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Back-shoring vs. Offshoring: The importance of innovating with host-country inventors

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ABSTRACT

This study investigates the association between the intensity of innovation activities that firms perform offshore with host-country inventors (IHCI) and the time before back-shoring, a rising form of de-internationalization. IHCI is viewed as a pull factor that alleviates liabilities of both foreignness and outsidership, hence creating incentives for more extended offshoring stays. Additionally, the study investigates whether specific types of IHCI are associated with offshoring duration, namely IHCI leading to exploratory innovation and IHCI leading to an innovation portfolio with a broad scope. The study employs a Cox model to analyze 301 offshoring initiatives implemented by US firms, partially or totally ended through back-shoring. Results suggest that IHCI is associated with longer offshore duration. Further, duration is longer when IHCI leads to a broader innovation portfolio.

1. Introduction

The last decade has witnessed the growth of de-internationalization initiatives (Kafouros, Cavusgil, Devinney, Ganotakis, & Fainshmidt, 2022; Tang, Zhu, Cai, & Han, 2021). Back-shoring (Di Mauro, Fratocchi, Orzes, & Sartor, 2018) or back-reshoring (Fratocchi, Di Mauro, Barbieri, Nassimbeni, & Zanoni, 2014) (back-shoring henceforth), i.e., voluntary relocations of previously offshored production back to the home country—either through insourcing or outsourcing—have become particularly notable and are currently being spotlighted as a prospectively rising form of de-internationalization (UNCTAD, 2020).

A growing stream of research has addressed firm-specific and external factors that explain de-internationalization in general (Kafouros et al., 2022; Schmid & Morschett, 2020) and, more specifically, the phenomenon of back-shoring (Di Mauro & Ancarani, 2022; Fratocchi et al., 2016; McIvor & Bals, 2021). The "hidden" costs of offshoring (Larsen, Manning, & Pedersen, 2013), changes in strategy and global network reorganizations (Ancarani & Di Mauro, 2024), and declining cost advantages (Pedroletti & Ciabuschi, 2023) have been pinpointed as significant drivers of the decision to terminate offshoring by relocating back home.

By contrast, comparatively little research focus has been placed on the duration of offshore initiatives and on discerning the factors that postpone the back-shoring decision (Ancarani et al. 2015). By shedding light on the "time dimension" of offshoring, this analysis may help predict conditions under which firms are likely to reduce operations in a host country and re-orient resources towards the home country. Furthermore, this analysis may improve our understanding of the tensions that firms experience between offshoring and back-shoring. This is especially important in the current world characterized by increasing protectionism and neo-localism (Ghauri, Strange, & Cooke, 2021), in which firms may experience a decoupling between national objectives and their own goals (Petricevic & Teece, 2019).

Our study addresses this relatively understudied line of inquiry, by investigating the duration of offshore initiatives in light of the advantages stemming from knowledge accumulation and innovation activities in the host country (Tan & Sousa, 2019). While the initial stages of offshoring were generally driven by the exploitation of host country advantages such as access to new markets, lower labour costs, and economies of scale (Dunning, 1980), over time, the accumulation of knowledge has become an increasingly significant factor motivating offshoring (Cantwell, 1995). The host country provides location-specific strategic advantage by allowing the foreign firm to tap into and exploit local knowledge (Cantwell and Piscitello, 2000; Dunning, 1998). In particular, cross-border knowledge accumulation allows enlarging the firm's previous knowledge base by providing access to new knowledge

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that exhibits valuable complementarities (Cantwell and Piscitello, 2000; Kuemmerle, 1999), often resulting in increased innovativeness (Gertler, 2003; Hung, Contractor, & Lo, 2022).

The back-shoring literature has investigated the advantages of the home country as a locus of innovation (Ancarani, Di Mauro, & Mascali, 2019; Elia, Fratocchi, Barbieri, Boffelli, & Kalchschmidt, 2021; Ketokivi, Turkulainen, Seppälä, Rouvinen, & Ali-Yrkkö, 2017) but has so far overlooked the benefits deriving from the global reach of innovation endeavors, which can potentially surpass or complement the attractiveness of innovating in the home country (Cantwell, 2017; Patel & Vega, 1999). In other words, advantages stemming from innovation opportunities in the host country can discourage exit strategies and postpone back-shoring (Tan & Sousa, 2019). In this direction, previous research has shown that, when subsidiaries develop own capabilities, the likelihood of divestment is reduced (Konara & Ganotakis, 2020).

Currently, no research explores the connection between host-country exit through back-shoring and offshore innovation opportunities. Our study contributes to address this gap by focusing on innovating with host-country inventors (IHCI, hereafter) as an important way through which foreign firms can innovate while operating offshore (Belderbos, Leten, & Suzuki, 2017; Gerybadze & Merk, 2014). In particular, the study argues that IHCI leads to a longer duration of the offshore initiative by supporting the establishment of closer contacts with individuals or groups with local specific knowledge (Marino, Mudambi, Perri, & Scalera, 2020). These contacts are also relevant because firms operating offshore have been known to be subject to liabilities of foreignness and outsidership (Johanson & Vahlne, 2009) that can be mitigated through IHCI, therefore encouraging companies to remain offshore. Hence, to increase our comprehension of the role of IHCI, this study addresses the following first research question:

1.1. RQ1: does IHCI matter for the duration of offshore initiatives prior to back-shoring?

While it seems intuitive that a positive impact of IHCI would extend the duration of offshore initiatives, it is worth questioning whether alternative IHCI strategies are equally appealing to foreign companies. Essentially, firms might leverage IHCI to develop a variety of innovative outcomes, each creating distinct value for their offshore presence. Past research has shown that the host country is valued as a source of diversified knowledge and competences with respect to the foreign company's core knowledge (Cantwell & Janne, 1999; Cantwell & Piscitello, 2015). By facilitating foreign firms' access to and utilization of diverse local knowledge, IHCI may create the potential for fostering technological innovation. This, in turn, could serve as a compelling incentive for foreign firms to prolong their presence in the host country. Thus, we aim to answer the following second research question:

1.2. RQ2: does IHCI offering knowledge diversification opportunities influence the duration of offshore initiatives prior to back-shoring?

To address the research questions, an empirical analysis is carried out on 301 back-shoring initiatives implemented by US firms with heterogeneous offshore duration. Patent applications during the offshore stay that include host-country inventors as members of the inventing team are used as proxy for IHCI. We explore two knowledge diversification opportunities that may arise through IHCI, namely developing new-to-the-firm innovative trajectories, i.e., exploratory innovations (Cui, Ding, & Yanadori, 2019; Fleming, 2001) and developing an innovation portfolio covering multiple technological areas, i.e., with a wider scope (Qiu & Cantwell, 2018). Results confirm the positive impact of IHCI on offshore duration and show that a longer duration is associated with IHCI that expands the scope of the innovation portfolio. Conversely, we find no evidence that IHCI leading to exploratory innovations is related to the length of the offshore stay.

Our findings contribute to the back-shoring literature by shedding new light on the time dimension of offshore initiatives (Ancarani et al., 2015) and by linking it with the emerging debate on the role of innovation in fostering back-shoring (Ancarani et al., 2019; Dachs, Kinkel, & Jäger, 2019; Ketokivi et al., 2017). Results also contribute to link research on back-shoring with international business studies on cross-border knowledge search and accumulation (Cantwell & Piscitello, 2000). In particular, by demonstrating that IHCI contributes to foster commitment in the host-country, results reinforce the importance of knowledge sourcing as a significant element of attractiveness of the host country.

The study also provides valuable policy insights to governments that aim at attracting/retaining foreign business (Mudambi & Zahra, 2007; Sui & Baum, 2014). The findings indicate that host-country policymakers seeking to attract foreign companies and prevent back-shoring should create innovation environments that enable local inventors to support the innovation activities of foreign firms. Finally, from a managerial perspective, the study suggests that the involvement of host-country inventors is a valuable host-country asset that should be considered among the costs of relocating back home and traded-off against home-country innovation opportunities.

2. Background

2.1. Offshoring and Back-shoring

Under pressure from the globalization dynamics and favoured by progress in information and communication technology, offshoring to low-cost countries has been a hallmark of the last thirty years (Mudambi & Venzin, 2010; Schmeisser, 2013). Although offshoring remains a key strategy, changes in markets, technology, and resources that create competitive advantage have challenged the attractiveness of foreign locations (Manning, 2014). This shift is exemplified by the surge in de-internationalization initiatives following the global crisis of 2008 (Kafouros et al., 2022; Tang et al., 2021). In particular, among the different exit strategies, the partial or complete relocation of production from foreign host countries to the home country (typically from low-cost to high-cost locations) has garnered significant attention (UNCTAD, 2020). Literature often articulates these relocations into back-shoring (return to the home or headquarter country) and near-shoring (relocation to a country within the firm's home region) (Fratocchi et al., 2014). Exogenous changes in the host-country environment have been used to explain back-shoring (Fratocchi et al., 2016; McIvor and Bals, 2021). These include shrinking labour-cost differentials between low-cost and high-cost locations, rising transport costs (Merino, Di Stefano, & Fratocchi, 2021; Simchi-Levi, Peruvankal, Mulani, Read, & Ferreira, 2012), as well as supply chain disruptions (Ciabuschi, Lindahl, Barbieri, & Fratocchi, 2019; Johansson & Olhager, 2018). Next, offshore costs in terms of loss of brand image, product quality, and intellectual property have been pinpointed as relevant back-shoring drivers (Larsen et al., 2013; Fratocchi et al., 2016). Additionally, back-shoring has been ascribed to firms' strategic shifts prompted by growing demand for product differentiation and upgrading (Baraldi, Ciabuschi, Lindahl, & Fratocchi, 2018; Di Mauro et al. 2018; McIvor & Bals, 2021). Back-shoring has also been associated with process and product innovation opportunities in the home country. In particular, new technologies may offset labour cost differentials and offer quality and flexibility advantages (Ancarani et al., 2019; Dachs et al., 2019). Similarly, when R&D is retained in high-cost countries (Mudambi, 2008), the geographical co-location of R&D and production has been recognized as advantageous for product innovation, particularly in cases of strong functional interdependencies (Ketokivi et al., 2017; Pisano & Shih, 2012). Finally, domestic regional ecosystems that provide innovation opportunities increase the region's attractiveness for back-shoring strategies (Elia et al., 2021; Pegoraro, De Propris, & Chidlow, 2022).

2.2. The duration of offshoring initiatives

Back-shoring studies have focused on the identification of the drivers of relocation decisions but have paid little attention to the time dimension of the exit strategy, i.e., to the factors affecting the length of time a firm spends offshore. A small body of research in International Business has analysed determinants of the duration of foreign ventures, showing that duration is positively related to host-country features, such as lower host-country risk (Jiang, Chu, & Pan, 2011) and lower market and technological uncertainty (Jiang, Aulakh, & Pan, 2009). Additionally, duration increases with firm-specific resources, as proxied by firm's size (Ancarani et al., 2015; Mudambi & Zahra, 2007; Sui & Baum, 2014), productivity and number of products exported (Sui & Baum, 2014). The impact of firm-specific resources is moderated by internationalization strategy and international experience. For example, born-global strategies have a negative effect on duration (Sui & Baum, 2014), as does limited international experience within the top management team (Mudambi & Zahra, 2007). Finally, longer duration is associated to investment irreversibility (Jiang et al., 2009, 2011; Song, 2022), late entry in international markets (Puig, Gonzalez-Loureiro, & Ghauri, 2018), offshore commitment as measured by re-investment (Wren & Jones, 2009), and host-country partners' relational assets (Kim & Kim, 2018). Ambiguous effects on duration have been found with respect to entry modes. For instance, McCloughan & Stone (1998) associate greenfield entry to longer survival of foreign subsidiaries, while Mata and Portugal (2000) to shorter survival. For offshore initiatives terminated through back-shoring, Ancarani et al. (2015) find evidence that shorter duration is associated with some of the drivers of the exit decision, such as loss of brand image and poor quality of production in the host-country.

Though the above contributions have offered important insights on offshore duration, other potential explanatory factors are yet to be unveiled. Offshoring has predominantly been associated to efficiency and market-seeking advantages. However, asset-seeking advantages, and notably the creation of new technological knowledge and innovation opportunities, have gradually become an important offshoring motivating factor (Cantwell, 2009; Cantwell & Piscitello, 1997; Dunning, 1995; Nieto and Rodríguez, 2011). In this respect, research has not yet investigated whether duration and exit are linked to knowledge accumulation in the host country and the ensuing innovation activities.

Prior studies have shown that integrating host-country specific knowledge into own knowledge creates innovation opportunities for foreign firms (Ambos, Ambos, & Schlegelmilch, 2006; Cantwell and Piscitello, 2000, 2015 among others). These conditions may create enduring advantages that encourage the company to remain offshore, whereas lack of innovation opportunities may lead firms to lose interest in the host country and relocate elsewhere.

2.3. The role of innovating with host-country inventors

The International Business literature has provided ample evidence that the host country can be a source of local capabilities that provide foreign firms with access to new knowledge. This perspective underscores the theory of knowledge accumulation (Cantwell, 1989, 1995; Cantwell and Piscitello, 1997, 2000; Teece, 2014), which delineates how the firm's cumulative development of knowledge occurs across national boundaries, especially as foreign subsidiaries acquire an autonomous role in generating innovation (Cantwell, 2017). According to this perspective, given the geographical dispersion of knowledge, firms can leverage global networks to expand their innovation potential by tapping into local capabilities and talent (Cantwell & Kosmopoulou, 2002). Location-specific knowledge may allow augmenting the foreign firm knowledge base, thus improving the scale and quality of innovation (Phene & Almeida, 2008) and/or enabling the adaptation of innovations to new markets (Berry, 2014; Kuemmerle, 1999). Finally, from a country perspective, the exploitation of the technological advantages of the host country may alleviate weaknesses at home (Patel and Vega, 1999). This flow of knowledge may occur also from emerging economies to advanced economies, thanks to the substantial improvements in market and institutional conditions (Dodourova, Zhao, & Harzing, 2023).

Interestingly, Maskell, Pedersen, Petersen, and Dick-Nielsen (2007) find that local knowledge may not represent the original source of attractiveness of a host-country but may surface only later in the offshore experience. Initially, companies are often attracted by efficiency advantages. However, over time, they may come to appreciate the additional opportunities offered by local knowledge and innovation in the host country (Cantwell, 2009). In this perspective, offshoring can be seen as a learning process whereby firms discover new possibilities and remain offshore, even when the original sources of host-country attractiveness have vanished.

However, the cross-border accumulation of knowledge is not straightforward, even for firms that pioneered routines (Castellani, Jimenez, & Zanfei, 2013) and created pipelines (Lorenzen & Mudambi, 2013) to facilitate the international transfer of physical resources and knowledge (Einola, Kohtamäki, Parida, & Wincent, 2017; Gertler, 2003; Meyer, Mudambi, & Narula, 2011). Issues such as the tacit nature of knowledge, the lack of focal firms' embeddedness within the foreign context, and cultural and linguistic barriers must be balanced against the possibility of attaining innovation-related advantages (Choudhury & Kim, 2019; Frost, 2001; Marino et al., 2020). In brief, the exploitation of local knowledge requires familiarity with the host-country environment to overcome liability of foreignness (Zaheer, 1995), and "embeddedness" in relevant business networks to overcome liability of outsidership (Belderbos, Capannelli, & Fukao, 2001; Johanson & Vahlne, 2009).

IHCI may contribute to alleviate the liability of foreignness and the liability of outsidership by facilitating involvement in local innovation communities and providing access to location-specific knowledge (Breschi, Lenzi, Lissoni, & Vezzulli, 2010). In this light, IHCI enhances host-country attractiveness over time, which may eventually lead to longer offshore duration. Indeed, the process of invention takes time, and builds on unreserved trust, close personal contacts, and open communications between co-inventors (Seo, Kang, & Song, 2020; Xiang, Cai, Lam, & Pei, 2013). Therefore, co-innovation experiences among inventors can support conformity (Patacchini & Venanzoni, 2014), trust, and shared communication codes (Castellani, Perri, & Scalera, 2022), hence enabling knowledge to flow with less noise and more swiftly (Breschi & Lenzi, 2016; Glaeser & Gottlieb, 2009). Also, in the case of IHCI, co-innovation experiences allow foreign firms to combine domestic and foreign technical knowledge activities and develop complementary skills (Abramovsky, Griffith, & Miller, 2017). In this direction, the presence of host-country inventors in a foreign firm's inventor network may eventually facilitate firms to source and integrate location-specific knowledge and, in turn, remain in the host country longer.

Next, host-country inventors can help firms to fill structural holes in the host-country business and innovation networks (Hymer, Press, & Technology, 1976), being linked to colleagues in the same field or invisible college (Verspagen & Werker, 2004). Entering host-country business and innovation networks is "costly and subject to various moral hazard and adverse selection problems" (Acs, Morck, Shaver, & Yeung, 1997, p. 10), yet it is pivotal to continue operating in a host location by minimizing the risks of internationalization and creating synergies for discovering new opportunities (Cavusgil & Knight, 2015; Hånell, Nordman, Tolstoy, & Sharma, 2018).

Host-country inventors may, at least indirectly, create opportunities for value-creating brokerage (Burt, 1995), which may be exploited over time by foreign firms (Agrawal, Cockburn, & McHale, 2006). Recalling the relevance of weak ties (Diemer & Regan, 2022; Granovetter, 1983), this can explain why IHCI may discourage an early decision to relocate out of the host country. In turn, forging close links with local business and innovation networks helps maintaining open-ended social relations and learning processes (Chen, Huang, & Lin, 2012), thus further contributing to a longer offshore stay. Additionally, IHCI may allow

foreign firms to improve absorptive capacity by building systems of knowledge-processing that mirror local innovation networks (Lane & Lubatkin, 1998), as well as building reputation and legitimacy in such networks (Frost, 2001). For instance, Hitachi's Cambridge Lab was named the "embedded laboratory" thanks to its research collaboration with local scientists (Song, Asakawa, & Chu, 2011). This is especially true for those firms that commit to IHCI for a longer time (Frost, 2001), thus encouraging them to stay in the host country longer.

Finally, knowledge of the host country in terms of industry norms (e.g., intellectual property regime, standards, regulations, etc.), manufacturing conditions, and customer requirements cannot be undervalued in innovation activities (Adams, Fontana, & Malerba, 2016; Jayaram & Pathak, 2013). Foreign firm inventors and host-country inventors differ in interpreting the signals of the markets as well as of political and legal systems of the host-country (Khoury, Cuervo-Cazurra, & Dau, 2014). Particularly, host-country inventors, having an insider view, possess a richer experience and understanding of how markets and institutions behave in the host country than foreign firm inventors, who have an institutional outsiders' view (Johanson & Vahlne, 1979). This allows host-country inventors to make more accurate inferences about the host-country context. Therefore, IHCI can also provide guidance on non-technical issues and changes in the host-country environment, thus placing foreign firms in a better position to exploit host-country opportunities and prolong offshoring duration. Following the forgoing discussion, we contend that:

Hypothesis 1. IHCI, by facilitating accumulation of the host-country localized knowledge, is associated with longer offshore duration.

2.4. IHCI and diversification of knowledge

IHCI may yield different innovative outcomes holding different degrees of appeal for the foreign company. Specifically, foreign firms can target host countries with more exploratory or exploitative innovation initiatives in mind. Exploitation implies searching along known trajectories aligned with initial knowledge (Nelson & Winter, 1982), thus providing firms with immediate advantages. However, the pursue of closely related innovation trajectories might not enhance innovativeness in the longer term (Dunlap, Marion, & Friar, 2014), as the capacity for novel combinations from similar knowledge is restricted (Fleming, 2001). Furthermore, exploitative endeavors may generate redundant knowledge, hence leading the firm into core rigidities (Zhang, Jiang, & Cantwell, 2015). Past research has shown that the host country is especially valued as a source of complementary but diversified knowledge and competences with respect to the foreign company core knowledge base (Cantwell & Janne, 1999; Cantwell & Piscitello, 2015), as this enables greater recombination opportunities (Piscitello & Thakur-Wernz, 2023). Therefore, foreign firms can benefit from pursuing collaborative efforts characterized by technological heterogeneity with respect to their core knowledge base, i.e., exploratory innovation (Dunlap et al., 2014).

Firms can achieve a competitive edge by acknowledging the knowledge present in the host country and integrating it with their domestic capabilities (Almeida, Song, & Grant, 2002). However, identifying, acquiring, and assimilating diverse knowledge remains challenging (Cohen & Levinthal, 1990), because several parameters of the learning environment can change simultaneously with respect to the home country (Marino et al., 2020; Teece, Pisano, & Shuen, 1997). In this context, host-country inventors can play a bridging function, acting as gatekeepers and knowledge brokers, thus facilitating the integration of the host-country knowledge with the foreign firm own knowledge. Thus, when IHCI results in the creation of exploratory innovation, it is likely to yield greater benefits compared to exploitative IHCI (Piscitello & Thakur-Wernz, 2023; Thakur-Wernz, Cantwell, & Samant, 2019), thereby encouraging the firm to prolong its offshore presence. The above argument leads to the following hypothesis:

Hypothesis 2a. IHCI leading to the development of exploratory innovations increases the duration of offshore initiatives prior to back-shoring.

When firms operating offshore integrate new areas of knowledge with their traditional strengths, the process of creating novel combinations is often bolstered by access to a broader knowledge base in the host country (Cantwell & Piscitello, 2015). The diversity of the knowledge building blocks that are recombined in innovation, i.e., the scope of the innovation portfolio that is developed, measures the extent of the integration process (Awate & Mudambi, 2018). When IHCI facilitates the development of an innovation portfolio with a wider scope, it contributes to enhance the potential of the knowledge accumulation processes in the host country (Kogut & Zander, 1992; Roper & Hewitt-Dundas, 2015). The resulting benefits increase the likelihood that foreign firms will seek to retain the value of host country-specific knowledge through longer offshore engagements. Formally, we test the following hypothesis:

Hypothesis 2b. IHCI leading to an innovation portfolio wider in scope increases the duration of offshore initiatives prior to back-shoring.

3. Methodology

3.1. Data collection

The analysis of offshoring duration undertaken in this study addresses initiatives terminated through the relocation of the firm's production activities back to its home country, namely the US. This choice offers the advantage of comparing the duration of initiatives that are homogeneous in two respects: the value chain activity that is being relocated (production) and the location advantages of the home country (the US). The Reshoring Initiative (RI) archives (https://www.reshorenow.org/) were the first source of data. RI collects information on back-shoring initiatives to the US from several sources (national press, local news, industry magazines, companies' webpages, etc.). RI provides basic information on each of the initiatives, such as the company denomination, industry, motivations for back-shoring, host country, and US state to which activities have been relocated to. A link to the original source of the information is appended to each record. The authors accessed the RI archives in August 2020 and manually consulted initiatives classified as "Reshoring" for the period 2009–2019. This time frame was chosen because back-shoring has accelerated after the global crisis and because back-shoring has been impacted by COVID-19, thus creating potential confounding effects. At the time of access, the archives included over 2000 initiatives. The authors used the links to the original sources of the news to verify content and to extract other relevant information. For each record, additional internet sources were searched and used for comparison and validation of content. In some instances, consultation of other web sources allowed the identification of new initiatives, not listed in the RI, through a snowballing approach. The following exclusion criteria were used to ensure data validity: initiatives did not satisfy the definition of back-shoring (Fratocchi et al., 2014), no web source was any longer accessible, conflicting information was reported in different sources, or initiatives represented duplicate cases. This process of data cleaning led to a dataset made up of 455 initiatives. Finally, initiatives were further excluded whenever the exact duration of the offshore initiative could not be ascertained. This reduced the dataset to 301 observations.

3.2. Measurement

3.2.1. Dependent variable

The unit of analysis was the single back-shoring initiative. The time elapsed between offshoring and the implementation of back-shoring (Time-to-back-shoring) (Ancarani et al., 2015) was used as the dependent variable.

3.2.2. Independent variables

To build independent variables relating to innovation in the host country, firms' patents were collected, alongside related bibliographic information, from the Questel Orbit Intelligence database (Orbit, hereafter) (https://www.questel.com/ip-intelligence-software/orbit-intelligence/). Using bibliographic information such as the application year and the country of residence of inventors, two members of the research team counted the number of patents filed during the offshore period that included a host-country inventor as part of the inventing team, which represents the main independent variable (IHCI). Indeed, the application year is a common reference period to assess when the invention underlying a patent has been developed. The country of residence of an inventor has often been used as a proxy for the location(s) where the invention has been created (Abramovsky et al. 2017; Agrawal et al. 2006).

To test H2a, the number of exploratory patents developed during the offshore period that include at least one host-country inventor as part of the inventing team was calculated (IHCI Exploratory). A patent is considered exploratory if it is assigned to a 4-digit IPC code that is not assigned to any of the patents developed by the same firm in the previous 5 years (Gilsing, Nooteboom, Vanhaverbeke, Duysters, & Van Den Oord, 2008; Guan & Liu, 2016; Ceipek, Hautz, De Massis, Matzler, & Ardito, 2021). Finally, to test H2b, we measured the degree to which a firm develops a repertoire of innovations that is wide in scope. To this end, we used patents developed during the offshoring period that include at least one host-country inventor as part of the inventing team (IHCI Scope) and computed a Herfindahl index as follows:

$$IHCI\ Scope = 1 - \sum_{i=1} \left(\frac{X_{iF}}{\sum_{i} X_{iF}}\right)^2,$$

where X_{iF} indicates the number of patents developed during the offshore period that include at least one host-country inventor as part of the inventing team, assigned to firm F in the technological field i (i.e., 4-digit IPC code). This index has been often used to measure technological diversification (Ardito, Natalicchio, Messeni Petruzzelli, & Garavelli, 2018; Lin & Chang, 2015; Qiu and Cantwell, 2018). The higher the value of the index, the wider the scope of the innovation portfolio.

3.2.3. Control variables

Several variables were computed to control for innovation activities performed by the foreign firm. First, the overall knowledge stock of a firm was proxied by counting the number of patents developed during the offshore period (Patent during Offshoring). The number of patents developed with host-country inventors prior to offshoring (IHCI prior Offshoring) was included to assess previous knowledge sourcing activities in the host country.

The effect of firm size on duration was controlled by checking whether the firm was an SME through a dummy variable. Various measures of distance between the home and the host country (Cultural Distance, Geographical Distance, Linguistic Distance) were calculated, under the assumption that the greater the distance the higher the likelihood of early termination of offshoring. A dummy variable equal to one if the foreign firm offshored to an Asian country was initially included and then discarded, as it was highly correlated with geographical distance (correlation value greater than 0.70).

Since IHCI as part of a FDI may have different modalities with respect to innovation within a subcontracting relationship, the entry mode in the host country (whether in insourcing mode with own plants or through outsourcing) was controlled for (Offshore Entry Mode). Additionally, entry in insourcing mode captures the effect of irreversible investments that the foreign firm may have undertaken in the host country as part of the offshore initiative. The insourcing mode, by engendering higher irreversibility, is expected to lead to longer duration (Dixit, 1992; Song, 2022).

The model controlled for the impact of back-shoring motivations by adding four dummy variables that captured whether back-shoring was driven by changes in offshore costs (Total Landed Cost), whether it depended on quality issues experienced offshore (Conformance Quality), whether greater flexibility in volume and mix was expected by relocating in the home country (Production Flexibility) and whether the firm had benefited from government support at federal or state level upon returning to the US (Government Support).

Two additional dummy variables accounted for innovation-related home-country pull factors that may counteract the effect of IHCI. Specifically, we controlled if the company adopted new process technologies as a consequence of back-shoring (Process_Innov_back-shoring). To identify cases of process innovation, we searched for codes such as robotics, advanced manufacturing, automation, digitalization and Industry 4.0 in the source text. As the analysis progressed, we continuously updated and expanded these codes to accommodate emergent ones. For example, upon noticing that several back-shoring companies consistently mentioned the adoption of 3D printing technologies as a relevant component of back-shoring, we added 3D printing to our list of codes. In building a variable that accounted for product innovation (Product_Innov_back-shoring), our aim was twofold, as we wanted to understand the relevance of product innovation as a success factor for the company's competitiveness, as well as its importance for the back-shoring decision (Ancarani et al., 2019). In this direction, we searched the text for phrases such as new product development, product redesign, product upgrading, in association with other terms such as growth, customer satisfaction, turnover, profitability, excellence. Two members of the research team carried out content analysis independently (Kolbe & Burnett, 1991) and a third researcher was involved in case of discordant interpretations until agreement was reached. Finally, industry dummies were added to the model. Table 1 details the description of the variables used in the models.

3.3. Model specification

An event history analysis (Allison, 2014) was conducted given the nature of the dependent variable. Particularly, let T be the time to back-shoring (i.e., the failure time), and X be the vector of covariates. A Cox model was adopted to make inferences about the effect of X on the time to back-shoring. The model estimates the hazard rate, i.e., the likelihood that an offshoring initiative terminates at time t, given that it has not terminated before t (Allison, 2014). The Cox model also offers the advantage of being semi-parametric, i.e., it does not require the specification of the distribution of the time-to-event random variable underlying the hazard function. A central assumption of the Cox model is proportionality (Cox, 1972; Fine & Gray, 1999), i.e., the hazard for any observation is a fixed proportion of the hazard for any other observation in the sample. To ensure that the assumption of proportionality is respected, we ran a global test of the proportional hazards model based on the Schoenfeld residuals (Allison, 2014) with regard to the two different Cox models we ran: a first model to test H1 and a second model to test H2a and H2b. The test was not statistically significant ($p > .10$) for both models, hence confirming the suitability of the Cox model.

When testing H1, the main independent variable (i.e., IHCI) is not a random choice, since it may assume a value of zero either because the offshoring firm has not involved host-country inventors in its innovation activities or because no patents have been filed during the offshore period. To address the potential sample selection bias, we relied on Heckman selection model (Heckman, 1979), computing the Inverse Mills Ratio (IMR1). A probit model (the selection model) was run on the 301 offshore initiatives to estimate the probability that each firm was involved in patenting during the offshore stay. In other words, the dependent variable was a binary variable taking value one if the offshoring firm has patented during the offshoring period, zero otherwise. The control variables were used as regressors, except for the number of patents during the offshoring period (Patent during Offshoring), which

has value different from zero only if the offshoring firm has patented during such period. The number of patents filed by the offshoring firm prior to the offshore initiative (Patent prior Offshoring) was adopted as the instrumental variable and therefore not included in the final model. The rationale underlying the choice of the instrumental variable is that firms having patented before the offshore initiative are more likely to patent during the offshore initiative. The probit model confirms this assumption ($p < .001$). After running the selection model, we calculated the IMR1 by dividing the normal density of the probability that the offshoring firm has patented during the offshore period by the standard cumulative normal distribution for such probability. The IMR1 thus obtained was included as a control variable for H1 testing.

When testing H2a and H2b, the relevant independent variables are "IHCI Exploratory" and "IHCI Scope", respectively. These variables may assume a value of zero either because no patents that include a host-country inventor as a part of the inventing team have been filed during the offshoring period (IHCI = 0) or because IHCI has not led to exploratory innovations or an innovation portfolio with broader scope. Similar to H1, we relied on Heckman selection model (Heckman, 1979) to address these potential sample selection biases, computing a second Inverse Mills Ratio (IMR2). A probit model (selection model) was run on the 301 offshore initiatives to estimate the probability that each firm engaged in IHCI, i.e., the dependent variable was a binary variable taking value one if IHCI is greater than zero, zero otherwise. The control variables were used as regressors and "Patent during Offshoring" was adopted as the instrumental variable and therefore not included in the (second) final model. The rationale underlying the choice of the instrumental variable is that firms having patented during the offshore initiative are more likely to engage in IHCI during the offshore initiative. The probit model confirms this assumption ($p < .05$). After running the selection model, we calculated the IMR2 by dividing the normal density of the probability that the offshoring firm has engaged in IHCI by the standard cumulative normal distribution for such probability. The IMR2 was included as a control variable for hypothesis testing. Instrumental variables are listed and described in Table 1.

Finally, robust firm-clustered standard errors were adopted to account for potential correlation among back-shoring initiatives by the same firm (Wooldridge, 2002) and to tackle firm-level heteroscedasticity (Baum, Nichols, & Schaffer, 2010; Jiang, Cannella, Xia, & Semadeni, 2017).

Table 1
Model variables.

Variable name	Description
Time-to-back-shoring (dependent variable)	Time elapsed between offshoring and the implementation of back-shoring (Ancarani et al., 2015)
IHCI (independent variable)	Number of patents developed with a host inventor during the offshoring period
IHCI Exploratory (independent variable)	Number of exploratory patents developed with a host inventor during the offshoring period (Gilsing et al., 2008)
IHCI Scope (independent variable)	Herfindahl index measuring the technological diversification of patents developed with a host inventor during the offshoring period
SME (control variable)	Binary variable equal to one if the firm is a SME (<500 employees) (Ancarani et al., 2015)
IHCI prior Offshoring (control variable)	Number of patents developed with a host inventor prior to the offshoring period
Patent during Offshoring (control variable and instrumental variable)	Number of patents developed during the offshoring period
Patent prior Offshoring (instrumental variable)	Number of patents developed prior the offshoring period
Offshore Entry Mode (control variable)	Binary variable equal to 1 if the firm operated offshore with own plants, 0 if in outsourcing mode (Ancarani et al., 2015)
Product_Innov_back-shoring (control variable)	Binary variable equal to 1 if product innovation is recognized as key determinant of competitive advantage and is relevant for back-shoring (Ancarani et al., 2019)
Process_Innov_back-shoring (control variable)	Binary variable equal to one if the company has invested in automation, digitalization, 3DP and other new manufacturing technologies in connection with back-shoring (Ancarani et al., 2019)
Conformance Quality (control variable)	Binary variable equal to one if back-shoring is motivated by a reduction in the rate of defective products
Government Support (control variable)	Binary variable equal to one if back-shoring is motivated by the home-country government support to relocate domestically
Total Landed Costs (control variable)	Binary variable equal to one if back-shoring is motivated by the increase in the total landed costs from producing/sourcing offshore
Production Flexibility (control variable)	Binary variable equal to one if back-shoring is motivated by the need to increase volume and mix flexibility
Geo Distance (control variable)	Distance, in Kilometers, between host country and US state of back-shoring
Linguistic Distance (control variable)	Index of difficulty of learning a foreign language for US speakers (adapted fromChiswick and Miller, 2005)
Cultural Distance (control variable)	Kogut & Singh's (1988) cultural index, based on the distance of each cultural dimensions defined in the Hofstede's 6-D model of national culture (power distance, uncertainty avoidance, masculinity/femininity, individualism, long term orientation, and indulgence) between the host country and the US
Clothing_Textile_Footwear (omitted category) Electronics Machinery_Mechanical Automotive Other Sectors (control variables)	Industry dummies (Ancarani et al., 2015)

4. Results

Table 2 shows descriptive statistics, pairwise correlations, and Variance Inflation Factors (VIFs). Correlation values are all below the 0.70 threshold (Cohen, Cohen, West, & Aiken, 2013), while VIFs are well below the value of 5. Hence, multi-collinearity is unlikely to be of concern.

Table 3 shows the results concerning the test of H1. The first column of each model reports hazard ratios (HRs), which inform about the proportional change in the hazard rate from a one-unit increase in the independent variable (Allison, 2014). This information is complemented by standard errors (in brackets). Z-scores calculated with robust-clustered errors are shown in the second column of each model, alongside the p-value (in brackets). Z-scores indicate the direction of each hazard ratio, with a positive (negative) z-score indicating that a regressor increases (decreases) the likelihood that back-shoring occurs earlier (later). Thus, a negative z-score implies a longer offshore duration.

Model 1 includes control variables only. The HR of back-shoring is positive for offshore initiatives undertaken by SMEs (HR=1.754, $z = 3.600$, $p < .001$), when "Conformance Quality" (HR=1.463, $z = 2.260$, $p < .05$) and "Production Flexibility" (HR=1.484, $z = 2.610$, $p < .01$) are relevant back-shoring motivations, and for initiatives that exhibit higher geographical (HR=1.080, $z = 3.080$, $p < .01$) and linguistic distance (HR=1.535, $z = 3.110$, $p < .01$). Specifically, results indicate that "SME", "Conformance Quality" and "Production Flexibility" are associated with a 75.4 %, 46.3 %, and 48.4 % increase, respectively, in the hazard rate of back-shoring. Likewise, increasing geographical distance and linguistic distance by one unit is associated with an 8 % and 53.5 % increase, respectively, in the hazard rate of back-shoring.

In Model 2, the independent variable "IHCI" is added. The HR for "IHCI" is 0.992 ($z = --4.470$, $p = <.001$), indicating that offshore duration tends to increase with "IHCI", hence supporting H1. A one-unit increase in "IHCI" is associated with a 1 % reduction in the hazard rate of back-shoring.

Table 2
Descriptive statistics and pairwise correlations.

	1	2	3	4	5	6	7	8	9
1-Time-to-back-shoring	1								
2-IHCI	.199*	1							
3-IHCI Scope	.246*	.530*	1						
4-IHCI Exploratory	.084	.539*	.397*	1					
5-SME	−.321*	−.175*	−.384*	−.134*	1				
6-IHCI prior Offshoring	−.014	.282*	.463*	.102	−.151*	1			
7-Patent during Offshoring	.240*	.251*	.656*	.147*	−.306*	.104	1		
8-Offshore Entry Mode	.269*	.150*	.288*	.126*	−.331*	.107	.222*	1	
9-Product_Innov_back-shoring	.007	0.000	−.032	.112*	−.041	−.051	−.045	−.004	1
10-Process_Innov_back-shoring	−.008	−.020	.082	.063	.023	−.023	.088	−.009	.239*
11-Conformance Quality	−.177*	−.050	.004	−.059	.112	−.001	.057	−.169*	−.028
12-Government Support	.105	−.040	−.057	−.016	−.060	−.033	−.046	.278*	.106
13-Total Landed Costs	−.066	−.060	−.102	−.049	.054	−.054	−.105	.009	.094
14-Production Flexibility	−.103	−.044	−.061	−.017	.107	−.037	−.087	−.107	.051
15-Geo Distance	−.416*	−.069	−.397*	−.040	.261*	−.075	−.397*	−.343*	.056
16-Linguistic Distance	−.227*	−.035	.213*	−.010	−.049	.079	.276*	.040	.028
17-Cultural Distance	−.382*	−.071	−.274*	−.036	.276*	−.118*	−.219*	−.217*	.099
18-Other Sectors	.057	−.062	−.143*	−.050	.006	−.066	−.157*	−.004	−.017
19-Electronics	−.089	.023	−.008	.104	−.002	.057	−.038	−.014	.047
20-Machinery_Mechanical	−.046	.143*	.053	.038	.051	.056	−.066	.072	−.055
21-Automotive	.122*	−.018	.293*	−.031	−.078	.032	.452*	.130*	.043
Mean	12.091	2.065	.0669	.477	.598	.241	669.931	.457	.137
Std. Dev.	13.261	14.191	.205	4.141	.491	1.909	2666.493	.499	.344
Min.	0	0	0	0	0	0	0	0	0
Max.	104	217	.959	69	1	25	16630	1	1
VIF – H1testing	-	1.29	-	-	2.11	1.19	1.83	1.40	1.12
VIF – H2a and H2b testing	-	-	1.33	2.82	4.09	1.41	-	3.20	1.16

	10	11	12	13	14	15	16	17	18	19	20	21
10-Process_Innov_back-shoring	1											
11-Conformance Quality	.071	1										
12-Government Support	−.012	−.169*	1									
13-Total Landed Costs	.199*	−.072	.033	1								
14-Production Flexibility	.080	−.104	.001	.032	1							
15-Geo Distance	−.052	.062	−.106	.082	.003	1						
16-Linguistic Distance	.119*	−.019	−.056	.131*	−.004	−.191*	1					
17-Cultural Distance	.0240	.052	−.092	0.000	.092	.459*	.194*	1				
18-Other Sectors	−.125*	−.080	−.043	−.127*	−.046	.017	−.158*	−.010	1			
19-Electronics	.029	.181*	.056	.097	−.012	.053	.004	.070	−.371*	1		
20-Machinery_Mechanical	−.002	.031	−.001	.006	−.041	.043	.015	−.006	−.336*	−.185*	1	
21-Automotive	.151*	−.018	.067	.023	−.028	−.258*	.188*	−.156*	−.318*	−.176*	−.159*	1
Mean	.297	.218	.183	.153	.124	9.985	1.577	3.298	.401	.169	.143	.130
Std. Dev.	.457	.414	.387	.361	.330	3.247	.510	1.033	.491	.376	.351	.337
Min.	0	0	0	0	0	1.007	0	.019	0	0	0	0
Max.	1	1	1	1	1	16.225	2.75	5.061	1	1	1	1
VIF – H1testing	1.16	1.22	1.17	1.14	1.08	1.69	1.40	1.56	2.74	1.92	1.93	2.67
VIF – H2a and H2b testing	1.17	1.27	1.17	3.22	1.48	2.52	1.40	1.57	2.32	2.40	3.17	3.04

*$p < .05$

Table 3
Results – H1 testing.

	Model 1 Hazard ratio (s.e.)	Z-score (p-value)	Model 2 Hazard ratio (s.e.)	Z-score (p-value)
IMR1	.786	−1.810	.715	−2.470
	(.105)	(.070)	(.097)	(.014)
IHCI			.992	−4.470
			(.002)	(.000)
SME	1.754	3.600	1.828	3.840
	(.274)	(.000)	(.288)	(.000)
IHCI prior Offshoring	1.020	.700	1.032	1.140
	(.029)	(.485)	(.029)	(.253)
Patent during Offshoring	1.000	−1.630	1.000	−.870
	(.000)	(.103)	(.000)	(.385)
Offshore Entry Mode	.866	−1.170	.883	−1.010
	(.106)	(.241)	(.109)	(.312)
Product_Innov_back-shoring	.812	−1.400	.830	−1.250
	(.121)	(.162)	(.124)	(.212)
Process_Innov_back-shoring	.940	−.500	.932	−.570
	(.116)	(.617)	(.115)	(.568)
Conformance Quality	1.463	2.260	1.395	1.970
	(.247)	(.024)	(.236)	(.049)
Government Support	.916	−.520	.910	−.560
	(.155)	(.604)	(.154)	(.576)
Total Landed Costs	1.029	.180	1.026	.170
	(.159)	(.855)	(.158)	(.866)
Production Flexibility	1.484	2.610	1.456	2.450
	(.224)	(.009)	(.223)	(.014)
Geo Distance	1.080	3.080	1.088	3.330
	(.027)	(.002)	(.028)	(.001)
Linguistic Distance	1.535	3.110	1.498	2.940
	(.212)	(.002)	(.206)	(.003)
Cultural Distance	1.042	.590	1.048	.680
	(.074)	(.557)	(.073)	(.499)
Other Sectors	.936	−.320	.896	−.530
	(.195)	(.750)	(.185)	(.594)
Electronics	1.242	.930	1.231	.900
	(.291)	(.353)	(.286)	(.370)
Machinery_Mechanical	.905	−.410	.942	−.250
	(.221)	(.682)	(.229)	(.804)
Automotive	.697	−1.110	.605	−1.510
	(.227)	(.268)	(.202)	(.132)
Wald chi2	123.640		214.780	
Log pseudolikelihood	−1389.131		−1387.323	

Note: Wald chi2 is statistically significant in all models at $p < .001$.

Table 4
Results – H2a and H2b testing.

	Model 1		Model 2		Model 3	
	Hazard ratio (s.e.)	Z-score (p-value)	Hazard ratio (s.e.)	Z-score (p-value)	Hazard ratio (s.e.)	Z-score (p-value)
IMR2	.778	−1.73	.650	−3.110	.650	−3.100
	(.113)	(.083)	(.090)	(.002)	(.090)	(.002)
IHCI Exploratory	.985	−1.220			.999	−.100
	(.012)	(.224)			(.008)	(.917)
IHCI Scope			.429	−2.490	.433	−2.130
			(.146)	(.013)	(.17)	(.033)
SME	2.001	3.660	2.265	4.590	2.264	4.580
	(.379)	(.000)	(.403)	(.000)	(.404)	(.000)
IHCI prior Offshoring	1.022	.820	1.043	1.550	1.042	1.500
	(.027)	(.415)	(.028)	(.122)	(.029)	(.132)
Offshore Entry Mode	.725	−2.130	.659	−2.860	.660	−2.840
	(.109)	(.033)	(.096)	(.004)	(.097)	(.004)
Product_Innov_back-shoring	.829	−1.250	.786	−1.620	.787	−1.580
	(.124)	(.210)	(.117)	(.104)	(.12)	(.115)
Process_Innov_back-shoring	.959	−.340	.971	−.240	.971	−.230
	(.119)	(.736)	(.123)	(.813)	(.123)	(.815)
Conformance Quality	1.552	2.620	1.640	2.940	1.639	2.890
	(.260)	(.009)	(.276)	(.003)	(.280)	(.004)
Government Support	1.028	.180	1.010	.070	1.009	.060
	(.154)	(.853)	(.148)	(.947)	(.147)	(.950)
Total Landed Costs	1.151	.630	1.312	1.290	1.312	1.280
	(.256)	(.529)	(.276)	(.196)	(.277)	(.199)
Production Flexibility	1.309	1.510	1.179	.900	1.179	.900
	(.233)	(.130)	(.216)	(.368)	(.216)	(.369)
Geo Distance	1.105	3.530	1.112	3.840	1.112	3.840
	(.031)	(.000)	(.031)	(.000)	(.031)	(.000)
Linguistic Distance	1.469	2.970	1.536	3.260	1.536	3.250
	(.190)	(.003)	(.203)	(.001)	(.203)	(.001)
Cultural Distance	1.053	.730	1.051	.700	1.051	.700
	(.074)	(.463)	(.074)	(.483)	(.075)	(.483)
Other Sectors	1.078	.380	1.101	.480	1.100	.480
	(.213)	(.702)	(.218)	(.629)	(.218)	(0629)
Electronics	1.169	.650	1.088	.350	1.089	.350
	(.282)	(.518)	(.218)	(.728)	(.265)	(.727)
Machinery_Mechanical	.794	−.870	.700	−1.330	0.701	−1.320
	(.210)	(.384)	(.188)	(.184)	(.188)	(.186)
Automotive	.595	−1.560	.564	−1.750	.564	−1.740
	(.198)	(.119)	(.184)	(.080)	(.186)	(.082)
Wald chi2	104.750		120.330		124.560	
Log pseudolikelihood	−1389.668		−1388.061		−1388.060	

Note: Wald chi2 is statistically significant in all models at $p < .001$.

Results reported in Table 4 allow testing H2a and H2b. Model 1 includes "IHCI Exploratory", alongside control variables. The HR for "IHCI Exploratory" is 0.985 ($z = --1.220$), which is in the direction expected by H2a, even if it is not statistically significant ($p > .10$), thus leading to reject H2a. Model 2 includes "IHCI Scope", alongside control variables. The HR for "IHCI Scope" is 0.429 ($z = --2.490$, $p < .05$), thus confirming H2b. Specifically, one unit increase in "IHCI Scope" prolongs the stay in the host country by 57.1 %. Model 3 includes both variables and confirms findings from previous models.

The robustness of the results was checked by using robust standard errors and several parametric models (generalized Gamma, Weibull, lognormal, loglogistic).

5. Discussion

This paper has delved into the role that IHCI plays in explaining the duration of offshore initiatives prior to the decision to back-shore. The study has been carried out by examining a sample of back-shoring initiatives to the US from diverse manufacturing industries with heterogeneous duration of stay in the host-country. Building on the contention that IHCI facilitates offshore knowledge sourcing and accumulation (Castellani et al., 2022; Song et al., 2011), the study has shown that IHCI leads to longer offshoring duration and has highlighted the importance of engaging in IHCI that leads to the development of a wider innovation portfolio.

5.1. Research implications

Results contribute to multiple streams of literature. First, findings add to the back-shoring research by providing a novel angle focused on the role of innovation. While back-shoring is typically explained by the relative waning of host-country location advantages (costs, efficiency, market) vis a vis home country sources of attractiveness (higher quality, flexibility, etc.) (Fratocchi et al., 2016; Pedroletti and Ciabuschi, 2023), results show that knowledge accumulation opportunities in the host country can partially offset the challenges that typically lead to back-shoring (Manning, 2014). Next, an emerging debate argues that new technologies foster back-shoring initiatives (Ancarani et al., 2019; Dachs et al., 2019) and that developed countries' endowment of innovation capabilities offset the cost advantages offered by offshore locations (Ketokivi et al., 2017). While our findings do not contradict this line of research, they also show that exploiting knowledge-related resources in the host-country (in our case, host-country inventors) results in a longer offshore duration. In this light, results suggest that future studies on relocation decisions should simultaneously take into account the innovation potential of the home country and of the host country and identify situations where the advantages of the former outweigh those of the latter. Our findings underscore that the involvement of host-country inventors can represent a substantial asset for the foreign firm. As such, this foregone advantage should be taken into account as a component of the opportunity costs associated with relocating back to the home

country (Gray, Helper, & Osborn, 2020).

Next, findings extend research on offshoring. Despite offshore innovation is a well-studied phenomenon (Cantwell & Piscitello, 2015), it has not yet been analyzed as a factor that affects the time dimension of offshoring. From a theoretical standpoint, findings strengthen Cantwell's theory of international knowledge accumulation (Cantwell, 1989; Cantwell and Piscitello, 2000) by demonstrating that co-innovating with local inventors contributes to foster commitment in the host-country. Specifically, results reinforce the importance of knowledge sourcing as a significant element of attractiveness of the host country and highlights IHCI as an effective mechanism to gain access to local knowledge and embeddedness in local innovation systems. Further, results expand the model of international knowledge accumulation to explain its relevance in the postponement of exit decisions from foreign countries. The determinants of offshoring duration have been pinpointed as an underdeveloped topic of the literature (Tan & Sousa, 2019) and, indeed, previous studies tackling offshore duration had focused on factors other than innovation strategies (Mata and Portugal, 2000; Puig et al., 2018). The positive impact of IHCI on offshore duration illustrates that firms value the availability of asset-augmenting possibilities in the host country, whatever the original motive that led to offshoring was.

While our results show that IHCI is less likely to trigger exit from the foreign market through back-shoring, we also provide evidence that this relationship can be better explained by delving into the types of innovation outcome resulting from IHCI. The investigation of the impact of IHCI leading to exploratory innovation and innovation portfolios with broader scope confirms the need to differentiate among innovation outcomes, as they have different influences on the timing of exit. On the one hand, we find that IHCI leading to exploratory innovation does not have a significant effect on the duration of offshoring. This result is counter-intuitive because it implies that foreign firms' willingness to remain in a host country is not affected by the possibility to develop new-to-the-firm innovative trajectories. However, this result may be explained by considering that exploratory innovation is inherently risky and focused on building long-term competitive advantage (Tushman & O'Reilly, 1996), whereas the challenges typically prompting back-shoring, whether strategic or operational, necessitate short-term solutions (Manning, 2014). Thus, decisions regarding back-shoring may be unlikely to be modified by opportunities for exploratory innovation in the host country, which executives may view as entailing a long-term commitment of resources with uncertain benefits. On the other hand, foreign firms that use IHCI to develop broader innovation portfolios exhibit longer stays in the host country. This finding may be linked to the expected positive outcomes of broad scope innovation. Specifically, literature offers evidence that firms with a broader technological focus outperform those with a more limited scope (Cantwell & Zhang, 2012), an outcome that may provide incentives to prolong the offshore stay. Next, the relation may be explained by the costs of carrying out broad scope innovation. Although multinational enterprises may have the ability to access knowledge that is geographically dispersed in their network, this process nevertheless requires coordination and effort, especially if knowledge is not only geographically dispersed but also technologically diversified (Cantwell & Zhang, 2012). A fortiori, this will be true for smaller firms or firms with limited geographical diversification. Therefore, the opportunity to develop a broad innovation portfolio in the same host country will reduce transaction costs and lead to longer offshore initiatives.

5.2. Managerial and policy implications

The findings offer managerial recommendations pertinent to decisions regarding offshoring and back-shoring. Prior to offshoring, executives and entrepreneurs of innovative firms should critically evaluate opportunities to innovate with local inventors (Tang et al., 2021), with the goal to increase their innovativeness and gain embeddedness in the local innovation networks. To this end, ex ante information on the possibility of leveraging skilled human capital available in the host country for innovation should be collected, by analyzing patents granted to host-country firms and research outputs of local institutions. Next, the development of a wider portfolio of innovations in collaboration with local inventors contributes to expand the foreign firm's technological competencies and to enhance its absorptive capacity. This entails that innovation capacities will be reinforced as firms will be better able to assimilate, process, and incorporate knowledge generated through IHCI. As a result, the broad portfolio of patents generated through IHCI favours the generation of new re-combinations and the development of new products.

With respect to back-shoring, many practitioner-oriented tools to support location decisions propose ad hoc Total Cost of Ownership (TCO) calculators (Reshoring Initiative, 2020). By recommending that offshore innovation opportunities be weighed against the innovation advantages offered by the home country, results lend support to the transition from TCO to Total Value Contribution (TVC) (Gray et al., 2020) models. In fact, TVC advocates the calculation of the value of future options in location and sourcing decisions, thus encompassing the incorporation of innovation capabilities and of firm's capacity for future growth.

From a policy perspective, results offer insights to policymakers of the countries that represent offshoring destinations, as well as policymakers of countries that are interested in supporting back-shoring. The former are eager to have foreign firms continuing to invest in their countries, while the latter have to handle mounting fears of dependency and rising global disruptions (Ghauri et al., 2021). Our results suggest that host countries that succeed in creating an institutional environment where foreign firms are encouraged to innovate with local inventors will enjoy longer lasting foreign ventures. Stated differently, supporting IHCI could be an additional mean through which host-countries can incentivize foreign firms to stay. More specifically, results suggest that foreign firms should be supported in leveraging local inventors' knowledge in ways that can help them expand the scope of innovation outcomes. For example, host-country governments could establish multidisciplinary national organizations or inventor networks designed to foster relationships with foreign firms operating locally.

For policymakers in developed countries, our results suggest that policies aimed at bringing businesses back should carefully consider sources of attractiveness related to innovation (Pisano & Shih, 2012) to offset the advantages offered by offshore locations (Pegoraro et al., 2022). Specifically, governments should focus less on reducing production costs through tax incentives and more on creating regional ecosystems that foster innovation (Elia et al., 2021). In this direction, when advocating the return of production to high-cost countries, governments should map the innovation needs of firms that are involved in offshore operations, to offer them suitable support in terms of innovation clusters, university spin-offs and innovation incubators (Spring, Hughes, Mason, & McCaffrey, 2017). These actions will be especially needed in industries that exhibit a decoupling between government pressures to defend national strategic interests and firms' own innovation goals and strategies (Petricevic & Teece, 2019).

6. Conclusions, limitations, and future research

In conclusion, by considering the role of IHCI, the paper adds to the comprehension of factors hindering or postponing back-shoring. However, some limitations that represent possible opportunities for future research should be acknowledged. First, the sample is limited to US-based firms that have already back-shored, thus do not allowing the generalization of the effect of IHCI to other exit strategies and other countries. Second, this study focuses on IHCI as an innovation strategy in the offshore country, while neglecting other innovation-related factors that could impact offshoring duration. Third, the study does not dig into the "type" of host-country inventor considered. Specifically, the study

does not control whether host-country inventors are employees of the foreign company or work for other companies (e.g., host-country suppliers) within the innovation ecosystem of the foreign company. Additionally, contingent factors related to innovativeness in the specific industry and in the host-country should also be considered to further complement our study. Fourth, while this study has focused on IHCI as a measure of the innovation-related attractiveness by the host-country, future studies should explore the role played by host-countries automation infrastructure. In fact, while the endowment of automation technologies of western countries is considered to act as a trigger of back-shoring, the investment in process technologies being undertaken by many emerging countries may significantly dampen or nullify the incentive to back-shore. Fifth, in light of the fact that US states exhibit substantial heterogeneity with respect to innovation capacity, state-level support policies and labour costs, by focusing on the US as the back-shoring location this study has neglected whether duration is affected by the characteristics of the specific federal state where the relocation takes place. Other more general limitations concern the identification of control variables that may significantly affect the exit decision. In this light, future studies should provide a more in-depth investigation of the impact of "distance". Additionally, the importance of financial performance should not be undervalued, as a short-term negative financial performance at project or firm level may accelerate the back-shoring decision and partially offset the long-term innovation benefits of offshoring. These limitations may represent additional lines of inquiry for the future.

Data availability

Data will be made available on request.

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