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Networking and Familiness as Factors Stimulating the Early Internationalization of High-Tech Firms

Nelly Daszkiewicz[1], Krzysztof Wach[2]

[1]*Gdansk University of Technology, Department of Economics*
Narutowicza 11/12, 80-233 Gdansk, Poland
E-mail: ndasz@zie.edu.pl

[2]*Krakow University of Economics, Department of International Trade*
Rakowicka 27, 31-510 Kraków, Poland
E-mail: wachk@uek.krakow.pl

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The problem of the role and importance of time in the process of firm's internationalization belongs to the mainstream of international business research, as is the problem of the key role of high-tech firms operating across borders. The main goal of the paper is to understand how selected factors determine early internationalization of high-tech firms in Poland as an emerging market. The theoretical framework of the article is built on international entrepreneurship literature, supported by the network perspective and family firm theory. Then, the article focuses on the high-tech firms that become international through export or any other entry mode in the first three years of their life. A survey was conducted on the sample of 263 firms operating in high-tech industries in Poland. The results of our empirical studies show that high-tech firms functioning in networks and clusters are more likely to start their international expansion early. Moreover, family high-tech firms are less likely to internationalize early than non-family firms.

Keywords: *Early Internationalization; High-Tech Firms; Born Globals; Internationalization of Firm; International Entrepreneurship; International Business; Familiness; Networks.*

Introduction

New technology-based firms (NTBFs), particularly those in high-tech industries, operate in a deep inter-relationship amongst the processes of innovation, internationalization and entrepreneurship (Onetti *et al.*, 2012; Gawel, 2021; Ahi *et al.*, 2022; Glodowska *et al.*, 2023; Zur & Walega, 2023). Therefore, this article will deal with these three themes. The first and main research theme will be the internationalization of firms. Secondly, we will focus on family entrepreneurship as one of the least explored areas in Polish international business literature (Hadrys-Nowak, 2018). Thirdly, the article will consider high-tech industries as highly innovative whose inherent feature lies in innovations.

The main goal of our research was to identify the role of networking and familiness as some key factors of the internationalization of Polish high-tech firms, also in the context of early internationalization. The key research field of this article is the internationalization of high-tech firms in Poland. The very first articles dealing with technological entrepreneurship in Poland were published in 2010s (Badzinska, 2016). Almost the same applies to the internationalization of high-tech firms in Poland (Daszkiewicz, 2019). In 1990–2014, few articles appeared linking internationalization and technology among Polish firms (Puslecki, Trapczynski, & Staszkow, 2016).

Although for some decades the international business research literature studied the role of cooperation and networks in the internationalization process (Johanson & Mattson, 1987), researchers mostly operated from the perspective of established economies and not that of late comers to the global marketplace. In their qualitative studies of 33 firms from Columbia and Peru, Gil-Barragan *et al.* (2018) found that the weak domestic networking and poor domestic institutional environment stimulate the accelerated internationalization of local firms. Similarly, based on 11 case studies from Columbia, Gonzalez-Perez *et al.* (2018) observe that the ability to build networks stimulates the process of internationalization of these firms. Usually, qualitative studies appear before the stronger quantitative verification of hypotheses. This article presents a quantitative study in hope to answer the needs observed in emerging markets.

The international entrepreneurship literature still provides few studies from emerging markets (Perenyi & Losoncz, 2018; Glodowska, 2019), including countries in Central and Eastern Europe (Cui *et al.*, 2018), Poland being one of the largest countries in Central Europe.

Based on their bibliometric analysis of literature on international business in Poland in leading Polish journals and selected international journals, Puslecki, Trapczynski, and Staszkow (2016) observe that there are few studies and publications about the role of networking and cooperation in the internationalization process of Polish firms. Moreover, their classification does not even include the internationalization of family firms, which motivated us to focus our empirical investigations on familiness. We should acknowledge that their bibliometric analysis reveals that over a span of 25 years (1990–2014) just four articles appeared regarding the role of technology and high-tech in the process of internationalization of firms in Poland. While many editors

of prominent journals in management, economics, and business studies advise and encourage the replication studies (Eden, 2002), there exists a diversity of scholarly perspectives on this matter, which remains unresolved (Hensel, 2019).

The above-mentioned arguments make this article seek answers to the following research question:

RQ: What are the relations between clusters, networks, and family contacts and the internationalization process of high-tech firms in Poland? Does the network approach matter?

These relations remain unexplored in the emerging markets, especially in Poland, which reveals a research gap in the literature. Moreover, scholars notice an evident lack of empirical investigations on emerging countries, including Poland (Wach, Glodowska, & Maciejewski, 2018). This article makes two contributions towards progressing and updating the research on internationalization of high-tech firms. Firstly, it is one of the first empirical studies on the internationalization of firms from high technology industries in Poland. Secondly, it contributes to the existing literature of international entrepreneurship by testing the internationalization of technology-based firms in a more recent context in an emerging economy in Central and Eastern Europe – Poland – which is a region so far avoided by studies on the internationalization of high-tech firms.

Literature Review and Hypotheses Development

Theoretical Background

We based the theoretical framework of the article on the literature review of international entrepreneurship literature (Mainela, Puhakka, & Sipola, 2018; Heredia-Portillo & Armas-Arevalos, 2023; Kljucnikov *et al*., 2020) and supported it with the network perspective and family firm theory (Marjanski & Sulkowski, 2018; Ingram & Krasnicka, 2023). Many researchers in diverse countries studied the factors determining a firm's early internationalization since the emergence of born globals. Already in 1997, Madsen and Servais identified four groups of internationalization factors of born global firms, *i.e.* the entrepreneur, the firm, the environment, and technology. The characteristics of the firm's founder, especially their specific features such as experience, ambitions, and motivation for early and rapid interna-tionalization, stimulate accelerated internatio-nalization. One such characteristic is familiness, but there are two contradictory streams in the literature, which treat a family firm status either as a stimulant or barrier in this regard (Hadrys-Nowak, 2018). What further impels early fast internationalization is characteristic of such elements as internationality of the offer, the board's structure and characteristics, strategic alliances, or network relations. Networks usually play a crucial role in stimulating internationalization, especially early internationalization. However, an entrepreneur can explore and exploit potential network relations with proper skills and attitudes (Gallego-Roquelaure, 2020). What can can also impact interna-tionalization are environment characteristics, both regarding market and industry. Various researchers foreground the level of internationalization, market/industry specialization, and technology (high/low), in particular in the area of digital transformation (Behandari *et al*., 2023; Corvello *et al*., 2022; Glodowska *et al*., 2023; Sabatini *et al*., 2022).

From the resource-based perspective, Rialp *et al*. (2005) indicate among the most important factors of the internationalization of born global material and capital resources, international capabilities (knowledge and international orientation), strategic features (speed and range of internationalization), and environmental factors (industry, geographical location, existence of different networks). These authors focus on firms' intangible resources, namely structural capital (technological capital + organizational capital + relational capital) and human capital, which further determine the strategies of early and rapid internatio-nalization. Moreover, Rialp *et al*. highlight external internationalization factors, such as industry (high-/low-tech, production/services), geographical context, and the firm's functioning in the network.

Johnson (2004) conducted a qualitative and quantitative study of US and UK small high-technology international start-ups. The research confirmed the factors previously identified in the literature. Furthermore, Johnson identified several new factors of early internationalization, most importantly about founders. An organization's founders are to possess a global vision that demonstrates their ability to identify unique international opportunities. They have valuable international contacts and are driven by the aspiration to become leaders in the global market. Zuchella, Palamara, and Denicolai (2007) focused on drivers of early internationalization when studying a sample of 144 Italian SMEs, among which they emphasize entrepreneurs' previous experience, especially their international experience, the niche positioning, and family entrepreneurship. Wach and Glodowska (2021) observed similar relations in a sample of 255 Polish firms.

In a similar vein, Cannone and Ughetto (2014) conducted a comprehensive cross-country survey to examine the factors that influence high-tech start-ups' decision to engage in internationalization from the early stages, and the extent to which they exhibit born-global characteristics, the degree of born-globalness, so to say. They proposed a theoretical framework based on the model established by Oviatt and McDougall (2005), which addresses the factors that impact the rate at which entrepreneurial internationalization occurs. Cannone and Ughetto (2014) developed a novel conceptual framework to identify the primary factors that contribute to firms' early internationalization. In their proposed model, the main drivers of the internationalization of a firm are the following:

(i) technology, meaning the rapid pace of technical advancements that compels technology-oriented firms to pursue international markets at an earlier stage of their development to mitigate risks of technological obsolescence and imitation;

(ii) home country conditions, namely various factors associated with prevailing home-country environment that can serve as catalysts or motivators to engage in early internationalization (as small domestic markets may propel firms to internationalize early in their life);

(iii) the entrepreneur, meaning one's main features grouped into three categories: human capital (*e.g.* age, high education level, proficiency in foreign languages), international commitment, and experiential knowledge

(Glodowska & Wach, 2021; Glodowska *et al.*, 2019a; Sarwoko & Nurfarida, 2021), international entrepreneurial orientation by risk attitude, pro-activeness, motivation, and innovation propensity;

(iv) network relationships, namely network size, density, and strengths of ties; networks are a source of information about foreign markets and help entrepreneurs create strategic alliances or cooperation agreements;

(v) firm's attributes, especially strategic emphasis and positioning, the characteristics of products on offer, the existence of a diverse range of experience within the management team, and firm's organizational flexibility.

This article will try to test some of the proposed factors from this theoretical model by combining high-techs and networks. Cannone and Ughetto (2014) showed that the presence of a limited domestic market and the potential for scalability of the product on offer positively influence the likelihood of a start-up venturing into foreign markets from the onset. Moreover, Cannone and Ughetto remark that the specialized approach and network contacts established by entrepreneurs play a crucial role in facilitating the early internationalization and determining the extent of worldwide expansion. The additional factors in this process are the entrepreneur's experiential expertise and international commitment, the team's diverse skills, and the firm's organizational flexibility. These factors significantly impact the born global's degree of born-globalness.

Prior Studies and Hypotheses Development

Knight and Cavusgil (2004) observed that the ability to internationalize early and fast often results from firms' ability to sustain innovation and create new knowledge. This observation explains why many scholars found born globals mainly initially mostly among high-tech and high-tech-related firms. Furthermore, Autio *et al*. (2000) remark that early internationalization and greater knowledge intensity are associated with faster international growth. Moreover, new technology-based firms are the source of technological innovations and they are characterized by a relatively higher level of expenditure on R&D in comparison with firms from traditional industries, which in consequence, determines their competitive advantage (Zou *et al.*, 2010). Many conducted studies on the determinants of the early internationalization of technology-oriented firms following the 'discovery' of born globals.

Cooperation and Networks

Networking is one of the key factors stimulating internationalization, and it is one of the main theoretical approaches explaining the internationalization phenomena (stages models, resource-based view, network perspective, international entrepreneurship, strategic and management perspective, integrated approach) (Wach, 2021; Maciejewski *at al*., 2021). Recent empirical evidence from studies on emerging economies by Gil-Barragan *et al.* (2018) and Lekovic *et al*. (2020) prove that operating in domestic networks stimulates firm's early and fast internationalization. Moreover, Gonzalez-Perez *et al*. (2018) observed that the ability to build networks is essential for accelerating internationalization. Much research supports the argument that networks significantly impact internationalization processes – their pace, pattern, market selection, and entry mode. Network relations allow firms to access additional relationships and established channels. For example, Lindqvist (1988) found that the presence of strong customer ties impacts the rate and manner in which small firms expand into international markets and their selection of an entry mode. Moreover, Coviello and Munro (1995) showed that firms can achieve rapid internationalization by leveraging network linkages and connecting with well-established networks. Rialp *et al*. (2005) propose a theoretical model linking networks and the early internationalization of various firms, including technology-based startups. Cannone and Ughetto (2014) suggest combining high-tech and networks in empirical studies. The literature review and especially the review of various empirical studies resulted in the following hypotheses to be tested for high-tech firms from Poland:

H1a: High-tech firms cooperating in any informal and formal networks are more likely to internationalize early compared to non-family firms.

H1b: High-tech firms operating in local clusters are more likely to internationalize early compared to non-family firms.

Familiness

Cano-Rubio *et al.* (2016) attempts to bridge the research gap regarding the composition of familiness. In the family firm literature, researchers use the term 'familiness' interchangeably with the term 'family involvement' and 'family effect.' We will apply it also in this article, and we will understand familiness as a declaration that the business under scrutiny is a family firm. During the last decade, family business has been an increasingly important research area worldwide (Ingram & Krasnicka, 2023). Nevertheless, there is still a divergence in research findings about the distinct ways in which family firms and non-family firms may undergo the internationalization process (Wach *et al*., 2023b). According to Kontinen and Ojala (2010), the participation of family members in managerial roles inside family firms can potentially lead to a sense of prudence during the internationalization process. Therefore, we may argue that family firms exhibit a higher propensity to pursue a conventional trajectory of international expansion. Kontinen and Ojala analyzed empirical data pertaining to the internationalization of family businesses (FBs) and discovered compelling evidence supporting the notion that the internationalization process of FBs is gradual, aligning with the internationalization process outlined in the Uppsala internationalization model. Furthermore, Kontinen and Ojala note that family-owned businesses often opt for nations that are geographically proximate and exhibit a preference for indirect entry modes over direct ones. In turn, Graves and Thomas (2006) claim that family businesses face unique internationalization barriers. Moreover, familiness is to be connected with social capital, thus also with the firm's external environment, which leads some to even use the term 'open ecosystem of familiness' (Cana-Rubio *et al.*, 2016). Thus, this article links cooperation and networks with familiness as the extension of the former element. Family involvement enables many contacts and social ties, which consequently make cooperation and networking easier.

Recently, the research on the internationalization of family firms has intensified in Poland. Noteworthy, the countries of Central and Eastern Europe are latecomers to international business due to their historical heritage of centrally planned economies and economic transformation. Thus, it is interesting to show how the processes of internationalization of family firms occurred in Poland, the largest economy in Central Europe. Therefore, there is a visible research gap (Wach *et al.*, 2023). Nevertheless, various researchers provided mixed evidence on how different factors foster or hinder the internationalization of family firms (Daszkiewicz & Wach, 2014; Hadrys-Nowak, 2018; Hanify *et al.*, 2019). It encouraged us to verify how familiness impacts not only internationalization in general but, in particular, the early internationalization of high-tech firms in Poland, as high-tech industries remain unexplored. Furthermore, familiness seldom combines with high-tech industries – reserved rather for international giants – so we aimed to fill the research gap by dealing with this issue. Thus, we decided to test the following research hypothesis:

H2: Family firms from high-tech industries are less likely to internationalize early compared to non-family firms.

High-Control Entry Modes

International business literature has studied entry modes since the 1970s. Most authors mention three categories of entry modes, namely (i) exporting modes, (ii) contractual modes, and (ii) investment modes. In this context, Hollensen (2017) uses a different terminology to indicate (i) export modes based on externalization, (ii) intermediate modes, and (iii) hierarchical modes based on internalization. A firm strategically decides on the selection of a foreign entry mode. According to Arregle *et al*. (2006), the level of resource commitment to the foreign market, the risk faced by a firm in the host country, and the extent of control exerted by a firm over its abroad activities are all under the influence of international market performance. Gabrielsson *et al*. (2008) observed that born globals frequently employ a strategic approach by utilizing several market entry approaches (a combination of different entry modes), such as forming partnerships, in order to successfully penetrate new markets. Furthermore, born global firms frequently devise distinct strategies to cater to diverse markets simultaneously. Hence, there is no single solution or answer in the literature. Generally, those who use hierarchical modes are mainly global companies or multinational corporations, whereas we studied high-tech firms of various sizes. We were interested whether the high-tech industry provides any further insights in this regard. Therefore, we decided to verify the following hypothesis:

H3: Early internationalized high-tech firms are more likely to use high control modes compared to non-family firms.

Research Methodology

Research Design

We decided to apply the quantitative strategy based on an in-field survey. As usual in the case of such studies, we conducted a literature review, retrieved hypotheses, then operationalized variables, and tested them using a dedicated computer statistical software (Statistica). We used a survey questionnaire consisting of the following six thematic areas: (i) firm, (ii) advanced technology, (iii) R&D and innovation, (iv) motives, entry modes, and scope of internationalization, (v) internationalization patterns and strategies, (vi) respondent.

Based on the literature review, we decided to investigate how selected factors determine the internationalization process of high-tech firms in Poland, in particular the early internationalization. During the empirical research phase, we applied a simple research model for hypothesis testing. The proposed model (Figure 1) assumes the impact of some key factors on the early internationalization of high-tech firms in Poland: (i) functioning in any formal or informal networks, (ii) cooperation in clusters, (iii) familiness, and (iv) using high control entry modes.

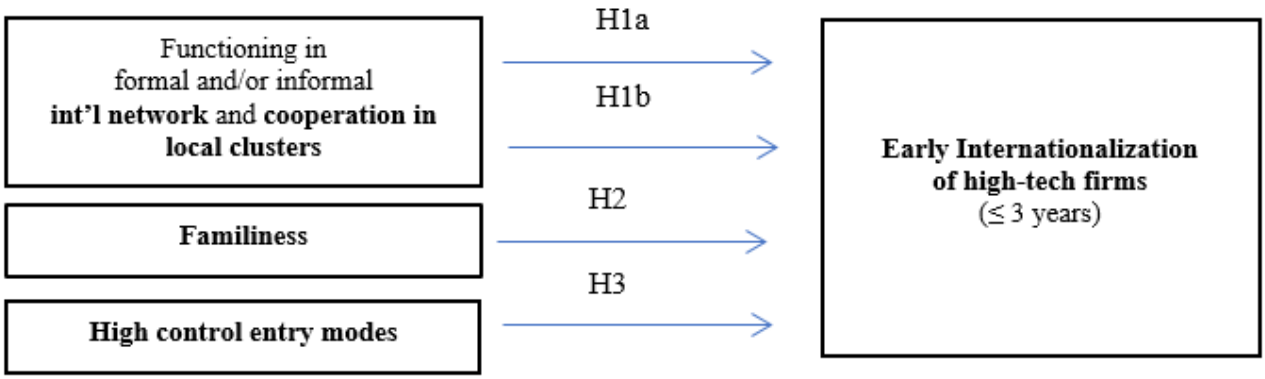

Figure 1. The Research Model for Empirical Hypotheses Testing

Source: own elaboration

Variables

Early Internationalization

We used early internationalization as the dependent variable. In the literature, there are two competitive approaches to the problem of time in the process of firm internationalization (Daszkiewicz, 2017). The first one – the traditional or classical one – perceives internationalization as a slow, sequential process (Johanson & Vahlne, 1977), whereas the other one as fast or accelerated (Knight & Cavusgil, 1996; Oviatt & McDougall, 2005). However, since the 1990s, scholars have frequently criticized the traditional approach, because an increasing number of firms expanded onto foreign markets right from their conception – or very soon after. Moreover, these firms, often small and technology-oriented, choose rapid internationalization through any entry mode, omitting some stages of traditional internationalization (Knight & Cavusgil, 1996). Such firms are usually called born globals (Rennie, 1993; Knight & Cavusgil, 1996; Madsen & Servais, 1997; Cannone & Ughetto, 2014). However, literature refers to born globals also as international new ventures, born internationals, early internationalizing firms, or globalizing internationals. Moreover, some researchers analysing the phenomenon of early and fast interna tionalization in high-tech industries use the following terms: high-technology start-ups, new technology-based/ technology-based firms, or high-tech new ventures (Jarosinski & Mierzejewska, 2017; Maciejewski & Wach, 2019).

The concept of born global firms appeared 30 years ago (Rennie, 1993) and even today, there exist many definitions which lead to the lack of conceptualisation. Nonetheless, scholars commonly define early internationalization as the duration of time between a company's establishment and the initiation of worldwide sales. Specifically, scholars categorize organizations that commence exporting or adopting other entry modes during the initial three years as early international firms (Knight *et al*., 2004). Moreover, Zucchella *et al*. (2007) classify firms that started exporting in three years as precocious, born globals, and early international firms (EIFs). In this article, we also accepted three years as the borderline separating the traditional internationalization from an early one.

Independent Variables (Including High-Control Entry Modes)

Finally, we used also 11 independent and control variables, of which four described networking, cooperation, familiness, and control, further four – R&D activities, and the last three – the age and foreign ownership of the investigated firms (Wach, 2017). Table 1 describes how we constructed the variables. We will follow the Table with a more detailed description.

Hollensen (2017) categorised foreign entry modes into three distinct categories based on the criteria related to the level of control: (i) high control, (ii) intermediate, and (iii) low control modes. High control modes encompass foreign direct investment (FDI) in the form of wholly owned subsidiaries (WOS) and/or direct selling to significant clients, such as original equipment manufacturers (OEMs). These entry modes provide an equivalent level of control over activity in foreign markets. Intermediate modes of business collaboration encompass strategic alliances (SA) and/or joint ventures (JV). We may classify the aforementioned entry modes as intermediate control modes, positioned between high-control modes and low-control modes. In these modes, partners typically engage in resource sharing, technology sharing, profit sharing, and job sharing. Commonly, local partners contribute market-specific knowledge in these arrangements. Low-control modes encompass indirect export and direct export strategies. Nevertheless, the degree of control is minimal when it comes to indirect export, which occurs when a parent business utilizes independent entities situated either in the parent firm's nation or a third country. When engaging in direct export, the parent company directly sells its products to an agent, distributor, or importer situated in the foreign market. This approach offers a greater level of control compared to indirect export. However, direct export still belongs to the low-control modes (Daszkiewicz, 2017).

Table 1

Used Variables in Empirical Models and Statistical Calculations

Abbreviation	Full name	Measures	Scale
Dependent variables			
Int_Speed	Internationalization speed	When the internationalization occurred as the number of years from the inception	continuous variable
Early_Int	Early internationalization	0/1 The time of the internationalization up to three years from the inception	dummy variable
Independent and control variables			
Networks	Functioning in any informal or formal networks	0/1	dummy variable
Clusters	Functioning in any domestic clusters	0/1	dummy variable
Familiness	Declaring to be a family firm	0/1	dummy variable
High_Control	High-control entry mode	0/1 Having any hierarchical entry modes (a foreign branch, a joint venture, or a wholly-owned subsidiary)	dummy variable
Age	Age of the firm	Number of years.	dummy variable
F_Owner	Foreign ownership	Foreign ownership of assents in percentage.	dummy variable
F_Owner_2	Foreign ownership 2	0/1 Any foreign ownership	dummy variable

Source: own elaboration

Sampling and the Characteristics of the Sample

Sample Selection

We conducted the survey on the internationalization of high-tech firms in Poland with the use of CATI (Computer-Assisted Telephone Interviewing). We employed the random sampling technique in the selection process, while adhering to the following parameters (Daszkiewicz, 2019):

1. The firm engages in international operations, specifically at least involving export activities.
2. The firm is classified under one of the designated categories of economic activity, specifically categorized as either 'high-tech' or 'medium-high-tech' according to the NACE/PKD (Polish Classification of Activities).
3. The firm must fulfil at least one of the three criteria outlined below:

– acquires patents or enters into licensing agreements in high-tech fields,

– hires personnel with significant scientific and technical expertise,

– engages in industrial research or development activities and prepares the outcomes of such research or work for implementation in the economy.

We based the selection of the target population on the aforementioned parameters. Initially, from the database of high-tech companies prepared by the Polish Agency for Enterprise Development (PARP), we drew 4075 firms drawn but reaching some of them proved impossible as they did not operate at the time. Through the survey, we collected 263 fully filled questionnaires (the return rate was 8.2 %), which were relevant for further statistical analysis. If it turned out that there was a conflict or lack of a valid date for further analysis, we removed the case using computer software.

The Characteristics of the Research Sample

The research sample covered businesses of all sizes: micro, small, medium-sized and large enterprises. In total, SMEs accounted for 82 % (216 firms) of the examined firms, whereas large enterprises accounted for 18 % (47 firms). Among the investigated firms, 31 % (80 firms) were 'old' firms, *i.e.* established before 1989. Thus, these firms started their activities before the transformation of the Polish economy from a centrally planned to a market economy. The largest number of enterprises – 59 % (156 firms) – were established during the transformation period, that is in the years 1989–2004. That period was characterized by a fast development of entrepreneurship and consequently the creation of many new, especially small and medium-sized enterprises. Only 9 % (24 firms) were established in the period 2005–2009, *i.e.* after the accession of Poland to the European Union. Only 1 % (three firms) – the youngest ones – were set up after 2010. We conducted the survey in all 16 regions of Poland.

The survey included all high-tech and medium-high-tech industries. The majority of firms surveyed are engaged in the manufacturing of computers and electronic and optical products, accounting for 13 % of all firms examined. Within the medium high tech (MHT) sector, the machinery and equipment industry – not classified elsewhere – had the highest number of operating enterprises. The two sectors with the highest percentage of production were electrical equipment (PKD 27) at 17 % and chemicals and chemical products (PKD 20) at 14 %. Based on the SITC product classification (Standard International Trade Classification), a significant proportion of enterprises were engaged in the manufacturing of electrical machines (34 %), non-electrical machines (27 %), electronics and telecommunications (17 %), and chemicals (14 %).

Internationalization Speed

In the given sample, we observed that 45 % of the firms can be classified as early internationalized, indicating that these firms initiated their first expansion into foreign markets less than three years following their foundation. In the case of 55 % of the studied firms, we saw that the initial expansion occurred more than three years after the establishment, which we classified as a traditional internationalization path. The histogram of the duration of the international expansion of the surveyed firms shows that the distribution of this variable was extremely right-skewed. This means that the vast majority of firms started their international expansion relatively early. The arithmetic mean of the moment of the firm's first expansion was 9.69 years and the standard deviation was 14.87 years. The standard deviation was significantly higher than the average. However, due to the extreme right-skewness of the distribution of the variable under study, we were unable to assess the significance of the above statistics. Hence, we focused on non-classical statistics. A median equal to 4.0 informed us that half of the surveyed firms first expanded in a maximum of four years. The lower quartile was 1.0 and it shows that 25 % of the surveyed firms started international expansion no longer than one year after they started operating, while the upper quartile of 12.0 indicates that 75 % of firms started international expansion no longer than 12 years after they started operating.

Empirical Findings

Correlations for the Internationalization Speed

We applied a correlation analysis to the only two continuous variables, *i.e.* early internationalization and the age of the surveyed firms. The analysis proved that there was a statistically significant correlation between the age of the surveyed enterprises and internationalization speed. Younger companies internationalized faster ($\chi2 = 49.416$, df = 3, p = 0.000, Spearman's $\rho = -0.412$, Cramer's V contingency coefficient = 0.437).

We also proved that there was a statistically significant relationship between the share of foreign ownership in the firm's assets and its internationalization speed ($\chi2 = 17.797$, df = 3, p = 0.000, Spearman's $\rho = 0.233$, Cramér's V contingency coefficient = 0.262). This is a moderate-intensity relationship. Thus, the higher the share of foreign ownership in assets, the faster the internationalization.

There was a weak statistical relationship between the early internationalization and the selection of foreign entry modes ($\chi^2 = 9.594$, $df = 4$, $p = 0.048$, Cramer's V contingency coefficient =0.192).

This suggests that hypothesis H3 is true and early internationalized firms are indeed more inclined to employ high

control modes. However, there were no unequivocal results as the descriptive statistics suggest something else (Table 2), and the statistical relationship was weak. In other words, the matter requires further in-depth empirical verification.

Table 4 presents the results of the descriptive analysis conducted on our data set with respect to the variables under consideration. A substantial proportion of the sample (45%) comprised early internationalized firms.

Table 2

Descriptive Analysis of the Research Sample for Early Internationalization

Items	Early internationalization (time to export)	
	≤ 3 years	> 3 years
Firms total (259*)	45.0%	55.0%
any networks, including:	54.6%	45.4%
formal international network	38.2%	29.1%
informal international network	16.4%	16.3%
no networks	45.4%	54.6%
family firm non-family firm	14.7%	24.3%
using high-control entry modes	3.1%	3.9%
using medium-control entry modes	27.8%	32.4%
using low-control entry modes	45.0%	55.0%
combination of various modes	24.1%	8.7%

Note: * we could not provide the expansion year for the oldest firms in the sample.

Source: own elaboration based on the survey (n = 263).

Logistic Regression for Early Internationalization

The next stage of the analysis was logistic regression for the early internationalization of high-tech firms. Because of the dichotomous nature of the time variable of international expansion, which assumes the analysis of the states '≤ 3 years' and '> 3 years,' we decided that logistic regression would be the most appropriate statistical analytical technique. We defined a set of exogenous variables which together significantly impact a firm's early international expansion, namely: (i) functioning in any informal or formal networks, (ii) a firm's familiness, and additionally (iii) cooperating in local clusters. Table 3 presents the results of the models' estimates.

The empirical statistic chi-squared $\chi 2 = 7.047$ gives the value of level $p = 0.029$, and thus, at the significance level $\alpha = 0.05$, we found that together, selected determinants significantly impact the time of first international expansion of the surveyed firms. The assessment of the parameter b_2 with the variable 'functioning in formal or informal network' equal to (-) 0.315 means that firm cooperation in international networks was accompanied by the reduction of time of the firm's first international expansion. The level $p = 0.076$ determined for the Student's t-test indicates that with the upper limit of the significance level $\alpha = 0.1$, the variable 'functioning in formal or informal network' statistically significantly affected the chances of reducing the time of the firm's first international expansion, which means that we confirmed hypothesis H1a. The assessment of the b_3 parameter with the 'familiness' variable equal to (+) 0.544 means that the familiness of the firms favoured the extension of the time of the firm's first international expansion. The level $p = 0.039$ determined for Student's t-test indicated that with the upper limit of significance level $\alpha = 0.1$, the 'familiness' variable statistically significantly impacted the chances of extending the time of the firm's first international expansion, which means that we confirmed hypothesis H2.

Moreover, we built the second model with three variables by adding 'cooperating in local clusters.' It improved the general estimations of the model (for familiness and networking) and confirmed hypothesis H1b that cooperation in local clusters affects the chances of reducing the time of a firm's first international expansion.

Table 4 below presents the classification of the surveyed firms according to the chance of finding in both analysed subgroups the time of the first international expansion. On this basis, we could assess the average validity of the estimated model in the classification of the surveyed firms to both subgroup (≤ 3 years,> 3 years). We saw that among firms whose real expansion period was > 3 years, the correct classification by the model was 90.8%. The result was much worse for firms with a real expansion period of ≤ 3 years as the model's classifications were accurate in this subset of only 15.4 %. For model 2, which included three variables (with added clusters), the calculations were respectively 82.4 % and 28.9 %.

Table 3

Results of Estimation of Parameters of the Logistic Models of the Time of International Expansion

Model 1. Two variables: networking and familiness			
n=259	Total loss: 174.793 Chi-squared (2) = 7.047 **p = 0.029** The modelled probability that the duration of expansion is ≥3 years		
	Constant	Functioning in int'l networks	Familiness
Assessment	-0.958	-0.315	0.544
Standard error.	0.329	0.177	0.263
t(256)	-2.907	-1.781	2.071

Model 1. Two variables: networking and familiness			
n=259	Total loss: 174.793 Chi-squared (2) = 7.047 **p = 0.029** The modelled probability that the duration of expansion is ≥3 years		
	Constant	Functioning in int'l networks	Familiness
P	0.004	0.076	0.039
Wald's chi-square	8.452	3.172	4.287
P	0.004	0.0749	0.038

Model 2. Three variables: networking, clusters and familiness				
n=259	Total loss: 177.065 Chi-squared (4) = 8.787 **p = 0.037** The modelled probability that the duration of expansion is ≥ 3 years			
	Constant	Clusters	Networks	Familiness
Assessment	0.097	-0.362	-0.476	0.600

Source: own elaboration based on the survey (n = 259)

Table 4

Case Classification of the Logistic Models of the Time of International Expansion

Estimating model	Observations	Estimated >3 years	Estimated ≤3 years	Percentage of correctly indicated firms
Model 1	>3 years	129	13	90.85
	≤3 years	99	18	15.38
	Classification	chances: 1.804 %, correct: 56.76%		
Model 2	>3 years	117	25	82.39
	≤3 years	86	35	28.92
	Classification	chances 1.905%, correct: 57.79%		

Source: own elaboration based on the survey (n = 259).

Discussion

The above empirical findings foreground previously unnoticed nuances about this this region of Europe in the literature. Although researchers studied the internationalization of technology-based global firms from different advanced economies for two decades (Choquette *et al.*, 2017; Onetti *et al.*, 2012), this topic remained undiscussed regarding some emerging markets like Poland. Although scholars might have negative associations regarding research replication in business studies seems (Hensel, 2019), we believe it to be relevant and in some conditions even crucial. Polish realities are different from those of advanced economies, so it was worth checking how internationalization processes described in the international literature occur among Polish high-tech firms.

Our quantitatively verified results that international networking and cluster cooperation stimulate early internationalization are consistent with the literature, so the replication of research was proper, and the conditions in Poland appear to be the same in this regard. Recent qualitative research on emerging economies suggested such a solution (Gil-Barragan *et al.*, 2018; Gonzalez-Perez *et al.*, 2018), which indeed agrees with the well-established results from advanced economies (Coviello & Munro, 1995).

The majority of researchers accept that familiness hinders and sometimes even inhibits firms' internationalization process (Kontinen & Ojala, 2010; Graves & Thomas, 2006; Daszkiewicz & Wach 2014). Nevertheless, this requires further exploration, as existing empirical evidence is contradictory (Hadrys-Nowak, 2018). For example, family firms listed on stock exchanges are usually more internationalized. On the whole, our results are not only consistent with the existing literature but are one of the first ones that combine familiness and internationalized high-tech firms in Poland.

In our research sample (n = 263), the majority of the early internationalized high-tech firms from Poland used low-control exporting forms (45 %) and a combination of various entry modes, exporting, cooperating, and investing (24.1 %). These descriptive statistics align with the findings of Gabrielsson *et al*. (2008), which indicate that born globals frequently employ a variety of market entry modes in their operations. Nevertheless, the weak statistical significance of our results is consistent with Hollensen's (2017) view that born globals are better prepared to use hierarchical high-control entry modes. As the research results do not provide clarity in this regard, the issue requires further investigation.

This article contributes to the technological entrepreneurship literature (Badzinska, 2016; Jafari-Sadeghi *et al.*, 2021) and extends our knowledge on interna-tionalization of high-tech firms in Poland (Daszkiewicz, 2019; Wach, 2016), especially in the context of the recent technological revolution and Industry 4.0 (Rymarczyk, 2020; Rymarczyk, 2021), the entrepreneurial economy (Sieja & Wach, 2019), dynamic development of international e-commerce (Grochal-Brejak & Szymura-Tuyc, 2018), and digital marketing (Bartosik-Purgat, 2019; Bednarz *et al*., 2023). Moreover, this article develops the international entrepreneurship literature from the perspective of Central Europe, which in itself constitutes an added value (Perenyi & Losoncz, 2018; Puslecki, Trapczynski, & Staszków, 2016) as our study replicated empirical research from other regions (Eden, 2002; Hensel, 2019) as there is an evident lack of

empirical investigations of emerging countries, including Poland (Wach, Glodowska, & Maciejewski, 2018). Our results are in line with the study by Johnson (2004) who – based on a qualitative and quantitative study of US and UK small high-technology international start-ups – confirmed the factors previously identified in the literature.

Conclusions

Summary of the Empirical Results

Studies on the determinants of the early and fast internationalization of high-tech firms appeared in the 1990s. Despite different conclusions concerning their international behaviour, much research to date supports the thesis that internationalization patterns of high-tech firms differ from those of low-tech firms. We based our empirical results on a sample of 263 firms operating in high-tech and medium-high-tech industries in Poland. We verified all hypotheses through statistical calculations and accepted all but one (Table 6). The key results of our empirical studies show that firms functioning in networks and clusters are more likely to start their international expansion early compared to non-family firms. Moreover, family firms are less likely to internationalize earlier compared to non-family firms.

Table 6

The Results of the Hypotheses Verification

No.	Hypotheses	Verification status	Method of verification
H1a	High-tech firms co-operating in any informal and formal networks are more likely to internationalize early compared to non-family firms.	Confirmed	Logistic regression (model 1 and model 2)
H1b	High-tech firms operating in local clusters are more likely to internationalize early compared to non-family firms.	Confirmed	Logistic regression (model 2)
H2	Family firms from high-tech industries are less likely to internationalize early compared to non-family firms.	Confirmed	Logistic regression (model 1 and model 2)
H3	Early internationalized high-tech firms are more likely to use high control modes compared to non-family firms.	lack of unequivocal results	Chi-squared independence test; Cramér's V contingency coefficient

Source: own elaboration

Contribution

The initial results presented in this article are undoubtedly preliminary and thus require further exploration. Nonetheless, the obtained and discussed empirical results allowed us to gain insight into the reality of Polish high-tech firms, which we find beneficial, as this industry appears to be flourishing in Poland at present. As empirical research replication in social sciences is not only possible but even very welcome (Eden, 2002; Hensel, 2019), it helps to see how operate other differing ecosystems in various corners of the globe. Furthermore, there is little empirical evidence on the internationalization of high-tech firms from emerging markets, especially from Central and Eastern Europe, including Poland.

Implications

Managers of high-tech firms in Poland should seek cooperation in local clusters, as it stimulates the internationalization process. In Poland, there are some advanced technology clusters such as the Three City Silicon Valley (Gdansk, Gdynia, Sopot), Lifescience Krakow, the medical cluster MedSilesia in Gliwice, and the Aviation Valley in Rzeszow. The capital city of Warsaw is the market leader in the high-tech field among all the Polish regions, including headquarters of Bioton and Celon Pharma, the largest biotechnology firms in Poland. Although memberships in various business organizations are not so popular in Poland – probably due to the recent communist past – our empirical results suggest that entrepreneurs and professionals should seek to operate within formal networks, especially with international networks, which can stimulate internationalization processes. Exporting consortia are rather unpopular in Poland, but taking international experiences into account they seem to facilitate firms' internationalization. Because family high-tech firms are less likely to internationalize early than non-family firms operating in advanced technology industries, family managers' activities should be more proactive in seeking new international opportunities (Wach *et al*., 2023).

Research Limitations

One of the main limitations of this research concerns the unrepresentative research sample, which implies that we cannot generalize the results to all high-tech firms in Poland. Importantly, the findings and conclusions drawn from this study are specific to the analysed high-tech firm (n = 263) and may not be directly applicable to other similar organizations.

Despite this limitation, the sample size of the 263 firms should be relatively large within the Polish context. It is a substantial dataset that allows for meaningful analysis and insights into the specific high-tech firms under investigation. This wide-ranging inclusion of firms from different industries enhances the diversity and breadth of the research sample, ensuring a comprehensive topic exploration.

Nevertheless, we should exercise caution when generalizing the findings beyond the specific high-tech firm and Polish context. The unique characteristics and circumstances of each organization and country may introduce variations that could influence the results differently. Therefore, we recommend further research with more diverse and representative samples to strengthen the finding's generalizability and gain a more comprehensive understanding of the implications of digital transformation for high-tech firms in Poland and potentially in other similar contexts.

Furthermore, we conducted the research within a specific timeframe and might not have captured the dynamic nature of digital transformation, as technology and business practices continue to evolve rapidly. Future studies should consider longitudinal approaches to track the changes over time and capture the ongoing impact of digital transformation on high-tech firms in a more comprehensive manner.

Future Research Directions

When examining the early internationalization factors of high-tech firms, future studies should consider a narrower group of firms, especially those operating within ultra-high technologies. Moreover, a review of the current research on the internationalization of high-tech firms – and especially determinants of a firm's early and fast internationalization – indicates several main directions, such as research into the relationship between internationalization, innovation, and networking or research on the relationship between technological capacity and internationalization strategies, as well as the role of international entrepreneurial orientation in the internationalization of high-tech firms. Furthermore, our methodology requires development and improvement, for example through additional research tools, *e.g.* qualitative research based on interviews with managers, or more sophisticated quantitative tools. Furthermore, this topic exhibits high potential for a good comparative study, *e.g.* analysis of determinants of the early internationalization of high-tech firms in Poland and other countries, especially in emerging markets like the Central and Eastern European countries.

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Authors' Biographies

Nelly Daszkiewicz – full professor at Gdańsk University of Technology, Faculty of Management and Economics (Poland). Since 2019, she is the head of the Department of Economics (until September 2021 the Department of Economic Sciences). She is a member of scientific committees of national and international scientific conferences and a reviewer of many journals. She was the promoter of three doctoral dissertations and a reviewer in numerous doctoral proceedings. She is the author and co-author of several books and numerous scientific articles and has participated in several national and international research projects. Main research areas of prof. Nelly Daszkiewicz include international entrepreneurship, in particular internationalization of firms and small and medium-sized enterprises.

Krzysztof Wach – full professor at Krakow University of Economics (Poland). Professor of social sciences (2020), habilitated doctor of economics (2013), PhD in management (2006), Head of the Department of International Trade (since 2016), Director of the Centre for Strategic and International Entrepreneurship (since 2014), Member of the Committee of Economic Science Polish Academy of Sciences (PAN, since 2020), member of. the Committee of Economic Science Polish Academy of Skills (PAU, since 2022), member of the Committee of Organization and Management Polish Academy of Sciences (PAN) – branch in Kraków (since 2023). Expert in international entrepreneurship, author of several books and over 200 articles, editor-in-chief of the scientific quarterly Entrepreneurial Business and Economics Review (ESCI WoS, Scopus), member of editorial boards of several scientific journals, including European Journal of International Management (SSCI WoS, Scopus), Central European Management Journal (ESCI WoS, Scopus). Visiting professor at various foreign universities, including ones in the USA, the UK, Spain, Croatia, China, Taiwan, Vietnam, Austria, Slovakia, and Ukraine.

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