



The role of collaboration networks for innovation in immigrant-owned new technology-based firms

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Abstract

This paper answers calls for a better understanding of the importance of domestic collaboration networks for innovation in immigrant- and native-owned firms. With a specific focus on the domestic networks established with other firms, research institutions, and business associations, we question whether cultivating such social capital with diverse actors is linked to better innovation performances for immigrant-owned firms. We investigate this research question by exploiting a unique matched-pair sample of immigrant and native domestic entrepreneurs who are active in high-tech mainstream (non-ethnic) markets. Our results show that universities and research institutions, along with business associations, are more important for innovation in immigrant-owned firms. In addition, we discover that immigrant entrepreneurs' acculturation to the host country's culture acts as a substitute for interactions with business associations. These findings contribute to the academic and policy knowledge on the link between immigrant entrepreneurship and innovation in developed countries.

Keywords Immigrant entrepreneurs · New technology-based firms · Innovation · Collaboration networks · Acculturation

JEL Classification O31 (Innovation and Invention: Processes and Incentives) · J61 (Immigrant workers) · L26 (entrepreneurship)

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1 Introduction

For many years, the economic and social contribution of immigrant entrepreneurs in developed economies has been a topic of significant political debate (Economist, 2008; OECD, 2021) and scientific interest (Bolzani, 2020; Sinkovics & Reuber, 2021). A growing literature shows the positive contribution of highly skilled migrants and diasporas to economic growth, technical change, and regional innovation (Bettin et al., 2019; Lissoni, 2018; Saxenian, 2006). Nevertheless, because much innovation takes place within firms and through the actions of entrepreneurs, the academic literature on the specific contribution of immigrant entrepreneurs to innovation, while rapidly growing, is still scant and awaiting to answer several questions (Brown et al., 2020).

Addressing the link between immigrant entrepreneurship and firm-level innovation is important for clarifying the role of immigration in the innovation performance of regions and countries where migrants locate. In fact, immigrant entrepreneurs have been known to deploy a variety of strategies and firm performances in relation to innovation patterns (Engelen, 2010): from firms specializing in ethnic markets or intermediary activities (e.g., Kloosterman, 2010; Zhou, 2004) to those “breaking out” in a variety of markets and sectors, such as in technology, business services, finance and creative industries (e.g., Arrighetti et al., 2014; Smallbone et al., 2005).

In this paper, we draw on the literature on technological change and innovation, which has unequivocally established that firms’ innovation activities flow from the networks of external interactions that facilitate knowledge acquisition from a broad set of organizations (e.g., Arora & Gambardella, 1990; Cassiman & Veugelers, 2006; Frenz & Ietto-Gillies, 2009). Recent studies have shown that immigrant entrepreneurs can achieve innovative outcomes (e.g., products and services) by building on their international and transnational social capital (e.g., Terjesen & Elam, 2009). However, since the majority of immigrant entrepreneurs do not appear to internationalize (e.g., Neville et al., 2014; Portes et al., 2002; Rusinovic, 2008), scholars remain unclear on how those entrepreneurs leverage the networks of external interactions in the host country.

To date, a vast body of literature has analyzed the crucial role of family and ethnic networks in immigrants’ entrepreneurial activities (Waldinger, 1995; Zimmer & Aldrich, 1987), which can provide access to information, financial resources, contacts, a flexible labor force, supplies and customers, and knowledge on procedures, markets and technologies (e.g., Chaganti & Greene, 2002; Nee & Sanders, 2001; Portes & Sensenbrenner, 1993). This literature suggests that immigrant entrepreneurs are embedded in different networks with respect to native entrepreneurs, partly due to the *homophilous* nature of the network ties established in the host country with their co-ethnic communities (Kerr & Kerr, 2019). This literature has revealed that immigrant entrepreneurs’ social embeddedness in the host country (as opposed to their “outsiderness”) is a key determinant of successful interaction with the local opportunity structure and business performances (Kloosterman, 2010). Therefore, there is a need to consider and analyze relationships with the broader society (i.e., looking beyond co-ethnic networks) in order to correctly grasp the opportunities for immigrant entrepreneurship (Kloostermann et al., 1999).

We build on these insights to investigate the following research question: *What is the role of networking with external actors for the innovation activities of new technology-based immigrant-owned firms?* We specifically study whether the interactions with local firms, academic and research institutions, and business associations are differently related to the innovation activities of immigrant- vs. native-owned firms. In addition, we explore

how the heterogeneity of immigrant entrepreneurs, in terms of acculturation to their host country's culture (Berry, 1997), moderates the effect of external collaborative networks and innovation activities in immigrant-owned firms.

We employed regression analyses on survey data collected from a unique matched-pair sample of 71 immigrant entrepreneurs and 69 native entrepreneurs who were active in domestic technology-based firms in the Emilia-Romagna region of Italy. All firms catered to mainstream (i.e., non-ethnic) markets. Our findings show that collaborative networks with academic/research institutions and with business associations are more relevant for firms owned by immigrant (vs. native) entrepreneurs. In contrast, networks with other firms are more relevant for native entrepreneurs. Additionally, networking with business associations is less relevant for immigrant entrepreneurs who are highly assimilated into the host country's culture.

The contribution of this work is threefold: First, it adds to the academic literature on firm-level innovation by showing whether external drivers of innovation activity, such as networks, hold different relevance for immigrant and native entrepreneurs (Brown et al., 2020; Kerr & Kerr, 2019). Second, it supplements the literature on immigrant entrepreneurship by shedding light on the factors that nurture innovation performance—and by extension, the potential competitive advantage of companies active in high-tech sectors (Brown et al., 2020). Importantly, we do so by comparing immigrant-owned firms with their native counterparts in order to relate their distinctive performance to their networking efforts (Kerr & Kerr, 2019; Neville et al., 2014). Third, the study contributes to the entrepreneurship literature by studying immigrant status as a characteristic that makes entrepreneurs heterogeneous in their networking behavior (Kerr & Kerr, 2019; Klostermann et al., 1999). The findings of this work yield important implications for policies aimed at improving the performance of immigrant businesses, particularly in relation to cultivating local networks for innovation.

The rest of the paper is organized as follows: Sect. 2 discusses the literature concerned with innovation activities and immigrant entrepreneurship, and then develops our main arguments. In Sect. 3, we present the data, the variables, and the methodology employed in the empirical analysis. Section 4 shows the results, including the robustness checks. Section 5 concludes by outlining our work's theoretical, managerial, and policy implications.

2 Literature review

2.1 The role of networks of collaboration for innovation

The systems of innovation, evolutionary economics, and open innovation approaches stress the importance of interactions between internal and external factors in firms' innovation processes (e.g., Chesbrough, 2006; Edquist, 1997, 2010; Freeman, 1987; Lundvall, 1988, 1992).¹ These theoretical perspectives suggest that a large part of firms' decisions

¹ In the systems of innovation approach, innovations are not developed and implemented in isolation, but within a technological, socio-cultural, and institutional context. For an innovation system to successfully develop and exploit technologies, its three coevolving building blocks—*technology, knowledge and skills*, and *networks of actors and institutions*—must be aligned (Malerba, 2004; Woolthuis et al., 2005). According to evolutionary economics, differences in firms' performance mainly rest on idiosyncratic features that are essentially related to the creation and accumulation of knowledge, which is partly tacit and firm-specific (Hodgson, 1998; Nelson, 1991). The open innovation paradigm assumes that companies can and should exploit both internal and external ideas and paths to advance their technology and remain competitive (Chesbrough, 2006).

to innovate—and ultimately, their innovation performance—stems from entrepreneurs' professional collaboration networks. Several empirical studies have shown that innovation performance at the firm level is positively and substantially influenced by establishing links with other companies, such as clients, suppliers, and competitors (see, e.g., Arora & Gambardella, 1990; Cassiman & Veugelers, 2006; Zeng et al., 2010), as well as with scientific and technological actors, such as universities, research centers, and other knowledge-brokering organizations (see, e.g., Faems et al., 2005; Parrilli & Heras, 2016).

The interactions that firms establish and maintain within their environment offer several benefits: accessing external knowledge; gaining fast access to technologies or markets; lowering costs; improving the economies of scale in joint R&D and/or production; reducing the uncertainties associated with R&D and innovation processes (Fischer & Varga, 2002), and inducing the selective pressure that is fundamental to innovative activities (Del Río et al., 2015; Scandura, 2019). These arguments particularly apply to firms operating within industries characterized by complex and inter-sectoral processes of new technology development (Hagedoorn, 1993).

While these collaborative relationships generally produce positive outcomes, firms may sometimes lack the capacity to manage and absorb the different types of knowledge inputs accrued from their wide networks. As a result, the network may substitute for, rather than complement, their efforts to produce innovation outputs (Haus-Reve et al., 2019). This is particularly important for SMEs, which command fewer financial and human resources, count on less internal R&D, and generally face more uncertainties and barriers to innovation compared with large companies. As a result, they must rely more on networks with diverse external actors to support their innovation efforts (e.g., European Commission, 2017; Usman et al., 2018).

Previous studies have suggested some stylized facts concerning the impact of collaborating with different external partners on firms' innovation performance. For instance, collaboration with other firms and academic institutions has been shown to positively affect the likelihood of pursuing product and process innovations (Nieto & Santamaría, 2010), as well as the sales growth of innovative products (Belderbos et al., 2004). Such collaborations, especially with suppliers and clients, can help firms accrue information about technologies, tailor-made solutions, users' and customers' needs, and markets (Faems et al., 2005; Miotti & Sachwald, 2003). Similarly, cooperative networks established with intermediary institutions lead to better innovative performance, thanks to the provision of technology information (Zeng et al., 2010) or direct/indirect support for network development and collaboration for innovation (Lee et al., 2010).

The accumulated evidence suggests that establishing and maintaining network relationships is fundamental for firms' activities, including innovation performance. In this work, we qualify these empirical findings to explore whether the relationships with those actors will be more important for the innovation activities of immigrant-owned companies than for their native counterparts, as we argue in the following sections.

2.2 Embeddedness and networking in immigrant-owned firms

To date, scholars recognize that immigrants' domestic entrepreneurship encompasses highly diversified strategies and performances, typically flowing from entrepreneurs' human capital and the available market opportunity structures (Kloosterman, 2010; Ram et al., 2013). For example, many immigrant-owned firms are established to meet the needs of a specific ethnic community (supplying the so-called “ethnic” products or services) and

thus exploit opportunities in the “enclave economy” (for a review, Zhou, 2004). These firms draw on entrepreneurs’ trusted network relationships within the ethnic community (e.g., Chaganti & Greene, 2002), which supply flexible and informal access to information, markets, and resources (e.g., Masurel et al., 2002; Portes & Sensenbrenner, 1993). Other companies are active in expanding or abandoned mainstream market niches; in low-skilled, post-industrial sectors (e.g., housecleaning, personal care, postal and parcel delivery services, Kloosterman, 2010); or in “post-industrial/high-skilled” sectors (e.g., technical, financial, legal/administrative advisory services, creative and high-tech industries) (Barrett et al., 2002; Engelen, 2001; Ram & Hillin, 1994). By entering domestic mainstream markets, immigrant entrepreneurs compete with native business owners and cannot rely as heavily on their family and co-ethnic community to sustain their competitive advantage (Arrighetti et al., 2014; Barrett et al., 2002). In such cases, immigrant entrepreneurs need to build relationships with business owners of other ethnicities, formal institutions representing economic interests, or professional counselors (Amin, 1995; Engelen, 2002). In short, they must build a bridging social capital with indigenous actors rather than bonding social capital within the co-ethnic community (e.g., Canello, 2016; Light & Dana, 2013).

The previous literature has documented that immigrant entrepreneurs—especially those born abroad and who have been socialized in their home countries in terms of education and professional experience—are endowed with different network connections in the host country compared to a typical native entrepreneur (Kerr & Kerr, 2019). For instance, some studies have shown that immigrant-owned firms feature smaller networks of local advisors, mentors, and partners (Rajjman & Tienda, 2000), as well as limited participation in formal consultancy networks (e.g., retail groups or trade associations), in comparison with native-owned businesses (Kloosterman, 2000; Sahin et al., 2011). Other studies have shed light on the risks faced by immigrant entrepreneurs of being marginalized and exposed to power imbalances along the supply chain (e.g., Canello, 2016; Ram et al., 2011). As suggested by other scholars (e.g., Kerr & Kerr, 2019), the processes of networking in the host country for immigrant entrepreneurs can be explained by the phenomenon of homophily (i.e., individuals’ propensity to associate with similar others) (McPherson et al., 2001), alongside factors related to one’s knowledge of the local environment (such as linguistic embeddedness), awareness of business norms and legislation, and cultural differences between immigrant and native entrepreneurs (Heilbrunn & Kushnirovich, 2007; Ivanova-Gongne et al., 2021).

To summarize, the “outsiderness” of immigrant-owned businesses with respect to the domestic environment is considered a significant impairment for them compared to native-owned businesses, especially in high-tech sectors (e.g., Bolzani & Mizzau, 2020; Kerr & Kerr, 2019). Not surprisingly, entrepreneurial support programs for immigrant entrepreneurs heavily invest in providing them with networking opportunities with local companies, research centers, and other actors of potential relevance (e.g., Rath & Swagerman, 2016; Solano et al., 2019). In this paper, we maintain that immigrant entrepreneurs, due to their different backgrounds, framed by some authors with labels such as “liability of ethnicity” (Jiang et al., 2016) or “migrant condition” (Hormiga & Bolívar-Cruz, 2014), could benefit to a greater extent from local networks of collaboration, compared to natives because they have more to learn from such domestic collaborations about the functioning of the local markets, scientific developments, and institutions.

One caveat of our argument is that immigrant entrepreneurs operating in post-industrial/high-skill markets might be heterogeneous in terms of their level of acculturation to their host country (Berry, 1997). Acculturation has been defined as “those phenomena which result when groups of individuals having different cultures come into continuous first-hand

contact with subsequent changes in the original culture patterns of either or both groups” (Redfield et al., 1936, p. 149). While the term acculturation can be used to neutrally account for changes in one or both groups, it mainly refers to the immigrant group in practice (Berry, 1990). In this study, we adopt this view and refer to an individual-level concept of acculturation (i.e., psychological acculturation) that has been shown to drive individual behavior (Berry, 1997). Acculturation can impact immigrant entrepreneurs’ preference for maintaining ethnic bonding networks vs. non-ethnic bridging networks, which will then shape their entrepreneurial decision-making and innovation activities (Dheer & Lenartowicz, 2018). In simple terms, we maintain that higher levels of acculturation will enable immigrant entrepreneurs to understand the local environment and internalize native habits and attitudes on a variety of topics. In other words, we argue that acculturation to the host country’s culture can substitute for some interactions with external actors (such as other firms, research and university institutions, and business associations). Formally phrased, acculturation should exert a negative moderating effect on the impact of external networks on firm innovation.

2.3 Networks of collaboration and innovation in immigrant-owned firms

As noted above, we contend that immigrant-owned firms’ innovation activities will likely benefit more (vs. native-owned firms) from interactions with other local actors in the host country. The literature suggests that firms involved in bridging networks with a diverse range of external actors might benefit from new or complementary information and practices that are conducive to firm innovation, differently from bonding networks which can potentially limit the amount of knowledge and novel information that are needed in innovation processes (e.g., Luo & Deng, 2009). We thus propose that for immigrant entrepreneurs, establishing relationships with local actors entails acquiring advice and knowledge that complement the resources from family or co-ethnic networks: for instance, about venture financing, customers and markets, technologies and scientific capabilities. Building on these insights, we explore the different network role played by three types of actors—*other firms, universities and research centers*, and *business associations*—for both immigrant- and native-owned firms.

Collaborative networks with local firms can make two positive contributions to innovation in immigrant-owned firms: First, they bring cognitive diversity and complementary knowledge about local customers’ needs, expectations and experiences in using products and services, about suppliers’ technological and operational competences and preferences, and about industry norms and codes of conduct (e.g., Kerr & Kerr, 2019; Luo & Deng, 2009). Second, firm collaboration—especially with those located downstream and upstream in the value chain—reduces marginalization and exploitation risks for immigrant-owned firms (e.g., Canello, 2016; Ram et al., 2011).

Firms often turn to academic and research institutions to support their innovative activities, even if these collaborations are typically more explorative and not necessarily tied to a commercial application (Haus-Reve et al., 2019). However, there is scant empirical evidence about the impact of immigrant entrepreneurs’ interactions with academic and research institutions. Given that gap, we wish to test whether such interactions positively relate to the probability of more innovation for immigrant versus native entrepreneurs. We have several reasons for this belief: Firstly, academic and research institutions could represent supportive environments for immigrant entrepreneurs operating in high-tech domains. Indeed, the possession of a common technical background could help overcome

the barriers arising from different cultural and institutional norms (Dasgupta & David, 1994; Mora Valentin, 2000) Secondly, establishing networks with universities and research centers may allow immigrant firms to bolster their reputation in the eyes of other actors in the entrepreneurial ecosystem (Dooley & Kirk, 2007). Lastly, universities may expose immigrant firms to culturally diverse, highly skilled personnel (e.g., local or international students and graduates) who can enrich the firm's available knowledge about cutting-edge local research (Scandura, 2016).

Finally, the academic literature shows that business associations can help sustain firms' innovation activities (Lee et al., 2010; Zeng et al., 2010) in the following ways: providing access to specialized information (e.g., laws and regulations on intellectual property rights, funding and programmes to support technological development); offering consulting services to strengthen and protect property rights; supporting the facilitation of vertical and horizontal coordination, and enhancing worker training (Doner & Schneider, 2000). Business associations typically offer their specialized competences and knowledge in their immediate territory (Dalziel, 2006), helping to create ties between their members, increase access to resources through network brokerage, and facilitate joint action through network closure.² Therefore, in light of our previous considerations, business associations may have a stronger role in acting as intermediary bodies for immigrant entrepreneurs with respect to native entrepreneurs, regarding several dimensions of business activities (e.g., consultancy on fiscal and regulatory aspects, human resource management, commercial development), including those that relate to innovation (e.g., new product development, intellectual property rights management, connection to innovation networks) (OECD, 2011). Their role might be particularly important in light of extant research showing that public policy support measures to immigrant-owned firms can be problematic for various reasons, including policymakers' inability to meet the needs of immigrant businesses and a lack of coordination with mainstream business policies (e.g., Crick et al., 2001; Ram et al., 2017).

3 Data, variables and methods

3.1 Sample

This study is based on primary data collected from entrepreneurs running new technology-based firms (NTBFs) (Colombo et al., 2004) located in the Emilia-Romagna region (Northern Italy).³ Immigrant entrepreneurs in Western countries are increasingly establishing activities in high-tech domains (e.g., De Lange, 2018; Hart & Acs, 2011). Because these companies compete to gain market share in mainstream, high-growth markets, they represent a suitable context for studying the role of collaboration networks for innovation. The Italian context is especially interesting in this regard: Around 13.1% of foreign-born individuals in 2018 were self-employed (OECD, 2021), of which around 40,000 were

² Empirical evidence on successful biotechnology clusters (Cambridge, US and Cambridge, UK) shows that they have exceptionally well-developed associations that manage collective affairs, lobby the government, organize common purchasing and handle other services for their member firms, such as promotion, educational placement, and careers development (Cooke, 2002).

³ NTBFs are defined with reference to the OECD definition of 'technology intensive' industries according to their average R&D intensity. NTBFs can belong to 'High-Tech' (R&D intensity above 8.5%) or 'Medium-Tech' (R&D intensity between 3.5% and 8.5%) industries (Almus & Nerlinger, 1999).

operating in the study's focal region (Emilia Romagna); this is equal to 17% of local entrepreneurs (CENSIS, 2018). While most of their activities are concentrated in services (notably trade and construction), they also operate in high-tech sectors such as ICT (OECD, 2014).

Following previous studies that compared immigrant and native entrepreneurs in NTBFs (e.g., Chaganti et al., 2008), we employed a matched-pair design in order to analyse different outcomes among similar participants. Matched-pair samples should be matched based on variables that have a strong correlation with the dependent variable so as to control for extraneous variables and reduce the error term (Kerlinger & Lee, 2000). We conducted the sampling and data collection in two steps: The first involved selecting NTBFs owned and managed by foreign-born entrepreneurs from the official business register of the Italian Chamber of Commerce (Unioncamere) (summary in Appendix, Table 7). The sample included independent, active, contactable firms, operating in the domestic market, owned and actively managed by at least one foreign-born entrepreneur ($n=71$; response rate=50.7%). After interviewing foreign-born entrepreneurs, in the second step of data collection, we matched these 71 firms with firms owned and managed by Italian-born entrepreneurs. The methodological literature recommends matched-pair samples to be selected so as to allow comparability on a range of firm characteristics (Kerlinger & Lee, 2000). Accordingly, we matched on the product/service produced, firms' industry, and the age of the firm and the entrepreneur (e.g., Chaganti et al., 2008) by utilizing data from Unioncamere and interviews. We removed two immigrant-owned companies that carried out very specific activities that could not be matched with any Italian-owned companies. Thus, we interviewed 69 Italian owner-managers in 69 firms.

The full sample included 140 entrepreneurs and firms. To collect the data, we conducted face-to-face interviews with each entrepreneur on their company's premises. Questions were based on an Italian-language questionnaire aimed at collecting a wide range of information about the entrepreneurs and their firms. Given that the questionnaire deals with self-reported measures, we designed it with care to reduce potential sources of common method bias (e.g., obtaining measures from different sources; separating the measurement of prediction and criterion variables; using reverse-coded and negatively worded items) (Podsakoff et al., 2003). The questionnaire was pre-tested on a panel of ten academics and entrepreneurs who were not involved in the study, who provided feedback on its completeness, clarity, and wording. When possible, we complemented the interview data with secondary data (e.g., companies' websites and financial statements).

To test for non-response bias, we compared respondents with non-respondents by running t-tests and ANOVA analyses. We found no significant differences with regard to the industry, location, legal form of the company, and age of the entrepreneurs (Table 9). We found that respondent firms were slightly younger than non-respondents (mean difference = 1 year; $p < 0.01$), but the difference was negligible. We concluded that non-response bias was not an issue in our study.

3.2 Variables

3.2.1 Dependent variable

The question to measure our dependent variable was modelled on similar questions from various innovation surveys (e.g., the European Union Community Innovation Survey) that collect insights on innovation activities by focusing on tangible innovation outputs, such as

product and process innovation, as well as activities linked to intellectual property rights. In particular, the question in our survey asked the following: “Has your company carried out any innovative activity in the past 3 years, such as (1) new products/services introduced to the markets before other competitors; (2) new products/services for the firm; (3) new production processes; (4) new supply chain methods; (5) new support activities; (6) registered patents; (7) filed patent applications; (8) registered trademarks; (9) registered copyrights; (10) no innovation”. Hence, innovative activity referred to both incremental and radical innovation outputs, while excluding inputs such as R&D expenditure and/or R&D workforce. Our dependent variable (*innovation*) was a binary indicator taking the value of 1 if companies carried out any of the innovative activities described in items (1) to (9), and 0 otherwise. The share of firms declaring any innovation activity was 55% (77 firms): the vast majority of those declared having introduced products/services that were new to the market (52 firms, corresponding to 37% of all firms and 67.5% of innovative firms) or new to the firm itself (20 firms, corresponding to 14% of all firms and 26% of innovative firms). The share of native vs. immigrant entrepreneurs who carried out innovation activities was 58% and 52%, respectively. The difference between the two groups was not statistically significant (see Table 1 for further information).

3.2.2 Independent variables

To capture the involvement of immigrant-owned firms with their environment, we employed three non-exclusive dummy variables indicating whether respondents interacted with firms (*firms*), universities and research institutions (*universities*), and business associations (*business associations*). The variables were identified from three questions about interactions with each of these actors: “How much did your company interact with firms/universities (or research centres)/business associations during the last year?”, measured on a 1–7 scale (where 1=very little and 7=very much). The three binary variables *firms*, *universities*, *business associations* equalled 1 when a given response was higher than the median value for the full sample.⁴ These variables therefore account for the relative importance of each respondent’s interactions with external organizations. Table 1 shows the distribution of the binary variables. The interactions with firms and business associations were quite common for companies in our sample (mean of *firms*=0.45, mean of *business associations*=0.38), while interactions with universities and research institutions were less frequent (mean of *universities*=0.19). These variables exhibited a similar distribution among the immigrant and non-immigrant sub-groups. Notably, the immigrant-owned firms did interact more with academic and research institutions compared to native-owned firms, while the opposite was true for interactions with business associations.

3.2.3 Moderation variables

In order to test our arguments, we interacted the aforementioned independent variables with two moderation variables in two different econometric models. First, we employed a dichotomous indicator (*immigrant*) that equalled 1 for companies established and owned in Italy by foreign-born entrepreneurs and 0 otherwise. Second, we employed a variable

⁴ Given that the mean and standard deviation are invalid parameters when the data fall on an ordinal scale (Allen & Seaman, 2007), we opted to use the median to identify our dichotomous indicators.

Table 1 Variable list, description and descriptive statistics

Variable	Description	Mean	SD	Min	Max	Mean immigr	Mean non-immigr	Difference <i>p</i> -value
Innovation	Dummy 0/1 for innovation activity (last three years)	0.55	0.50	0	1	0.52	0.58	0.755
Firms	Dummy 0/1 for interaction w. firms; 1 if > median(firms_value) (t-1)	0.45	0.50	0	1	0.48	0.42	0.244
Universities	Dummy 0/1 for interaction w. univ.; 1 if > median(univ_value) (t-1)	0.19	0.39	0	1	0.24	0.13	0.049
Business associations	Dummy 0/1 for interaction w. assoc; 1 if > median(busass_value) (t-1)	0.38	0.48	0	1	0.34	0.42	0.840
Acculturation	Factor score based on 3-items, 5-point Likert scale of immigrants' orientation toward the host country (Sánchez & Fernández, 1993)	4.09	0.89	1	5	— ^a	— ^a	—
Immigrant	Dummy 0/1 for immigrant-owned firms	0.51	0.50	0	1	1	0	—
Agefirm	Age of firms at time of survey	5.86	3.70	1	12	5.7	6	0.713
Turnover(t-3)	Turnover in t-3 (thousands)	340.113	947.517	0	7656.734	216.635	467.171	0.059
Intangibles(t-3)	Net intangible fixed assets in t-3	51.236	388.57	0	4495.334	23.341	79.939	0.804
Manufacturing	Dummy 0/1 for manufacturing firms thousands	0.53	0.50	0	1	0.57	0.47	0.121
ICT	Dummy 0/1 for ICT firms	0.41	0.50	0	1	0.41	0.40	0.487
Others	Dummy 0/1 for firms in other sectors	0.06	0.24	0	1	0.01	0.11	0.006

N = 140 except for accult (N = 71)

^aThe t-test was not performed for the variable acculturation because this measure is meaningful and collected for immigrant entrepreneurs only

measuring orientation to the host culture (*acculturation*). Several measures of acculturation exist, relying either on demographic variables as proxies of acculturation (e.g., generational status, age at immigration, years lived in the new country) or on psychometric scales (Ryder et al., 2000). Because demographic indicators are quite rudimentary in accounting for individual differences (Ryder et al., 2000), we decided to use a validated psychometric scale. Following Arends-Tóth and Van de Vijver (2006), we chose a scale featuring a bicultural perspective on the measurement of acculturation: that is, one that treats cultural maintenance (heritage acculturation orientation) and mainstream culture adoption (host culture acculturation orientation) as two independent constructs. Thus, we employed the scale created by Sánchez and Fernández (1993), which measures immigrants' acculturation to the host country culture through three, 5-point Likert scale items: "I have difficulties identifying with *host country nationality* people"; "I think of myself as being *host country nationality*", and "If someone insults *host country*, I get angry" (we replaced *host country/host country nationality* with Italy/Italian). Since this scale measures immigrants' degree of acculturation to the host country, we did not use it for the Italian entrepreneurs. The variable *acculturation* is a factor score created by averaging the raw scores of the three items ($\alpha=0.69$; min = 1, max = 5, mean = 4.09); the factor loadings ranged between 0.68 and 0.84.

3.2.4 Control variables

Building on the vast literature on the link between innovation and firms' characteristics, we selected a vector of firm-level variables that are likely to influence the probability of pursuing innovative activities. In particular, we focused on firm age, size, R&D effort and industry. Age may have two opposite effects on innovation: on the one hand, firms' market experience increases their absorptive capacity through learning processes (Cohen & Levinthal, 1989), and by extension, their ability to innovate; on the other hand, older firms may face "organizational inertia" due to immovable routines (Nelson & Winter, 1982a) that limits their ability to innovate (Hannan & Freeman, 1984). To control for the age effect, we used a count variable for the years since foundation (at the time of the survey and as indicated by respondents) (*agefirm*). Firm size—perhaps one of the most debated determinants of innovation—can also support two opposing views: that small firms are more likely to innovate due to their flexibility or that large companies are more likely to innovate due to their power and resources (Nelson & Winter, 1982b; Schumpeter, 1950). To control for firm size, we added the 3-year lagged company turnover (*turnover_t-3*, in log), either collected from AIDA-Bureau Van Dijk (in the case of limited liability companies) or self-reported by the entrepreneur (in the case of non-limited liability companies). This variable allows us to account for not only firms' size effects, but also their growth trends. To control for the direct determinants of innovative activities, such as R&D expenditure, we included the 3-year lagged value of the intangible fixed assets (*intangibles_t-3*, in log), either collected from AIDA-Bureau Van Dijk (in the case of limited liability companies) or self-reported by the entrepreneur (in the case of non-limited liability companies).⁵ Intangible fixed assets provide a reliable measure of firms' effort in R&D because R&D-related costs fall into the category

⁵ For companies established at time t-3, t-2 and t-1, we used the first available data on turnover and intangible fixed assets.

of internally generated intangible assets. Importantly, R&D effort directly influences the propensity to innovate, as well as firms' degree of reliance on external sources of knowledge (Cassiman & Veugelers, 2006). Economies of scale and scope, along with entry barriers, also influence companies' innovation propensity (Acs & Audretsch, 1987). For this reason, we controlled for industry determinants via three dummy variables, based on the NACE-rev2 industry sector, that equalled 1 if companies belonged, respectively, to the ICT, manufacturing and other sectors (*ICT*, *manufacturing*, *others*). Table 1 presents the list of variables along with their descriptions and main statistics.

3.3 Descriptive statistics

The 140 firms were primarily active in manufacturing sectors (53%), including the production of computers, electronics and optical products, machinery, and electrical and non-electrical equipment; in ICT sectors (41%), including the production of software and the supply of ICT services; and in other sectors (6%), such as specialized construction works and R&D. The companies' localization is representative of the geographical distribution of industrial activities in the region (Appendix, Table 8). These firms were small companies with very flat organizational structures: On average, they were established by two partners in 2006 and employed approximately four employees at the time of the interviews. We found no significant differences between immigrant- and native-owned firms with respect to several firm-level characteristics, such as size, age, equity capital at foundation, or targeted clients' and suppliers' location (Appendix, Table 9). We observed that the sampled companies were active in mainstream domestic markets, mainly serving regional clients (on average, 72% of clients) and nested in regional or national supply chains (respectively, 60% and 30% of suppliers on average). Immigrant-owned firms served Italian clients (for example, 97% of Italian regional clients, vs. 96% for native-owned firms). Both types of firms had relationships with Italian suppliers (77% of Italian regional suppliers vs. 82% for native-owned firms; the difference was not statistically significant).

Approximately 76% of entrepreneurs were male. On average, respondents were 41 years old ($SD=8.21$). They had completed 15 years of education ($SD=3.23$) and had previous professional experience (13 years on average) before starting their own business ($SD=8.24$). Immigrant entrepreneurs migrated to Italy at 15 years old, on average ($SD=11$); 35% of them had previously worked in their country of origin for two years, on average. The sources of information that both types of entrepreneurs used for business purposes were the following: informal contacts with Italian entrepreneurs (91%), the Internet (88%), formal contacts with firms (61%), Italian friends (59%), business associations (30%), public bodies (17%), informal contacts with foreign entrepreneurs (16%) and foreign friends (16%). Immigrant entrepreneurs scantily resorted to informal contacts with co-ethnic entrepreneurs (7%) and co-ethnic friends (2%). Interestingly, immigrant entrepreneurs were significantly more likely than native entrepreneurs to rely on information from friends: both Italian friends (68% vs. 51%, $p<0.05$) and foreign friends (22% vs. 10%, $p<0.05$).

When comparing immigrant and native entrepreneurs on a set of key characteristics—including age, gender, human capital, entrepreneurial experience and entrepreneurial motivation—we found no significant differences, save for the length of working experience in Italy (i.e., immigrants had spent less working time in Italy; $p<0.10$) (Appendix, Table 10). This confirms that our matched-pair strategy was highly effective in identifying similar pairs of companies.

3.4 Methodology

To answer our research question about the role of interactions with external actors, we estimated an equation where the probability of innovating depends upon collaboration with firms, universities, and business associations, along with their interaction with the dummy *immigrant* and the vector of control variables. Our empirical estimations relied on probit regressions with robust standard errors. We also estimated the marginal effects of the coefficients and plotted the interaction effects so that we could interpret the results as exact probabilities. To substantiate our arguments on the role of immigrants' acculturation, we ran a probit model on the sub-sample of immigrant firms only, where the variables regarding collaborations (with firms, universities and business associations) were interacted with *acculturation*.

4 Results

4.1 Main results

Pairwise correlations among our set of dependent, independent and control variables are reported in Table 11 in the Appendix. Table 2 shows our main results: in column (1) only control variables are regressed against the probability of innovating; in column (2) the variables *firms*, *universities* and *business associations* are added to the regression and marginal effects are calculated and reported in column (3); the interaction terms *immigrant*firms*, *immigrant*universities* and *immigrant*business associations* are added in columns (4), (5) and (6), respectively.

In column (2), we observe that companies interacting with other firms and with universities and research centres have a significantly larger probability of pursuing an innovative activity compared with companies that are not interacting. In particular, developing a network of collaboration with firms increases the probability of innovation by 14.8%, while interacting with universities and research centres increases the probability of innovating by 20%. The interaction effect in column (4) shows that collaborating with other companies does not have any additional effect on the sample of immigrant-owned firms. In contrast, collaborating with universities and research centres as well as with business associations has a significantly larger effect on immigrant-owned companies, as shown by the statistically significant coefficients of the interaction terms in columns (5) and (6). In particular, the probability of innovating increase by more than 100%, hence doubling, in the subsample of immigrant-owned firms who interacted with academic and research institutions, while it increases by 70% around those interacting with business organizations. The Wald tests carried out on the interaction terms further corroborate the latter results. Among control variables, while firm age and size do not seem to play a significant role, intangible fixed assets and sectoral dummies both positively influence the dependent variables, as expected.

We provided additional evidence for the results by plotting the statistically significant interaction terms. Figures 1 and 2 show the predictive margins of the probability of innovating for immigrant- and native-owned companies. Interacting with universities and

Table 2 Probit regressions

Variables	Baseline models			Interaction models		
	(1)	(2)	(3)	(4)	(5)	(6)
	Innovation	Innovation	Margins	Innovation	Innovation	Innovation
Immigrant	-0.180 (0.238)	-0.292 (0.253)	-0.092 (0.0785)	-0.109 (0.329)	-0.418 (0.267)	-0.542* (0.315)
Firms		0.474** (0.233)	0.148** (0.0705)	0.721** (0.338)	0.467** (0.236)	0.466** (0.233)
Immigrant*firms				0.256 (0.323)		
Universities		0.653** (0.330)	0.205** (0.100)	0.676** (0.327)	0.013 (0.485)	0.612* (0.334)
Immigrant*universities					1.053*** (0.408)	
Business associations		0.264 (0.254)	0.0829 (0.0794)	0.251 (0.256)	0.267 (0.255)	-0.102 (0.352)
Immigrant*business associations						0.702* (0.364)
Agefirm	-0.0285 (0.0378)	-0.0255 (0.0401)	-0.00799 (0.0125)	-0.0207 (0.0407)	-0.0242 (0.0409)	-0.0276 (0.0405)
l_turnover(t-3)	0.0222 (0.0245)	0.0183 (0.0250)	0.00573 (0.00778)	0.0161 (0.0250)	0.0214 (0.0254)	0.0269 (0.0265)
l_nintangibles(t-3)	0.119*** (0.0252)	0.113*** (0.0265)	0.0355*** (0.00679)	0.116*** (0.0261)	0.117*** (0.0269)	0.116*** (0.0271)
Manufacturing	0.772 (0.472)	1.056** (0.449)	0.331** (0.135)	1.096** (0.455)	1.040** (0.449)	0.930** (0.446)
ICT	1.083** (0.485)	1.364*** (0.477)	0.427*** (0.140)	1.384*** (0.486)	1.389*** (0.468)	1.299*** (0.477)
Constant	-1.140** (0.527)	-1.708*** (0.550)		-1.842*** (0.574)	-1.694*** (0.556)	-1.546*** (0.554)
<i>Wald tests</i>						
Chi2		11.91		0.63	6.68	3.72
Prob > Chi2		0.0077		0.42	0.00	0.05
Observations	140	140	140	140	140	140
r2_p	0.143	0.194		0.199	0.205	0.206
P	0.000171	5.16e-05		3.00e-05	1.99e-05	0.000124
chi2	26.62	35.35		38.59	39.61	35.02
L1	-82.59	-77.65		-77.19	-76.58	-76.46

Effects of the network of collaboration with firms, universities and research centers, and business associations

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

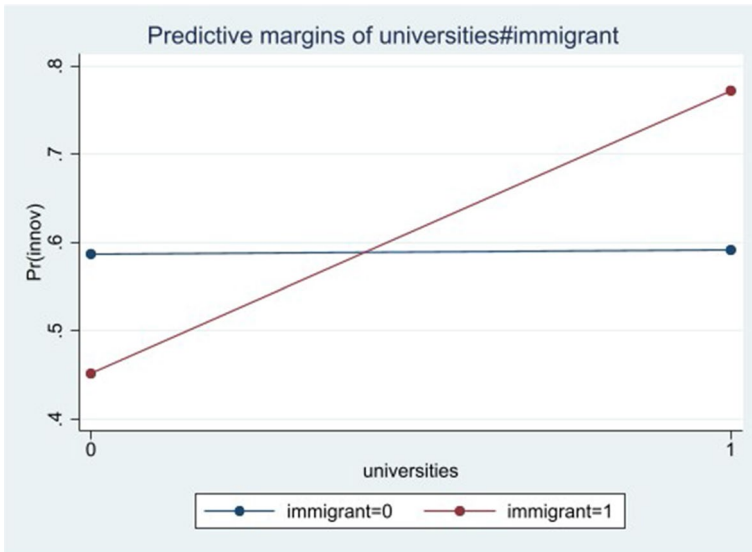


Fig. 1 Plot of interaction term universities*immigrant from Table 2 column (5)

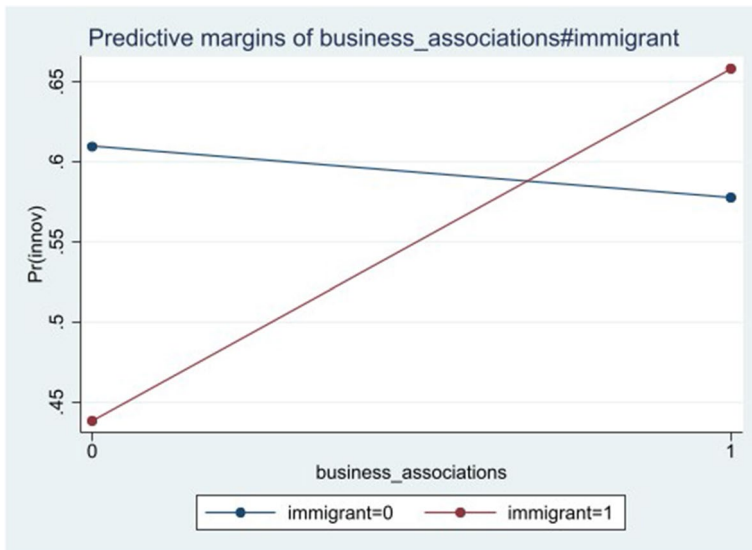


Fig. 2 Plot of interaction term business associations*immigrant from Table 2 column (6)

research institutions has a larger positive effect on the probability of innovating for immigrant-owned firms, while it has a negligible effect on native-owned companies (Fig. 1). Similarly, interacting with business associations has a larger positive effect on the probability of innovating for immigrant-owned firms, while it seems to decrease it for native-owned firms (Fig. 2).

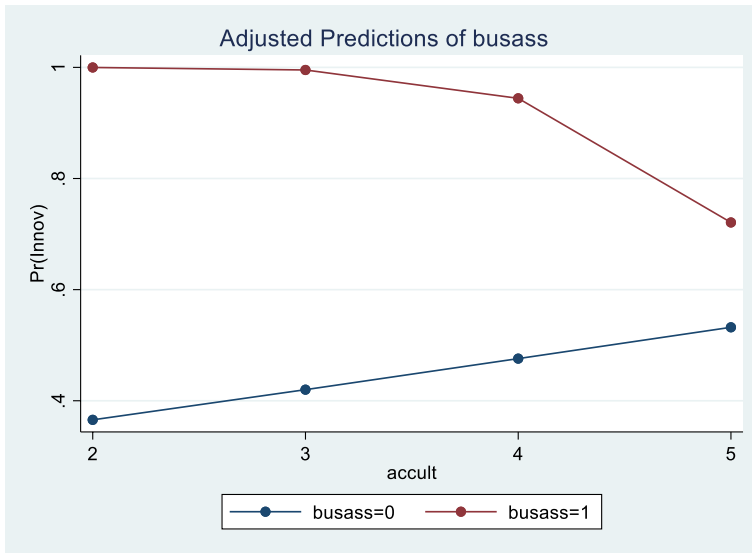


Fig. 3 Plot of interaction term business associations*acculturation from Table 3 column (3)

To investigate the role of immigrant's acculturation as a moderating factor of interactions with external actors, we added the regressor *acculturation* and in turn the interaction terms *firms*acculturation*, *universities*acculturation* and *business associations*acculturation* in separate regressions (see Table 3). The results show that acculturation to the host country has a statistically significant moderating effect on the relationship between linkages with business associations and innovation in the sub-sample of immigrant-owned companies. This means that the positive influence of interactions with business associations on the probability to innovate is weaker for immigrant entrepreneurs who feel highly acculturated to the Italian culture. The coefficients in column (3) shows that, while the probability of innovating among immigrant-owned firms who interact with business associations is six times larger than non-interacting peers, it decreases by around 100% for each percentage increase in the level of acculturation. This result is confirmed by Fig. 3, where we plotted the acculturation level and the predictive margins of the probability of innovating across the groups of immigrant entrepreneurs interacting with business associations and those not interacting with them. As the level of *acculturation* increases, we observe a decreasing probability of innovating for immigrant firms collaborating with business associations, hence suggesting a substitution effect.

4.2 Robustness checks

To corroborate our findings, we carried out several robustness checks in which we employ a different econometric method and different measures of networking. First, we replicated the analysis presented in Table 2 separately on the two sub-samples of immigrant and non-immigrant owned firms (see Table 4). This econometric approach allowed us to directly investigate the impact of every single regressor on the probability of innovating among

Table 3 Probit regression. Moderating effect of acculturation in the sub-sample of immigrant-owned companies

Variables	(1) Innovation	(2) Innovation	(3) Innovation
Acculturation	-0.150 (0.251)	0.0187 (0.232)	0.141 (0.270)
Firms	-2.335 (1.807)	0.140 (0.360)	0.135 (0.366)
Firms*acculturation	0.603 (0.437)		
Universities	0.839* (0.451)	1.004 (1.587)	0.933** (0.440)
Universities*acculturation		-0.0218 (0.376)	
Business associations	0.785** (0.387)	0.873** (0.381)	6.245*** (2.331)
Business associations*acculturation			-1.148** (0.532)
Agefirm	-0.00395 (0.0646)	0.00597 (0.0616)	0.0204 (0.0657)
l_turnover(t-3)	0.0499 (0.0394)	0.0475 (0.0363)	0.0511 (0.0384)
l_nintangibles(t-3)	0.152*** (0.0426)	0.145*** (0.0419)	0.154*** (0.0447)
Manufacturing	-3.890*** (0.565)	-3.988*** (0.551)	-3.804*** (0.544)
ICT	-3.299*** (0.615)	-3.373*** (0.601)	-3.185*** (0.613)
Constant	2.837** (1.239)	2.202* (1.242)	1.420 (1.452)
<i>Wald tests</i>			
Chi2	1.91	0	4.65
Prob > Chi2	0.16	0.95	0.03
Observations	71	71	71
ll	-34.20	-35.01	-33.29
chi2	365.7	369.1	372.8
p	0.0000	0.0000	0.0000
r2_p	0.304	0.288	0.323

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

immigrant and domestic firms. Such sub-sample analysis confirmed the results of Table 2, thus showing that developing collaboration networks with universities and research centres as well as with business associations increases the probability of innovating among immigrant-owned firms. The results further showed that interacting with firms is particularly beneficial for native owned firms.

Table 4 Robustness check: Probit regressions and marginal effects on sub-samples of immigrant-owned (col. (1) and (2)) and native-owned firms (col. (3) and (4))

Variables	(1) Immigrant Innovation	(2) Margins_ immigrant y1	(3) Nonimmigrant Innovation	(4) Margins_nonimmigrant y1
Firms	0.141 (0.350)	0.0389 (0.0965)	0.767** (0.338)	0.237** (0.0979)
Universities	0.914** (0.433)	0.253** (0.113)	0.171 (0.498)	0.0529 (0.154)
Business associations	0.875** (0.375)	0.242** (0.0956)	-0.00847 (0.367)	-0.00262 (0.113)
Agefirm	0.00521 (0.0601)	0.00144 (0.0166)	-0.0392 (0.0640)	-0.0121 (0.0196)
l_turnover(t-3)	0.0477 (0.0354)	0.0132 (0.00977)	-0.000701 (0.0446)	-0.000217 (0.0138)
l_nintangibles(t-3)	0.145*** (0.0422)	0.0400*** (0.00878)	0.115*** (0.0377)	0.0355*** (0.00994)
Manufacturing	-3.988*** (0.552)	-1.105*** (0.211)	1.203** (0.484)	0.372*** (0.140)
ICT	-3.375*** (0.612)	-0.935*** (0.229)	1.366*** (0.530)	0.423*** (0.152)
Constant	2.284*** (0.871)		-1.471** (0.652)	
Observations	71	71	69	69
ll	-35.01		-37.98	
chi2	365.5		20.81	
p	0.0000		0.0077	
r2_p	0.288		0.191	

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Secondly, we replicated the results of Tables 2 and 3 after replacing the previously employed dichotomous variables (*firms*, *universities*, *business associations*) with the original 1–7 scale responses provided by entrepreneurs variables (*firms_value*, *universities_value*, *business associations_value*), indicating the extent to which they interacted with external organisations (see Tables 5 and 6). Table 5 presents the estimates that employ the 1–7 scale response variables *firms_value*, *universities_value* and *business associations_value*. Both full-sample and sub-sample analyses confirmed our previous findings.

We then checked the robustness of our findings about the moderation effect of *acculturation* by employing *firms_value*, *universities_value* and *business associations_value* as independent variables instead of the dichotomous variables previously used (see Table 6). The results confirmed the moderation effect on the extent of interaction with business associations.

5 Discussion and conclusion

This paper sought to investigate the role of collaboration networks in the innovative activities of immigrant- vs. native-owned firms. We were specifically interested in how innovation processes unfold from collaborations with external actors—including firms, academic and research centers, and business associations—among immigrant- and native-owned domestic firms. Additionally, we wanted to understand whether immigrant entrepreneurs' degree of acculturation to the host country culture influences the impact of those collaboration networks (e.g., whether that factor provides a substitution effect). Our arguments are grounded in the innovation literature devoted to the study of firms' interactions with external organizations for innovation, and on the immigrant entrepreneurship literature addressing the role of relationships with non-co-ethnic, external agents in immigrant-owned firms. In particular, the growing literature on migrant entrepreneurship has only partly explored the role of collaborative networks for the innovation performance of high-tech migrant businesses. To that end, we conducted an empirical analysis on a unique and original survey of comparable immigrant- and native-owned firms, operating in the high-tech market of Italy's Emilia-Romagna region, and combined that data with secondary, firm-level data sources.

The regression analyses showed that interacting with academic/research institutions, as well as with business associations, has a significantly larger effect on the innovation propensity of immigrant-owned companies. The robustness checks additionally revealed that interactions with firms have a larger effect on the sub-sample of native-owned firms. Our data also suggest that higher levels of acculturation to the host country culture lead to business associations exerting less influence on innovation potential, which suggests that immigrants' acculturation offers a substitution effect.

This work adds to the literature and policy debates regarding immigrant-owned companies' innovation behavior and the role of network interactions. Our findings generally align with the extant innovation literature concerning the positive influence of collaboration networks on innovation activities (see, e.g., Allen & Cohen, 1969; Arora & Gambardella, 1990; Cassiman & Veugelers, 2006). In fact, among all the sampled firms, we found a positive and significant effect from interacting with two of the three external actors: namely, other firms and academic/research institutions. Most importantly, our results substantiate that some interactions are more important for immigrant-owned firms than their native-owned peers. Whereas extant research has shown that innovation strategies are relevant for immigrant entrepreneurs in high-tech sectors (e.g., Chaganti et al., 2008; Hart & Acs, 2011), this literature has not firmly established the specific role of external knowledge networks for innovation in immigrant-owned firms (Kerr & Kerr, 2019; Neville et al., 2014). In that vein, our study underscores the key role of academic/research institutions and intermediary business associations in supporting immigrant businesses. Our results seem to support the idea that universities and research centers provide infrastructure and expertise (e.g., via collaborative research, training, consulting, or placement of graduate students) that are more useful for immigrant entrepreneurs. Because they are outsiders to local scientific and technological networks, immigrant entrepreneurs are likely to find complementary expertise and technical support in university settings. Our interviews with Italian entrepreneurs revealed that academia and industry are perceived as two separate spheres of action, with different norms, timing, and expectations about collaborations. Meanwhile, having being raised in other national and institutional contexts, the immigrant entrepreneurs maintained a more positive view about having relationships with academia and research

Table 5 Robustness check: Probit regressions and marginal effects on full sample (col. (1) and (2)), on subsamples of immigrant-owned (col. (3) and (4)) and native-owned firms (col. (5) and (6))

Variables	Full sample		Immigrant owned firms		Native owned firms	
	(1)	(2)	(3)	(4)	(5)	(6)
	Probit	ME	Probit	ME	Probit	ME
Immigrant	-0.352 (0.252)	-0.106 (0.0747)				
Firms_value	0.110* (0.0580)	0.0331** (0.0168)	0.0276 (0.0888)	0.00763 (0.0244)	0.183** (0.0814)	0.0543** (0.0225)
Universities_value	0.323*** (0.111)	0.0971*** (0.0330)	0.354** (0.179)	0.0977** (0.0485)	0.234** (0.113)	0.0694** (0.0339)
Business associations_value	0.103 (0.0640)	0.0311 (0.0190)	0.241** (0.101)	0.0666*** (0.0254)	0.0150 (0.0865)	0.00444 (0.0257)
Agefirm	-0.0279 (0.0409)	-0.00838 (0.0122)	0.000428 (0.0589)	0.000118 (0.0163)	-0.0546 (0.0638)	-0.0162 (0.0185)
l_turnover(t-3)	0.0212 (0.0261)	0.00637 (0.00778)	0.0541 (0.0374)	0.0150 (0.0101)	0.00239 (0.0446)	0.000709 (0.0132)
l_nintangibles(t-3)	0.112*** (0.0272)	0.0338*** (0.00674)	0.141*** (0.0424)	0.0389*** (0.00879)	0.113*** (0.0380)	0.0334*** (0.00975)
Manufacturing	1.285*** (0.486)	0.386*** (0.139)	-2.643*** (1.011)	-0.730** (0.307)	1.263** (0.497)	0.374*** (0.138)
ICT	1.583*** (0.516)	0.476*** (0.145)	-2.076** (1.058)	-0.574* (0.317)	1.345** (0.564)	0.399** (0.157)
Constant	-2.507*** (0.654)		0.375 (1.388)		-1.978*** (0.708)	
Observations	140	140	71	71	69	69
ll	-74.69		-34.87		-36.52	
chi2	44.03		359.9		30.03	
p	0.0000		0.0000		0.0002	
r2_p	0.225		0.291		0.222	

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

bodies: They perceived those institutions as endowing them with different knowledge (via internships and consulting) and the enhanced reputation necessary for innovative activities. One could also speculate that the immigrant entrepreneurs who attended a tertiary or post-tertiary education course in Italian universities (in our case, around 34%) might have developed social networks with academics and a more profound understanding of scientific environments compared to business ones. Therefore, they might regard relationships with universities and research centers as more valuable than (local university educated) native entrepreneurs, who are more attuned to the whole institutional and business environment.⁶

⁶ We thank an anonymous reviewer for suggesting this. We believe that this additional socialization channel through schooling and universities can increase the likelihood of innovation among immigrant firms, but more research is needed to form a definitive answer.

Table 6 Robustness check: Probit regressions on sub-sample of immigrant-owned firms

Variables	(1)	(2)	(3)
	Accult firm	Accult universities	Accult business associations
	Innovation	Innovation	Innovation
Acculturation	-0.497 (0.357)	-0.104 (0.353)	0.567 (0.432)
Firms_value	-0.767* (0.449)	0.0266 (0.0905)	0.0396 (0.0913)
Acculturation*firms_value	0.192* (0.106)		
Universities_value	0.325* (0.189)	0.123 (0.841)	0.387** (0.174)
Acculturation*universities_value		0.0562 (0.202)	
Business associations_value	0.214** (0.108)	0.242** (0.102)	1.816* (0.945)
Acculturation*business associations_value			-0.349* (0.202)
Agefirm	-0.00766 (0.0629)	-0.00188 (0.0600)	0.0174 (0.0659)
l_turnover(t-3)	0.0526 (0.0408)	0.0546 (0.0385)	0.0505 (0.0397)
l_nintangibles(t-3)	0.151*** (0.0443)	0.140*** (0.0420)	0.153*** (0.0448)
Manufacturing	-3.542*** (0.895)	-2.578** (1.057)	-2.429** (1.009)
ICT	-2.929*** (0.729)	-2.020* (1.101)	-1.837* (1.054)
Constant	3.417* (1.760)	0.754 (1.830)	-2.515 (2.626)
Observations	71	71	71
ll	-33.41	-34.84	-33.04
chi2		361.8	379.2
p		0.0000	0.0000
r2_p	0.320	0.291	0.328

Robust standard errors in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Regarding business associations, our interviews confirmed that these entities act as intermediary bodies for several innovation-related business activities (e.g., consulting on intellectual property rights management, connecting to innovation networks, finding information about regional/national/international funding schemes). Our analyses support the argument that business associations supply firms with the network ties and expertise that small- and medium-sized immigrant-owned companies often lack.

Last, we want to note that the relationships with other firms appeared to be relevant for all sampled companies, even if some of our analyses suggested that they play a stronger role for native-owned firms. We speculate that immigrant- and native-owned firms accrue the same

benefits from collaborating with peers (e.g., meeting new clients, developing new supply solutions, or tapping into specialized knowledge), but the latter may have an easier time accessing said benefits. Granted, we have to consider that a measure of relationships with firms does not capture all informal exchanges; after all, many entrepreneurs declared that they seek information from personal contacts, such as other entrepreneurs and friends. Thus, our measure of collaboration with other firms might not reflect the nuances of interactions with different partners.

Generally, our results support the argument that family members and ethnic communities are no longer unique sources of support for immigrant entrepreneurs (Arrighetti et al., 2014; Barrett et al., 2002). Instead, our findings suggest that immigrant entrepreneurs benefit greatly from building relationships with formal institutions, such as universities and business associations. Relatedly, we believe that our finding that acculturation can substitute for interactions with business associations could inspire new research on the key role of immigrant entrepreneurs' acculturation orientations (Arrighetti et al., 2017; Dheer, 2018).

As with any study, this work features some limitations. First, the study was conducted in a single region of a single country (Italy). While this choice answers calls for more research in Southern Europe (Ilhan-Nas et al., 2011), we acknowledge that a wider geographical scope would provide a more accurate description of firms' engagement with external collaboration networks. Second, the study focused on domestic, technology-based companies. Future studies should extend our approach to other countries, industries, and markets. Third, our relatively small sample mainly included new, small firms with flat hierarchical structures, which made it difficult to assess the dynamics of entrepreneurial teams.⁷ Future studies could produce more complete insights by considering how team diversity shapes firms' engagement with different innovation networks (e.g., Amoroso et al., 2020). Fourth, the cross-sectional data used for the empirical analysis did not allow us to ascertain neat causality relationships. After all, there may be reverse causality between the likelihood of innovation and the importance of collaboration networks. While we empirically showed that collaboration networks exert a positive influence on immigrant businesses' probability of innovating, it may also be that more innovative firms are more likely to build inter-organizational linkages to strengthen their market position. That said, our empirical setting did allow us to control for highly relevant lagged factors that influence innovation—such as firm age, size, R&D effort and industry—which helped limit the risks of endogeneity. Future research should exploit longitudinal data and appropriate econometric techniques in order to properly disentangle causality connections.

To conclude, this work provides implications for academics and policymakers interested in developing policies to foster firm-level innovation, especially that target the specific subset of immigrant entrepreneurs. Specifically, this work supports the argument that some external actors in a collaboration network are more essential than others for immigrant-owned businesses. Our results should encourage policy-makers to craft instruments that link immigrant-owned firms with host country universities, research

⁷ While in our sample all immigrant entrepreneurs are actively involved in strategic and daily decision-making within the firms, in 32% of the firms they do not represent the majority of entrepreneurial teams' members. We run additional analyses by including (1) a control variable measuring the total number of owners per firm, or (2) the total number of native (Italian) owners per firm. The interaction results described in the main findings are confirmed. We have also repeated the analysis by replacing the variable "immigrant" with a dummy variable measuring whether immigrant owners were a majority of the entrepreneurial team ("immigrant majority"). These models provide support to the larger significant effect of collaboration with universities/research centers for immigrant-majority-owned companies. Results are available upon request.

bodies, and business associations. Oftentimes, business support programs targeting immigrant entrepreneurs focus on measures that enhance individual skills (e.g., information, education, mentoring, training, or counseling) rather than on those that address structural features (Rath & Swagerman, 2016). Thus, some public policy actions should seek to strengthen immigrant entrepreneurs' relationships with local intermediaries, emphasizing the development of joint programs with local actors rather than detaching immigrants from "mainstream" business support initiatives (Ram et al., 2017). An example of a policy that might accomplish these objectives is "start-up visa" programs which can help immigrant-owned firms transition into certified mainstream incubators in the host country (e.g., de Lange, 2018). Of course, any moves in this direction should be accompanied by a more culturally sensitive bureaucracy and attention to "tailor-made" approaches (e.g., services in immigrant languages, intercultural mediators, outreach officers) (Rath & Swagerman, 2016; Solano et al., 2019). In that vein, practitioners and policymakers must recognize that immigrant entrepreneurs are not a homogeneous category (e.g., Ram et al., 2013). In our study, for instance, we considered different levels of acculturation among the immigrant entrepreneurs, which helped clarify that cultural integration can substitute for their interactions with local business associations. In short, our findings reinforce calls for more nuanced policy approaches that can sustain innovation among immigrant entrepreneurs (e.g., Ram et al., 2013).

Appendix

See Tables 7, 8, 9, 10 and 11.

Table 7 Summary of the sample selection process for immigrant entrepreneurs' firms

(1) Full population established by at least a foreign-born partner in high-tech and machinery sector in last 10 years	n = 560
(2) Non-independent companies to be excluded	n = 53
(3) Firms starting a failure process to be excluded	n = 37
Subtotal A) Independent active firms	n = 470
(4) Companies with no contact to be excluded	n = 194 (*)
(5) Companies already active on international markets to be excluded	n = 60
(6) Companies not reachable through any contact (4 rounds of contacts)	n = 69
(7) Companies where the foreign-born partner is not active	n = 7
Subtotal B) Independent, active, non-international companies to be included	n = 140
(8) Companies not interested in the project	n = 69
Subtotal C) Independent, active, non-international companies interviewed	n = 71
(9) Companies owned by "chance" foreign-born entrepreneurs	n = 17
Subtotal D) Independent, active, non-international, ethnic-immigrant-owned companies	n = 54
(10) Companies owned by immigrant entrepreneurs from OECD countries	n = 17
Subtotal E) Independent, active, non-international, developing-country-immigrant-owned companies	n = 37

(*) This number reflects a documented problem in the management of the Italian business official directories, where many inactive, failed or closed firms do not officially close their position at the Chamber of Commerce. To this extent, the regulation D.P.R. 247/2004 established a procedure to allow the default deletion from the business directories after three years of missing documentation. This problem might be further exacerbated by the peculiarity of the selected sample (foreign-born entrepreneurs), for different reasons (e.g., individuals who opened a firm just as a means of obtaining a work visa for Italy and do not carry out any 'real' activity or left the country; individuals whose firms failed or closed down and were not aware that they have to close their position at the Chamber of Commerce; etc.). Because it was not possible to find these firms in any manner, we do not consider these firms in the calculation of our response rate

Table 8 Localization of firms

Province	Sample N	Regional population ^a		
		% on total	N	% on total
Piacenza	6	4.3%	23,818	6.2%
Parma	17	12.1%	38,525	10.1%
Reggio Emilia	15	10.7%	43,695	11.4%
Modena	25	17.9%	59,990	15.7%
Bologna	34	24.3%	89,139	23.3%
Ferrara	9	6.4%	26,202	6.9%
Ravenna	11	7.9%	30,923	8.1%
Forlì-Cesena	0	.0%	35,280	9.2%
Rimini	23	16.4%	34,614	9.1%
Total	140	100.0%	382,186	100.0%

^a Source: ISTAT, Asia archives (2010)

Table 9 Firms' characteristics: Native- vs. immigrant-owned firms

	Native-owned			Immigrant-owned			Difference <i>p-value</i>
	N	Mean	SD	N	Mean	SD	
Firm age	69	6.04	3.52	71	5.69	3.88	0.574
N. of employees (t-1)	69	4.06	1.06	71	3.87	6.06	0.885
N. of partners (t-1)	69	2.33	1.60	71	2.58	1.99	0.426
Equity	69	16442.65	26171.83	71	13821.83	23191.24	0.734
% of business-to-business sales	69	90.74	24.75	71	94.63	17.71	0.282
% of regional clients	69	69.35	32.91	71	75.32	29.70	0.261
% of Italian-nationals clients	69	96.52	17.03	71	97.22	13.41	0.786
% of regional suppliers	69	64.89	36.05	71	55.51	41.42	0.155
% of Italian-nationals suppliers	69	82.07	38.07	71	77.18	41.99	0.472
% of regional competitors	69	60.20	38.39	71	58.13	38.78	0.751

Table 10 Entrepreneurs' characteristics: Native vs. immigrant entrepreneurs

	Native			Immigrant			Difference <i>p-value</i>
	N	Mean	SD	N	Mean	SD	
Entrepreneur age	69	41.71	8.25	71	41.24	8.21	0.736
Entrepreneur gender (male)	69	0.81	0.39	71	0.72	0.45	0.196
Years of education	69	14.59	3.34	71	15.45	3.08	0.123
Years of work experience	69	13.18	9.03	71	12.22	7.43	0.493
Years of work in Italy	69	13.71	9.02	71	10.50	7.75	0.062
Portfolio entrepreneur (a)	69	0.22	0.41	71	0.29	0.45	0.292
Years working as entrepreneur	69	9.83	6.63	71	8.93	7.04	0.439
Necessity entrepreneur	69	0.19	0.39	71	0.28	0.45	0.196

(a) Dummy variable being 1 if the entrepreneur is owner of other companies, 0 otherwise

Table 11 Correlation table

	Innovation	Firms	Universities	Business associations	Acculturation	Immigrant	Agefirm	L _{t-3} turnover	L _{t-3} nintangibles	Manufacturing	ICT	Others
Innovation	1											
Firms	0.1833*	1										
Universities	0.2104*	0.0849	1									
Business associations	0.1436*	0.1228	0.1574*	1								
Acculturation	0.0535	0.0633	-0.0627	0.1163	1							
Immigrant	-0.0589	0.0589	0.1401*	-0.0848	-0.5851*	1						
Agefirm	-0.1074	0.0177	-0.0921	0.1367	0.0612	-0.048	1					
L _{t-3} turnover	0.1978*	0.0328	-0.0212	0.2358*	0.1227	-0.1327	0.0981	1				
L _{t-3} nintangibles	0.1144	-0.0438	-0.0426	0.129	0.0445	-0.0731	-0.0389	0.6714*	1			
Manufacturing	-0.0777	-0.1237	-0.1009	0.1471*	-0.1254	0.0994	0.1245	0.1562*	0.0845	1		
ICT	0.1067	0.0979	0.0529	-0.1972*	0.0622	0.0027	-0.1313	-0.1628*	-0.0738	-0.8775*	1	
Others	-0.0556	0.0556	0.0995	0.0956	0.1306	-0.2076*	0.0097	0.0083	-0.0242	-0.2775*	-0.2172*	1

N = 140. Coefficients significant at 10% level

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