ABSTRACT

Title of Dissertation: Competition, Firm Financial Pressure, and Location Strategy: 3 Essays on Firm Domestic and International Expansion

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This dissertation examines the relationship between firm capabilities, including firm financial condition, and expansion strategy in a competitive environment. In Essay 1, I build a formal model of firm geographical expansion and entry timing based on Cournot competition that is driven by heterogeneity in firm, location, and competition traits. Using Monte-Carlo simulation, I identify firm best responses and Nash Equilibrium which serve as predictions for empirical inquiry in Essay 2 and Essay 3. Variation in firm traits and location traits lead to different expansion outcomes including whether firms expand at all, whether firms enter a market early or later, and which geographical location firms choose. While similar firms choose similar expansion behavior, as firms' relative capabilities and revenue pressure differ, staggered entry becomes more appealing, resulting in differential firm profits. Additionally, expansion strategy becomes more nuanced when considering the interaction between firm, competitor, and location traits, both domestically and internationally. I focus on two key mechanisms of interest and test these empirically: revenue pressure in Essay 2, and liability of foreignness in Essay 3.

I focus on a subset of propositions that map to my empirical setting: expansion into cities by firms in the micro-mobility industry (scooter, bike, and moped share companies). In Essay 2, the empirical results for US expansion activity support model predictions that more capable firms expand before less capable firms, but that revenue pressure pushes firms to expand earlier than they would prefer. Extending the model to capture international expansion in Essay 3, I find that liability foreignness helps explain the entry timing of firms at the country level, as well as a subset of entry decisions at the city level. This final essay highlights the nuances of various measures of liability of foreignness, as well as the importance of separating out different levels of analysis (e.g., at the city and country level) when examining firm entry decisions.

COMPETITION, FIRM FINANCIAL PRESSURE, AND LOCATION STRATEGY: 3 ESSAYS ON FIRM DOMESTIC AND INTERNATIONAL EXPANSION

By

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Dissertation submitted to the Faculty of the Graduate School of the
University of Maryland, College Park, in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
2022

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Dedication

I dedicate this dissertation to my parents, Lynn and Austin Jaffe. I am forever grateful for our amazing adventures around the world; our time spent living and traveling in lands near and far continue to spark my imagination and thirst for knowledge today.
I did it, Dad!

Acknowledgements

I want to thank my professors and advisors at the University of Maryland for their unwavering support over the past six years. I have learned and grown more than I ever imagined. I especially want to thank my advisor, Wilbur Chung, for his mentorship and willingness to share his time, wisdom, and endless food analogies with me. I look forward to a [productive] lifelong career and friendship with you.

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Essay 1: A Model of Competition, Firm Financial Pressure, and Location Strategy

1.1 Introduction

Firms constantly face strategic choices that may affect firm performance. Two such strategic choices are the timing and location of firm expansion. Firms must decide whether to enter a given location early or later (before or after competitors). They must also decide which locations to enter across a diverse set of geographical markets. The timing and location of entry is a complex decision as it depends on location, firm, and competition traits. Failing to account for key firm-level heterogeneity in explaining strategic choices can lead to misidentification of the impact of these choices on firm performance (Shaver, 1998).

Much of the empirical efforts on entry timing and location strategy focus on well-developed industries such as automotive, airline, manufacturing and semiconductor (e.g. see Cho, Kim, and Rhee, 1998; Claussen, Essling, and Peukert, 2018; Disney, Haskel, and Heden, 2003). There has been less attention to newer industries, including those with a large startup presence, where firm financial performance is less clear. However, firms in these newer industries expand geographically as well, partly as a result of increased venture capital (VC) funding in the past two decades. According to estimates using PitchBook-NVCA data, U.S. VC deal activity rose from 4,491 deals totaling $27.2B in 2009, to 9,845 deals totaling $134.7B in 2018. Given this growth in funding and the prospects of becoming the next big "unicorn", startups face additional pressure for growth and revenue, and "must move even faster, expand their ambitions and collect more investment money than ever—even if they might not be ready" (New York Times, 2018).

Our existing models do not yet fully capture the expansion and entry timing decision of firms in these newer industries, with a heavy startup footprint. This dissertation first considers the role of VC funding trends for startup firms and models their expansion behavior in the U.S. I then expand the study to capture firm internationalization. When do firms enter a new location early, before their competition, and when do firms enter a location later, after their competition? Which locations do firms enter? How does revenue pressure impact firm geographical expansion? How does liability of foreignness impact firm internationalization and entry timing abroad?

The extant location strategy research emphasizes that firm capabilities (e.g. Shaver and Flyer, 2000), and location traits (e.g. Alcácer and Chung, 2014) help explain firm location choices. The presence and traits of competitors also affect firm entry decisions (Alcácer, Dezső, and Zhao, 2015). Two main components have not been considered in the existing models or empirical studies: 1) location specific start-up costs and 2) firm financial condition. First, new location start-up costs are typically assumed away, as the existing strategy literature focuses on different location-specific mechanisms. For example, Alcácer, Dezső, and Zhao (2015), examine firms' international expansion while allowing for learning across time, but assume start-up (fixed) costs are the same for all markets.

Second, there is evidence that firm financial condition matters for firm strategic choices. One aspect of financial condition, earnings pressure, makes firms more likely to engage in price wars in the airline industry (Busse, 2002), curtail factory expansion in the shipbuilding industry (Audia and Greve, 2006), offer lower quality products in grocery retail (Matsa, 2011), or restrict output in the competitive electricity industry (Zhang and Gimeno, 2010). While prior studies seem to predict more contractionary firm behavior when presented with underperforming

financials, for startups, current earnings (if any) may not reflect the viability or future performance of the firm. Investors instead look for growth potential, based on current and projected future revenue.

In the most extreme case of WeWork—a privately-held real estate firm providing co-working spaces—company executives coined their own term and measurement of earnings for presentation to investors, called "community-adjusted EBITDA", based largely on revenues, and excluding most costs (Brown and Farrell, 2021). Emphasizing one distinction between financial constraints and reporting for large publicly held firms compared to privately-held startups. More generally, as illustrated in the 2015 Wall Street Journal article, "Up-and-coming companies that see themselves through rose-colored glasses are of little concern to many venture capitalists and other investors as long as growth remains strong," highlighting the emphasis on growth at all costs. [1]

Finally, the existing literature on entry timing has focused on the effect of early mover (dis)advantages for firm performance (Lieberman and Montgomery, 1988 and 1998). In this way, entry timing is an independent variable and firm performance is the dependent variable. Said another way, entry timing is the first stage, and firm performance is the second stage, but failing to account for an underlying mechanism affecting entry timing in the first stage—such as revenue pressure examined in Essay 2, and liability of foreignness examined in Essay 3—will lead to misidentification of the relationship between entry timing and performance in the second stage (Certo, Busenbark, Woo, and Semadeni, 2015; Hamilton and Nickerson, 2003; Heckman, 1976). Additionally, modeling efforts employing Stackelberg games will exogenously assign an

[1] Theranos serves as another extreme case; founder Elizabeth Holmes and partner Sunny Balwani faced tremendous pressure to commercialize their product, and in fact expand to new markets. They feared that failing to do so would upset both investors and board members. In the end, the company's rapid expansion (before a safe product was even available for use) lead to its downfall (Carreyrou, 2018).

early entrant, typically a large incumbent firm. These games then observe the response and outcomes of later movers, given the behavior of the large incumbent, first mover (Gibbons, 1992). This suggests more work on endogenizing entry timing will provide a fuller picture of firm expansion, including the behavior of startup firms facing pressure for revenues and decisions to expand abroad.

I will formally model entry timing as endogenous. Firm expansion in the model is based on Cournot competition that is driven by heterogeneity in firm capabilities—now including financial condition—location traits—now including location-specific start-up costs—and interactions with competitors. Firms choose quantities to produce which maximize firm profits at a given location. The formal model provides solutions to the firm maximization problem: the firm market share and profits at a location based on entry timing and competition. Using numerical simulation, I then identify all mutual best responses (Nash Equilibrium) for whether firms enter a location, which locations they enter, and when. I explore how constructs in the model, and the interactions between them, shape firm strategic choices, resulting in a set of propositions.

The formal model and numerical solutions provide predictions for empirical inquiry. Using hand-collected data of entry activity in the micro-mobility industry, I test these predictions. The dataset in Essay 2 includes 3,312 possible city-firm expansions in the U.S. based on more than 600 news articles, social media posts, and company websites. Consistent with the set of model propositions, I find empirically that wealthy, more experienced firms expand more often and sooner than less experienced, less wealthy firms, but that pressure for revenues leads firms to expand earlier.

The dataset in Essay 3 includes the global census of micro-mobility entry activity, resulting in 1,939 realized expansions to over 900 cities in 60 different countries. The empirical results partially support model predictions that liability of foreignness (defined by Zaheer, 1995, as additional costs associated with expansion into foreign markets, exceeding the costs incurred by local firms) which increases the fixed and marginal costs of international expansion, will lead firms to enter foreign markets later, after competitors. The unique dataset of micro-mobility activity highlights the importance of both city and country level analysis for firm international expansion decisions. Furthermore, Essay 3 emphasizes how various measures of foreignness play a role in shaping firm entry timing decisions; while some aspects of foreignness may wane for experienced firms, others appear to persist.

The formal model and numerical solutions provide predictions for empirical inquiry in Essay 2. All empirical tests are based on propositions from the formal model and numerically simulated results. Essay 2 focuses on one mechanism, revenue pressure, which I test using data on micro-mobility expansion timing in the U.S. In Essay 3, I extend the model described in Essay 1, focusing on the role of liability of foreignness for firm geographical expansion, both in the U.S. and abroad.

This dissertation includes two key contributions: first, the formal model provides a starting point to study numerous mechanisms and relationships between firm, competitor, and location traits. Second, the unique empirical dataset provides new opportunities to explore firm expansion strategy across a diverse set of firms and countries. These three essays explore two mechanisms of interest and highlight the novel dataset of firms in the growing micro-mobility industry, with several avenues for future research.

1.2 Formal Model

One challenge in studying firm strategic behavior such as entry timing and location choice, is its endogenous nature (Lieberman and Montgomery, 1988). Using a formal model allows for exogenous assignment of both firm and location traits, including how these exogenous traits result in endogenous outcomes. Formal modeling also makes clear the relationship between interrelated mechanisms that are less obvious and can be difficult to articulate. Moreover, I can identify more nuanced boundary conditions and secondary effects, as a result of the formal modeling techniques.

I model the location and timing of firm expansion and simultaneity of entry in a game theoretic model of Cournot competition with decreasing profits overtime due to the time value of money. The model includes two firms, *A* and *B*, that must simultaneously decide whether to expand to locations *j* and/or *k* early (time $t=1$), later (time $t=2$), or not at all. Firms are exogenously endowed with traits including financial condition (revenue pressure and wealth), efficiency or productivity (marginal cost), and the ability to capture demand away from competitors (switching costs). Revenue pressure makes firms more eager for current revenue, as in Busse's 2002 paper, and suggested by trends in VC funded firm expansion. Marginal cost captures each firm's ability to produce goods, therefore dictating market share. The presence of switching costs exacerbates the firm's marginal cost.

Each location is characterized by exogenously assigned demand (market size) and start-up (fixed) costs. The market size and start-up costs both make markets more attractive or less attractive. Table 1 provides the full list of model parameters and variables including whether the variable is exogenous or endogenous.

Table 1. Summary of formal model parameters and variables

Location Vars.	FC_j: fixed start-up cost	Exog. pre $t = 1$, endog. on/after $t = 1$
	a_j: market size (inverse demand intercept)	Exog.
Focal Firm Vars.	c_A: Firm A's marginal cost	Exog.
	s_A: Firm A's switching cost	Exog.
	CFP_A: Firm A's cash flow pressure	Exog.
Competitor Firm Vars.	c_B: Firm B's marginal cost	Exog.
	s_B: Firm B's switching cost	Exog.
	CFP_B: Firm B's cash flow pressure	Exog.
Outcome: Firm-Location Value	$V_{A(B)jt}$: Value to A (B) from expanding to location j in time t	Endog., function of location, firm A & B traits, and timing of expansion
Outcome: Entry Vars	Early, late, or no entry	Endog. function of V_{Ajt} and V_{Bjt}
	Co-entry, staggered entry, solo entry, no entry	Endog. function of V_{Ajt} and V_{Bjt}

Firms *A* and *B* have the same choice set consisting of three options at each location: i) expand early in *t=1*, ii) expand later in *t=2*, and iii) do not expand. This yields nine possible expansion scenarios in location *j*, and 9 possible expansion scenarios in location *k*, described in Table 2. Note that scenarios 7 and 8 are included for completeness but are always inferior outcomes. Table 3 presents the full set of 81 possible expansion scenarios across both locations. Note that firms can expand to different locations at different times. For example, firm A may enter location *j* at *t=1*, and location *k* at *t=2*, while firm B may enter both location *j* and *k* at *t=1*.

Table 2. Description of nine expansion scenarios

		B's Choice		
		t=1	t=2	None
A's Choice	t=1	1) Early Co-Entry	2) Staggered: *A* 1st, *B* 2nd	6) Solo Entry (*A*)
	t=2	3) Staggered: *B* 1st, *A* 2nd	4) Late Co-entry	8
	None	5) Solo Entry (*B*)	7	9) No-entry

Table 3. Description of 81 expansion scenarios in both locations *j* and *k*

			Firm B's Choice								
	t into *j*		1	2	0	1	2	0	1	2	0
		t into *k*	0	0	0	1	1	1	2	2	2
Firm A's Choice	1	0									
	2	0									
	0	0									
	1	1									
	2	1									
	0	1									
	1	2									
	2	2									
	0	2									

Each scenario has a different value to the firm as there exists trade-offs between early entry, and late entry. Firms simultaneously choose quantities that maximize the value to the firm, subject to the behavior of their competitor (mutual best responses). This is a game of complete information; firms know one another's traits and the traits of the market.

Expansion timing and co-entry require start-up costs associated with setting-up a new market, including overcoming institutional barriers and attracting customers. The firm's wealth must be equal or greater than the start-up cost of entry. If a firm enters first and alone, the firm incurs the full fixed cost, as firm *B* does in scenarios 3 and 5 and *A* does in scenarios 2 and 6 (see Table 2). Firms share the fixed costs in scenarios 1 and 4, thus they each pay half the fixed cost. If the firm enters after the market is developed, as a late entrant, for example firm *A* under scenario 3, the firm pays a fraction of the fixed cost, less than the shared costs under co-entry.

There are opportunity costs to entering a market early or late. Already, I described one benefit to staggered, late entry: the late entrant pays a reduced fixed cost as the market is already set-up by the earlier entrant. On the other hand, one drawback of late entry is foregone first period profits. The other possible costs to late entry are switching costs and a revenue pressure penalty. If the late entrant has non-zero switching costs, this means that the late entrant will have to provide additional incentives to consumers to switch from buying goods from the early entrant. Also, if the late entrant faces revenue pressure from current and future investors, the firm pays a first period penalty when entering later.

Early entry also has costs and benefits. If the firms choose early co-entry (scenario 1 in Table 2), they share the fixed costs, and they avoid any revenue penalties and switching costs. Early staggered entry requires the early entrant to pay the full fixed costs, but in exchange the firm enjoys a full period of monopoly rents. Additionally, the early entrant may benefit from switching costs incurred by the late entrant. Finally, under early entry, the firm receives rents starting in the first period. This is important due to the time value of money; even though firms calculate the net present value of entry based on an infinite horizon, the discount factor will increasingly discount future rents. For example, if tomorrow's money is worth 95% in today's dollars (interest rate=.05), then the net present value of $\$X$ is $X + .95 * X + .95^2 * X \ldots . = X * \frac{1}{1-.95} = \$X * 20$. And if the firm waits a period, and foregoes the first $\$X$, the NPV is only $.95 * X + .95^2 * X \ldots . = X * \frac{1}{1-.95} = \$X * 19$.

Next, I provide the maximization problems and solutions for the set of single-location expansion scenarios described in Table 2. The maximization problems for the full set of scenarios described in Table 3 are analogous to those in Table 2, including a summation across locations *j* and *k*, with two additional assumptions: 1) firm wealth ($W_{A(B)}$) is discounted in t=2,

as is fixed costs and revenues; 2) firms incur revenue pressure when there is no expansion in *t=1*—a firm need only to expand to one location in *t=1* to avoid a revenue pressure penalty.

Under scenario 1, both firms *A* and *B* co-enter location *j*, early in *t=1*. *A*'s location *j* problem is given in equation (i.A) and *B*'s in (i.B).

$$Max_{q_A} V_{Aj} = -\frac{FC_j}{2} + q_{Aj}\left(P(Q)_{Aj} - c_A\right) * \frac{1}{1-\delta}\ s.t. W_A\ \geq \frac{FC_j}{2} \quad \text{(i.A)}$$

$$Max_{q_B} V_{Bj} = -\frac{FC_j}{2} + q_{Bj}\left(P(Q)_{Bj} - c_B\right) * \frac{1}{1-\delta}\ s.t. W_B\ \geq \frac{FC_j}{2} \quad \text{(i.B)}$$

Replacing $P(Q)$ with the inverse demand function in (i.A) and (i.B) and solving each firm's best response yields critical values q_{Aj}^* and q_B^* in equations (ii.A) and (ii.B). Finally, substituting (ii.A) and (ii.B) back into the value functions yields V_{Aj}^* and V_{Bj}^* in equations (1.A) and (1.B), respectively.

$$q_{Aj}^* = \frac{a_j - 2c_A + c_B}{3} \quad \text{(ii.A)}$$

$$q_{Bj}^* = \frac{a_j - 2c_B + c_A}{3} \quad \text{(ii.B)}$$

$$V_{Aj}^* = -\frac{FC_j}{2} + \left(\frac{a_j - 2c_A + c_B}{3}\right)^2 * \frac{1}{1-\delta} \quad \text{(1.A)}$$

$$V_{Bj}^* = -\frac{FC_j}{2} + \left(\frac{a_j - 2c_B + c_A}{3}\right)^2 * \frac{1}{1-\delta} \quad \text{(1.B)}$$

There is also the possibility of staggered entry. Under scenario 2, *A* enters early in *t=1*, while *B* enters after in *t=2*. Because *A* entered first and alone, *A* must pay the entire fixed costs, but enjoys one period of monopoly rents. Firm *B* forfeits first period rents but incurs only a fraction of the fixed costs (β >2) when *B* enters in the second period. There is the possibility that firm *B* incurs a revenue pressure penalty due to non-entry in *t=1*. Additionally, non-zero switching costs will help firm *A* capture larger market share relative to firm *B*. These switching

costs can persist through time (Gómez and Maícas, 2011). Equations (iii.A) and (iii.B) provide each firms' maximization problem, and equations (2.A) and (2.B) provide the solutions.

$$Max_{q_A} V_{Aj} = -FC_j + q_{Aj1}(a_j - q_{Aj1} - c_A) + q_{Aj2} * (a_j - q_{Aj2} - q_{Bj2} - c_A) * \frac{\delta}{1-\delta} \, s.t. W_A \geq FC_j \quad \text{(iii.A)}$$

$$Max_{q_B} V_{Bj} = -\frac{FC_j}{\beta} - RP_B + q_{Bj2} * (a_j - q_{Bj2} - q_{Aj2} - (1+s_B)c_B) * \frac{\delta}{1-\delta} \, s.t. W_B \geq \frac{FC_j}{\beta} \quad \text{(iii.B)}$$

$$V_{Aj}^* = -FC_j + \left(\frac{a_j - c_A}{2}\right)^2 + \left(\frac{a_j - 2c_A + (1+s_B)c_B}{3}\right)^2 * \frac{\delta}{1-\delta} \quad \text{(2.A)}$$

$$V_{Bj}^* = -RP_B - \frac{FC_j}{\beta} * \delta + \left(\frac{a_j - 2(1+s_B)c_B + c_A}{3}\right)^2 * \frac{\delta}{1-\delta} \quad \text{(2.B)}$$

Like scenario 2, now in scenario 3 firm *B* enters early, and firm *A* enters later in *t=2*. The maximization problems are the same as in scenario 2, but with the opposite firm entering the market early vs late. Without loss of generality, the same maximization problem is solved for scenario 3 and the solutions are provided in equations (3.A) and (3.B).

$$V_{Aj}^* = -RP_A - \frac{FC_j}{\beta} * \delta + \left(\frac{a_j - 2(1+s_A)c_A + c_B}{3}\right)^2 * \frac{\delta}{1-\delta} \quad \text{(3.A)}$$

$$V_{Bj}^* = -FC_j + \left(\frac{a_j - c_A}{2}\right)^2 + \left(\frac{a_j - 2c_B + (1+s_A)c_A}{3}\right)^2 * \frac{\delta}{1-\delta} \quad \text{(3.B)}$$

Another scenario is that both firms enter a location late. This fourth scenario of late co-entry looks very similar to scenario 1, however all costs and revenues are discounted due to the time value of money, and firms with revenue pressure will incur a penalty for non-expansion in *t=1*. Equations (4.A) and (4.B) are the solutions to firms' maximization problems under late co-entry.

$$V_{Aj}^* = -RP_A - \frac{FC_j}{2} * \delta + \left(\frac{a_j - 2c_A + c_B}{3}\right)^2 * \frac{\delta}{1-\delta} \quad \text{(4.A)}$$

$$V_{Bj}^* = -RP_B - \frac{FC_j}{2} * \delta + \left(\frac{a_j - 2c_B + c_A}{3}\right)^2 * \frac{\delta}{1-\delta} \quad \text{(4.B)}$$

If firm *A* chooses not to enter the market, and *B* chooses to enter the market in *t=1*, firm *B* will have to pay the full fixed costs, but firm *B* receives monopoly rents in every period. The solution to this fifth scenario is given in (5.B), while firm *A*'s value at the location is zero. Conversely, if *B* does not enter, and *A* does enter, as in scenario 6, firm *A*'s solution is provided in equation (6.A)

$$V_{Bj}^{*} = -FC_j + \left(\frac{a-c_B}{2}\right)^2 * \frac{1}{1-\delta} \quad (5.B)$$

$$V_{Aj}^{*} = -FC_j + \left(\frac{a-c_A}{2}\right)^2 * \frac{1}{1-\delta} \quad (6.A)$$

Let us consider scenarios 7 and 8. In scenario 7, *B* enters in the second time period, while firm *A* does not enter. And in scenario 8, *A* enters in the second time period, while firm *B* does not enter. For completeness, equations (7.B) and (8.A) provide the firms' solutions, although, these scenarios are always strictly dominated by scenario 5, 6, or 9. This is because under scenarios 7 and 8, the expanding firm forfeits monopoly rents, but there is no benefit to doing so, as was the case with staggered entry in which the late entrant pays a reduced fixed cost in *t=2*. Finally, if both firms do not expand, the value of the location to each firm is zero, as in scenario 9.

$$V_{Bj}^{*} = -RP_B - FC_j * \delta + \left(\frac{a_j-c_B}{2}\right)^2 * \frac{\delta}{1-\delta} \quad (7.B)$$

$$V_{Aj}^{*} = -RP_A - FC_j * \delta + \left(\frac{a_j-c_A}{2}\right)^2 * \frac{\delta}{1-\delta} \quad (8.B)$$

The formal model provides insights about the impact of each variable on the value of expanding to the location, for each firm. Table 4 presents a summary of a selection of partial derivatives from the model. Of note, switching costs behave the same as marginal cost when

triggered, as a result of staggered expansion. For simplicity's sake, switching costs are assumed to be zero going forward, for consistency with the data context discussed in the next Essay.

Table 4. Formal model summary of key partial derivatives

Level	Var "x"	$\frac{\partial V_{Ajt}}{\partial x}$	$\frac{\partial^2 V_{Ajt}}{\partial x^2}$
Location Vars	FC_j	-	0
	a_j	+	+
Focal Firm Vars	c_A	-	+
	RP_A	- if *A* expands in *t=2*	0
Competitor Firm Vars	c_B	+	+

Table 4 highlights the impact that location, focal firm, and competitor firm heterogeneity have on the value of location *j* to a focal firm, *A.* First, location traits make *j* more or less attractive to firm *A.* Of course, higher fixed costs decrease the value of the location, while larger market size increases the value of the location. Second, market size and firm capabilities are interrelated. The market share captured by firm *A* will depend on both firm *A*'s own efficiency (marginal cost), as well as it's competitor's. Last, triggering the revenue pressure payment has a negative impact on the value of location *j*, if focal firm *A* waits to expand in the second time period.

The formal model provides the direction of relationships between key variables and the expansion outcome. The model also gives the payoffs for each firm, from solving the Cournot solution for each of the expansion scenarios. These solutions give indication of market attractiveness and competitiveness of each firm (the size of each firm's market share). Nevertheless, there are two primary challenges in using the formal model to make entry timing and location choice conclusions. First, there is complexity in the formal model as a result of the interaction between location and firm traits. Second, because firms are simultaneously choosing their expansion strategies, there are strategic interactions between the behavior of the focal firm

(when and where *A* expands) and the competitor firm (when and where *B* expands). A numerical simulation allows one to distinguish superior outcomes across scenarios. For example, which of the 81 scenarios is preferred given a set of parameters? Additionally, the numerical simulation allows for identification of mutual best responses (Nash Equilibrium).

1.3 Simulation Model

The numerical modeling approach resembles a Monte-Carlo simulation in which I generate all potential formal model outcomes based on a large and varied set of paraments. Each observation in the simulation represents a different game. As in the formal model, there are two firms, *A* and *B* competing for quantities (market share) in two markets, *j* and *k.* The firms must simultaneously decide when to enter each market, if at all. For each game, I identify the Nash Equilibrium (NE): the mutual best expansion timing scenario across the 81 scenarios.

Numerical examples are used to illustrate how the simulated data identifies NE entry timing outcomes. First consider two identical firms ($c_A = c_B = 1$) with no switching costs or revenue pressure. Suppose market *k* is very small and unattractive, while market *j* is relatively attractive, meaning that firms can cover the fixed cost in *j* with one to two periods of rents ($FC_j = 500$ and $a_j = 40$, thus one period of monopoly rents for either firm is $(\frac{a_j - c_A}{2})^2 = 380.25$). Table 5.i presents the full game for this set of parameters, based on the nine expansion scenarios described in Table 2 (note that these scenarios are the same as the 9 upper-left scenarios in Table 3). Underlined and in bold are each firm's best responses to the other firm's expansion timing choice. For example, if firm *B* chooses to expand in *t=2,* then firm *A*'s best response is to expand in *t=1*. Furthermore, if *A* chooses to expand in *t=1,* firm *B*'s best response is also to

expand in *t=1*. Expanding in *t=1* is a strictly dominant strategy for both firms. The mutual best response given the parameters in Table 5.i is for both firms to expand in *t=1,* highlighted in gray.

Table 5.i NE example: FC_j=500, a_j = 40, $c_A = c_B = 1$, $s_A = s_B = 0$, $CFP_A = CFP_B = 0$

		B's Choice		
	V_{Aj}; V_{Bj}	t=1	t=2	None
A's Choice	t=1	**$3,130, $3,130**	**$3,091**, $3,092	**$7,105**, $0
	t=2	$3,092, **$3,091**	$2,974, $2,974	$6,750, $0
	None	$0, **$7,105**	$0, $6,750	$0, $0

Changing a single parameter in the Table 5.i example changes the payouts to firms in the game, thus potentially changing the Nash Equilibrium. For example, consider the same market as in Table 5.i, but now firm *B* is less efficient than firm *A*. In Table 5.ii, firm *A*'s marginal cost is a fraction of firm *B*'s. This example illustrates how different marginal costs will lead to different market shares for the firms. Because firm *A* is more efficient than *B,* firm *A* will produce and sell a larger quantity, therefore have higher rents than *B.* Additionally, while expanding in *t=1* remains a strictly dominant strategy for firm *A,* it is no longer a dominant strategy for firm *B*. If firm *A* chooses to expand in *t=1*, firm *B* prefers to enter in *t=2* as the payoffs for firm *B* are larger from staggered entry than early co-entry. A discussion of the drivers of this outcome is presented in Section 1.4 Model Predictions.

Table 5.ii NE example: FC_j=500, a_j = 40, $c_A = 5c_B = 1$, $s_A = s_B = 0$, $CFP_A = CFP_B = 0$

		B's Choice		
	V_{Aj}; V_{Bj}	t=1	t=2	None
A's Choice	t=1	**$3,859**, $1,886	**$3,784, $1,910**	**$7,105**, $0
	t=2	$3,785, **$1,835**	$3,666, $1,791	$6,750, $0
	None	$0, **$5,625**	$0, $5,344	$0, $0

Finally, consider how changing the parameters of the location traits might change firm behavior. Take the same two identical firms as in Table 5.i. In Table 5.iii, firms must decide if and when to expand to a smaller market. The parameters of this market correspond to 24 periods of monopoly rents required to cover the fixed cost of entry, but due to the time value of money, even if a firm operates as a monopolist forever, the firm will be unable to cover the fixed costs. The only scenarios resulting in positive value to the firm are staggered entries, yet these scenarios are not mutual best responses. The Nash Equilibrium for this set of parameters is non-entry for both firms, thus both firms receive $0 in rents.

Table 5.iii NE example: FC_j=500, a_j = 10, c_A = c_B = 1, $s_A = s_B = 0$, $CFP_A = CFP_B = 0$

		B's Choice		
	V_{Aj}; V_{Bj}	t=1	t=2	None
A's Choice	t=1	-$70, -$70	-$309, **$52.5**	-$95, $0
	t=2	**$52.5**, -$309	-$67, -$67	-$90, **$0**
	None	$0, -$95	**$0**, -$90	**$0, $0**

The examples in Tables 5i, 5.ii, and 5.iii show how changes in the starting set of parameters will lead to different firm behavior. The full set of parameter combinations provide several insights into how location, firm, and competitor heterogeneity impact firm expansion and entry timing. Due to the complexity of the system and set of possible parameters, there are infinite potential outcomes. As in the partial derivatives from the formal model, I first consider how changing one variable changes the entry timing decision. Then, I examine the interactions between variables.

1.4 Model Predictions

Using comparative statics, I present different sets of possible parameters and compare outcomes across them. I examine more than 100,000 simulated scenarios. The small, selected sets of parameters highlight some of the nuanced results of the simulation, though the formal model and simulation are equipped to handle other parameter configurations. I focus on four key mechanisms which build on the existing firm expansion and entry timing literature: 1) how changes in location traits impact location choice, entry, and timing; 2) how the two firm's relative efficiencies impact expansion and entry timing; 3) how revenue pressure impacts entry timing; and 4) how firm wealth impacts location choice, entry, and timing. For legibility, unless explicitly specified, I show results in a 1-location game.

1.4.1 Impact of Location Traits on Expansion

The formal model informs the direction of the relationship between the location start-up costs and the market size on the value of a given location to the firm. Large, fixed start-up costs make a location less appealing for expansion, while a large market size makes a location more appealing for expansion. Including the start-up costs in the model reflects the expansion decision for firms in new industries. Additionally, this creates a trade-off for firms between fixed costs and market size (demand). Therefore, firms consider the attractiveness of a market based on both the costs of entry and the size of the market.

This study is largely concerned with expansion outcomes for firms in the same industry because firms are competing for the same demand. This demand may change considerably across locations, while for comparative statics analysis, fixed costs are assumed to remain constant. Certainly, larger markets are more likely to attract firms as demand is higher, thus

rents from expanding to a larger market will be greater than rents from expanding to a smaller market, all else equal. The numerical simulation predictions are consistent with this intuition that firms are less likely to expand to smaller markets than larger markets.

Simulation findings in Figure 1 show how changes in market size (demand) impact firm entry for equally efficient firms (same marginal cost) with no switching costs or revenue pressure. There are three locations considered, with decreasing market size from left to right. Again, within a single-location, *j*, there are nine possible expansion scenarios described in Table 2. A colored box with an "X" indicates a Nash Equilibrium. The color helps identify the associated NE scenario: green indicates entry in *t=1* (A1 or B1), yellow indicates entry in *t=2* (A2 or B2), and red indicates non-entry (A0 or B0). As expected in the baseline Proposition 1, the Nash Equilibrium for the smaller markets is non-entry.

Baseline, Proposition 1: All else equal, as market size decreases (a_j), relative to the fixed cost of entry (FC_j), firms prefer to enter later, or not at all.

Figure 1: Impact of market size (a_j) on entry

Large Market				→						**Small Market**		
A1	X											
A2				X			X					
A0												X
A\B	B1	B2	B0	B1	B2	B0	B1	B2	B0	B1	B2	B0
	1.3 pds			**2.4 pds**			**10 pds**			**24 pds**		

 # Pds. Rents = fixed cost

The simulation predictions show a less obvious result for moderately sized markets (games 2 and 3 in Figure 1). These locations bring to light the tension between the costs and

benefits of expansion early versus later. The benefit to expanding after a competitor is the reduced fixed costs, but the opportunity cost is a full period of rents. For locations with large demand relative to fixed costs, the opportunity cost to waiting a period is much higher than the opportunity cost of waiting to enter a smaller market. As in Figure 1, both firms will expand early in the large market as the opportunity cost to waiting a period is larger than the benefit of reduced fixed cost from waiting.

As the size of the market decreases relative to the fixed costs, firms encounter a sort of prisoner's dilemma resulting in a less than optimal solution. In this situation, first period rents are smaller than in the large market, thus these rents are a smaller portion of the fixed costs. Now, avoiding part of the fixed costs is more appealing. In the middle two games in Figure 1, both firms get higher rents from expanding after their competition and paying the reduced fixed cost. Meaning that if firm *A* expands in *t=1*, firm *B* prefers to expand in *t=2*. However, if firm *B* is expanding in *t=2,* firm *A* prefers also to expand in *t=2* so that firm *A* can share the fixed costs with firm *B.* Note that the early co-entry scenario results in higher payoffs for both firms than the late co-entry scenario, but as in a prisoner's dilemma, if the focal firm enters in *t=1* (corresponding to non-confession in a prisoner's dilemma), then the competitor will wait until *t=2* to expand (corresponding to confession in a prisoner's dilemma).

1.4.2 Impact of Relative Firm Efficiency

Business and strategy scholars have long studied the relationship between firm capabilities and competitive advantage (Porter, 1979). While we often focus on how a focal firm's capabilities might lead to different strategic choices and performance outcomes, the focal firm's capabilities may be relatively "good" or "bad" versus their competition. While focal firm

traits impact the focal firm's strategic choices, what also matters in a competitive environment is the difference between focal firm traits and competitor firm traits.

For example, a focal firm competing against a weaker competitor can produce more output for the same cost, and thus capture a larger market share. By contrast, if the focal firm faces a strong competitor, the focal firm will produce output at a higher cost than their competitor, therefore the focal firm's rents will be less than the strong competitor. This intuition is consistent with the results in the formal model that increasing focal firm marginal cost reduces focal firm rents, while increasing competitor firm marginal costs increases the focal firm's rents. Figure 2 shows the mutual best responses for firms entering a large market (the first game in Figure 1), with varied competitor marginal cost.

Figure 2: Impact of competitor efficiency (c_B) on entry

		A & B efficient →						**A more efficient than B**		
Large Market size, *j*	**1.3 pds**	A1	X			X			X	
		A2								
		A0								
		A\B	B1	B2	B0	B1	B2	B0	B1	B2	B0
				A=B			**2A=B**			**5A=B**	

When firm *B*'s marginal cost increases, *B* becomes less efficient. This reduces monopoly and duopoly rents for firm *B* and increases duopoly rents for firm *A*. With higher marginal costs, firm *B* faces lower rents, and it becomes more challenging for *B* to pay the fixed entry costs with post entry rents. This leads firm *B* to prefer staggered entry, after firm *A*, so that firm *B* enjoys lower fixed costs. In the last game of Figure 2, when firm *B*'s marginal cost is much larger than firm *A*'s, firm *B* prefers to enter the market in *t=2*, after firm *A*.

Baseline, Proposition 2: All else equal, as firm B's efficiency decreases relative to firm A, firm B is more likely to expand after firm A.

While the result that efficient firms enter before less efficient firms (an assumption in most Stackelberg models) seems more pedestrian, the formal model helps identify the precise mechanism driving this entry timing outcome. The reason that firm *B*'s entry decision changes in Proposition 2 is the result of opportunity costs of early versus late entry. Increasing a firm's marginal cost will change the opportunity costs associated with different expansion timing. If firm *B*'s marginal cost increases, the trade-off between early and late entry changes with late entry yielding a higher value to firm *B*: first period duopoly rents minus early co-entry fixed costs is less than the reduced staggered entry fixed costs. Increasing marginal cost will change market share and rents for firms.

The baseline Propositions 1 and 2 are consistent with existing theory and intuition. While it may seem obvious that markets with higher demand are more attractive and that more efficient firms expand first, this in fact is not always the case. Next, I present a set of novel propositions that highlight less-intuitive location choice and entry timing outcomes. First, I consider how firm financial condition, both revenue pressure and wealth constraints, impact expansion choice, including inflection points which flip some of the outcomes suggested in Proposition 2. Then I discuss one scenario that provides a theoretical result, emphasizing the interrelated nature of firm and location traits, easily articulated using formal modeling techniques.

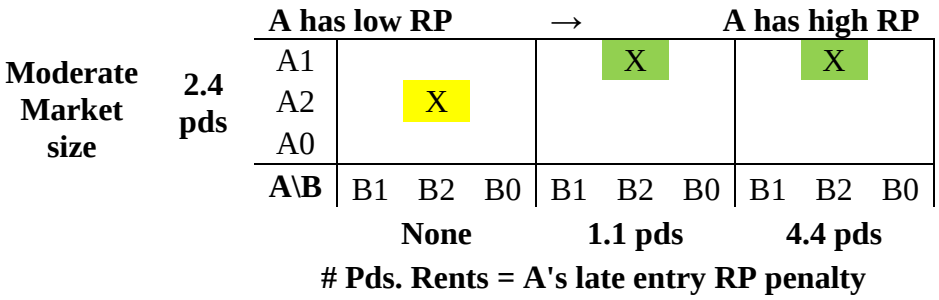
1.4.3 Impact of Firm Financial Condition on Expansion

Firms that raise considerable capital through venture funding face short-term revenue pressure such as growth requirements for future capital and revenue incentives to maintain the interest and support of investors by demonstrating firm potential (WeWork and Theranos provide some of the most extreme cases of revenue pressure). This is operationalized in the model as a revenue pressure (*RP)* penalty, only incurred if a firm is a late entrant. If the firm waits to expand, there is an absence of first period revenue, investors and outside stakeholders are uncertain of the firm's potential because of the lack of revenue, thus the firm incurs a penalty. As this revenue pressure increases, the value of late expansion decreases. This incentivizes firms facing revenue pressure to expand earlier to avoid a financial penalty, presented below as Proposition 3.

Proposition 3: All else equal, as focal firm revenue pressure increases (RP_A), the focal firm is more likely to expand early.

While Proposition 3 comes directly from the direction of the partial derivative in the formal model, because there are strategic interactions between firms *A* and *B,* firm *A's* choice to expand early as a result of revenue pressure may have an impact on the expansion behavior of firm *B.* Therefore, I find different mutual best responses. Figure 3 considers how changing the focal firm's revenue pressure results in different Nash Equilibrium than under no revenue pressure. These simulated results come from a moderately sized market in which fixed costs are roughly 2.4 periods of monopoly rents at the location.

Figure 3: Impact of focal firm revenue pressure (RP_A) on entry



The first game in Figure 3 is a repetition of the second game in Figure 1. Games two and three in Figure 3 relax the assumption that firm *A* has no revenue pressure; with no pressure firm *A* prefers later expansion in t=2. In the second game, firm *A* has a moderate revenue pressure penalty, and that pressure increases in the third game. Firm *A* now avoids paying the revenue pressure penalty by expanding in *t=1*. Firm *B* does not have any revenue pressure in this example and will wait a period to expand. By waiting to expand after firm *A*, firm *B* pays a lower fixed cost.

Already, by changing a single firm-trait-parameter, new entry strategies emerge. Of particular interest is that revenue pressure may change the behavior of equally efficient firms. For example, in Figure 3, firms are equally efficient in the first game, but as firm *A*'s revenue pressure increases, firm *A* is pushed to expand earlier than it would have preferred under no revenue pressure. Failing to consider firm financial condition including revenue pressure when examining firm expansion decisions, especially for VC funded organizations, may lead to misidentification of mechanisms for explaining firm strategies.

In addition to revenue pressure, a firm's wealth endowment plays an important role in firm expansion and is theoretically different from revenue pressure in the formal model, and empirically unique, as is discussed in the next section. Firm wealth serves as a constraint for firm expansion in two ways: 1) whether the firm can afford to expand to a new market—does the

firm's wealth far exceed the fixed entry cost?; 2) what entry timing can the firm afford, when entering a new geographical market—does the firm's wealth exceed only the shared fixed entry cost?

All else equal, less wealthy firms are less able to expand to new locations, as they are unable to afford the fixed cost associated with expanding to new geographical markets. This result comes directly from the maximization problem's wealth constraint and is formally stated in Proposition 4a.

Proposition 4a: All else equal, as focal firm wealth decreases (W_A), the focal firm is less likely to expand to new locations.

However, introducing the possibility of expanding into different markets paints a new picture. Figure 4 presents a game in which market *j* has larger demand and larger fixed cost, while market *k* is still attractive, yet with slightly lower demand and lower fixed cost. Holding constant firm efficiency, revenue pressure (none), and firm *B*'s wealth, consider how changes in focal firm wealth impact location choice. Wealth constrained firms, unable to expand to large locations with high fixed cost, may be able to expand to moderately sized markets with smaller fixed costs. Smaller markets with lower fixed costs allow less wealthy firms an opportunity to enter.

Proposition 4b: All else equal, as focal firm wealth decreases (W_A), the focal firm is more likely to expand to smaller locations.

As in Proposition 4a, for small wealth levels, firm *A* will be more constrained and less likely to expand to market *j*. Yet, firm *A* may possess enough capital to expand to the smaller, less expensive location, *k*. As firm *A*'s wealth increases, the firm can more easily afford the fixed cost of expansion in both locations.

Figure 4: Impact of wealth (W_A) on entry and location choice

			Firm B's Choice								
	t into *j*		1	2	0	1	2	0	1	2	0
		t into *k*	0	0	0	1	1	1	2	2	2
Firm A's Choice	1	0									
	2	0									
	0	0									
	1	1				Large W_B					
	2	1									
	0	1									
	1	2									
	2	2				Moderate W_B					
	0	2				Small W_B					

Several more nuanced results come from the interaction between firm traits, competitor traits and market size. There are numerous theoretical propositions from interacting variables in the model. Proposition 5 is one such example. Now, relaxing the assumption that firms are equally efficient, consider how both firm efficiency and location traits (fixed cost and demand) impact both location choice and entry timing. Suppose that location *k* is large with attractive demand and a high fixed cost of entry, and location *j* is much smaller with less demand. Additionally, suppose that firm *A* is more efficient than firm *B*. Recall that the baseline Proposition 2 is that more efficient firms expand before less efficient firms. This is not necessarily the case across all markets though, as wealth constrained firms may only be able to

expand to a single market. Figure 5 and Proposition 5 highlight a scenario in which the more efficient firm (*A*) expands early in one market (*j*), but later in another market (*k*).

Proposition 5: All else equal, as fixed cost decreases in a location (FC_j), firms are more likely to enter, and wealth constrained efficient firms are more likely to enter larger locations ***after*** *wealth constrained inefficient firms.*

Figure 5: Impact of firm capabilities and location traits on location choice & timing

			Firm B's Choice								
	t into *j*		1	2	0	1	2	0	1	2	0
		t into *k*	0	0	0	1	1	1	2	2	2
Firm A's Choice	1	0									
	2	0									
	0	0									
	1	1									
	2	1									
	0	1						Large FCj			
	1	2						Moderate FCj			
	2	2									
	0	2									

This flip-flop in entry timing into location *j* (efficient firm after inefficient firm) is driven by the trade-offs associated with expanding earlier and later as well as the opportunity costs of expansion into different market types. Firm *B* is unable to make a profit at location *j* due to the small demand, and more efficient competition from firm *A*. Thus, firm *B* will not expand to location *j*. However, firm *A* can make a profit at location *j* when fixed costs are low enough. Additionally, firm *A* can wait for firm *B* to expand in location *k*, and expand after firm *B*, thus incurring a reduced fixed cost of entry.

Propositions 3, 4, and 5 present outcomes emphasizing boundary conditions which change entry timing and location strategy for heterogeneous firms and locations. While there exist additional interactions in the formal model, I present a set of outcomes that can be tested empirically, with exception of Proposition 5. Proposition 5 cannot currently be explored empirically due to data availability but suggests how less intuitive outcomes can be theoretically untangled using formal modeling techniques.

1.5 Conclusion

This essay provides a formal model of entry timing into geographical locations. The contribution of this model compared to previous modeling efforts is motivated by systemic changes across industries in the past few decades. One such change is the evolution of new service-based industries relying on platform and application technologies. Additionally, the increase in venture capital funding for new firms has made rapid firm expansion more feasible. This means that start-up firms can compete with existing firms more easily, especially if they are able to expand quickly.

This model endogenizes the entry timing decision. Entry timing is a function of focal firm traits, competitor firm traits, and location traits. Different combinations of these variables lead to several expansion outcomes. While the impact of one variable, for example market size, on firm expansion might seem obvious, it is the interaction of variables that leads to less obvious firm strategies. Numerical simulation helps elucidate some of these more complex relationships by identifying mutual best responses across different expansion strategies including early and late co-entry, staggered entry, and non-entry.

Propositions 1 through 5 are a sample of predictions based on the formal model and numerical simulation. These propositions focus on three main mechanisms in explaining entry timing: first is the size of the market, second is the relative efficiency of competing firms, and third is firm revenue pressure. These propositions are empirically tested in Essay 2. In Essay 3, I add an additional variable to the model, liability of foreignness, to extend model predictions to capture firm international expansion decisions.

Essay 2: Competition, Firm Financial Condition, and Location Strategy: Evidence from the Micro-Mobility Industry

2.1 Introduction

The model in Essay 1 is motivated by an absence of research on firm geographical expansion in newer industries, for example industries with firms offering services through different platforms and apps, and those with a large startup presence. Firms in these types of industries are expanding quickly, partly due to the increase in venture capital funding and the revenue pressure associated with this funding. One such industry is micro-mobility. This industry includes firms offering scooter, bikeshare, and electric moped services around the world.

In the past five years, the micro-mobility industry has seen considerable growth with many new entrants and an increase in venture capital funding. Firms such as Lime and Bird have each raised over $700,000,000 in VC funding in just three years. Additionally, scooter and bikeshare companies represent a relatively new industry with most firms founded in the past half-decade. U.S. cities saw their first dockless bikeshares starting in 2015 followed by electric scooters in 2017, and most recently electric mopeds in 2019.

Another interesting feature of this industry is that entry timing is precise. For example, unlike a manufacturing plant which might take years to build, entry timing in the micro-mobility industry can happen within one day. Expansion to a new market only requires the firm to deploy units to the market. Consumers interact with those units through a smartphone application. Therefore, this is an excellent context to study firm expansion, specifically entry timing, order, and location choice.

2.2 Empirical Context

The micro-mobility industry was born out of necessity to solve what is called the "last-mile transportation" problem. Last-mile transportation is a term first borrowed from telecommunications to describe the distance between networks and consumers. The term was later used in supply chain management as the final piece of the supply chain. This final leg was often a large share of the total transportation costs. Providing cheaper last-mile solutions presents a great opportunity for firms and innovators. Entrepreneurs saw bikes and scooters as one solution to the last-mile problem. Cities all over the world now have micro-mobility transportation options, including most large metropolitan areas in the U.S. Additionally, operating in the U.S. alone, there are more than 20 scooter and bikeshare firms, largely all founded after 2015.

2.2.1 Data Collection

For this essay, I collect entry timing and location data for all micro-mobility firms operating in the U.S. My data includes all cities and municipalities with present or past micro-mobility activity. For each location, I identify all firms currently operating in the city and all firms that have ever entered the location. I also collect information on the fleet size for each firm's entry.[2] The dataset comes from more than 600 unique news articles, social media posts, and company websites. Company websites provided a list of current operating locations, coupled with company social media accounts including Instagram and Twitter, helping to generate a more complete list of each firm's current city locations. Precise entry timing comes from online print

[2] The data collection on fleet size at entry resulted in 10% of observations missing data. I extrapolate these values based on the fleet size of competitors who entered a given city at the same time.

sources and includes smaller local newspapers such as the *Sacramento City Express* as well as national news sources such as the *New York Times*.

The data collection process resulted in 138 unique locations with entry from 24 different firms, or 3,312 possible firm-city expansions. For each city, I create a timeline of entry activity precise to the day of entry. Figure 6 is one such timeline and shows major events and entry timing for micro-mobility firms in Washington, D.C. This timeline also includes some information on the size of each entry event.

Figure 6: Timeline of micro-mobility industry in Washington, D.C.

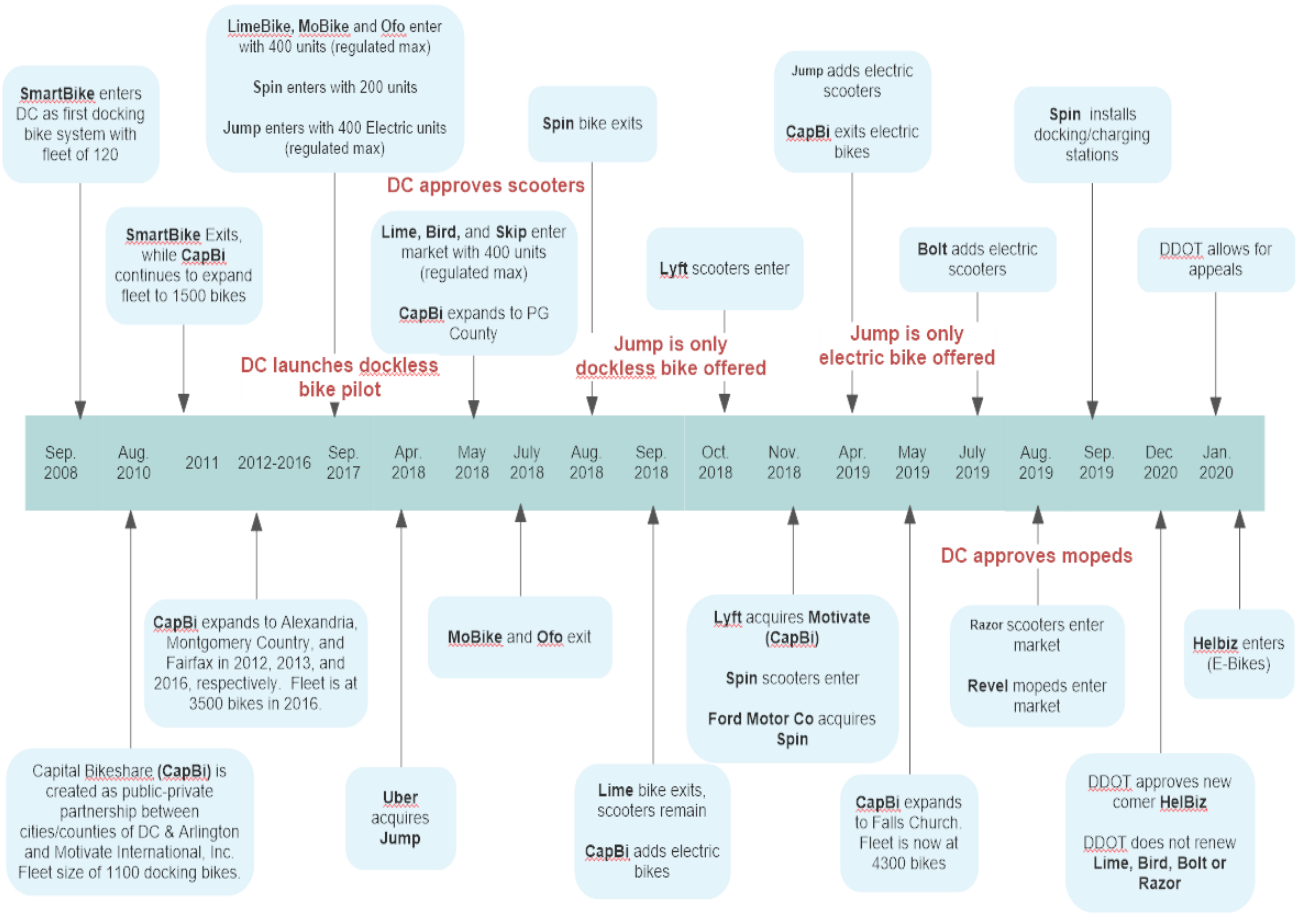


Figure 6 nicely illustrates the rapid acceleration of the micro-mobility industry. In less than three years, from September 2017 to January 2020, 12 different micro-mobility firms have entered Washington, D.C. From this timeline, we can already see overlap between the outcomes captured in the formal and simulation model. For example, early entrants to the market include Lime, MoBike, Ofo, Spin, and Jump. The most recent, but later entrants include Bolt, Razor, and Helbiz, three smaller firms that have raised considerably less funding than Lime, Bird, and Spin.

I also collect data on firm-level traits from company websites and popular press. Investment data including the size of each funding round come from Crunchbase and Pitchbook. For each firm, I also search for additional funding information from news sources and company blog entries, in order to corroborate funding information from the Crunchbase and Pitchbook data.

2.2.2 Summary Statistics

In total, there are 3,312 possible firm expansions, resulting in 424 realized entries. Firm age, number of employees, headquarter location, and ownership information are available for all firms. I find funding data for 17 of the 24 firms. This funding data varies across time, as firms raise additional capital. All funding variables in the regression analyses are based on the firm's total amount of capital raised at the time of entry. Table 6 presents the full list of 24 firms. Included is a sample of key firm level traits.

Table 6: Summary of firm level traits (N=24)

Firm	Yr Founded	Current Parent	Cnt Employees	Funding (Millions)	Ownership	Cnt Expansions
Bird	2017		201-500	$ 768	Private	37
Blueduck	2018		51-200	$ 28	Private	3
Bolt	2018		51-200	$ 30	Private	8
Goat	2018	Seamount Consulting	1-10		Acquired	1
Gotcha	2009	Ojo	51-200		Acquired	2
Gruv/Clevr	2018		1-10		Private	2
Helbiz	2015		51-200	$ 27	Private	2
Jump	2010	Uber	51-200	$ 12	Acquired	20
Kuhmute	2018		1-10	$ 1	Private	2
Lime	2017		501-1000	$ 777	Private	42
Lyft	2007		1001+	$ 5,150	Public	23
Lynx	2018		1-10		Private	1
Mobike	2015	Meituan Dianping	1001+	$ 928	Acquired	5
Ofo	2014		1001+	$ 2,151	Private	18
Ojo	2014		11-50	$ 5	Public	3
Pace/Zagster	2007	Zagster	51-200	$ 32	Private	4
Razor	2000		51-200		Private	10
Revel	2018		201-500	$ 32	Private	6
Scoot	2011	Bird	51-200	$ 46	Acquired	2
Sherpa	2019	Bird	1-10		Franchise	2
Skip	2017		51-200	$ 168	Private	7
Spin	2016	Ford	501-1000	$ 8	Acquired	32
Veoride	2017		11-50		Private	7
Wheels	2018		11-50	$ 90	Private	9
Mean				**603**		**10.33**

Finally, for each city I identify whether the location has a city-run bikeshare program, such as Capital Bikeshare in Washington, DC, Divvy in Chicago, and CitiBike in New York City. City-run bikeshare programs typically use docked bicycle stations and are operated jointly by a private firm and the local government. There is heterogeneity in the size of cities (based on

2018 census data), and the presence of a city-run bikeshare program. Having a city-run micro-mobility sharing program suggests amenability to alternative transportation options, typically bicycles and electric bicycles.

The primary constructs of interest from the formal model described in Essay 1 are firm capabilities (efficiency), firm revenue pressure, firm wealth, and location demand. Table 7 includes the definition of each variable (how it is operationalized empirically) and how it relates to the constructs in the formal and simulation models.

Table 7: Description of Variables

Construct in Model	Operationalization
Dependent Variables	
Entry	1= firm enters locations; 0 otherwise
Early vs Late Entry	1= firm enters location within 30 days of first entrant(s); 0 otherwise
Location Choice	1= firm enters top 25 MSA; 2= firm enters top 26-50 MSA; 3= firm enters small MSA (<50)
Independent Variables	
Relative efficiency	Focal firm total operating experience divided by average experience of existing competitors in city, at focal firm's time of entry. Used in entry models.
	Focal firm total operating experience divided by average experience of all existing competitors, at focal firm's time of entry. Used in entry timing models.
Wealth	Investor Funding >$100M at entry=1
Revenue pressure	Late-Stage Funding=1
Correlated w/ demand and fixed cost	Size of MSA
Correlated w/ demand	City-Run Program=1

Table 5 and 6 demonstrate key independent variables at the firm and city level which relate to firm expansion and entry timing. Table 7 provides a description of each variable. Among the 248 city-firm entries, 111 of those are firms that entered first with 76 of those early

entries coming from co-entry. Early entry is defined as the first firm to expand to a location, as well as any firm expansion within 30 days of the first firm entry. Early-co entry is defined as any early expansions involving more than one firm. For example, in Figure 6, Lime, MoBike, Ofo, Spin, and Jump are all early co-entrants in Washington, D.C.

Dependent Variables

Firm entry, timing of entry, and location choice are the three dependent variables. Firm entry takes a value of 1 for any of the possible 3,312 firm-city combinations where the firm began operating units, and 0 otherwise. For each of the 424 realized entries, I capture the date the firm entered and define the firm as an early entrant if it is the first entrant to a location or within 30 days of the first entrant(s). The firm is considered a late entrant if it enters a location after 30 days from the first entrant(s). Finally, among the 424 realized entries, I also consider which type of location the firm chose: large MSA (top 25 in terms of population), moderately sized MSA (top 26-50 in terms of population), and small MSA (less than top 50 MSA in terms of population).

Independent Variables

There are three main independent variables described in the formal model. First, efficiency captures the experience of firms over time. Empirically, this is measured as the total number of units (fleet size) the firm has deployed in all realized expansion locations, prior to the next expansion in question. Relative efficiency captures the focal firm experience compared to its competitors. I define relative experience in two ways for the two types of dependent variables: 1) based on the experience of existing competitors in a city at a given time of entry,

and 2) based on the experience of all existing competitors in the industry at a given time of entry. The former construct is used in the models of entry (did the firm enter a given location?) and location choice (what type of location did the firm choose?), while the latter construct is used in the model of entry timing (is the firm an early or later entrant?). The key difference in the constructs is the comparison group (the measure's denominator). For first entrants, there are no existing competitors at a location, so the firm considers all possible entrants, meaning all firms in the industry. By contrast firms choose whether and where to expand based on the existing competition at a location. However, model results are robust to either type of relative efficiency measure, formally defined in equation 9.[3]

$$\frac{\sum_{j=1}^{J} Fleet\ Size_{jit<T}}{\sum_{i>1}^{I}\sum_{j=1}^{J} Fleet\ Size_{jit<T} \Big/ I} \tag{9}$$

Two additional constructs at the firm level are wealth and revenue pressure. Wealth is operationalized as total amount of funding, and revenue pressure comes from the firm's funding stage information. Based on data from carta.com (Socias, 2017) and an interview with a prominent New York City VC investor, the presence of revenue pressure is based on firm funding round. Firms face very little pressure for revenue during seed funding rounds, where the primary goal is proof of concept. However, the pressure for positive revenue increases as firms enter later stages of funding. Finally, mature, publicly traded firms face less revenue pressure,

[3] The denominator in equation 9 differs for entry and location choice models, and for the entry timing model. For the entry and location choice models, the denominator is only based on the fleet size of firms (*I)* which entered a given city at the time of entry. In the entry timing models, the denominator is based on the fleet size of all firms in the industry. For example, consider a world of 3 firms (A, B, and C) in which A and B operate in location X, C operates in location Y, and no firm operates in location Z at t=1. Now suppose firm A enters location Y in t=2. For the entry and location choice models, firm A's relative efficiency is only based on the fleet size of firm C, since this captures firm A's competition at location Y. Now instead, suppose firm A is the first to enter location Z in t=2. For the entry timing model, firm A's relative efficiency is based on the fleet size of all potential competitors to Z, meaning firms B and C.

compared to pressure for overall earnings/profit. While funding rounds and total funding are related, there is variance in total funding across funding stages. In fact, the correlation between VC funding of more than $100M at time of entry and being in a late-stage funding round at time of entry is only .205. In model regressions, I include a wealth dummy which takes a value of 1 for firms with VC funding exceeding $100million at the time of expansion. I allow both the wealth and revenue pressure variables to change across time, as firms raise additional funds, and enter later stages of funding.

Location-level variables include the metropolitan statistical area (MSA) size for which the city resides, and a dummy for whether the location has a city-run bicycle share program. Acknowledging omitted variables related to demand, I include city fixed effects, in applicable regressions.

2.3 Empirical Results

I study the relationship between firm traits, location traits, and entry decisions. For entry and entry timing regression analyses, I use linear probability models and include key independent variables consistent with those discussed in section 2. All linear probability model results are robust to logistic regression models. Multinomial logistic regressions are used in the model of location choice. I present results using data based on all micro-mobility products (scooter, bike, and moped), but the results do not change, for analyses at the product level. All model predictions—the propositions presented in section 4—about the relationship between each independent variable and dependent variable, were defined before collecting and analyzing the micro-mobility data.

2.3.1 Entry

The first set of analyses, in Table 8, explores firm entry. The dependent variable is whether the firm entered a given location. Models 1 and 2 include measures of location traits. Model 3 adds controls for funds raised, and Models 4 and 5 include relative efficiency. Larger values of relative efficiency indicate that the focal firm has more experience operating micro-mobility units than their average competitors in a given city. Model 5 also includes city fixed effects, dropping all city-level variables. All models examine the full set of possible expansions, with 3,312 observations. Pseudo R-squared is presented for each model, highlighting the explanatory power of each model, and the impact that each new independent variable has on explaining entry.

Table 8: Entry Regression Analysis

DV: Entry=1, Non-Entry=0	(1)	(2)	(3)	(4)	(5)
City in top 25 largest MSA	0.133	0.108	0.112	0.113	
	(0.015)	(0.016)	(0.015)	(0.015)	
	0.000	*0.000*	*0.000*	*0.000*	
City in 26th to 50th largest MSA	0.062	0.040	0.040	0.042	
	0.015	(0.016)	(0.015)	(0.015)	
	0.000	*0.012*	*0.008*	*0.005*	
City-Run Bikeshare?		0.054	0.053	0.054	
		(0.012)	(0.012)	(0.012)	
		0.000	*0.000*	*0.000*	
Funds at Entry > $100M			0.183	0.177	0.182
			(0.014)	(0.014)	(0.013)
			0.000	*0.000*	*0.000*
Focal Firm Experience/Avg Competitor Experience in City				0.007	0.007
				(0.002)	(0.002)
				0.002	*0.001*
City FE?	NO	NO	NO	NO	YES
Obs.	3,312	3,312	3,312	3,312	3,312
R-sq	0.029	0.035	0.100	0.112	0.182

Notes: Results from a linear probability model. Robust standard errors appear in parenthesis below the coefficient. P-values appear in italics below standard errors.

This empirical model tests propositions 1 and 4a. Unsurprisingly, locations in the largest 25 MSAs are more likely to see firms enter, consistent with proposition 1. The coefficient is positive and significant at a 1% level in models 1-4. Also, cities with a locally run bikeshare program are more likely to see firms enter. The coefficient is positive and significant at a 1% level in models 1-4. There is also evidence that wealthier firms are more likely to expand to new locations, as in Proposition 4a. The coefficient is positive and significant at a 1% level in models 3-5. In fact, wealthy firms are almost two times more likely to enter new cities than less wealthy firms, based on venture capital funding raised. Additionally, more experienced firms are more likely to expand to new locations, with a positive and significant coefficient at a 1% level in models 4 and 5. The results for firm wealth and focal firm experience are robust when city fixed effects are introduced (which suppresses the time invariant city traits), with a corresponding increase in r-squared from model 4 to model 5, which suggests that additional location traits help explain firm entry into new locations.

2.3.2 Entry Timing

The next set of analysis takes the sample of all firm-city entries. In total there are 424 observations. In Table 9, the dependent variable, conditional on entry, is whether the firm entered the location early—within thirty days of the first entrant(s)—or later—after thirty days of the first entrant(s). Results are robust to slightly smaller and larger early versus late entry windows. In this empirical model, late entry only occurs if a firm enters after a competitor. Described in propositions 2 and 3, respectively, I expect that early entry is a function of firm relative efficiency and revenue pressure, holding constant firm wealth.

Table 9: Early vs Late Entry Regression Analysis

DV: Early Entry=1, Later Entry=0	(1)	(2)	(3)
Funds at Entry > $100M	0.033	-0.199	-0.159
	(0.05)	(0.064)	(0.056)
	0.516	*0.002*	*0.004*
Focal Firm Experience/Avg Competitor Experience		0.147	0.093
		(0.027)	(0.026)
		0.000	*0.000*
Late-Stage Funding			0.215
			(0.058)
			0.000
Obs.	424	424	424
R-sq	0.001	0.092	0.123

Notes: Results from linear probability models. Robust standard errors appear in parenthesis below coefficients. P-values appear in italics below standard errors. Sample excludes non entry observations.

From proposition 2, as firms become more efficient, I expect them to expand earlier. I find support for this proposition that more efficient firms expand earlier. The coefficient on relative firm efficiency is positive and statistically significant at a 5% level in models 2 and 3. There is also support for proposition 3 that revenue pressure pushes firms to expand earlier. In model 3 I find that firms facing revenue pressure—those in later stage funding rounds—are 2 times more likely to enter new locations early, all else equal. This finding is statistically significant at a 10% level and is consistent with the rapid expansion phenomenon observed in startup firms: startup firms expand more quickly than seed stage, and mature firms, to increase revenue growth, to appease current and future investors. Including revenue pressure in model 3 increases the r-squared value, suggesting that in addition to wealth and relative efficiency, revenue pressure improves the explanatory power of the regression model.

2.3.3 Location Choice

The last model proposition to be tested empirically is the relationship between wealth and location choice. Based on proposition 4b, I expect that as wealth decreases, firms will be more willing to enter smaller locations, compared to larger locations. Table 10 is a multinomial logit model and provides partial support for the relationship between wealth and location choice. The interpretation of each independent variable is the impact that a given variable has in explaining the choice between large MSAs (group 1) vs small MSAs (group 3), as well as moderately sized MSAs (group 2) vs small MSAs (group 3). Note that the table includes relative risk ratios, as this is a non-linear model.

As presented in Table 10, wealthier firms are more likely to enter larger locations compared to smaller locations (the omitted base group). This result is partially supported when controlling for the presence of a city-run bikeshare program and relative firm efficiency in model 3. I find that wealthy firms prefer moderately sized locations (MSAs in the top 26 to 50) compared to smaller locations—a statistically significant relative risk ratio at a 5% level. However, the point estimate for the relationship between the largest 25 MSAs and the smallest is noisier, and not statistically significant. This suggests that other factors, rather than wealth, explain the choice of entry into the largest markets compared to the smallest markets. One explanation is that less wealthy firms enter fewer locations, often entering only a handful of large markets. Whereas wealthy firms can expand to all types of markets, and do not have to prioritize certain locations (i.e., large MSAs with the most demand) over others.

Table 10: Location Choice Regression Analysis

DV: 1=Top 25 MSA, 2=Top 26-50 MSA, 3=Small MSA (Base Outcome)		(1)	(2)	(3)
City-Run Bikeshare?				
	1	8.130	8.119	7.924
		(2.130)	(2.126)	(2.125)
		0.000	*0.000*	*0.000*
	2	7.977	7.938	7.724
		(2.710)	(2.704)	(2.664)
		0.000	*0.000*	*0.000*
Funds at Entry > $100M				
	1		1.171	1.342
			(.291)	(.346)
			0.524	*0.254*
	2		1.905	2.187
			(.592)	(.693)
			0.038	*0.014*
Focal Firm Experience/Avg Competitor Experience				
	1			0.953
				(.039)
				0.233
	2			0.951
				(.035)
				0.175
Obs.		424	424	424
Pseudo R-sq		0.096	0.101	0.109

Notes: Results from a multinomial logit regression. Robust standard errors appear in parenthesis below the relative risk ratios. P-values appear in italics below standard errors. Sample includes only observations where entry occurred.

2.4 Discussion and Conclusion

In this Essay, I test model predictions from the formal model presented in Essay 1. I examine how location, firm, and competitor traits shape firm entry timing and location choice, highlighting a new mechanism that leads to early geographical expansion for startup firms: revenue pressure. Prior literature on mature industries suggests that financial pressure leads to

contractionary firm behavior, such as reducing total output (Zhang and Gimeno, 2010). This financial pressure in mature industries is fundamentally different than the financial pressure facing some startup firms, who are rarely profitable at first, and whose primary goal is to increase revenue through expansion (e.g., gaining new users in new cities in the micro-mobility industry context).

Acknowledging this phenomenon of VC funded startup firms focusing on perceived firm performance via revenue growth rather than current profitability, I explore how firm traits—including revenue pressure—shape firms' entry timing and location choice. I develop a formal model of firm geographical expansion, and numerically simulate model results. Using data from the VC backed micro-mobility industry, I identify the entry timing and location choice of all scooter, bike, and moped share firms that entered all U.S. metropolitan areas. The data collection effort resulted in 3,312 possible expansions at the firm-city level and 424 realized expansions.

I find that location traits will attract or deter firm entry, and that firm capabilities and experience matter for expansion decisions: more experienced firms enter locations before less experienced firms. However, firms in late-stage funding rounds, who face considerably more revenue pressure than seed-stage funded or mature firms, will still expand earlier, even after controlling for experience and firm wealth (total VC funding). In fact, firms facing revenue pressure, in late-stage funding rounds, enter cities earlier at a rate two times that of seed-stage firms and mature companies.

I see a few key contributions to the literatures on geographical expansion and firm financial condition. First is the importance of various layers of heterogeneity (firm, location, and competitor traits) in explaining firm strategic choices. Formal and simulation modeling can be

especially helpful tools in handling research with such complexity in terms of the interactions of these multiple levels of variation. Second, I identify a new mechanism, revenue pressure, which leads to rapid growth and expansion for startup firms, different than the impact of earnings pressure on mature firms. The increase in venture capital funding has led to rapid firm expansion, as both firms and their investors hope to be the next tech giant, sitting along the ranks of Uber, Airbnb, and Amazon. For startup firms, gaining new users by expanding to more locations appeases existing investors and helps attract new investors, in lieu of traditional metrics of firm performance (Brown and Farrell, 2021).

Understanding the firm traits that lead to firm choices is vital for then understanding how these choices shape firm performance. As discussed in Shaver (1998) and Hamilton and Zenger (2003), strategic management research must be cautious in its examination of the link between strategic choices and firm performance. In the areas of governance choice, from a transaction cost economics perspective, Masten (1993) argues that "the relation between governance and performance cannot be accurately assessed without an appreciation of the factors that lead transactors to adopt one form of organization over another." In my research context, failing to include key drivers of firm strategic choices (e.g., how revenue pressure impacts entry timing) will lead to misidentification of the relationship between these choices and firm performance.

I acknowledge some research limitations, which also provide opportunity for future research. First, theoretical modeling predictions come from the exogenous assignment of firm and location traits, resulting in causal claims. Empirically, in the micro-mobility context, it is possible that firms and locations have unobservable traits, which also contribute to firm entry timing and location choice outcomes. Second, while the extensive data collection process resulted in the census of micro-mobility activity in the U.S., additional data on other countries

and other industries would lead to further external validity. Finally, an important contribution of this paper is bringing into focus the role of revenue pressure for strategic choices, in particular because these choices have implications for firm performance. How entry timing and location, as a function of revenue pressure, shape firm performance is left for future research.

In this study, I build a formal model of entry timing and location choice. Entry timing is a function of focal firm and competitor firm traits, and location traits. Different combinations of these variables lead to several possible expansion outcomes and a set of model predictions, tested empirically. I find that wealthy, more experienced firms are more likely to enter new locations, and that firms prefer to enter larger locations over smaller locations. However, while experienced firms expand to new locations earlier than less experienced firms, revenue pressure will push firms to expand early.

Essay 3: Competition, Liability of Foreignness, and Foreign Market Entry Order

3.1 Introduction

In the first essay, I build a mathematical model of entry timing as a function of firm traits (both focal and competitor firms) and location traits. In the second essay, I test a set of predictions pertaining to firm-specific and location-specific traits, using empirical data on U.S. micro mobility activity. However, firms in this industry are also expanding to cities outside the U.S.; entry timing then becomes more complex in the context of firm internationalization, as now, entry timing is a function of both firm, location, and firm-location specific characteristics: firms may gain location-specific expertise as a result of expanding to foreign countries (Johanson and Vahlne, 1977). In particular, for international expansion, firms must weigh the possible challenges associated with liability of foreignness, including competing with domestic firms (Zaheer, 1995). I define liability of foreignness consistent with Zaheer's 1995 study: all additional costs overseas, exceeding those incurred by a local firm.

This liability of foreignness, often conceptualized as the cross-national, institutional distance between a firm's home country (HQ or founding country) and host country (destination of the foreign investment), then varies based on both firm and expansion location, and is a key independent variable in explaining firm internationalization decisions (Werner, 2002). In this way, liability of foreignness is firm-location specific. Additionally, as a firm expands to new locations, liability of foreignness may change across time. In "Entry Mode and Location Choice: Foreignness and Intangible Type", liability of foreignness is dynamic, as firms learn location specific intangibles across time, and redeploy those intangibles at future locations (Jaffe, Sharma, and Chung, *working project).*

Furthermore, firm internationalization has long been explored at the country-level (e.g. Zaheer and Zaheer, 1997; Pajunen, 2008), due to both data availability, and choice of industry. Also, location choice research has focused on different firm mechanisms for firms within a small set of developed countries, with particular focus on either U.S. inflows or outflows of foreign direct investment (e.g. Flower, 1976; Shaver and Flyer, 2000; Flores and Aguilera, 2007). Of note here is that foreign direct investment historically was only common for a small set of developed countries and used by large multinationals in developed industries—for example the airline industry, manufacturing, or semiconductors.

Today's micro-mobility industry presents an opportunity to study additional firm-location dynamics, that may not have existed in previous decades. In particular, for industries in which entry into a particular country is coupled with operational boundaries more granular than the country level (such as the city level, for micro mobility firms in this study), analysis at the country level may miss key city-level dynamics. And, studies that capture more variance in country traits—with firms originating and expanding to a diverse set of nations, not only the U.S—allow for a more nuanced investigation of firm-host country specific capabilities across time.

One possibility is that firms may expand to the same country multiple times, but across different cities within the country. This study takes seriously that firm entry may occur at the city level, and while country level institutions matter, competition at the city level, and firm experience within a country will also shape entry timing decisions. In fact, I find that country-level institutions, which are associated with varied firm-location levels of liability of foreignness, have a differential impact on entry timing at the country versus city level. For example, I find that while the geographical and economic distance between countries helps explain country level

entry timing in the micro-mobility industry, at the city level, economic distance matters most, but only when a firm has no prior experience in a country.

There is a prominent stream of research which explores the importance of liability of foreignness and dyadic country distance for firm behavior and strategic choice (Ghemawat, 2001), but data availability has limited opportunities to study how foreignness differentially shapes entry timing across both country and city geographies, for a wide variety of home (founding/HQ) and host country dyads. For example, studies of U.S. multinationals lack firm-country level variance, as all firms originate from the same set of U.S. institutions.

In this essay, I hand-collect data on firm entry timing around the world in the micro-mobility industry. The data includes firms originating from 36 founding countries and expanding to 60 different host countries, providing ample variance in terms of founding country and host country distances. This data captures firm behavior across times, and for multiple expansions within a country. Here lies a unique opportunity to study how different aspects of foreignness shape firm internationalization decisions, both for a firm's first entry into a foreign country, and for all subsequent entries.

This essay asks: how does liability of foreignness impact firm entry timing, at the city and country level? Which aspects of foreignness shape entry timing in the micro-mobility industry? Ex-post analysis of regression results then explores how liability of foreignness changes at the firm level, across time: does firm-country specific liability of foreignness wane after a firm's initial entry into a country?

3.2 Formal Model Extension

I use the mathematical infrastructure developed in Essay 1 to analyze entry timing decisions for internationalizing firms. In a model of internationalization, firms must choose the entry timing and location of expansion for both domestic and international cities. As in Essay 1, each location is characterized by exogenously assigned demand (market size) and fixed start-up costs. Locations can be foreign or domestic to the firm. Firms face additional friction when doing business abroad due to the liability of foreignness. Firms that expand to a location within their own country are considered "locals" and face no additional costs associated with expansion within their home country. The market size and fixed start-up costs both make markets more attractive or less attractive. Additionally, liability of foreignness *(LOF)* increases both fixed costs and marginal costs for non-local (foreign) firms.

Equations (1.A.iii) and (1.B.iii) show the maximization solutions when two firms, *A* and *B*, enter a location *j* at the same time. Of note, *LOF* here is firm-location specific; meaning that firm A's *LOF* is firm specific, and will change depending on the location *j* (a city within a country).

$$V_{Aj}^{*} = -\frac{LoF_{Aj}FC_{j}}{2} + \left(\frac{a_{j}-2LoF_{Aj}c_{A}+LoF_{Bj}c_{B}}{3}\right)^{2} * \frac{1}{1-\delta} \quad \text{(1.A.iii)}$$

$$V_{Bj}^{*} = -\frac{LoF_{Bj}FC_{j}}{2} + \left(\frac{a_{j}-2LoF_{Bj}c_{B}+LoF_{Aj}c_{A}}{3}\right)^{2} * \frac{1}{1-\delta} \quad \text{(1.B.iii)}$$

LOF similarly impacts location-specific fixed costs and firm-specific marginal costs across all other entry timing outcomes, without loss of generality: as *LOF* increases, so too do fixed and marginal costs. Larger *LOF* makes *j* more expensive and more challenging for a firm to extract rents.

3.3 Model Prediction

The formal model informs the direction of the relationship between *LOF* and firm entry timing, holding constant other firm, competitor, and location traits. Firms expanding to foreign countries face increased costs as a result of the challenges associated with doing business abroad. These additional costs vary based on the instructional distance ("foreignness") between a firm's founding and host countries. All else equal, as *LOF* for entry into *j* increases, the overall value of expansion to *j* decreases, and the attractiveness of late expansion increases. This push towards later expansion is due to the benefit of reduced fixed costs, as a result of late expansion. [4] This incentivizes firms facing large liability of foreignness to expand after their competition, stated formally in Proposition 6.

Proposition 6: All else equal, as focal firm liability of foreignness increases (LOF), the focal firm is more likely to expand later.

Firms that may prefer early entry in their local countries, will prefer later entry into foreign markets where *LOF* is high. This has to do with the trade-offs associated with early entry compared to late entry: the benefits of early entry subside when firm costs increase as a result of foreignness. Both increasing fixed and marginal costs from foreignness make later entry more attractive; higher fixed costs will lead to firms entering later, since late entrants incur lower fixed costs in markets that have already been developed by early entrants. And, higher marginal costs relative to competition, makes early entry less attractive, analogous to Proposition 2, presented in Essay 1.

[4] Recall that firms incur a reduced fixed start-up costs when they enter locations after competition. Early entrants pay a larger fixed start-up costs as they must attract customers and overcome any institutional barriers.

3.4 Empirical Context

I test Proposition 6 using hand-collected data from the micro-mobility industry (see section 2.2 of Essay 2 for a description of the industry), for all private or formerly private firms, from all countries in the world. This data comes from more than 2,000 individual sources including company websites, social media posts, and popular business press. To the best of my knowledge, the dataset represents the census of micro-mobility expansion activity around the world, from the industry's inception to March 2022. This data presents a unique opportunity to explore firm expansion for privately held startup companies across a large variety of founding and host countries.

3.4.1 Data Description

The data collection resulted in a dataset of 110 firms, across 36 countries.[5] These 110 firms expanded 1,939 times, to 922 different cities across 60 countries. For each firm, information is collected on firm age, founding city and country, primary product offerings, and funding amount and type. Additional data is collected on each firm's portfolio of locations, including the date, and fleet size of each entry. Table 11 provides an overview of firms with the largest geographical footprint, in terms of total entries. Lime, an American based firm, has made the most expansions at 205 across 30 countries. Tier of Germany and Bird of the US, follow Lime, each with 18 countries entered.

[5] Founding country, refers to the country the firm was founded. Foreignness measures are based on the distance between the firm's founding country ("home"), and host countries.

Table 11: Summary of firm level traits

Firm	Yr Founded	Founding Country	Total Funding	Ownership (Current)	Cities Entered	Countries Entered
Lime	2017	USA	1,470,000,000	Privately Held	205	30
Tier	2018	Germany	629,439,744	Privately Held	177	18
Bird	2017	USA	928,000,000	Privately Held	156	18
Spin	2016	USA	8,000,000	Acquired	98	3
Voi	2018	Sweden	502,789,504	Privately Held	88	13
Mobike	2015	China	928,000,000	Acquired	67	17
Blinkee City	2016	Poland	2,628,188	Privately Held	57	9
Veoride	2017	USA	16,000,000	Privately Held	55	1
Go Sharing	2019	Netherlands			49	5
Ofo	2014	China	2,150,853,120	Privately Held	48	11
Link	2019	USA	261,700,000	Privately Held	47	10
Wind	2017	Spain	72,000,000	Acquired	44	14
Hello Travel	2016	China	852,210,304		42	1
Jump	2010	USA	11,625,000	Acquired	39	2
Helbiz	2015	USA	78,400,000	Publicly Held	37	3
Swing	2019	South Korea	32,383,570	Privately Held	34	1
Dott	2018	Netherlands	141,707,008	Privately Held	33	11
Beam	2018	Singapore	126,400,000	Privately Held	31	4
Neuron Mobility	2016	Singapore	34,181,616	Privately Held	31	5
Lyft	2007	USA	5,149,899,776	Publicly Held	30	1
Zeus	2019	Ireland	2,701,483	Privately Held	29	5
Bit Mobility	2019	Italy			27	1
Gbike	2017	South Korea	500,000	Privately Held	25	1
Whoosh	2018	Russia	25,900,000	Privately Held	17	1
Bolt	2018	USA	40,400,000	Privately Held	17	1
Rekola	2013	Czech Rep.	479,000	Privately Held	15	3
Muving	2017	Spain			15	3

Notes: Data includes all firms with 15 expansion or more, regardless of funding data availability.

As Table 11 suggests, the micro-mobility industry has seen considerable activity from a number of firms all over the world, especially startups in American and China, as well as numerous firms throughout Europe. Most firms were founded in the last decade, with considerable industry activity within the past 5-years, especially from 2017-2019. Based on

available funding data, firms in the micro-mobility industry have collected more than $15 Billion worth of capital.

Next, Table 12 provides the list of 60 host countries receiving at least one micro-mobility entry. The table also includes the number of firms founded in the host country, and the total number of expansions to each host country. While the US, UK, Netherlands, and Spain have the largest presence of founding firms (18 within the US, and 7 firms each from the UK, Netherlands, and Spain), it is the US, Germany, Italy, and South Korea with the greatest number of micro-mobility expansions.

Table 12: List of Host Countries

Host Country	# Firms Founded in Country	Total Expansions to Country
USA	18	550
Germany	5	188
Italy	4	151
Korea, Rep.	5	90
UK	7	86
Poland	2	82
Netherlands	7	81
Spain	7	74
China	3	63
France	3	57
Australia		37
Sweden	1	35
India	4	34
Turkey	5	30
New Zealand	2	26
Canada	3	26
Belgium	1	25
UAE	3	23
Norway		21
Austria		20
Russian Federation	1	20
Switzerland		18
Czech Republic	2	17

Israel	1	15
Portugal	1	14
Finland		13
Denmark		13
Mexico	2	12
Latvia	3	11
Brazil	1	10
Chile		10
Iceland	1	9
Lithuania	1	7
Saudi Arabia	2	5
Georgia	2	5
Hungary		5
Colombia	1	4
Ireland	4	4
Malaysia		4
Romania		4
Thailand		3
Kazakhstan	2	3
Belarus	1	3
Slovak Republic		3
Ukraine		3
Bahrain		3
Malta		2
Argentina		2
Bulgaria	1	2
Croatia		2
Greece		2
Egypt, Arab Rep.	1	2
Qatar		2
Singapore	2	2
Estonia		1
Albania		1
Pakistan	1	1
Peru		1
Japan		1
Luxembourg		1

Notes: Data includes all firms, regardless of funding data availability.

A key feature of this dataset is that expansion activity occurs at a more granular level than country—for micro-mobility firms, entry occurs at the city level. Table 13 shows the list of cities with the largest micro-mobility presence in terms of total firm expansions (those with five or more entries). Washington, DC and Madrid top the list, each with 17 expansions, followed by Austin, Milan, and Paris, each with 15 entries. Table 13 also indicates whether the city is one of the largest in the world, based on population.

Table 13: List of Host Cities (>5 Expansions)

City	Top 100 Largest City?	Top 101 - 300 Largest City?	Total Expansions
Washington, DC (USA)			17
Madrid (Spain)	Yes		17
Austin, TX (USA)			15
Milan (Italy)		Yes	15
Paris (France)	Yes		15
Rome (Italy)	Yes		14
San Diego, CA (USA)			14
Turin (Italy)		Yes	13
Berlin (Germany)		Yes	13
Atlanta, GA (USA)			13
Barcelona (Italy)	Yes		13
Dallas, TX (USA)			12
Chicago, IL (USA)		Yes	12
Brussels (Belgium)		Yes	11
Miami, FL (USA)			11
Bordeaux (France)			11
Oakland, CA (USA)			10
Seoul (S. Korea)	Yes		10
Santa Monica, CA (USA)			10
Los Angeles, CA (USA)		Yes	10
Mexico City (Mexico)	Yes		10
Malaga (Spain)			10
Lisbon (Portugal)		Yes	9
Scottsdale, AZ (USA)			9
Dusseldorf (Germany)			9
Istanbul (Turkey)	Yes		9

Columbus, OH (USA)			9
Nashville, TN (USA)			8
Vienna (Austria)		Yes	8
Palermo (Italy)			8
Durham, NC (USA)			8
Stockholm (Sweden)			8
London (UK)	Yes		8
San Francisco, CA (USA)			8
Seattle, WA (USA)			8
Denver, CO (USA)			7
Cologne (Germany)			7
Rotterdam (Netherlands)			7
The Hague (Netherlands)			7
Oslo (Norway)			7
Florence (Italy)			7
Valencia (Italy)		Yes	7
Portland, OR (USA)			7
Warsaw (Poland)		Yes	7
San Antionio, TX (USA)			7
Seville (Spain)			7
Cleveland, OH (USA)			7
Charlotte, NC (USA)			7
Mesa, AZ (USA)			7
Baltimore, MD (USA)			6
Sacramento, CA (USA)			6
Abu Dhabi (USA)			6
Verona (Italy)			6
Lyon (France)		Yes	6
Zaragoza (Spain)			6
Hamburg (Germany)		Yes	6
Red Dear (Canada)			6
Tallahassee, FL (USA) (USA)			5
Minneapolis, MN (USA)			5
Tempe, AZ (USA)			5
Amersfoort (Netherlands)			5
Orlando, FL (USA)			5

Notes: Data includes all firms, regardless of funding data availability.

3.4.2 Summary Statistics

In Essay 2, I find that funding amount and type are key factors in explaining entry timing. Data collection for this essay resulted in 342 of 1,939 (17%) expansions with unknown funding information. Thus, moving forward I exclude all observations with missing funding information, resulting in a sample of 1,597 observations (at the geographical expansion level). However, these 342 observations without funding data are included in all calculations of firm experience (see Table 14 for a description of variables) and included when identifying firm entry timing. Table 14 provides a description of all dependent, independent, and control variables used in the regression analyses. Summary statistics for dependent, independent, and control variables appear in Table 15.

Table 14: Description of Variables

Construct	Operationalization
Dependent Variables	
Entry timing to city	1=firm enters city within 30 days of first entrant(s); 0 otherwise
Entry timing to country	1=firm enters country within 30 days of first entrant(s); 0 otherwise
Control Variables	
Firm Experience	Age at time of Entry
Relative Efficiency	Focal firm total operating experience (fleet size) divided by average experience of all existing competitors, at focal firm's time of entry.
Wealth	Investor Funding >$100M at entry=1
Funding Stage	Series A or B=1
Independent Variables	
Liability of Foreignness	Min. Geographical Distance Founding - Host Geographical Distance Min. Economic Distance Founding - Host Economic Distance Min. Administrative Distance Founding - Host Administrative Distance

Table 15: Summary of Variables

Variables	Mean	St. Dev.	Cnt 1	Min	Max	N
Dep. Vars.						
First to City	0.55	0.50	878	0	1	1,597
First to Country	0.04	0.21	71	0	1	1,597
Control Vars.						
Firm Age at Entry	2.94	2.32	345	-1	23	1,597
Relative Efficiency	0.64	2.57	0	0.00	41.16	1,597
# Firm Expansions in Country (at entry)	15.26	23.26	211	0	119	1,597
# Firm Expansions (at entry)	45.60	48.16	58	1	205	1,597
Funds at Entry > $100M	0.50	0.50	799	0	1	1,597
Series A or B	0.29	0.45	466	0	1	1,597
Indep. Vars.						
Min. Geographical Dist.	0.01	0.06	0	0	0.63	1,597
Founding - Host Geographical Dist.	0.11	0.18	0	0	0.97	1,597
Min. Economic Dist.	0.00	0.02	0	0	0.44	1,597
Founding - Host Economic Dist.	0.04	0.09	0	0	0.67	1,597
Min. Administrative Dist.	0.01	0.06	0	0	0.57	1,597
Founding - Host Administrative Dist.	0.07	0.11	0	0	0.60	1,597

Notes: Data includes all firms with available funding data.

Dependent Variables

There are two dependent variables of interest: 1) entry timing at the city-level and 2) entry timing at the country-level. I define entry as any firm-city observation where the firm began operating units. For each expansion, I capture the date the firm entered and define the firm as an early entrant if it is the first entrant to a location (city or country) or within 30 days of the first entrant(s). The firm is considered a late entrant if it enters a location (city or country) after 30 days from the first entrant(s). [6]

[6] Note that a firm-city observation is not considered an entry until the firm has operating units at that location. In particular, firm founding location alone is not considered an entry until the firm has available units in the founding location.

All first entrants at the country level are also first entrants at the city level. By contrast, a key distinction between the two dependent variables is that a firm can be an early entrant at the city-level, but a late entrant at the country-level. For example, the American firm, Bird, was the first entrant into Canada with expansion to Calgary in July 2019. Therefore, Bird was both an early entrant to the city of Calgary and was also the first firm to enter Canada. Prior to this July 2019 expansion, no other firms had micro-mobility units operating in Canada. In 2021, Bird was the first entrant to the city of Red Deer, Canada, but this entry is not considered an early entry into Canada, as the country had already been populated by both Bird and its competitors, via entry into other Canadian cities.

Control Variables

I consider a set of control variables at the firm level. Firm age controls for firm experience and relative efficiency captures a firm's experience relative to its competition, across time. Empirically, relative efficiency is measured as the total number of units (fleet size) the firm has deployed in all realized expansion locations, prior to the next expansion in question. Relative efficiency captures the focal firm experience compared to its competitors. Because all analyses in this essay are about entry timing, I define relative experience based on the experience of all existing competitors in the industry at a given time of entry. I proxy for country-specific firm experience based on the number of a firm's existing expansions within a country (at the time entry).

Two additional financial constructs at the firm level are wealth and revenue pressure. Wealth is operationalized as the total amount of funding a firm received, and revenue pressure comes from the firm's funding stage information, as in Essay 2. All regression models include

both year and location fixed effects, which account for additional unobserved heterogeneity at the year, city, and country level.

Independent Variables

There are six key independent variables, each capturing different aspects of liability of foreignness. All foreignness variables are updated annually and provided by Berry, Guillen, and Zhou (2010). These variables capture the dyadic distance between two countries, in terms of geographical, economic, and administrative factors. Geographical distance is the distance between two countries based on their geographic center. Economic distance accounts for both countries' GDP per capital, inflation, exports and imports component variables. Administrative distance includes whether the country dyad shares a colonial tie, the percent of the population that share the same religion in the country dyad, and whether the country dyad shares the same legal system.

The normalized raw distance measures are represented by the variables "Founding – Host Geographical Distance", "Founding – Host Economic Distance", and "Founding – Host Administrative Distance". The additional three independent variables ("Min. Geographical Distance", "Min. Economic Distance", and "Min. Administrative Distance") are constructed based on the method developed by Jaffe, Sharma, and Chung (working project). These variables are based not only on the distance between a founding and host country, but also based on the distance between a host country, and all prior host country expansions. Specifically, the variables capture the minimum distance between a host country expansion at t=1, and all prior expansions at t-1, including the firm's founding location.

The minimum distance variables acknowledge that a firm may redeploy location-specific capabilities across countries, rather than rely only on location capabilities specific to the firm's founding country. For example, the American firm Lime first expanded to Sweden in November 2018, and later to Denmark in April 2019. Sweden and Denmark are more similar in terms of geographical, economic, and administrative distance than are Denmark and the U.S. (e.g. Denmark and Sweden are much closer on a map than Denmark and the U.S.). When Lime decided to expand to Denmark in 2019, simply looking at the distance between Denmark and the U.S., in terms of liability of foreignness, fails to acknowledge Lime's experience in Sweden; Lime may use its experience in Sweden to reduce the liability of foreignness when entering Denmark. By instead comparing the distance between Denmark and Sweden when Lime expands to Denmark (since Lime had already expanded to Sweden the prior year), allows for the possibility that the firm may redeploy country-specific capabilities across host countries; as in location-specific capabilities in Nocke and Yeaple, 2007.

For the data summarized in Table 15, the founding – host country dyad with the largest administrative distance is China and Israel and the dyad with the smallest administrative distance is Italy and Spain. The dyad Luxembourg and the US top the list in terms of economic distance, while the UK and France are the most economically similar. Finally, Chile and China are the most geographically distant, and Belgium and the Netherlands are the closest in terms of geographical distance.

However, one way to overcome—or at least dampen—these large distances is through international experience. For instance, Mobike, the Chinese firm with expansion into Chile, may use its prior experience, for example in the US, to dampen the impact of geographical distance on subsequent entry decisions. Because the U.S. and Chile are more geographically proximate

than Chile and China, Mobike's expansion into the U.S. provides a springboard for subsequent entry into Chile. In this way, the measures of liability of foreignness should not only be based on the firm's founding and host country, but also incorporate the firm's prior experiences abroad—thus, liability of foreignness is dynamic, and changes across time based on the firm's experience around the world.

3.5 Regression Analysis Results

I analyze firm entry timing (whether a firm is an early or late entrant to a location) at the city and country level. Control variables are based on model constructs, discussed in Essay 1. All regressions include location fixed effects to capture location-specific traits such as demand and fixed costs; unobserved city and country heterogeneity will be captured by the location-level fixed effects. Models also include year fixed effects. Controls for firm age and relative efficiency proxy for firm efficiency. Total funding at entry, and whether the firm is in a series A or B stage of funding capture the firm's financial condition, proxying for wealth, and revenue pressure at the time of entry.

For the regression Tables 16-18, Model 1 always includes the full set of control variables as well as year and location fixed effects. Models 2 – 7 add firm – host country specific distance variables, one at a time. Comparing changes in log-likelihood and r-squared values from Model 1 to the subsequent 6 models, captures the additional explanatory power of each distance variable in explaining the dependent variable (see log likelihood estimates at the bottom of each table). Finally, Model 8 presents regressions results including all controls, fixed effects, and distance variables. As in Essay 2, all regressions employ linear probability models with robust

standard errors. Unless otherwise indicated, regressions are the sample of all observations with available funding data.

3.5.1 City – Level Entry Timing

The first set of results, presented in Table 16, explores firm entry timing (early vs late entry) at the city level. The dependent variable is whether the firm entered a given city early—within thirty days of the first entrant(s) to the city—or later—after the first thirty days of the first entrant(s) to the city. All models examine the full set of expansions, for the 1,597 expansions with funding information. R-squared is presented for each model, highlighting the explanatory power of the model in explaining variance in entry timing. Changes in log likelihood provides evidence of the importance of each additional independent variable (the six distance measures). Each dyadic distance measure captures a different aspect of liability of foreignness.

Table 16: City-Level Entry Timing Regression Analysis

DV: Early Entry to City=1, Late Entry to City=0	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Age at Entry	-0.004	-0.004	-0.004	-0.004	-0.003	-0.004	-0.004	-0.003
	(0.006)	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)
	0.469	*0.470*	*0.463*	*0.476*	*0.558*	*0.487*	*0.469*	*0.530*
Relative Efficiency	-0.001	-0.001	-0.002	-0.001	-0.005	-0.001	-0.001	-0.015
	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)	(0.023)	(0.023)	(0.027)
	0.974	*0.979*	*0.933*	*0.950*	*0.835*	*0.956*	*0.975*	*0.571*
Funds at Entry > $100M	0.054	0.053	0.051	0.053	0.062	0.054	0.054	0.043
	(0.033)	(0.033)	(0.034)	(0.033)	(0.033)	(0.033)	(0.035)	(0.035)
	0.107	*0.110*	*0.140*	*0.113*	*0.061*	*0.104*	*0.122*	*0.228*
Series A or B	0.149	0.149	0.150	0.148	0.157	0.150	0.149	0.166
	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.037)	(0.038)
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Min. Geographical Distance		0.030						-0.047
		(0.235)						(0.288)
		0.899						*0.872*
Founding - Host Geographical Distance			0.026					0.161
			(0.108)					(0.135)
			0.808					*0.234*
Min. Economic Distance				-0.442				0.189
				(0.579)				(0.66)
				0.445				*0.775*
Founding - Host Economic Distance					-0.611			-0.859
					(0.251)			(0.288)
					0.015			*0.003*
Min. Administrative Distance						-0.149		-0.090
						(0.406)		(0.516)
						0.715		*0.862*
Founding - Host Administrative Distance							-0.003	0.131
							(0.227)	(0.257)
							0.989	*0.611*
Year FE?	YES	YES	YES	YES	YES	YES	YES	YES
City FE?	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	1,597	1,597	1,597	1,597	1,597	1,597	1,597	1,597
R-sq	0.747	0.747	0.747	0.747	0.750	0.747	0.747	0.751
Log Likelihood	-52.9	-52.8	-52.8	-52.4	-44.5	-52.6	-52.9	-40.6
Compare vs.		(1)v(2)	(1)v(3)	(1)v(4)	(1)v(5)	(1)v(6)	(1)v(7)	(1)v(8)
ΔLogL		0.0	0.1	0.5	8.3	0.3	0.0	12.2
d.o.f.		1	1	1	1	1	1	6
Chi-sq test of 2ΔLogL		0.839	0.663	0.318	0.000	0.473	0.980	0.000

Notes: Results from a linear probability model. Robust standard errors appear in parenthesis below the coefficient. P-values appear in italics below standard errors. Data includes all firms with available funding data.

All models consistently show noisy point estimates for the control variables, excluding the series A or B funding dummy. This is largely attributed to the lack of variation of firm level variables, within a given city (city fixed effects). Firms beyond the seed stage of funding (specifically in series A or B) tend to expand to new cities earlier, consistent with the idea that revenue pressure pushes firms to expand quickly, as discussed in Essay 2.

Interestingly, founding – host distance (Model 5) is the only distance variable which is significant at a 5% level, and improves the fit of the model, beyond the existing controls and fixed effects in Model 1. The coefficient is negative, consistent with Proposition 6, that liability of foreignness (measured as the distance between countries) will decrease the likelihood of firms being early entrants. All other distance variables are insignificant, and do not significantly improve model fit.

3.5.2 Country – Level Entry Timing

The next set of analysis pertains to entry timing at the country-level. In Table 17, the dependent variable is whether the expansion is an early or late entrant to a country. Analysis at the country level in Table 17, includes country, rather than city level fixed effects. There are 71 instances of early entry at the country level.[7]

[7] There are more first entries (71) at the country level than there are host countries in the dataset, because the dependent variable is robust to 30 days beyond the first entry, and because firms may expand to a country at the same time.

Table 17: Country-Level Entry Timing Regression Analysis

DV: Early Entry to Country=1, Late Entry to Country=0	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Age at Entry	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
	0.162	*0.172*	*0.126*	*0.164*	*0.147*	*0.177*	*0.154*	*0.114*
Relative Efficiency	0.003	0.003	0.004	0.003	0.003	0.003	0.003	0.003
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
Funds at Entry > $100M	-0.001	-0.002	0.007	0.001	0.000	0.000	0.002	0.007
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
	0.947	*0.866*	*0.423*	*0.949*	*0.969*	*0.963*	*0.832*	*0.483*
Series A or B	-0.012	-0.007	-0.014	-0.011	-0.010	-0.011	-0.011	-0.008
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
	0.196	*0.419*	*0.130*	*0.242*	*0.269*	*0.229*	*0.203*	*0.390*
Min. Geographical Distance		0.479						0.546
		(0.174)						(0.201)
		0.006						*0.007*
Founding - Host Geographical Distance			-0.069					-0.081
			(0.03)					(0.036)
			0.022					*0.024*
Min. Economic Distance				0.352				-0.011
				(0.452)				(0.41)
				0.436				*0.979*
Founding - Host Economic Distance					-0.222			-0.182
					(0.082)			(0.09)
					0.007			*0.045*
Min. Administrative Distance						0.208		-0.031
						(0.136)		(0.161)
						0.126		*0.845*
Founding - Host Administrative Distance							-0.049	0.025
							(0.053)	(0.063)
							0.356	*0.696*
Year FE?	YES	YES	YES	YES	YES	YES	YES	YES
Country FE?	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	1,597	1,597	1,597	1,597	1,597	1,597	1,597	1,597
R-sq	0.456	0.471	0.458	0.457	0.460	0.458	0.456	0.478
Log Likelihood	742.4	763.9	745.3	743.7	748.2	745.5	742.8	774.7
Compare vs.		(1)v(2)	(1)v(3)	(1)v(4)	(1)v(5)	(1)v(6)	(1)v(7)	(1)v(8)
ΔLogL		21.5	2.9	1.3	5.8	3.1	0.4	32.3
d.o.f.		1	1	1	1	1	1	6
Chi-sq test of 2ΔLogL		0.000	0.016	0.109	0.001	0.013	0.368	0.000

Notes: Results from a linear probability model. Robust standard errors appear in parenthesis below the coefficient. P-values appear in italics below standard errors. Data includes all firms with available funding data.

Again, as in Proposition 6, we would expect that increasing foreignness pushes firms to enter cities later. Coefficient estimates for geographical, economic, and administrative distance yield mixed results. While increasing the minimum geographical distance measure corresponds to early entry, increasing the simplified founding – host country geographical distance corresponds to later entry. Both point estimates are significant at a 5% level. Additionally, coefficient estimates for founding – host economic distance yield significant estimates at the 1% level: increasing this economic distance leads to late entry timing at the country level. Point estimates for the relationship between administrative distance and entry timing at the country level are noisy.

3.5.3 City – Level Entry Timing by Country-Specific Firm Experience

The last set of analyses aims to untangle the discrepancies around the role of foreignness for entry timing at the city vs country level. First, entrants to a country are also first entrants to a city, both relative to the firm's self and its competitors. However, first entrants to a city, may or may not be the first entrants to the country. In particular, firms may have existing expansions in other cities within a country, prior to a given expansion. For example, as mentioned in the previous section, Bird was an early entrant to both Calgary and Red Deer, in Canada. However, Bird entered Red Deer a year after expanding to Calgary. Thus, at the time of Bird's expansion to Red Deer, Bird may already possess Canada-specific capabilities from its previous entry into Calgary, which it may redeploy for its expansion into Red Deer.

This means that liability of foreignness may change across time, as firms gain country-specific experience. I would expect firms to face the highest liability of foreignness at cities for which the firm has no prior expansions in the same country. As firms expand to additional cities

within a country—for entries beyond their first within a country—the impact of liability of foreignness on entry timing should wane. Thus, Table 18 explores the entry timing of firms, when the city is the firm's first expansion into the country (where liability of foreignness should be highest), and Table 19 explores all subsequent expansions (where liability of foreignness should wane). While the dependent variable is identical to that in Table 16, the set of observations are split across Tables 18 and 19. Table 18 only includes the 316 observations for which the entry is the firm's first within the country (e.g. for Bird in Canada, only Calgary appears as an observation in Table 18; Red Deer does not). Table 19 includes all other observations (the remaining 1,281) for which the entry is not the firm's first expansion into a country.

The 316 observations in Table 18 serve as expansions with high expected liability of foreignness, as firms have yet to acquire host country-specific capabilities. Table 19 provides evidence of whether liability of foreignness wanes across a firm's subsequent expansions into a country. Said another way, for Bird's second entry into Canada—to Red Deer—does liability of foreignness persist, or has this friction been resolved after Bird's experience in Calgary? And, do additional expansions into a foreign country, beyond the firm's second, continue to reduced the impact of liability of foreignness for firm strategic choice?

Table 18: City Entry Timing (for Firm's 1st Entry into Country) Regression Analysis

DV: Early Entry to City=1, Late to City=0 (for firm's 1st entry into country)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Firm Age at Entry	0.012	0.012	0.013	0.012	0.012	0.018	0.017	0.015
	(0.018)	(0.018)	(0.018)	(0.018)	(0.017)	(0.018)	(0.018)	(0.018)
	0.485	*0.495*	*0.480*	*0.523*	*0.476*	*0.295*	*0.346*	*0.417*
Relative Efficiency	-0.112	-0.109	-0.080	-0.108	-0.114	-0.120	-0.097	-0.056
	(0.124)	(0.123)	(0.129)	(0.123)	(0.128)	(0.124)	(0.122)	(0.123)
	0.368	*0.377*	*0.537*	*0.382*	*0.375*	*0.333*	*0.431*	*0.648*
Funds at Entry > $100M	0.060	0.052	0.134	0.060	0.097	0.088	0.099	0.145
	(0.11)	(0.109)	(0.116)	(0.11)	(0.113)	(0.108)	(0.107)	(0.117)
	0.587	*0.638*	*0.249*	*0.586*	*0.392*	*0.417*	*0.354*	*0.218*
Series A or B	0.122	0.121	0.121	0.122	0.129	0.132	0.160	0.120
	(0.095)	(0.095)	(0.096)	(0.095)	(0.094)	(0.09)	(0.096)	(0.098)
	0.201	*0.204*	*0.206*	*0.201*	*0.173*	*0.147*	*0.097*	*0.224*
Min. Geographical Distance		0.189						1.148
		(0.371)						(0.441)
		0.610						*0.010*
Founding - Host Geographical Distance			-0.376					-0.508
			(0.288)					(0.384)
			0.194					*0.189*
Min. Economic Distance				0.477				2.337
				(1.496)				(1.393)
				0.750				*0.096*
Founding - Host Economic Distance					-0.888			-0.260
					(0.604)			(0.69)
					0.144			*0.707*
Min. Administrative Distance						-1.510		-2.577
						(0.516)		(0.723)
						0.004		*0.001*
Founding - Host Administrative Distance							-0.645	0.381
							(0.501)	(0.558)
							0.201	*0.496*
Year FE?	YES	YES	YES	YES	YES	YES	YES	YES
City FE?	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	316	316	316	316	316	316	316	316
R-sq	0.745	0.745	0.750	0.745	0.750	0.763	0.750	0.787
Log Likelihood	-12.2	-11.8	-9.0	-12.0	-9.1	-0.5	-9.0	16.3
Compare vs.		(1)v(2)	(1)v(3)	(1)v(4)	(1)v(5)	(1)v(6)	(1)v(7)	(1)v(8)
ΔLogL		0.4	3.2	0.2	3.2	11.7	3.2	28.5
d.o.f.		1	1	1	1	1	1	6
Chi-sq test of 2ΔLogL		0.358	0.011	0.546	0.012	0.000	0.011	0.000

Notes: Results from a linear probability model. Robust standard errors appear in parenthesis below the coefficient. P-values appear in italics below standard errors. Data includes all firms with available funding data.

The results from the first set of subsample analyses suggest that higher minimum administrative distance, with a significant coefficient at the 1% level, leads to later expansion for a firm's first entry into a country. In fact, this minimum administrative distance, added in model 6, improves model fit more than any of the other five distance variables. While the minimum geographic and economic distance are statistically significant in model 8, they are not individually significant in models 2 or 4 respectively. Finally, while the simple founding - host distance measures were impactful in the country-level analysis in Table 17, Table 18 suggests that these simpler distance measures play less of a role than the minimum distance measures at the city-level, especially when the country is new to the firm. Thus, the significance of the minimum administrative distance measure in Table 18 provides some support for the idea that firms may redeploy location-specific capabilities across countries.

Next, in Table 19, I explore whether the distance measures matter across a firm's subsequent expansions into a country. Table 19 includes the entry timing of firms for a set of observations for which an entry is the firm's second expansion (or beyond) in a given country. Note that for expansions to a country beyond the firm's first, the minimum distance measures will be set to 0, as the measures assume that firms may redeploy country-specific capabilities after the firm has expanded to a country. Thus, Table 19 only includes the distance between a firm's founding and host country. I include interactions between the distance measures, and the count of firm experience in the country (i.e. the firm's number of existing expansions in a given country). If liability of foreignness wanes across country-specific experience, then I expect the interaction term to be statistically significant and have the opposite sign of the distance measure's direct effect.

Table 19: City Entry Timing (for Firm's Non 1st Entry into Country) Regression Analysis

DV: Early Entry to City=1, Late to City=0 (for firm's NON 1st entry into country)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Firm Age at Entry	-0.005	-0.006	-0.006	-0.005	-0.005	-0.005	-0.006	-0.005	-0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
	0.364	*0.317*	*0.285*	*0.450*	*0.419*	*0.366*	*0.302*	*0.391*	*0.351*
Relative Efficiency	-0.046	-0.059	-0.061	-0.053	-0.056	-0.046	-0.051	-0.097	-0.099
	(0.05)	(0.053)	(0.053)	(0.05)	(0.05)	(0.05)	(0.051)	(0.055)	(0.057)
	0.359	*0.268*	*0.257*	*0.295*	*0.269*	*0.357*	*0.314*	*0.082*	*0.084*
Funds at Entry > $100M	0.068	0.062	0.068	0.075	0.077	0.066	0.073	0.061	0.066
	(0.043)	(0.043)	(0.043)	(0.043)	(0.043)	(0.045)	(0.045)	(0.044)	(0.045)
	0.110	*0.145*	*0.118*	*0.079*	*0.072*	*0.138*	*0.106*	*0.171*	*0.145*
Series A or B	0.127	0.132	0.129	0.131	0.135	0.128	0.129	0.148	0.145
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.052)
	0.011	*0.008*	*0.010*	*0.009*	*0.007*	*0.011*	*0.010*	*0.003*	*0.006*
Founding - Host Geographical Distance		0.118	0.025					0.340	0.278
		(0.135)	(0.171)					(0.173)	(0.246)
		0.382	*0.883*					*0.049*	*0.259*
Founding - Host Economic Distance				-0.556	-0.867			-1.136	-0.935
				(0.332)	(0.427)			(0.357)	(0.562)
				0.094	*0.043*			*0.002*	*0.097*
Founding - Host Administrative Distance						0.050	-0.251	0.120	-0.057
						(0.281)	(0.387)	(0.307)	(0.478)
						0.858	*0.516*	*0.695*	*0.905*
Founding-Host Geo. Dist. * # Firm Expansions in Country			0.010						0.006
			(0.015)						(0.029)
			0.499						*0.841*
Founding-Host Econ. Dist. * # Firm Expansions in Country					0.057				-0.041
					(0.063)				(0.1)
					0.362				*0.684*
Founding-Host Admin. Dist. * # Firm Expansions in Country							0.046		0.034
							(0.04)		(0.062)
							0.260		*0.581*
Year FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES
City FE?	YES	YES	YES	YES	YES	YES	YES	YES	YES
Obs.	1,281	1,281	1,281	1,281	1,281	1,281	1,281	1,281	1,281
R-sq	0.792	0.792	0.793	0.793	0.794	0.792	0.793	0.797	0.797
Log Likelihood	89.1	90.7	91.6	94.3	96.3	89.2	91.8	104.5	105.7
Compare vs.		(1)v(2)	(2)v(3)	(1)v(4)	(4)v(5)	(1)v(6)	(6)v(7)	(1)v(8)	(8)v(9)
ΔLogL		1.6	0.9	5.2	2.0	0.1	2.6	15.3	1.2
d.o.f.		1	2	1	2	1	2	3	6
Chi-sq test of 2ΔLogL		0.076	0.399	0.001	0.142	0.725	0.075	0.000	0.873

Notes: Results from a linear probability model. Robust standard errors appear in parenthesis below the coefficient. P-values appear in italics below standard errors. Data includes all firms with available funding data.

In Table 19, economic distance is negative and statistically significant in models 4, 5, and 6. Meaning that as economic distance increases, firms prefer late entry, for city expansions beyond the first in a country. No other distance measures are significant at a reasonable level. Additionally, the interaction term between economic distance and the count of firm experience in a country is noisy (with a p-value of .362 in model 5 and .684 in model 9). This result indicates that economic distance persists across firm entries into a country. Liability of foreignness associated with economic distance does not appear to wane.

3.6 Discussion and Conclusion

This essay examines the relationship between liability of foreignness and entry timing at the city and country level. Prior literature has focused on the distance between home-host countries, for well-developed industries, where firms tend to serve entire countries. Additionally, prior research has focused on a small set of developed countries with large flows of foreign direct investment. By contrast, firms in the micro-mobility industry expand to cities within countries and provide services to citizens within a city, across a wide variety of country types. Using hand-collected data from the global micro-mobility industry, I test model predictions at the city and country level and use a subsample analysis to untangle discrepancies between the two levels of analysis. Finally, I explore whether liability of foreignness persists across a firm's subsequent expansions into a foreign country.

First, I find that founding – host country economic distance shapes firm entry at the city and country level. Additionally, both measures of geographical distance help explain entry timing at the country level, though the coefficient estimates are not always consistent. Second, for observations in which the city is the first of its country in the firm's portfolio, I find that

increased administrative distance leads to late entry at the city level. However, as firms continue to expand to a foreign country, the role of economic distance persists, suggesting that while some aspects of liability of foreignness may get resolved or reduced through country-specific experience, other aspects persist across time; specifically economic distance continues to shape entry timing across repeat country expansions, in the micro-mobility industry and for this dataset.

I see three key contributions to the global strategy literature on firm international expansion. First is the importance of different geographical levels of analysis in the study of firm internationalization. While the formal model can be simplified to a singular level of analysis, empirically, there is complexity associated with entry timing at the country level, as firms may enter numerous cities within a country.

Second, I illustrate how different measures of foreignness shape firm strategic choice. While economic distance seems to matter for both city and country level entry decisions, administrative distance is significant in explaining the entry behavior for cities within novel country locations. Yet, the importance of administrative distance subsides for a firm's subsequent expansions into a country. Relatedly, subsample analysis presented in Tables 18 and 19 provides evidence that liability of foreignness is dynamic, and measures such as those developed by Jaffe, Sharma, and Chung, may better capture the importance of liability of foreignness. Furthermore, while country-specific experience may alleviate some frictions associated with liability of foreignness, others persist.

I acknowledge some research limitations that may provide opportunity for future research. First, there are several noisy or inconsistent point estimates, in particular for the country level analysis. One explanation is due to the lack of variance in the distance variables

for observations that are early country entrants. There are only 71 expansions which are first entrants to cities, and among these 71, only 48 are from non-local firms. Thus, the models in Table 17 are estimating the variation in the distance measures for these 48 firms relative to more than 1,500 other expansions. Industries with more firms, or more instances of non-local entrants at the country level will better identify the roll of liability of foreignness on entry timing for this level of analysis.

Second, this is a single industry study. One advantage of this approach is that it allows for a more in-depth look at the role of liability of foreignness at various geographical levels. One challenge then is the study's external validity across other industries. Research on other industries will help elucidate which types of distance measures matter for firm expansion outside micro-mobility. While foreignness associated with economic distance persists across time for firms in the micro-mobility industry, other aspects of foreignness may matter more or less in different types of industries.

Finally, this essay explores the relationship between liability of foreignness and firm entry timing, emphasizing how distance between countries may shape firm expansion decisions. Future research might focus on the role of liability of foreignness, entry timing, and performance outcomes for internationalizing firms.

In this essay, I add an additional mechanism—liability of foreignness—to the model of entry timing developed in Essay 1. Increased foreignness increases both the fixed and marginal costs associated with entry into new geographical locations. The formal model suggests that large liability of foreignness will make late entry more attractive. Empirically, I find that increasing liability of foreignness, as measured by founding – host country economic distance, is associated with later entry at both the city and country level, as well as geographical distance at

the country level. Furthermore, for cities which are the first in the firm's portfolio within a country, I find that increased administrative distance is associated with late entry, while geographical and economic distance do not seem to shape entry timing for these types of expansions. Furthermore economic distance continues to shape entry timing decisions for subsequent expansions to the same foreign country.

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