Competing with multinational enterprises’ entry: Search strategy, environmental complexity, and survival of local firms

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ABSTRACT

This study examines the competitive dynamics between foreign and local firms. We posit that multinational enterprises’ (MNEs)’s entry in foreign markets significantly reduces the survival rate of local firms in the short term, but that this effect gradually diminishes over time. The proposed conceptual framework is operationalized through the combination of the widely used agent-based model and the economic model of competition. The agent-based model allows us to study the behavior of firms under the context of different markets and the environmental complexity while the competition model determines the competition between firms as well as the entry and exit of firms. Our results obtained from the simulation study reveal that the negative effect of foreign entry is heightened as environmental complexity increases. However, local firms with a broader knowledge search are better able to confront the negative impact of foreign entry over time. We also find that the negative effect of foreign entry on the survival of local firms is weaker for local firms with a strong retrieval capacity.

1. Introduction

In the increasing globalization, multinational enterprises (MNEs) flow into foreign markets to extend the product life cycle (Vernon, 1966), to produce in a better location (Dunning, 1980) and to leverage their substantial financial resources, advanced technology, superior products, powerful brands, and skilled marketing and management techniques (Dawar & Frost, 1999a). The entry of foreign firms has been widely recognized as having important consequences and challenges for local firms, who struggle to find effective strategies to cope with such challenges (Wu & Pangarkar, 2006). One basic tenet of the interaction between foreign and local firms has been firmly established: foreign firms’ entry has negative consequences on local firms’ performance and survival (Aitken & Harrison, 1999). Generally, as foreign firms enter a local market, they seek business resources and customer bases from domestic companies, increasing market niche overlap (Graham & Krugman, 1995; Seth & Quijano, 1991). Intensive competition from foreign companies has been shown to be associated with local firms’ decreased performance (Li, 2008). Although the importance of foreign firms’ presence on local firms’ survival and performance is now clear, we remain unclear about (a) whether/how the entry of foreign firms will have different effects on local firms’ performance in the short- and long-term, (b) how environmental complexity may affect the performance implications of foreign entry, and (c) how local firms may initiate specific strategies that are effective in alleviating negative consequences.

These questions are important because most prior research has focused on the local consequences of foreign entries with the assumption that local firms are passive actors (e.g., a market defender that shifts to a market in which a foreign threat is weak, or a market dodger that focuses on a locally oriented link in the value chain) or followers (Dawar & Frost, 1999a), leaving the key research question—that is, how local firms would be able to design effective strategies to increase their competitiveness toward the challenge of foreign rivalries—largely unexplored. Un (2016) tackles this theme by proposing that managers of domestic firms can compensate for this liability of localness in two ways: by investing in the training of their employees and by exporting. Therefore, to further advance our understanding of competitive interactions between foreign and local firms, it is important to investigate whether and how search strategies elicited by different local firms result in distinct performance outcomes associated with foreign entries.

Another aspect of the literature on competitive interactions between foreign and local firms that has received less attention is the role of environmental context. Li (2008) argued that local managers facing increasing foreign competition would be wise to recognize a natural decay of the liability of foreignness over time, as foreign firms gradually
acquire local market knowledge and the local environment becomes accustomed to the foreign firm presence (Zaheer & Mosakowski, 1997). However, variations in the number, diversity, and distribution of task-environment elements affect information in organizations’ processing requirements (Bracker, Keats, & Pearson, 1988). To date, some limited evidence has indicated that task environment creates an important link between intra-group and inter-group competitive interaction (Porac, Thomas, & Baden-Fuller, 1989). Zhou and Guillén (2015) approaches this theme by proposing the concept of dynamic liability of foreignness, defined relative to the home base, as a predictor of entry into a foreign market, but it still has not paid enough attention to the external environment.

To resolve these theoretical puzzles concerning the boundary conditions of the effects of foreign entry, in this study, we theorize that the effect of foreign entry pertains to environmental complexity and strategies of local firms. We define environment complexity as the degree of heterogeneity of environmental elements in which a firm is operating (Keats & Hitt, 1988). We conceptualize environmental complexity as a multi-dimension construct consisting of different factors that include competitive complexity, market diversity, resource complexity, and process/facility complexity (Cannon & John, 2007). A high level of heterogeneity of an organization’s activities relevant to the organization’s operations implies a highly complex environment being confronted (Child, 1972). In this study, we treat environmental complexity as a contextual variable that influences the salience of the negative consequences related to foreign entries. Numerous studies have suggested that managers facing a more complex (i.e., heterogeneous) environment will perceive greater uncertainty and have greater information-processing requirements than managers facing a simple environment (Duncan, 1972; Pennings, 1975; Tung, 1979). This is especially significant for foreign firms that choose to enter a unfamiliar local market (Hymer, 1960; Kindleberger, 1969). Moreover, we examine important contingencies related to the role of strategies of local firm, which may increase or reduce the effects of foreign entries on local firm performance. We propose that search radius will reduce the negative impact of foreign entry on local firms’ performance, and the negative effect of foreign entry will be attenuated by retrieval capacity.

The present research tests this framework using a simulation analysis. Employing a simulation analysis to study competitive dynamics between foreign and local firms in a complex task environment has a number of merits. First, unlike a real-world setting, a simulation design allows controlling for systematically varying external factors, as well as the direct observation of human behavior (Arthur, 1991; Sterman, 1987). For example, the degree of environmental complexity or the decision factors to process can easily be varied. Levintal and Workiewicz (2018) applied NK model to study organizational structures and adaptations. Second, one of the challenges in empirical studies is to systematically collect the data about decision making over a relatively long period (e.g., more than twenty years). Although using interviews with business managers who have the knowledge is useful to collect such kind of data, this method is usually constrained by respondents’ (e.g., memory) capacity of accurately tracing back to more than twenty years (Holam & Phillips, 2004). In contrast, a simulation analysis provides this convenience by describing behavioral models of human-bounded rationality aiming to actual, rather than optimal decision making (Argote & Greve, 2007; Cyert & March, 1963; Simon, 1962, 1976), thus yielding valuable insights into human behavior in a controlled environment over a relatively long period (Edmonds, 2001; Sterman, 1987). Third, simulation results on decision making may advance theoretical development and motivate further empirical studies (Adner, Czaszar, & Zemsky, 2014; Arthur, 1991).

2. Theoretical background

2.1. Research background on foreign and local firm competition

Competition is one of the most common phenomena in organizational activities. Different from the early treatments of competition as an exogenous factor (e.g., Thompson (1967)), macro organizational theories have now considered competition to be an endogenous process that evolves as an organization changes (e.g., Carroll & Hannan, 2000; Grimm, 1999; Hannan & Freeman, 1989). A key argument is that the process of competition creates scarcity and constraint on organizational actions. In his study on competition between foreign and local firms, Li (2008) showed a U-shaped effect from the presence of foreign banks on U.S. domestic bank entries in the U.S. commercial loan sector, and a linear effect of U.S. domestic banks on a foreign bank entry, indicating the existence of the asymmetric interaction between the entry of foreign and domestic companies. He attributed this finding to the existence and persistence of a liability of foreignness in certain industrial settings, and that asymmetries between foreign and domestic firms might vary across different strategic groups. Li found that “foreign bank entries in a particular strategic group initially increase the competitive pressures in an industry, leading, in this case, to an initial negative effect on the entry of domestic banks into the same group. Yet as the number of foreign banks in a particular strategic group further accumulated, foreign bank entries stimulated new domestic bank entries” (p. 888). He concluded that these findings of different effects of foreign entries are consistent with the theory of liability of foreignness that foreign companies face, as well as the perspective of leading domestic entrepreneurs to perceive further foreign entries as a signal of favorable market opportunities and to launch new domestic entries.

Despite nuanced theorizing regarding the likely consequences of foreign entries (DeYoung & Nolle, 1996; Kostova & Zaheer, 1999; Miller & Parkhe, 2002; Zaheer, 1995), relatively fewer efforts have examined search strategies initiated by local firms to confront the negative consequences of foreign entries (Wang, Yuan, & Wu, 2017). Organizational theorists have long proposed a common consequence for organizations facing competition: when the firm performance falls below a satisfactory level, it will trigger a so-called “problemistic search” as the firm attempts to survive by restoring the satisfactory performance (March, 1989: Winter, 2000). After improving firm performance in response to competition, an organization in turns becomes a stronger rival against other organizations (Cyert & March, 1963). Lesser-performing firms then search for valuable knowledge with the potential to find new solutions to intensive competition. In the context of competitive dynamics between foreign and local firms, local firms face a competitive disadvantage against foreign rivals, as the latter possess advanced technology, novel products, and creative solutions. To reverse their competitive disadvantage, local firms are motivated to search for new technology and knowledge solutions to their performance problems.

However, knowledge is imperfectly distributed across individuals, groups, organizations, and industries (Hargadon & Sutton, 1997). While knowledge generated from one organization might solve the problems of another organization, the key challenge is to first search for problem-solving solutions and then build the connections between potential solutions and the problems such solutions encounter (Baer, 2012). When such connections are made, new and creative ideas can merge with other existing, previously unconnected ideas, to build new objects or concepts and address different requirements raised by various users (Sirmon & Hitt, 2007). Research on knowledge search and knowledge brokerage has been examined separately, yet the literature has not paid adequate attention to the relevance of the two complementary strategies for asymmetric interaction between foreign and local firms.

2.2. Knowledge search vs. brokerage perspectives

The knowledge search perspective highlights search as fundamental
to human decision making. Simon (1957) suggested that the set of alternatives available to a decision maker is not given in its entirety but discovered and constructed through search activities. Viewed from this perspective, Newell (1994) considered search not just another method or cognitive mechanism, but a fundamental process. In managerial and competitive advantage settings, the search for new alternatives unfolds through the (re)combination of salient decision variables (Fleming, 2001; Levinthal, 1997; Rivkin, 2000). Rivkin (2000) described the quest for competitive advantage as a search for effective combinations of such decision variables. Levinthal (1997) argued that organizations tend to engage in the immediate neighborhood of a status quo alternative (a so-called local search). This local search reflects political and routine processes within organizations that constrain search to local improvements (Cyert & March, 1963; Nelson & Winter, 2009). However, a few organizations do search for more alternatives in distant areas (so-called distant search) (Siggelkow, 2001; Tushman & Romanelli, 1985). A key question is: Are human subjects systematically able to identify better-performing combinations in the search space, especially when under pressure to find solutions to improve the performance?

Previous knowledge search studies have centered around how human participants choose among local and more distant search and compared the performance difference between computational agents searching in identical landscapes but with different search radii (Billinger, Stieglitz, & Schumacher, 2013). In the context of dynamic competition between foreign and local firms, local firms restless search for performance improvement in the marketplace. The search is more likely initiated when the performance is falling behind a satisfactory level. A firm has to make a decision whether to search locally or distantly. This knowledge search procedure has been considered in the form of search radii (Aggarwal, Siggelkow, & Singh, 2011), cognitive ability (Giannoccaro & Nair, 2016) and supply chain management (Capaldo & Giannoccaro, 2015; Giannoccaro, Nair, & Choi, 2018). In this study, we employ the denotation from Aggarwal et al. (2011)'s study, in which search locally refers to a narrow search radius while search distantly refers to a wide search radius.

In contrast, the knowledge brokerage perspective emphasizes the role of retrieval capacity in turning potential knowledge and technologies from elsewhere into useful solutions for existing problems (Huber, 1991; March & Simon, 1958; Walsh & Ungson, 1991). To understand how retrieval capacity makes connections between existing solutions and new problems over time and across people, scholars have pointed out the retrieval capacity that individual members and teams use to create new products by learning of possible solutions, remembering them, and retrieving them in new forms that fit new combinations (Hargadon & Sutton, 1997). Walsh and Ungson (1991) described retrieval capability as such routines that support the application of stored information to an organization's present decisions. We extend this description of retrieval capacity to an organizational ability to combine potential knowledge and technology with existing resources to develop effective solutions for problems encountered.

Previous knowledge brokerage studies have largely focused on high-tech organizations, making analogies between current design problems and past solutions, and retrieving that past knowledge to generate new solutions to design problems in other industries (Hargadon & Sutton, 1997). The current study, however, focuses on local firms making analogies between their current problems and novel practices and ideas emerging in the market to generate new solutions to solve their problems. This may provide insight into the dynamics of international expansion, which seems timely given the intensified international competition in many industries (Bartlett, Ghoshal, & Birkinshaw, 2004).

### 3. Hypotheses

#### 3.1. Effect of foreign presence on local firms in the short- vs. long-term

These insights offered above have important implications for competitive interactions between foreign firms and local rivals, especially when emerging markets are open to foreign MNEs. As the protection barriers crumble in these markets around the world, foreign MNEs have rushed in to find new markets and opportunities (Dawar & Frost, 1999a, 1999b). Foreign MNEs that have survived competition in their home markets have competitive advantages such as substantial financial resources, advanced technology, superior products, global brands, flexible marketing, and so forth, which can be leveraged to emerging markets (Li, 2008; Wu & Pangarkar, 2006). However, local firms are still in early growth stages and must suddenly face a flush of foreign firms. Such local firms lack the necessary capabilities or financial resources to upgrade their technology and redesign their operations. Some local firms even believe that new operations and technology possessed by foreign rivals are not superior and can be overcome, and thus double their efforts to upgrade their existing operations and technology (Baumann, Schmidt, & Stieglitz, 2018). However, such attempts usually only postpone the day of reckoning, as foreign firms' superior operations and technology enable them to offer products and services that are more attractive to local customers (e.g., more reliable quality, high brand recognition, excellent after-sale services, etc.). Because of such advantages, foreign firms tend to win the competition, while local firms with older operations and technology that try to delay the inevitable often waste resources and damage their companies (Ramamurti, 2012). As a result, local firms facing intense competition are likely to perform below a satisfactory level and many have probably been forced to exit the market during misguided improvements. Others sell out and leave the market and industry.

Although the entry of foreign firms can have a negative impact on local firms in the short run, we posit that this negative consequence will diminish as local firms gradually enhance their competitiveness over time. Organizational learning scholars have shown that organizations exposed to intensive competition are likely to perform below a satisfactory level, triggering a so-called problematic search (March, 1988, 1994; Winter, 2000). The search problem will end once the performance has improved to a satisfactory level (Cyert & March, 1963). While the process of competition eliminates the weakest competitors, it also turns survivors into stronger rivals against other organizations over time. Further, MNEs operating abroad may face environments that are dramatically different from those at home. For instance, Li (2008) has reported that foreign-owned banks in the U.S. are subject to higher operation costs, lower operating efficiency and profitability, and diminished competitiveness relative to local banks (Beechler & Scher, 1993). In addition, the liability of foreignness tends to persist over time. Miller and Parke (2002) showed that foreign banks encountered a strong liability in the global banking industry over the 1989–1996 period. As local firms increase their competitiveness over time, and foreign firms are trapped by the liability of foreignness, the negative effect of foreign entries will diminish. Supporting this theory, many previous studies have demonstrated the existence and persistence of a liability of foreignness in diverse industrial settings (Grilly, Ni, & Jiang, 2016; Un, 2016; Zhou & Guillén, 2015). For instance, DeYoung and Nolle (1996) have reported that foreign-owned banks operating in the U.S. were less profitable than local U.S. banks. Similarly, Un (2016) argued that the liability of foreignness limits the identification, transfer, and integration of a diverse set of knowledge that supports product innovation. Thereby, we posit the following:

**H1.** Although competition from foreign entries has a negative effect on the survival of local firms at the early stage, this negative effect diminishes over time.
3.2. Interactions between foreign presence and environmental complexity

Environmental complexity has an important impact on firms’ behaviors; a high level of environmental complexity may prevent firms from growing, as they are forced to deal with competitive and resource complexity, market diversity, and other factors (Keats & Hitt, 1988). In the same vein, environmental complexity can influence both foreign and local firm behaviors in seeking business resources in a local market. By the time a foreign MNE expands to a local firm, they usually possess certain aspects of competitive advantages (e.g., stronger marketing capabilities, advanced technologies, management skills, global brands, etc.) relative to local firms. With such advantages, the MNE quickly drains key resources and builds a strong network with local suppliers and customers, resulting in greater scarcity and constraints on local firms’ strategic choices, which basically threatens their viability. The negative effects of foreign entry on local firms are particularly salient in local markets characterized by high levels of environmental complexity. As foreign MNEs have developed strong competitive advantages in their home countries, they can leverage these capabilities to achieve the best performance outcomes. In so doing, MNEs provide products with higher quality and lower costs than local firms, which causes a significant reduction in the survival rate of local firms. On the other hand, in the same market with high levels of environmental complexity, local firms find it increasingly difficult to find ways to improve (e.g., it is harder to achieve lower costs). In a highly complex environment, managers need to process greater information than managers in a less complex environment (Dess & Beard, 1984). Local firms are constrained by limited resources and information-processing capacity. As a result, they not only have to choose to cede most of the established market, but also possess the capability to establish a defensible niche, in which their old operations and technology still have an advantage. We hypothesize the following:

H2. The negative effect of foreign entry on local firms’ survival (H1) is strengthened in an increasingly complex environment.

3.3. Interactions between foreign presence and local firms’ search radius

To survive intensive competition, local firms have no choice but to adapt to their environments by launching search to explore new knowledge and better solutions in addressing market demands and improving their performance. We focus on local firms’ search radii—the extent to which firms engage in a search for innovative solutions to improve their performance. A broad search radius facilitates the search of new knowledge and solutions. For example, when a local firm is faced with new challenges from a foreign entry, it can reconstruct its supply base by changing one (a small change in the supply chain) or multiple suppliers (a large change in the supply chain). This must result in a performance difference between local firms engaging in a broad search radius and firms engaging in a narrow search radius. As firms with a broad search radius are more likely to explore new solutions in adapting to new environments, they are thus more likely to perform better than firms with a narrow search radius. Although the entry of foreign firms will impose a disruptive effect on local firms, local firms with a broad search radius are more able to deal with this negative impact than their peers with a narrow search radius. The logic is that a broad search radius enables problematic firms to quickly find the best solutions to improve their performance (Rosenkopf & Nerkar, 2001). In contrast, firms with a narrow search radius are likely to indulge in a local search by focusing on similar technology (Rivkin & Siggelkow, 2003). This focus enables them to build the necessary competence in their current domain over time, and is especially useful in competing against foreign rivals with superior technologies and management skills (Rosenkopf & Nerkar, 2001). Thus, we posit the following:

H3. The negative effect of foreign entry on local firms’ survival (H1) is weaker for local firms with a broad search radius.

3.4. Interactions between foreign presence and local firms’ retrieval capacity

It is important to note that the extent to which a broad innovation radius helps local firms improve their survival depends on the organization memory that supports their organizational innovation (Cyert & March, 1963; Kantrow, 1987; Neustadt, 2011; Walsh & Dewar, 1987). Organizational memory can support innovation by retaining a broader range of potential responses and provide more options for organizational decision makers. As March (1972: 427) asserted, “For most purposes, good memories make good choices.” The extent to which a broad search radius will support local firms’ competition against foreign rivals depends on how well local firms can draw on past solutions and adapt a routine for drawing on alternatives to fit the problems of the present circumstances. Local firms with a strong retrieval capacity tend to learn faster than local firms with a weak retrieval capacity. In contrast, foreign firms tend to suffer from the liability of foreignness. We thereby hypothesize the following:

H4. The negative effect of foreign entry on local firms’ survival (H1) is weaker for local firms with a strong retrieval capacity.

We present the theoretical framework in Fig. 1 illustrating the hypothesized relationships above.

4. Simulation

4.1. The NK model of fitness landscape

The NK model of fitness landscape is a mathematical model that was originally utilized to simulate adaptive evolution process in the context of biological systems (Kauffman, 1993). Fitness landscape is defined as the mapping between all possible combinations of attributes (e.g., genetic attributes) to fitness value. Therefore agents (e.g., organisms represented by a set of genes) can be localized and search for different fitness through modifying their attributes. An NK model provides a design framework of the fitness landscape, while the ruggedness of the landscape is tunable through a pre-defined degree of interdependence between attributes. This model has been popular in the management literature for exploring the relationship between a firm’s strategies and organization structure (Aggarwal et al., 2011; Alnuaimi & George, 2016; Baumann et al., 2018; Rivkin & Siggelkow, 2003; Welter & Kim, 2018). Following prior literature, firms’ search strategies are represented by a set of decisions; each decision set is then mapped to a specific fitness value in the fitness landscape (i.e., the market in which firms search for competitive advantage). Firms in the market aim at achieving better fitness through decision modification. There is no specific assumption on the decisions and the fitness; instead they represent general concept of factors and performance that dominate the firm metrics. Following this mapping, terms such as fitness/payoff, agent/firm, and landscape/market will be used interchangeably in the rest of the paper.
For simplicity, a firm’s search decisions are generally described by a binary string \(d\) (e.g., 100101). Two parameters, \(N\) and \(K\), are the basic parameters of the NK model where \(N\) defines the length of string and \(K\) defines the ruggedness of the landscape. As corresponding to market conditions, \(N\) denotes the number of decisions and \(K\) denotes the degree of interdependence between those decisions. The interdependence can also be interpreted as environmental complexity (Ganco & Hoetker, 2009). A payoff value is then assigned to each of the \(2^{N\times K}\) combinations of decisions following Eq. (1),

\[
P(d) = \left[ \sum_{n=1}^{N} F_n(d_{a1}, d_{a2}, ..., d_{aK}) \right]
\]

(1)

The payoff value \(P(d)\) is contributed by each of the decision \(d_{a1}(...,d_{aN})\) following mapping function \(F_n\). Moreover, the contribution of each single decision is affected by \(K\) interdependence decision \(d_{ai}, ..., d_{ak}\), resulting in \(2^{K+1}\) possible fitness contributions from each decision (i.e., domain and range of \(F_n\) have \(2^{K+1}\) possible value). Accordingly, if we take all possible contributions from a decision such as column vector and concatenate the vectors from all decisions, we can form a \(2^{n\times K+1}\) \(N\) payoff matrix. A single element of the payoff matrix is randomly drawn from uniform distribution \(U(0,1)\). The mapping function \(F\) is then defined by this payoff matrix rather than from an analytic expression. Since the payoff matrix is randomly generated, the NK model generates heterogeneous and independent landscapes in each trial, in which each landscape can be considered as a specific market. However, we are interested in the average performance of firms rather than a specific performance. To achieve statistical significance, hundreds or thousands trials are repeated for different landscapes. It is worth mentioning that although the choice of \(N\) refers to how many decisions are going to be made in a practical case, its exact value is not really important as long as enough variety is observed in the generated landscape (e.g., \(N = 12\) is generally used in the literature, where 4,096 sets of strategies are available\(^3\). In contrast, environmental complexity is the major modeling parameter and it is meaningful when discussing the scaling of \(N\). More precisely, we want to know how firms perform in a low interdependence environment (e.g. \(K = 1\)) compared with a high interdependence environment (e.g. \(K = N-1\)).

The abovementioned model has considered potentially complex, but fixed landscape topographies. However, landscapes may also be coupled to varied factors and mutual adaption can happen when the factors are changed (Levinthal & Warglien, 1999). One example factor is the cultural differences between different countries (e.g., Hofstede (1991)). A good decision in one country may turn into a bad decision in another country due to such a difference, or vice versa (Wu, Wu, & Zhuo, 2015). Such a factor is uncontrollable for firms and can be frequently adapted, resulting in different market environments between the local and foreign firms. The idea is modeled by the NK model of coupled landscape, namely the NKC model (Hordijk & Kauffman, 2005; Kauffman, 1993). We adopt the NKC model and modify it to incorporate the heterogeneous characteristics between local and foreign markets into the landscape model. In this study, a binary number \(M\) is defined as market background — e.g., \(M = 0\) represents the background of local market and \(M = 1\) represents the background of foreign market. The market background may affect firm decisions. Here we define the number of affected decisions by the parameter \(C\), while \(C\) is in the range of 0 (the market background does not affect any effect of decisions) to \(N\) (all decisions are affected).

5. Cournot model

With the NKC model, the firms are now represented by their decisions and the decisions have the corresponding payoff. The firms can use different strategies for searching the decision that makes better payoff. However, the interaction between firms cannot be described in the NK model. Lenox, Rockart, and Lewin (2006) first coupled the Cournot model with NK model for simulating the competition between firms while later empirical study is done by the same group and verified the predictability of the coupled models (Lenox, Rockart, & Lewin, 2010). Therefore, we can determine how the firms react to entry, exit and the survival rate. The Cournot model assumes undifferentiated competition, i.e., there is no quality difference between the product provided by the firms. Moreover, firms can recognize their interdependence and choose output quantities that maximize their profits. There are several key elements to formulate the model, including (1) the demand in the market \(Q\), which is also equal to the total product output from all the firms, (2) the price of product \(p\), which is the function of demand, (3) the cost of the product of ith firm \(c_i\), which is completely determined by the decision of the firm \(d\), and (4) the quantities of product output \(q_i\), which is determined by the maximization of profit. In Cournot model, the total product output is assumed to be the linear function of the price. Or equivalently, the price is also determined by the total product output (demand), which is formulated by Eqs. (2) and (3),

\[
Q = \alpha - (1 - \beta)p
\]

(2)

\[
p = \alpha - \beta Q
\]

(3)

The parameters \(\alpha\) and \(\beta\) control the capacity of the market, e.g., the price is at higher initial level when increasing \(\alpha\) or decreasing \(\beta\), it leads to higher possible profit and allows more firms to survive in the market. For simplicity, we set both parameters as 1 in our simulation. Assume the price has been known by the firms, then the expected profit of the ith firm can be determined by Eq. (4),

\[
\pi_i = pq_i - c_i q_i
\]

(4)

where the cost \(c_i\) is related to the firm’s decision by \(c_i = 1 - P(d_i)\). By defining that \(Q = \sum q_i\), the firms determine their output by maximizing the profit, as given by (5),

\[
\max \pi_i = (\alpha - \beta \sum q_i)q_i - c_i q_i
\]

(5)

Assume all the firms are rational, they will produce the optimal output solved by (5), which is given as follow,

\[
q^*_i = (\alpha + \sum c_i)/\beta(N_{firm} + 1) - c_i/\beta
\]

(6)

Detail derivation can be found in the supplement material of Lenox, Rockart, and Lewin (2006). Note that the output is re-determined at each trial and result in the sequence \(q_i(t), t = 1, 2, ..., T\). To determine the output at the new trial, the firms are assumed to know the cost of the other firms at the last trial, i.e., \(c_i(t - 1)\). Finally, when the production cost of firm is too high, the optimal quantity can be negative. Under this condition, the firm will not be able to make profit and will exit from the market.

\(^3\)One comment here is to take account of the fact that other competitors that enter a local market lately can learn from the first movers and become more competitive. The Cournot model takes account of this comment in the way it allows to enlarge the capacity of a local market via increasing the parameter \(\alpha\) and/or decreasing the parameter \(\beta\) in Eqs. (2) and (3). An enlarged market capacity allows more potential MNEs to survive in their original market, resulting in more local market candidates. Moreover, a higher capacity in local market allows more firms to survive therefore also allow more MNEs entry. Either way takes account of entry by other competitors that learn from first movers.
6. Search radius

On the landscape generated from the NK model, firms search for better payoff by changing their search decisions (i.e., change the bits in the string that represent the decision change from 0 to 1, or vice versa). Two main categories of search strategy are discussed in studies by (Lenox et al., 2006; Rivkin, 2000), and are generally summarized as innovation and imitation. By engaging in innovation strategy, firms change their decisions and adopt the change if and only if it actually improves the payoff. The market leader is defined as the firm with the highest payoff in the market and the non-leader firm employs imitation strategy to mimic the leader’s strategy. Due to firm-specific heterogeneity, such change of decision by non-leaders may not improve their current performance and may possibly reduce it. In this study, given our specific interest in effective strategies employed by local firms to confront foreign rivals, we focus on the search strategies of local firms (e.g., local search vs. distant search). The distinction between local and distant search is based on the number of decisions changed simultaneously: local search refers to minor change involving one or two decision parameters, whereas distant search refers to major change involving more than two parameters. While a major change (i.e., the number of changed parameters is large) could potentially bring rapid performance improvement on (e.g., making several good decisions in one step compared with making minor changes over several steps), firms will bear a higher risk for making several bad decisions in a major change. The effect is exacerbated when variation exists in performance evaluation. We include this variation in the landscape model, as it reflects well the practical case—i.e., that a firm can never do a perfect estimation on the performance outcome of new decisions, and therefore can misjudge the conditions, treating bad decisions as good decisions and implementing them, or vice versa.

In our simulation model, the number of changed decisions is defined by a parameter search radius (Aggarwal et al., 2011; Sigge1kow & Rivkin, 2006). Search radius (SR) takes the values of one, two, or three, etc. When SR = 1, firms only change one decision in each move (e.g., when d = 101, it will randomly consider 001, 111, or 100 as the next move), thus representing local search. Furthermore, firms are able to estimate the performance of change in a more accurate way. With SR = 3, firms consider changing one, two, or three decisions, respectively. For example, when d = 101, its will consider 001, 111, 100, 011, 110, 000, or 010 as the next move. The change is selected according to the estimated performance, and the major change represents distant search.

7. Retrieval capacity

Retrieval capacity (RC) is related to how efficient the firm decision makers are able to retrieve (extract) useful information from their knowledge base and past experience. New decisions are then possibly inspired by the retrieved information. This characteristic is closely related to the cognitive ability (Rivkin & Siggelkow, 2003) and cognitive effort of the decision makers (Giannoccaro & Nair, 2016). With stronger retrieval capacity, decision makers can reduce their workload to process the information from multiple proposals when making decisions on the changes of decision parameters. Consequently, they can consider multiple alternatives in an accessible search radius. In this study, we consider three levels of retrieval capacity: RC = 1, 3, and 6, and refer to them as weak, moderate and strong retrieval capacity, respectively. For instance, when d = 000000 and SR = 1, there are 6 possible new decision sets 100000, 010000, 001000, 000100, 000010, and 000001. With RC = 1, decision makers can only randomly take one of the new decision sets and compare its corresponding payoff to the original decision set. With RC = 3, three of the new decision sets can be considered and similarly all six new decision sets can be considered when RC = 6. Finally, the decision makers can take the best-performed decision set from the original decision set as well as the selected new decision sets.

8. The simulation setting

The parameters shown in Table 1 are initialized for the generation of the landscape model. N indicates the length of the string. Under a market context, each bit of the string refers to one kind of market decision. The string is generated randomly and independently for each firm at the beginning of the simulation. K indicates the environmental complexity of market. The value of environmental complexity describes the interdependence between the decisions. The larger the value of K, the more interactions exist between decisions; therefore changing one decision can greatly affect the payoff when K is large. For example, K = 5 indicates that each decision in the decision set interacts with five other decision. Previous studies have introduced different interaction patterns (Aggarwal et al., 2011; Rivkin & Siggelkow, 2003) for specific organization structure. Without a loss of generality, we randomly generate the interaction patterns in this study since no specific assumption is made on the organization structure. The value of M is used to describe the background difference between markets, and M = 0 and M = 1 are assigned to local market and foreign market, respectively. C takes a value in the range 0 to N and describes how many decisions interact with the market background. The larger the value of C is, the bigger the difference between the local and foreign market. Consequently, there is higher probability of failure when firms are trying to enter another market (i.e., foreign entry) since the optimal decisions in one market may not be optimal in a different market. Survival rate is used as the performance index in this simulation, which is calculated by two parameters: the number of survival firms at time t–1 (denoted by \( S_{t-1} \)) and the number of firms that survive at both t–1 and t (denoted by \( S_{t(t-1)} \)). The survival rate \( R(t) \) at time t is then defined by:

\[
R(t) = \frac{S_{t(t-1)}}{S_{t-1}} \times 100\%.
\]

Following the initialization of parameters, two markets are generated (the same landscape but with a different market background). As we assume the entry of mature foreign firms into a local market, we simulate this characteristic by allowing foreign firms to have sufficiently long periods to grow before entering local market—i.e., in other words, 80 simulation steps in this study. Starting with 100 firms in foreign markets, the simulations consider searching different decisions to increase the firms’ payoffs. Here we define the baseline searching strategy as local search (SR = 1) and weak retrieval capacity (RC = 1). Furthermore, we assume that foreign firms always use this baseline searching strategy. To model the competition between firms in a market, the Cournot model is employed and combined with the landscape model. Lenox, Rockart, and Lewin (2007) have demonstrated that the combination of Cournot model and landscape model allows for the observation of industry dynamics and industry cycle characteristics. We are interested in the case in which the foreign market is in a stage of maturity or decline, which they have identified as optimal or sub-optimal decision sets. Foreign firms thus seek to enter the local market in an introduction or growth stage for potential profit. Without a loss of generality, we assume no competition exists between foreign firms in the local market before they enter the local market. Therefore, all of these 100 foreign firms will be candidates for foreign entry.

Meanwhile, local firms enter and grow in local markets before foreign entry. Starting with 100 local firms with randomly generated decision sets in the local market, local firms search decisions that lead to lower production costs (higher payoff) and compete with others.
through cost competition. In addition to the baseline searching strategy, the same local firms are allowed to search with different SR and RC for verifying Hypotheses H3 and H4. Firms then decide the quality of output through Eq. (6). The worst-case scenario is no output while a firm's production cost is too high, and therefore no demand for their products/services. If a firm cannot make a profit in multiple periods (for simplicity, we let the firms exit after one period), it exits from the market forever. As time goes by, the 100 mature foreign firms will seek to enter local markets. Following the abovementioned setting, foreign firms become potential entries of local markets at the tenth simulation step—i.e., local firms have until the tenth simulation step to prepare and confront foreign entry. On the other hand, when a foreign firm considers entering a market, it must first decide whether to enter based on a probability (which is set to 20%, though it can be any percentage in this simulation). After the firm decides to enter a local market, it must further determine if a profit is expected. Foreign firms enter a local market when the above two conditions are satisfied. Following this framework, we can determine the effects of foreign entry on local firms based on the survival rate, the different levels of environmental complexity, the search radius, and the retrieval capacity. The simulation is repeated in 1000 randomly generated landscapes and the simulation is set to 80 periods, which is sufficient enough to observe a stable result. The survival rate is collected from each simulation and its average is presented. The basic setting is the same for all of the hypotheses, with a change in only one parameter (either \( K \), \( SR \), or \( RC \)) when verifying the different hypotheses.

9. Simulation results

Hypothesis 1 (H1) predicted that foreign competition has a negative effect on the survival of local firms initially, but that this negative effect declines over time. To test H1, in the simulation, we examined the initial impact on local firms when foreign firms enter the local market. We assume that \( N = 10, K = 9, C = 3, SR = 1, \) and \( RC = 1 \) for both local and foreign firms. The simulation results are reported in Fig. 2, where the dashed blue line indicates the normal trend of the local firm survival rate in the local market (without foreign entry). The solid orange line indicates the survival rate of the local firms when foreign firms enter into local market at the tenth simulation step (indicated by the vertical dashed line). A dramatic drop can be observed in local firms’ survival rate due to foreign entry. The reduction of the local firms’ survival rate exists for some periods (about 10 periods), and then the survival rate increases rapidly. These results support H1—that is, foreign competition has a negative effect on local firms initially, but the negative effect declines over time. We ascribe the survival rate increase to the fact that local firms have become more stronger by a “test by fire” (Barnett & Pontikes, 2008), as they learn from prior competition (e.g., knowledge spillover, imitation) and develop strong competitiveness. However, we believe that this situation happens only after a relatively long period.

We further examined the change of the negative H1 effect by comparing the survival rate of local firms with foreign firms entering (the dashed line in Fig. 2a) and the survival rate of local firms that have foreign entry (the solid lines in Fig. 2a) and plot the difference between in Fig. 2b. This difference shows that, compared with local firms without foreign entry, the survival rate of local firms associated with foreign entry quickly drops to below zero at the beginning and then gradually increases over time—that is, it is a U-shape. While Figs. 2a and 2b are equivalent in illustrating the results of H1, they provide two different but complementary perspectives to better understand the results of H1. Therefore, in our subsequent hypotheses testing, we will use both perspectives to illustrate the results.

Hypothesis 2 (H2) predicted that the negative effect of foreign entry on local firms’ survival (H1) is more salient at high levels of environmental complexity. To test H2, we examined how the entry of foreign firm influences the survival rate of local firms under different levels of environmental complexity. We let \( K \) takes the values of 1, 3, 5, 7, and 9 to represent different levels of environmental complexity and \( N \) takes the values of 10.\(^6\) We replicate the results of H1 when \( K \) takes the different values and plot the results in Figs. 3a–f. The dashed line in Figs. 3a–e represents the survival rate of local firms with foreign entry in different \( K \). Apparently, the negative effect of foreign entry increases when \( K \) increases from 1 to a large number. To accurately describe the survival rate change of local firms, we plot the changes in Fig. 3f (as in Fig. 2b). As shown in Fig. 3f, when \( K \) increases from 1 to 9, it leads to a lower survival rate. That is, the decrease (negative change) of the survival rate of local firms increases when \( K \) increases. However, the speed of this (increasing) effect slows down as time elapses (see the Figs. 3a–e as well as Fig. 3f as the period after 40).

Moreover, the speed of this effect varies as \( K \) changes to different values. In particular, the degree of change in the survival rate when \( K \) changes from 7 to 9 is much smaller than when \( K \) changes from 1 to 3. Thus, although we conclude that the negative effect of foreign competition on local firms strengthens as the complexity of market increases, the increasing trend of this effect decreases as market complexity increases.

\(^5\) The higher the value of \( K \) indicates a higher level of environmental complexity.

\(^6\) We tried other values of \( N \) (e.g., 7, 8, or 9) and the results are qualitatively the same as the results with \( K = 10 \).
complexity \((K)\) increases to a much higher level. As such, Hypothesis 2 (H2) is also supported.

Hypothesis 3 (H3) predicted that the negative effect of foreign entry on local firms’ survivals (H1) is weaker for local firms with a broad search radius. To test H3, we investigated how the entry of foreign firms influences the survival rate of local firms with different search radii. While the basic model setting is same with H1, the environmental complexity \(K\) takes the value of 9 while the value of search radius \(SR\) varies. Specifically, \(SR\) takes three values to represent three different levels of search radius: \(SR = 1\) denotes a narrow range of search (local search), \(SR = 2\) denotes a moderate range of search, and \(SR = 3\) denotes a relatively wide range of search (distant search). The results are reported in Fig. 4 and different survival rate situations with different \(SR\) are shown in Figs. 4a–c. Although the entry of foreign firms has a negative effect on the survival rate of local firms, this negative effect is much weaker when the search radius of the local firm is larger (e.g., compare \(SR = 1\) with \(SR = 3\)). We then focus on the change in survival rate, as shown in Fig. 4d, which is a combination of a–c based on the definition of survival rate change. When \(SR\) is larger, the line is higher and much closer to 0, which means a weakened negative effect for local firms as the \(SR\) increases. Therefore, local firms with a larger search radius are more capable of dealing with the negative impact of foreign entry. H3 is thus supported.

Hypothesis 4 (H4) predicted that the negative effect of foreign entry on local firms’ survivals (H1) would be weaker for local firms with a strong retrieval capacity. To test H4, we examined how the entry of foreign firms influences the survival rate of local firms with different levels of retrieval capacity. While the model setting is same as H1, and environmental complexity \(K\) again takes the value of 9 (for comparison across results), the value of retrieval capacity \((RC)\) takes various values: \(RC = 1\) denotes a low level of retrieval capacity, \(RC = 3\) denotes a moderate level of retrieval capacity, and \(RC = 6\) denotes a strong level of retrieval capacity. The results of the survival rate and changes in the survival rate of local firms across the different levels of retrieve capacity in the short- and long-term are shown in Figs. 5a–d, respectively. In Fig. 5d, it can be observed that a strong retrieval capacity \((RC = 6)\) leads to a slight decrease in the local firm survival rate as compared to a weak retrieval capacity \((RC = 1)\). This is not surprising, as local firms with a weak retrieval capacity find it hard to achieve a satisfactory performance with a limited choice of solutions in the face of foreign entry. In contrast, firms with a strong retrieval capacity provide decision makers with multiple solutions, which quickly guide them to improve their performance in face of foreign rivals. Consequently, a strong retrieve capacity weakens the negative effect of foreign entry on the survival rate of local firms. Hypothesis 4 (H4) is thus supported.

10. Theoretical contributions and implications

With increasing globalization, MNEs are expanding to multiple foreign markets in places such as Latin America, East Europe, and Asia, and leveraging their accumulated resources and capabilities to reap more returns. Foreign MNEs’ investments in these markets generate a strong competitive pressure on local firms’ strategic choices. Many local firms have not survived this intense competition. By building organizational learning and memory theory to explain how local firms cope with the negative effect of foreign entries into emerging markets, this study contributes to the literature in several key aspects.

First, this study contributes to the literature on competitive interactions between foreign and local firms. Prior studies have examined the impact of foreign entries on local firms (e.g., asymmetric competition between foreign and local firms examined in Li (2008)), but have
Fig. 3. The survival rate change of survival rate of local firms under different levels of environmental complexity (K). Note: The change of survival rate refers to the difference between the two lines in Fig. 1.

Fig. 4. Survival rate and change of survival rate with foreign entry, under different ranges of the search radius.
paid relatively less attention to different strategies of local firms in coping with the negative consequences associated with foreign entries. We add to the extant literature by examining how foreign entries negatively affect local firms’ performance outcomes in the short- and long-term, and investigate the specific strategies (e.g., search strategy, retrieve capacity) elicited by local firms as they respond to the negative performance consequences. We argue that local firms can reconstruct effective search strategies that enable them to fight against foreign rivals. Our simulation results and longitudinal data analyses indicate that the negative effect of foreign entry on local firms’ survival is weaker for local firms with a broad knowledge search radius. Moreover, the negative effect of foreign entry on local firms’ survival becomes weaker for local firms with a strong retrieve capacity, indicating that retrieval capacity is another key contingency that distinguishes high-performing local firms from poor-performing local firms in the face of foreign entries’ negative consequences. These findings add insight to the existing literature by showing that local firms could effectively improve their competitiveness and better cope with foreign competition over time by adopting appropriate search strategies.

Second, this study contributes to the dynamic competition literature by suggesting that the effects of foreign competition on local firms’ survival are contingent upon the temporal and environmental contexts. Specifically, we argue and find that although the entry of foreign firms would reduce the survival rate of local firms in the short run, this effect diminishes over time. We further show that environmental complexity increases the negative effect of foreign entries, as such levels of environmental complexity heighten the effect of entry of foreign firms on the survival rate of local firms. We attribute this to the fact that, due to increased requirements and differences in information processing, local firms take a longer time to identify and configure appropriate solutions to improve their unsatisfactory performance than foreign firms. Our study thus sheds light on dynamic competition theory by pinpointing environmental complexity and time as two key moderators that strengthen or weaken the negative effects of competitive intensity associated with foreign entries on local firms’ effective learning strategies in interacting with foreign competition.

This study has important managerial implications. First, the managers of local firms can learn from the findings that they would confront a high pressure resulted from MNEs’ entry at the initial stage and it is critical for them to search for an appropriate strategy that extricate themselves from a plight and surpass their local peers. Meanwhile, they can leverage their advantage of local market knowledge to fight against those foreign intruders. Second, managers of MNEs benefit from this study that their success at the initial beginning may have a fore-shadowing on their failure in the long run, due to managerial arrogance and learning myopia. They need to pay particular attention to environmental complexity in a local market that may render competitive advantage to be null. Third, the findings of this study also send a message to policymakers of local markets that market environment is a critical factor that shapes the competitive landscape for local firms and MNEs with a credo of constantly improving and maintaining the effectiveness and transparency of market environments. Appendix A summarizes the theories, hypotheses, and key findings linking to prior studies.

Like other studies, our work has limitations that provide potential directions for future research. First, we focus on two specific search strategies—search radius and retrieval capacity—that are particularly relevant for a local firm’s searching and transforming knowledge in order to enhance competitiveness. We acknowledge that other strategies, such as imitation and innovation strategies, may also have influence on the effects of foreign entries on local firms’ performance outcomes, as well as the extent to which local firms can effectively fight against foreign rivals. Fruitful future research could take into account other strategies embraced by local firms in nullifying the negative consequences associated with foreign entries. Second, in addition to examining competitive dynamics between foreign and local firms in a simulation setting, Future research would be beneficial in collecting empirical data from different business contexts such as those in China, Brazil, Russia, or India to verify the theoretical framework we proposed in this study.

In conclusion, we built on and extend prior studies (Ganco, 2017; Lenox et al., 2010) that have demonstrated that NK model and Cournot model can successfully capture the relationship between the environment complexity and the performance. The simulation is employed to verify how the complex relationships among different factors, including the environment complexity and exploration ability, all together...
contributing to the effects of foreign entry and local firms’ survivals. The scientific method thereby well reflects the effect of the considered factors and serves as an innovative and beneficial complement to the empirical studies. This study challenges the basic tenets concerning the negative consequence of foreign entries by illustrating how the effects vary over time and degrees of environmental complexity. In this study, we highlight that rather than simply being passive actors, local firms can elicit effective strategies to improve their competitiveness against foreign rivals in the marketplace.

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Appendix A

Table that summarizes the theories, hypotheses, and key findings linking to prior studies

<table>
<thead>
<tr>
<th>Theories</th>
<th>Hypotheses</th>
<th>Findings</th>
<th>Prior studies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Competitive advantage perspective/Org. learning perspective</td>
<td>H1: Although competition from foreign entries has a negative effect on the survival of local firms at the early stage, this negative effect diminishes over time.</td>
<td>1. A dramatic drop can be observed in local firms’ survival rate due to foreign entry. 2. The survival rate of local firms associated with foreign entry quickly drops at the beginning and then gradually increases over time (i.e., U-shape).</td>
<td>Figure 4 in Lenox, Rockart, and Lewin (2007) showed that in unique industry (no foreign entry), the survival rate of firms become stable over time.</td>
</tr>
<tr>
<td>Contingency perspective/Environmental complexity theory</td>
<td>H2: The negative effect of foreign entry on local firms’ survivals (H1) is strengthened in an increasingly complex environmental setting.</td>
<td>1. The negative effect of foreign entry increases when the market complexity (K) becomes higher (i.e., K increases). 2. The increasing trend of this effect decreases as market complexity increases to a much higher level.</td>
<td>Figure 4 in Lenox et al. (2007) showed that as the complexity increases, the survival rate of firms is decreased.</td>
</tr>
<tr>
<td>Knowledge search perspective</td>
<td>H3: The negative effect of foreign entry on local firms’ survivals (H1) is weaker for local firms with a broad search radius.</td>
<td>1. The negative effect of foreign entry is much weaker when the search radius (SR) of the local firm is larger.</td>
<td>Aggarwal et al. (2010) showed that search radius may have different effects under different governance structure (Larger SR/RC, increase exploration but also coordination failures).</td>
</tr>
<tr>
<td>Org. memory literature/Org. learning perspective</td>
<td>H4: The negative effect of foreign entry on local firms’ survivals (H1) is weaker for local firms with a strong retrieval capacity.</td>
<td>1. The negative effect of foreign entry is much weaker when the retrieval capacity (RC) of the local firm is larger.</td>
<td>Same as above.</td>
</tr>
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References

Hong Kong (No. 16050817), National Natural Science Foundation of China (No. 71728003), the University of Macau Research Committee under MYRG projects (No. MYRG 2016-00207-FBA/MYRG2018-00171-FBA), Macau Science and Technology Development Fund (FDCT) under project 055/2015/A2, the University of Macau Research Committee under MYRG projects 2016-00240-FST and 2017-00207-FST. The authors appreciate the comments from Strategic Management Society Special Issue in Rome and also Academy of International Business in Dubai in 2017.


