EXPLORING THE UNKNOWN REQUIRES LEVERAGING UNCERTAINTY: TWO ESSAYS ON A REAL OPTIONS PERSPECTIVE ON THE PATTERN AND DECISION MAKING OF ENTREPRENEURIAL INTERNATIONALIZATION

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DEDICATION

Dedicate to my beloved parents Jun Yan and Baoyan Wang

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ABSTRACT

Uncertainty is at the center of both entrepreneurship and international business research. One of the fundamental underlying assumptions of entrepreneurship and internationalization theories is that entrepreneurial firms and entrepreneurs constantly operate in uncertain environments. Even more so in a cross-border context, increasing levels of host country uncertainty can drastically reshape entrepreneurial firms' internationalization patterns and outcomes as well as entrepreneurs' internationalization decision-making. Yet, the fields of entrepreneurship and international business still lack theoretical explanations for the role of uncertainty in entrepreneurial internationalization. In this two essay dissertation, we applied real options theory, a theoretical perspective that emphasizes decision making at high levels of uncertainty as well as taking advantage of changing levels of uncertainty over time to achieve better organizational outcomes, to re-conceptualize the role of uncertainty in entrepreneurial firms' internationalization process and entrepreneurs' internationalization decision making.

In Essay one, we complement prior internationalization theories with the Real Options Theory (ROT) in predicting entrepreneurial firms' internationalization patterns and outcomes. In particular, by merging several international trade and FDI databases, we empirically tested the impact of host country institutional and economic uncertainty on entrepreneurial firms' choice of real options entry as well as the effect of real options entry on firms' entry time, entry location, market exits, and post-entry performance.

In Essay two, we investigate the uncertainty conditions under which individual entrepreneurs align their thinking with real options reasoning (ROR) in their internationalization decision-making process. I theorize an uncertainty leveraging perspective by applying real options reasoning to entrepreneurs' internationalization decision making. Empirically, I employed a 2 by 2 randomized between and within-subjects mixed design experiment on a representative sample of U.S. international entrepreneurs.

Taken together, the two essays examine the role of uncertainty in entrepreneurial internationalization process and decision-making. The dissertation contributes to entrepreneurship, internationalization, and real options literature by offering a real options perspective of uncertainty leveraging and by empirically testing the effects of both perceived and actual host country uncertainty in entrepreneurial firms' internationalization process and entrepreneurs' internationalization decision making.

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CHAPTER I. INTRODUCTION

Uncertainty is at the center of both entrepreneurship (Knight, 1921; McMullen & Shepherd, 2006; Schumpeter, 1934) and international business research (Johanson & Vahlne, 1977; Johanson & Wiedersheim - Paul, 1975; Schweizer, Vahlne, & Johanson, 2010). One of the fundamental underlying assumptions of entrepreneurship and internationalization theories is that entrepreneurial organizations and individual entrepreneurs constantly operate in uncertain environments (McKelvie, Haynie, & Gustavsson, 2011; McMullen & Shepherd, 2006). Even more so in a cross-border context, increasing levels of host country uncertainty can drastically reshape firms' entrepreneurial internationalization patterns and outcomes as well as entrepreneurs' internationalization decision making process (Alimadadi, Bengtson, & Hadjikhani, 2018; Cuervo-Cazurra, Ciravegna, Melgarejo, & Lopez, 2017; Liesch, Welch, & Buckley, 2011; Vahlne, Hamberg, & Schweizer, 2017).

International entrepreneurship (IE), positioned at the intersection of international business (IB) and entrepreneurship (McDougall & Oviatt, 2000), started as a scholarly inquiry on a unique internationalization phenomenon: international new ventures (Oviatt & McDougall, 1994; Oviatt & McDougall, 2005). It focuses on examining firms that from inception or early on during their life cycle sought to obtain competitive advantages across national borders which has shifted scholarly attention from incremental internationalization to more rapid internationalization by young firms and born globals (Knight & Cavusgil, 2004; Knight, 1996; Oviatt & McDougall, 2005). In recent years, an opportunity-based view of IE has redefined the field as "the discovery, enactment, evaluation, and exploitation of opportunities-across national borders-to create future goods and services" (Oviatt & McDougall, 2005a: p7). The study of IE has integrated IB theories on internationalization process with entrepreneurship theories on opportunity process (Reuber,

Dimitratos, & Kuivalainen, 2017; Reuber et al., 2018; Schweizer et al., 2010; Zahra, 2005; Zahra & George, 2002; Zahra, Korri, & Yu, 2005). Most importantly, at the center of both internationalization and opportunity process theories lies the construct of uncertainty (Johanson & Vahlne, 1977; McKelvie et al., 2011; McMullen & Shepherd, 2006). One of the most fundamental assumptions of entrepreneurial internationalization is that entrepreneurial firms and the individuals that found and lead them constantly operate in uncertain environments. The uncertainty of entrepreneurship becomes even more acute in a cross-border context because new entrepreneurial firms face not only the liability of newness but also the liability of foreignness before and during the initial internationalization process (Oviatt & McDougall, 2005; Sapienza, Autio, George, & Zahra, 2006; Zahra, 2005). International entrepreneurs often have to face greater levels and varieties of home or host country uncertainty than their domestic counterparts (Butler, Doktor, & Lins, 2010). As a result, uncertainty influences both individual entrepreneurs' international opportunity recognition and exploitation, and firms' entrepreneurial internationalization process and outcomes.

Yet, the extant research on IE (Cavusgil & Knight, 2015; McDougall & Oviatt, 1996, 2000; Oviatt & McDougall, 1994; Reuber, Knight, Liesch, & Zhou, 2018) still lacks theoretical explanations for how entrepreneurs and entrepreneurial firms can go beyond managing uncertainty to leveraging uncertainty when decide to enter the foreign market. We highlight three areas where lack of theorizing on uncertainty in entrepreneurship and internationalization is quite problematic. First, it limits our understanding of the dynamic nature and process of entrepreneurial internationalization at both the organizational and individual levels. For example, prior studies tend to choose a static view on entrepreneurial internationalization and focus only on the initial international entry and neglect firms' evolvement after the initial entry (Reuber, Dimitratos, &

Kuivalainen, 2017). Second, it results in existing research's over-reliance on one dominant theoretical perspective that treats uncertainty in general as an impediment to internationalization regardless of different types and levels of uncertainty and neglects how entrepreneurs and their firms can act in the face of changing uncertainty (Brouthers, Brouthers, & Werner, 2008; Madsen & Servais, 1997). Lastly, the lack of theory development on uncertainty also results in mixed findings on the outcomes of entrepreneurial internationalization with some studies finding no or equivocal results on the performance implications of entrepreneurial internationalization (Carr, Haggard, Hmieleski, & Zahra, 2010; Fernhaber & Li, 2010; Lu & Beamish, 2001, 2004; Yan & Williams, 2020).

To address those issues associated with a lack of theorizing on uncertainty in both entrepreneurship and internationalization literature, we draw from Real Options Theory (ROT) and extend it to the entrepreneurial internationalization context. ROT (MacMillan, Van Putten, McGrath, & Thompson, 2006; McGrath, 1997, 1999; Reuer & Tong, 2007; Trigeorgis & Reuer, 2017) is a theoretical perspective that emphasizes strategic action at high levels of uncertainty as well as taking advantage of changes in uncertainty levels over time to achieve better organizational outcomes. It offers entrepreneurs and their firms the strategic flexibility to adjust their investment levels as uncertainty changes over time. In particular, we propose that by applying ROT, entrepreneurs and their firms can leverage changing levels of host country uncertainty to contain potential downside losses while maximizing upside gains during and after initial international entry. Drawing from ROT, we re-conceptualize the process, outcome, and decision making of entrepreneurial internationalization at both organizational and individual levels through two distinctive but interconnected essays.

Essay one reexamines and tests firms' entrepreneurial internationalization patterns and outcomes in terms of entry mode (how), entry timing (when), entry location (where), market exit, and post-entry performance through the lens of real options theory (ROT). Specifically, it examined the impact of actual host country institutional and economic uncertainty on entrepreneurial firms' choice of real options entry as well as the effect of real options entry on firms' entry time, entry location, market exits, and post-entry performance. In this essay, we answer the research question of *how does host country uncertainty influences entrepreneurial firms' internationalization patterns and outcomes?*

Essay two investigates whether and how individual entrepreneurs align their thinking with real options reasoning during their internationalization decision making. Specifically, we examine the uncertainty conditions under which entrepreneurs apply real options reasoning to leverage changing levels of perceived host country uncertainty during the entrepreneurial internationalization decision making process. In doing so, we answer the questions of *under what conditions and how do entrepreneurs apply real options reasoning to leverage uncertainty in their internationalization decision making?*

The implications of this dissertation are multiple: first, it contributes to both the entrepreneurship and internationalization literature by offering a real options perspective of leveraging uncertainty in the context of entrepreneurial internationalization. Specifically, the dissertation resolves the issues associated with prior entrepreneurship and internationalization research's lack of theorizing on the role uncertainty during the entrepreneurial internationalization process both at the individual and organizational levels. Second, the dissertation further advances IB research on entry mode choice and entry location by complementing the dominant TCE perspective with ROT and reexamines the role of host country uncertainty at initial and subsequent

internationalization stages. It offers ROT as an alternative theoretical perspective to explain entrepreneurial firms' internationalization patterns and post-entry performance. Third, the dissertation contributes to the real options literature by unpacking the uncertainty and individual boundary conditions of real options reasoning and its implications. It enhances the micro-foundation of real options reasoning by looking at entrepreneurs' decision-making process that aligns with real options reasoning under different uncertainty conditions. It further distinguishes ROT from other theoretical perspectives by defining and testing host country exogenous uncertainty in particular and by demonstrating the combination of initial investment, local collaboration, and resource reallocation as distinctive real options that provide access to potential upside gains while containing downside losses during internationalization. This further advance the theoretical relevance and importance of ROT by proving the existence of real options both at the entrepreneur and entrepreneurial organization level and by demonstrating the performance implications of ROT in the context of entrepreneurial firms' internationalization. From the practical point of view, this dissertation offers entrepreneurs and entrepreneurial firms a real options perspective to determining international entry decisions (i.e., entry timing, entry mode, and entry location). It informs entrepreneurs and their firms on how to effectively navigate through increasingly uncertain foreign markets and achieve superior post-entry performance.

CHAPTER II. LITERATURE REVIEW: UNCERTAINTY IN THEORIES OF ENTREPRENEURSHIP, INTERNATIONAL BUSINESS, AND REAL OPTIONS

Uncertainty in Entrepreneurship

The construct of uncertainty is central to various domains of entrepreneurship theory and practice (Knight, 1921; McKelvie, Haynie, & Gustavsson, 2011; McMullen & Shepherd, 2006; Townsend, Hunt, McMullen, & Sarasvathy, 2018a). Modern entrepreneurship theory is based on the Knightian argument that uncertainty is the fundamental precondition of entrepreneurial opportunities that are necessary for the growth of emerging business organizations and economies (Knight, 1921). According to Knight, entrepreneurship is an enterprise system that leverages economic disequilibrium and profit from market imperfection as results of uncertainty (Knight, 1921, p279). He also clearly distinguished uncertainty from risk by defining risk as "measurable uncertainty" which pertains to the capability of capturing the probability distribution of all the possible outcomes. Whereas uncertainty means both the potential outcomes and probability distribution of all potential outcomes are unknown and unmeasurable, it relates to the "unmeasurable" nature of probability distributions (Knight, 1921, p20) Thus, uncertainty cannot be easily hedged, pooled, or neutralized.

In that sense, Knight argued that it is the ubiquity of "true" uncertainty that causes the disequilibrium of the economy which necessitates the existence of the class of entrepreneurs who are capable of leveraging the disequilibrium and eventually restoring the balance (Knight, 1921, p20). He recognized the importance of uncertainty as a key tenet of opportunity discovery and individual entrepreneurial pursuit (Knight, 1921, p265). Indeed, Shane and Venkataraman (2000) later proposed individual-opportunity nexus based on the assumption that entrepreneurs act under the context of a *priori* irreducible uncertainty meaning that the uncertainty cannot be reduced or simplified because the outcomes and distribution of the outcomes of the decision cannot be predicted before the decision is made. Researchers have reached the consensus that the activity of

value creation is contingent upon how individual entrepreneurs react to various levels of uncertainty (Kirzner, 1979; McMullen & Shepherd, 2006; Shane & Venkataraman, 2000; Venkataraman, 1997).

Besides being the central assumption of the individual-opportunity nexus, uncertainty has been widely used by researchers to describe and define various conditions, contexts, determinants, and outcomes of entrepreneurship. Examples include research on the entrepreneurial environment (Busenitz, Plummer, Klotz, Shahzad, & Rhoads, 2014; Hannan & Freeman, 1984; Knight, 1921), individual entrepreneurs/founders' experiences (Basu, Sahaym, Howard, & Boeker, 2015; Chandler & Hanks, 1994; Kirzner, 1979), entrepreneurial competitions (Delbono & Rossini, 1992; Kirzner, 2015; Peneder, 2001), entrepreneurial strategy (Russell & Russell, 1992), emerging industry dynamics (Déjean, Gond, & Leca, 2004; Morgan, 2002; Wernerfelt & Karnani, 1987), and entrepreneurial internationalization conditions and process (Butler, Doktor, & Lins, 2010; Cuervo-Cazurra, Ciravegna, Melgarejo, & Lopez, 2017; Liesch, Welch, & Buckley, 2011; Vahlne, Hamberg, & Schweizer, 2017). Among all of those ties between uncertainty and topics of research within entrepreneurship, the most salient and researched relationship is between uncertainty and entrepreneurial action (Townsend et al., 2018a).

Uncertainty and Entrepreneurial Action.

Uncertainty is fundamental to entrepreneurial action and outcomes of action including new venture creation, venture growth, and individual utility maximization (Douglas & Shepherd, 2000; Kirzner, 1979; Knight, 1921; Schumpeter, 1934; Simon, Houghton, & Aquino, 2000). This is because entrepreneurship requires judgment about an action based on the evaluation of uncertainty (McMullen & Shepherd, 2006). Specifically, both the perceived amount of uncertainty and willingness to bear uncertainty fundamentally influence entrepreneurial decisions and actions

(McMullen & Shepherd, 2006). Two streams of research have conceptualized the role of uncertainty in determining entrepreneurial actions. The first stream of research argues that the willingness to bear uncertainty is determined by individual differences including motivation, attitude, and risk propensity. Thus, it believes that some individuals' unwillingness to bear uncertainty prevent them from taking entrepreneurial actions (Douglas & Shepherd, 2000; Knight, 1921; Schumpeter, 1934). For example, some research believes that entrepreneurs are a group of people with higher risk propensity and willing to bear greater amount of uncertainty to seek entrepreneurial rents from the economy than others in the general population (Carland, Hoy, Boulton, & Carland, 1984; Knight, 1921; Stewart Jr & Roth, 2001; Zhao & Seibert, 2006). Individuals' attitudes toward income, risks, work, and independence influence their choice to become entrepreneurs or employees (Douglas & Shepherd, 2000).

The second stream believes that the amount of perceived uncertainty determines who might act entrepreneurially and who does not. In other words, entrepreneurs' subjective perception of levels of uncertainty is a key determinant of entrepreneurial action. This view discriminates those who act entrepreneurially and those who do not base on individual knowledge and experience (Busenitz & Barney, 1997; Kirzner, 1979, 1997; Shaver & Scott, 1991; Stewart Jr & Roth, 2001). Individuals' knowledge determines their perceived levels of uncertainty, and uncertainty takes the form of doubt which impedes actions by undermining prospective actors' beliefs on feasibility and desirability of the opportunity (McMullen & Shepherd, 2006). Thus, a high amount of perceived uncertainty is considered to be the barrier between prospective entrepreneurs and entrepreneurial action.

However, the nature of uncertainty being *a priori* unknowingness does not necessarily entail absolute obstacles to entrepreneurial action. One of the unique characteristics of

entrepreneurship research that differentiates it from other social science fields is that it is based on the logic that uncertainty does not necessarily constitute entrepreneurial failure or market losses (Townsend et al., 2018a). The Knightian view suggests that the presence of *a priori* uncertainty concerning the prospect of an entrepreneurial opportunity is, in essence, the necessary condition for the very existence of the business venturing opportunity and value-creation condition (Knight, 1921; McGrath & MacMillan, 2000b; Sorenson & Stuart, 2008). From the economic perspective, entrepreneurial rents, defined as the abnormal return beyond market expectations, can only be earned by those who take a chance on opportunities that are not obvious to others or in other words unknown to others (McGrath, 1999; Rumelt, 1987). Individual entrepreneurs often have to make decisions about resource allocation that can generate entrepreneurial rents before the value creation condition is known, thus the uncertainty of the opportunity becomes the precondition of entrepreneurial action (Alvarez, 2007). Just as McGrath (1999: p13) stated that "embracing entrepreneurship, implies accepting all that goes with it, particularly the recognition of a *priori* irreducible uncertainty."

Uncertainty and Risk

However, this role of uncertainty in entrepreneurship necessitates differentiating between uncertainty and risk. Knight distinguished between risk and uncertainty based on whether or not the probability distribution of potential outcomes with a decision is known or not before the decision can be made. Risk, what Knight calls measurable uncertainty (but we typically just call risk), is characterized as the capability to capture the probability distribution of all the possible outcomes. Uncertainty, on the other hand, represents an unmeasurable aspect of various outcomes. For example, an entrepreneur does not know what exactly is going to happen if he starts a landscaping business in northern New Jersey. However, he (hypothetically) does know the chances

for three likely outcomes: survive, thrive, and closure are equally distributed (e.g., the probability of one third) (cf. Knight, 1921, p198). Then, this circumstance can be defined as the measurable risk. However, we know that first, there are more than three possible outcomes beyond survive, thrive, and closure, such as acquired, suspended, and different levels of growth or losses, etc. Second, the exact probability of each outcome cannot be easily predicted. Thus, unmeasurable uncertainty (what we typically just label as uncertainty) is mostly to be the situation that the entrepreneur must deal with. In fact, entrepreneurs who often explore uncharted markets must be able to make decisions regarding resource allocation that can create entrepreneurial rent before the value associated with exploring the market opportunity and the distribution of the possible outcomes is known (Alvarez, Afuah, & Gibson, 2018; Alvarez, 2007). In general, entrepreneurs often face more unmeasurable uncertainties than measurable risks (McKelvie et al., 2011; McMullen & Shepherd, 2006; Townsend et al., 2018a).

Despite the clear distinction between uncertainty and risk as argued by the Knightian view (Coase, 1937; Knight, 1921; Keynes, 1937), management and entrepreneurship researchers have conceptualized uncertainty and risk in various ways: some have treated uncertainty as equivalent to risk (Anderson, 1981; Arrow, 1951), some broadly define uncertainty as ambiguity (Hogarth, 1987), turbulence (Bourgeois III, McAllister, & Mitchell, 1978), equivocality (Koufteros, Vonderembse, & Jayaram, 2005), information overload (Speier, Valacich, & Vessey, 1999), and information asymmetry (Akerlof, 1970; Geertz, 1978). This proliferation of conceptualizations on uncertainty and its relations with risk have caused the empirical misuse of uncertainty and confusion about the construct in theories of entrepreneurial action (Townsend et al., 2018a). I believe that the view of uncertainty as the roadblock to entrepreneurial action has taken a negative connotation toward uncertainty. This is in contrast with the view that some level of uncertainty is

necessary for entrepreneurship to occur which has taken a neutral connotation toward uncertainty. Thus, the assumption on entrepreneurial action is that the very existence of uncertainty does not necessarily constitute an adverse state (Lerner, Hunt, & Dimov, 2018; Townsend et al., 2018a). Uncertainty tends to be more pervasive in entrepreneurial setting than any other business and organizational scenarios and the existence of *a prior* uncertainty is necessary for entrepreneurial opportunity exploration process (Folta, 1998; McGrath, 1999; Sorenson & Stuart, 2008). Entrepreneurs are individuals who can make value out of uncertainty (York & Venkataraman, 2010). Such a view of uncertainty distinguishes the field of entrepreneurship from other social sciences (Townsend et al., 2018a).

Dimensions – and Differing Conceptualizations – of Uncertainty

The uncertainty construct is multidimensional in the broader management literature as well as entrepreneurship literature. While the Knightian view focuses mainly on the objective unknowability of the external environment (Miller, 2012), or in other words environmental uncertainty, micro-level research often employs a multidimensional approach to examine how individual entrepreneurs perceive and respond to three different types of uncertainty - state, effect, and response uncertainty (McKelvie et al., 2011; Milliken, 1987). In Milliken's original work, state uncertainty is defined as the unpredictability of how the environment is changing. Effect uncertainty refers to the difficulty of predicting how the changes can impact the individual or firm. Response uncertainty is the unpredictability of understanding the consequence of one's action. A recent study showed that although entrepreneurs' perceived environmental uncertainty (state uncertainty) does not impact entrepreneurs' willingness to engage in entrepreneurial action, entrepreneurs' perceived uncertainty about the impact of the change (effect uncertainty) does

negatively influence entrepreneurs' willingness to engage in entrepreneurial action (McKelvie et al., 2011).

However, besides entrepreneurs perceived uncertainty, the objective uncertainty in the environment in which entrepreneurial firms are facing can also influence the structure, strategy, and outcome of the firm (Jauch & Kraft, 1986). The relationship between perceived and objective uncertainty is less understood in prior literature. For example, prior entrepreneurship research often focused on entrepreneurs' perceived uncertainty yet overlooked the objective uncertainty in the environment and its influence on entrepreneurial firms. I believe the uncertainty construct must be examined in a multidimensional way to further unpack the underlying relationships between uncertainty and various entrepreneurial actions. It is necessary to examine both perceived uncertainty at the individual level and objective uncertainty at the organizational level. Indeed, recent works have called for more multidimensional studies on uncertainty construct in entrepreneurship and management research (Alimadadi, Bengtson, & Hadjikhani, 2018; Alvarez et al., 2018; Townsend et al., 2018a).

Uncertainty can be endogenous or exogenous regarding the source of uncertainty (Chi, Li, Trigeorgis, & Tsekrekos, 2019; Chi & McGuire, 1996; Dixit & Pindyck, 1994; Ipsmiller, Brouthers, & Dikova, 2018). Specifically, endogenous uncertainty results from individuals' or firms' internal lack of knowledge or information, which can be more easily mitigated, whereas exogenous uncertainty derives from the external environment and are less affected by firm actions, but it can change over time (Folta, 1998). Exogenous uncertainty is less mitigable compared with endogenous uncertainty. The previously discussed Knightian view focuses mainly on exogenous uncertainty, yet Milliken's typology emphasizes both exogenous and endogenous uncertainty.

The recent development of the uncertainty construct emphasizes the mitigability of uncertainty and further differentiates mitigable ignorance of pertinent but knowable information (i.e., epistemic uncertainty) from immitigable indeterminacy (i.e., aleatory uncertainty) (Packard Jr & Clark, 2020). On one hand, epistemic uncertainty originates from the ignorance of knowable information (Der Kiureghian & Ditlevsen, 2009; Perlman & McCann Jr, 1996). The outcomes are presumed to be knowable *ex-ante* and the probability distribution of outcomes is unknown mainly due to the ignorance of underlying criteria needed to predict the outcomes, which make epistemic uncertainty mitigable. On the other hand, aleatory uncertainty comes from indeterminate and unknowable factors that contribute to stochastic events. It presumes that outcomes are unknown and unknowable *ex-ante*, and the probability distribution of outcomes is unbounded or indeterminate. In other words, the outcomes are truly random, and the determination of their probability distributions is completely unknowable, therefore, aleatory uncertainty is immitigable (Packard Jr & Clark, 2020; Packard, Clark, & Klein, 2017). The distinctive nature of epistemic uncertainty and aleatory uncertainty influence managers' decisions to adopt predictive or nonpredictive strategy (Packard Jr & Clark, 2020).

When considering these various views of uncertainty, this dissertation focuses on the uncertainty in entrepreneurial internationalization context that possesses several unique characteristics:

1) alignment with a Knightian view of uncertainty: it focuses on *a priori* exogenous uncertainty such that the probability distribution of the potential outcomes of the decision is unknown before the decision is being made;

2) the uncertainty construct is multidimensional: this dissertation not only looks at objective uncertainty (i.e., host country uncertainty) at the entrepreneurial firm level but also looks at perceived uncertainty at the individual entrepreneur level;

3) the uncertainty construct varies in terms of mitigability: this dissertation focuses mainly on epistemic uncertainty that is caused by the ignorance of knowable information and outcomes presumed to be knowable *ex ante*;

4) the uncertainty construct is dynamic: this dissertation looks at not only at uncertainty at the time of initial international entry but also the changing levels of uncertainty over time.

Although uncertainty is central to the theories of entrepreneurship and entrepreneurial action, uncertainty has also been studied within several subdomains of entrepreneurship research, some of which align with the dominant Knightian view of uncertainty in entrepreneurship whereas others depart from this dominant view. I briefly turn to these now before focusing on the specific context of the dissertation (entrepreneurial internationalization) and the use of real options theory and real options reasoning to leverage uncertainty in this context.

Uncertainty and Subdomains of Entrepreneurship

Entrepreneurship, as an interdisciplinary field of research, often intercepts with many social science fields such as sociology, psychology, and international business (Busenitz et al., 2014; Zahra & Wright, 2011). This has created many subdomains of entrepreneurship research that borrows theories and assumptions from other related social science disciplines including social entrepreneurship (Gras & Mendoza-Abarca, 2014; Peredo & McLean, 2006; Shapero & Sokol, 1982), institutional entrepreneurship (Garud, Jain, & Kumaraswamy, 2002; Greenwood &

Suddaby, 2006; Pacheco, York, Dean, & Sarasvathy, 2010; Santos & Eisenhardt, 2009), and international entrepreneurship (Jones, Coviello, & Tang, 2011; Knight, 1996; McDougall & Oviatt, 2000; Oviatt & McDougall, 1994; Oviatt & McDougall, 2005b). Notably, the fundamental role of uncertainty in entrepreneurship theory and practice is manifested in those subdomains of entrepreneurship as well.

In social entrepreneurship research, scholars have defined the "entrepreneurial" aspect of social entrepreneurship as including 1) recognition and pursuit of new opportunity to fulfill the mission of creating social value and 2) taking bold action under the condition of uncertainty and resource limitation (Dees, 1998; Shapero & Sokol, 1982). This line of research aligns with the Knightian view and conceptualized uncertainty as the unpredictability or unknowingness of the changing social environment and social needs such as public education, social welfare, environmental conservation, and poverty alleviation, etc. (Dees, 1998; Mair & Noboa, 2006; Peredo & McLean, 2006; Perrini & Vurro, 2006; Shapero & Sokol, 1982).

Institutional entrepreneurship research emphasizes how an individual can reconstruct market boundaries and develop new institutional arrangements (Pacheco et al., 2010). Entrepreneurs' power of reshaping institutional arrangement becomes more salient when market conditions and competitive dynamics are uncertain (Maguire, Hardy, & Lawrence, 2004; Santos & Eisenhardt, 2009). Specially, institutional entrepreneurship researchers have viewed uncertainty as to the unpredictability of changes in the institutional environment and institutional arrangement (Aldrich & Fiol, 1994; Shah, 2005). Institutional levels of uncertainty are exogenous uncertainty in nature, which aligns with the Knightian view.

However, among all those subdomains of entrepreneurship research, international entrepreneurship is mostly related to the construct of uncertainty (Alimadadi et al., 2018; Butler et

al., 2010; Liesch et al., 2011) due to its unique place, as I describe below, at the intersection of two fields for which uncertainty is a critical construct.

Uncertainty and International Entrepreneurship

International entrepreneurship (IE), positioned at the intersection of international business (IB) and entrepreneurship (McDougall & Oviatt, 2000), started as a scholarly inquiry on a unique internationalization phenomenon: international new ventures (Oviatt & McDougall, 1994; Oviatt & McDougall, 2005a). It focuses on examining firms that from inception or early on during their life cycle sought to obtain competitive advantages across national borders which has shifted the attention from incremental internationalization to more rapid internationalization by young firms and born globals (Knight & Cavusgil, 2004; Knight, 1996; Oviatt & McDougall, 2005a). In recent years, an opportunity-based view of international entrepreneurship has redefined the field as "the discovery, enactment, evaluation, and exploitation of opportunities-across national borders-to create future goods and services" (Oviatt & McDougall, 2005a: p7). The study of IE, has integrated IB theories on internationalization process with entrepreneurship theories on opportunity process (Reuber, Dimitratos, & Kuivalainen, 2017; Reuber, Knight, Liesch, & Zhou, 2018; Schweizer, Vahlne, & Johanson, 2010; Yan & Williams, 2020; Zahra, 2005; Zahra & George, 2002; Zahra, Korri, & Yu, 2005).

Most importantly, at the center of both internationalization and opportunity process theories lies the construct of uncertainty (Johanson & Vahlne, 1977; McKelvie et al., 2011; McMullen & Shepherd, 2006). One of the most fundamental assumptions of entrepreneurial internationalization is that entrepreneurial firms and the individuals that found and lead them constantly operate in uncertain environments. The uncertainty of entrepreneurship becomes even more acute in a cross-border context because new entrepreneurial firms face not only the liability

of newness but also the liability of foreignness before and during the initial internationalization process (Oviatt & McDougall, 2005a; Sapienza, Autio, George, & Zahra, 2006; Zahra, 2005). International entrepreneurs often have to face greater levels and varieties of home or host country uncertainty than their domestic counterparts (Butler et al., 2010). As a result, uncertainty influences both individual entrepreneurs' international opportunity recognition and exploitation, and firms' entrepreneurial internationalization in several important ways.

First, both home and host country uncertainty influence the opportunity development and exploitation process in a cross-border context (Butler et al., 2010; Cuervo-Cazurra et al., 2017; Liesch et al., 2011). Notably, international opportunities may be more difficult to pursue than domestic ones due to higher levels of information asymmetry which results from institutional, cultural, and psychic distance (Deng & Sinkovics, 2018; Dow, Baack, & Parente; Evans & Mavondo, 2002; López-Duarte & Vidal-Suárez, 2010; O'grady & Lane, 1996). In other words, levels of uncertainty that potential international entrepreneurs have to bear often are greater than in domestic settings (Alimadadi et al., 2018). Uncertainty often exists through all stages of the entrepreneurial internationalization process. For example, international entrepreneurs must face the uncertainty of market entry barriers (i.e., trade tariffs, non-trade barriers) before entering the foreign market. Then they might also encounter uncertainties of regulatory changes and the macroeconomic downturn of the host country after initial entry. Also, at all foreign locations, entrepreneurs encounter triple liabilities: liabilities of newness (Stinchcombe & March, 1965), foreignness (Zaheer, 1995), and outsidership (Johanson & Vahlne, 2009) which results in greater levels and varieties of uncertainty. Entrepreneurs' response to that uncertainty directly influences how they can recognize international opportunities and how opportunities can be exploited (Liesch et al., 2011; Reuber et al., 2018).

Moreover, uncertainty is directly linked to resources committed, hence it influences both the patterns and outcomes of young firms' entrepreneurial internationalization. For example, the growth theory of the firm (Penrose & Penrose, 2009) argues that market uncertainty is future dependent and it dictates the amount of resources committed by an organization. In addition, as discussed in the prior section, uncertainty, differing from risk, is often unmeasurable and uninsurable (Knight, 1921; McKelvie et al., 2011; Townsend et al., 2018a). When pursuing a business opportunity in a foreign market, firms align their levels of resource commitment with their existing market knowledge (Johanson & Wiedersheim-Paul, 1975) but might also face the unexpected uncertainty that is unknown and unmeasurable until it appears as internationalization process deepens. When realized, the unexpected uncertainty can cause firms to change levels of resource commitment (Santangelo & Meyer, 2011) and disrupt existing market relationships (Podolny, 1994). All of this can influence the outcomes of entrepreneurial internationalization, such as the firm growth (Schueffel, Amann, & Herbolzheimer, 2011), innovation (Wong, Ho, & Autio, 2005), and survival (Carr, Haggard, Hmieleski, & Zahra, 2010; Sapienza et al., 2006; Yan & Williams, 2020).

Above I have demonstrated the importance of the uncertainty construct to both IE and entrepreneurship research in general. Yet, IE research also draws heavily from IB theory. Therefore, to fully understand the role of uncertainty in IE, we must revisit international business theories on uncertainty. Specifically, I focus on internationalization theory and transaction cost economics (TCE), each of which have been used to explain firms' internationalization patterns and processes (Brouthers, 2002; Brouthers, Brouthers, & Werner, 2003; Johanson & Vahlne, 1990; Johanson & Wiedersheim - Paul, 1975; Zhao, Luo, & Suh, 2004)

Uncertainty in International Business

Typical international businesses often operate in constantly changing, dynamic, and complex environments, where actions and decisions must be made under varying levels of uncertainty (Hitt, Bierman, Uhlenbruck, & Shimizu, 2006; Hitt, Hoskisson, & Kim, 1997; Johanson & Vahlne, 1990; Johanson & Wiedersheim - Paul, 1975). The cross-border context creates incomplete information, misaligned strategic goals, and complex market conditions for both multinational enterprises and international news ventures or born globals (Knight & Cavusgil, 2004; Kogut & Zander, 1993; Oviatt & McDougall, 1994; Vahlne et al., 2017). Various types of both home country (Cuervo-Cazurra et al., 2017; Gooris & Peeters, 2014; Wu & Chen, 2014) and host country uncertainties (Bhardwaj, Dietz, & Beamish, 2007; Rhee & Cheng, 2002) can influence multinationals international entry timing (Liesch et al., 2011), entry mode (Anderson & Gatignon, 1986; Brouthers et al., 2003; Rhee & Cheng, 2002; Zhao et al., 2004), entry location (Buckley, Devinney, & Louviere, 2007; Lu, Liu, Wright, & Filatotchev, 2014), and internationalization outcomes (Brouthers, 2002; Brouthers et al., 2003; Yan, Mmbaga, & Gras, 2019).

Uncertainty and the U-Model

Uncertainty is a central piece in the internationalization literature (Johanson & Vahlne, 1977, 1990, 2009). For example, the internationalization process theory or Uppsala internationalization process model (U-Model), relies on two assumptions: uncertainty and bounded rationality, to argue an incremental staged internationalization process in which firms gain market knowledge by learning from the prior experience of foreign operations. This determines the next level of market commitment which prompts new learning (Johanson & Vahlne,

1977, 1990). The model was then extended to include business network relationships and to account for the role of insidership and firms' liability of outsidership in the internationalization process (Johanson & Vahlne, 2003, 2009).

The U-Model has been widely applied to explain firms' internationalization patterns and processes in the mainstream IB literature (Forsgren, 2002; Santangelo & Meyer, 2011). Specifically, regarding entry timing, the U-Model predicts a slowly incremental internationalization process. Regarding entry mode, the U-Model suggests an "establishment chain" that starts with exporting, then formalizes into a collaborative agreement with intermediaries, and finishes with establishing a highly controlled foreign subsidiary. Lastly, in terms of entry location, the U-Model argues that firms initiate internationalization in markets that are close to the domestic market in terms of psychic distance and then gradually enter the more distant markets. Thus, the U-Model is essentially an uncertainty reduction model whereby firms increasingly reduce uncertainty via incremental commitments and gains in knowledge. Indeed, the most recent development of the model highlights the central, yet often forgotten concept of the theory: management under uncertainty (Vahlne et al., 2017).

However, the U-model does not account for the opportunity dimension of experiential learning (i.e., past experiential knowledge informs current opportunity perception or formulation). Further, it neither provides a clear explanation of firms' approach to uncertainty management nor explains a rapid internationalization phenomenon.

Uncertainty and TCE

To address the question of uncertainty management, many scholars have turned to transaction cost economics (TCE). Uncertainty is a central piece of TCE that has been widely

adopted by the IB literature to predict firms' choice of entry mode when internationalizing. we begin with a brief primer on TCE before focusing on the link between TCE, uncertainty, and internationalization.

TCE is primarily concerned with minimizing firms' transactional costs, and it defines the nature and boundary of the firm (Masten, Meehan, & Snyder, 1991; Walker & Weber, 1984; Williamson, 1981, 1996). A firm emerges when it becomes more efficient to direct resources and minimize transaction costs than open market exchange. Firms will keep expanding until the cost of organizing the extra transaction is equal to the cost of carrying out the same transaction through the open market exchange (Coase, 1937). TCE classified three types of organizational structures: Market, Hybrid, and Hierarchy (Internal organizations) (Williamson, 1991). TCE assumes that people are rationally bounded and opportunistic. The assumption of bounded rationality suggests that the cognitive limits on individuals' ability to fully comprehend the environment lead to incomplete contracts. Because of the assumption that individuals are opportunistic, they will be most likely to exploit incomplete contracts.

Three distinctive dimensions of transactions influence transactional cost: uncertainty, frequency, and asset specificity (Williamson, 1981). First, high uncertainty can drive firms away from market-based transactions. For example, when demand uncertainty is high, firms are more likely to make as supposed to buy products (Walker & Weber, 1984). Second, when transactions occur at high frequency between two parties, more opportunistic behavior will emerge. Thus, firms might internalize transactions that occur at high frequency. Finally, when asset specificity is high, the asset cannot be used in an alternative context. In a buyer-seller scenario, this might lead to higher transaction costs if the seller knows that the buyer is dependent on their transaction because of high asset specificity. Asset specificity can be classified into three categories: site specificity,

physical asset specificity, and human asset specificity. Site specificity occurs when the product can only be a product at a specific place. Physical asset specificity refers to the requirement of a specific product or physical assets. Human asset specificity relates to tacit knowledge developed from engaging in the task. In sum, high asset specificity results in one party's opportunistic behavior against the other which results in higher transaction costs.

More specifically, there are three different types of transaction cost: the cost of searching for information, the cost of bargaining, and the cost of policing or enforcing (Coase 1937). TCE is often used to explain the antecedents of firm diversification. It predicts how firms make decisions to make or buy. Firms engaging in diversifications to minimize transaction costs, and they constantly involve choosing between internalizing market transactions and engaging in open market exchange based on comparing the cost (Masten et al., 1991).

TCE, Uncertainty, and Entry Mode Choice

Prior international entry mode choice literature relies on the assumptions of TCE (Coase, 1937; Williamson, 1981, 1996), bounded rationality and opportunism, and argues that firms' choice of international entry mode is determined by the core transaction cost attributes: control uncertainty, investment uncertainties, and asset specificity (Anderson & Gatignon, 1986; Brouthers et al., 2003; Zhao et al., 2004). Specifically, TCE argues that as asset specificity increases, firms tend to choose the internalized modes of structures such as hybrid and hierarchical entry mode over a market-based mode to mitigate increased transaction cost: the cost of policing or enforcing in particular (Coase, 1937). This is because as levels of asset specificity increase, so do the chances of failure of choosing the market-based mode that provides little protection over proprietary knowledge and no hedge against partners' opportunist behavior. In summary, TCE suggests that the best way to mitigate potential transaction cost associated with increased asset

specificity is to choose an internalized entry mode over market-based mode (Brouthers et al., 2003; Morschett, Schramm-Klein, & Swoboda, 2010; Zhao et al., 2004).

TCE also suggests that control uncertainty and investment uncertainty also affect transaction costs, hence firm choice of entry (Williamson, 1981). Specifically, control uncertainty increases the cost of monitoring and enforcing which leads the firm to internalized activities such as choosing an internalized entry mode over market-based entry mode when internationalizing (Brouthers et al., 2003). Similarly, investment uncertainty results from market environment turbulence, political and economic uncertainties in the host country, increases to firms' cost of monitoring and of enforcing the contracts. When asset specificity is high, increased investment uncertainty magnifies firms' needs for internal control, and they hence prefer an internalized entry mode over market-based mode (Brouthers et al., 2003; Erramilli & Rao, 1993). Because internalized entry modes are more complex and costly than the market-based modes, high uncertainty often leads firms to delay or avoid market entry. In summary, this line of work based on TCE assumptions on control and investment uncertainty argues that a firm's choice of international entry mode is the result of minimizing transaction costs and managing market uncertainty in the cross-border context.

However, the TCE view mainly focuses on the cost minimization when firms internationalize but neglect the potential growth potential of making decisions under high uncertainty. It also does not account for the opportunity cost associated with delaying or avoiding making the investment decision under uncertain conditions. More importantly, it ignores the fact that firms often can obtain strategic flexibility by learning from past and current operations. Also, TCE mainly looks at endogenous uncertainty stem from firms' internal lack of knowledge and neglects exogenous uncertainty that results from the external environment (Ipsmiller et al., 2018).

Prior IB research that adopted the TCE view has also primarily focused on examining the internationalization of large established Multinational Corporations (MNCs).

Real options theory (ROT), on the other hand, emphasizes decision making under uncertainty and argues that options provide firms the flexibility to adjust to changing levels of uncertainty (McGrath, 1997; McGrath, Ferrier, & Mendelow, 2004; McGrath & MacMillan, 2000b; Trigeorgis, 1996; Trigeorgis & Reuer, 2017). It accounts not only for the strategic flexibility that stems from learning but also the opportunity cost of not making the investment decision (Brouthers, Brouthers, & Werner, 2008). It further complements the traditional TCE view on firm internationalization patterns and outcomes by looking at not only endogenous uncertainty but also exogenous uncertainty (Brouthers et al., 2008; Buckley & Tse, 1996; Trigeorgis & Reuer, 2017). In addition, it extends the U-model's central premise of a market knowledge-market commitment framework by looking beyond uncertainty reduction or managing uncertainty and focusing on uncertainty leveraging (Vahlne et al., 2017; Vahlne & Johanson, 2017). ROT complements the Knightian view of uncertainty in entrepreneurship and its relation to entrepreneurial action by looking beyond static uncertainty and focusing on how changing levels of uncertainty over time impact entrepreneurial decision making. It reconciles the barrier view and necessity view of uncertainty in entrepreneurship by acknowledging the important role of uncertainty leveraging in the entrepreneurial process (McGrath, 1999; McGrath & MacMillan, 2000b). More importantly, in contrast to TCE's predictions of MNCs' internationalization, ROT becomes even more appealing to the entrepreneurial internationalization setting when entrepreneurial firms and entrepreneurs often have to face greater levels and varieties of home and host country uncertainty (Butler et al., 2010; Liesch et al., 2011). Thus, ROT provides a critical

means to understand how entrepreneurs and entrepreneurial firms leverage uncertainty when internationalizing. As such, I turn to the ROT literature on the uncertainty construct.

Uncertainty in Real Options

Uncertainty and Real Options Theory

Aligned with the Knightian view (Knight, 1921) on the role of uncertainty, real options theory (ROT) also believes that *ex-ante* uncertainty is a crucial determinant of value creation (McGrath, 1997, 1999; Trigeorgis, 1996; Trigeorgis & Reuer, 2017). Uncertainty is the most important antecedent to real option reasoning (ROR) (McGrath, 1997; Reuer & Tong, 2007; Trigeorgis, 1993; Trigeorgis & Reuer, 2017).

However, differing from the traditional TCE view that focuses on endogenous uncertainty and argues for uncertainty reduction and avoidance, ROT takes a different perspective on the role of uncertainty and argues that decision-makers can leverage uncertainty and achieve desirable decision-making outcomes by choosing and exercising real options (Trigeorgis & Reuer, 2017). Specifically, it suggests that when making decisions in an uncertain environment, firms or individuals can defer investment or make small investments as opposed to making full or no investment. In this way, they can reserve the right but not obligation to pursue future opportunities which provides them with potential upside benefits while reducing downside risks (Janney & Dess, 2004; McGrath, 1997; Reuer & Tong, 2007). Myer (1977: p163) defines the term real options as an "opportunity to purchase real assets on possible favorable terms." The term "real" emphasizes the nature of the underlying assets is as a "real" asset. In financial investment, an option is the right to acquire financial security (i.e., shares of stock) as underlying assets. In real options, the underlying asset is "real" in the sense that assets that involve incremental cash flows that connect

to the construction of a plant, development of new products, or exploitation of a new market, etc. The term option is a right, but not obligation, to take specific future actions (i.e., investment) under favorable conditions. In the organizational setting, such a right can be obtained through contracts (e.g., joint venture, licensing agreement), preferable access to investment opportunities (e.g., financial options), and possession of idiosyncratic knowledge (e.g., a joint R&D program).

Real options can take many forms in firms' strategic decision-making process. Trigeorgis and Reuer (2017: p45) classified five types of stand-alone real options: 1) the option to defer or stage market entry in the presence of market demand uncertainty, 2) the option to take a partial equity stake in another company when entering a foreign market with the possibility to expand in the future, 3) the option to change scale (either expand or contract), 4) the option to switch input, output, suppliers, and 5) the option to exit including exit a market or terminate the partnership. At its core, a real option is the decision asymmetry of options involving the right but not the obligation to act upon opportunities only if it can benefit the decision-maker in the presence of uncertainty (Trigeorgis & Reuer, 2017). The hallmark of ROT is that it provides firms with a " wait and see" approach in which firms defer initial investment and later choose to invest, abandon the investment (divest), or continue to wait (Dixit & Pindyck, 1994). ROT also provides firms with an "invest and see" approach in which firms make a small initial investment and later make the further investment, abandons the investment (divest), or maintain the status quo (McGrath, 1997). Firm choice of those options is determined by changing levels of exogenous uncertainty.

ROT argues that different types of uncertainty can affect the value of options on real assets. Those uncertainties can be broadly categorized into exogenous uncertainty, endogenous uncertainty, and behavioral uncertainty (Trigeorgis & Reuer, 2017). Real options theory focuses mainly on exogenous uncertainty. However, because firms often encounter both exogenous and

endogenous uncertainty when making investment decisions, researchers often combine ROT with other theories (i.e., TCE) (Brouthers et al., 2008; Leiblein & Miller, 2003; MacMillan, Van Putten, McGrath, & Thompson, 2006). In the context of technology investment, ROT includes four sources of uncertainty (total cumulative net revenues, sustainability, commercialization cost, technology development cost) which can significantly influence the value of a real option (McGrath, 1997). For example, in the context of determining technology investments, the uncertainty regarding net revenue and cost can increase anticipated variances of the investment outcome which determine the value of a real options investment.

Uncertainty entails different empirical issues depending on types of investment decisions under consideration. For example, in market entry decisions, exogenous demand uncertainty is the primary concern (Brouthers et al., 2008; Li & Tang, 2010). For decisions regarding technology or R&D investment, exogenous technological uncertainty is the focus (MacMillan et al., 2006; McGrath & MacMillan, 2000a). In a recent systematic review of 54 ROT studies, Ipsmiller et al. (2018) classified empirical measures of uncertainty into four broad categories. Notably, Ipsmiller et al. (2018) suggest that the majority of prior real options studies have not appropriately measured exogenous uncertainty and called for more precise operationalization of exogenous uncertainty rather than endogenous uncertainty in future studies.

More importantly, real options theorists suggest that the nature of uncertainty plays a critical role in determining the value of any chosen real options and firms' investment outcomes. They argue that firms' uncertainty profiles are heterogeneous, suggesting that the objective of taking an options approach is to leverage uncertainty for itself, not necessarily for competitors. The distinguishing characteristic of an options approach lies in firms making an investment decision that confers the ability to select an outcome only if it is favorable. In general, the greater

the uncertainty, the greater the attractiveness and value of making an options investment, contingent on firms' capabilities of containing the possible downside losses (MacMillan et al., 2006; McGrath, 1997; McGrath & MacMillan, 2000a). An option becomes more attractive if the firm can approach it through sequential development so that incurring the cost of development in one stage does not commit firm to the next stage of development (McGrath, 1997).

Uncertainty and Real Options Reasoning

Real options reasoning (ROR) relies on ROT's assumption about uncertainty and provides an alternative way of thinking about decision making under uncertainty. Real options reasoning is one type of decision making logic that decision-makers employ to position investments and allocate assets that maximize learning and access to upside opportunities while containing costs and downside risk (McGrath, 1997, 1999; McGrath & MacMillan, 2000a, b). ROR suggests that the main objective of a real options approach is to reduce information asymmetry through securing an option that can maximize learning and confer firms' ability to select an outcome only if it is favorable in the near future. ROR provides decision-makers with a robust and alternative way of leveraging highly uncertain situations and achieving superior investment performance. Such performance rent is achieved when option decision-makers pursue opportunities that appear to have significant upside potential in a manner that contains downside risks (McGrath & MacMillan, 2000a).

ROR has been widely applied to explain firms' decisions on R&D, technology, and innovation (Gunther McGrath & Nerkar, 2004; MacMillan et al., 2006; McGrath et al., 2004; McGrath & MacMillan, 2000a). Similarly, ROR has also been applied to entrepreneurial contexts to re-conceptualize the role of entrepreneurial failure and initiatives during opportunity creation, discovery, evaluation, and exploitation (Ireland, Hitt, & Sirmon, 2003; McGrath, 1997; McGrath

& MacMillan, 2000b). Specifically, McGrath proposed a real options perspective on entrepreneurial failure that views entrepreneurial initiatives as entrepreneurial options that can manage uncertainty by pursuing high variance outcomes but invest only if conditions are favorable. The value of entrepreneurial options is determined by levels of uncertainty and entrepreneurial rent that can be achieved when entrepreneurs take out real options in certain highly uncertain opportunities that are not obvious to others.

Differing from mainstream entrepreneurship theories, ROR suggests that entrepreneurial failure has certain positive consequences and the key issue in entrepreneurship is not to avoid or manage uncertainty but to leverage uncertainty by limiting exposure to the downside while maintaining access to future attractive opportunities despite their high variances. The anti-failure and anti-uncertainty mindset could result in unintended negative consequences such as misjudgment, reduced incentive to take actions, inability to assess potential outcomes, etc.

However, despite the significant role of uncertainty in ROR in terms of determining both the value of the option as well as the likelihood of taking a real options approach, we know little about the boundary conditions of uncertainty in terms of influencing real options decision making. This is mainly because first, the prior literature on ROR remains mainly at the firm and industry level and rarely examines the antecedents of ROR at the individual level. Second, it treats uncertainty homogenously and focuses mostly on environmental uncertainty. The multidimensional nature of the uncertainty construct calls for a more in-depth examination of the role of uncertainty in ROR.

In summary, departing from traditional IB and entrepreneurship theory that treats uncertainty as necessary but also as a barrier that prevent entrepreneurial actions, ROT and ROR emphasize how decision-makers can exploit different levels of uncertainty to discover or create

entrepreneurial opportunity by choosing real options in the presence of information asymmetry and uncertainty (McGrath, 1997; McGrath & MacMillan, 2000b). ROT provides an alternative and balanced view of the role of uncertainty in the entrepreneurial process. It emphasizes actively managing uncertainty and making investment decisions on high variance outcomes conditioned on changing levels of uncertainty (McGrath, 1999).

CHAPTER III. EXPLORING THE UNKNOWN REQUIRES LEVERAGING UNCERTAINTY: A REAL OPTIONS PERSPECTIVE ON PATTERNS AND OUTCOMES OF ENTREPRENEURIAL FIRMS' INTERNATIONALIZATION

Abstract

Especially in this era of increasing trade tensions, uncertainty plays a major role in both entrepreneurial and internationalization processes. Yet, prior international entrepreneurship (IE) and international business (IB) literature has not fully accounted for the nature of high and changing levels of host country uncertainty when predicting entrepreneurial firms' internationalization patterns and outcomes. By applying real options theory (ROT), we re-conceptualize firms' internationalization patterns, processes, and outcomes as the result of active uncertainty-management in the face of elevated and ever-changing levels of host-country institutional and economic uncertainty. Utilizing a representative sample of 680 new U.S.-based firms that exported goods to 147 different host countries from 2009 to 2019, we find that host country uncertainty positively relates to firms' choice of "real option" entry (i.e., low initial investment combined with high collaboration). In contrast to prior theory predictions, a ROT approach enables firms to achieve relatively faster entries, enter more distant destinations, and allow flexibility to exit markets over time. Moreover, we uncover that firms using such "real options" entry can mitigate the negative performance impact of host country uncertainty.

Introduction

Uncertainty is central to both entrepreneurship (Knight, 1921; McMullen & Shepherd, 2006; Schumpeter, 1934) and internationalization (Johanson & Vahlne, 1977; Johanson & Wiedersheim-Paul, 1975; Schweizer et al., 2010). With respect to the entrepreneurship, both the perceived amount of uncertainty and willingness to bear uncertainty fundamentally influence entrepreneurial decisions and actions (McMullen & Shepherd, 2006), Uncertainty impedes entrepreneurial actions by creating hesitancy, indecisiveness, and procrastination, which in turn lead to entrepreneurial inaction and missed opportunities (Wood, Williams, & Drover, 2017).

International Business (IB) scholars, particularly those focused on large multinational corporations (MNC) and utilizing transaction cost economics (TCE), have also generally treated uncertainty as something to avoid because it increases transaction costs in cross-border contexts (Brouthers & Nakos, 2004; Walker & Weber, 1984; Williamson, 1981, 1996). Thus, due to increased uncertainty, (e.g., lack of international experience) firms tend to choose entry modes with high degrees of integration or control (e.g., greenfield investment) rather than more flexible or collaborative entry modes (Morschett et al., 2010; Zhao et al., 2004), and firms often delay or avoid foreign investment due to high uncertainty (Brouthers & Hennart, 2007; Walker & Weber, 1984; Zhao et al., 2004).

Yet, as highlighted in the international entrepreneurship (IE) literature, which focuses on "the discovery, enactment, evaluation, and exploitation of opportunities-across national borders-to create future goods and services" (Oviatt & McDougall, 2005: p7), entrepreneurial firms' internationalization approaches are inconsistent with this theory's predictions. Entrepreneurial firms enter more uncertain foreign markets rather than more certain and stable markets (Deng & Sinkovics, 2018); employ collaborative or flexible entry modes rather than ownership-based entry modes (Liesch, Welch, & Buckley, 2011); and generally prefer to move quickly rather than delaying or avoiding entry (Bingham, 2009). Although opportunity-seeking entrepreneurial internationalization often involves decision-making under uncertainty, our understanding of how uncertainty influences the pattern, process and outcome of entrepreneurial firms' internationalization is limited.

There are three particular areas where the lack of theorizing on uncertainty in internationalization and entrepreneurship is particularly problematic: first, internationalization involves actions under both endogenous (i.e., originating from organizations' internal lack of

information and control) and exogenous (i.e., originating from the external environment) uncertainty (Jones & Coviello, 2005; Schweizer et al., 2010). Yet, current theorizing mainly focuses on the impact of endogenous uncertainty, neglects how firms act in the face of exogenous uncertainty, and treats uncertainty in general as an impediment to internationalization regardless of the different types and levels of uncertainty (Brouthers et al., 2008; Madsen & Servais, 1997).

Second, internationalization is dynamic and involves changing levels of uncertainty over time (Mathews & Zander, 2007). Yet, scholars have not paid enough attention to how entrepreneurial firms develop after their initial international market entry (Reuber et al., 2017). Specifically, the question of how entrepreneurial firms evolve over time as host country uncertainty changes remain under-addressed (Bingham, 2009). This is problematic because rather than the implied static approach in prior theorizing (Anderson & Gatignon, 1986; Brouthers et al., 2003; Rugman & Verbeke, 2005), changing uncertainty continues to influence internationalization over time.

Third, internationalization's performance implications are very complex (Johanson & Vahlne, 1977; Oviatt & McDougall, 1994; Sapienza et al., 2006; Yan & Williams, 2020). Performance outcomes (e.g., firm growth and survival) due to internationalization diverge. Researchers highlight conflicting and equivocal findings with respect to internationalization and firm performance (Carr et al., 2010; Fernhaber & Li, 2010; Lu & Beamish, 2001, 2004; Yan & Williams, 2020). Thus, the lack of theory with respect to the role of uncertainty in internationalization may very well limit our ability to understand the conditions under which some firms achieve superior post-entry performance.

We argue that real options theory (ROT) can address these issues and provide insights into entrepreneurial firms' internationalization patterns and outcomes. ROT suggest that firms can take

real options, defined as "the opportunity to purchase real assets on possible favorable terms (Myer, 1977: p163)," to manage specific types of uncertainty over time and obtain the strategic flexibility to achieve superior performance (Buckley & Tse, 1996; McGrath, 1997; Trigeorgis, 1993; Vassolo, Anand, & Folta, 2004). ROT also accounts for opportunity cost (i.e., the cost of a missed opportunity by not acting) and the dynamic nature of uncertainty in the internationalization process (Brouthers et al., 2008). As a result, by drawing from ROT, this paper contrasts with and complements existing theory to holistically examine how firms manage uncertainty (exogenous uncertainty in particular). It also provides the theoretical basis for understanding entrepreneurial firms' internationalization beyond the initial international entry decision and offers insights into how they are likely to react to changing levels of uncertainty. Specifically, this paper examines the question of *how does host country uncertainty influences entrepreneurial firms' internationalization patterns and outcomes?*

By applying ROT to entrepreneurial firms' internationalization, we make several theoretical and practical contributions. First, we resolve problems related to the role of uncertainty in internationalization by examining both levels and dynamics of uncertainty and by proposing a real options perspective that looks at the impact of exogenous uncertainty on entrepreneurial firms' internationalization pattern Second, we advance ROT by further establishing boundary conditions of ROT and by proving the theoretical relevance and applicability of ROT in the context of entrepreneurial firms' internationalization. Third, we contribute to international entrepreneurship literature by looking beyond the timing aspects of initial entry. Instead, we propose that entrepreneurial firms' internationalization evolves during and after the initial entry is a function of changing uncertainty. Finally, for practice, we further contribute to the ongoing conversation about the outcomes of internationalization (Fernhaber & Li, 2010; Zhou & Wu, 2014) by examining how

a real options entry can maximize entrepreneurial firms' internationalization performance over time.

Theory and Hypothesis

Market Entry, Uncertainty, and Real Options Theory

Prior IB research has mainly taken a transaction cost view in predicting established multinational firms' (MNEs) modes of foreign market entry (Anderson & Gatignon, 1986; Brouthers, 2002; Brouthers et al., 2003; Madhok, 1997; Morschett et al., 2010; Zhao et al., 2004). It suggests that firms choose entry modes based on the cost of transactions in specific foreign market entries (Madhok, 1997; Morschett et al., 2010; Zhao et al., 2004). Certain host country factors such as culture (Bhardwaj et al., 2007; Brouthers & Brouthers, 2000), institutional (Brouthers, 2002; Brouthers & Brouthers, 2000), and industry (Rhee & Cheng, 2002) influence the transaction costs associated with the foreign market entry. In particular, IB scholars identified three core transaction cost attributes that influence firms' international entry mode choice: control uncertainty, investment uncertainty, and asset specificity (Zhao et al., 2004). Notably, because both control uncertainty and investment uncertainty originate from firms' internal lack of experience or knowledge, they are mainly associated with endogenous uncertainty. Thus, this line research has focused primarily on endogenous uncertainty but neglected exogenous uncertainty (i.e., that from the external environment) (Ipsmiller et al., 2018).

This line of research also focuses on cost minimization during MNEs' internationalization. It predicts that firms often avoid or delay foreign market entry associated with high host country uncertainty to minimize potential foreign market transaction costs (Delios & Henisz, 2003b; Rhee & Cheng, 2002; Tseng & Lee, 2010). However, this view of cost minimization overlooked the value creation aspects of international entry and neglected the opportunity cost associated with the

timing of entry and mode of entry. Specifically, it did not account for the opportunity cost of missing out on (versus taking advantage of) the potential for future growth created by making an investment under high uncertainty. In addition, the cost minimization view discounted the firms' strategic flexibility and organizational learning capabilities. In fact, firms often can learn from past investments and develop organizational capabilities to redeploy resources as the uncertainty level changes (Levitt & March, 1988; March, 1991). In sum, according to this view, high host country uncertainty will drive firms away from market entry.

Yet, differing from established MNEs, many entrepreneurial firms, in fact, choose to enter foreign markets despite high host country uncertainty (Bloodgood, Sapienza, & Almeida, 1996; Knight, 1996; Liesch et al., 2011). In particular, those entrepreneurial firms employ more flexible entry modes to enter more distant foreign markets with a faster pace despite high host country uncertainty (Bloodgood et al., 1996; Burgel, 1999; Monaghan & Tippmann, 2018)

For example, the recent case of TikTok's internationalization strategy (Fannin, 2019) depicts a Chinese high-tech start-up firm entering the foreign market despite high host country uncertainty in order to seize future market growth opportunity. Those acts of entrepreneurial firms' internationalization call for new alternative theoretical explanations for market entry under high and changing levels of host country uncertainty.

Real options theory (ROT) is an ideal theoretical framework to explain entrepreneurial firms' internationalization under high and changing levels of host country uncertainty. ROT takes a different perspective on the role of uncertainty and argues that decision-makers can leverage uncertainty and achieve desirable decision-making outcomes by choosing and exercising real options (Trigeorgis & Reuer, 2017). Specifically, it suggests that when making decisions in a highly uncertain environment, firms can defer initial full-scale investment or make small

investments as opposed to making full or no investment. In this way, they can reserve the right but not obligation to pursue future opportunities which provides them with potential upside benefits while reducing downside losses (Janney & Dess, 2004; McGrath, 1997; Reuer & Tong, 2007). Myer (1977: p163) defines the term real options as an "opportunity to purchase real assets on possible favorable terms." The term "real" emphasizes the nature of the underlying assets is as a "real" asset. The underlying asset is "real" in the sense that the assets that involve incremental cash flows are connected to the construction of a plant, development of new products, or exploitation of a new market, etc. An "option" is a right, but not an obligation, to take specific future actions (i.e., investment) under favorable conditions. In the organizational setting, such a right can be obtained through contracts (e.g., joint venture, licensing agreement), preferable access to investment opportunities (e.g., financial options), and possession of idiosyncratic knowledge (e.g., a joint R&D program). At its core, a real option is the decision asymmetry of options involving the right but not the obligation to act upon opportunities in the presence of uncertainty only if it can benefit the decision-maker (Trigeorgis & Reuer, 2017).

ROT, as an alternative theory, differs from prior theoretical frameworks in several important ways: first, ROT accounts mainly for exogenous uncertainty rather than endogenous uncertainty (Ipsmiller et al., 2018; Trigeorgis & Reuer, 2017). The main distinction between the two is that endogenous uncertainty results from individuals' or firms' internal lack of knowledge or information (Chi & McGuire, 1996; Dixit & Pindyck, 1994; Ipsmiller et al., 2018), whereas exogenous uncertainty derives from the external environment and is less affected by firm actions, but it can change over time (Folta, 1998). Specific to the context of market entry mode, the sources of exogenous uncertainty (uncertainty thereafter) come from both the home country and the host country (Zhao et al., 2004). These sources of uncertainty can affect the value of real options, and

they play major roles in determining firm internationalization patterns, processes, and outcomes (Acedo & Jones, 2007; Cuervo-Cazurra, Ciravegna, Melgarejo, & Lopez, 2017; Zahra, Korri, & Yu, 2005).

Second, ROT recognizes the mitigability of uncertainty and differentiates mitigable ignorance of pertinent but knowable information (i.e., epistemic uncertainty) from immitigable indeterminacy (i.e., aleatory uncertainty) (Packard Jr & Clark, 2020). On one hand, epistemic uncertainty originates from the ignorance of knowable information (Der Kiureghian & Ditlevsen, 2009; Perlman & McCann Jr, 1996). The outcomes are presumed to be knowable *ex ante* and the probability distribution of outcomes is unknown mainly due to the ignorance of underlying criteria needed to predict the outcomes, which make epistemic uncertainty mitigable. On the other hand, aleatory uncertainty comes from indeterminate and unknowable factors that contribute to stochastic events. It presumes that outcomes are unknown and unknowable *ex ante*, and the probability distribution of outcomes is unbounded or indeterminate. In other words, the outcomes are truly random, and the determination of their probability distributions is completely unknowable, therefore, aleatory uncertainty is immitigable (Packard Jr & Clark, 2020; Packard, Clark, & Klein, 2017). ROT emphasizes the mitigable nature of epistemic uncertainty and suggests that firms can achieve superior outcomes by taking real options to contain potential downside losses while securing access to future growth opportunities. Specifically, the epistemic uncertainty can be mitigated by taking real options to reduce the ignorance of knowable information over time. Moreover, three sources of epistemic uncertainty: complexity, dynamism, and stochasticity (Child, 1972; Dess & Beard, 1984) originate from the external environment which pertain to exogenous uncertainty. Thus, ROT suggests that they can be mitigated by taking a real options approach.

Lastly, both subjectively perceived and objective epistemic uncertainty influence the value of real options and results in firms' performance heterogeneity.

Lastly, departing from the prior IB theory that treats uncertainty as a barrier that prevents MNEs' internationalization, ROT emphasizes how decision-makers can exploit uncertainty to discover or create entrepreneurial opportunities by choosing real options (McGrath, 1997; McGrath & MacMillan, 2000b). Specifically, ROT offers an alternative view on the role of uncertainty in the entrepreneurial process. It emphasizes actively leveraging uncertainty and making investment decisions on high variance outcomes conditioned on changing levels of uncertainty (McGrath, 1999).

The hallmark of ROT is that it provides firms with an "invest and see" approach in which a firm makes a small initial investment and later makes either further investment, abandons the investment (divest), or continues to wait (McGrath, 1997) as opposed to a "wait and see" approach in which a firm defers initial investment and later chooses to invest, abandon the investment (divest), or continue to wait (Dixit & Pindyck, 1994). In the context of foreign market entry, it argues that firms' choice of those options is determined by changing levels of host country uncertainty which can be reflected in firms' both internationalization patterns such as internationalization mode, speed, location as well as internationalization outcomes such as market exits and post-entry performance.

ROT and internationalization mode

Prior IB entry mode literature takes a cost minimization view and suggests that high host country uncertainty drives firms to choose internalized modes such as the hierarchical entry modes (i.e., wholly-owned subsidiary, greenfield investment) over hybrid or market-based modes (i.e., joint venture, alliance, franchising) in order to mitigate potential transaction cost (Anderson &

Gatignon, 1986; Brouthers, 2002; Brouthers et al., 2003; Brouthers & Hennart, 2007; Zhao et al., 2004). However, because internalized entry modes such as full-scale acquisitions or wholly-owned subsidiaries are more complex and costly to employ (Morschett et al., 2010; Zhao et al., 2004), high host country uncertainty often leads firms to delay or avoid market entry. This is reflected in a "wait and see" approach when uncertainty is high during the firms' internationalization process.

ROT, on the other hand, emphasizes decision making under uncertainty and argues that real options provide firms the flexibility to act under high uncertainty and adjust to changing levels of uncertainty. ROT focuses on maximizing potential upside growth while containing downside losses. In particular, ROT suggests that firms' choice of international entry modes is based on the rationale to obtain a real option to contain potential downside losses while securing access to future values contingent on host country uncertainty decreasing or until more information can be obtained (Brouthers et al., 2008; Buckley & Tse, 1996; McGrath, 1997; Trigeorgis, 1996). One example is to combine direct exporting with the collaboration of host country local partners (i.e., joint venture, foreign licensing/franchising, strategic alliance) (Brouthers et al., 2008). Another example is to choose a small-scale greenfield start-up venture like a regional sales office over the full-scale acquisition of a local company (Brouthers & Dikova, 2010). Such an approach manifests via a decision-making process that emphasizes leveraging present host country uncertainty by using low-cost entry modes and by building collaboration with local partners to obtain access to potential future value should changing levels of future host country uncertainty increase the benefit of further commitment.

Firms that keep their initial investment low while maintaining the option for future investment can benefit from and leverage changing host country uncertainty. They benefit because a low investment entry mode enables firms to mitigate potential investment loss while securing

the rights for future investment when (if) future uncertainty is reduced (Posen, Leiblein, & Chen, 2017). Moreover, unlike high investment entry modes (i.e., wholly-owned subsidiaries or acquisitions) which often require firms to either delay or avoid the current investment decision in the face of high host country uncertainty, the low cost of a 'real options entry mode' enables firms to initiate market entry. In sum, utilizing a ROT approach results in a low initial investment and collaborative entry mode that minimizes the potential downside risk exposure by deferring part of the initial investment until the uncertainty is reduced while securing the option to participate in future upside growth through collaboration if conditions change. Thus, we hypothesize:

Hypothesis 1*: Host country uncertainty is positively associated with firms' choice of low initial investment and collaborative entry modes (i.e., real options entry) over high initial investment and internalized entry modes (i.e., non-real options entry)*

ROT and internationalization speed

Prior IB studies suggest that high host country uncertainty often leads firms to choose highly internalized entry modes to mitigate transaction costs and potential for opportunistic behavior (Brouthers et al., 2003; Zhao et al., 2004). However, this highly internalized approach often demands more resources and time from the firm to implement which causes firms to delay or avoid the internationalization process in the face of high host country uncertainty. ROT presents an alternate view and predicts that when high host country uncertainty prevents firms from accurately assessing the value of foreign investment opportunities, firms do not need to delay investment or abandon the plan to exploit the foreign opportunity. Instead, firms often choose an entry mode that keeps the initial investment low while obtaining an option for future investment when uncertainty changes (Dixit, 1989; Kogut & Zander, 1993).

Beyond entry mode considerations, such an approach also enables a relatively faster international entry in the face of high host country uncertainty. Initial low investment and collaborative entry enables relatively faster international entry by providing firms means to deal with host country uncertainty. Specifically, it allows a platform to cope with high host country uncertainty by gaining a low-cost foothold while waiting to see what happens over time. It also enables firms to quickly capitalize on emerging foreign market opportunities despite seemingly high host country uncertainty through collaborating with local partners. This will accelerate firms' internationalization speed (i.e., time to market entry). On the other hand, real options entry contrasts with high internalized and costly entry modes which do not provide an ability to leverage host country uncertainty, instead, they require the firm to absorb them – and all of the costs associated with host country uncertainty which often lead firms to either delay or avoid market entry altogether. Therefore, we hypothesize:

Hypothesis 2*: Firms' choice of low initial investment and collaborative entry modes (i.e., real options entry) is positively associated with internationalization speed, in other words, firms that employ real options entry internationalize faster than those that do not.*

ROT and internationalization location

When choosing where (which markets) to enter, prior research highlights the powerful influence of seeking commonalities while avoiding differences or being attracted by familiarity of a market (Clark, Li, & Shepherd, 2018; Williams & Grégoire, 2015). As a result, firms tend to choose markets that fit their past routines or experiences and partnership, and that share more commonalities than differences with their home country. Firms compare similarities and differences between the potential host country and home country in terms of industry, market characteristics, cultures, institutions, and economies. More importantly, firms can learn from their

past home country experience, and they tend to choose markets that fit their past routines or experiences, and that share more commonalities than differences.

In the face of high host country uncertainty, prior research suggests that firms should choose high investment and internalized entry mode in order to exercise control and mitigate potential cost (Brouthers et al., 2003; Erramilli & Rao, 1993; Zhao et al., 2004). Such an approach, however, often means that firms have to choose less distant countries that share more commonalities with their home country than distant ones (Evans & Mavondo, 2002; Tihanyi, Griffith, & Russell, 2005). Firms thus can utilize their own home country experience to mitigate the potential investment loss and reduce potential costs due to high control and investment uncertainty in the host country (Rugman & Verbeke, 2005).

In contrast, in the face of high host country uncertainty, firms that choose more distant host countries that share fewer commonalities are making high-risk gambles, given that the potential downside risk is high compared with choosing a country that shares more commonalities (Tihanyi et al., 2005). Firms' liability of foreignness and outsidership can be exacerbated in dissimilar markets (Johanson & Vahlne, 2009). They must build new routines and capabilities to meet the specific characteristics of the dissimilar market (Barkema & Shvyrkov, 2007; Sun, Mellahi, & Thun, 2010). Over time, these market entry choices lead to patterns of market entry. There are two generally accepted sequence patterns: 1) from culturally similar countries to distant countries 2) from bigger countries to smaller countries (Bingham, 2009). This line of work argues that firms can enhance internal learning by sequencing their international entry locations. Foreign learning becomes more effective when the firm can follow a series of orderly steps (e.g., entering more distant countries over time) because managers can develop more experiences and improve absorptive capacity through sequential learning (Delios & Henisz, 2003a).

ROT, on the other hand, suggests that in the face of high host country uncertainty, the firm should choose an entry mode with low initial investment but secure the options for future investment through local collaboration. We argued that such an approach does not restrain firms from entering more distant countries because by making a low initial commitment, firms can mitigate high cost or investment losses associated with the distant entry. Second, collaborative entry offers firms the ability to learn from local partners from a distant country, and it can reduce information asymmetry over time despite initial high uncertainty due to shared interests and responsibility among collaborating partners (Brouthers et al., 2008; Reuer & Tong, 2005; Tong, Reuer, & Peng, 2008). Therefore, we believe that real options entry can liberate firms from costs and restrictions associated with entering more distant markets. In other words, the features of real options entry (i.e., low initial commitment and collaborative) provide firms the means to realize more distant entries through mitigating potential downside losses while securing access to valuation information and market opportunities.

In sum, real options entry characterized as the low initial investment and collaborative entry provide firms the flexibility to enter more distant countries over time by offering ways to cope with high host country uncertainty. Therefore,

Hypothesis 3*: Firms' choice of low initial investment and collaborative entry modes (i.e., real options entry) is positively associated with entry countries' distance over time.*

ROT and international market exit

One of the defining characteristics of ROT is that it provides firms the investment flexibility (Ipsmiller, Brouthers, & Dikova, 2019; Trigeorgis & Reuer, 2017) and ability to balance market commitment and strategic flexibility during and after internationalization (Chi et al., 2019). In particular, ROT enables firms to be more flexible on resource reallocation and divestments in

certain products or market segments (Klingebiel & Adner, 2015). This is due to the low investment irreversibility as a result of a staged investment approach.

When the host country's political or economic conditions deteriorate over time and make it's market increasingly unpredictable (e.g., Venezuela crisis in 2014), ROT suggests that firms can employ the option to exit, meaning exit a market or terminate the partnership (Trigeorgis & Reuer, 2017). We further argue that in the face of increasing host country uncertainty, firms that choose real options entry with the low initial investment are more likely to exit the international market than those who do not. This is because, first, the low initial investment mode provides more flexibility for firms to exit the international market in the face of increased host country uncertainty than high initial investment modes that often lock a firm into specific markets due to high investment irreversibility. Second, by choosing to exit international markets, firms can mitigate potential downside losses brought by increased host country uncertainty and ensure the survival of long-term operations. In other words, firms' real options entry offers more flexibility for them to exercise the option of exiting in the face of increasing host country uncertainty over time. Thus, we hypothesize:

Hypothesis 4*: Firms' choice of low initial investment and collaborative entry modes (i.e., real options entry) is positively associated with international market exit over time.*

ROT and internationalization performance

Host country uncertainty has adverse effects on post international entry performance (Rhee & Cheng, 2002; Tseng & Lee, 2010). Specifically, high host country uncertainty requires firms to devote more resources to search for additional information about the environment change which incurs additional costs (i.e., the cost of searching). It also demands firms to closely monitor market partners' opportunistic behavior (i.e., the cost of monitoring) and enforce contractual terms among

market players (i.e., the cost of enforcing). Failure to do so can lead to misalignment of transactions that result in adverse performance consequences and eventually failure (Coase, 1937; Masten et al., 1991; Walker & Weber, 1984; Williamson, 1981, 1996).

On the other hand, the main objective of ROT is to maximize desirable investment outcomes in the presence of high uncertainty (McGrath, 1997; Trigeorgis, 1993; Trigeorgis & Reuer, 2017). When uncertainty is high, ROT offers opportunities for firms to maximize learning and gain knowledge about the particular market while withholding much of the resource commitment until information asymmetry is alleviated and a path becomes clear for either exit or to leverage the value of an option. This, in turn, offers superior performance outcomes despite high uncertainty (McGrath, 1997; Trigeorgis & Reuer, 2017).

Besides the learning benefits, ROT provides the mechanism for firms to minimize potential downside risks especially when uncertainty is high. When uncertainty changes, it provides firms the flexibility to either increase the resources committed or completely exit the market. Just as McGrath (1999, p.16) suggested: "real options suggest that the key issue is not avoiding failure but managing the cost of failure by limiting exposure to the downside while preserving access to attractive opportunities and maximizing gains."

Further, ROT prevents firms from becoming locked into the initial internationalization decision and from being fully exposed to potential uncertainty caused by a turbulent institutional environment (Anderson & Gatignon, 1986). In contrast, in the presence of high uncertainty, the inflexibility of a high investment entry mode approach not only exposes firms to potential downside risk but also limits their choice for future investment which leads to increased chances of either foreign entry failure or missing growth opportunities. Thus, we hypothesize:

Hypothesis 5*: Firms' choice of low initial investment and collaborative entry modes (i.e., real options entry) attenuates the relationship between host country uncertainty and internationalization performance, such that when host country uncertainty is high, firms that choose real options entry perform better than those do not.*

The specific hypothesized relationships among host country uncertainty, real options entry, entry timing, entry location, international market exit, and performance are illustrated in Figure 3.1

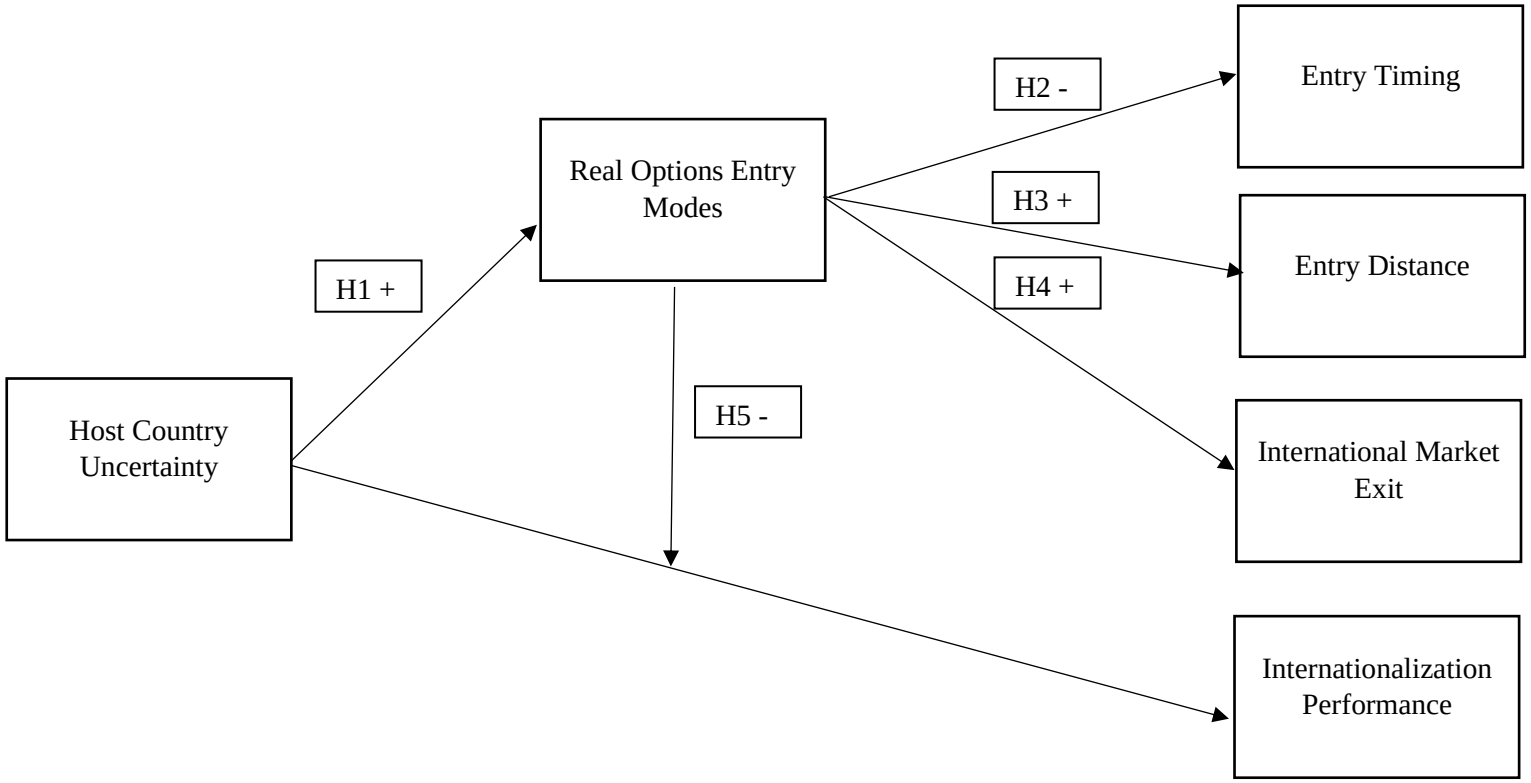

Figure 3.1: Theoretical Model

Method

Sample and Data

Our sample comprises United States-based public and private new firms that engage *at least* in exporting in recent decades from 2009 to 2019. We selected this time frame because, during this period, both the home country (the U.S.) and potential host countries have experienced significant trade and economic uncertainty. The U.S. has also experienced significant institutional changes – for instance, the 2016 presidential election and U.S. exit of the Trans-Pacific Partnership – while worldwide increases in nationalism have fueled the so-called de-globalization (Brexit and EU crisis in 2016). Such changes create the ideal context for studying firms' internationalization under high and changing levels of host country uncertainty.

In particular, we leveraged several unique proprietary databases of international trade and FDI including Datamyne, SDC platinum, World Scope, and Dun & Bradstreet. Datamyne is an international trade intelligence database that tracks all U.S.-based firms' maritime exports since 2008. It discloses U.S. firms' detailed exporting data including exporting destination, shipment time, shipment volume, shipment values, product nature, etc. The data are compiled based on the original U.S. Customs and Border Protection (CBP) form 7501. Datamyne has been widely used for international trade intelligence. It provided very fine-grained internationalization data that allowed us to look at specific foreign entry destinations and entry patterns over time.

Specifically, we first obtained the sample frame of all U.S. based firms that have at least two international export shipments from 2009 to 2019. Notably, we excluded firms that had export shipments in only one year for both theoretical and methodological reasons. Theoretically, the development of real option entry requires firms to commit to the international market to a certain extent, so that the real option value can be achieved as uncertainty level changes over time. Firms

that internationalize once, but then retrench (return to domestic only) within one year can't fully realize the real option values as market changes. Methodologically, including these firms in the sample introduces new sources of potential endogeneity issues to our estimation models because one-time firms are randomly driven to internationalize and they are distinctive from other international firms in our sample (Bloodgood et al., 1996; Brouthers & Nakos, 2004; Wansbeek, 2001). In sum, our sampling strategy allows us to track the broadest possible set of international firms as exporting is the most typical form of entrepreneurial internationalization adopted by firms (Cavusgil & Knight, 2015).

The initial search yielded 15,532 U.S.-based business entities across 588 4-digit SIC industry classification codes. Among those, we excluded industries associated with freight-forwarding, transportation arrangement, and cargo handling, because exporters in those industries are serving as trade agents or intermediaries rather than as direct exporter of the products or commodities. Moreover, consistent with prior international entrepreneurship studies, we only sampled new firms that internationalized within 6 years of founding and initiated the international entry within our study period 2009-2019 (Bloodgood et al., 1996; Coviello & Jones, 2004; Deng & Sinkovics, 2018; Fernhaber & Li, 2010, 2013; McDougall & Oviatt, 2000; Zahra, Ireland, & Hitt, 2000). We only include independent exporters or corporate headquarters and exclude corporate branches or subsidiaries. The main difference between these two is that that the former is operated by independent management while the latter is managed by other established companies. We then merged those data with Thomson Reuters' SDC mergers and acquisitions segment, which covers U.S. firms' major overseas merger and acquisition activity, to collect additional entry mode choices besides exporting. Finally, we used World Scope Segment data

from Thomson Reuters and Dun & Bradstreet to collect public and private firms' performance and industry-level data.

Through the above selection procedures, the final sample comprised 680 U.S.-based public and private independent new international firms across 253 industries as represented by 4 digit SIC codes. Those firms export (collectively) to more than 147 different host countries between our study period of 2009 and 2019. The data is structured as the firm-entry panel with 1653 foreign market entries nested in 680 firms.

Measures

Dependent variables. Our first dependent variable is *Real Options Entry* that pertains to *low initial investment and high collaborative entry mode*. Consistent with prior real options studies, we measured *Real Options Entry* as firms' initial international entry through direct exporting combined with joint ventures or equity-based strategic alliance (Brouthers et al., 2008; Kogut, 1991; Reuer & Tong, 2005). We employed a dummy variable with value 1 being Real Options Entry and 0 otherwise. Prior theory has suggested that firms' initial choice of joint ventures or strategic alliance rather than other alternative governance structure conforms to the real options logic (Folta, 1998; Folta & Miller, 2002; Kogut, 1991). In particular, joint ventures keep firms' initial investment low yet provide preferential access to future upside gains through preemptive collaboration with local partners. This is in contrast with other entry modes such as a greenfield investment which requires high upfront investment and high reliance on the internationalizing firms' internal structure and resources to navigate in the foreign market.

We examined firms' entrepreneurial internationalization patterns in terms of entry timing and entry distance. Consistent with prior studies (Carr et al., 2010; Cavusgil & Knight, 2009; Fernhaber & McDougall, 2010), firms' entry timing, or *Age at Entry*, is measured as the difference

between new firms' founding year and initial international entry year in each specific foreign market. This ranges from 0 to 6 with 0 being that firms initiated international entry within the same year of founding and 6 years being the upper bound.

For *Entry Distance*, rather than using the Euclidean approach that captured dyadic cultural distances based on Hofstede's four measures of culture dimensions, we followed recent works of Berry and colleagues and Dinner and colleagues (Berry, Guillén, & Zhou, 2010; Dinner, Kushwaha, & Steenkamp, 2019) and employed a multidimensional measure that captured cross-national psychic distance in four main dimensions: Cultural, Administrative, Economic, and Geographic (CAGE) distance. Specifically, we followed Dinner and colleagues' work and used 28 country characteristics including 13 cultural, 7 administrative, 3 geographic, and 5 economic factors. We then used Mahalanobis method as suggested by Berry and colleagues (2010) to calculate psychic distances (Harms, DeSimone, & Psychology, 2015):

$$PD_{xy} = \sqrt{(X_t - Y_t)' S^{-1} (X_t - Y_t)}$$

Where *x* refers to the host county and y to the home country (the U.S. in this case), *t* referred to our study period (2009-2019), *S* is the 28 x 28 covariance matrix between PD input factors and X_t. Finally, we take the sum of the psychic distance of all entered host countries by the focal firm to calculate total *Entry Distance*. Table 3.1 shows the dyadic psychic distance measures between all 147 host countries involved in our sample and the home country of the U.S.

Table 3.1
Psychic Distance of Host Countries and Home Country of the U.S.

Two-letter country code	Psy distance	Two-letter country code	Psy distance	Two-letter country code	Psy distance	Two-letter country code	Psy distance
AD	8.65	BG	7.91	CU	8.35	GH	8.55
AE	8.45	BH	8.32	CY	8.45	GL	8.25
AF	8.65	BI	8.9	CZ	8.21	GR	7.98
AG	8.01	BO	8.1	DE	8.07	GT	7.73
AI	8.65	BR	7.99	DK	7.8	GU	7.71
AL	8.7	BS	7.8	DM	8.21	HK	7.91
AM	8.65	BT	8.6	DO	8.21	HN	7.51
AO	8.55	BW	8.6	DZ	8.35	HR	7.89
AQ	10	BY	8.55	EC	8.21	HT	8.16
AR	7.91	BZ	8.3	EE	8.55	HU	8.21
AS	7.9	CA	7.8	EG	8.21	ID	7.63
AT	7.67	CD	8.65	EH	8.69	IE	7.98
AU	7.29	CF	8.77	ES	7.89	IL	7.8
AW	8.24	CG	8.67	ET	8.45	IN	8.18
AZ	8.75	CH	7.56	FI	8.33	IQ	8.65
BA	8.35	CL	7.79	FR	7.35	IR	8.98
BB	8.57	CM	8.65	GB	6.27	IS	7.98
BD	8.35	CN	8.35	GD	8.01	IT	8.04
BE	7.6	CO	7.22	GE	8.45	JM	8.01
BF	8.65	CR	7.87	GF	8.01	JO	8.67

Table 3.1 (Continued)
Psychic Distance of Host Countries and Home Country of the U.S.

Two-letter code	Psy distance	Two-letter code	Psy distance	Two-letter code	Psy distance	Two-letter code	Psy distance
JP	8.37	MO	8.01	RU	8.53	UY	8.31
KE	8.21	MX	8.25	RW	8.45	UZ	8.67
KH	8.71	MY	7.99	SA	8.01	VE	8.35
KP	9.79	NG	8.21	SD	8.56	VI	7.9
KR	8.27	NL	7.5	SE	7.86	VN	8.29
KW	8.01	NO	7.73	SG	8.25	YE	8.98
KZ	8.69	NP	8.45	SI	7.61	ZA	8.31
LA	8.71	NZ	8.63	SK	8.21		
LB	8.21	PA	7.89	SN	8.54		
LI	8.31	PE	7.52	SO	8.78		
LK	8.45	PG	8.31	SS	8.9		
LR	7.98	PH	8.11	SV	7.45		
LS	8.56	PK	8.32	SY	9.21		
LU	8.21	PL	7.6	TH	7.69		
LV	8.45	PR	8.01	TR	7.83		
LY	8.65	PS	8.65	TW	7.97		
MA	8.13	PT	7.8	TZ	8.35		
ME	8.45	PY	7.89	UA	8.55		
MM	8.65	RO	7.72	UG	8.64		
MN	8.75	RS	8.23	US	0		

We tested firms' entrepreneurial internationalization outcomes in terms of both market exit and firm performance. Specifically, consistent with prior studies (Carr et al., 2010; Patel, Criaco, & Naldi, 2018; Puig, González-Loureiro, & Ghauri, 2014; Sui & Baum, 2014), we operationalize *Market Exit* as whether firm chooses to exit out of each foreign markets during the study period. We used a dummy variable with 1 being the firm ceasing to operate internationally in that market and 0 being otherwise (Boeker, Goodstein, Stephan, & Murmann, 1997). Firm performance is measured as the firms' total *Sales Growth* one year after entering each specific foreign market (Fernhaber & McDougall, 2010; Lu & Beamish, 2001; Schwens et al., 2017; Zhou & Wu, 2014).

Independent variables. The key explanatory variable in our study is *Host Country Uncertainty*. Aligned with ROT's emphasis on exogenous and epistemic uncertainty and Milliken's (1987) work on state uncertainty, we measured *Host Country Uncertainty* as a composite measure of host country macro-economic and institutional conditions that capture two dimensions: institutional uncertainty (Lu et al., 2014) and economic uncertainty (Fisch, 2008; Lu et al., 2014). In particular, for institutional uncertainty, we adopt the worldwide governance indicator (WGI) constructed by Kaufmann, Kraay, and Mastruzzi (2009). WGI is widely used in studies on the impact of institutional conditions on firms' internationalization decisions (e.g., Cantwell, Dunning, & Lundan, 2010; Lu et al., 2014; Slangen & Beugelsdijk, 2010). Among six dimensions of WGI, we use political stability and absence of violence/terrorism (PSAVT) as the proxy for institutional uncertainty because it directly captures the unpredictable political conditions that influence firms' internationalization decisions. Therefore, we operationalize institutional uncertainty as the standard deviation of the yearly PSAVT of the host country over the study period from 2009 to 2019. For economic uncertainty, we adopt the world development

indicators (WDI) that captures a wide range of economic characteristics of the host country. Similar to Fisch's (2008a, 2008b) studies, we capture leading economic indicators (i.e., GDP growth, unemployment rate, inflation rate, manufacturing value-added) that predict the cyclical differences of the economic development of the host country. We then measure the economic uncertainty as the aggregated standard deviations of those indicators over the study period. Since institutional and economic uncertainty are highly correlated with each other, we take the mean to obtain the total *Host Country Uncertainty*.

Control variables. We included several theoretical relevant control variables in the model to account for any potential effects on our outcome variables. In particular, we followed Becker (2005)'s general guidelines on including control variables that are theoretically relevant to our model and empirically significant to the results.

Consistent with prior entrepreneurial internationalization studies especially that examining internationalization patterns and outcomes (Bloodgood et al., 1996; Carr et al., 2010; Coviello & Jones, 2004; Fernhaber & Li, 2013; Milanov & Fernhaber, 2014; Shrader, Oviatt, & McDougall, 2000; Zahra et al., 2000), we account for the role of industry characteristics, firm factors, and internationalization factors as each of these has been found to influence firms' entrepreneurial internationalization strategy and outcomes. First, to account for prior work on the effects of industry (Hitt et al., 1997; Mauri and Michaels, 1998), we controlled for *industry* effect by utilizing firms' primary 4-digit SIC codes. Differing from prior studies using only 2-digit SIC codes, our use of 4-digit SIC codes accounts for more fine-grained industry heterogeneity and its effects on our outcome variables.

Second, we control for a series of firm-level characteristics including *firm age*, measured by the current age of the firm, and *firm size*, measured by the total number of full-time employees.

Firms' *private status*, a binary measure with 1 being private firms and 0 being public firms. Prior studies have found firms' use of subsidiaries can influence internationalization patterns and performance, thus we control for firms' *Subsidiary* status as whether the firm directly owns any subsidiaries.

Lastly, consistent with prior studies, we control for numbers of internationalization factors including international scope as measured by the number of *Entered Countries*, *Industry Exporting Scale* as measured by focal firms' industry average exporting values, Exporting *Values* as measured by firms' annual total exporting dollar values, and exporting scale as measured by firms' annual number of *Shipments*.

Analytical Methods

Because two of our dependent variables (i.e., *Real Option Entry and Market Exit*) are binary outcome variables, we employed logistics regressions to predict a firm's likelihood of choosing real options entry and exiting from specific foreign markets (Hayes & Matthes, 2009). Specific to *Market Exit* outcome, we used discrete-time logit models to predict firms' decisions to exit (i.e., survivability). This is consistent with prior related studies (Carr et al., 2010; Wiklund, Baker, & Shepherd, 2010) that examined the firm's market exit as a discrete-event that occurs during a time period (Allison, 2010).

Regarding the remaining outcome variables (i.e., *Age at Entry*, *Entry Distance*, *Sales Growth*), due to the data structure, particularly the presence of time-invariant variables and the unbalanced panel structure, we employed pooled ordinary least squares (POLS) with unclustered robust standard errors to test our hypothesized relationships. POLS treat unit effects as error terms and can derive unbiased and consistent estimates of parameters even when time-invariant attributes are present and a serial correlation exists in the data (Acemoglu, Johnson, Robinson, & Yared,

2005; Wooldridge, 2003). The Dubin-Wu-Hausman test showed that POLS is the most efficient estimating technique. The Breusch-Pagan test ($\chi 2$ = 16.61, p = 0.000) showed the presence of heteroscedasticity. Thus, a corrected error term was employed using un-clustered robust standard errors (Hoechle, 2007). All outcome variables are lagged one period to account for potential reverse causality.

Lastly, we accounted for potential endogeneity issues, that is, we recognize that a firm's choice of real options entry in the host country might not be exogenous, meaning the relationships between real options entry and entrepreneurial internationalization pattern (i.e., entry timing and entry location) may be influenced by the existence of omitted variables that contribute to both. Thus, we conducted a series of robustness analyses using the 2SLS (two-stage least squares) model with one identified instrumental variable: *State's International Dependency*. This measures the annual outward international trade volume of each firm's home state (e.g., California or Illinois). Theoretically, this variable is the ideal candidate as an instrument due to two main reasons. First, the residing state's international dependency is expected to be correlated with firms' real options entry because of geographical (Fernhaber, Gilbert, & McDougall, 2008) and network effects (Fernhaber & Li, 2013). In other words, the infrastructure exists in the firm's home state to support the firm's international activity. However, and second, the international dependency of the home state does not necessarily direct predict firms' overall pattern of internationalization, which is mainly driven by firms' internal governance structure and strategic decisions (Brouthers et al., 2003; Nielsen & Nielsen, 2011). Empirically, we performed an F-test after the first-stage regression (F = 71.24, p = 0.00) and Sargan's (Hansen's J) over-identification test ($\chi 2$ = 0.38, p = 0.53), as well as sensitivity analysis for our proposed instrument, which confirmed the relevance

and excludability of the proposed instrument variable (Ashley, 2009; Semadeni, Withers, & Certo, 2014).

Results

Table 3.2 presents descriptive statistics and correlations for all related variables. A check of variance inflation factors (VIFs) showed no issues with multicollinearity (all VIFs are below 4, with the mean at 1.95). Descriptive statistics are rounded to two digits, except for values greater than 4 digits, which are expressed in scientific notation.

Table 3.2
Descriptive Statistics and Correlations

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Real Options Entry	1.00														
2. Host Country Uncertainty	0.22	1.00													
3. Total Sales Growth	0.02	0.08	1.00												
4. Market Exit	0.14	0.07	-0.02	1.00											
5. Age at Entry	-0.22	-0.10	0.01	0.15	1.00										
6. Entry Distance	0.18	0.05	-0.03	-0.29	-0.26	1.00									
7. Firm Age	-0.08	-0.09	-0.03	-0.04	0.65	0.01	1.00								
8. Firm Size	0.09	-0.01	-0.19	-0.03	-0.16	-0.06	-0.15	1.00							
9. Industry Exporting Scale	-0.02	0.01	-0.13	0.05	-0.18	0.11	-0.10	0.20	1.00						
10. Shipments	-0.03	-0.01	0.05	-0.16	-0.11	0.11	0.00	0.00	0.40	1.00					
11. Exporting Values	-0.08	-0.04	-0.09	0.06	0.10	-0.04	0.08	-0.01	-0.01	-0.01	1.00				
12. Entered Countries	-0.13	0.00	0.06	-0.87	-0.19	0.40	0.04	0.04	-0.09	0.05	-0.04	1.00			
13. Subsidiary	-0.10	-0.06	-0.71	0.04	-0.08	0.02	-0.08	0.19	0.15	-0.01	0.09	-0.08	1.00		
14. Industry SIC code	-0.08	0.09	0.55	-0.10	0.06	-0.02	-0.01	-0.12	-0.15	-0.02	0.00	0.10	-0.43	1.00	
15. Private Status	-0.06	-0.07	-0.21	0.04	0.04	-0.04	0.03	-0.06	0.00	-0.06	0.11	-0.10	0.11	-0.15	1.00
Mean	0.65	11.02	0.07	0.38	3.14	20.80	9.15	0.88	23.00	1581.44	101.00	3.49	0.33	5036.00	0.28
Std.Dev.	0.48	6.62	0.01	0.48	1.95	5.57	2.63	4.91	10.00	7454.64	147.00	1.67	0.47	2440.43	0.45
Min	0.00	3.73	0.06	0.00	0.00	0.00	2.00	0.00	0.00	1.00	0.00	1.00	0.00	1720.00	0
Max	1.00	89.75	0.08	1.00	6.00	25.77	13.00	900.00	120.00	16000.00	23800.00	7.00	1.00	9999.00	1

N=1653, Correlations with absolute values no less than 0.12 are significant at the $p < 0.05$ level, values greater than 100 are in thousands.

Real Options Entry and Market Exit (H1 and H4):

Table 3.3 shows logistic regression results with robust standard errors predicting firms' real options entry and market exit outcomes. Both models' statistical fit improves (AIC and BIC decrease, whereas Log-likelihood, LR_χ2, and R^2 increase) when the model becomes more restricted (i.e., when our independent variables are added). Model 1 and Model 2 predict firms' likelihood of choosing real options entry with Model 1 including only the control variables and Model 2 introducing the direct effect of host country uncertainty on real options entry. It shows statistically significant positive coefficient for host country uncertainty ($\beta = 0.36$; $p < 0.001$). This supports hypothesis 1, meaning host country uncertainty positively relates to firms' choice of real options entry over other types of entry. Holding all other conditions constant, a one-unit increase of host country uncertainty (i.e., one standard deviation increase of the unpredictability for host country's institutional and economic conditions) increases the likelihood of a firm choosing real options entry by 36 percent.

Model 3 and Model 4 use discrete logistical models to predict firms' market exit with Model 3 including only the control variables and Model 4 introducing the direct effect of real options entry on market exit outcome. It shows a statistically significant positive coefficient for real options entry choice ($\beta = 1.71$; $p < 0.05$). This supports hypothesis 4, meaning firms' choice of real options entry is positively associated with international market exits over time. Holding other conditions constant, our results suggest that firms that choose real options entry are 71 percent more likely to exit a specific foreign market than those who do not.

Table 3.3
Discrete-Time Logistic Models Predicting Real Options Entry and Market Exit

	Model 1	Model 2	Model 3	Model 4
DVs	Real Options Entry	Real Options Entry	Market Exit	Market Exit
Controls:				
Firm Age	-0.07	-0.10	-0.22	-0.24^{+}
	(0.07)	(0.08)	(0.15)	(0.14)
Firm Size	0.00	-0.00	0.00^{+}	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Industry Exporting Scale	0.00	0.00	0.00*	0.00*
	(0.00)	(0.00)	(0.00)	(0.00)
Shipments	-0.00	-0.00	-0.01*	-0.01*
	(0.00)	(0.00)	(0.00)	(0.00)
Exporting Values	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Entered Countries	-0.23*	-0.22^{+}	-6.10***	-6.35***
	(0.11)	(0.12)	(0.89)	(0.98)
Subsidiary	-2.06*	-1.65^{+}	-0.72	-0.30
	(0.84)	(0.88)	(0.70)	(0.74)
Private Status	-0.07	-0.11	-1.62*	-1.32
	(0.44)	(0.48)	(0.78)	(0.81)
Industry SIC-4 digits	Included	Included	Included	Included
Independent Variables:				
Host Country Uncertainty		0.36***		
		(0.07)		
Real Options Entry				1.71*
				(0.81)
Constant	1.59*	-1.41	17.94***	17.48***
	(0.80)	(1.03)	(2.91)	(2.92)
Model Fit Statistics:				
Log likelihood	-127.30	-109.97	-36.44	-34.04
AIC	314.62	281.95	88.87	86.09
BIC	416.15	386.87	122.84	124.30
LR_χ2	39.45^{+}	74.12***	642.26***	647.04***
Pseudo R2	0.13	0.25	0.89	0.91

N= 1653, Standard errors in parentheses $^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Entry Timing, Entry Distance, and Post-Entry Performance (H2, H3, and H5)

Table 3.4 shows POLS regression results with robust standard errors predicting firms' entry timing (age at entry), entry distance, and post-entry performance (sales growth). All three estimation models' statistical fit improves (AIC and BIC decrease, whereas R2 increases) when the model becomes more restricted (i.e., when our independent variables and interaction term are added). Model 1 and Model 2 predict firm entry timing (age at entry) with Model 1 including only control variables and Model 2 introducing the direct effect of real options entry on entry timing. It shows a statistically significant negative coefficient for real options entry choice ($\beta = -1.10$; $p < 0.001$), meaning firms that choose real options entry have younger (earlier) age at international entry. Thus, hypothesis 2 is supported. From a practical point of view, our results suggest that when holding all other conditions constant, firms that choose real option entry, on average internationalize 1.1 years earlier than those who do not.

Model 3 and Model 4 predict firms' entry distance with Model 3 including only control variables and Model 4 introducing the direct effect of real options entry on entry distance. It shows a statistically significant positive coefficient for real options entry choice ($\beta = 4.69$; $p < 0.001$), meaning firms that choose real options entry entered more distant countries over time. Thus, hypothesis 3 is supported. From a practical perspective, our results suggest that when holding all other conditions constant, firms that choose real option entry, on average entered foreign markets that are 4.69 units further than those who do not in terms of country distance. This can be translated into the changes associated with entering at least one significantly distant country (e.g., U.S. firms entering Burundi instead of United Kingdom) among the set of countries that focal firm entered.

Model 5 and Model 6 predict firms' post-entry performance (sales growth) with Model 5 including only control variables and Model 6 introducing the direct effect of host country

uncertainty and moderating effect of real options entry on post-entry performance. First, the final model 6 shows a statistically significant negative coefficient for host country uncertainty ($\beta = -0.0023$; $p < 0.05$), and it also shows a statistically significant positive coefficient for the interaction term between uncertainty and real options entry ($\beta = 0.00024$; $p < 0.05$). This result indicates that real options entry attenuates the negative effects of host country uncertainty on post-entry performance. To further illustrate the moderating effect of real options entry, we graph the relationships in Figure 3.2, which shows the relationship between host country uncertainty and post-entry performance at two levels of real options entry (i.e., real options entry or not). The margins test in Stata (i.e., margins command in Stata 15) indicated that the simple slope coefficients for real options entry and non-real options entry are significantly different from each other. Notably, the slope for the positive line (i.e., real option entry) is significantly different from zero. As a matter of fact, when entry choice changes from non-real options entry to real options entry, the negative effect of host country uncertainty on post-entry performance flipped and becomes positive. Therefore, hypothesis 5 is supported. From a practical perspective, when the host country uncertainty increases, firms that choose real options entry outperform those who do not by nearly 18 percent of annual sales growth.

Table 3.4
POLS Regression Predicting Age at Entry, Entry Distance, and Performance

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
DVs	Age at Entry	Age at Entry	Entry Distance	Entry Distance	Sales Growth	Sales Growth
Controls:						
Firm Age	0.53***	0.52***	0.03	0.08	-0.00*	-0.00+
	(0.03)	(0.03)	(0.14)	(0.13)	(0.00)	(0.00)
Firm Size	0.00	0.00	0.00***	0.00**	-0.00+	-0.00+
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Exporting Scale	-0.00***	-0.00***	0.00**	0.00**	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Shipments	-0.00***	-0.00***	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Industry Exporting Values	-0.00*	-0.00	-0.00	-0.00*	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Entered Countries	-0.16**	-0.19***	1.71***	1.86***	0.00*	0.00*
	(0.05)	(0.04)	(0.20)	(0.19)	(0.00)	(0.00)
Subsidiary	-0.57+	-0.84**	-0.64	0.53	-0.01***	-0.01***
	(0.31)	(0.29)	(1.31)	(1.23)	(0.00)	(0.00)
Private Status	0.29+	0.25	-0.25	-0.11	-0.00+	-0.00+
	(0.17)	(0.16)	(0.74)	(0.69)	(0.00)	(0.00)
Industry SIC-4 digits	Included	Included	Included	Included	Included	Included
Independent Variables:						
Real Options Entry		-1.10***		4.68***		-0.00
		(0.14)		(0.61)		(0.00)
Host Country Uncertainty						-0.00023*
						(0.00)
Interactions:						
Uncertainty * Real Options Entry						0.00024*
						(0.00)
Constant	-1.85***	-0.62	20.69***	15.42***	0.07***	0.07***
	(0.51)	(0.50)	(2.15)	(2.11)	(0.00)	(0.00)
Model Fit Statistics:						
R^2	0.80	0.83	0.61	0.66	0.87	0.88
AIC	1616.80	1543.05	3111.31	3037.53	-3700.04	-3701.28
BIC	2228.24	2158.74	3722.75	3653.22	-3129.03	-3117.86

N= 1653, Standard errors in parentheses + p < 0.10, * p < 0.05, ** p < 0.01, *** p < 0.001

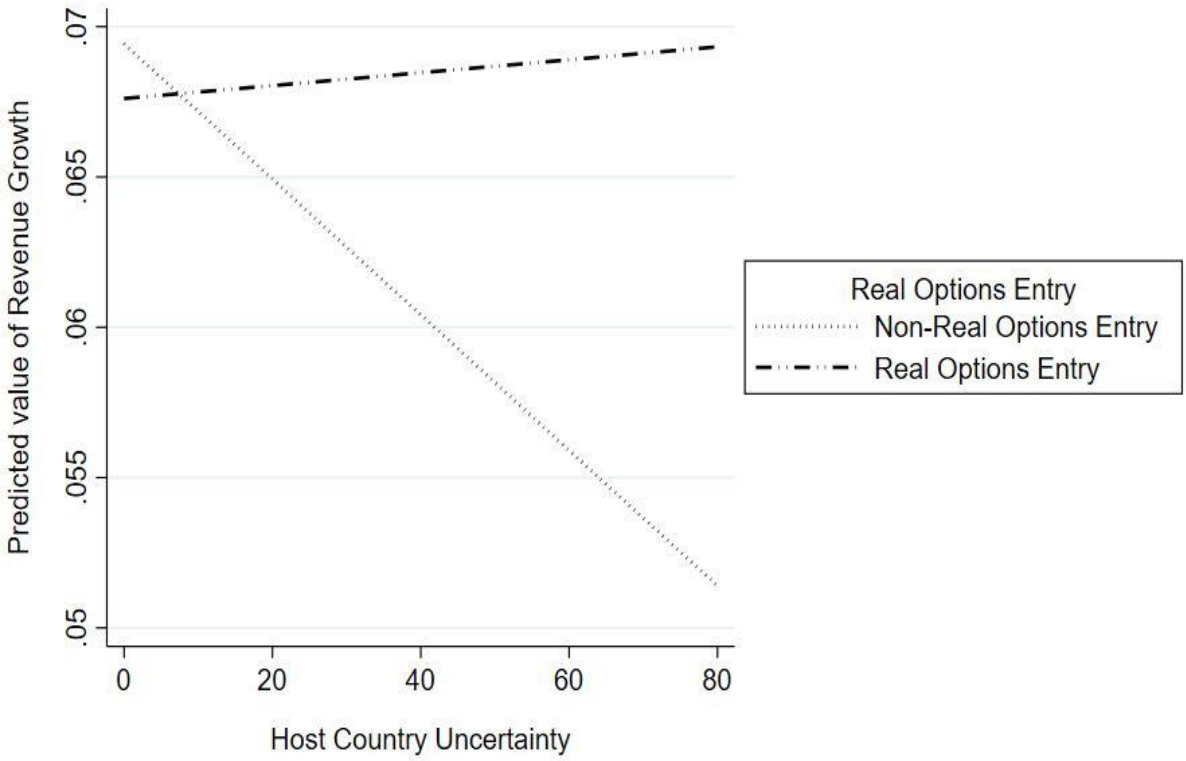

Figure 3.2: Interaction between Real Options Entry and Host Country Uncertainty

Robustness and Post Hoc Analysis

To ensure our results are robust to model specifications and measurement errors, we performed a series of post hoc analyses by altering the estimation models, measures for key variables of interest, and the sampling frame. First, as described above, we used 2SLS models with one identified instrumental variable: *State's International Dependency* and performed tests to ensure the validity of the identified instrument. The results are consistent with our primary analysis with slightly smaller effect sizes. This is not surprising given adding additional instrument variables makes the models more restrictive.

Second, we also ran several other robustness tests related to variable measurements. For example, we changed our dependent variable post-entry performance from total sales growth to international sales growth, we substituted entry distance with the traditional Euclidean approach that only captured dyadic cultural distances based on Hofstede's four measures of culture dimensions, and we separately estimated the effects of host country institutional uncertainty and economic uncertainty. Each of these tests yielded results consistent with our original analyses and indicate our results are robust to measurement alterations.

Third, we conducted further post hoc analysis to test for potential mediating and moderating relationships among the key variables. For example, we tested the mediating role of real options entry in the relationship between host country uncertainty and internationalization pattern (i.e., entry speed, entry distance, market exits). We found no full or partial mediations for entry speed or market exits, but we found partial mediation for entry distance. This hints that future work can further examine indirect relationships among the related variables.

Lastly, although 6 years of firm age at initial international entry is the most widely accepted sampling frame for new firms, some related studies also sampled firms that internationalized within 3 years of founding or 10 years of founding to characterize entrepreneurial internationalization, thus, we restricted and expanded our sampling frame to include both cases. Results are consistent with our primary results.[1] In sum, through these robustness and post hoc analyses, we ensured that our results are robust to model specifications, measurement, and sampling alternations.

Discussion

Our study examines entrepreneurial firms' internationalization patterns, processes, and outcomes from the ROT perspective. It advances research on firms' internationalization by answering the fundamental question of how does host country uncertainty influences firms' internationalization process, patterns, and outcomes regarding entry mode, entry timing, entry location, market exits, and post-entry outcome. By doing so, it addresses critical theoretical and empirical issues in the literature and makes important contributions to internationalization, real options, international entrepreneurship literature.

Implications for Internationalization

We contribute to internationalization literature by introducing ROT as a new theoretical explanation for the role of host country uncertainty in firms' internationalization. Specifically, by theorizing and testing that firms actively leverage host country uncertainty via their choice of real options entry, our paper alters extant thinking on the role of uncertainty in the process of internationalization. Prior internationalization researchers view host country uncertainty as a

[1] The results from all the robustness tests are available from the authors upon request.

roadblock to internationalization and suggest a reactive role of the firm in the face of high host country uncertainty such as delaying or avoiding entry, entering a less distant country, being locked into specific markets, and suffering a performance downturn as results of increased host country uncertainty. In our study, we argue that firms must engage in decision making under uncertainty and that they can take on a proactive role of actively leveraging host country uncertainty in order to seize emerging opportunities through the faster entry, entering more distant countries, have the strategic flexibility of exiting the market, and effectively mitigating a performance downturn as results of increased host country uncertainty. We propose real options entry offers a way to achieve superior post-entry performance in the face of high and changing host country uncertainty. By offering ROT as a way for firms to leverage uncertainty, we enhance the theoretical foundation of the internationalization literature particularly regarding entrepreneurial firms' internationalization that is often being criticized for lack of theory development (Jones et al., 2011; Reuber et al., 2018). We do so by explicitly treating host country exogenous uncertainty as the determinant of firms' choice of real options entry. Second, we account for the dynamic nature of uncertainty and proposes the conditions under which uncertainty can be leveraged rather than being avoided. Lastly, we provide a nuanced understanding of the influence of real options entry on firms' internationalization patterns in terms of entry timing, entry location, and market exit over time.

Moreover, our study resolves the prior inconsistency between prior internationalization theory and findings. Specifically, we discovered that in contrast to prior research on MNEs' internationalization that emphasizes a more reactive, conservative, and internalized internationalization strategy, our findings emphasize a more proactive, aggressive, and collaborative internationalization strategy. This is consistent with the nature of entrepreneurial

internationalization as opportunity-seeking in cross broader contexts (Oviatt & McDougall, 2005a). As a result, we establish additional boundary conditions between internationalization of MNEs and entrepreneurial firms, with the former emphasizing on the conservative and internalized internationalization and the latter aligning with the ROT that predicting more proactive and collaborative internationalization in the presence of high and changing host country uncertainty.

Last, we make important contributions to internationalization literature on entry mode choice and entry location. First, our study advances prior theories concerned with the antecedents and outcomes of firms' choice of foreign entry mode and entry location. In contract to prior internationalization research that predicts firms' entry mode and location choice in the face of endogenous uncertainty, our study suggests that ROT offers strong theoretical explanations for firms' entry mode and location choice in the face of exogenous uncertainty. This adds more theoretical precision to the literature. Moreover, we add to the ongoing conversation on ROT in international business research (Chi et al., 2019; Sears, 2019) by further unpacking the performance implications of internationalization. In particular, we account for the role of exogenous uncertainty (Ipsmiller et al., 2019) in internationalization and offer the condition under which firms can achieve better post international entry performance in the face of changing host country uncertainty

Implications for Real Options Theory

We also contribute to Real Options Theory (ROT) in three important ways. First, our study provides additional boundary conditions for ROT by theorizing and testing what specifically leads to superior performance in the presence of uncertainty. We conceptualize 'real options entry' as low initial investment combined with high collaboration and suggest that such entry allows for flexible resource reallocation (i.e., market exit) which enables firms to hedge and leverage host

country uncertainty and achieve superior performance. We demonstrate that the real options features of the low initial investment and collaborative international entry include securing access to potential growth opportunities while containing downside losses in the face of high and changing host country uncertainty. Notably, we acknowledge that there has been an ongoing debate on the boundaries of ROT since Adner and Levinthal (2004) first raised the questions about ROT's applicability, particularly under two conditions: endogenous uncertainty and path-dependent learning. Our study adds more precision to ROT's applicability by defining and testing host country exogenous uncertainty and suggesting the combination of initial investment, local collaboration, and resource reallocation as real options that distinguish ROT from other theoretical explanations (Klingebiel & Adner, 2015).

Moreover, we extend the applicability of ROT by linking it with the internationalization literature, particularly in the context of entrepreneurial firms' internationalization. Our findings suggest that the nature of entrepreneurial internationalization (i.e., an opportunity-seeking process in cross border context (Oviatt & McDougall, 2005; Reuber et al., 2018) aligns well with ROT's argument on active uncertainty management or leveraging. Besides benefiting internationalization literature by introducing a new theoretical perspective, our study also informs ROT by applying a new context (i.e., internationalization) and establishing additional boundary conditions of ROT being firms' aggressive, proactive, collaborative, and uncertainty-leveraging internationalization strategy. This further distinguishes ROT from other theoretical perspectives that predicting firms' conservative, reactive, internalized, and uncertainty avoidance internationalization strategy.

Importantly, we demonstrate the theoretical relevance and importance of ROT by proving the existence and performance implications of ROT in the context of entrepreneurial firms' internationalization. Specifically, our findings suggest that entrepreneurial firms do adopt the real

options entry characterized as low initial investment and collaborative entry mode in the face of high host country uncertainty. Such real options entry enables entrepreneurial firms to initiate market entry faster, enter more distant markets, and exit markets with more flexibility despite high host country uncertainty. Firms employing real options entry can achieve superior post-entry performance in the face of high uncertainty. This further demonstrates ROT as a relevant and robust theoretical perspective to explain entrepreneurial firms' internationalization patterns and outcomes.

Implications for International Entrepreneurship

We also contribute to the international entrepreneurship literature (IE) by ventures beyond the timing aspect of entrepreneurial internationalization, which has been a central tenet of early work in IE (Cavusgil & Knight, 2015; Knight, 1996; McDougall & Oviatt, 2000; Oviatt & McDougall, 2005). Instead, we holistically examine the evolution of entrepreneurial firms' internationalization regarding entry timing, entry location, entry modes, market exit, and post-entry performance during and after initial entry. Especially, by looking beyond the initial entry, our study provides a more nuanced understanding of the dynamic nature of entrepreneurial internationalization. This broadens the scope of entrepreneurial internationalization which has been recently called for to advance IE research (Reuber et al., 2018). In addition, we apply ROT and propose the conditions under which uncertainty can be leveraged rather than being avoided. This offers a strong theoretical foundation for entrepreneurial firms' internationalization in the face of high host country uncertainty and addresses the questions of how entrepreneurial firms evolve over time as uncertainty changes.

Implications for Practice

From the performance perspective, by looking at how real options entry can maximize post international entry performance, our study further unpacks the practical implications of entrepreneurial firms' internationalization, especially in today's high-uncertainty global market. In particular, our findings suggest that entrepreneurial firms are not powerless in the face of high host country uncertainty. Notably, prior theories argue that firms often have to delay or abandon the plan to pursue international opportunities in highly uncertain host countries (often causing missed opportunity and type I error). However, we suggest that firms can strategically keep their initial investment low but engage using local collaborations to secure access to future growth opportunities. Such 'real options entry' can significantly mitigate the potential negative performance influence of host country institutional and economic uncertainty. Indeed, our study indicates that when host country uncertainty is high, firms that choose real options entry outperform those do not by nearly 18 percent in terms of post-entry sales growth. For an average-sized firm in our sample with annual revenue of 10 million USD, this reflects a difference of 1.8 million USD. For many young and entrepreneurial firms, this difference matters for both short term sustainable growth and long-term survivability.

Limitations and Future Research

Our study is not without limitations and future studies can build upon those to further our understanding of uncertainty, ROT, and firms' entrepreneurial internationalization. First, our study only examined a single home country with the U.S. as the main study context. We acknowledge that the effects of home country institutional and cultural heterogeneity (Lu et al., 2014; Marano, Arregle, Hitt, Spadafora, & van Essen, 2016) on post-entry performance are quite salient. Due to research design and data limitations, we were only able to examine the U.S. as the main home

country context. We strongly encourage further studies to explore multiple home country contexts and further unpack its effect on entrepreneurial internationalization processes and patterns (Deng & Sinkovics, 2018).

Second, the performance implications of firms' entrepreneurial internationalization are multifaceted. Our study only examined post-entry performance in terms of growth. Future studies should look at additional performance outcomes such as firm survival and sustainability.

Lastly, we measured host country exogenous uncertainty as institutional and economic uncertainty. Future studies can further define and test additional dimensions of host country uncertainty, for example, uncertainty from different sources (i.e., cultural, industry, or competitor). In sum, our hope is that this is the pioneering study that informs and invites more scholars to examine and connect entrepreneurial internationalization with ROT.

Conclusion

Host country uncertainty plays a major role in firms' entrepreneurial internationalization process and outcome. As a complement to transaction cost economics and other theories in the IB and IE literature, ROT offers new theoretical insights on firms' entrepreneurial internationalization patterns and outcomes under high and changing levels of host country uncertainty. Entrepreneurial firms can employ real options entry to navigate highly uncertain foreign markets and achieve superior post-entry performance.

CHAPTER IV. LEVERAGING THE UNKNOWN: A REAL OPTIONS REASONING PERSPECTIVE ON THE ROLE OF UNCERTAINTY IN ENTREPRENEURS' INTERNATIONALIZATION DECISION MAKING

Abstract

Uncertainty plays an essential role in both entrepreneurial and internationalization decision-making processes. International entrepreneurs often face greater levels and varieties of uncertainty when making foreign market entry decisions. Yet, existing Entrepreneurship and International Entrepreneurship (IE) literature lack theoretical explanations on the role of uncertainty in entrepreneurs' internationalization decision-making. Although both literatures treat uncertainty as precursor to entrepreneurial activities, in general, they view uncertainty as the roadblock for substantial entrepreneurial commitment such as entrepreneurial internationalization. This does not adequately account for the fact that international entrepreneurs constantly face uncertainty and, thus, they often must embrace uncertainties rather than avoid or ignore them. By applying real options reasoning (ROR), we re-examine the role of uncertainty in entrepreneurs' internationalization decision-making process and propose an uncertainty leveraging perspective. We employed a 2 by 2 randomized between and within-subjects mixed design experiment on a representative sample of 181 U.S. international entrepreneurs. The findings suggest that entrepreneurs routinely align their thinking with ROR to leverage changing levels of uncertainty by strategically bundling levels of investment commitment and local relationship development. This work contributes to entrepreneurship literature on uncertainty and further unpacks the micro-foundations and establishes the boundary conditions of ROR.

Introduction

Uncertainty underpins entrepreneurial decision making (Douglas & Shepherd, 2000; Kirzner, 1979; Knight, 1921; Schumpeter, 1934) because entrepreneurship requires judgment about action based on the evaluation of uncertainty (McMullen & Shepherd, 2006). This evaluation involves an individual's perception of the amount of uncertainty and one's willingness to bear the

uncertainty required to take entrepreneurial action (McMullen & Shepherd, 2006). Individuals' knowledge and experience influence their perceived amount of uncertainty which, in turn, affect whether to act entrepreneurially or not (Kirzner, 1979; Knight, 1921). Willingness to bear uncertainty is determined by individual characteristics (i.e., motivation, attitude, risk propensity), and the degree of willingness to bear uncertainty determines whether entrepreneurs act upon certain opportunities (Douglas & Shepherd, 2000; Knight, 1921; Schumpeter, 1934). Specifically, theories on entrepreneurial action explain that uncertainty takes the form of doubt that prevents action by undermining prospective actors' beliefs on feasibility and desirability of the opportunity (Dean & McMullen, 2007; Simon & Shrader, 2012; Wood, Williams, & Drover, 2017).

Uncertainty is also a central premise in decisions to internationalize because decision making in cross border contexts is often accompanied by uncertainty due to liabilities of foreignness (i.e., the cost of being foreign) (Zaheer, 1995; Oviatt & McDougall, 1994), outsidership (i.e., the cost of being an outsider) (Johanson & Vahlne, 1977, 1990, 2009), and newness (i.e., the cost of being new or inexperienced) (Freeman, Carroll, & Hannan, 1983; Singh, Tucker, & House, 1986). Specifically, the internationalization process model (Uppsala Model) delineates an incremental internationalization process that managers use in order to mitigate high foreign market uncertainty by taking an incremental approach. The most recent development of the model highlights the central, yet often forgotten piece of the theory: management under uncertainty (Vahlne et al., 2017). In response to this gap, empirical studies have started to emphasize the approaches decision-makers take towards the management of uncertainty when internationalizing (Aharoni, Tihanyi, & Connelly, 2011; Cuervo-Cazurra et al., 2017; Liesch et al., 2011; Nielsen & Nielsen, 2011; Perks & Hughes, 2008).

However, despite recent advances in understanding the role of uncertainty in entrepreneurship (McKelvie et al., 2011) and internationalization (Cuervo-Cazurra et al., 2017; Liesch et al., 2011) decision making, our understanding of the role of uncertainty in entrepreneurs' internationalization decision-making remains incomplete. Specifically, existing international entrepreneurship (IE) literature has not systematically examined changes in uncertainty over time, nor the manner in which uncertainty influences entrepreneurs' internationalization decisions. In addition, prior studies overlooked the fact that international entrepreneurs often must embrace or even leverage uncertainties rather than avoid uncertainty in the cross-border context (Liesch et al., 2011; McGrath, 1999; Rhee & Cheng, 2002). Lastly, the field of IE still lacks strong theoretical explanations of how international entrepreneurs perceive host country uncertainty and how such perceptions influence foreign market entry decisions.

Therefore, the purpose of our study is to develop and test an uncertainty leveraging perspective by applying Real Options Reasoning (ROR) to entrepreneurs' internationalization decision making. ROR provides a perspective on leveraging uncertainty by limiting exposure to the downside losses while preserving options to capture future attractive opportunities, thus avoiding missed opportunities (McGrath, 1997; 1999; 2004; McGrath & MacMillan, 2000). ROR provides decision-makers with a robust and coherent way to leverage uncertainty and offers superior decision outcomes (McGrath & MacMillan, 2000b). For example, in the face of high uncertainty, ROR offers a "stepping stone," or staged investment process. This stepping stone approach allows decision-makers to wait and see how uncertainty changes while also providing an option to increase investment or commitment should uncertainty decrease. (McGrath, 1999; McGrath et al., 2004; McGrath & MacMillan, 2000b). Specifically, this paper looks at if and how entrepreneurs align their thinking with ROR to leverage uncertainty during the internationalization

decision making process. In doing so, it answers the question of *whether and in what fashion entrepreneurs apply real options reasoning (ROR) to leverage host country uncertainty in internationalization decision making?*

By answering this question, this paper makes several important contributions. First, it examines the role of uncertainty in the entrepreneurial internationalization decision making process by applying ROR as an alternative way to view uncertainty in both the entrepreneurship and IE literature. Specifically, this paper empirically tests the dynamic nature of the uncertainty construct and how it influences entrepreneurs' internationalization decisions. Moreover, since research on individual-level real options decision making is still in its infancy (McGrath et al., 2004; Posen et al., 2017; Trigeorgis & Reuer, 2017), by applying ROR to examine entrepreneurs' internationalization decision making, this paper further enhances the micro-foundations of ROR. This is our response to recent calls for more real options studies at the strategic decision-making level (Chi et al., 2019; Ipsmiller et al., 2019; Trigeorgis & Reuer, 2017). Lastly, it contributes to ROR first by proving that international entrepreneurs do align their thinking with ROR in the face of changing uncertainty when making internationalization decisions. Second by theorizing and testing real options as international entrepreneurs' strategic bundling of low initial commitment, local relations development, and reallocation of resources as levels of uncertainty changes over time which further distinguishes ROR from other decision-making logics and clarifies the boundary conditions for ROR as the unique strategic bundling of those actions in the face of changing uncertainty (Klingebiel & Adner, 2015).

Theory and Hypothesis

Giving the role of uncertainty is less understood in entrepreneurial internationalization decision making and the promise of ROR in terms of providing meaningful theoretical insights, we first discuss the theory of ROR and how it relates to uncertainty.

ROR and Uncertainty

ROR is one type of logic with which decision-makers often can align their thinking in order to position investments and allocate assets that maximize learning and gain access to upside opportunities while containing potential costs and downside risk (McGrath, 1997, 1999; McGrath & MacMillan, 2000a, b). It relies on the assumption that because managers or firms differ in their tolerance of market uncertainty, taking real options can reduce information asymmetry through securing the option that maximizes learning and gives firms the ability to choose outcomes only if it is favorable in the near future (McGrath, 1997). Although there have been discussions on the boundaries and use of ROR (see Adner & Levinthal, 2004; McGrath, 2004), the proponents of ROR suggested that ROR provides a robust and alternative way of leveraging highly uncertain situations and offers firms a pathway to superior performance. Better performance is achieved when decision-makers pursue opportunities that appear to have significant upside potential in a manner that contains downside losses (McGrath & MacMillan, 2000a). Specifically, ROR emphasizes on the notions of a “stepping stone” approach (McGrath & MacMillan, 2000a) and an “affordable losses” mindset (McGrath & Nerkar 2004; Hunt & Yue, 2015). ROR has been widely applied to explain firms’ investment decisions on R&D, technology, and innovation (Gunther McGrath & Nerkar, 2004; MacMillan et al., 2006; McGrath et al., 2004; McGrath & MacMillan, 2000a).

Similarly, ROR has also been applied in entrepreneurship to re-conceptualize the role of entrepreneurial failure and entrepreneurial opportunity pursuit in the context of uncertainty (Ireland et al., 2003; Lee, Peng, & Barney, 2007; Li, 2008; McGrath, 1997; McGrath & MacMillan, 2000b; O'Brien, Folta, & Johnson, 2003). Specifically, McGrath (1999) proposed a real options perspective on entrepreneurial failure that views entrepreneurial actions as entrepreneurial options. The greater level of uncertainty, the greater value/profits can be obtained by taking entrepreneurial actions. In other words, entrepreneurial values or profits can be achieved when entrepreneurs act upon highly uncertain opportunities that are being perceived as unfeasibility or undesirable by others. ROR suggests a positive side to entrepreneurial failure because it serves as a precursor to entrepreneurial actions and the cost of failure can be contained by taking the ROR approach. As a result, entrepreneurs should not avoid uncertainty but rather leverage uncertainty by taking a real option that allows them to limit exposure to the downside while maintaining access to future attractive opportunities. ROR contrasts with the anti-failure and anti-uncertainty mindset that could lead entrepreneurs to avoid action due to high degree of uncertainty and fear over failure.

In general, ROR suggests that the nature of uncertainty plays a critical role in determining the value of any real options (Dixit & Pindyck, 1994; Lin & Wu, 2004; McGrath & MacMillan, 2000b). For example, in the context of determining technology investments, the uncertainty regarding net revenue and cost can increase anticipated variances of the investment outcome which determine the value of a real options investment (i.e., higher variances equal higher possible values). ROR also differentiates the source of uncertainty (i.e., exogenous vs endogenous) and suggests different influences on choosing options (Li, 2008; Sears, 2019). In general, ROR argues that greater uncertainty induces greater performance heterogeneity, thus the greater the attractiveness and value of making an options investment, contingent on firms' ability to contain

the possible downside losses (MacMillan et al., 2006; McGrath, 1997; McGrath & MacMillan, 2000a). In sum, uncertainty underpins the assumptions and application of ROR, and both entrepreneurship and international business scholars have started to further theorize and unpack the role of uncertainty in decision-makers' real options reasoning process (Chi et al., 2019; Ipsmiller et al., 2018; Janney & Dess, 2004; Li, 2008; Sears, 2019; Trigeorgis & Reuer, 2017).

Real Options Reasoning and International Entrepreneurship

Consistent with prevailing scholarship, international entrepreneurship (IE) is most widely defined as "the discovery, enactment, evaluation, and exploitation of opportunities-across national borders-to create future goods and services" (Oviatt & McDougall, 2005a: 7). The field of IE, at the intersection of international business (IB) and entrepreneurship (McDougall & Oviatt, 2000; Oviatt & McDougall, 1994; Oviatt & McDougall, 2005b), studies the process of entrepreneurial internationalization, having integrated IB theories on internationalization process with entrepreneurship theories on opportunity processes (Reuber et al., 2017; Schweizer et al., 2010; Zahra, 2005; Zahra & George, 2002; Zahra et al., 2005). At the center of both internationalization and opportunity process theories lies the construct of uncertainty (Johanson & Vahlne, 1977; McKelvie et al., 2011; McMullen & Shepherd, 2006).

Uncertainty is a central construct in international business literature and is, therefore, integral to the process of entrepreneurial internationalization because typically international firms operate in a constantly changing, unstable, unknown, and unpredictable market environments, and strategic decision-makers often have to make choices based on incomplete and unknowable information (Hitt et al., 2006; Hitt et al., 1997; Johanson & Vahlne, 1977, 1990; Zahra et al., 2000). The Uppsala internationalization process model (U-Model) relies on two assumptions – the ubiquity of uncertainty and the inescapable reality of boundedly rational decision-makers – in its

characterization of an internationalization process in which firms gain market knowledge by learning from prior experience of foreign operations. This critical process determines the next level of firm-level market commitment, which in turn prompts new learning (Johanson & Vahlne, 1977, 1990).

Proponents of the U-model have over time extended the theory to include business network relationships and account for the role of insidership and firms' liability of outsidership in the internationalization process (Johanson & Vahlne, 2003, 2009). In particular, the liability of outsidership refers to the cost of doing business due to lack of relevant network positions or simply being an "outsider" to a business network (Johanson & Vahlne, 2009). Both the original and now extended U-model has been used to explain firms' initial preference for low commitment entry modes to minimize uncertainty (Vahlne & Johanson, 2013). However, the internationalization process theory does not account for unique managerial and technological capabilities that can enable a more rapid internationalization process (Oviatt & McDougall, 1994; Oviatt & McDougall, 2005a). Therefore, the IE literature complemented the U-model by suggesting that certain firms, such as international new ventures possess unique organizational capabilities and can and do internationalize earlier in their lifecycle than the U-model predicted (Knight & Cavusgil, 2004; McDougall & Oviatt, 2000; Oviatt & McDougall, 1994; Sapienza et al., 2006; Yan & Williams, 2020).

Despite the importance of the uncertainty construct in the U-model, specific attentiveness to the uncertainty management piece of the theory remains underdeveloped in the literature. Researchers either take a transaction cost approach (Coase, 1937; Masten et al., 1991; Williamson, 1981) or an entrepreneurial action approach (McMullen & Shepherd, 2006) to argue that managers often take either an uncertainty avoidance or uncertainty reduction view for internationalization

decision making (Brouthers et al., 2003; Rugman & Verbeke, 2005; Zhao et al., 2004) -- that is, U-model theorists have traditionally viewed uncertainty as an aversive state that entrepreneurs find to be deleterious to the business venturing process. However, more recent developments of the U-model have called for the re-conceptualization of management under uncertainty (Vahlne et al., 2017). We argue that ROR offers decision-makers an alternative decision-making framework that emphasizes leveraging real options to navigate through highly uncertain internationalization situations. This is especially pertinent to the entrepreneurial internationalization decision-making process that involves a high degree of uncertainty in cross border opportunity pursuit (Oviatt & McDougall, 2005a; Reuber et al., 2017).

Initial Uncertainty Conditions and ROR

According to ROR, the degree of uncertainty plays a major role in determining the value of the real options. In general, the greater the uncertainty, the greater the attractiveness of making an options investment, contingent upon the firms' ability to contain the possible downside losses. More interestingly, ROR becomes more attractive when the firm can approach it through sequential development so that the cost incurred in one stage does not affect the development of the next stage (Gunther McGrath & Nerkar, 2004; MacMillan et al., 2006; McGrath, 1997, 1999; McGrath et al., 2004). Similarly, in entrepreneurial internationalization, entrepreneurs often perceive a high degree of host country uncertainty originating from cross country distances (Berry et al., 2010; Evans & Mavondo, 2002; Gooris & Peeters, 2014; O'grady & Lane, 1996) and dynamic market conditions (Cuervo-Cazurra, Maloney, & Manrakhan, 2007; Liesch et al., 2011; Perks & Hughes, 2008).

In line with these arguments, we posit that the perceived degree of host country uncertainty positively affects the attractiveness of the real options reasoning (ROR) approach during

entrepreneurs' initial internationalization decision-making process. High perceived uncertainty drives entrepreneurs to align their thinking with ROR to make decisions on foreign market entry in order to maximize learning, reduce information asymmetry, and gain access to future growth opportunities. Because the nature of real options is keeping initial investment low while securing the options for future opportunities through collaborations, we argue that ROR is reflected in entrepreneurs' decisions to keep initial investment low (Klingebiel & Adner, 2015) both in terms of financial and nonfinancial investment while simultaneously investing in local relationships/linkages (Chen et al., 2004) or Guanxi (Hwang, Golemon, Chen, Wang, & Hung, 2009; Yeung & Tung, 1996). In particular, when perceiving a high degree of uncertainty, entrepreneurs can contain the potential downside losses by keeping the initial financial and nonfinancial investment low. This reflects the notion of taking on "affordable losses" (Dew, Sarasathy, Read, & Wiltbank, 2009; Hunt & Song, 2015; Townsend, Hunt, McMullen, & Sarasvathy, 2018b). More important, by investing in local relationships/linkages or "Guanxi", entrepreneurs secure exclusive access to potential future favorable opportunities that otherwise would not be available to them. Moreover, entrepreneurs also need to maximize learning and gain a foothold in the market by investing in developing local relationships/linkages to provide current and future access to the market. Thus:

> ***Hypothesis 1a:*** *When entrepreneurs initially perceive a high degree of host country uncertainty, they are more likely to align their thinking with ROR by keeping initial financial investment low.*
>
> ***Hypothesis 1b:*** *When entrepreneurs initially perceive a high degree of host country uncertainty, they are more likely to align their thinking with ROR by keeping initial non-financial investment low.*
>
> ***Hypothesis 1c:*** *When entrepreneurs initially perceive a high degree of host country uncertainty, they are more likely to align their thinking with ROR by investing in local relationships/linkages.*

Besides configuring and bundling investments in financial, non-financial, and local relationships/linkages, entrepreneurs might also align their thinking with ROR by choosing specific types of commitment modes. In particular, when perceiving high host country uncertainty, entrepreneurs can choose modes (i.e., joint venture, alliances) that involve high degree of local relationships/linkages than other modes (i.e., wholly-owned subsidiary, direct exporting). This will ensure that potential downside losses can be contained by sharing costs and responsibility with local relationship partners which also provides potential access to future growth opportunities. Indeed, prior work shows that host country demand uncertainty is positively associated with firms' use of collaborative entry modes (i.e., joint venture and alliances) (Brouthers, Brouthers, & Werner, 2008). Thus:

> ***Hypothesis 1d:*** *When entrepreneurs initially perceive a high degree of host country uncertainty, they are more likely to align their thinking with ROR by choosing modes with a higher degree of local collaboration.*

Lastly, entrepreneurs align their thinking with ROR by opting to defer entry when encountering high-uncertainty situations (Reuer & Tong, 2007; Sears, 2019). In particular, entrepreneurs can delay their entry timing by choosing a later entry rather than early entry. This "wait and see" approach allows them to further explore other potential options and reduce information asymmetry before making substantial commitments to an uncertain market. Thus, we hypothesize:

> ***Hypothesis 1e:*** *When entrepreneurs initially perceive a high level of host country uncertainty, they are more likely to choose a later entry timing than those who perceived a low level of host country uncertainty.*

Changing Uncertainty and ROR

Uncertainty is a dynamic construct that changes over time, often quite suddenly and quite radically (McKelvie et al., 2011; Milliken, 1987; Podolny, 1994). ROR emphasizes the role of uncertainty not only at the time of an initial decision but also at future points in time (MacMillan et al., 2006; McGrath, 1997; McGrath et al., 2004). ROR thus differs from other decision logics, such as transaction cost economics, in offering decision-makers the strategic flexibility to adjust investment levels and strategies when uncertainty conditions change over time, especially in cross border decisions (Brouthers et al., 2008; Chi et al., 2019; Li, 2007). In particular, ROR emphasizes leveraging the changing degree of uncertainty over time, thereby allowing decision-makers to adjust their investment levels and to exercise options in order to maximize gains and minimize potential losses (Bowman & Moskowitz, 2001; Ipsmiller et al., 2018; MacMillan et al., 2006; McGrath, 1997; Trigeorgis & Reuer, 2017). In the context of entrepreneurial internationalization, we argue that when the degree of perceived host country uncertainty increases over time, ROR provides decision makers the flexibility to decrease both their financial and non-financial investment levels in order to mitigate potential downside losses.

However, in order to maintain future preferential access to opportunities, when perceived uncertainty increases over time, decision-makers should try to increase their development of local relationships and collaborations. This is because local relationships can enhance knowledge sharing and learning among collaborative parities, which leads to reduced information asymmetry, thereby granting entrepreneurs preferential access to future markets. In other words, increasing perceived host country uncertainty will drive entrepreneurs to rely more on local relationships and collaborations. Similar to the increasing commitment to local relationships, entrepreneurs might also switch their commitment modes to those that involve higher levels of local collaboration so

that potential downside losses can be mitigated and responsibility can be shared among collaborating partners.

In summary, increased perceived uncertainty over time drives decision-makers to exercise "put" options by reducing both financial and non-financial investment while increasing levels of collaboration and switching to high collaborative entry mode in order to reduce information asymmetry and minimize potential downside losses. Thus, we hypothesis:

> ***Hypothesis 2a:*** *When perceived host country uncertainty increases from time 1 to time 2, entrepreneurs are more likely to decrease financial investment.*
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> ***Hypothesis 2b:*** *When perceived host country uncertainty increases from time 1 to time 2, entrepreneurs are more likely to decrease non-financial investment.*
>
> ***Hypothesis 2c:*** *When perceived host country uncertainty increases from time 1 to time 2, entrepreneurs are more likely to increase local collaboration.*
>
> ***Hypothesis 2d:*** *When perceived host country uncertainty increases from time 1 to time 2, entrepreneurs are more likely to switch to modes with a higher degree of local collaboration.*

ROR also provides decision-makers the flexibility to further explore potential attractive opportunities when perceived uncertainty decreases. This reflects the notion that the value of options is to provide future choices or preferential access to upside potential (Bowman & Hurry, 1993) The attractiveness of growth options (Cao, Simin, & Zhao, 2006; Tong et al., 2008) drives decision-makers to further bet on the improved situation by adjusting their investment levels and strategies. In particular, we argue that when the degree of perceived uncertainty decreases over time, which presents better growth options due to improved market prospects and reduced information uncertainty, decision-makers would further increase both financial and nonfinancial investment in order to further tap into potential upside growth or exercise the "call" options. In other words, they leverage the situation by exercising the preferential accesses that they have obtained previously in time 1 and increase both financial and nonfinancial investment.

However, decreased perceived uncertainty in the host country also makes collaboration with local partners unnecessary and even obsolete. Maintaining the same levels of commitment to collaboration can be costly and redundant in this situation. Prior studies have shown that the establishment and maintenance of deep collaborations with host country local partners can be resource-demanding (Dussauge & Garrette, 1995) and expose entrepreneurial firms to potential opportunism (Lu & Beamish, 2006). Thus, when perceived host country uncertainty decreases, entrepreneurs should decrease their engagement in local collaborations and switch to entry modes that involve a lower degree of local collaboration in order to reduce the cost of maintaining the relationship.

In summary, when entrepreneurs perceive that uncertainty decreases in the host country, they tend to exercise "call" options by doubling down on both financial and non-financial resources while reducing levels of collaboration and switching to modes that involve a lower degree of local collaboration in order to maximize potential upside gains. Thus, we hypothesize:

> ***Hypothesis 3a:*** *When perceived host country uncertainty decreases from time 1 to time 2, entrepreneurs are more likely to increase financial investment.*
>
> ***Hypothesis 3b:*** *When perceived host country uncertainty decreases from time 1 to time 2, entrepreneurs are more likely to increase nonfinancial investment.*
>
> ***Hypothesis 3c:*** *When perceived host country uncertainty decreases from time 1 to time 2, entrepreneurs are more likely to decrease local collaboration.*
>
> ***Hypothesis 3d:*** *When perceived host country uncertainty decreases from time 1 to time 2, entrepreneurs are more likely to switch to modes with a lower degree of local collaboration.*

ROR and Market Exit

If entrepreneurs align their thinking with ROR during the internationalization decision-making process, decisions should entail more than just increases or decreases in investment and

collaboration. Decisions to exit are also a function of the perceived degree of uncertainty by entrepreneurs during both the initial and subsequent decision-making process.

As previously argued, the defining nature of aligning with ROR is that it provides strategic flexibility for decision-makers. This includes the option to exit the market when perceived uncertainty increases (Trigeorgis & Reuer, 2017). In her response to Adner and Levinthal's (2004) comment on ROR, McGrath (2004) suggested that the distinctive feature of a real option is that it allows for preferable access to future opportunities, and it provides strategic flexibility for future investment adjustment. Specifically, one of the advantages of aligning with ROR is that prior investment decisions do not substantially influence following each phase of investment (i.e., low investment irreversibility) (Chi et al., 2019; Ipsmiller et al., 2019). In other words, entrepreneurs who align their thinking with ROR are not "locked into" any specific foreign markets, and they have more flexibility of exiting. Therefore, we believe that when entrepreneurs perceive uncertainty increases at time 2, they exercise the option to exit in order to minimize potential downside losses. Thus, we hypothesize:

> ***Hypothesis 4:*** *When perceived host country uncertainty increases at time 2, entrepreneurs are more likely to exit the market.*

ROR and Growth Options

Decision-makers who align their thinking with ROR can seek further growth options as uncertainty changes. Specifically, growth options pertain to valuable choices to further expand under favorable uncertainty conditions (Cao et al., 2006; Tong et al., 2008). Myers's (1997) original theorizing on real options suggested that firms' discretionary future investment actions are growth options in nature, or "call options on real assets". Such options provide firms the flexibility to decide whether or not they want to exercise the option to undertake these investments

in “real assets” contingent upon uncertainty conditions (Myers, 1977). Indeed, empirical studies have shown that uncertainty changes can lead firms to switch to more internalized governance structures in order to capture potential growth option value (Folta, 1998; Folta & Miller, 2002; Kogut, 1991; Reuer & Tong, 2007; Tong et al., 2008).

In the context of entrepreneurial internationalization decision making, we suggest that when entrepreneurs perceive that host country uncertainty decreases at time 2, the attractiveness of the opportunity increases. Specifically, the improved host country uncertainty situation at time 2 increases the prospects of growth potential, decreases information asymmetry, and improves overall market conditions, all of which make it more likely for entrepreneurs to seek potential growth options in the market and drive them to increase commitment to the market in order to capture potential upside gains. Thus, we hypothesize that:

> ***Hypothesis 5:*** *When perceived host country uncertainty decreases at time 2, entrepreneurs are more likely to seek growth options.*

The general main effects and hypotheses are shown in figure 4.1 below.

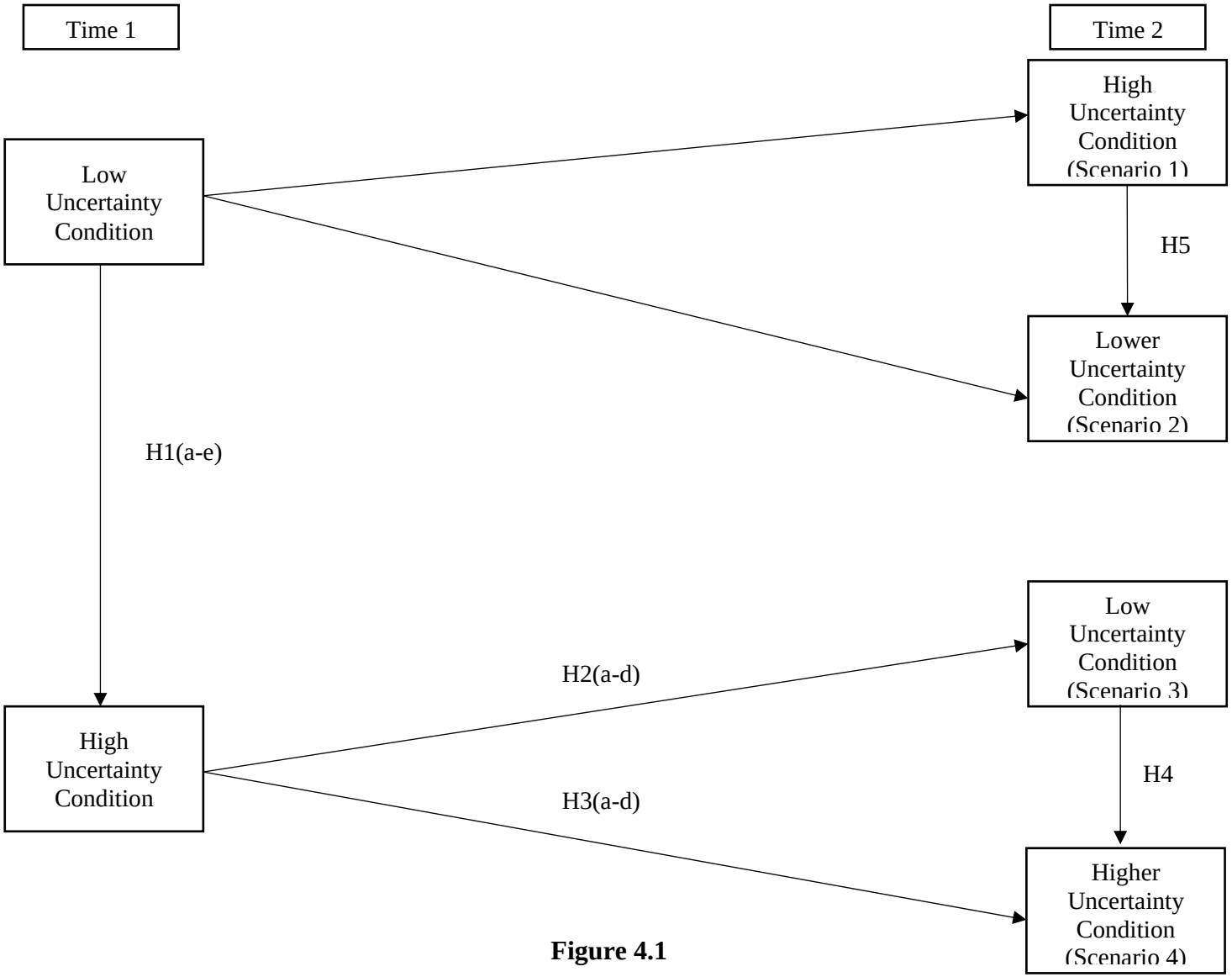

Figure 4.1

Theoretical Model and Hypotheses

Method

Multi-Stage Experimental Research Design

As the foregoing discussion reveals, ROR-based internationalization decisions require entrepreneurs to assess host country exogenous uncertainty in a continually evolving, Bayesian fashion and then respond accordingly. In this sense, our hypotheses inherently involve the investigation of unobservable judgments. This raises several design issues for which we have employed varied measures to substantively mitigate.

First, research involving nascent stage phenomena such as international market entry is particularly subject to selection issues (Heckman, 1979) since it is the initially successful entrants who primarily remain visible. This is related to the survival bias due to the data's left side truncation issue (Hunt & Lerner, 2017; Yang & Aldrich, 2012). Designs using only the existing international entrants in a typical industry would pre-select only the successful ones. Another design consideration is that cleanly capturing the effect of host country uncertainty on foreign market entry decisions in a field setting is clouded by endogeneity and omitted variable problems related to other factors in host country opportunities, decision-maker individual differences, and cross-national differences.

Perhaps the most important consideration in the design is that the process of ROR is typically unobservable, thus prior studies have mainly relied on measuring the outcomes of ROR rather than the reasoning processes (Brouthers et al., 2008; MacMillan et al., 2006; McGrath et al., 2004; McGrath & MacMillan, 2000a). All in all, conventional survey designs would be threatened by retrospective bias, and by common method bias. The single-stage conjoint analysis could overcome these issues and provide information on initial decisions that may be consistent with real

options reasoning but would not allow for understanding how such decisions change over time, as uncertainty varies.

To overcome these various confounds and provide a precise causal test of the theorized effects of real options reasoning, we utilize a 2 by 2 mixed between and within-subject multi-stage experiment (Williams, Wood, Mitchell, & Urbig, 2019). As summarized in figure 4.1, we begin by randomly assigning subjects to a low or high initial uncertainty condition at Time 1 (T1). This represents the initial between-subjects aspect of our design. All subjects then evaluate their opportunity again at Time 2 (T2). This within-subject portion of the experiment involves the following conditions, to which subjects are randomly assigned: low_{T1} to $high_{T2}$; low_{T1} to $lower_{T2}$; $high_{T1}$ to low_{T2}; $high_{T1}$ to $higher_{T2}$. The result of pairing the between- and within-subjects design described thus far is a series of additional, randomized and manipulated between-subject comparisons: $high_{T1}$-low_{T2} vs $high_{T1}$-$higher_{T2}$; low_{T1}-$high_{T2}$ vs low_{T1}-$lower_{T2}$. Data related to our dependent variables were collected after each scenario as part of the decisions that subjects were asked to make after viewing the opportunity scenario. A post-experiment questionnaire collected information on individual subjects and their firms. This design was modeled on prior entrepreneurship research using experimental designs where subjects evaluated more than one scenario (Grégoire & Shepherd, 2012; Lerner, 2016) and made sequential decisions (Wood, Williams, & Drover, 2017). Notably, the temporal design is very prudent since the essence of real options reasoning is about decision making under changing degrees of uncertainty across time (Ipsmiller et al., 2018; McGrath, 1997; Reuer & Tong, 2007). Further detail on the research design is described in Table 4.1.

Table 4.1
Experiment Research Design

Design Steps	Descriptions
1. Cover page/placebo stimuli 0:	A brief explanation and contextualization of the task. The presentation of a general scenario of the market opportunity in the host country.
2. Data collection part 0	One question regarding factors affecting subjects' decision to enter the host country.
3. Study stimuli 1	Manipulation via a description of host country uncertainty in Time 1 with random assignment to low or high condition (see Time 1 column in figure 4.1).
4. Data collection part 1	Questions regarding subjects' evaluation of initial investment and collaboration levels, entry mode, and entry timing (dependent variables).
5. Distractor questions	Questions designed to provide a time lag between initial manipulation (uncertainty level at time 1) and subsequent manipulation (uncertainty level at time 2).
6. Study stimuli 2	Manipulation via a description of the host country uncertainty in Time 2 with random assignment to one of four Time 2 conditions (see Time 2 column in figure 4.1).
Notes	For the group that was assigned to the low condition in Time 1, half were randomly assigned to a high uncertainty condition in Time 2; the other half were assigned to a "lower" uncertainty condition in Time 2. For the group that was assigned to the high condition in Time 1, half were randomly assigned to a low uncertainty condition in Time 2; the other half were assigned to a "higher" uncertainty condition in Time 2.
7. Data collection part 2a-d	Questions regarding subjects' evaluation of sequential investment and collaboration levels, entry mode, propensity for exit, and perception of growth options (dependent variables).

Sample and Data Collection

Pre-testing. Before the main data collection effort, the research stimuli, experimental design, and survey instruments went through multiple rounds of pretesting with upper-level undergraduate business students enrolled in either entrepreneurship or international business courses at a major public research university in the U.S. A majority of student subjects were seniors, with remainder juniors. The student subjects were not paid nor graded based on their participation/responses. They had no incentive to respond one way or another and simply received participation credit for completing the research instrument. Through these pretesting efforts, we were able to ensure the reliability and effectiveness of manipulation, survey instruments, and randomization design.

Main study sample. Consistent with general experimental research: the study received university (IRB) approval. The target population was entrepreneurs whose businesses have engaged in cross-border activities, and the participant must be a key decision-maker for the internationalization efforts of the firm. The final sample comprised of 181 U.S. independent business founders/operators across 52 industries (as represented by four-digit SIC codes). This multiple industry design allows for potential heterogeneity in the sample and limits threats to external validity that might be present if we studied only a single industry. Sixty percent of the sample is male with a mean age of 35 years and full-time working experience of 10 years. A majority of them have operated multiple businesses during their entrepreneurial career. Regarding international business experience, the sample averages 3.5 years working abroad, and on average, they had worked in 5 different countries. In sum, the final sample is comprised of entrepreneurs with significant entrepreneurial experience, consisting of prior responsibility making important

foreign market entry decisions for their firms, and whose businesses are engaged in intensive international business activities. Data was collected via a Qualtrics Panel.

Attention/knowledge check and screening. To account for potential careless responding and screen out unqualified respondents (Tourangeau, Rips, & Rasinski, 2000), we designed multiple attention and knowledge checks throughout the survey including three commonsense questions and two international business-specific knowledge test questions. Responses were dropped if either test was failed. We also carefully analyzed responses to several open-ended questions which asked participants to explain the logic behind their decisions. This analysis ensured that participants were carefully considering the decisions they were asked to make.

Temporal and placebo design. Because our experimental design involves decision-makers making sequential decisions (i.e., time 1 and time 2), we designed several distraction questions to create a lag between the two time points. Such a design mitigates the potential spillover/carryover effects between decision-making time points (Hsu, Simmons, & Wieland, 2017; Williams et al., 2019). Also, to immerse participants into the decision-making context, we designed a "placebo" mechanism at the beginning of the experiment where all participants were presented with an introductory scenario of foreign market opportunity and then asked to complete a simple decision task. This design allows participants to engage with the decision-making context before we begin manipulating the degree of country uncertainty.

Measures

Dependent variable. To capture the outcomes of ROR, we employ five 7-point Likert scale questions, involving the level of financial and nonfinancial investment, the extent that decision-makers rely on local collaborations/relationships, the type of entry mode, and speed of

entry timing at initial decision time (T1). In addition to those measures, we capture the propensity of exit and perceived growth options at a subsequent decision time (T2). Table 4.2 provided details on instruments and measures for DVs.

Table 4.2
Summary of Dependent Variable Operationalization (Survey Items)

Dependent Variables	Summary of items (on 7-point Likert type scales except when noted)
Levels of financial investment	How many financial resources would you invest in this market?
Extent of reliance on local collaborations	To what degree would you rely on local relationships to navigate in this market?
Levels of non-financial investment	How much time, effort, and energy would you invest in this market?
Type of entry mode	What entry mode would you use to enter this market? (1. Wholly-Owned Subsidiary, 2. Exporting, 3. Online Platform 4. Licensing/Franchising 5. Merger or Acquisition 6. Strategic Alliance (no equity commitment) 7. Joint Venture (equity commitment)
Speed of entry timing	How quickly would you enter this market?
Propensity to exit	How likely would you exit the market?
Perception of growth option (potential)	To what degree do you believe that there is future growth potential in this market?

Independent variable as the experimental factor. The independent variable is the perceived uncertainty level manipulated at two-time points (i.e., time 1 and time 2). Consistent with prior literature on exogenous uncertainty and state uncertainty (McKelvie et al., 2011; Milliken, 1987; Townsend et al., 2018a), we captured the degree of host country uncertainty as the unpredictability of host country product/service demand as well as the unpredictability of general changes in bilateral trade relationship, technological and cultural environment, and demographic shifts. Table 4.3 provides the details of our uncertainty manipulation.

Table 4.3 **Summary of Key Differences (Manipulation) and Similarities Between Stimuli (Host Country Uncertainty/Opportunities)**	
Common conditions at Time 0 (Placebo scenario)	
Country A/B is an open market economy with trade and economic collaboration with your home country. Over the years, the demand for your products and/or services in Country A/B has increased steadily and the level of local competition is manageable. There are some cultural and economic differences between Country A/B and your home country. You observed that some of your direct competitors have started to enter Country A/B. Although you are waiting for more information, Country A/B is under consideration for your firm's next international expansion.	
High Uncertainty Condition at Time 1	**–Low Uncertainty Condition at Time 1**
In particular, according to reliable sources, the demand for your product and/or service in Country A is relatively unpredictable. In addition, general changes in the bilateral trade relationship (i.e., tariff and non-tariff barriers), technological and cultural environment, and demographic shifts are also relatively unpredictable.	*In particular, according to reliable sources, the demand for your product and/or service in Country B is relatively predictable. In addition, general changes in the bilateral trade relationship (i.e., tariff and non-tariff barriers), technological and cultural environment, and demographic shifts are also relatively predictable.*
Low Uncertainty Condition at Time 2	**–High Uncertainty Condition at Time 2**
Since your initial decision, some conditions in Country A have changed. Just recently, reliable sources have indicated that the demand for your product and/or service in Country A has become relatively predictable. In addition, general changes in the bilateral trade relationship (i.e., tariff and nontrade barriers), technological and cultural environment, and demographic shifts have become relatively predictable as well.	*Since your initial decision, some conditions in Country B have changed. Just recently, reliable sources have indicated that the demand for your product and/or service in Country B has become relatively unpredictable. In addition, general changes in the bilateral trade relationship (i.e., tariff and nontrade barriers), technological and cultural environment, and demographic shifts have become relatively unpredictable as well.*
Higher Uncertainty Condition at Time 2	**–Lower Uncertainty Condition at Time 2**
Since your initial decision, some conditions in Country A have changed. Just recently, reliable sources have indicated that the demand for your product and/or service in Country A has become completely unpredictable. In addition, general changes in the bilateral trade relationship (i.e., tariff and nontrade barriers), technological and cultural environment, and demographic shifts have become completely unpredictable as well.	*Since your initial decision, some conditions in Country B have changed. Just recently, reliable sources have indicated that the demand for your product and/or service in Country B has become completely predictable. In addition, general changes in the bilateral trade relationship (i.e., tariff and nontrade barriers), technological and cultural environment, and demographic shifts have become completely predictable as well.*
Equivalent information across conditions:	
Market economy condition; General bilateral trade relationship; General host country demand; Levels of local competitions; Competitive environment and actions	

Manipulation Check

It is crucial to test and ensure that the uncertainty descriptions are effective in terms of establishing the focal explanatory variable (i.e., international entrepreneurs' different perceptions of foreign market uncertainty). In addition to the pre-testing described above, Table 4.4 provides paired t-tests results on group mean comparisons across different uncertainty conditions of the main study sample. It confirms that the stimuli yielded two distinctive uncertainty conditions at time 1 and four distinctive uncertainty conditions at time 2. In particular, at time 1, the host country of the high uncertainty condition was seen significantly higher in uncertainty than the low uncertainty condition (Paired t-test means 4.82 > 4.35, $t_{1, 179} = 2.18$, $p < 0.01$; repeated measure GLM; $F_{1, 179} = 4.95$, $p < 0.01$). At time 2, the low uncertainty condition was seen significantly lower in uncertainty than higher uncertainty condition (t-tests means 4.60 < 5.30, $t_{2, 87} = -2.22$, $p < 0.05$). At time 2, the high uncertainty condition (Country B1) was seen significantly higher in uncertainty than lower uncertainty condition (Country B2) (t-tests means 5.08 > 3.72, $t_{2, 90} = 3.89$, $p<0.001$).

Table 4.4
Manipulation Test for Experimental Stimuli (Uncertainty Conditions)

Decision Time	Means of Uncertainty Conditions (High/Low & Higher/Lower)		*t*-statistics	Comparison Type
T1	High	Low		
	4.82	4.35	2.18**	Between subject
	(1.32)	(1.52)		
T2	Low	Higher		
	4.60	5.31	-2.22*	Between Subject
	(1.50)	(1.48)		
T2	High	Lower		
	5.08	3.72	3.89***	Between Subject
	(1.47)	(1.86)		
T1 → T2	High	Low		
	5.05	4.6	2.29*	Within Subject
	(1.04)	(1.49)		
T1 → T2	High[2]	Higher		
	4.63	5.31	-3.13**	Within Subject
	(1.50)	(1.49)		
T1 → T2	Low	High		
	4.46	5.08	-2.72**	Within Subject
	(1.47)	(1.47)		
T1 → T2	Low	Lower		
	4.25	3.72	2.69**	Within Subject
	(1.59)	(1.86)		

Note: Standard errors in parentheses, + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

[2] The difference between the Time 1 High conditions (Low, Higher; 5.05, 4.63) is not significant ($t = 1.50$, $p = 0.14$). Similarly, the difference between T1 Low conditions (High, Lower: 4.46, 4.25) is not significant ($t = 0.65$, $p = 0.52$).

We also find significant differences in perceived host country uncertainty for within-subject comparisons from time 1 to time 2: from the high uncertainty condition to the low uncertainty condition (Paired t-test means 5.05 > 4.6, $t_{1, 39}$=2.29, p<0.05), from the high uncertainty condition to the higher uncertainty condition (Paired t-test means 4.63 < 5.31, $t_{1, 49}$=-3.13, p<0.01), from low uncertainty condition to the high uncertainty condition (Paired t-test means 4.46 < 5.08, $t_{1, 47}$ =-2.72, p<0.01), and from the low uncertainty condition to the higher uncertainty condition (Paired t-test means 4.25 > 3.72, $t_{1, 43}$ = 2.69, p<0.01). Also, based on the 1 to 7 scoring scale of our manipulation check question, those values (e.g., 5.05 > 4.6, 4.63 < 5.31) show that the experimental stimuli were not extreme characterizations of uncertainty. In sum, the manipulation test results were significant and the research stimuli (uncertainty conditions) were perceived in the directions as intended, which allow for straightforward tests of our hypothesized relationships.

Individual and Firm Differences

The randomization design of the experiment should eliminate any threat posed by subjects' individual characteristics (e.g., age, education, experience) or firm-level factors (e.g., firm size, firm age, firm industry) and provides better generalization across types of entrepreneurs. However, in order to perform tests on potential direct and indirect effects of individual characteristics and check the effectiveness of randomization design, we captured a number of important firm and individual characteristics related to our study. At the firm level, we include *firm age (number of years since firm founding), firm size* (the number of full-time employees), *industry* (represent by 4 digit SIC code), *international scope* (the number of countries where the firm operates), i*nternational intensity* (the percentage of international revenue to total revenue), *international entry time* (the difference in years between founding year and the firm's first international entry year), and *performance* (measured by 7 items-self-reported about their firm's performance

compared with competitors) (Covin, Prescott, & Slevin, 1990; Gupta & Govindarajan, 1986; Simsek & Heavey, 2011).

At the individual level, we capture entrepreneurs' demographic information including *age*, *education*, and *gender*. We also measure entrepreneurs' general experience including the number of *business owned*, years of *full-time working experience*, and whether they received *finance training* (such as training might relate to real options reasoning). Moreover, to account for decision-makers' individual characteristics that might influence the decision making process and outcomes, we measure *decision power* as the extent to which the entrepreneur is responsible for major decisions for internationalization of the firm, *uncertainty tolerance* measured by 4 items asking individual attitude toward uncertainty (Greco & Roger, 2001), *risk propensity* measured as 7 items asking individual propensity toward risk, also known as general risk propensity scale (Zhang, Highhouse, & Nye, 2019). Specific to our study context, entrepreneurs' international experience might affect internationalization decision making, thus we capture two indicators of an entrepreneur's international experience. The first measure *international work experience* relates directly to an individual's exposure to foreign market environments and asks whether the entrepreneur ever worked outside the U.S in their professional career, and if so, how many years (Filatotchev, Liu, Buck, & Wright, 2009). The second measure *countries worked* taps into the scope of international exposure and ask about in how many foreign countries entrepreneur has worked (Reuber & Fischer, 1997). The descriptive statistics and correlations among variables are shown in Table 4.5.

Table 4.5
Descriptive Statistics and Correlations

Variables	1	2	3	4	5	6	7	8	9	10
1.Firm age	1.00									
2.Firm size	0.06	1.00								
3.International scope	0.13	-0.06	1.00							
4. International intensity	0.13	0.07	0.26	1.00						
5. International entry time	0.82	0.16	0.02	0.04	1.00					
6. Decision power	-0.12	-0.04	-0.05	0.06	-0.08	1.00				
7. Performance compare	0.17	0.14	0.15	0.44	0.06	0.30	1.00			
8. Uncertainty tolerance	0.03	-0.07	0.23	0.12	-0.13	0.14	0.21	1.00		
9. Risk propensity	-0.04	-0.07	0.15	0.33	-0.12	0.22	0.47	0.48	1.00	
10. Entrepreneur age	0.22	-0.07	0.17	0.07	0.06	0.22	0.02	0.07	0.02	1.00
11. Entrepreneur gender	-0.10	-0.07	0.20	0.03	-0.12	0.08	-0.11	0.01	-0.17	0.11
12. Business owned	0.37	0.07	-0.01	0.18	0.21	0.21	0.37	0.01	0.24	0.20
13. Full time work experience	0.14	-0.07	0.16	-0.16	0.03	0.12	-0.07	0.18	0.02	0.51
14. Education	-0.05	-0.23	0.16	0.10	-0.07	0.03	-0.08	0.06	0.08	0.12
15. Intl work experience	0.33	-0.05	0.20	0.29	0.12	0.13	0.37	0.17	0.19	0.27
16. Country worked	0.24	-0.01	0.37	0.33	0.08	0.01	0.20	0.11	0.11	0.26
17. Finance training	0.02	-0.04	-0.14	-0.19	0.04	-0.18	-0.15	-0.06	-0.14	-0.03
18. Industry (SIC4)	-0.12	0.09	-0.06	0.01	-0.04	0.02	0.02	0.14	-0.14	-0.04
Mean	15.66	6470	4.65	4.71	8.31	4.27	28.21	17.43	40.54	3.71
Std. Dev	11.22	7452	2.76	1.73	9.27	0.87	4.42	4.26	10.30	0.97
Min	1.00	2.00	1.00	1.00	0.00	2.00	15.00	6.00	10.00	2.00
Max	67.00	10^6	17.00	11.00	52.00	5.00	35.00	28.00	56.00	6.00

Table 4.5 (Continued)
Descriptive Statistics and Correlations

Variables	11	12	13	14	15	16	17	18
11. Entrepreneur gender	1.00							
12. Business owned	-0.20	1.00						
13. Full time work experience	0.02	0.16	1.00					
14. Education	0.08	-0.11	-0.01	1.00				
15. Intl work experience	0.01	0.36	0.33	-0.02	1.00			
16. Country worked	-0.01	0.22	0.09	0.08	0.44	1.00		
17. Finance training	0.05	-0.03	-0.02	-0.03	-0.27	-0.19	1.00	
18. Industry (SIC4)	0.17	-0.08	-0.11	0.04	-0.05	0.03	0.00	1.00
Mean	1.39	2.47	4.71	7.73	3.56	2.07	1.14	1424
Std. Dev	0.50	0.66	1.03	1.52	1.31	0.57	0.35	23.75
Min	1.00	2.00	2.00	4.00	1.00	1.00	1.00	1388
Max	3.00	5.00	7.00	10.00	7.00	4.00	2.00	1473

N=181

Analytical Methods

We first employed a paired t-tests approach to test our main hypotheses. This approach has been widely adopted by experimental research since between/within-subject conditions comparison offers straightforward and precise tests given the randomized design of the experiment (Colquitt, 2008; Lerner, 2016). We then reconstructed our data and used General Linear Modeling (GLM) with repeated measures analysis to test the effects of focal research stimuli (i.e., uncertainty conditions) on our key dependent variables. Lastly, we employed a Structural Equation Modeling (SEM) approach - Structured Mean Model (SMM) - for a robustness analysis that accounted for variances among variables across groups and the effect of manipulation on measurement (Breitsohl, 2019). It replicates the tests from GLM and further validates the effects of focal research stimuli.

Results

Group Mean Comparison, t-tests and Hypothesis Testing

Table 4.6 presents means, standard deviations, and t-test statistics for our dependent variables according to different host country uncertainty conditions at two decision times (T1 and T2). For convenience, the table also lists related hypothesis number and name of dependent variables.

Table 4.6
Variable Means, Standard Deviations, and t-tests for Hypothesis Testing

Hypothesis	Decision Time	Means (by uncertainty conditions: High/Low & Higher/Lower)		*t*-statistics	Comparison Type
H1a Financial investment	T1	High	Low		
		4.34 (1.51)	4.80 (1.41)	-2.15*	Between subject
H1b Nonfinancial investment	T1	High	Low		
		4.84 (1.46)	5.43 (1.27)	-2.91**	Between subject
H1c Collaboration	T1	High	Low		
		5.48 (0.68)	4.98 (1.13)	3.57***	Between subject
H1d Entry mode	T1	High	Low		
		4.10 (1.71)	3.40 (1.43)	2.98**	Between subject
H1e Entry timing	T1	High	Low		
		3.75 (1.54)	3.00 (1.28)	3.57***	Between subject
H2a Finance investment	T1→T2	Low	High		
		4.24 (1.51)	3.10 (1.90)	5.72***	Within subject
H2b Nonfinancial investment	T1→T2	Low	High		
		4.82 (1.44)	3.39 (1.94)	5.99***	Within subject
H2c Collaboration	T1→T2	Low	High		
		5.02 (1.42)	3.63 (1.95)	6.05***	Within subject
H2d Entry mode	T1→T2	Low	High		
		3.85 (1.80)	3.65 (1.56)	0.80	Within subject

Table 4.6(continued)
Variable Means, Standard Deviations, and t-tests for Hypothesis Testing

Hypothesis	Decision Time	Means (by uncertainty conditions: High/Low & Higher/Lower)		*t*-statistics	Comparison Type
H3a Financial investment	T1→T2	High	Low		
		4.45	4.23	0.90	Within subject
		(1.53)	(1.40)		
H3b Nonfinancial investment	T1→T2	High	Low		
		4.88	4.68	0.74	Within subject
		(1.51)	(1.54)		
H3c Collaboration	T1→T2	High	Low		
		5.45	4.89	2.97**	Within subject
		(1.00)	(1.33)		
H3d Entry mode	T1→T2	High	Low		
		4.35	3.55	2.35*	Within subject
		(1.89)	(1.87)		
H4 Market Exit	T2	Low	Higher		
		3.68	4.32	-2.32*	Between subject
		(1.29)	(1.34)		
H5 Growth Option	T2	Higher	Low		
		3.63	4.88	3.70***	Between subject
		(1.72)	(1.38)		

Note: Standard errors in parentheses, + $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Initial uncertainty condition and ROR (H1a, H1b, H1c, H1d, H1e). At time 1, the results suggest that higher perceived host country uncertainty leads to entrepreneurs' lower initial financial investment (paired t-tests means 4.34 < 4.80, $t_{1, 179} = -2.15$, $p < 0.05$) and lower initial nonfinancial investment (paired t-tests means 4.84 < 5.43, $t_{1, 179} = -2.91$, $p < 0.01$) This supports hypothesis 1a and hypothesis 1b. In addition, higher perceived host country uncertainty results in entrepreneurs' higher engagement with local relationships/collaborations (paired t-tests means 5.48 > 4.98, $t_{1, 179} = -3.57$, $p < 0.001$) and to choose an entry mode that involves a high degree of local collaboration (paired t-tests means 4.10 > 3.40, $t_{1, 179} = 2.98$, $p < 0.01$). These results support hypothesis 1c and 1d. Finally, supporting hypothesis 1e, the results show that higher perceived host country uncertainty leads to entrepreneurs taking a longer time to initiate foreign entry (paired t-tests means 3.75 > 3.00, $t_{1, 179} = 3.57$, $p < 0.001$).

Sequential uncertainty increases and ROR (H2a, H2b, H2c, H2d). We now examine what happens as perceived uncertainty increases from T1 to T2. The results show that entrepreneurs decrease financial (paired t-tests means 4.24 > 3.10, $t_{1, 48} = 5.72$, $p < 0.001$) and nonfinancial investment (paired t-tests means 4.82 > 3.39, $t_{1, 48} = 5.99$, $p < 0.001$). This provides support for hypothesis 2a and hypothesis 2b. However, the results also show that entrepreneurs decrease their engagement with local relationships/collaborations (paired t-tests means 5.02 > 3.63, $t_{1, 48} = 6.05$, $p < 0.001$) which is the opposite of what we have predicted. Thus, hypothesis 2c is not supported. Lastly, the study finds no statistically significant differences between groups for entry mode choice ($t_{1, 48} = 0.80$, $p<0.1$); thus, hypothesis 2d is not supported. This merit some interesting theoretical and empirical implications for which we provide detailed explanations in the Discussion session.

Sequential uncertainty decreases and ROR (H3a, H3b, H3c, H3d). We next examine what happens as perceived uncertainty decreases from T1 to T2. The results show no statistically

significant differences between groups for financial ($t_{1, 39}$ = 0.90, p<0.1) and nonfinancial investment ($t_{1, 39}$ = 0.74, p<0.1). Thus, we found no support for hypothesis 3a and hypothesis 3b. However, the results also show that as perceived uncertainty decreases from T1 to T2, entrepreneurs decrease their engagement with local collaboration (paired t-tests means 5.45 > 4.89, $t_{1, 39}$ = 2.97, p< 0.01) which support hypothesis 3c. Lastly, the study found that as uncertainty decreases over time, entrepreneurs switch to entry modes that involves a lower degree of local collaboration (paired t-tests means 4.35 > 3.55, $t_{1, 39}$ = 2.35, p< 0.05), thus, hypothesis 3d is supported. This merit some interesting theoretical and empirical implications for which we provide detailed explanations in the discussion session.

ROR and Market Exit (H4). At time 2, the results suggest that as perceived uncertainty *increases*, entrepreneurs are more likely to exit the market (t-tests means 3.68 < 4.32, $t_{2, 87}$= -2.32, p< 0.05). This provides support for hypothesis 4.

ROR and Growth Option (H5). On the other hand, at time 2, the results suggest that as perceived uncertainty *decreases* in the host country, they are more likely to perceive growth options (t-tests means 3.63 < 4.88, $t_{2, 87}$= 3.70, p< 0.001). Thus, hypothesis 5 is supported.

Tests of Uncertainty Effects with Repeated Measures GLM.

To further test the robustness of the above results and to assess the potential effect sizes accounting for repeated measures for dependent variables, we employ General Linear Modeling with repeated measures analysis. Table 4.7 presents the results of the GLM analysis. In particular, we found similar and highly significant effects (all F >3, p<0.01) except for the effect on entry mode choice (hypothesis 2d) which shows a marginal significant effect (p<0.1) in contrast to no support found for this hypothesis in the paired t-test. In addition, all the effects of perceived host

country uncertainty on DVs are large and substantial with partial eta squared statistics greater than 0.50. These large effects provide strong support for our hypotheses and indicate that our research stimuli (i.e. the degree of uncertainty) play a statistically significant role in entrepreneurs' internationalization decision making.

Table 4.7
Results of General Linear Modeling (GLM) with Repeated Measures Analysis

Independent Variable	Dependent Variables	Type III sum of squares	df	Mean square	F	Significance(*p*)	Partial eta squared
Uncertainty Conditions	Financial Investment	99.74	3	33.24	8.26	<0.0001	0.69
	Nonfinancial Investment	99.52	3	33.17	9.16	<0.0001	0.58
	Collaboration	37.16	3	12.38	3.38	<0.01	0.56
	Entry Mode	2.89	3	0.97	0.19	<0.1	0.51
	Entry Timing	108.91	3	36.30	9.70	<0.0001	0.95
	Market Exit	61.35	3	20.45	3.65	<0.01	0.95
	Growth Option	149.62	3	49.87	10.24	<0.0001	
Error	Financial Investment	154.71	177	0.87			
	Nonfinancial Investment	210.55	177	1.19			
	Collaboration	203.47	177	1.15			
	Entry Mode	294.09	177	1.66			
	Entry Timing	663.47	177	3.75			
	Market Exit	992.47	177	5.61			
	Growth Option	862.24	177	4.87			

Subject Individual Differences: Potential Direct Effects and Moderation.

When considering the individual differences in study subjects, the randomized design should eliminate the threat posed by subjects' individual differences and provide better generalization across types of individuals. An ANOVA analysis on the four randomized groups found no significant differences across groups in terms of entrepreneurs' individual differences including age, gender, education, work experience, entrepreneurial experiences, international experiences, risk propensity, uncertainty avoidance, and decision-making power (all $p>0.1$). Results of Levene's tests (all $p>0.1$) confirmed equal variances of those variables across randomized groups. The same results (all $p> 0.1$) hold for firm-level characteristics including firm age, firm size, international scope, and intensity and firm performance. In sum, those results confirmed the effectiveness of the randomization design.

Nevertheless, we conducted the additional analysis using multiple regression and multilevel mixed-effect models to test for potential direct or indirect effects of entrepreneurs' individual differences on internationalization decision outcomes (i.e., our study's DVs). We found no direct or indirect effects of entrepreneurs' age, gender, education, decision-making power, entrepreneurial experience, international working experience, the country of employment, and uncertainty avoidance on financial and nonfinancial investment (all $p>0.1$). However, significant effects were found for entrepreneurs' risk propensity on financial investment ($\beta= 0.15$ $p<0.001$), and it moderated the relationship between perceived host country uncertainty and financial investment ($\beta= 0.016$ $p<0.01$) by attenuating the main effects of hypotheses 1a, 2a, and 3a, which test the effect of uncertainty on financial investment. This suggests that entrepreneurs' risk propensity does play a role in how host country uncertainty is being perceived and the decisions on financial investment and may explain the non-significance of H3a.

Further Robustness Analysis Using SEM.

In order to account for variances among key DVs across groups, measurement error, and potential dysfunction of manipulation in any specific groups (Breitsohl, 2019), we conducted additional robustness analysis using a Structural Equation Modeling (SEM) approach with Structured Mean Models (SMM). The robustness analysis replicated the results from GLM and indicates that four assigned groups significantly differ in their latent means on the DV (f_{-total}= 13.72, $p<0.001$). This confirmed that our research stimuli (i.e., uncertainty conditions) have significant effects on our DVs.

Discussion

Theoretical Contributions

By theorizing and testing the role of uncertainty in entrepreneurial internationalization decision making, this paper makes several important theoretical contributions to entrepreneurship theory, international entrepreneurship literature, and real options literature.

Uncertainty and Entrepreneurship Theory

Prior entrepreneurship theory such as the entrepreneurial action literature (McKelvie et al., 2011; McMullen & Sheperd, 2006; Townsend et al., 2018; Wood et al., 2012) treats uncertainty as a roadblock to substantial entrepreneurial endeavors, for example, entrepreneurial internationalization. This casts the entrepreneur as either a heroic figure overcoming uncertainty or the need for entrepreneurs to reduce or manage uncertainty which takes a “reactive” approach to uncertainty (Butler et al., 2010; McMullen & Shepherd, 2006; Townsend et al., 2018a). This paper complements prior entrepreneurship theory on uncertainty by proposing an alternative view of uncertainty; one where uncertainty is not explicitly aversive and can be leveraged through the

lens of ROR (McGrath, 1999; McGrath & MacMillan, 2000b). This reflects a "proactive" approach to uncertainty. Specifically, our findings suggest that, in the face of highly uncertain situations, entrepreneurs can align their thinking with ROR by leveraging the degree of uncertainty besides simply managing or reducing it. This proactive view further advances our understanding of the uncertainty construct in general entrepreneurship theory and opens new research avenue to unpack the relationship between uncertainty and entrepreneurial actions. Specifically, our findings suggest that the dynamic nature of uncertainty influence entrepreneurs' decision making. In other words, uncertainty is not a static and uniform construct, and future research should further explore how changing degree of perceived uncertainty over time can affect entrepreneurial actions and how different sources of uncertainty (e.g., exogenous vs. endogenous) play a role in entrepreneurial decision making.

Uncertainty and International Entrepreneurship

Specific to the field of IE, the process of entrepreneurial internationalization is coupled with assorted types of uncertainty and degrees of variance (Bingham, 2009; Butler et al., 2010; Liesch et al., 2011; McDougall & Oviatt, 1996). Yet, the prior IE literature still lacks theoretical explanations on the role of uncertainty in entrepreneurs' internationalization decision-making. Specifically, IE scholars have overlooked both types of uncertainty and dynamic changes of uncertainty in entrepreneurs' internationalization decision making. Also, IE literature has been criticized for its lack of distinctive theorizing and clear boundary conditions (Jones, Covielle, & Tang, 2011; Verbeke & Ciravegna, 2018). As a direct answer to those concerns, our paper introduces the ROR perspective to further unpack the role of uncertainty in entrepreneurial internationalization decision making. Specifically, we theorize and test specific types of uncertainty - perceived host country exogenous uncertainty - and the dynamic changes of

uncertainty influencing entrepreneurs' internationalization decision making. This advances the IE literature by proposing a new theoretical perspective and providing empirical evidence on how entrepreneurs align their thinking with ROR when making internationalization decisions. In addition, prior IE studies have predominantly focused on international new venture or born global firms' internationalization and overlooked entrepreneurs' decision-making process and outcomes, our study further unpacks entrepreneurs' decision-making black box by systemically examining how the dynamic changes of entrepreneurs' perceived host country uncertainty influences their decisions on financial and nonfinancial investment, local collaboration, market exits, and growth options. Lastly, there have been increasing calls to enhance the use of experimental approaches in both entrepreneurship and international business research (Williams et al., 2019; Zellmer et al., 2016) to significantly improve evidence for causal relationships; in support of those calls, our paper further advances IE literature methodologically by developing and implementing a mixed-design, multi-stage experiment to examine the process of entrepreneurial internationalization decision making.

Uncertainty and ROR

Prior ROR studies predominately focus on the firm level-of-analysis (Brouthers et al., 2008; Kogut, 1991; Li, 2007; Trigeorgis & Reuer, 2017), yet the decisions that stem from ROR emanate from strategic decision-making by individual actor-agents (Bowman & Moskowitz, 2001). Recent developments of ROR have called for more studies at the strategic decision-making level (Chi et al., 2019; Ipsmiller et al., 2019; Trigeorgis & Reuer, 2017). This paper contributes to the ROR literature by employing an experimental method to unpack the uncertainty conditions under which strategic decision-makers align their thinking with ROR. We demonstrate the theoretical relevance and importance of ROR by showing that entrepreneurs do align their thinking with ROR when

they initially perceive high uncertainty. Specifically, our findings suggest that when uncertainty is being perceived as high initially, entrepreneurs are more likely to align their thinking with ROR by keeping financial/non-financial investment low and engaging in developing local relationships or collaboration.

However, when uncertainty is perceived as increasing over time, entrepreneurs do not completely align their thinking with ROR. For example, although they decrease financial and nonfinancial investment, they do not necessarily further engage in local collaborations. This reflects that entrepreneurs are more sensitive to uncertainty increases overtime, and they are more reluctant to engage in local collaborations than ROR would have suggested. On the other hand, when uncertainty is perceived as decreasing over time, entrepreneurs do not necessarily align completely with ROR by increasing financial and non-financial investment. Nevertheless, they do disengage from local relationships or collaborations. This reflects that entrepreneurs hold static their investment position longer than ROR would have suggested.

In sum, we demonstrate the use and limitations of ROR such that entrepreneurs are more likely to adjust their investment and collaboration levels consistent with what ROR predicts only when initial perceived uncertainty is high, yet entrepreneurs are more sensitive to uncertainty changes overtime and do not completely align their thinking with ROR under changing circumstances. Thus, the paper further enhances the micro-foundations of ROR by further unpacking the uncertainty conditions in which entrepreneurs align their thinking with ROR and offers new research avenues for studying ROR in strategic decision making by inviting more studies to look at uncertainty and individual factors of ROR.

More importantly, prior ROR research has been criticized for lack of theoretical boundary conditions and the resultant overlap with alternative theoretical explanations (Adner & Levinthal,

2004; Ragozzino & Moschieri, 2014). The recent development of ROR (Klingebiel & Adner, 2015) however, further established the theoretical boundary conditions of ROR as the unique bundle of low initial investment, resource reallocation, and sequencing. Our paper theorizes entrepreneurs' thinking align with ROR as the strategic bundle of initial investment level, engagement in local relationship/collaboration, and sequential resource reallocation which are consistent with Kingebiel and Adner's arguments. Our findings provide further evidence of the theoretical distinctions of ROR and establish additional boundary conditions for ROR.

Lastly, our paper offers a more nuanced understanding of exogenous uncertainty's role in ROR by examining the dynamic nature of uncertainty. In particular, our findings suggest that the alignment with ROR occurs not only at the initial decision making time point but also at sequential decision-making time points. The dynamic nature of uncertainty plays a major role in decision-making processes. In sum, our paper advances the ROR literature by theorizing and testing the role of changing degree of perceived uncertainty over time. It opens new research avenues that examining ROR at strategic decision-makers' level and the role of changing uncertainty in ROR, for example, future research can further look at uncertainty changes beyond initial two time points or examine potential contingent factors contributing to entrepreneurs' alignment with ROR

Practical Implications

According to the 2018 State of Small Business and Entrepreneurship Annual Report, international entrepreneurship accounts for 30% of U.S. economic growth and 40% of new employment creation. It has a fundamental impact on the socio-economic development of American society in terms of job creation, international relations, and business development. This paper provides entrepreneurs a means to leverage host country uncertainty that results from recently increasing trade tensions and de-globalizations. It offers ROR as a robust and alternative

way of thinking about how to navigate through today's increasingly volatile global market and uncertain trade environment, and it informs entrepreneurs how to achieve better entrepreneurial and internationalization outcomes when perceive high host country uncertainty. It also informs policymakers on how to assist entrepreneurs to better make entry decisions.

Limitations and Opportunities

As is the case of all investigations requiring complex methodological tradeoffs, our study is not without limitations: the single home country context (i.e., U.S.) did not account for potential home country heterogeneity. Second, our study does not directly observe the process of ROR but rather looks at the outcomes or actions as results of ROR. Third, our study did not directly measure respondents' reasoning as they made their decisions. Finally, we only captured two decision time points in the experimental design.

Though each of these limitations constitute boundary conditions pertaining to the new ground covered by our line of inquiry, each also provides avenues for future research. Indeed, by proposing and testing the ROR perspective in entrepreneurs' internationalization decision making, this paper offers several important opportunities for future research. First, both the dynamic nature of uncertainty and source of uncertainty (i.e., exogenous vs endogenous) should be further examined. For instance, future studies can examine how entrepreneurs perceive and act upon endogenous or exogenous uncertainty differently over time. Second, researchers can further unpack the ROR process and enhance the micro-foundations of ROR. For instance, future studies can look at how individual differences influence the way strategic decision-makers align with ROR. Also, researchers should employ more qualitative and inductive approaches to further unpack the workings and mechanisms of ROR. In addition, our findings suggest that although entrepreneurs will decrease financial and nonfinancial investment while increasing local collaboration when

perceived uncertainty increases, they are not willing to increase financial and nonfinancial investment when uncertainty decreases. This suggests certain conditions beyond "time 2" might influence entrepreneurs' decisions. Future studies should design additional decision time points (i.e., time 3 or time 4) in order to further unpack conditions in which whether and how entrepreneurs align their thinking with ROR when making strategic decisions.

Conclusion

Perceived host country uncertainty plays a crucial role in entrepreneurs' internationalization decision making. Specifically, entrepreneurs are more likely to keep their initial investment low while maintaining high levels of local collaboration when perceiving a high degree of host country uncertainty. However, as perceived uncertainty increases over time, entrepreneurs are more likely to decrease their investment levels as well as the local collaboration level. On the other hand, as perceived uncertainty decreases over time, entrepreneurs do not substantially adjust their investment levels, yet they tend to decrease the local collaboration level. This suggests that entrepreneurs align their thinking with real options reasoning when making international entry decisions. In particular, as perceived host country uncertainty changes, entrepreneurs strategically adjust their investment and local collaboration levels to contain potential downside losses while securing access to future growth potentials. Real options reasoning enables entrepreneurs to actively leverage changing degree of perceived host country uncertainty rather than passively avoid them which provide more robust thinking in highly uncertain situations. All in all, entrepreneurs are not powerless in the face of high and changing degrees of perceived host country uncertainty. Instead of avoiding them, entrepreneurs can align their thinking with real options reasoning to leverage changing degree of perceived host country uncertainty and to achieve better foreign market entry outcomes.

CHAPTER V. CONCLUSIONS AND IMPLICATIONS

Uncertainty is at the center of internationalization and entrepreneurship theories. Yet, the role of uncertainty in both entrepreneurial firms' internationalization process and entrepreneurs' internationalization decision making is still less understood. Prior international business and entrepreneurship research overlooked the multidimensionality and dynamic nature of uncertainty which results in a passive view of uncertainty as barriers to entrepreneurial internationalization. This leads to inconsistency between prior theory and empirical findings and further impedes our understanding of the entrepreneurial internationalization phenomenon. In this dissertation, we holistically reexamine the role of both perceived uncertainty in entrepreneurs' internationalization decision making and objective uncertainty in entrepreneurial firms' internationalization patterns and outcomes from a real options perspective. Particularly, we suggest that entrepreneurs and entrepreneurial firms can apply a real options approach to leverage the changing degree of host country uncertainty over time in order to achieve superior decision-making outcomes and post-entry performance. By doing so, we make several important contributions to internationalization, entrepreneurship, real options theory, and practice.

First, we contribute to internationalization literature by offering real options theory as a new theoretical explanation for the role of host country uncertainty in entrepreneurial firms' internationalization. In contrast to prior IB research focusing on MNCs internationalization, we theorize and test that entrepreneurial firms actively leverage host country uncertainty via their choice of real options entry. This alters our thinking on the role of uncertainty in the process of internationalization. Prior internationalization researchers view host country uncertainty as roadblocks to MNCs' internationalization and suggest a reactive role of the firm in the face of high host country uncertainty such as delaying or avoiding entry, entering a less distant country, being locked into specific markets, and suffering a performance downturn as results of increased host

country uncertainty. we suggest that entrepreneurial firms must engage in decision making under uncertainty and take on a proactive role of actively leveraging host country uncertainty in order to seize emerging opportunities through faster entry, enter more distant country, have the strategic flexibility of exiting the market, and effectively mitigating performance downturn as results of increased host country uncertainty. This also establishes additional boundary conditions between the internationalization of MNEs and entrepreneurial firms, with the former emphasizing conservative and internalized internationalization and the latter aligning with the ROT that predicts more proactive and collaborative internationalization in the presence of high and changing host country uncertainty.

Second, we further advance entrepreneurship theory by reconceptualizing the role of perceived uncertainty in entrepreneurs' internationalization decision making. In contrast to the prior reactive view of uncertainty as a roadblock to substantial entrepreneurial endeavors, for example, entrepreneurial internationalization, we propose a proactive view of uncertainty in which entrepreneurs can align their thinking with real options reasoning by leveraging changing degrees of perceived uncertainty over time. Instead of simply managing or avoiding uncertainty, entrepreneurs can capitalize on the changing degree of uncertainty by aligning their thinking with real options reasoning. This proactive view further advances our understanding of the uncertainty construct in general entrepreneurship theory and opens new research avenue to unpack the relationship between uncertainty and entrepreneurial actions. Moreover, we contribute to international entrepreneurship literature by offering a real options perspective as a new theoretical lens to further unpack entrepreneurs' internationalization decision making black box and offer a nuanced understanding of uncertainty in the international entrepreneurship literature. we also expand the scope of international entrepreneurship research by venturing beyond the timing aspect

of entrepreneurial internationalization and holistically examining entrepreneurial firms' internationalization pattern in terms of entry timing, entry mode, entry location, and market exits.

Third, we make important contributions to real options literature in three ways: first, we further establish the theoretical boundary conditions of real options theory. Specifically, in essay one, we conceptualize the real options entry as entrepreneurial firms' adoption of low initial investment and collaborative entry mode. In essay two, we theorize entrepreneurs' thinking alignment with real options reasoning as the strategic bundle of initial investment level, engagement in local relationship/collaboration, and sequential resource reallocation. Both clearly distinguish ROT from other alternative theoretical explanations and further establish theoretical distinctions of ROT. The findings provide further evidence for the existence of ROT and establish additional boundary conditions for ROT. Second, through this dissertation, we further unpack the role of uncertainty in ROT. Specifically, essay one demonstrates that the host country exogenous uncertainty influences entrepreneurial firms' adoption of real options entry and real options entry can mitigate the adverse performance influence of host country uncertainty. Essay two discovers that the dynamic nature of perceived uncertainty plays a major role in entrepreneurs' ROR and entrepreneurs' thinking alignment with ROR occurs not only at the initial decision-making time point but also at sequential decision-making time points. Lastly, we enhance the micro-foundation of ROT by further examining the individual and uncertainty conditions of ROT. Particularly, we employ an experimental method in essay two to unpack the uncertainty conditions under which strategic decision-makers align their thinking with ROR. This offers a new research avenue for studying ROR in strategic decision making.

Lastly, through this dissertation, we make several important contributions to practice. First, we further unpack the performance implications of entrepreneurs and their firms'

internationalization in the face of high host country uncertainty. This is even more relevant in today's high-uncertainty global market. Specifically, for entrepreneurs, we offer real options reasoning as a robust and alternative way of thinking when making market entry decisions. We suggest that instead of delay or abandon market-entry when facing high host country uncertainty which often causes missed foreign market opportunity and slowed venture growth, entrepreneurs can adopt a real options approach to strategically keep their initial investment low but engage using local collaborations to secure access to future growth opportunities. Such an approach provides them an effective way of internationalization that can minimize potential downside losses while keeping the door open for future growth opportunities. Second, for entrepreneurial or young firms that are often constrained by resources, we offer the real option entry that combines low cost exporting with local collaboration as an effective way to mitigate the negative effect of host country uncertainty on post-entry performance. In fact, our studies suggest that when host country uncertainty is high, firms that choose real options entry outperform those do not by nearly 18 percent in terms of post-entry sales growth. For an average-sized firm in our sample with annual revenue of 10 million USD, this reflects a difference of 1.8 million USD. This difference matters for both short term sustainable growth and long-term survivability of many entrepreneurial firms. Lastly, for policymakers, we offer an effective way on how to assist entrepreneurs and their firms to better make market entry decisions and achieve better post-entry performance.

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