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LOCATION CHOICES UNDER STRATEGIC INTERACTIONS

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We explore a fundamental aspect of firms' location choices largely overlooked in the literature: strategic interaction. We formalize the notion that strategic interaction renders collocation less appealing by fostering competition, which erodes firms' profits. Strategic interaction also impacts location choices across time. Specifically, because firms learn by doing in markets, location choices are shaped by two novel effects: entrenchment benefits from entering early in a market and improving capabilities relative to rivals, and opportunity costs from postponing entry to other markets where rivals enter and learn. When learning is local, firms collocate more: rivals are preempted from improving relative capabilities in higher-value markets. However, when learning is global, firms collocate less: they can transfer capabilities from lower-value to higher-value markets, blocking rivals from achieving entrenchment benefits.

INTRODUCTION

What determines firms' geographic expansion strategies? Most of the literature emphasizes the role of location characteristics (Caves, 1996) and predicts that firms collocate in the most valuable markets (Alcácer, 2006). Casual observation, however, suggests a more nuanced picture of firm behavior, in which firms leverage their competitive position across markets and time. For example, Walmart favored rural markets, where competition was weak or nonexistent, before entering densely populated ones, where Kmart was a strong incumbent. Similarly, Emirates Airlines honed its business model in less competitive routes before entering markets served by strong competitors such as British Airways and Air France. Examples like these indicate that firms take their rivals' current and future locations into account, plotting their own expansions across time and markets in a deliberate location strategy to grow and defend their relative competitive positions. A geographic diversification strategy thus resembles a chess game: each move depends not only on the board—an array of potential locations—but also on the pieces in play—firm heterogeneity—and, more importantly, on the interaction between players—strategic interaction. Exploring firms' location choices without including all three components misses key elements of the game.

In this paper, we ask: How does strategic interaction and learning across time and markets influence location strategies? By answering this question, we bring strategic interaction back to the discussion of location choices, a perspective that has not received much attention since it was proposed by Hotelling (1929) in the

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industrial organization (IO) literature and assimilated into the international business (IB) literature by Knickerbocker (1973) and Hymer (1976). The few papers that did look into the effect of strategic interactions on location choices, such as Flyer and Shaver (2003), took a static approach, even though in reality firms choose strategies dynamically, evaluating the trade-offs of potential geographic expansion paths across time and markets. A single decision that appears suboptimal may actually be part of an overall location strategy that guarantees the firm's long-term competitive advantage.

Learning introduces dynamic trade-offs to location strategies. Learning processes lie at the heart of our understanding of how firms build capabilities to generate and sustain competitive advantage, and geographic expansion is often cited as a tool to elicit learning. Chang (1995) and Guillén (2002), for example, associated firm capability and learning with entry decisions; Delios and Henisz (2003) and Perkins (forthcoming) showed that learning from institutional environments affects firms' location choices as well as their subsequent performance in a host country. While bringing dynamics (through learning) into the realm of location choices, these studies overlooked the role of interactions between rival firms, an important feature of oligopolistic competition that characterizes multinational enterprises (MNEs). By highlighting the role of strategic interaction in location choices while incorporating dynamic trade-offs associated with learning across time and markets, our study mimics more closely the realities of global competition and provides new insights into competitors' strategic location choices.

We take a formal approach. In particular, we employ a game-theoretical model in which heterogeneous firms choose to enter new geographic markets across time, taking their competitors' actions into account. The model is solved using the traditional game theory concept of sub-game perfect equilibrium under three learning scenarios: no learning, local learning, and global learning. These scenarios capture the ability of a firm to transfer its capabilities across markets. With no learning, firms keep their initial capability levels across time. With local learning, capability gains are location-specific and are not transferrable across markets. With global learning, firms can transfer capabilities gained in one market to other markets.

When location characteristics alone drive location choices, as the literature generally asserts, collocation is the predicted outcome in every case. In contrast, with strategic interaction, two equilibrium strategies emerge from our baseline model: collocate and avoid. In fact, our model suggests that collocation is the exception rather than the norm. We identify how these strategies, collocate and avoid, are more or less likely to emerge depending on (1) heterogeneity between locations (market attractiveness), (2) heterogeneity between firms (relative firm capabilities), (3) competition intensity (the erosion in market profits resulting from the way firms compete), and (4) scenarios and rates of learning. Using the chess analogy, the first two factors account for the board and the pieces at play, while the third one underpins the strategic interaction between players. Learning adds an extra element that brings dynamism to the strategic interaction.

The model suggests that firms will always avoid each other initially when markets are similar, because capturing the total value of a slightly smaller market is preferable to sharing a marginally larger market with a rival. Only when one market becomes disproportionately less attractive does collocation emerge. When markets are dissimilar, symmetry in capabilities leads to more collocation. As a less capable firm improves is relative competitive standing, it is better able to brave competition in a significantly larger market instead of aiming for monopoly rents in a considerably smaller market. Notably, increasing competition intensity erodes the potential profits firms may earn, even in a larger market, and thereby increases the likelihood that firms avoid each other.

Two novel effects that drive location strategies emerge when firms learn in the markets they occupy: (1) the entrenchment benefit of entering a market early, and (2) the opportunity cost of not entering the other market. When firms expand into new geographic markets, they have a vast set of common options from which to choose. But entering a new market requires resources, so firms are limited in the number of markets they can enter simultaneously in a given period of time. In effect, a firm that chooses one new geographic market improves its competitive position in that market but also postpones its entry into other potential markets, giving competitors in those markets valuable lead time to improve their competitive positions. This trade-off—between the benefits of entering and the opportunity costs of postponing—determines whether firms will choose a location strategy that avoids competitors or one that collocates with them. As a result, a firm is driven not only by relative market size, its initial capabilities, and competition intensity, but also by the need to preserve, improve, or minimize the erosion of its relative competitive position over time (as its competitors learn). How effective firms are at this task depends on the learning rate and learning scenario. Under local learning, as the learning rate increases, the entrenchment benefit of early entry increases (decreasing collocation), as does the opportunity cost of not entering the other market (increasing collocation). We use numerical estimation to predict the overall effect and find that the faster the learning rate, the more likely it is that collocation emerges. Under global learning, the ability of firms to transfer improvements in firm capabilities across markets decreases the propensity to collocate. Both entrenchment benefits and opportunity costs are very robust strategic effects: they emerge regardless of the order or timing (sequential or simultaneous) with which firms enter.

As in any attempt to formalize a complex phenomenon, we face a trade-off between narrow richness—taking a few elements that are fully characterized—and comprehensive simplicity—including all elements but in a stylized manner. We opted for the latter. We condense the many dimensions of location heterogeneity that are common to all firms, such as regulation and market size, into a single measure of market value. We model firm heterogeneity through initial competitive positions represented by the share of market value a firm can capture. We model strategic interaction based on competition intensity and how knowledge is accumulated and transferred on a limited time horizon. Moreover, we model only two of the aspects of knowledge diffusion that affect strategic interaction: its speed—through learning rates—and its scope—through global learning and local learning scenarios.

Clearly, this approach misses some of the richness present in competitive landscapes: locations vary in more than their potential value, competitors differ along many dimensions, strategic interaction may be triggered by factors other than competition intensity and learning, competitors may be numerous, and learning can occur across firms and is more than a one-dimensional phenomenon. However, we believe that, in spite of its simplicity, our model captures the essential aspects of the context we are studying. More importantly, it offers a comprehensive approach to understanding the drivers of firm location choices by modeling the impact not only of location, but also of strategic interactions among heterogeneous firms.

MODELING APPROACH

We employ a game-theoretical model to explore how strategic interaction and learning jointly affect the geographic expansion of heterogeneous firms across time and markets. We assume an oligopolistic industry in which firms offer a homogenous product that potentially appeals to multiple markets worldwide. In this context, global expansion is desirable, and selecting locations across countries becomes critical not only because it increases profits, but also because it could improve, preserve, or minimize the erosion of a firm's competitive position.

Our approach is two-fold. We first develop a stylized model that provides the intuition for the four effects that drive entry choices: market value, competition, entrenchment benefits, and opportunity costs. The advantage of this model is that it is simple, easy to follow, and reasonably general. However, because it does not capture the richness of more specific models or predict an unambiguous net impact of learning on entry choices for each of the learning scenarios we consider, we complement it with numerical analyses based on a specific, well-established competition model (the Cournot model of competition based on quantities) and a specific functional form for learning (an exponential learning curve). Both the Cournot model and the exponential learning curve fit reasonably well in our stylized model.

The stylized model

In our stylized model, two firms, $i = h, l$ (high-capability and low-capability, respectively), expand sequentially into two markets, $j = H, L$ (high-value and low-value, respectively). Markets differ in the value firms might appropriate, denoted by V^j.[1] We consider that $V^L = \gamma V^H$, so γ represents the relative value of market *L*, and $\gamma \in [0,1]$.

[1] We understand that market value may vary depending on firm capabilities. To keep the model simple and tractable, we keep *V* fixed for now, but will allow it to be endogenously determined in the numerical solution of our Cournot model.

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For example, when $\gamma = 0.5$, the gross profits in the low-value market, V^L, are half of those in the high-value market, V^H. In addition, to reflect the idea that competition reduces market profits, we define the market value under duopoly as $W^j = \rho V^j$, with $\rho \in [0,1]$. For example, when $\rho = 0.5$, duopoly market value becomes 50 percent of the monopoly market value. The parameter ρ captures the effect of competition intensity, e.g., the extent to which market value is eroded because of the mode firms use to compete. Lower values of ρ are associated with higher competition intensity. For instance, price competition (Bertrand) results in more market value erosion, making competition more intense, and has a lower value of ρ associated with it compared to quantity competition (Cournot).

We introduce firm heterogeneity through differences in firms' initial capabilities to produce and sell in markets. Any capability advantage that a firm has over its competitor (e.g., better management, higher efficiency, superior product quality, etc.) is reflected in a larger market share and gross profit. We denote with α_{ijt} the share of market value that firm i captures in market j in period t when it competes with its rival, $-i$. Firms' gross profits are $\pi_{ljt} = \alpha_{ljt} W^j$ and $\pi_{hjt} = \alpha_{hjt} W^j$, and $\alpha_{ljt} + \alpha_{hjt} = 1$. Note that α_{ljt} reflects the relative capability of firm l with respect to firm h: a more capable firm will capture a larger proportion of market value. We assume that $\alpha_{lj1} < 1/2$, so that firm l is less capable in the first period,[2] and that its disadvantage is equal across markets, that is, $\alpha_{lL1} = \alpha_{lH1} = \alpha_{l1}$. Note that there are only two relevant competitors in the model and there are no local firms in any market.

In this stylized model, we make no assumption about the competition mode (i.e., Bertrand, Cournot, etc.) between the two firms. This allows us to focus on conceptual development and to make robust predictions about the direction in which strategic interaction with learning impacts entry choices. However, to make predictions about the overall impact of strategic interaction under learning on firms' entry choices, we need a specific mode of competition as well as well-specified functional forms for profit generation and learning. For illustration, we use a quantity-competition Cournot model with exponential learning.

In the Cournot model, the markets are characterized by inverse demand functions $p = \Gamma^j - q$, where p represents price, q represents quantity, and Γ^j represents the potential market size, that is, the quantity sold in market j when the price is zero ($j = H, L$). For simplicity, we normalize the potential size of the high-value market, Γ^H, to 1 and denote that of the low-value market with $\Gamma^L = \Gamma \leq 1$, so Γ parallels the parameter γ from our baseline model. Firm heterogeneity is captured by differences in firms' marginal costs: the low-capability firm l has a marginal cost $c_l = c$, while the high-capability firm h has a marginal cost $c_h = \varepsilon c$, where $\varepsilon \leq 1$. A higher value of ε means that firm h has a smaller capability advantage over its rival, allowing firm l to capture a relatively larger share (though still less than half) of the market, thus ε parallels the parameter α_{l1} in our baseline model.

We make several assumptions about the timing of the game. First, we assume that firms expand to one market per period. Restricting entry to no more than one market is sensible because managers are limited in their capacity to supervise simultaneous expansions, financial resources for concurrently opening operations may not be available, and transferring technology into new markets is difficult. For example, IKEA enters new markets very slowly in order to guarantee homogeneity in operations across countries and to minimize external financing.[3] Second, we assume that firms expand sequentially. We favor a model of sequential entry (rather than simultaneous entry) for factual and practical reasons. Our motivating examples (Walmart vs. Kmart; Emirates vs. British Airways) as well as casual observations suggest that firms observe their competitors' entry behavior and can react when making entry decisions, which is inconsistent with the assumption of a simultaneous-entry model. Finally, within the context of a sequential-entry model, we assume that the high-capability firm h enters first into a market and the low-capability firm l enters into a market upon observing its rival's action. We make this assumption purely for expositional reasons, as it allows us to avoid repetition and present the effects underlying entry for a single firm. We acknowledge that these assumptions impact equilibrium outcomes; as such, in APPENDIX 1 we discuss

[2] This assumption is without loss of generality since the other case, $\alpha_{hj1} < 1/2$, is symmetrical.

[3] Milne, R. "IKEA chief drops plan to double pace of store openings," *Financial Times*, 1 September, 2013.

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Table 1. Timing

$t = 1$	(a)	h expands into a market
	(b)	l expands into a market after observing h's choice
	(c)	l and h compete and decide how much to produce; first-period profits and second-period capabilities realized
$t = 2$	(a)	l and h expand in the other markets
	(b)	l and h compete and decide how much to produce; second-period profits realized

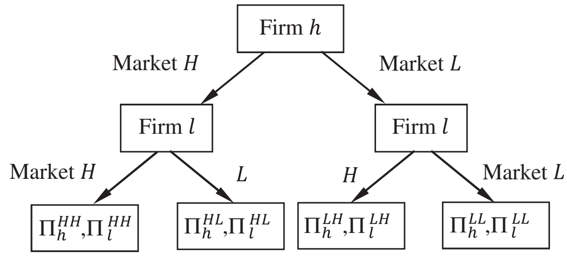

Figure 1. The game tree: the high-capability firm moving first

several models based on different entry order and timing, and show that our analysis and the main effects underlying entry choices are the same as in our baseline model, where the high-capability firm enters first.

The timing of the game is depicted in Table 1.

Firm i's strategy, s_i, is defined as a tuple $s_i = s_{it} \mid t = 1, 2$, where s_{it} represents firm i's market presence in period t, with $s_{it} \in \{(\emptyset, \emptyset), (L, \emptyset), (\emptyset, H), (L, H)\}$. For example, if firm l enters market H in period 1 and market L in period 2, we write the firm's strategy as $s_l = \{(\emptyset, H), (L, H)\}$. For simplicity, we assume there are no fixed costs, and we restrict the parameters so that firms are always profitable in all markets. Therefore, firms do not exit from markets entered in the first period, and they always enter the remaining market in the second period.[4] As a result, the markets that the two firms enter in the first period uniquely determine the strategies for the entire game. To save on notation, we use $s = LL$, LH, HL, or HH to describe the strategies employed by both firms, where the first (second) letter indicates the market that the high-capability (low-capability) firm enters in the first period. For instance, $s = HL$ means that firm h follows strategy $s_h = \{(\emptyset, H), (L, H)\}$, entering market H first, and firm l follows strategy $s_l = \{(L, \emptyset), (L, H)\}$, entering market L first.

Strategic interaction between the firms happens in two dimensions; one pertains to entry and the other to competition. In each period, the firm that moves first makes its entry choice anticipating its rival's optimal response. Then, in each period, firms engage in competition, whereby their choices (e.g., price, quantity, etc.) take into consideration their rivals' choices.

Firms choose strategies that maximize their total profits across time and markets considering rivals' moves. Consequently, total profits depend on firms' strategies, and we denote firm i's profits by Π_i^s. If under strategy s, firm i enters market j in the first period and market $-j$ in the second period, its total profit across time is $\Pi_i^s = \pi_{ij1}^s + \pi_{ij2}^s + \pi_{i-j2}^s$.[5] For example, if both firms enter high-value market H in the first period ($s = HH$), firm l's total profit will be $\Pi_l^{HH} = \pi_{lH1}^{HH} + \pi_{lL2}^{HH} + \pi_{lH2}^{HH}$. Figure 1 illustrates all the possible strategies the firms can employ and the profit outcomes associated with each strategy.

Note that in the absence of strategic interaction, firms will make entry choices based solely on location characteristics. As a result, both firms will enter high-value market H in the first period and low-value market L in the second period, a path of continuous collocation that corresponds to the first, left-most branch in the game tree depicted in Figure 1.

To provide a more realistic representation of actual firm behavior, we follow previous work in economics (Spence, 1981) and management (Epple, Argote, and Devadas, 1991), and introduce

[4] These assumptions are without a loss of generality in terms of the effects that drive firms' entry choices. In terms of the numerical results, they only impact the range of parameters over which firms employ one entry strategy or another. In particular, any positive fixed costs of production would have the same impact on profits regardless of the market a firm enters, and thus it would not affect the firm's location preference. Fixed costs would, however, affect the firm's decision to enter or remain in a market at all. Consequently, the range of parameters over which firms are always profitable in both markets is smaller; over the remainder of the range, the firm might choose not to enter in the remaining market or it might choose to exit altogether.

[5] For simplicity, we assume that there is no discounting of future profits. As with the assumption about fixed costs, this is without loss of generality in terms of the effects driving firms' entry choices; in terms of numerical results, this assumption only impacts the range of parameters over which firms employ one entry strategy or another. For a model with discounting across time and fixed costs, please refer to Alcácer *et al.* (2013).

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dynamic firm capabilities by assuming that firms learn from experience. As firms become more familiar with the production process in a new market, identify the best suppliers there, develop working routines, and adapt their technology to market conditions and regulations, they are able to improve their absolute capabilities. We assume that improvement happens at a learning rate λ. In the Cournot specification of our model, we follow Spence (1981) and assume that firms' marginal costs follow an exponential learning curve with a common learning rate λ, where $\lambda \geq 0$. Thus, the second-period cost of firm i in market j, where it first entered and produced a quantity q_{ij1}, is given by:

$$c_{ij2} = c_{i1}\, e^{-\lambda q_{ij1}} \quad (1)$$

A unique advantage of multimarket firms is their ability to transfer knowledge across markets and leverage learning in one market for their operations in another (Bartlett and Ghoshal, 1989). Hence, we assume that a fraction of the learning in one market is transferrable to other markets, and denote the transferability rate as $\mu \in [0,1]$. Thus, if firm i enters and produces in market j in the first period, its second-period cost in market j will be determined according to Equation 1, and its second-period cost in the other market, $-j$, will be given by:

$$c_{i-j2} = c_{i1}\, e^{-\mu\lambda q_{ij1}} \quad (2)$$

Although learning improves a firm's absolute capability, the effect on its relative capability is unclear until the rival's learning is calculated. Let α^{s}_{lj2} denote firm l's second-period relative capability in market j when firms follow strategy s at time $t = 1$. For example, when high-capability firm h enters high-value market H, and low-capability firm l enters low-value market L, firm l's second-period relative capability in market j is α^{HL}_{lj2}; when both firms enter the high-value market at time $t = 1$, firm l's second-period relative capability in market j is α^{HH}_{lj2}. Thus, a firm can use its expansion to affect its own and its rival's learning and to improve, preserve, or minimize the erosion of its relative capability. Learning is the key element in the model that links entry decisions across time.

To investigate the effect of learning on firms' entry strategies, we analyze our model in three scenarios that differ in how firms' relative capabilities (α_{ijt}) change over time: no learning (firms' absolute and relative capabilities are static and identical across markets), local learning (the cumulative experience a firm gains in one market improves its second-period absolute capability *only* in that market), and global learning (a firm's cumulative experience improves its second-period absolute capability across all markets). Regardless of the learning scenario, we solve the game by backward induction and use the sub-game perfect Nash equilibrium (SGPNE) concept to identify the equilibrium strategies that maximize firms' overall profits.

The no-learning scenario

Under the no-learning scenario, firms' absolute and relative capabilities do not depend on their first-period strategies and are static across time and markets ($\alpha^{s}_{ij2} = \alpha^{HL}_{ij2} = \alpha^{HH}_{ij2} = \alpha^{LH}_{ij2} = \alpha_{i1}$, $\forall\, i = h, l$ and $\forall\, j = H, L$). Similarly, firms' second-period profits do not depend on first-period strategies. Consequently, we identify equilibrium strategies comparing only first-period profits.

Assume that high-capability firm h enters high-value market H in the first period (strategy $s_{h1} = (\emptyset, H)$). Low-capability firm l can either avoid firm h by entering low-value market L (strategy $s_{l1} = (L, \emptyset)$, with associated profit $\pi_{lL1} = V^L$), or collocate with firm h by entering the high-value market (strategy $s_{l1} = (\emptyset, H)$, with associated profit $\pi_{lH1} = \alpha_{l1} W^H = \alpha_{l1}\rho V^H$). Firm l will avoid firm h when its benefit from being a monopolist in the low-value market, V^L, is greater than its benefit from sharing the high-value market, $\alpha_{l1}\rho V^H$, that is, when

$$\gamma > \alpha_{l1}\rho \quad (NL - l)$$

Naturally, when firm l enters low-value market L (if ($NL - l$) holds), firm h has no incentive to deviate from its strategy of entering high-value market H: being a monopolist in market H and earning V^H is better than competing in market L and earning $\alpha_{h1} W^L$. In fact, even if firm l enters high-value market H (if ($NL - l$) fails to hold), firm h has no incentive to deviate from its strategy of entering high-value market H. By entering low-value market L, firm h would earn V^L, whereas by remaining in high-value market H, it would earn $\alpha_{h1} W^H$. But firm h's profit in high-value market H is larger than firm l's profit in the same market ($\alpha_{h1} W^H > \alpha_{l1} W^H$), and since

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firm l already prefers to enter high-value market H ($\alpha_{l1}W^H > V^L$), it follows that firm h prefers the same option ($\alpha_{h1}W^H > V^L$).

As a result, two distinctive equilibrium entry strategies emerge, depending on whether condition ($NL - l$) holds. When condition ($NL - l$) holds, firms locate apart in the first period: high-capability firm h enters high-value market H and low-capability firm l enters low-value market L. This equilibrium strategy, which we name *avoid*, corresponds to $s_h = \{(\emptyset,H),(L,H)\}$ and $s_l = \{(L,\emptyset),(L,H)\}$. When condition ($NL$-$l$) fails, low-capability firm l initially enters high-value market H, as well. This equilibrium strategy, which we name *collocate*, corresponds to $s_h = \{(\emptyset,H),(L,H)\}$ and $s_l = \{(\emptyset,H),(L,H)\}$.

These two equilibrium entry strategies—firms avoid each other or they collocate—depend on two fundamental effects: the market value effect and the competition effect. The market value effect, parameterized by γ, captures the idea that as markets become more similar in value (if γ increases), firm l's loss from entering low-value market L, given by $V^H - V^L = (1-\gamma)V^H$, decreases. As a result, firms are more likely to adopt the *avoid* strategy. By contrast, as markets become more dissimilar (as γ decreases), firm l's loss from entering low-value market L increases, making it more likely that firms adopt the *collocate* strategy.

The competition effect captures firm-level profit erosion resulting from (1) *competition intensity*, which reduces market value, and from (2) *market sharing*, which reduces a firm's share of the already reduced market value. *Competition intensity*, parameterized by ρ, reflects the idea that as competition intensifies (ρ decreases), firm l has more to lose by entering high-value market H (because market value erodes from V^H to $W^H = \rho V^H$), thereby making it more likely that firms adopt the *avoid* strategy.

Market sharing reflects the idea that, when firms compete, firm l's share of the market decreases from a monopoly share of 100 percent to one determined by its relative capabilities, parameterized by α_{l1}. If firm l's relative capability weakens (if α_{l1} decreases), firm l has more to lose by entering high-value market H because it can only capture a smaller part of the reduced market value ($\alpha_{l1}W^H$). Because firm h decided to enter high-value market H, both firms become more likely to adopt the *avoid* strategy. By contrast, if firms become more similar, they also become likely to adopt the *collocate* strategy.

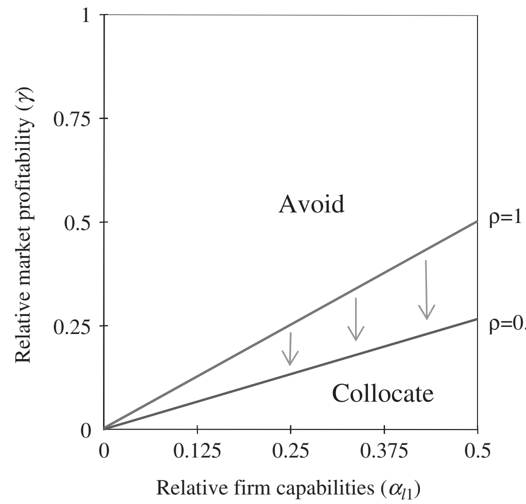

Figure 2. Equilibrium strategies: no-learning scenario

Figure 2 shows the equilibrium areas determined by condition ($NL - l$). The change along the y-axis reflects the market value effect, the change along the x-axis reflects the market sharing effect, and the pivoting of the line in Figure 2 reflects the competition intensity effect. Summarizing the above, an increase in the value of low-value market L (an increase in γ, for a fixed capability differential α_{l1}) has the equivalent effect of an increase in the intensity of competition or a decrease in firm l's relative capability (a decrease in ρ or α_{l1}, for a fixed market-value differential γ), all resulting in a decrease in the likelihood of collocation. In fact, our model shows that firms never collocate when markets are similar in value (when γ is high) because capturing the total value of a slightly smaller market is preferred to sharing a slightly larger market with a rival.

Recall that without strategic interaction, firms choose markets myopically, e.g., based only on their characteristics (market value) without considering the actions of rivals. In this case, the market value effect is the sole driver of firms' entry choices, and the prediction is that firms always collocate. The emergence of a significant area where firms choose *not* to collocate highlights the value of adding strategic interaction to location decisions.

Figure 3 replicates Figure 2 using a specific mode of competition, the Cournot model, and a value of $c_l = 0.3$ for the low-capability firm's

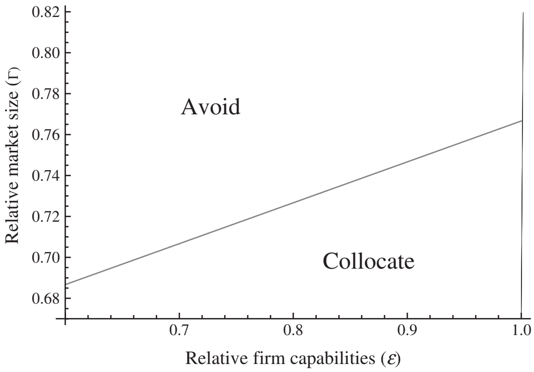

Figure 3. Equilibrium strategies: no-learning scenario, Cournot model

marginal cost. We restrict the value of Γ (which captures the relative size of the low-value market and parallels parameter γ in Figure 2) and ε (which captures firm l's relative cost disadvantage and parallels parameter α_{l1} in Figure 2) to the interval [0.6,1] to ensure that both firms are present in both markets in the second period. We solve the model for firms' optimal quantities and maximum profits for each point in the parameter space under each strategy. Figure 3 depicts the combination of parameters ε and Γ whereby $(NL - l)$ holds as equality (e.g., where the maximum profits that firm l can earn by avoiding or collocating with firm h are equal).[6]

Naturally, the results based on the Cournot model are the same as in the baseline model: as markets become more similar (Γ increases), firms' need to enter the most unique and attractive market decreases, as does the likelihood of collocation. As firms become more similar (ε approaches 1), the likelihood of collocation increases because the low-capability firm is better equipped to compete in the high-value market, where it can capture a larger share.

Local learning

Under the local learning scenario, firms learn from their first-period experience at a rate $\lambda > 0$, and the knowledge that firms accumulate through experience in one market is *not* transferable to the other market, so $\mu = 0$. As a result, in the local learning scenario, $\alpha_{ij2}^{HL}(\lambda) \neq \alpha_{ij2}^{LH}(\lambda) \neq \alpha_{iH2}^{HH}(\lambda) \neq \alpha_{i1}$, $\alpha_{iL2}^{HH}(\lambda) = \alpha_{i1}$, and $\alpha_{iL2}^{s} \neq \alpha_{iH2}^{s}$ for all strategies s. Clearly, local learning links firms' first-period expansion strategies to their second-period absolute and relative capabilities: if firms locate apart in the first period, their absolute *and* relative capabilities in the markets they entered will improve, but these improvements are smaller in magnitude when they collocate.

We solve the game by backward induction. Since firm h always enters high-value market H in the first period (strategy $s_{h1} = (\emptyset, H)$), we focus only on firm l's entry strategy. Low-capability firm l can *avoid* firm h by entering market L (strategy $s_{l1} = (L, \emptyset)$), earning total profits $\Pi_l^{HL} = V^L + \alpha_{lL2}^{HL} W^L + \alpha_{lH2}^{HL} W^H$, or it can *collocate* with firm h by entering market H (strategy $s_{l1} = (\emptyset, H)$), earning total profits $\Pi_l^{HH} = \alpha_{l1} W^H + \alpha_{lL2}^{HH} W^L + \alpha_{lH2}^{HH} W^H$. Firm l avoids firm h when its total benefit from initially being a monopolist in low-value market L exceeds its total benefit from initially sharing high-value market H, that is, when

$$\gamma + \left(\alpha_{lL2}^{HL} - \alpha_{lL2}^{HH}\right) \rho\gamma + \left(\alpha_{lH2}^{HL} - \alpha_{lH2}^{HH}\right) \rho > \alpha_{l1} \rho \qquad (LL - l)$$

with $\alpha_{ij2}^{s} = \alpha_{ij2}^{s}(\lambda)$.

Compared to the equivalent condition in the no-learning scenario, $(NL - l)$, two new terms in $(LL - l)$ capture the effect of learning on firm l's equilibrium entry strategy: what we call *the entrenchment benefit* of early presence in market L and *the opportunity cost* of absence from H.

The first term, $\left(\alpha_{lL2}^{HL} - \alpha_{lL2}^{HH}\right) \rho\gamma$, captures firm l's *entrenchment benefit* from an early presence in low-value market L. This term is always positive and it decreases firm l's incentives to collocate with firm h in the first period compared to the no-learning scenario, more so when the learning rate, λ, increases. The intuition for this is that when firm l enters and monopolizes market L initially, its relative capability in L improves because firm l learns while firm h does not, so $\alpha_{lL2}^{HL} > \alpha_{l1}$. The more firm l can learn— that is, the higher λ becomes—the more it improves its relative capabilities. By contrast, when firm l enters and competes with firm h in market H, neither firm improves its absolute or relative capability in market L because neither firm learns there, so $\alpha_{lL2}^{HH} = \alpha_{l1}$. As a result, $(LL - l)$ is more likely to hold compared to $(NL - l)$.

[6] Note that in Figure 3, as well as in all figures based on the Cournot model, the parameter Γ on the vertical axis is depicted in the [0.67,0.82] range only for visualization purposes.

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The second term, $\left(\alpha^{HL}_{lH2} - \alpha^{HH}_{lH2}\right)\rho$, captures the *opportunity cost* to firm l of allowing firm h to improve its relative position in market H. This term is always negative and, compared to the no-learning scenario, it increases firm l's incentives to collocate with firm h in the first period, more so when the learning rate, λ, increases. Intuitively, when firm l enters and monopolizes market L, it forgoes the opportunity to learn in the other market, H, and it allows firm h to improve its absolute and relative capability as a monopolist in that market, even more when the learning rate, λ, increases. By collocating with firm h in the early stages of expansion, firm l's relative capability in market H decreases less because it curbs firm h's gains while boosting its own absolute capabilities through learning; therefore, $\alpha^{HH}_{lH2} > \alpha^{HL}_{lH2}$. As a result, $(LL - l)$ is less likely to hold compared to $(NL - l)$.

The extra terms in $(LL - l)$ introduce a new element to the trade-off between collocation and avoidance that is absent when learning does not occur. With local learning, firms are driven not only by initial firm and market heterogeneity, but also by the need to improve, preserve, or minimize the erosion of their relative capabilities over time. For example, firm l chooses between the low- and high-value markets to maximize learning and improve or contain the erosion of its relative capability in these markets.

While the effect of learning on firm l's entrenchment benefit and opportunity cost is clear,[7] we are unable to use our stylized model to predict the net effect of learning on firm l's equilibrium strategy. Equilibrium strategies depend on the comparison of total profits associated with each strategy, which in turn depend on the specific mode of competition and functional forms assumed for demand, costs, and learning.

To circumvent this limitation, we use the Cournot model with exponential learning functions described previously in The Stylized Model.

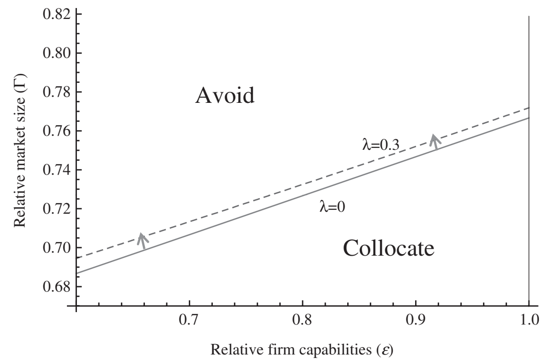

Figure 4. Equilibrium strategies: local learning scenario, Cournot model

Although ideal, closed-form solutions are impractical for solving this type of highly complex and nonlinear model. We opt instead to illustrate the model's outcome numerically. The model is solved dynamically, so firms choose the quantities that maximize their profits across time. In particular, firms produce more in the first period in order to increase their competitive edge in the second period, even though the overproduction may compromise their profit in the first period. The steps followed in the numerical analysis are (1) selecting a value for the learning rate, (2) computing firms' optimal quantities and maximum overall profits for each point in the parameter space under each strategy, and (3) finding the combination of parameters ε and Γ whereby $(LL - l)$ holds as equality (e.g., where the maximum profits that firm l can earn by avoiding or collocating with firm h are equal).

Figure 4 shows the results of this numerical analysis for $\lambda = 0$ (our base case of no learning) and for $\lambda = 0.3$—a value that is calibrated to produce empirically reasonable cost declines.[8] As the learning rate increases from 0 to 0.3, firms adopt the *collocate* strategy more often. Under Cournot competition, firm l's opportunity cost of being absent from high-value market H is larger than its entrenchment benefit from being present in low-value market L. By avoiding competition, firm l's cost position erodes and it loses market share to firm h in a high-value market, and the forgone profit is not compensated for by its improved cost

[7] Entrenchment benefit and opportunity cost are triggered by the same mechanism: a firm's capability improves through learning when it enters a market. However, they are defined *relative* to a benchmark case, that of a firm being initially a monopolist in a given market (and implicitly allowing its rival to be a monopolist in the other market). Therefore, when firm h enters market H, the entrenchment benefit that h gains in H is quantitatively different from the opportunity cost that l experiences by not entering H. Similarly, the entrenchment benefit that l gains by entering market L is quantitatively different from the opportunity cost that it experiences by not entering H.

[8] This value means that each additional unit of quantity produced results in an approximate 30% reduction in marginal costs relative to the marginal cost of the last unit produced. This is in line with previous studies, as summarized in Argote (1999), first chapter.

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position or by its gain in market share over firm h in the low-value market. Finally, note that both Γ and ε have the same effect on strategies in the local learning scenario as in the no-learning scenario: collocation increases as firms become more similar in capabilities and decreases as markets become more similar in value.

Global learning

Similar to the local learning case, the strategies followed in the first period determine firms' second-period relative capabilities under a global learning scenario. However, these two scenarios differ on how transferable knowledge is across markets. Under local learning, cumulative experience gained by firm i in market j changes the firm's second-period absolute capability *only* in market j; under global learning, a proportion of its learning, μ, can be transferred across markets. As a result, in the global-learning scenario, $\alpha^{HL}_{ij2}(\lambda,\mu) \neq \alpha^{LH}_{ij2}(\lambda,\mu) \neq \alpha^{HH}_{ij2}(\lambda,\mu) \neq \alpha_1$ and $\alpha^{s}_{iL2}(\lambda,\mu) \neq \alpha^{s}_{iH2}(\lambda,\mu)$ for all strategies s.[9]

As before, firm l can *avoid* firm h by entering low-value market L (strategy $s_{l1} = (L, \emptyset)$) and earn total profits $\Pi^{HL}_{l} = V^L + \alpha^{HL}_{lL2}W^L + \alpha^{HL}_{lH2}W^H$, or it can *collocate* with firm h in high-value market H (strategy $s_{l1} = (\emptyset, H)$) and earn total profits $\Pi^{HH}_{l} = \alpha_{l1}W^H + \alpha^{HH}_{lL2}W^L + \alpha^{HH}_{lH2}W^H$. Rewriting the profits, firm l avoids firm h when

$$\gamma + \left(\alpha^{HL}_{lL2} - \alpha^{HH}_{lL2}\right)\rho\gamma + \left(\alpha^{HL}_{lH2} - \alpha^{HH}_{lH2}\right)\rho > \alpha_{l1}\rho. \qquad (GL-l)$$

(GL − l) is similar to *(LL − l)*: aside from the market value and competition effects, as in the local learning scenario, firm l would attain an entrenchment benefit by monopolizing low-value market L, and would bear an opportunity cost by foregoing high-value market H. However, in contrast to the local-learning case, α^{s}_{ij2} is now a function of both the learning rate, λ, and the rate of transfer, μ, so that $\alpha^{s}_{ij2} = \alpha^{s}_{ij2}(\lambda,\mu)$, and the transferability of knowledge across markets affects the magnitude of both the entrenchment benefit and the opportunity cost.

Consider first the *entrenchment benefit* $\left(\alpha^{HL}_{lL2} - \alpha^{HH}_{lL2}\right)\rho\gamma$. When firm l is a monopolist in market L in the first period, firm l learns at a rate λ in that market. In the local learning scenario, this would lead to an increase in firm l's absolute *and* relative capabilities, because firm h does not learn in that market. In the global learning scenario, however, firm h's absolute capability in market L also increases because firm h can transfer, at a rate μ, the higher absolute capability achieved in market H in the first period. As a result, in the global learning scenario, firm l's increase in absolute capability is counterbalanced by an increase in firm h's absolute capability, so firm l's relative capability from entrenching in low-value market L is lower than under the local learning scenario (e.g., α^{HL}_{lL2} (global learning) $<$ α^{HL}_{lL2} (local learning)). The magnitude of the drop in firm l's relative capability in the global learning scenario as compared to the local learning scenario is determined by firm h's absolute capability improvement as a monopolist in market H: the larger the portion of absolute capability improvement that firm h can transfer to market L (the larger μ is), the larger the drop in firm l's relative capability in market L becomes.

If firm l collocates with firm h in high-value market H, its relative capability *in low-value market L* also decreases compared to the local learning scenario because firm h, due to its higher relative capability, produces and learns more than firm l ($\alpha^{HH}_{lL2} < \alpha_{l1}$). However, in the collocation case, the drop in firm l's relative capability in the global learning scenario, as compared to the local learning scenario, is smaller in magnitude than in the avoidance case because (1) firm h's absolute capability improvement in market H is lower when it is a duopolist, and because (2) firm l also improves its absolute capability in that market. Consequently, because α^{HL}_{lL2} decreases more than α^{HH}_{lL2}, firm l's entrenchment benefit of being a monopolist in market L decreases, and firm l is more inclined to collocate with firm h in high-value market H. The urge to collocate becomes stronger when the proportion of capabilities that firms can transfer across countries increases (e.g., as μ increases).

We now analyze the *opportunity cost* $\left(\alpha^{HL}_{lH2} - \alpha^{HH}_{lH2}\right)\rho$. When firm l is a monopolist in market L in the first period, its absolute *and* relative capabilities *in high-value market H* erode in the local learning scenario, because firm

[9] Note that when the rate of transfer is complete, that is, when $\mu = 1$, firm i's relative capabilities are equalized across markets, so that $\alpha^{s}_{iL2}(\lambda,\mu) = \alpha^{s}_{iH2}(\lambda,\mu)$.

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l does not learn in that market, while firm h does. However, in the global learning scenario, firm l is able to transfer to market H, at rate μ, the absolute capability improvement attained as a monopolist in market L in the first period. As a result, even if firm l entrenches in low-value market L in the first period, its relative capability in market H erodes less under the global learning scenario than under the local learning scenario (e.g., α_{lH2}^{HL} (global learning) $>$ α_{lH2}^{HL} (local learning)). The erosion in firm l's relative capability in the global learning scenario, as compared to the local learning scenario, is determined by the absolute capability improvement that firm l attains as a monopolist in market L; when firm l can transfer a larger portion of its absolute capability improvement from market L to market H (when μ becomes larger), the erosion in firm l's relative capability in market H is smaller, and thus its relative capability is higher.

On the other hand, when firm l collocates with firm h in high-value market H, its relative capability in market H decreases compared to the local learning scenario. The intuition for this is that (1) firm h produces and learns more than firm l because firm h has higher absolute capabilities to start with, and (2) firm h has incentives to produce and learn even more when it can apply its capability improvement to a larger market, $(H+L)$, than when it can apply any improvement only to high-value market H, as in the local learning scenario. Consequently, because α_{lH2}^{HL} increases and α_{lH2}^{HH} decreases, firm l's opportunity cost decreases. This tilts firm l's balance toward avoiding firm h and entering low-value market L. This inclination will increase as it becomes easier for firms to transfer their capability improvements across markets (e.g., as μ increases).

The effect of the rate of transfer of capabilities on firm l's equilibrium entry strategy depends on the comparison of total profits associated with each strategy, and these total profits depend on the mode of competition and the functional forms assumed for demand, costs, and the learning process. Therefore, to illustrate the effect of μ, we rely on numerical analysis, using again the Cournot model introduced in the previous section and the learning functions described in Equations 1 and 2. The numerical analysis repeats the process described in the previous section for a particular calibrated value for the learning rate and for selected rates of transfer. Figure 5 depicts the results of this numerical analysis for $\lambda = 0.3$ and $\mu = 0$ (the local-learning case) and for $\lambda = 0.3$ and $\mu = 0.5$, as well as $\lambda = 0.3$ and $\mu = 1$.

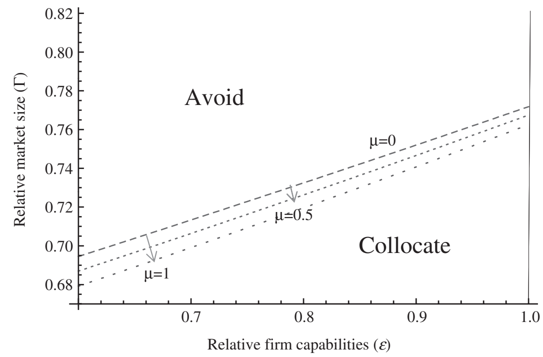

Figure 5. Equilibrium strategies: global learning scenario, Cournot model. $\lambda = 0.3$

Figure 5 shows that, for a given learning rate ($\lambda = 0.3$), firms *collocate* less often as the transfer rate increases from 0 to 0.5 and then to 1.[10] More generally, firms collocate less in the global-learning scenario than in the local-learning one. In comparison to the local-learning case, where firm l's opportunity cost of absence from the high-value market was larger than its entrenchment benefit in the low-value market, the opportunity cost decreases faster than the entrenchment benefit in the global learning scenario. Intuitively, firm l no longer needs to collocate with firm h to avoid incurring the opportunity cost of absence from the high-value market; it can simply avoid firm h and transfer more of the capability improvement it gains in the low-value market to the high-value market. Thus, capability transfer acts as a substitute for market entry.

Figure 6 brings together all of the learning scenarios to summarize the effect of learning on equilibrium strategies. As shown in Figures 4 and 5, firms are more likely to collocate in the local learning scenario than in the no-learning scenario, and less likely to collocate in the global learning scenario than in the local learning scenario. It is apparent from Figure 6, however, that if the transfer rate is high, firms are less likely to collocate in the global learning scenario than in the no-learning one.

[10] Although almost imperceptible due to the scale, note that, consistent with Figure 2, the slope of the line separating the collocate and avoid strategies changes with the learning rates in Figures 4 and 5.

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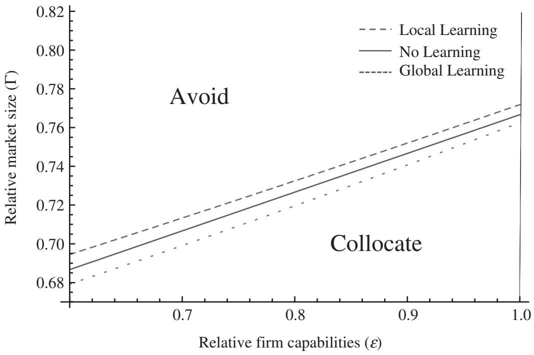

Figure 6. Equilibrium strategies: no-learning, local learning, and global learning scenarios, Cournot model

DISCUSSION

When commenting on the economic geography literature, Krugman expresses the need to move beyond the assumption of perfect competition when he writes,

> Essentially, to say anything useful or interesting about the location of economic activity in space, it is necessary to get away from the constant-returns, perfect competition approach that still dominates most economic analysis (1991: 4).

This call triggered a revival of work that looks at firms interacting across markets and time (Antràs and Yeaple, 2013; Ellickson and Zame, 2005), an effort to which our paper aims to contribute. In the same way that Ghemawat (2001) introduced multidimensional distance between home and host markets as a lens affecting a location's attractiveness, our work suggests a similar role for strategic interaction. Importantly, this lens helps us to explain not only one location decision at a point in time, but also a set of location decisions across time. After all, location decisions are not static and isolated decisions related to specific geographic markets; they are events linked across time and geography. When studying these patterns empirically, overlooking strategic interaction amounts to an omitted variable problem that may bias estimates for coefficients associated with location traits.

However, strategic interaction does not always translate into the competition and deterrence our paper suggests. The multimarket contact literature suggests that firms enter the same markets as competitors to soften competition. For instance, Gimeno *et al.* (2005) find that firms competing in the domestic market tend to follow each other to the same foreign markets, while noncompeting firms tend to avoid each other geographically. While the multimarket contact literature focused more on the consequences of firms sharing markets, our work provides a theoretical framework to understand the antecedent of multimarket contact: the competitive constraints in product markets that determine the number of contacts across markets.

Our work creates a valuable and necessary link between strategy and IB scholarship. By adding concepts familiar to strategy scholars, such as competitive advantage and strategic interaction, we underline that a firm's operations abroad are also an important source of sustainable competitive advantage in oligopolistic competition. The paper also offers an alternative explanation for collocation in global expansion. For example, our model suggests different geographic expansion paths depending on the relative value of markets within a region. When a region is dominated by one large country, collocation ensues and firms compete. Competing firms produce less and learn less, and as a result their costs in the second period will be higher than if they hadn't collocated. By contrast, when a region has multiple countries with similar market value, collocation is rare, firms monopolize markets, and they produce and learn more. As a consequence, their costs are lower in those markets than they would be with collocation.[11] Our model also demonstrates that collocation depends in part on an industry's mode of learning, with local learning increasing the likelihood of initial collocation, and global learning decreasing it. In other words, instead of explaining collocation as a function of agglomeration benefits (David and Rosenbloom, 1990; Marshall, 1892) or mimetic behavior (Lieberman and Asaba, 2006) due to asymmetric information or uncertainty (Henisz and Delios, 2001), our model offers an explanation based on strategic interaction.

Our study has relevance for other research streams in strategy, as well. It suggests that firms can time market entry strategically, across

[11] Thanks to an anonymous reviewer for highlighting this point.

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time and locations, to make themselves more competitive. For example, if in equilibrium a low-capability firm foresees a better outcome when it moves first, it may use that timing advantage to shift the balance of power against its rivals. These findings are consistent with Lieberman and Montgomery (1988), who suggested that the geographic scope of learning may be considered a source of first-mover advantages that fuels spatial preemption under strategic interactions. Other factors influencing firm's timing decisions can be explored with similar game-theoretical approaches. For example, Comino (2006) takes a game-theoretical perspective to suggest that firms may deliberately delay investment in a host country in order to conceal information from competitors. More recently, Hawk, Pacheco-de-Almeida, and Yeung (2013) find that firms with high-speed capabilities may wait longer to make high levels of investment because they can afford to wait out uncertainty in new markets. Our paper adds to these a different potential role for timing: altering the equilibrium routes of entries, and hence the ability to improve capabilities, between rival firms.

The implications of entry timing also vary across different learning scenarios. For example, Walmart and Emirates Airlines avoided rivals initially. With global learning (experiences are partially transferable across rural markers, and less travelled routes), both firms located apart strategically. In industries characterized by local learning, such as banking (due to different regulatory environments and client needs across markets), MNEs tend to enter in the same market for fear of losing out in the learning game and thus allowing entrenchment by their competitors. Such collocation patterns were obvious, for example, when countries in Latin America first, and China later, opened up their banking sector.

The level of abstraction in the model also allows us to extend its predictions beyond entry in geographic markets to, for instance, entry into new product markets, contributing to the corporate strategy literature. In this new context, learning scenarios (i.e., local vs. global learning) represent the ability of firms to exploit synergies across industries when firms diversify; transferability maps to the level of relatedness across industries.

Admittedly, there are limitations with our approach, which also provide opportunities for future research. First, our paper abstracts from production factors, so it leaves out the role of endowments or agglomeration economies as centripetal forces that trigger collocation (Hanson, 2001). Neither does it consider the effect of strategic interaction in inputs markets on locations (Alcacer and Chung, 2013). An obvious next step would be to add agglomeration economies associated to inputs to our model, similar to the work of Pacheco-de-Almeida and Zemsky (2012) in knowledge spillovers and competition.

Second, we made some assumptions in our model to decrease its complexity. Relaxing those assumptions can reveal new interesting dynamics and identify boundary conditions for our findings. For example, we assume that markets are equally attractive to all firms while previous research in IB suggests that attractiveness varies by an MNE's country of origin (Ghemawat, 2001); we don't allow for firms to exit, while exit is a common outcome in international expansions (Caves, 1996). Although some recent research relaxes some of these assumptions (Alcácer *et al.*, 2013), more work is needed.

Third, although we exploited firm heterogeneity by assuming difference in initial costs, other sources of potential firm heterogeneity remained unexplored in our model. Both the Walmart and Emirates stories suggest that firms diverge not only in their initial capability endowment, but also in their ability to upgrade such capabilities—an example of dynamic capabilities as defined in the strategy literature (Teece, Pisano, and Shuen, 1997). In the context of our model, that would mean that learning rates may vary by firm. Moreover, we assumed that the type of learning, local or global, is industry driven and thus common for all firms. Yet even within an industry, organizational structure and incentives, human resources practices, and communication mechanisms are all important drivers of knowledge transfer within firm boundaries. Thus, certain firms may follow a local learning model while others emulate a global learning one. It will be interesting to explore how heterogeneous learning scenarios and/or learning rates affect firms' expansion trajectories over time.

Finally, our model focuses on one type of strategic interaction: competition in the product market. Other forms of strategic interaction also need development, such as collocation to soften competition through price collusion, as suggested by Ghemawat and Thomas (2008) among others. We hope this study inspires future work to that end.

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CONCLUSION

This paper explores how strategic interaction and learning jointly affect the geographic expansion of heterogeneous firms across time and markets. Our model crystalizes two novel effects at play when firms strategically expand in the geographic space: the opportunity costs of not entering a market—an effect that encourages contemporaneous entry—and the entrenchment benefits of entering early—an effect that encourages firms to delay collocation. Including both effects in future research will provide a richer framework that better describes actual location patterns across time and markets. These strategic effects are very robust: they emerge even when we use specifications with different entry order and timing (high-capability firm entering first, low-capability firm entering first, and simultaneous entry).

Results from our model suggest that firms' location decisions look substantially different when strategic interaction is included. In fact, contrary to the prevailing view in the global strategy literature, it would appear that collocation is the exception rather than the norm. The model provides several testable predictions. First, firms are more likely to avoid each other when geographic markets are similarly attractive because being a monopolist in a slightly smaller market is preferable to being a duopolist in a larger market. Second, when markets are highly asymmetric in value, collocation becomes more likely as firms become more similar. This is because as a less-capable firm improves is relative competitive standing, it braves competition in a significantly larger market instead of aiming for monopoly rents in a significantly smaller market. Third, as competition intensity increases, leading to a significant erosion of market value from competition, firms tend to collocate less. This effect grows when firms are more similar.

Finally, learning plays an important role in determining the equilibrium entry strategies. The avoid strategy provides a firm with an entrenchment benefit created by learning and using that learning to improve its competitive position as a monopolist in a market. But the avoid strategy also entails an opportunity cost, because abstaining from entering the other market allows a rival firm to improve its competitive position as a monopolist there. When learning is local, an increase in the learning rate increases the entrenchment benefit of locating in a smaller market, but it increases even more the opportunity cost of *not* locating in a larger market, so that a less-capable firm is more likely to collocate in order to preempt its rival from learning and building a stronger competitive position in a larger market. By contrast, when learning is global, a less-capable firm can preempt its rival from learning and building a stronger competitive position in a larger market by transferring capability improvements it gains as a monopolist in a smaller market. This ability to preempt rivals increases with the rate at which learning is transferred. Thus, transferability acts as a substitute for market entry, decreasing the likelihood of collocation.

For managers, this paper illustrates different ways firms can use location choices across time and geographic markets as a tool to enhance or preserve a firm's competitive position within an industry. In that sense, it reveals the importance of further research on geographic diversification and its impact on value creation.

For strategy scholars, our paper aims to elicit interest on dynamic strategic interaction among rivals across markets. We followed a path of formal modeling that has advantages and disadvantages. On the positive side, a formal model allows us to explore the complex relationship between market heterogeneity, firm heterogeneity, and spatial strategic interaction in a parsimonious and unequivocal way. However, to parsimoniously deconstruct a complex phenomenon, we needed to simplify the model's elements. We hope that this study will inspire future work in strategy to revisit many of the simplifying assumptions we made and to provide, collectively, a more accurate picture of firms expanding across markets.

For managers, this paper offers important—and sometime counterintuitive—insights into firms' location choices. First, entering the most attractive market is not an optimal strategy for all firms. In fact, as learning becomes more global, some firms would be better off avoiding competitors until they have managed to increase their capabilities in less crowded markets. Second, there is not a one-size-fits-all strategy for international expansion: a location strategy that works in an industry characterized by local learning may not work in an industry with global learning. Local learning requires collocation with rivals across markets to preempt them from attaining a strong competitive position in those markets;

global learning encourages avoiding rivals because knowledge transfer allows firm to more effectively improve, or prevent the erosion of, their competitive position across countries. Finally, this paper prompts managers to think beyond a single location choice-—based on evaluating the characteristics of an individual market—to a location strategy—a set of actions that link location choices across time and geographic markets and that account for the present and future locations decisions likely to be made by rival firms.

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APPENDIX ALTERNATIVE SPECIFICATIONS

In this appendix, we discuss two variations in our model: (1) the low-capability firm moving first, and (2) both firms entering simultaneously.

Table A1. Timing

$t = 1$	(a)	l expands into a market
	(b)	h expands into a market, after observing l's choice
	(c)	l and h compete and decide how much to produce; first-period profits and second-period capabilities realized
$t = 2$	(a)	l and h expand in the other markets
	(b)	l and h compete and decide how much to produce; second-period profits realized

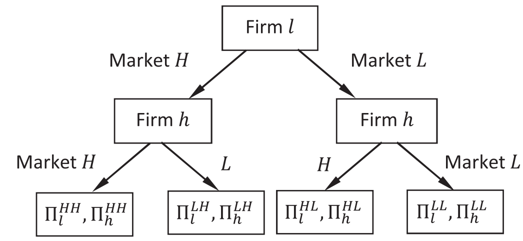

Figure A1. The game tree: the low-capability firm moving first

Low-capability firm moves first

A key assumption of our baseline model is that the high-capability firm h moves first and then the low-capability firm l acts upon observing h's decision. While this assumption simplifies the exposition of the main ideas and is appropriate in some real-life situations, in others the order of expansion is reversed[12] so that in the first period, $t = 1$, (a) low-capability firm l expands first into a market, and then (b) high-capability firm h observes l's decision and subsequently expands into a market. In this Appendix we show that, in this alternative scenario, the ranges of parameters over which firms avoid each other or collocate are the same, but avoidance strategies can take two forms: *forfeit* (when low-capability firm l concedes high-value market H to its rival in the first period) and *seize* (when firm l enters market H anticipating that firm h will enter market L). The timing of the game in the alternative scenario is depicted in Table A1.

Maintaining the notation from our baseline model, namely, that $s = LL, LH, HL$, or HH describes the strategies employed by both firms, where the first (second) letter indicates the

[12] For example, Mobil entered the Russian oil market after observing the entries of smaller firms such as Philbro and Conoco (Janosz, Kou, and Spar, 1995).

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market that the high-capability (low-capability) firm enters in the first period, this game can be depicted as Figure A1.

As before, to identify the equilibrium entry strategies that maximize firms' total profits, Π_i^s, we solve the game by backward induction—first, for the no-learning scenario—and use the subgame perfect Nash equilibrium concept to identify equilibrium strategies.

We start with the case where there is no learning. Assume that low-capability firm l enters high-value market H in the first period (strategy $s_{l1} = (\emptyset, H)$). High-capability firm h can either avoid firm l by entering low-value market L (strategy $s_{h1} = (L, \emptyset)$, with associated profit $\pi_{hL1} = V^L$), or collocate with firm h by entering the high-value market (strategy $s_{h1} = (\emptyset, H)$, with associated profit $\pi_{hH1} = \alpha_{h1} W^H = \alpha_{h1} \rho V^H = (1 - \alpha_{l1}) \rho V^H$). Firm h will avoid firm l when its benefit from being a monopolist in the low-value market, V^L, is greater than its benefit from sharing the high-value market, $\alpha_{h1} \rho V^H = (1 - \alpha_{l1}) \rho V^H$, that is, when

$$\gamma > \alpha_{h1} \rho = (1 - \alpha_{l1}) \rho. \qquad (NL - h)$$

Naturally, when firm h enters the low-value market (if $(NL - h)$ holds), firm l has no incentive to deviate from its strategy of entering the high-value market because being a monopolist in a high-value market and earning V^H is better than competing in the low-value market and earning $\alpha_{l1} W^L$. However, if $(NL - h)$ fails to hold and firm h prefers to enter the high-value market in the first period (strategy $s_{h1} = (\emptyset, H)$), firm l is in the same situation as in our baseline model, where firm h enters first into a market: firm l can either avoid firm h by entering low-value market L (strategy $s_{l1} = (L, \emptyset)$, with associated profit $\pi_{lL1} = V^L$), or collocate with firm h by staying in the high-value market (strategy $s_{l1} = (\emptyset, H)$, with associated profit $\pi_{lH1} = \alpha_{l1} W^H = \alpha_{l1} \rho V^H$). Firm l will avoid firm h under the exact same condition as in our baseline model, that is, when its benefit from being a monopolist in the low-value market, V^L, is greater than its benefit from sharing the high-value market, $\alpha_{l1} \rho V^H$, or

$$\gamma > \alpha_{l1} \rho. \qquad (NL - l)$$

As a result, three distinctive equilibrium strategies for entry emerge, depending on whether conditions $(NL - h)$ and $(NL - l)$ hold. When condition $(NL - h)$ (and implicitly $(NL - l)$) holds, that is, when $\alpha_{l1} \rho < (1 - \alpha_{l1}) \rho < \gamma$, firms locate apart in the first period. However, in contrast to our baseline model, it is now low-capability firm l that seizes the high-value market, anticipating that high-capability firm h will avoid collocation by entering the low-value market. This equilibrium strategy, *seize*, corresponds to $s_l = \{(\emptyset, H), (L, H)\}$ and $s_h = \{(L, \emptyset), (L, H)\}$. When condition $(NL - h)$ fails to hold and condition $(NL - l)$ holds, that is, when $\alpha_{l1} \rho < \gamma < (1 - \alpha_{l1}) \rho$, firms also locate apart in the first period as in our baseline model: low-capability firm l enters the low-value market (*forfeiting* the more attractive high-value market) and avoids firm h, anticipating that firm h will enter the high-value market. This equilibrium strategy, *forfeit*, corresponds to $s_l = \{(L, \emptyset), (L, H)\}$ and $s_h = \{(\emptyset, H), (L, H)\}$. Finally, when both $(NL - h)$ and $(NL - l)$ fail to hold, that is, when $\gamma < \alpha_{l1} \rho < (1 - \alpha_{l1}) \rho$, both firms enter the high-value market. This strategy, *collocate*, corresponds to $s_h = \{(\emptyset, H), (L, H)\}$ and $s_l = \{(\emptyset, H), (L, H)\}$. Since (*NL-l*) in this alternative model is the same as in our baseline model, the range of parameters over which firms collocate or avoid each other in equilibrium is the same as in our baseline model.

As with our baseline model, these equilibrium entry strategies—whether firms avoid each other or collocate—depend, in the absence of learning, on the same fundamental effects: market value and competition. The market value effect captures the idea that, as markets are more similar in value (if γ increases), each firm's loss from entering the low-value market, given by $V^H - V^L = (1 - \gamma) V^H$, decreases. As a result, firms are more likely to adopt a variant of the *avoid* strategy (*forfeit* or *seize*). Similarly, the competition effect captures the firm-level profit erosion resulting from (1) *competition intensity*, which reduces market value, and (2) *market sharing*, which reduces either firm's share of the already reduced market value. *Competition intensity* reflects the idea that, as competition intensifies (ρ decreases), each firm has more to lose by entering the high-value market (because market value erodes from V^H to $W^H = \rho V^H$), and therefore firms are more likely to adopt a *forfeit* or *seize* strategy. Finally, *market sharing* reflects the idea that, when firms compete, a firm's share of the market decreases from a monopoly share of 100 percent to a share

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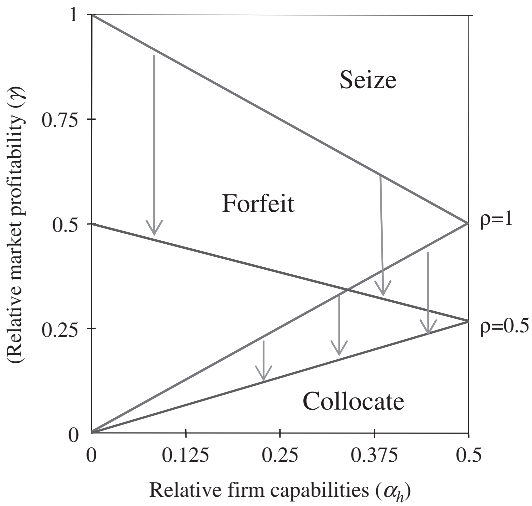

Figure A2. Equilibrium strategies: alternative-entry-order model, no-learning scenario

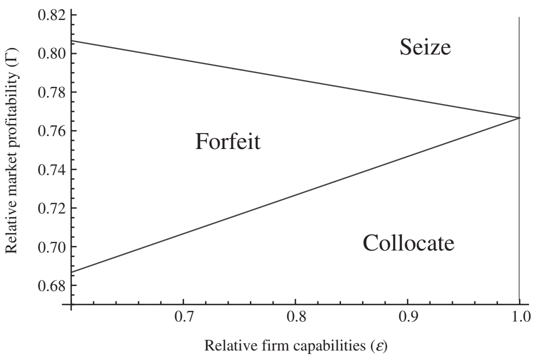

Figure A3. Equilibrium strategies: alternative-entry-order model, no-learning scenario, Cournot model

determined by the firm's relative capability. Thus, when a firm's relative capability weakens (if α_{i1} decreases), it has more to lose by entering the high-value market because it can only capture a smaller part of the reduced market value ($\alpha_{i1}W^H$). Again, firms become more likely to adopt a variant of the *avoid* strategy (*forfeit* or *seize*).

Figures A2 and A3 show the equilibrium areas determined by conditions $(NL - h)$ and $(NL - l)$ for the general and the Cournot models, respectively. The parameter for the Cournot model is the same as in Section Modeling Approach, of the paper: $c_l = 0.3$ for the low-capability firm's marginal cost.

We now move to the scenarios where learning occurs. As in our baseline model, the presence of learning (whether local or global) introduces two new terms in firms' decision about whether to avoid one another or collocate. Condition $(NL - h)$ is rewritten as

$$\gamma + \left(\alpha_{hL2}^{LH} - \alpha_{hL2}^{HH}\right)\rho\gamma + \left(\alpha_{hH2}^{LH} - \alpha_{hH2}^{HH}\right)\rho > \alpha_{h1}\rho = (1 - \alpha_{l1})\rho \qquad (L - h)$$

while condition $(NL - l)$ is rewritten in the same way as conditions $(LL - l)$ and $(GL - l)$ in our baseline model

$$\gamma + \left(\alpha_{lL2}^{HL} - \alpha_{lL2}^{HH}\right)\rho\gamma + \left(\alpha_{lH2}^{HL} - \alpha_{lH2}^{HH}\right)\rho > \alpha_{l1}\rho \qquad (L - l)$$

where α_{ij2}^{s} is a function of only the learning rate, λ, in the local learning scenario, and a function of both learning rate λ and the rate of transfer, μ, in the global-learning scenario.

The new terms in $(L - h)$ and in $(L - l)$, $\left(\alpha_{hL2}^{LH} - \alpha_{hL2}^{HH}\right)\rho\gamma$ and $\left(\alpha_{lL2}^{HL} - \alpha_{lL2}^{HH}\right)\rho\gamma$, capture the *entrenchment benefits* firms accrue from an early presence in the low-value market. In the local-learning scenario, these terms are positive and increase as learning rate λ increases, tilting firms' balance toward avoiding one another and entering the low-value market. Intuitively, the higher the learning rate, the better entrenched a firm becomes with its early presence in the market. In the global learning scenario, these terms decrease in magnitude (and potentially change sign) as rate of transfer μ increases. That is, with the ability to transfer knowledge across markets, an early presence becomes less critical for remaining competitive in the second-period in the low-value market, tilting firms' balance toward collocating in the high-value market.

The other new terms in $(L - h)$ and in $(L - l)$, $\left(\alpha_{hH2}^{LH} - \alpha_{hH2}^{HH}\right)\rho$ and $\left(\alpha_{lH2}^{HL} - \alpha_{lH2}^{HH}\right)\rho$, capture firms' *opportunity costs* of absence from the high-value market. In the local learning scenario, these terms are negative and become more so as learning rate λ increases, tilting firms' balance toward collocating in the high-value market. Intuitively, with a higher learning rate, the absentee firm loses more ground to its rival in the high-value market in the second period, as the rival has significantly improved its capability there. In the global learning scenario, being absent from the market is not as detrimental because firms can transfer their capabilities from one market to another. Thus, these terms decrease in magnitude (and potentially change sign) as rate of transfer

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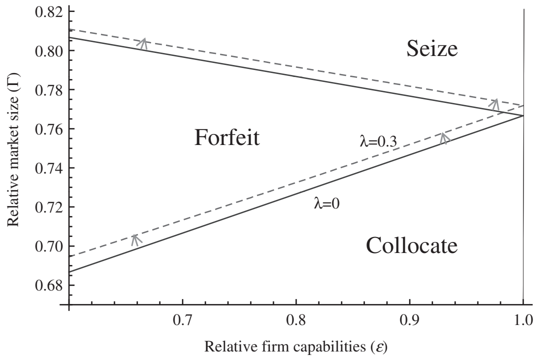

Figure A4. Equilibrium strategies: alternative-entry-order model, local learning scenario, Cournot model

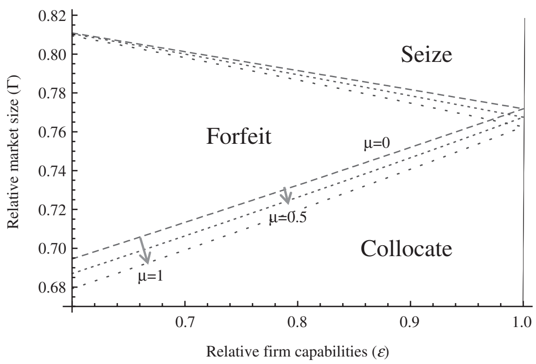

Figure A5. Equilibrium strategies: alternative-entry-order model, global learning scenario, Cournot model

μ increases, tilting firms' balance toward avoiding each other.

Figure A4 depicts the results of the numerical analysis on the Cournot model with the same learning functions as described earlier, for $\lambda = 0$ (no learning) and for $\lambda = 0.3$ (the local learning scenario). Figure A5 depicts the results of this numerical analysis for $\lambda = 0.3$ and $\mu = 0$ (the local-learning case), and, respectively, $\mu = 0.5$ and $\mu = 1$ (the global-learning case).

Similar to our baseline model described in Section Modeling Approach, Figures A4 and A5 show that, in the local learning scenario, both firms are more likely to enter the high-value market to avoid the high opportunity costs associated with absence from this market. In the global learning scenario, both firms are also less likely to enter the high-value market because they can avoid the high opportunity costs of absence from this market by transferring knowledge accumulated in the low-value market.

Simultaneous-entry game

Another key assumption of our model is that entry in markets is sequential. In particular, we assumed that, in the first period, $t = 1$, (1) one firm expands first into a market, then (2) the rival expands into a market upon observing the first firm's decision. This assumption is realistic when firms can observe their rivals' expansion and can change course in response. If expansions are not observable, or if firms commit resources to particular courses of action before observing their rivals' expansions, then the more realistic modeling assumption is one wherein firms expand simultaneously.

In this alternative model, the same four effects underlie firms' entry choices. Moreover, because under any strategy, s, firms maximize the same profits as in the sequential-entry models, the conditions that determine firms' equilibrium entry choices and the areas where each equilibrium strategy prevails remain unchanged compared to the scenario where low-capability firm l enters first into a market (which yields three equilibrium strategies). The main difference is that, when firms enter simultaneously, each firm has the opportunity to enter high-value market H. Thus, in the area where *seize* is the equilibrium strategy and firm l enters first, the equilibrium could now be *forfeit*, as in the scenario where firm h enters first into a market. In fact, there exists a third "mixed-strategy" equilibrium, whereby each firm expands initially into high-value market H with some particular equilibrium probability.

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