which showed that endogeneity was present in the models predicting international propensity, but not in the models predicting international intensity. We therefore employed a bivariate probit methodology in the propensity models (Greene, 2012) to account for the endogenous character of the commercialization strategy choice using two instrumental variables (see Section 4 for details of this procedure). Our chosen instrumental variables are introduced and justified in Section 4.

In the second part of the analysis, we employed an ordered logistic regression. Since the Durbin-Wu Hausman test for the exogeneity of the (presumed) endogenous variable was not significant, in Table 4 we report our estimates of the non-instrumented regression, as

these adequately control for firm-specific effects. In our robustness tests, we also employed a two-step Heckman procedure to correct for potential selection bias in examining start-ups with international sales. Finally, we calculated the variance inflation factor, which showed no multicollinearity problems.

## 4 Results

Table 2 provides descriptive statistics and correlations. Around 39% of the technology ventures in our sample had internationalized their sales. The firms' owners had previously founded, on average, approximately three businesses, and the founders had received a high level of education. We performed additional t-tests, comparing technology ventures with and without international sales, and found that, in general, the owners of firms with international sales had more college education and experience ($p < 0.001$). These new ventures tended to have a stronger focus on R&D and licensing out IPRs ($p < 0.001$).

--INCLUDE TABLE 2 HERE--

Table 3 reports analyses testing Hypotheses 1a and 1b. In Model 1, we included only the control variables. In Model 2, we added our main independent variables using a hybrid commercialization strategy as the reference. The product-based strategy variable exhibited a negative and significant effect on internationalization propensity relative to hybrid firms, our baseline group (-0.84, $p < 0.05$). Estimating the marginal effect of this relationship, we found that, *ceteris paribus*, product-based firms exhibited a 20% lower propensity to internationalize than hybrid firms. The coefficient of the IP-based strategy dummy was not significant in the model.

To address the potential endogeneity of the product strategy variable, we used the Durbin-Wu Hausman test. This test for the exogeneity of the (presumed) endogenous variable was significant, implying that our estimates of the non-instrumented regression reported in

Table 3 (Models 1-2) did not adequately control for unobservable firm-specific effects. We therefore interpret our findings based on Models 3 and 4, which we describe next.

Models 3 and 4 report a two-step bivariate probit analysis, which corrected for endogeneity using two instrumental variables. Our first instrument was an industry-level variable calculated using the average number of IPRs of firms in the relevant four-digit industry. The rationale for using this instrument was that a firm's product commercialization strategy is influenced by the average number of IPRs of other firms in the same industry. Theoretically, according to Gans and Stern (2003), a firm's choice of commercialization strategy is regulated by its commercialization environment. Nevertheless, the IPRs of other firms do not directly influence the international propensity of the focal firm. Previous papers have also used industry-level variables as instruments (Cheng et al., 2014; Friedberg, 2003; Hanlon et al., 2003; Leiponen and Poczter, 2016; Nevo, 2000). Our second instrument, "hotspot" was a binary variable that equaled one when the start-up was located in one of the US states ranked in the top ten as high in technology and science assets, and zero otherwise. This variable captured the firm's commercialization environment as it measured the available technology and science assets in a region (O'Shea and Ulph, 2008). Although this variable is linked to the commercialization strategy of the focal firm, from the firm's point of view it is exogenously determined, and it is unlikely to be directly associated with the firm's international propensity. Using two instruments allowed us to run a number of tests for their exogeneity. Although we found little theoretical reason to expect our instruments to be invalid, we also examined their validity by reporting Hansen's J-test of over-identifying restrictions, which tests whether the instruments are correlated with the error term. An empirical check on the robustness of the average number of IPRs in the industry and hotspot revealed that they are good exogenous variables which are not correlated with international propensity but which do predict the focal firm's commercialization strategy (Hamilton and

Nickerson, 2003; Sirmon and Hitt, 2009).[8] This shows that the instrumental variables in the two-step method relieve concerns of endogeneity. In Model 4, we see that, after correcting for the endogenous character of the product strategy, Hypothesis 1a receives support, as a product-based strategy is more negatively and significantly related to international propensity than a hybrid strategy. However, Hypothesis 1b is not supported, since the coefficient of the IP-based strategy dummy is not significant.

--INCLUDE TABLE 3 HERE--

As shown in Table 4, we employed an ordered logistic regression to test Hypotheses 2a and 2b on the sample of firms that had international operations (i.e., we examined only firms with international sales). Model 1 in Table 4 includes only the control variables, while Model 2 adds the main independent variables. We examined whether product-based ventures exhibited lower international intensity than hybrid firms (H2a) and whether IP-based ventures exhibited higher international intensity than hybrid firms (H2b). The results reveal that a product-based commercialization strategy does not have a more significant effect on international intensity than a hybrid strategy, whereas an IP-based strategy has a positive and significant effect (3.74, $p < 0.05$), as expected. This means that the ordered logit for IP-based firms being in a higher international intensity category is 3.74 times greater than for hybrid firms when all other variables in the model are held constant.

To address the potential endogeneity of the product strategy variable, we used the Durbin-Wu Hausman test. This test for the exogeneity of the (presumed) endogenous variable was not significant, indicating that the null hypothesis of exogeneity could not be rejected. This implies that our estimates of the non-instrumented regression reported in Table 4 (Models 1-2) adequately controlled for unobservable firm-specific effects. We therefore

[8] Hansen's J test clearly approves the null of no correlation between instruments and the error term: the Chi-squared p-value is 0.3935.

interpret our findings based on Models 1 and 2. Our findings suggest that firms with an IP-based strategy exhibit higher international intensity than firms with a hybrid strategy, thus supporting Hypothesis 2b.

In further analyses, we estimated the likelihood that a given firm was assigned to any particular category of internationalization intensity (i.e., 5%, 5–25%, 26–50%, 51–75% or 76–100%) based on whether or not the firm had adopted an IP-based strategy. All other variables were held constant. We found that if a given firm had *not* adopted an IP-based strategy, its likelihood of being assigned to a *higher* category of internationalization intensity *decreased*. However, if the firm *had* adopted an IP-based strategy, the respective likelihood *increased*. For example, the probability of a given firm being assigned to the highest category of internationalization intensity (i.e., 76-100% international sales) was 0.01 if the firm had *not* adopted an IP-based strategy and 0.37 otherwise. For the category of lowest international intensity (i.e., 5% or less international sales), the probability of a non-IP firm being assigned to this category was 0.43, while the respective probability for IP-based firms was 0.01. This analysis provides further support for Hypothesis 2b. However, a product-based strategy was positively but not significantly related to international intensity compared with hybrid firms, providing no support for Hypothesis 2a.

--INCLUDE TABLE 4 HERE--

Since Hypotheses 1b and 2a are not supported, we performed additional analyses using IP (rather than hybrid) strategy as a reference to further examine the relationship between technology commercialization strategy and firm internationalization. These analyses show that a product-based strategy is negatively related to international propensity (-1.08, $p < 0.10$) compared with an IP-based strategy, but there is no association between a hybrid strategy and international propensity. Furthermore, we find that both product-based and

hybrid strategies are negatively related to international intensity compared with an IP-based strategy.[9]

We conducted several robustness checks to ensure the accuracy of our findings and to eliminate other possible explanations for our results. First, because our sample was not random (as it included start-ups that had international sales), we employed a two-stage estimation method that allowed us to correct for self-selection into internationalization (Hamilton and Nickerson, 2003; Heckman, 1979). In the first step, we used R&D intensity to predict the propensity to internationalize. In the second step, we corrected for selection bias by including a transformation of the predicted probability as an additional explanatory variable. The inverse Mills ratio showed a non-significant influence, suggesting that selection bias was not a concern in our model.[10] Second, because sample attrition was a potential concern (as some firms went bankrupt within our seven-year panel), we conducted the same analysis using a reduced sample (i.e., we removed firms that went bankrupt). The results from analyses of this sub-sample were fully consistent with the results reported here. Third, as product firms may need more time to generate sales in foreign markets, we tried alternative lags of our independent variables (t-2), and our results were consistent. Fourth, we ran a Cox model to predict the time to internationalization, and our results were consistent with the logit models reported here.[11] Finally, we added the number of patents as an additional control variable, and our results again remained consistent.

## 5 Discussion

### *5.1 Key findings*

We explored how the type of commercialization strategy (product-based, hybrid, and IP-based) influences the internationalization outcomes of technology-based new ventures. We

9 Tables available from the authors on request.
10 Tables available from the authors on request.
11 We would like to thank an anonymous reviewer for this point.

found that product-based new ventures are less likely than hybrid and IP-based firms to internationalize sales. We also found that an IP-based commercialization strategy endows new ventures with an internationalization advantage over both product-based and hybrid firms once the international entry has occurred. However, contrary to expectations, we found that IP-based new ventures do not differ from hybrid new ventures with respect to their international propensity. These results generally support our argument that different commercialization strategies and consequent external resource dependencies impact differentially on new venture internationalization outcomes.

### *5.2 Theoretical implications*

First, our study contributes to the international entrepreneurship and broader international business literatures. We contribute to the growing body of research on new venture internationalization by examining the effect of commercialization strategies and associated external resource dependencies on internationalization outcomes (De Clercq et al., 2012; Oviatt and McDougall, 2005; Zahra et al., 2000). We believe that a resource-dependence perspective is particularly useful for new venture internationalization, as new ventures need to access and mobilize external resources in order to build their operations, both domestically and abroad. Because different commercialization strategies depend on differing external resource access, they are likely to lead to different internationalization outcomes. In this study, we distinguished between ventures that commercialize products, ventures that sell IP, and those that commercialize both products and IP.

Our findings provide novel insights into how resource dependencies and liabilities of outsidership manifest themselves in technology ventures adopting different commercialization strategies. As stated by Schweizer (2013: 82), "*While we know how firms can overcome the liability of foreignness… little is known about how firms can prevail over the liability of outsidership.*" When undertaking internationalization, IP-based new ventures may

position themselves upstream in the value chain (Arora et al., 2001) and leverage the benefits associated with IP rights, such as quality signals (Hsu & Ziedonis, 2013) and greater resource fungibility (Autio et al., 2000). While hybrid firms seem to enjoy similar benefits to IP-based firms at initial foreign market entry, firms selling both products and IPRs experience greater external resource dependencies and consequent liabilities of outsidership, which lower their international performance *after* initial entry.

Intriguingly, we found that, compared with IP-based firms, hybrid firms are not disadvantaged with respect to entering foreign markets, but *are* disadvantaged in exploiting foreign market opportunities. This finding suggests that the fixed costs of foreign market entry may not be significantly different between IP-based and hybrid firms. Thus, differences in resource dependencies between hybrid and IP-based firms may only become apparent once international entry has occurred. This finding may signal that the ambidextrous nature of hybrid firms (by virtue of having to run dual business models) raises the operational costs of foreign operations and may subsequently impede their ability to exploit foreign market opportunities effectively. Running dual business models may be challenging because it may require different and often incompatible value chain activities (Markides, 2013). For this reason, hybrid firms may be able to leverage the benefits provided by selling IPRs at initial foreign market entry (supporting H1a), but these benefits may be offset by the challenges and costs of running dual business models when trying to increase international sales (not supporting H2a). Future research is needed to analyze more fully the temporary advantage of hybrid ventures.

Second, this study also extends the growing body of research exploring the internationalization of intangible resources (Knight & Kim, 2008). Previous research shows that knowledge intensity and the quality of technological resources affect international performance (Autio et al., 2000; Filatotchev and Piesse, 2009; Tseng et al., 2007). Intangible

assets (e.g., IPRs) provide firms with competitive advantage, enhancing their ability to internationalize (Dunning, 2000). The greater fungibility of technologies relative to physical resources makes it less costly to leverage and scale technologies across a range of foreign markets (Martin and Salomon, 2003). Our findings provide a more nuanced insight into the benefits provided for internationalization by intangible assets, but they also suggest that these benefits may be reduced when firms also embody their knowledge in products. Stated differently, our results suggest that only a pure IP-based commercialization strategy enables technology ventures to fully exploit the benefits of IPRs to scale up international operations.

Our study also provides the internationalization literature with a more nuanced perspective on the role of foreign market knowledge. Dominant perspectives, such as international new venture theory (Oviatt and McDougall, 1994) and international process theory (Johanson and Vahlne, 1977), attribute great importance to foreign market knowledge for successful firm internationalization. The former perspective emphasizes the prior international experience of the founders, while the latter highlights the firm's experiential learning from operating abroad (Bruneel et al., 2010). However, existing research on new venture internationalization has tended not to study the effects of a new venture's commercialization strategy on resource access and mobilization and consequent internationalization outcomes, focusing instead on exploring determinants of early and proactive internationalization in the context of traditional value chains. Thus far, the internationalization literature has not considered how technology commercialization strategy regulates the need for foreign market knowledge. The findings of this study suggest that there is less need for such knowledge when technology ventures sell IPRs to foreign markets, as these firms are less reliant on foreign knowledge because they do not have to build and access downstream assets in foreign markets. A firm's technology commercialization strategy seems

to regulate its dependence on foreign market knowledge for international propensity and intensity.

Our focus on the effects of the choice of commercialization strategy on internationalization outcomes calls for greater attention to be given to the effect of business model choice on internationalization (Onetti et al., 2012). Thus far, the new venture internationalization literature has almost completely side-stepped the study of business models, choosing instead to consider internationalization itself as a kind of business model. As demonstrated in this study, commercialization strategy, which has important implications for the design of business models (Arora et al., 2001), has non-trivial consequences for internationalization.

Third, our study extends the literature on commercialization strategies in new ventures by investigating the internationalization propensity and intensity of start-ups adopting IP-based, hybrid, and product-based commercialization strategies (Gans et al., 2002). This literature has focused primarily on explaining the choice between product and technology markets, with limited attention to the internationalization implications of adopting alternative technology commercialization strategies. We extend the literature on commercialization strategies of technology ventures by considering a hybrid strategy as distinct from IP-based and product-based commercialization strategies. A hybrid strategy combines product-based and IP-based commercialization strategies. To our knowledge, extant research has considered commercialization strategy as a dichotomous choice between IP or product, overlooking firms that combine both commercialization strategies. Our findings reveal interesting differences between the three commercialization strategies in terms of internationalization outcomes. We suggest that future studies should also include a hybrid technology commercialization strategy as a separate category involving sales of both products and IPRs.

### *5.3 Implications for practice*

Our study has important implications for practitioners. Our findings suggest that entrepreneurs seeking to exploit international opportunities should pay close attention to the relative merits and drawbacks of product-based, hybrid, and IP-based commercialization strategies in international markets. Where possible, entrepreneurs should make the best use of their exclusive IPRs by licensing their technologies to foreign markets. This will allow them to reduce their exposure to liabilities of outsidership by generating additional revenues, and to benefit from the increased legitimacy and fungibility of their resources (Autio et al., 2000). When adopting a product-based or hybrid commercialization strategy, entrepreneurs should be aware of the greater difficulties they will encounter in achieving "insidership" in networks abroad, especially when trying to exploit international opportunities.

Our findings also suggest how investors can add more value to product-based and hybrid technology ventures in their portfolio. Investors should pay particular attention to connecting these ventures to other organizations, as this should help overcome liabilities of outsidership, thus facilitating international performance. For policy-makers, our study reveals the importance for new ventures of accessing relevant networks to exploit international opportunities. Liability of outsidership among product-based and hybrid commercialization ventures may constitute a significant challenge to internationalization. Based on this insight, policy-makers should give attention to facilitating and supporting such new ventures in their international networking efforts.

### *5.4 Limitations and avenues for future research*

Our study examined technology-based new ventures based in the US. The generalizability of our results is limited by country and industry, and future research should therefore examine the effects of commercialization strategies in different country and industry contexts. A further limitation of our study is that we could not distinguish between

different foreign markets entered by the ventures in the dataset. Therefore, we cannot predict how the observed effects would pan out in, for instance, geographically more distant markets. Our theory implies that the effects of IP-based, hybrid and product-based strategies on internationalization should grow more pronounced in geographically and culturally distant markets. This is an interesting question for further research. In addition, owing to data constraints, we were unable to explore the effects of foreign market entry mode choice, such as whether some product-based new ventures also use intermediaries rather than direct exports (Blum et al., 2010). Future research should test whether firms using intermediaries are less exposed to resource dependencies during internationalization.[12] Moreover, owing to data constraints, we were unable to use continuous indicators to measure internationalization intensity. Future studies might use international sales or growth in sales in foreign markets to measure internationalization intensity. Future research might also investigate the effect of firms' knowledge characteristics (e.g., radicalness and scope of patents, or whether the patent is a result of collaboration with other [foreign] firms) on the internationalization of new ventures. Scholars might make use of use of patent data to explore this question.[13]

Owing to data limitations, we could not explore the mitigating effect of pre-existing inter-organizational relationships on the liabilities of outsidership experienced by new ventures adopting different commercialization strategies. Previous research indicates that collaboration with other firms may facilitate access to foreign markets and fuel international expansion (Barkema et al., 1997; Coviello, 2006; Khanna et al., 1998; Osborn and Baughn, 1990). In addition, data limitations prevented us from controlling for the international business experience of the founders. However, the omission of the variables discussed above is unlikely to have influenced the interpretation of our findings, as we employed instrumented

12 We thank an anonymous reviewer for this comment.
13 We thank an anonymous reviewer for this comment.

variable models to control for unobservable firm-specific effects (Wooldridge, 2001). Future research might examine how the breadth of a new venture's network across different types of partnership, as well as the international character of the partner network, influences the commercialization strategy–internationalization relationship. In addition, future research might fruitfully examine the temporary advantage of hybrid ventures. We suggest that future studies should also include a hybrid technology commercialization strategy as a separate category involving sales of both products and IPRs. Finally, underlying processes in the emergence of liabilities of outsidership in new ventures remain unexplored. Future research might include case studies and other qualitative approaches to examine how these liabilities emerge.

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