**Does knowledge intensity always support international new venturing?**

**The moderating role of international networks and prior international experience**

**ABSTRACT**

Knowledge intensity may either endorse new ventures' internationalization or restrict the intensity and diversity of international activities, because of knowledge appropriation risks. However, International New Ventures (INVs) employ international networks or prior international experience to safeguard knowledge intensive resources, and, thus utilize these resources to achieve higher international intensity and diversity. We observe how knowledge intensity's impact on the likelihood to form distinct INV types (Export Start-ups, Multinational Traders, Geographically Focused Start-ups and Global Start-ups), is moderated by international network size, international network strength and prior international experience of the management. We draw hypotheses from Transaction Cost Economics and structural embeddedness and apply multinomial regression analysis on a sample of 149 INVs. Findings show that international network strength increases the impact of knowledge intensity on INVs' likelihood to become another INV type than an Export Start-up, while network size has a converse effect, reducing the likelihood to become an INV type with high international diversity and/or intensity. Moreover, we observe different configurations of network strength, prior international experience and knowledge intensity by calculating triple interaction effects. Thereby, we find that knowledge intensity even becomes negatively associated to international expansion if INVs lack both, strong international networks and prior international experience.

# INTRODUCTION

Knowledge intensity plays an important role in the literature on international new ventures (INVs) (Autio, Sapienza & Almeida, 2000; Bell, McNaughton, Young & Crick, 2003; Coviello & McAuley, 1999; Jones, 1999). Lacking sufficient demand from the domestic market, knowledge intensive INVs enter foreign markets early in their lifecycle in order to secure firm growth and survival. However, this causes an obvious dilemma: On the one hand knowledge intensive INVs have to expand internationally in order to amortize high R&D costs and to find sufficient demand for their products to be able to grow and survive (Autio et al. 2000). On the other hand the risk of losing the firm's most valuable asset – its knowledge – may increase with a higher the intensity and diversity of internationalization (Li, Eden, Hitt & Ireland, 2008).

Prior studies exemplify that international networks and prior international experience of the management provide the opportunity to achieve fast international coverage while at the same time securing the firm's valuable knowledge. International network contacts offer the opportunity to get access to foreign markets (Weerawardena, Mort, Liesch & Knight 2007) and to share knowledge in trusty relationships (Yli-Renko, Autio & Tontti, 2002). Moreover, knowing the rules of the game in international markets, management teams with prior international experience are better able to overcome the liabilities of foreignness (Zaheer, 1995) and to secure the firm's proprietary knowledge in foreign environments (Yli-Renko et al., 2002).

However, two major issues largely remain unanswered concerning the relationship between knowledge intensity, international network contacts, prior international experience, and international new venturing. First, a differentiated analysis of how the size (number of network contacts) and strength (frequency of contact with network partners) of international networks impacts the relationship between knowledge intensity and international new venturing is largely missing to our knowledge. However, due to the different meaning of

network size and network strength in the internationalization of the firm more contingent knowledge is necessary. While the size of the international network may provide access to numerous foreign markets allowing for fast international coverage it may also enforce the risk of knowledge diffusion due to a limited degree of trustful relationships between the firm and a high number of network partners. Second, we lack knowledge of how prior international experience impacts the interplay of knowledge intensity, international networks, and international new venturing. Knowing about how different configurations of prior international experience and network strength affect knowledge intensity's impact on international new venturing would be interesting for two reasons. On the one hand this would provide information if own experience in international markets substitutes experiences and security gains from international networks. On the other hand it will provide more detailed knowledge how the impact of knowledge intensity changes if neither own experience nor strong networks exist to secure knowledge.

The aim of this paper is to empirically investigate how the size and the strength of international networks moderate the impact of knowledge intensity on the type of international new venturing (Export Start-up, Multinational Trader, Geographically Focused Start-ups or Global Start-up). Further, we observe how prior international experience moderates these relations in a triple interaction effect. Figure 1 displays our research model.


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To address our questions we draw hypotheses from a theoretical framework supplementing Transaction Cost Economics (TCE) (Williamson 1985, 1996) with the concept of structural embeddedness (Granovetter, 1985). Hypotheses are tested on a sample of 149 German INVs by applying hierarchical moderated multinomial logistic regression.

This paper makes several contributions in terms of theoretical development and practical implications. We combine TCE with structural embeddedness and apply this framework to the phenomenon of international new venturing. Thus, we advance explications about the occurrence of different types of INVs under divergent levels of network embeddedness and resource base. Moreover, we contribute to the network discussion by showing that only strong networks help to globally expand knowledge intensive products and services. For managers we show that it pays off to foster a small, but close network, than applying a huge, loosely connected network if knowledge intensive resources ought to be protected. In addition we show that fostering strong relations abroad gets increasingly eminent if the management lacks own priory gained international experience.

## TYPES OF INTERNATIONAL NEW VENTURES

The predominant definition of INVs has been introduced by Oviatt & McDougall (1994), and describes an INV as "a business unit that, from inception, seeks to derive significant competitive advantages from the use of resources and the sale of outputs in different counties" (Oviatt & McDougall, 1994: 49). These firms mainly build their competitive advantage on knowledge intensity (Sapienza, Autio, George & Zahra, 2006), and at the same time serve small niche markets (Knight & Cavusgil, 1996). Therefore, in order to amortize high R&D costs these ventures are forced to capitalize their products internationally from early on.

As an established framework in the research field, the International New Venture Theory (INVT) (Oviatt & McDougall, 1994) focuses on the question of how it is possible for knowledge intensive companies to venture into foreign markets from inception. INVT has challenged traditional stage models of internationalization by stating that foreign markets are not only entered by large and internationally experienced multinational enterprises (MNEs), but also increasingly by start-ups at or near their inception (Autio et al., 2000). However,

within the discussion of INVs authors distinguish between different types of INVs operating on divergent levels of scale and scope of internationalization. Along the dimensions international intensity (revenues generated abroad) and international diversity (number of foreign markets served) INVT differs between four different types of INVs, namely:

(1) Export-Import Start-ups with a limited international intensity and diversity.

(2) Multinational Traders with low international intensity and high international diversity.

(3) Geographically Focused Start-ups with high international intensity and low international diversity.

(4) Global Start-ups with high international intensity and high international diversity.

Figure 2 illustrates the different types of international new ventures along the dimensions international intensity and international diversity.

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## THEORY AND HYPOTHESES DEVELOPMENT

To examine how international network size and strength and prior international experience moderate the relationship of knowledge intensity on the types of international new venturing we apply transaction cost reasoning supplemented with elements of structural embeddedness. We propose that knowledge intensive resources foster international new venturing (Autio et al., 2000; Sapienza et al., 2006) but also bear risks of opportunistic behavior and sunk costs (Miller & Shamsie, 1996). According to TCE, knowledge intensive specific assets require reliable governance structures in order to positively impact internationalization.

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Knowledge intensive firms need to capitalize on their specific assets on a global scale and scope. Knowledge intensive resources are highly specific assets. They are often customized on specific needs (Knight & Cavusgil, 2004) and thus, involve acting in small niche markets. The domestic market is often too limited to amortize R&D investments and to secure firms' survival. This leads new ventures to pursue an international strategy by increasing international intensity and diversity. New ventures with specific, knowledge intensive resources will therefore more likely become Global Start-ups and less likely act only on a low international scale and scope as characteristic for Export Start-ups.

Focusing on the efficiency and effectiveness of single transactions, TCE has its limitations when including the embeddedness of a transaction. According to TCE, specific assets, or knowledge intensive resources need protection. They are most efficiently governed in hierarchical structures which allow for avoiding behavioral and environmental uncertainty (Williamson, 1996). This means that international firms possessing knowledge intensive resources should enter foreign markets rather with own subsidiaries than with loosely connected contractual partners of foreign sales distributors. However, new ventures, symptomatically short in resources (Zahra, 2005), cannot afford such expensive institutional arrangements. This is why they have to rely on alternative governance structures, such as networks (Oviatt & McDougall, 1994). TCE, focuses on the single transaction not taking the embeddedness into consideration. Thus, supplementing TCE with elements of structural embeddedness may be worthwhile to more completely explain the relationship of knowledge intensity, networks, and the types of international new venturing.

The concept of embeddedness (Granovetter, 1985) enriches the understanding of international new venturing by referring to the criticism of transaction cost theory, such as the atomization of the unit of analysis, the strict assumption of opportunism, and neglecting the embeddedness of the single transaction (Zajac & Olsen 1993; Calof & Beamish 1995,

Ramanathan, Seth & Thomas 1997; Zafarullah, Ali & Young 1998; Gulati, Nohria & Zaheer 2000). In contrast to TCE it conceptualizes economic actors as „being socially constructed – shaped and constrained by the groups to which they belong" (Pressman & Montecinos, 1996: 878). Networks enable long-term relationships between two or more transaction partners and offer the opportunity to generate learning-effects (Richter, 2002: 6). That way the access to resources of which the network partner disposes can be achieved. In addition, restrictions can be overcome and information asymmetries and uncertainties can be reduced (Brouthers & Brouthers, 2003; Rooks et al., 2000).

Networks significantly contribute to new ventures´ internationalization. A wealth of studies emphasizes the impact of international networks on the intensity and diversity of international new venturing (Weerawardena, Mort, Liesch & Knight 2007; Young, Dimitratos & Dana, 2003; Zahra, Matherne & Carleton 2003). Networks facilitate foreign market entry (Nerkar & Paruchuri, 2005), reduce uncertainty (Freeman, Edwards & Schroder, 2006), provide financial backup (Shane & Cable, 2002), and support learning in and about foreign markets (Yli-Renko et al., 2002; Schwens & Kabst, 2009). However, as networks show multiple facets, their impact on international new venturing needs a more differentiated analysis. A large, but loosely connected network has a different impact on knowledge intensive new ventures than a tightly bonded and trusty network cultivating intensive contact.

Moreover, the strength of international networks has an impact on the possibility to exploit knowledge intensive resources on an international level (Dyer & Singh, 1998; Levinson & Asahi, 1996; Powell et al., 1996). Although knowledge intensity provides the opportunity for international growth (Yli-Renko et al., 2002) its impact may be restricted if risks for patent infringement or product piracy occur. Thus, knowledge intensive firms are particularly in need of a secure environment to minimize these risks and to exploit their competitive knowledge and abilities on a full scale. A large network which is weakly tied can

be compared to markets with opportunistic actors. In such a scenario knowledge will be hard to protect. Conversely, strong international networks are more likely to nourish trust and may provide ground for the international expansion of knowledge intensive firms.

**Hypotheses**

A strong international network moderates the relationship between knowledge intensity and the types of international new venturing. Strong networks foster the transition of knowledge intensive products and services into international markets. Compared to weaker ties, strong networks imply a higher intensity of interaction and the information exchange is "more proprietary and tacit than the price and quantity data […] traded in arm's-length ties" (Uzzi, 1997: 45). This way, a strong international network provides rich information composed to information chunks which better endorse internationalization and security than sequential pieces of dissimilar price and quantity data.

The high interaction rate, inherent to strong networks, is strongly associated with interfirm trust (Ahuja, 2000; Kogut et al., 1992) since "trust increases interactions and closeness among actors in a relationship, thus enhancing their ability to recognize and effectively evaluate information (Athuane-Gima & Murray, 2006: 7)." Trust is the predominant governance tool for strong network ties (Hoang & Antoncic, 2003) and it is eminent for sharing vital information (Cowan & Jonard, 2009). Managers, for example, more comfortably exchange their knowledge with other organizations if they are connected by strong and trusting relationships (Kelley, Peters & O'Connor, 2009; Perry-Smith & Shalley, 2003). This is particularly true when knowledge involves a high level of complexity (Hansen, 1999). Therefore, a constant and trust based interaction "between partners is often cited as a critical [network] element that in turn enhances the quality of the resource flows." (Hoang & Antoncic, 2003: 166).

An intensive contact with foreign network partners "contributes to lowering risk and uncertainty inherent in international operations" (Weerawardena et al., 2007: 301). Hence, strong ties are a powerful tool to facilitate international new venturing (Oviatt & McDougall, 2005; Selnes & Sallis, 2003) by yielding security and financial backup (Shane & Cable, 2002). This is why new ventures with strong social ties rather profit from innovation (Rao et al., 2008) compared to new ventures lacking these ties. By providing information and trust (Uzzi, 1997), intensive inter-organizational contact reduces transaction costs and environmental uncertainty and, thus, fosters the distribution of knowledge intensive products and services abroad.

Moreover, strong international networks promote opportunities for market development and help to identify international business opportunities (Oviatt & McDougall, 1995) as well as economies of time (Uzzi, 1997). Oviatt & McDougall (1994: 57) support this view stating that new ventures frequently "using network governance structures may limit the expropriation of venture knowledge. The network structure to a certain extent tends to control the risk of knowledge dissemination and intellectual property violence."

Thus, strong international networks help to exploit knowledge intensity on an international scale by providing increased market knowledge and higher transaction security (Filaster & Spiess, 2008). Strong international networks help firms to overcome the barriers to internationalization and to increase both international intensity and international diversity.

*Hypothesis 1. The intensity of international networks will positively moderate the impact of knowledge intensity on the likelihood to become another INV type than an Export Start-up.*

In contrast to the relationship of international network strength, the size of an international network negatively moderates the relationship between knowledge intensity and the types of international new venturing other than Export Start-ups. Even though a big network supports internationalization in general by providing visibility and legitimacy (Choi & Shepherd, 2005; Gulati, 1995; Suchman, 1995) in the first place, it may also cause severe problems which outweigh its benefits in particular for knowledge intensive firms (Adler & Kwon 2002; Athuane-Gima & Murray 2006). In some cases an INV does not aim at full visibility, especially concerning its technological base, because knowledge dissemination and product piracy become more likely if the company's visibility increases (Carayannopolus, 2009).

Moreover, as networks grow they also become more disperse and network members are less connected to each other. The manageability of the respective network companies diminishes and social ties become weaker. This effect is further enforced by the remoteness of international network partners. Compared to physical firm-clusters international cooperation suffers from lower face-to-face interaction. Former research has already shown that face-to-face interaction is a prerequisite for enhancing innovation and information exchange (Carayannopolus, 2009; von Hippel, 1998) and to form strong ties.

Therefore, a big international network holds characteristics of weak ties (Athuane-Gima & Murray 2006). Uzzi (1997) mentioned that "market ties conformed closely to the concept of an arm's-length relationship as commonly specified in the economic literature" (1997: 42). Same as market relations, weak ties are quickly established, but also quickly resolved and do not allow for rigorous behavioral control (Williamson, 1996). Accordingly, proprietary knowledge cannot be safeguarded efficiently via this conduit and knowledge dissemination becomes more likely. This is why "weak social ties [may] help to speed up projects when knowledge complexity is low, but slow down projects when knowledge complexity is high" (Hansen, 1999: 82). In such case, strong ties may be required. Following a TCE rationale,

knowledge intensive INVs will be deterred from further internationalization if they have a wealth of international contacts, since such a loose network does not allow for knowledge protection but furthers knowledge dissemination. Therefore, an INV will profit less from its knowledge intensity if it holds numerous international network contacts.

*Hypothesis 2. The quantity of international social ties will negatively moderate the impact of knowledge intensity on the likelihood to become another INV type than an Export Start-up.*

Prior international experience may provide an alternative way to overcome liabilities of foreignness and, thus, to make use of the full potential of knowledge intensity. According to Cohen & Levinthal (1990), prior international experience is a proxy for new venture's absorptive capacity, which increases the "ability to identify, value, select and assimilate new knowledge" to existing knowledge (Zahra, 2005: 25). Due to an increased ability of knowledge acquisition, internationally experienced managers will more easily spot and exploit growth opportunities in foreign markets than those without prior international experience. Prior international experience may facilitate internationalization at an early stage of the firm´s lifecycle (Bürgel & Murray, 2004) and provide extensive knowledge about foreign market structures and customer needs. An internationally experienced management will have profound insights into foreign markets allowing to better deal with opportunities and potential pitfalls of the investment abroad. Therefore, especially firms with internationally experienced management teams may have the capacity to manage problems in foreign markets such as the threat of knowledge appropriation. Accordingly, tacit information about foreign markets may be gathered through prior international experience of the management.

Therefore, prior international experience will enable the transferring of knowledge intensive products and services to foreign countries by providing security (Sapienza et al., 2006). However, the gain in security of prior international experience is also dependent on the presence of international networks. Only if international networks are underdeveloped, prior international experience will positively influence the exploitation of knowledge intensity, since the safeguard effect from strong social ties alleviates the safeguard effect of entrepreneurs' prior international experience (Zhang, Soutaris, Soh & Wong, 2008). Thus, the effects of international networks and prior international experience will cancel each other out.

On the other hand, if both international networks and prior international experience are weak there will be no mechanism to secure own knowledge. Knowledge intensive resources only facilitate international expansion if the potential wins exceed the risks. If no mechanism for knowledge protection exists, INVs will more likely act in few countries on a low scale than pursing a global strategy, since knowledge appropriation abroad cannot be sufficiently prevented. Therefore we hypothesize:

*Hypothesis 3a. Only at low levels of international network contact intensity prior international experience will positively moderate the impact of knowledge intensity on the likelihood to become a Global Start-up opposed to becoming an Export Start-up.*

*Hypothesis 3b. If both international network contact intensity and prior international experience are low, knowledge intensity will be negatively related to the likelihood to become a Global Start-up opposed to becoming an Export Start-up.*

# METHODS

## Sample

To collect data, we conducted a questionnaire-based statistical survey of young German technology firms from four different future-oriented technology areas: Nanotechnology, Biotechnology, Microsystems, and Renewable Energies. From February until April 2007 we sent out questionnaires to the total population of German firms from these technology fields.

Questionnaires were sent to CEOs, export managers, or owners of the firms as they are perceived to have the most profound knowledge about the internationalization practices and strategic decisions of the firm. In total we sent out N=1,944 questionnaires. The response rate was about 17%, which is a total number of 340 questionnaires. As we surveyed the total populations of German Nanotechnology (N=305), Biotechnology (N=526), Microsystems (N=292) and Renewable Energies (N=821) firms, our sample included both international firms and firms only active in the domestic market. Due to the research aim of our study we had to eliminate those firms with explicit activities restricted to the domestic market only (n=87). Further, in order to include firms which fulfill the characteristics of an international new venture, we included only firms which started international activities within ten years after inception (Bürgel & Murray, 2000) into our analyses. Therefore, a sample of n=149 remained for our analyses. The average firm age of the companies in our sample was seven years and the average age at first internationalization was two years with the firms realizing on average 28.6% of their annual sales abroad. The firms in our sample internationalized into twelve foreign markets on average. These statistics show a very proactive internationalization behavior of the young firms in our sample.

We controlled the returned questionnaires for non-response bias according to Armstrong & Overton (1977). We compared early and late respondents in terms of selected constructs. A

t-test showed no significant differences (p < 0.05). Thus, results indicate that differences between respondents were not related to non-response bias.

**Measurement**

**Types of International New Ventures.** Our dependent variables "types of International New Ventures" is measured by four different INV types: Export Start-ups, Multinational Traders, Geographically Focused Start-ups, and Global Start-ups. To measure these four INV types we applied a categorization along two dimensions: 1) the percentage of foreign market sales to total sales (international intensity) and 2) the number of foreign countries served (international diversity). This classification is an adaptation of Oviatt and McDougall's model (1994).[1]

A major challenge with such classification is to identify the thresholds for the different INV types. The original model by Oviatt & McDougall (1994) does not provide such thresholds defining the four INV types along the two dimensions international intensity and international diversity. Further, existing thresholds applied by other authors from the field of international entrepreneurship vary largely for both intensity and diversity of internationalization. Kanndasaami & Huang (2000) define a start-up as global if it realizes at least 10% of its turnover abroad, whereas Johnson (2004) sets the threshold at 20%, Madsen

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[1] Instead of the intensity of internationalization Oviatt & McDougall employ the coordination of value chain activities abroad and the number of countries involved to distinguish the different INV types from each other. However, applying the value chain dimension in order to classify INVs can cause some problems (Jones & Tagg, 1999; Saarenketo et al., 2001). Especially young firms pursue individual combinations of foreign activities and international development paths, making it difficult to classify them according to value chain criteria (Jones, 1999). Moreover, a classification regarding the mere number of value chain activities does not account for the relative importance of activities. An INV may be globally acting and at the same time only coordinating few but important activities abroad (such as logistics, marketing, R&D etc.). To avoid these measurement problems and to get a more meaningful and established scale for the international intensity, the value chain dimension was changed into the percentage of foreign market sales to total sales in this study.

et al. (2000) at 25%, McKinsey (1993) at 75% and Lummaa (2002) even calls for 90% of foreign sales to define a Global Start-up. In terms of the diversity of international action it is discussed whether to take the number of different markets, geographical regions or countries worked in to differ Global Start-ups from other types of INVs. In accordance with Kandasaami (1998), we chose the number of five countries as threshold for the international-diversity dimension. The threshold of the international-intensity scale was set at 30%. We conducted a median-split confirming both thresholds as the median of each scale. Thus, Export start-ups operate in less than 5 countries and generate less than 30% of international revenues, Multinational Traders operate in 5 or more foreign countries and generate less than 30% of international revenues, Geographically Focused Start-ups operate in less than 5 countries and generate more than 30% of international revenues, and Global Start-ups operate in 5 or more foreign countries and generate more than 30% of international revenues. According to this classification we identified 41 Export Start-ups, 17 Multinational Traders, 23 Geographically Focused Start-ups, and 68 Global Start-ups in our dataset.

**Knowledge intensity.** To measure knowledge intensity we adapted a three-item scale developed by Yli-Renko et al. (2002). Questions yielded the technological excellence of the firm such as "we are known for our excellent technological expertise and knowledge" (Likert scale from "1=do not agree" to "5=strongly agree"). We applied multi-item measurement covering the different aspects of knowledge intensity. Factor analysis shows the items loading on one factor delivering a scale with a Cronbach´s alpha of .78.

**International network contacts.** We measure international network contacts in terms of two aspects: the size as well as the strength of international network contacts. The *size* is measured by combining two questions about the number of partnerships or network ties a new venture has with foreign companies (SMEs, or MNEs respectively) which is suggested by various authors (Baum et al., 2000; Reuber & Fischer, 1997). To determine the total number of partnerships a new venture holds abroad, the two measurements are merged into one index.

The *strength* is measured by asking for the frequency of contact with the most important international cooperation partner (Dyer & Singh, 1998; Kale et al., 2000). This is also in line with the findings of Uzzi (1997) stating that "constant communication [.] [makes] the difference" (Uzzi, 1997: 45) between strong and weak ties.

**Prior international experience of the top management.** Due to the young age at the timing of internationalization, prior international experience of INVs is more likely rooted in the individual level than in the organization itself (Schwens, 2008; Saarenketo et al., 2001) Thus, we decided to measure prior international experience on the individual level rather than on the organizational level as this better applies to INVs. We adapted two questions from Bloodgood et al. (1996). One example is whether or not the person with the most international experience has already worked in an internationally operating company. Both items are merged and coded binary (0 if no international experience exists and 1 if at least one aspect was answered positively). This type of coding is applied, since "the relationship between international experience and organizational outcomes is unlikely to be linear across time or across individuals and strategic management literature suggests that exposure to a particular type of experience, regardless of its length, is likely to be consequential" (Reuber & Fischer, 1997: 816).

We included **firm age** and the **team size at foundation** as control variables. Firm age and team size at foundation have high importance in prior entrepreneurship research (Chandler & Hanks, 1994). Both can be seen as proxies for the firm's resource endowment, which is of particular interest when focusing on the internationalization of new ventures. Firm age is measured by subtracting the year of firm foundation from the year of data collection (2007). Team size at foundation is directly measured by asking about how many persons constituted the founding team of the firm. Furthermore, we controlled for **international growth orientation** and **learning orientation**, since both have proven their explanatory value for the phenomenon of INVs in many studies. International growth orientation was measured with a

three items scale (Autio et al., 2000; Nummela et al., 2004; Yli-Renko et al., 2002) with a Cronbach´s alpha of .75. An example item is "The growth we are aiming at can be achieved mainly through internationalization". Learning orientation was also measured with three items (Emden et al., 2005; Hult & Ferrell, 1997; Sinkula et al., 1997), resulting in a scale with a Cronbach´s alpha of .85. One example item is "Learning in this organization is viewed as key to organizational survival".

**Analytical approach**

To examine our hypotheses we applied multinomial logistic regression (MLR) analysis. This procedure is a variant of maximum likelihood-based estimations which is employed if the dependent variable is categorical and has more than two values. MLR requires one of the dependent variable categories to be selected as reference group. Effects are then computed and assessed in comparison to the reference group. MLR shows how the chance of belonging to another group than the reference category is affected by the independent variables. Thus, MLR is an appropriate means in order to examine which organizational characteristics distinguish between the four different types of INVs.

Before conducting multinomial regression analysis, we tested the independent variables for multicollinearity by calculating zero order correlations as well as variance inflation factors (VIF) for all independent variables (Table 1). The results show no significant risk for multicollinearity since no correlation exceeds 0.7 (Anderson, Sweeney & Williams, 1996). Moreover all VIF values stay below 4.0 (Neter, Wassermann & Kutner, 1983) and even below 2.5 (Allison, 1999).


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As the measures applied in our study are self-reported and collected from an identical source, there could be a problem of common method variance, in which a bias in the source might contaminate all measures in the same direction. For this reason it was critical to identify whether there is a systematic error in the data. In order to examine the extent of common method variance in our data, we followed Podsakoff and Organ (1986) using the Harman´s one-factor test. We executed a principal component factor analysis based on the predictor and control variables. This analysis revealed three factors with an eigenvalue greater than 1, which together account for 49.0% of the total variance. The presence of several factor loadings, combined with the relatively low percentage of the three factors – only 19%, 16% and 14%, respectively – indicate that the data do not suffer from common method variance. A substantial amount of common method variance is present, either if a single factor will emerge from the factor analysis, or if one general factor will account for the majority of the covariance among the variables (Podsakoff & Organ, 1986; Podsakoff, MacKenzie, Lee & Podsakoff, 2003).

To further validate the quality of our data we checked firm website information, brochures, and other publicly available information and compared some of the information (e.g. year of foundation, number of employees, internationalization patterns) with the data from our survey (Cloninger & Oviatt, 2007). Additionally we collected secondary data from three different databases (Hoppenstedt and Markus firm directory and Factiva) to verify the information from our survey.

To test our set of hypotheses we applied hierarchical multinomial logistic regression analysis (Cohen, Cohen, West & Aiken, 2003). As proposed by Aiken and West (1991), establishing different models allows a comparison between alternative models with or without interaction terms by showing changes in $R^2$ and, therefore, delivers an indicator for the explanatory power of the moderator effects. In order to analyze the hypothesized moderator

effects, we standardized the variables before creating interaction terms to avoid multicollinearity (Aiken & West, 1991).

Due to the ongoing debate in literature about the difficulties in applying interaction terms in logistic regression models (Li and Meyer, 2009; Powers, 2005; Shaver, 2005) the application of this methodology requires explanation. Just recently, Hoetker (2007) commented critically on the use of logit and probit models in strategic management research, stating that interaction effects are complicated to compute and interpret in nonlinear models (Norton, Wang and Ai, 2004). Interaction effects cannot simply be interpreted by looking at the sign, magnitude, or statistical significance of the coefficient on the interaction term when the model is nonlinear. We computed and interpreted the interaction effects in our models according to Ai and Norton (2003) and Jaccard (2001). We computed the correct marginal effect of a change in the interacted variables in our logit model and identified the correct standard errors by applying commands as suggested by Norton, Wang, and Ai (2004).

In order to better interpret the interaction terms we followed Jaccard (2001) and Hoetker (2007) and supplemented the numerical information with plots of the predicted log odds. "A graphical presentation provides the reader with the most complete understanding of interaction effects" and provides assistance to interpret the complex associations related with interactions in logit models (Hoetker, 2007: 337). As suggested by Jaccard (2001), we selected a low, medium, and high score on the moderator variable to illustrate the curves. The low level condition was defined as a standard deviation below the mean of the moderator, the medium level condition was defined as the mean, and the high level condition as a standard deviation above the mean of the moderator.

Applying three-way interaction analysis in logistic regression necessitates the same procedures to interpret the outcomes as two-way interactions (Jaccard, 2001). In line with Stam and Elfring (2008) we accordingly draw the conditional impact of knowledge intensity on the chance to become a Global Start-up opposed to become an Export Start-up at high and

low values of network strength and prior international experience, respectively. Moreover, two analytic procedures are conducted to advance our understanding of the three-way interaction. First, we apply simple slope analysis (Aiken & West, 1991) to test if the respective slopes are significantly different from zero. Second, we apply slope difference tests (Dawson & Richter, 2006) to further evaluate significant differences between different pairs of slopes.


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**RESULTS**

Table 2 shows the results of the hierarchical MLR. In model 1 we included the control and predictor variables, which together explain a significant proportion of the variance in the dependent variable (model 1: $R^2 = 0.41$, $p < 0.01$). Interestingly, network strength does not have a direct impact on the likelihood to become an INV type other than Export Start-ups (model 1a : b = -0.22, n.s.; model 1b : b = 0.34 , n.s.; model 1c : b = 0.22 , n.s.), while prior international experience (model 1a : b = 0.12, $p < 0.1$; model 1b : b = 0.49 , $p < 0.1$; model 1c : b = 0.98, $p < 0.05$) and international network size (model 1a : b = 0.09, $p < 0.05$; model 1b : b = 0.00 , n.s.; model 1c : b = 0.06, $p < 0.1$), have a partial effect.

In model 2 we entered the two-way interaction terms to test our moderator hypotheses. The model leads to higher variance explanation compared to the model without interaction terms (model 2: $\Delta R^2 = 0.10$, $p < 0.01$) supporting our assumption of a significant impact of the interaction effects on the types of INV. To better understand the interaction effects we plotted them according to the procedure proposed by Jaccard (2001). Figure 3 shows the two-way interaction plots.

In Hypothesis 1 we argued that international network strength will positively moderate the impact of knowledge intensity on the likelihood to become another INV type than an Export Start-up. As shown in models 2a, 2b, and 2c the interaction term has a significant positive value, meaning that international network strength increases the effect of knowledge intensity on international new venturing. Thus, Hypothesis 1 is supported. Next, Hypothesis 2 stipulates that international network size negatively influences the relationship between knowledge intensity and the type of international new venturing. Supporting Hypothesis 2, the results in models 2a and 2c show that the interaction between knowledge intensity and international network size indeed has a negative effect on the formation likelihood of Multinational traders (model 2a: b = -0.27, p < 0.05) and of Global Start-ups (model 2c: b = -0.31, p < 0.01) opposed to Export Start-ups. For Geographically Focused Start-ups the interaction term is negative, but not significant on common significance levels (model 2b: b = -0.18, n.s.). However, Hypothesis 2 can be partly accepted for Multinational traders and Global start-ups in reference to Export start-ups.

Finally in model 3 we included the three-way interaction between knowledge intensity, international network strength and prior international experience to test hypotheses 3a and 3b. The model shows a moderate, but significant increase in R² compared to model 2 (model 3: $\Delta R^2 = 0.02$, p < 0.1).

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Insert Figure 3 about here
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To make notions about Hypothesis 3a and 3b we plotted the significant three-way interaction effect and conducted simple slope and slope difference tests (Dawson & Richter, 2006). As Figure 4 shows, we find a positive relation between knowledge intensity and the likelihood to become a global start-up when international network strength is high and prior

international experience is low (t = 3.36, p < 0.01). We furthermore find a positive, but insignificant effect of knowledge intensity if prior international experience is high and international network strength is low. We also find a positive, but insignificant effect of knowledge intensity on the types of international new venturing when both moderators (international network strength and prior international experience) are high. However, in line with Hypothesis 3a, a slope difference test shows that the relation between knowledge intensity and becoming a Global Start-up is significantly stronger when international network strength is low and prior international experience is high and significantly weaker when international network strength and prior international experience are both low (t = 1.75, p < 0.1). Thus, Hypothesis 3a, in which we stipulated that only at low levels of international network strength prior international experience will positively moderate the impact of knowledge intensity on the likelihood to become a Global Start-up receives partial support. Moreover the results show a significant negative relationship between knowledge intensity and the likelihood to become a global start-up if both moderators are low (t = -2.1, p < 0.05). Thus, hypothesis 3b can be accepted.

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Insert Figure 4 about here
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## DISCUSSION

The aim of our study was to investigate the moderating effect of international network strength and size on the relationship between knowledge intensity and the type of international new venturing. Further, we observed if prior international experience influences these relations.

Concerning the moderating role of international networks (strength and size) on the relation between knowledge intensity and international new venturing we found several

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significant effects, enriching the theoretical as well as practical discussion. The international network strength increases the positive impact of knowledge intensity on the chance of the formation of another INV type than Export-Start-ups. If an INV fosters close relationships to international partners it can better exploit its inherent knowledge. High-tech products can be distributed easier and at lower transaction costs, as a close international network provides security. "[D]ensity (or 'closure') facilitates the role of social capital that allows for reputation effects, trust, social norms and social control (Gilsing, Lemmens & Duysters, 2007: 230)". Risks of patent infringement and product piracy are reduced by a strong international network which allows for a higher degree of international activity from early on. Not only the international intensity may increase this way, but also the number of countries served and thus, the international diversity. Strong international networks appear to provide both, a higher protection against failure as well as better chances to distribute the firm´s products on a higher international scale and scope. Thus, an intensive contact to foreign partners helps to foster knowledge intensive products and services on international markets.

Interestingly, the size of the international network works conversely. While international network strength positively moderates the impact of knowledge intensity on the types of international new venturing, the international network size negatively moderates the impact of knowledge intensity on the chance of the formation of an INV type other than Export-Start-ups. Regarding Global Start-ups, the effect of knowledge intensity even turns negative if the INV has many international network contacts (see Figure 3). Thus, in such case, knowledge intensity will be rather a deterrent to internationalization than a facilitator.

Following a transaction cost theories' rational, knowledge intensive products are characterized by high specificity and strategic relevance for INVs. Combined with the environmental uncertainty inherent in foreign markets, the optimal institutional arrangement would be hierarchical integration, for instance by building up a sales subsidiary abroad. Due to their limited resources, INVs often cannot choose this option and have to employ

alternative, less resource intensive governance structures, such as networks (Oviatt & McDougall, 1994). However, as our results show, it is not the size of the network that provides the fruitful ground for knowledge exploitation, but it is rather the strength of the network contacts. Strong social ties provide trust and security, and thus, allow for lower arrangement and monitoring costs than weak social ties (Filaster & Spiess, 2008). Nourishing a big international network does not provide such trust based security and even increases the propensity for opportunistic behavior. In a loose network at a larger size the knowledge base could easily diffuse, eroding the competitive advantage of an INV. Previous researchers already mentioned that alliance scope aggravates the protection of technological assets as mutual exposure of core technologies increases (Khanna, 1998; Li et al., 2008; Oxley & Sampson, 2004; Sampson, 2007). The same rationale seems to apply to international network size: As the network grows, technologies can more easily disseminate as more contact points to external firms exist. An INV will recognize this threat and restrain international activity, preferring to remain an Export Start-up rather than a Global Start-up to avoid this disadvantageous outcome.

Our study shows that prior international experience may provide the same effect as international network strength. While one of the two security providers is mandatory to exploit knowledge intensity, both together do not further account for an additional increase in security. Thus, their effects alleviate each other. Only if international ties are weak, prior international experience has a significant positive impact on the exploitation of knowledge intensity on an international scale and scope (Zhang et al. 2008). This means, that knowledge intensive resources may foster the formation of Global Start-ups even when international networks are weak, but only if the management team possesses own international experience.

On the other hand, we showed that knowledge intensive INVs need at least one protection mechanism to become a Global Start-up. If an INV neither has strong international networks nor prior international experience, the effect of knowledge intensity on internationalization

even turns negative. Knowledge intensity only facilitates international expansion if the potential revenues exceed the potential risks. If no mechanism for knowledge protection exists, knowledge appropriation abroad cannot be sufficiently prevented. Accordingly, INVs will more likely act on a restricted international scale and scope than becoming Global Start-ups.

**Limitations and Implications for Further Research**

As is the case for most empirical studies, several limitations apply to our study as well. First, as internationalization is more a process than a state, we face measurement problems of the INV phenomenon as we are lacking longitudinal data. Longitudinal research designs could delineate changes over time, and show if INVs develop gradually from one type to another, or if the choice of certain INV types is stable over time. Changes in the international intensity and diversity or management's cognitions can only be analyzed in depth when powerful longitudinal data is available. This would help to clarify if changes in the employed variables really result in a change of the INV type, which would prove the results found in this study.

Second, even though including multiple technologies, this study was only focused on German technology-based companies and, therefore, is lacking a comparative value on an international scale. Thus, we cannot state if influential factors vary across different countries or cultural regions. Third, an observation of the cultural distance between INVs' country of origin and the focal markets could delineate differences between the INV types. Companies acting in a very restricted geographical area (e.g. Europe) do not have to cope with such psychically distant cultures, laws and business practices as firms acting in geographical as well as cultural distant markets. Such firms may be more dependent on prior experiences of their founders or strong ties than INVs – mainly acting in culturally close areas. Another limitation of this study can be seen in the small group size of the INV types. Therefore, larger samples are needed in future research in order to compare the four types of INVs.

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**TABLES AND FIGURES**

**FIGURE 1**

**Research Model**
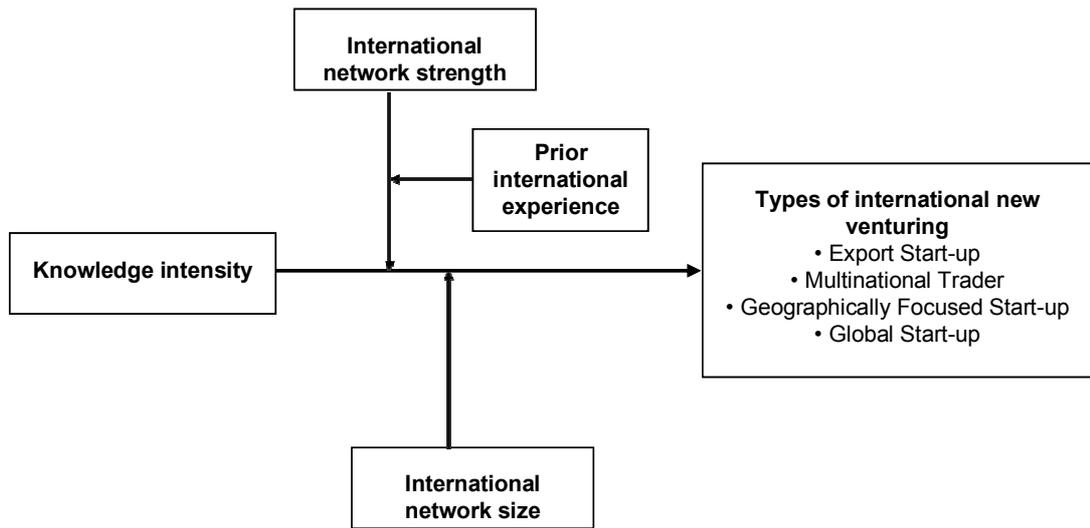
**FIGURE 2**

**The Classification of International New Ventures**

|  | few | many |
|---|---|---|
| **high** | **Geographically focussed Start-up** | **Global Start-up** |
| **low** | **Export Start-up** | **Multinational Trader** |

Percentage of foreign sales on total sales

Number of countries involved

**FIGURE 3**

**Figure 3: Significant Two-Way Interactions between Knowledge Intensity and
International Network Strength and between Knowledge Intensity and
International Network Size on Types of INVs**
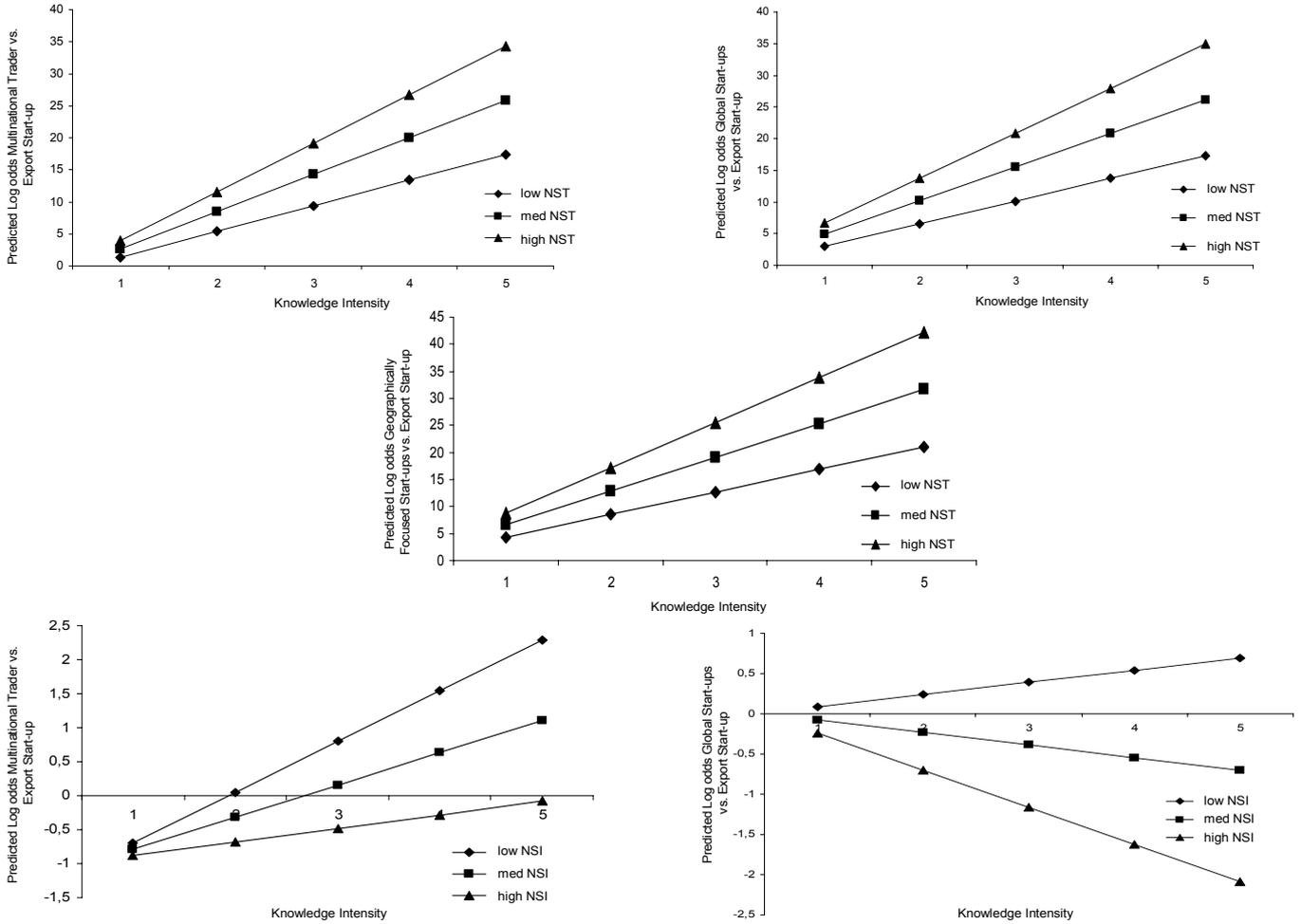


Note:   NSI = International Network Size

NST = International Network Strength

**FIGURE 4**

**Three-Way Interaction between Knowledge Intensity, International Network Strength and Prior International Experience**
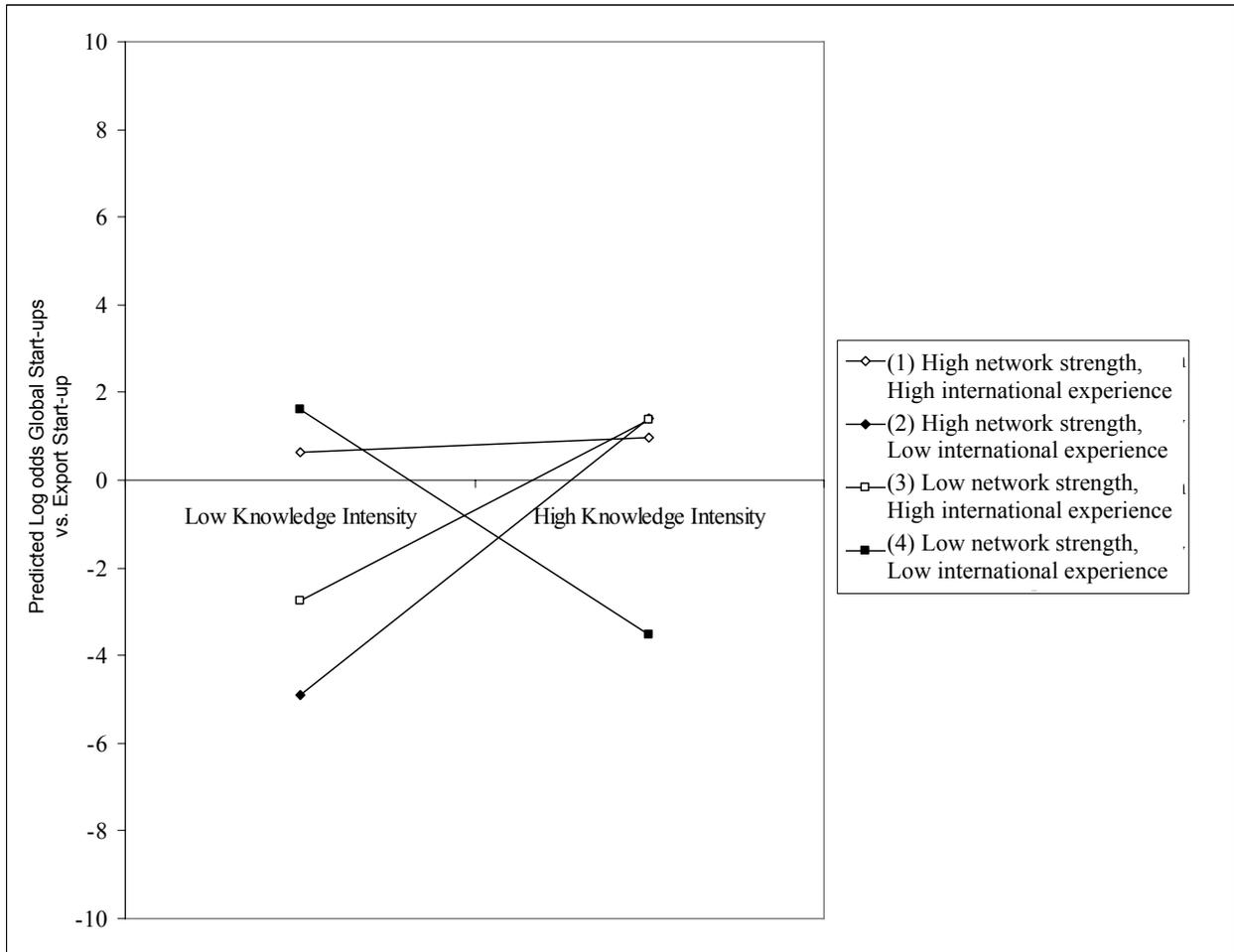
**TABLE 1**

**Means, Standard Deviations, Variance Inflation Factors (VIF) and Correlations**

| Variables | Mean | s.d. | VIF | International Growth Orientation | Prior International Experience | Knowledge Intensity | Learning Orientation | International Network Size | International Network Strength | Firms Age |
|---|---|---|---|---|---|---|---|---|---|---|
| International Growth Orientation | 3.43 | 1.04 | 1.07 | 1 | | | | | | |
| Prior International Experience | 0.51 | 0.50 | 1.02 | 0.04 | 1 | | | | | |
| Knowledge Intensity | 4.32 | 0.64 | 1.21 | 0.06 | 0.09 | 1 | | | | |
| Learning Orientation | 4.34 | 0.73 | 1.22 | 0.02 | 0.07 | 0.33 (**) | 1 | | | |
| International Network Size | 5.39 | 7.66 | 1.06 | 0.12 | 0.03 | -0.08 | -0.09 | 1 | | |
| International Network Strength | 2.31 | 1.06 | 1.05 | 0.12 | -0.01 | -0.06 | -0.05 | 0.11 | 1 | |
| Firms Age | 10.02 | 7.13 | 1.07 | 0.15 (*) | -0.06 | 0.00 | -0.14 (*) | 0.12 | 0.06 | 1 |
| Team Size at Found | 4.53 | 10.68 | 1.05 | 0.07 | 0.10 | 0.00 | 0.04 | 0.06 | 0.12 | 0.02 |

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed). † Correlation is significant at the 0.10 level (2-tailed).

**TABLE 2**

**Results of the Moderated Multinomial Logistic Regression**

| reference category: Export Start-ups | Multinational Traders | | | Geographically Focussed Start-ups | | | Global Start-ups | | |
|---|---|---|---|---|---|---|---|---|---|
| | Model 1a | Model 2a | Model 3a | Model 1b | Model 2b | Model 3b | Model 1c | Model 2c | Model 3c |
| Variables | $b$ | $b$ | $b$ | $b$ | $b$ | $b$ | $b$ | $b$ | $b$ |
| Constant | -2.48 ** | -2.21 ** | -2.25 ** | -0.21 | -0.01 | 0.01 | -0.93 | -0.68 | -0.64 |
| Age | 0.08 | 0.10 † | 0.13 * | -0.06 | -0.04 | -0.01 | 0.10 ** | 0.12 ** | 0.14 ** |
| Team Size at Found | 0.20 | 0.16 | 0.14 | 0.04 | 0.01 | -0.01 | 0.18 | 0.14 | 0.12 |
| International Growth Orientation | -0.17 | -0.09 | -0.07 | 0.48 | 0.59 * | 0.59 * | 0.89 ** | 1.04 ** | 1.05 ** |
| Learning Orientation | -1.24 ** | -1.57 ** | -1.74 ** | -0.93 * | -1.22 * | -1.44 * | -0.95 * | -1.29 ** | -1.50 ** |
| Knowledge Intensity (KI) | 1.34 * | 1.96 * | 1.76 * | 1.34 * | 1.78 ** | 1.52 ** | 0.83 † | 1.53 ** | 1.27 ** |
| Prior International Experience (PIE) | 0.12 † | 0.17 | 0.04 | 0.49 † | 0.30 | 0.13 | 0.98 * | 0.90 † | 0.70 |
| International Network Size (NSI) | 0.09 * | 0.18 ** | 0.17 ** | 0.00 | 0.05 | 0.05 | 0.06 † | 0.14 * | 0.14 † |
| International Network Strength (NST) | -0.22 | -0.41 | -0.36 | 0.34 | 0.13 | 0.16 | 0.22 | 0.09 | 0.13 |
| KI * NSI | | -0.27 * | -0.29 * | | -0.18 | -0.21 | | -0.31 ** | -0.32 ** |
| KI * NST | | 1.71 * | 1.61 * | | 2.06 ** | 2.13 ** | | 1.67 ** | 1.73 ** |
| KI * PIE | | 0.09 | -0.77 | | 1.08 | 0.52 | | -0.05 | -0.58 |
| INI * PIE | | 0.01 | 0.49 | | -0.22 | -0.05 | | 0.06 | 0.31 |
| KI * NST * PIE | | | -3.37 * | | | -2.36 | | | -2.73 * |
| | | | | | | | | | |
| ΔR-square | | 0.10 ** | 0.02 † | | 0.10 ** | 0.02 † | | 0.10 ** | 0.02 † |
| Nagelkerkes R-square | 0.41 | 0.51 | 0.53 | 0.41 | 0.51 | 0.53 | 0.41 | 0.51 | 0.53 |
| Chi-Square | 69.44 | 93.50 | 99.83 | 69.44 | 93.50 | 99.83 | 69.44 | 93.50 | 99.83 |
| df | 24 | 36 | 39 | 24 | 36 | 39 | 24 | 36 | 39 |
| Significance | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| N | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 | 149 |

Significance Levels: ** $\leq$ 0.01; * $\leq$ 0.05; † $\leq$ 0.10; Unstandardized coefficients are reported