Entry to a New Technology-enabled Product Category

How New Market Uncertainty and Old Market Growth Influence Entry-timing Effects

Timo M. Partanen
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Aalto University
School of Science
Department of Industrial Engineering and Management
Institute of Strategy and Venturing
Abstract

Timing is an essential part of any decision to enter a new market. Conventional wisdom suggests that early entrants can often gain first-mover advantages, but even after decades of research on entry timing, it remains still somewhat unclear when and how first-mover advantages are achieved. It has been suggested that one reason for that partial inconclusiveness may be that researchers have too myopically investigated the timing only in relation to competitors. Thus, in my dissertation, I suggest and empirically test two other entry-timing anchors besides of competitors’ entries: timing in relation to growth in firm’s existing market and timing in relation to uncertainty concerning the new market potential.

The empirical context of this study is wireless telecommunication operators’ adoption of 3G WCDMA technology and introduction of fast wireless data communication services – "the biggest ever gamble on the introduction of a new technology". The new services were believed to have huge potential, but for several years, it was uncertain if the new technology and its ecosystem would be viable. Furthermore, in many markets, new 3G services were introduced when the demand for earlier 2G voice-only services was still rapidly growing.

My first essay draws from the technology adoption literature and suggests that post-entry performance is a joint outcome of timing in relation to competitors’ entries and timing in relation to the maturity of the new market. In the second essay, I apply opportunity cost theory. I argue that when a firm needs the same non-scale-free and imperfectly fungible resources and competences in both old and new markets, its overall performance will suffer if it enters the new market when the old market is still rapidly growing. In the third essay, I investigate what influences firms’ entry-timing decisions when the viability of the new market is uncertain. I apply organizational learning theory, and in contrary to previous research I suggest that in an ambiguous environment, learning from parent group’s experience advances the entry timing, and learning from competitors delays it. My empirical findings support all these arguments.

This study has a few implications for theory and research practice related to entry-timing effects. First, entry-timing effects depends on multiple anchors, and the timing should not only be measured from pioneer’s entry to the market. Indeed, multiple effects can co-exist and even have opposite effects. Thus, researchers should decompose entry-timing effects into smaller sub-effects rather than attempt to explain entry-timing effects on a general level. Second, entry-timing decisions are not isolated events but should be studied in relation to firms' other activities. Indeed, our impression of entry-timing advantages can be seriously biased if we do not pay attention to the opportunity cost of forgoing firms' other growth opportunities. Third, this thesis highlights the need to align timing measure better to the underlying dynamic phenomena.

Keywords Entry-timing effects, technology adoption, opportunity costs, organizational learning
Tiivistelmä
Ensimmäisenä markkinoille tulevien yritysten on ajateltu hyötyvän etsikkoajastaan, mutta vaikka markkinoille menon ajoitusta on tutkittu jo vuosikymmeniä, emme vieläkään täysin ymmärrä milloin ja miten edelläkävijä hyötyy asemaan. Onkin esitettä, että markkinoille menon ajoitusta on tarkasteltu liian suppeasti ainoastaan suhteessa muiden yritysten ajoitukseen. Tässä väätös- kirjassani ehdotan ja empiirisesti tutkin kahta muuta tekijää, joihin yrityksen markkinoille menon ajoitus pitäisi linkittää: epävarmuus uuden markkinan potenciaalista ja yrityksen nykyisten markkinoien kasvu.


Ensimmäinen esseeni pohjautuu tutkimukseen uusiin teknologioiden käyttöönotosta. Esitän siäntä, että yrityksen markkinoille menon kannattavuuteen ei vaikuta pelkästään ajoitus suhteessa kilpailijoihin vaan myös mm. ajoitus suhteessa uuden markkinan epävarmuuteen. Toisessa esseessäni sovellan teoriaa vaihtoehtoiskustannuksista ja esitän, että jos yrityksen vanhat ja uudet markkinat vaativat samoja skaalautumattomia resurseja, yrityksen kannattavuus kärsii yrityksen mennessä uudelle markkinnalle vanhan markkinan kasvaessa yhä nopeasti. Kolmannessa esseessäni tutkin kuinka yrityksen päättöön mennä epävarmelle markkinnalle vaikuttaa oppiminen omasta ja toisten yritysten kokemuksista ja esitän, että eri kokemuksista oppimisella on erilainen vaikutus ajoitukseen. Kaikissa kolmessa esessessä empiiriset havainnot tukevat väitteitäni.

Näistä havainnoista seuraa muutamia suosituita tulevalle tutkimukselle. Ensinnäkin kannattavuuteen vaikuttaa useampi ajoitukseen liittyvä mekanismit, ei pelkästään markkinoille menojärjestys suhteessa kilpailijoihin. Tämä voi selittää osaltaan aikaisempiä ristiriitaisia löydöksiä ja tutkijat saattaisivat löytää enemmän säännönmukaisuuksia tutkimalla pienempiä osamekanismeja. Toisekseen, markkinoille menoi ei tapahdu erityisksiä yrityksen muusta toiminnasta. Teemme helposti vääriä johtopäätöksiä ajoitukseen edusta, jos emme huomioi vaihtoehtoiskustannuksia, jotka aiheuttavat yrityksen muiden mahdollisten kasvuhankkeiden lykkäämisestä. Lisäksi tämä tutkimus osoittaa kuinka tärkeää olisi, että ajoituksen mittatar olisivat yhdenmukaisia taustalla vaikuttavien ajan yli muuttuvien ilmiöiden kanssa.

Avainsanat
Markkinoille menon ajoitus, teknologian käyttöönotto, vaihtoehtoiskustannukset, organisaatioiden oppiminen

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Time is a strange thing. Sometimes you find ahead of you something you thought you left in the past.

At the turn of the millennium, I worked for Nokia Networks in strategic marketing. One of my key tasks was to convince wireless telecommunication operators to invest in a new 3G WCDMA technology to improve their business. I told them that they could double their revenue in no time and that they better hurry up and enter markets first. Consequently, operators worldwide spent several hundred billion dollars adopting the new technology. However, in 2006, five years after the first 3G launches, the New York Times wondered, “3G cost billions. Will it ever live up to its hype?” and concluded, “3G has still not found a reason to be” (O’Brien, 2006). It has often puzzled me how such a big industry could collectively get its timing so wrong. What drove operators’ adoption of the new technology? Did they just blindly follow the conventional idea of first-mover advantages? Did they learn anything from the experiences of their peers and competitors? Eventually, who performed best?

Getting a doctoral degree had long been my dream. The time to pursue it came when Nokia announced its voluntary severance packages, which enabled me to quit my day job and, among other things, to pursue doctoral studies and research. When I started my doctoral studies more than five years ago, little did I know how deeply I would immerse myself in those questions I had pondered. Writing a dissertation was not the straightforward path I had envisioned. It took much more time than I had expected, and there were quite a few turns and dead ends. In the process, I learned a lot. I am really happy that I started this project, and I am really satisfied that I eventually completed this dissertation.

This would not have been possible without assistance and support from several people. In particular, I would like to thank my supervisors and advisors, Professor Thomas Keil from University of Zurich and Professor Markku Maula from Aalto University. Your guidance, advice, and feedback during the process have been immensely valuable, as was your support when my research did not progress as planned. Several other Aalto faculty members have also provided knowledge and support to this work. This list includes, but is no means limited to (in alphabetical order), Robert van der Have, Markus Kajanto, Pasi Kuusela, Yu Liu, Pardeep Maheshware, Mikko Rönkkö, Jens Schmidt, Joosef Valli, Hannele Wallenius, Riku Österman and many other Aalto colleagues. I also thank reviewers and conference commentators for their feedback. I thank
Professor Lanzolla and Professor Zachary for their work as pre-examiners for their careful examination and valuable suggestions. I thank professor Tobias Kretschmer from Ludwig Maximilian University of Munich for his work as my opponent. It is an honor to have an opponent with such experience.

I thank Aalto University for employing me to work on this dissertation. This was partly financed by the Academy of Finland’s funding for the “Managing corporate initiative programs for strategic renewal” project (decision number 252725). I also deeply appreciate the personal research grants I received from The Finnish Foundation for Economic Education at the beginning of my doctoral studies and from Yrjö Uitto’s Foundation at the end of my studies. I thank the wireless telecommunication operators’ industry association GSMA for the data. I thank also an anonymous Nokia ex-employee who helped me locate a few old files.

Last but definitely not least, I would like to thank my dearests. Together, my wife, Jiemin, and I learned that writing a dissertation is not a nine-to-five job; sometimes inspiration comes in the evening or on holidays. Despite this, you have always been there to support me in this project. And while I have been reading, writing, and crunching numbers, you have given us wonderful children, Jade and Leo. Papa promises to be at home more in the coming months.

Espoo, September 19th, 2017
Timo M. Partanen
Acknowledgements

List of Publications

Author’s Contribution

PART I: Introduction and Overview

1. Introduction

1.1 Introduction

1.2 Research questions

1.3 Scope and Limitations

2. Theoretical Foundation

2.1 The literature on entry-timing advantages

2.2 The role of time in entry-timing literature

2.3 The literature on technology adoption

2.4 The literature on organizational learning

2.5 The literature on opportunity costs

2.6 The summary of the dissertation’s theoretical basis

3. Data and Methods

3.1 Industry context

3.2 Data, variables, and methods

4. Results

4.1 Findings on uncertainty of the new market and new market entry timing (RQ1)

4.2 Findings on uncertainty of the new market and new market entry performance (RQ2)

4.3 Findings on growth in the existing market and new market entry timing (RQ3)

4.4 Findings on growth in the existing market and new market entry performance (RQ4)

5. Discussion

5.1 Theoretical implications

5.2 Practical implications

5.3 Limitations and future research
This doctoral dissertation consists of a summary and of the following publications that are referred to in the text by their numerals


* The version submitted to AOM conference had a shorter title “Entry-Timing Effects and Opportunity Costs in Generational Technology Adoption”
Author’s Contribution

**Publication 1:** Entry to a New Technology-Enabled Product Category: Behavioral and Performance Effects of Multiple Anchors

Sole author.

**Publication 2:** The Trade-Off between Existing and New Product Generations: How Does Growth in a Firm’s Existing Markets Influence Its New Market Entry Performance?

Sole author.

**Publication 3:** Keeping the Course in the Fog: How to Maintain Strategic Direction in an Ambiguous Environment.

Sole author.
PART I: Introduction and Overview
1. Introduction

1.1 Introduction

The decision on timing is an essential part of entering a new market or product category. Conventional wisdom has often attributed better market entry performance to being first. In academic research, already Schumpeter (1942) argued that first-to-market, innovative firms are the driver of economic growth in societies and Lieberman's and Montgomery's (1988) seminal article on first-mover advantages firmly established the topic in management research and managerial practice.

The idea of first-mover advantages is intuitive and appealing also to practitioners. For example – related to the empirical context of this research – Nokia Networks urged its wireless telecommunication operator customers to “Be the First to Launch [new 3G services]” (Nokia, 2000, p. 9), and operators, such as Dutch KPN, agreed and aimed “to supply [3G] services as soon as possible” KPN (2001, p. 13).

However, there is less of a consensus in academia. More than three decades of research on market-entry timing advantages has concluded that entry timing matters; there are often first-mover benefits, but it remains somewhat unclear when and why (Fosfuri, Lanzolla, and Suarez, 2013; Lieberman and Montgomery, 2013; Zachary et al., 2015).

A recent literature review (Zachary et al., 2015) suggests that one reason for that partial inconclusiveness may be that the research has too myopically focused only to the timing in relation to competitors. I.e., researchers have usually measured entry timing either as continuous time (e.g., months) from the first entry, or as nominal measure (e.g. dummies for the pioneer, the second entrant and other entrants) and they have largely ignored other entry-timing anchors.

Thus, deriving from that suggestion the main research question of this study is “Should entry timing be measured from other anchors besides of competitors’ entries?” In this dissertation, I suggest and empirically test two other anchors. Timing in relation to growth in firm’s existing market (Essay #2) and timing in relation to the uncertainty concerning the new market potential (Essays #1 and #3).

The empirical context of this study is wireless telecommunication operators’ adoption of third generation (3G) WCDMA technology and introduction of fast wireless data communication services during the years 2000-2012. This was
described as “the biggest ever gamble on the introduction of a new technology” (The Economist, 2004). Operators considered that the new data services had huge potential. For example, Spanish Telefonica (2001, p. 7) expected that “the launch [...] of new technologies and the design of new services is [...] a tremendous opportunity”. However, even five years after the launch of the new 3G services, there were still major concerns about 3G’s viability. For example, in July 2006, The New York Times argued that “the modest gains 3G has made do not begin to justify the massive costs of the technology” and that “3G has still not found a reason to be” (O’Brien, 2006).

In addition to the general research on market-entry timing I derive from technology adoption literature. That literature suggests that firms should consider both the interaction in the product market (i.e., potential first-mover advantages) and the uncertainty regarding the value of the new technology (i.e., the risk of adopting immature or entirely wrong technology) when they decide the timing for the new technology adoption (e.g. Hoppe, 2002). I apply organizational learning research, such as studies by Baum and Dahlin (2007) and Simon and Lieberman (2010), to investigate how the uncertainty regarding the value of new technology or new practice is reduced when the firm gains more experience on it. Prior research has investigated the new practice or new technology adoption usually in contexts where the new practice or technology has been clearly valuable. I investigate this question in a context where the technology was initially immature and may even have been value-destroying.

Another key theory from which I derive is the opportunity cost theory. It asserts that when a firm selects between mutually exclusive alternatives, it must consider not only the profitability of the selected alternative itself but also the loss of potential benefits from other alternatives. This is especially relevant when alternative investments rely on the same non-scale-free resources or capabilities which cannot be used simultaneously in multiple alternatives. Typical examples of this kind of resources are efficient management teams, product development expertise, or prime retail locations. Levinthal and Wu (2010) suggest that if there is any imperfect fungibility in the value of assets a firm should diversify only when its existing markets do not provide enough growth opportunities. Following similar logic I suggest that firm’s new market-entry performance is reduced if its existing markets grow rapidly.

My empirical findings confirmed my theoretical predictions: the timing both in relation to technology maturity (i.e. uncertainty) and in relation to the growth in existing market (i.e. opportunity cost) were important antecedents for post-entry performance and they also influenced firm’s entry-timing decisions. I argue that the analysis of entry-timing effects could be seriously biased if these other timing anchors are ignored. For example, in Essay #2, the timing in relation to competitors did not have statistically significant direct effect to post-entry performance when the timing in relation to existing market growth was included as a moderator.

The findings of this study make a few contributions to the theory on entry-timing effects. Entry-timing effects depends on multiple anchors, and the timing should not only be measured from pioneer’s entry to the market. Indeed,
these multiple effects can co-exist and even have opposite effects. In Essay #1 I found that total entry-timing performance dependent negatively on timing in relation to competitors (i.e. earlier entry, better performance) and positively on timing in relation to technology maturity (i.e. later entry, better performance). This echoes Lieberman and Montgomery (2013, p. 322) suggestion that instead of searching “general phenomenon of market timing advantage” we should “elucidate particular mechanisms impacting performance in relation to entry order and their interactions”.

Another finding to highlight is that market entries should not investigated in isolation, but as a part of firms’ business portfolio. The earlier research had identified that characteristics of the firm itself (e.g. Franco et al., 2009; Hawk, Pacheco-De-Almeida, and Yeung, 2013) and the new market (e.g. Suarez and Lanzolla, 2007) influence post-entry performance. My finding shows that also the characteristics of firms’ existing business influence post-entry performance. This issue may be a concern as approximately one third of entry-timing studies analyzed product-level outcomes and ignored new product’s impact to existing business and firm’s total performance (Zachary et al., 2015).

Finally, this thesis highlights the need to align timing measure to the underlying phenomena. Researchers use equally often nominal and continuous time measures (Zachary et al., 2015), but according my review they rarely provide justification why certain measure would be better than other. I argue that the passage of time itself does not cause change, but it is just a proxy for complex underlying phenomena such as change in the competitive intensity or consumer preferences. Although continuous clock-time may be perceived to have highest precision, it should be only used when the underlying change process is linear. That may not be case so often in business, where the changes are often punctuated and rapid (e.g. Tushman and Anderson, 1986) and e.g. the nature of competition changes stepwise when new competitors enter the market. Thus, researchers should first identify what dynamic mechanisms they believe to cause entry-timing effects, and then align their time measures to the dynamics of those mechanisms.

This dissertation is organized in two parts: this compiling part and three essays. The compiling part is organized so that next I introduce more in details my research questions and my study’s limitations. After that I review the most important literatures related to my research in chapter 2. An interested reader is advised to read also more detailed theoretical discussion in essays. Chapter 3 describes dissertation’s empirical context and introduces most important variables. My findings are summarized in relation to my research questions in chapter 4, and theoretical and practical conclusions are discussed in the final chapter 5.

1.2 Research questions

The overall research question of this dissertation is “Should entry timing be measured from other anchors besides of competitors’ entries?”. This is derived from Zachary and colleagues’ (2015) recent review of entry-timing
literature, in which they expressed concern that entry-timing research has too myopically focused only on timing in relation to competitors and suggested identifying also other entry-timing anchors. They argue that entry timing is not relative to clock time, but to broader context including entrants’ resources and capabilities, incumbents’ strength, market attributes, and industry dynamics. They encourage researchers to identify other contextual anchors besides of competitors’ entries. The entry-timing literature is discussed more in section 2.1 and the timing measures used in the entry-timing literature in section 2.2.

I identified two ideas for additional anchors from closely related streams of literature – literature on technology adoption and literature on diversification – which I consider inadequately integrated into entry-timing research. Based on these literatures, I suggest that entry timing should be measured also in relation to the uncertainty of the new market and in relation to growth opportunities in existing markets. My review of the core body of entry-timing literature indicates that researchers have not addressed these issues. Both of these new anchors have both behavioral and performance aspect. How does the anchor influence firm’s market-entry timing? How does the entry-timing (in relation to the new anchor) influence performance?

Technology adoption literature, which is discussed more in the section 2.3., has theorized that the optimal timing of a new technology adoption is dependent on two factors: the interaction with competitors in the product market (i.e., potential first-mover advantages) and uncertainty concerning the value of the new technology. The former suggesting that early technology adoption may give advantage over competitors, and the latter suggesting that by waiting and entering later, the firm is less likely to invest in immature or entirely wrong technology. My first research question investigates if the uncertainty influenced firms’ market entry timing and my second research question investigates if the level of uncertainty at the time of entry had an impact on firm’s post-entry performance. Especially for the RQ1 I derive from the organizational learning literature which is discussed more in section 2.4.

**Research Question 1 (RQ1):** How does the uncertainty concerning the new market potential influence new market entry timing?

**Research Question 2 (RQ2):** How does the timing in relation to the uncertainty concerning the new market potential influence new market entry performance?

In the diversification literature already Penrose (1959) suggested that firms diversify to new industries when they have excess capabilities that cannot be utilized in the current industry. Levinthal and Wu (2010) argued that firms should not diversify to new industries if their existing industries continue to provide sufficiently favorable opportunities. The reason for this is the opportunity cost that applies to firm’s non-scale-free resources or capabilities with imperfect fungibility. Opportunity cost means the loss of the potential
benefits from the other use of assets. This applies to resources that cannot be scaled and their use in one project precludes their use elsewhere.

Only a few major corporations are single business entities; most organizations target many product-market combinations (Nippa, Pidun, and Rubner, 2012) and many of firms' valuable resources – such as R&D or management capabilities – are limited and cannot be scaled freely (Levinthal and Wu, 2010). Thus, firms regularly face portfolio management decisions regarding the growth initiatives to which they should allocate their limited resources and capabilities. One particular decision is how much resources to allocate to pursue growth in existing industries and markets and in new industries and markets. A decision where firms should consider not only the profitability of the new market or the new industry itself, but also forgone profits from the growth options in other markets or industries to which they did not allocate their resources.

However, according to Levinthal and Wu (2010) at least in the diversification literature, firms' resources are often (implicitly and often mistakenly) treated as being scale-free. I.e. the research on diversification has often ignored what a firm could have achieved if it would had invested its resources in its existing businesses instead of diversifying to other industries. I reviewed the core literature on entry-timing effects, and concluded that also research on entry-timing effects often ignores the opportunity cost perspective and especially the further growth opportunities in the existing market have not been considered as an alternative. Sometimes also the post-entry performance is measured at product level, ignoring any effects the new product may have to firm's other businesses. The opportunity cost theory and how it has been applied in the entry-timing literature is discussed in the section 2.5. My next two research questions focus on one specific opportunity cost: the growth opportunities in the existing business as an alternative for an entry to a new business.

**Research Question 3 (RQ3):** How does the growth in existing market (i.e., opportunity costs) influence new market entry timing?

**Research Question 4 (RQ4):** How does the timing in relation to the growth in existing market (i.e., opportunity costs) influence new market entry performance?

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<td>Performance (after entry)</td>
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**Figure 1:** Essays and research questions
These four research questions are studied in three essays. The research questions related to performance (RQ2 and RQ4) are studied in separate essays (#1 and #2). Essay #1 also touches on RQ1, but the behavioral questions (RQ1 and RQ3) are primarily examined in Essay #3. (See Figure 1.)

1.3 Scope and Limitations

Entry to a new market and introduction of a new product are likely among the most studied topics in the business literature. Thus, to make a feasible study and a meaningful contribution, I have to limit the scope of this study.

This study is about the adoption of a new technology generation and the introduction of new products based on that technology. This study will thus not cover other types of market entries, such as an entry to a new geographical market, the introduction of a new-to-world product or diversification to another industry. I believe, however, that my findings are generic enough that they can also be applied to other types of market entries.

This study focuses on market-entry timing i.e., when firms entered new markets. Other entry aspects, such as entry mode (i.e., how they entered) are outside of the scope. Nor will I focus on topics in international business research, such as the order of entry to different geographical markets. Although I study technology adoption, my primary question is not a choice between the technologies per se, although this is an important factor causing the uncertainty. Thus, I limit my discussion on that topic.

My empirical context also creates some limitations. Telecommunication business is a capital-intensive, regulated, oligopolistic environment with very high entry barriers. Thus, my study is limited to large firms, which are often subsidiaries of multi-national enterprises. Furthermore, as my focus is on how existing firms adopt a new technology, I focus on incumbent telecommunication operators. My findings may not be applicable to new firms that enter with new technology.

Methodologically, my research is based on externally observable quantitative archival data. Due to this limitation, I cannot study aspects that would require collecting non-public data. Particularly, one limitation is that I do not have data to study firms’ capabilities such as technological capabilities (Franco et al., 2009) or speed capabilities (Hawk et al., 2013) that earlier research has suggested to moderate entry-timing advantages. Another similar limitation is that I cannot study the decision-making process within firms.
2. Theoretical Foundation

This dissertation investigates how the timing of entry to a new technology-enabled product market was impacted by the uncertainty regarding new market and the growth in existing markets. Thus, the “home base” for this research is the literature on entry-timing effects in general (section 2.1) and the literature on technology adoption timing in particular (section 2.3). My theoretical foundation is in organizational learning theory (section 2.4), particularly the way ambiguity is reduced by learning from own experience and vicariously from others’ experience, and in opportunity cost theory (section 2.5), particularly how diversification to new markets is influenced by the growth in the existing market. Additionally, I discuss the time measures in the entry-timing literature in the section 2.2. because during my research I found that some issues that hamper the development of this literature may be related to the inadequate attention to the measures of time itself in the entry-timing research.

2.1 The literature on entry-timing advantages

Market-entry timing, particularly the role of first movers, has a long history in economics and management research. Schumpeter (1942) argued that economic growth in societies is driven by first-to-market, innovative firms. From the 1970s onwards, the idea of first-mover advantages gained popularity among practitioners and researchers. For example, Prescott and Visscher (1977) and Schmalensee (1978) developed a theory on how early movers gain advantage by preempting rare assets such as spatial space. Boston Consulting Group promoted, according Lieberman and Montgomery (1988), in the 1970s an idea that by being a first mover, one can get ahead of others on a learning curve. The topic became firmly established in management research and managerial practice when Lieberman and Montgomery published their seminal Strategic Management Journal article “First-mover advantages” in 1988. As of today, that article has been cited more than 3700 times, according to Google Scholar.

Although the research started by focusing on first-movers, it quickly evolved and identified e.g., first-mover disadvantages and late-mover advantages (e.g., Lieberman and Montgomery, 1998; Shankar, Carpenter, and Krishnamurthi, 1998) and benefits of being a fast second (Markides and Geroski, 2004). Thus, the recent literature has preferred to use more generic terms such as “entry-timing advantages” or “entry-timing effects” in lieu of “first-mover advantages” (Fosfuri et al., 2013). This dissertation follows this practice.
The research has focused on three broad areas (Fosfuri et al., 2013): isolating mechanisms that protect the first mover from competition, firm-level resources and capabilities that enable a firm to turn the first-mover position into a competitive advantage, and environmental conditions that enable or disable first-mover advantages.

Isolating mechanisms are those factors that protect an early mover from competition and enable it to enjoy higher profitability than its competitors. The most commonly used categorization of isolating mechanisms is probably Lieberman and Montgomery’s (1988) framework of technology leadership, preemption of scarce assets, and customers’ switching costs. These are often cited as reasons why telecommunication industry, the empirical context of this study, is considered to have strong first-mover advantages (e.g. Bijwaard, Janssen, and Maasland, 2008; Gomez and Maicas, 2011; Jakopin and Klein, 2012; Sarkar, Cavusgil, and Aulakh, 1999; Sung, 2014; Whalley and Curwen, 2012). For example, a wireless telecommunication operator that introduces a new 3G network earlier than others might get ahead on the learning curve and be able to reduce costs or increase differentiation faster than its competitors. It might also have preempted the best locations both for the infrastructure and retail outlets, or it may have sourced exclusive content to its service offer. It could also lock its customers into its service through fixed-length contracts or through enabling a network effect that incentivizes customers to stay in the same network as his or her friends and other contacts.

A first-mover position does not automatically guarantee that isolating mechanisms will turn the first-mover position into a competitive advantage; this requires firms to have the proper resources and capabilities. For example, a firm with strong technological capabilities may be better positioned to establish a technological leadership position, and thus reduce its prices or differentiate its offering. For example, Klepper and Simons (2000) found that firms with experience in radio manufacturing performed better in a new television manufacturing industry. Similarly, Franco et al. (2009) and Hawk, Pacheco-De-Almeida, and Yeung (2013) showed, respectively, that firms’ technological capabilities and speed capabilities influence entry-timing effects. Gaba, Pan, and Ungson (2002) found that firms with high international experience are likely to enter early to new markets, although Mueller et al. (2012) found somewhat surprisingly that firm’s learning capabilities do not always automatically improve firm’s entry performance.

The existence of first-mover advantages, or other entry-timing effects, is not guaranteed for every market. The characteristics of some markets make it easier (or harder) to establish isolating mechanisms and thus make it easier (or harder) for first movers to gain performance advantages. For example, Suarez and Lanzolla (2007) proposed that first-mover advantages are less common if the pace of technology or market evolution is fast. However, as I will discuss later in the section on opportunity costs (2.5) the characteristics of firm’s existing markets and existing business are rarely considered in the entry-timing literature.
Several decades of research have generally concluded that entry timing matters. There are often first-mover advantages, but there are persistent issues in the literature, as highlighted in the summaries of recent reviews:

“Despite significant progress, the extant entry timing literature still suffers from several shortcomings and, in particular, it fails to integrate into a coherent and integrative framework the latest findings from contiguous management literature streams” (Fosfuri et al., 2013, p. 300).

“Some fundamental problems complicate continued progress in this area” (Lieberman and Montgomery, 2013, p. 313).

“The empirical evidence in this review confirms [that] support for [first-mover advantages] remains mixed and context specific with only a few regularities” (Zachary et al., 2015, p. 1389).

These reviews all highlight somewhat different issues hampering the research of entry-timing advantages. Fosfuri et al. (2013) are concerned that the entry-timing literature, which has been developed by scholars from different disciplines, is fragmented and lacks integrative widely accepted theory. They suggest that scholars bring in new approaches from related research streams and attempt to derive from them a more integrative theory of entry-timing advantages. In this dissertation, I attempt to integrate some findings and theory from technology adoption and diversification literatures based on organizational learning and opportunity cost theories.

Lieberman and Montgomery (2013) raise issues on the definition and measurement of first-mover advantages. They state that theoretically, an entry-timing advantage means that part of firm’s profit is attributable to its time of entry. However, underlying this definition is the notion that one could compare how a firm’s profitability varies based on different entry times to the same market. In practice, this is not possible, as we can ex-post observe only the realized entry and its outcome. Thus, the practical approach has been to measure firms’ entry timing and their performance, to eliminate the performance differences caused by firm and market characteristics, and to attribute the remaining performance differences to the timing. However, this approach leads to several issues regarding the definition and measurement of variables. In the section 2.2 I will address especially my concerns regarding the measurement of time itself in the entry-timing research.

Additionally, the market definitions are a source of confusion: When did a new market really begin? How finely should markets be defined? What about markets that evolve, merge, diverge, or disappear? For example, was Xerox a pioneer in plain paper copiers or a follower in copiers (Golder and Tellis, 1993)? Lieberman and Montgomery (2013, p. 317) divide new markets into three categories: “(a) new-to-the-world products; (b) new “generations” of product, characterized by discrete waves of improvement over the existing technology (e.g., successive generations of computer hard disk drives, game consoles, and
semiconductor memory); and (c) introduction of existing products into new geographic locations (e.g., introduction into a national market, such as China). This study focuses on category (b), research on generational products, which addresses industries such as computers or game consoles, in which product manufacturers must regularly adopt new technologies and launch new product generations based on new technologies.

Furthermore, it can be challenged if entry-timing effects are endogenous (Moore, Boulding, and Goodstein, 1991): If firms select their market-entry timing so that it maximizes their (expected) profitability given their assets and capabilities, is the entry timing endogenous, and can differences in firm performance ultimately be explained by the different capabilities and be mediated through entry-timing decisions? If every firm enters the market based on its capabilities in order to maximize its performance, do all firms enjoy entry-timing advantages simultaneously?

In addition to those methodological challenges, Lieberman and Montgomery (2013) take a cautious view regarding generic entry-timing advantages, and they encourage studying particular mechanisms that cause entry-timing performance effects:

“It seems advisable to abandon any idea that we are in a grail search to understand some general phenomenon of market timing advantage. At this point, we believe that focused analyses that elucidate particular mechanisms impacting performance in relation to entry order and their interactions are more likely to advance the field than more general studies or labels.” Lieberman and Montgomery (2013, p. 322).

In the most recent review, Zachary et al. (2015) list numerous improvement opportunities (see page 1406 in their study), such as the lack of multi-level and repeated decision designs. One concern that Zachary and colleagues particularly emphasize is that the literature may have been too myopic and studied entry timing only in relation to competitors, and researchers should identify other anchors beyond the competitors. They argue that

“[E]ntry timing — much like rivalry, competitive advantage, and performance — is imbedded in relativity. Entry is neither relative to clock time nor independent but, instead, relative to a broader context, including entrants’ resources and capabilities, incumbents’ strength, market attributes, and industry dynamics. As such, we generally see the timing of entry as a sequential act relative to some contextual anchors, and the length of time separating actions, outcomes, and reactions is important. In fact, identifying the contextual anchors without myopically assuming they should be limited to the first entrant is the next important evolutionary step for empirical and conceptual research in this literature.” (Zachary et al., 2015, p. 1404).

These two suggestions - Lieberman and Montgomery's (2013) suggestion to focus on particular mechanisms rather than entry order in general, and Zachary and colleagues' (2015) to identify entry-timing anchors beyond competitors...
entries – form the basis for this dissertation. As proposed by Fosfuri \textit{et al.} (2013), I derive insights from a few related research domains – the opportunity cost theory literature (see section 2.5), organizational learning theory (see section 2.4), and the technology adoption literature (see section 2.3) and I suggest two particular mechanisms or additional entry-timing anchors – timing in relation to the existing market growth, and timing in relation to the uncertainty of the new market.

In addition, my study has a multi-level set-up, and it investigates entry decisions that multi-national firms repeated in their subsidiaries, both of which were listed by Zachary \textit{et al.} (2015) as under-researched topics. My findings on the measurement of entry-timing performance also provide an additional perspective of questions raised by Lieberman and Montgomery (2013), especially regarding omitted variable bias, the level at which entry-timing effects should be measured and what kind of time measures we should use.

2.2 The role of time in entry-timing literature

Despite entry-timing literature focuses on time, I argue that the concept of time itself has been treated somewhat lightly in the literature. The entry-timing research has applied several different measures of time, but it has been somewhat neglectful that different methods imply different conceptualization of the time.

Zachary and colleagues (2015) count that 47% of the studies they considered to form the core body of the literature apply a continuous time measure. I.e. time is measured (in varying units) since the first entry to the market. 43% of studies apply time as nominal variable (e.g. dummies for first-movers) and 5% have ordinal timing measure. (It is not clear what timing measures the remaining 5% applied.)

When should different entry-timing measures be used? Is some timing measure superior to others? Is it more important that a firm was third entrant (nominal variable) or that it entered ten months after the pioneer (continuous variable)? When I reviewed those articles that Zachary and colleagues (2015) considered to form the core literature on entry-timing research I found that usually researchers provided little theoretical reasoning for the selection of time measures. The research question guides the selection in some studies. For example, when Boulding and Christen (2003, 2008, 2009) investigate if pioneering firms differ from other firms, they simply categorize firms to pioneers and others (i.e. they apply nominal measure). However, if there is not obvious reason why one or other measure should be used, the reasoning – if it exists – is often vague. For example, Gomez and Maicas (2011) and Gomez, Lanzolla, and Maicas (2016) recognize different concepts of time used in the entry-timing literature, but they do not provide much reasoning why they selected to use nominal rather than continuous measure: "Given that we have 19 independent markets and the first-mover advantage should be related to the order of entry into each of these markets, we define a set of dummy variables that takes into account whether the firm is the pioneer, the second
Theoretical Foundation

entrant, the third entrant or a late follower” (Gomez and Maicas, 2011, p. 1256). Why should entry-timing advantages be related to the order of entry rather than to time since the first entry?

Zachary and colleagues (2015) suggest that continuous measures have become the most popular measure because they are considered to have the highest measurement precision, and that nominal measures are often used because they have been easiest to derive from commonly used PIMS data. It should, however, be understood that these measures have different conceptualization of time. Ancona, Okhuysen, and Perlow (2001) present five different concepts of time used in temporal research: linear clock time, cyclical time, predictable and unpredictable event time, and life cycle time. The continuous measure conceptualizes time as linear clock time and nominal measure as event time (in which competitors’ entries are events). I argue that more attention should be paid that the time measure is better aligned to the underlying dynamic phenomenon.

Although we often consider that things change over the time, the time itself is rarely (if ever) the ultimate driver of the change. Rather time is only a proxy for a (complex) underlying phenomenon that causes the change. For example, the most obvious time-related change to us, human aging does not happen because of passage of time itself but it represents the changes that accumulate over the time e.g. as a result of DNA oxidation and DNA methylation (Lindahl, 1993). Although there is variation between individuals’ aging speed, in a large group we can observe a clear lifecycle pattern. We could still roughly right predict a person’s stage in the ageing process from the passage of time from the person’s birth even if we would not know (and indeed, we still do not fully know) the underlying reasons for ageing. It would be perfectly reasonable proximation to describe human-beings’ ageing as a non-linear function of time. However, describing aging as linear clock time would be a mistake. Similarly, it would be a mistake to apply human’s ageing pattern to other species, such as lobsters, which are arguably considered to be biologically immortal.

Similarly, the changes that social sciences are interested, such as individual learning, do not just happen automatically over the time. It is true that we learn more things when we grow older, but it is not the result of the passage of time itself, but it is the result of schooling and other accumulated experiences.

A typical example of a change over time in the business research is a concept of competitive advantage. Competitive advantages are often considered to be temporary and to erode over the time (e.g. D’Aveni, Dagnino, and Smith, 2010). Similarly Lieberman and Montgomery (2013, p. 321) conclude that “entry order effects on performance diminish over time and can be overcome by competitor actions”. Yet again, it is not the time itself that causes the erosion of competitive advantages (including first-mover advantages) but time is just a proxy that captures the underlying phenomena – one of those being competitors’ actions. Over the time competitors take actions to overcome the isolating mechanisms: for example, competitors may develop a new technology that evades first-mover’s patent protection. In addition to competitors’ actions also other phenomena may erode competitive advantages. For example, one could argue
that consumers, who tend to form a preference for pioneering brands (Carpenter and Nakamoto, 1989), might change their preferences later when they learn more about new products and new brands.

The underlying change process can be linear or non-linear. In business changes are often punctuated, meaning that a long period of relative calmness is followed by a rapid period of change (Loch and Huberman, 1999; Tushman and Anderson, 1986), which can result e.g. in s-curve pattern that is typically observed in technology adoption (Geroski, 2000). In this kind of cases the same amount of clock time (e.g. six months) may have very different impact to the business environment or the firm during the period of calmness and during the period of intense change.

The change can also be continuous (clock time) or non-continuous (event time). The example of latter would be dividing time to before and after 9/11 attacks. Often also the changes that are seemingly continuous consist of small non-continuous events. For example, the changes in the nature of competition are non-continuous stepwise changes with diminishing marginal effects. Initially they are clearly non-continuous event-time changes: the first-mover enjoys a monopoly position which changes when the second company enters the market and an oligopoly is established. The level of competition changes again when third and fourth company enters. Eventually when enough companies have entered and market has become more competitive, an additional entry will change the nature of market only marginally.

Thus, when we study entry timing, we should apply timing measure that aligns to the underlying dynamics we are interested in. For example, if we argue that first-mover’s better performance is due to their price-setting power we should apply stepwise event-time measures (first, second, third entrant etc.) because the level of competition and price-setting power changes with new entrants. However, if we argue that first-mover’s better performance is caused by customer lock-in, the time variable should ideally measure how many new customers entered the market between the first and second (or nth and nth+1th) firm entries. If we know the customer number we should use it directly, but if we do not know it we should probably approximate it e.g. with an s-curve shaped adoption model. (I.e. continuous but non-linear timing.) The linear clock time (e.g. months after the first entry) should be applied only when we expect that the underlying change is constant so that the same amount of clock time (e.g. six months) would have same impact both right after pioneer’s entry and later when the market has taken off and multiple competitors have entered.

In this dissertation, I apply different time measures in different essays, which are described more in details in the Chapter 3.2.

2.3 The literature on technology adoption

Technology adoption literature addresses questions of whether and when a firm should adopt a new technology that has the potential to improve firm performance, either by reducing costs or enabling new revenue sources. For example, Banker et al., (2013) found that in the wireless telecommunication
industry, investments in 3rd generation technology in the USA had a positive effect on profitability, albeit with some delay. The two main questions in this body of literature are focused on the selection among a few competitive technologies (e.g., Greve and Seidel, 2014; Suarez, 2005) and when to adopt a new technology. For example, Simon and Lieberman (2010) investigated when consumer magazines adopted new internet technologies and created online editions.

The idea that a new technology improves performance seems to suggest that all firms should race to adopt the new technology as soon as possible, both in clock time and in relation to competitors (e.g., Lawless and Anderson, 2009). However, in reality, most firms do not do so; rather, technology adoption often follows an s-curve (e.g., Geroski, 2000). Why does that happen if the new technology improves performance? Jensen (1982) presented a model that shows that firms should invest in new technology only when its expected value (i.e., cost savings or the new revenue that it enables multiplied by the probability of obtaining that value) exceeds its costs. Both the cost of the new technology and uncertainty about its benefits decrease over time, which improves the expected value. However, this process, particularly the reduction in uncertainty, does not happen at same speed for everyone, and thus, firms find it beneficial to invest in the new technology at different times.

Hoppe (2002) proposed that a firm considering adopting a new technology must strike a balance between the interaction with competitors in the product market (i.e., potential first-mover advantages) and uncertainty concerning the value of the new technology. Together, these two perspectives suggest different timing decisions. The first perspective, potential first-mover advantages at the product market, often suggests – as discussed earlier - that early movers can often utilize isolation mechanisms and build competitive advantages. The latter perspective, uncertainty, often suggests to delay the technology adoption until the technology has been proven valuable. Hoppe (2002) elaborates on how uncertainty influences the timing decision:

“\textit{In the presence of uncertainty, the expected post-adoption profit depends on the belief that the adoption of the new technology is profitable. A firm will find it optimal to adopt if and only if the current estimate of the likelihood that the innovation is profitable exceeds a reservation level and if it is not more profitable to wait for new information or the arrival of better technology. That is, uncertainty about the value of a new technology reduces or increases a firm’s adoption incentive at any date, depending on whether beliefs are pessimistic or optimistic, whereas the possibility of resolving uncertainty over time by collecting information about the unknown value or the arrival of better technology unambiguously introduces an incentive to delay adoption. The uncertainty may also be reduced by observing the experience of other adopters, which generates an incentive to wait until another firm moves first.}” (Hoppe, 2002, p. 59).
For example, Eggers and Kaplan (2009) describe how communication technology firms deciding to enter into fiber optic technology faced a decision between the attractiveness and uncertainty of the new market opportunity:

“On the one hand, incentives to adopt optics were high due to the attractiveness of the technology to a critical set of communication technology firms’ customers, the telecommunications service providers (carriers) [...] On the other hand, despite the potential attractiveness of the opportunity, there was still a great deal of risk and uncertainty present. [The new technology was] not the kind of incremental improvement that all incumbent firms would logically be expected to adopt quickly and efficiently. Outcomes were uncertain because, especially in the early days, it was not clear which specific technologies should be pursued nor whether the complex equipment would work. Because investment costs to enter the fiber-optic product market were extremely high, the technological uncertainties presented the incumbent firms with a risky choice.” (Eggers and Kaplan, 2009, p. 466).

The uncertainty that prevails before the entry decision may continue after the technology adoption. However, uncertainty eventually reduces – it becomes clearer whether the technology is valuable or not – and post-entry performance is influenced by this materialized outcome. An early adopter risks investing in immature technology or even selecting an entirely wrong technology. For example, Dowell and Swaminathan (2006) showed that early entrants that had invested in a wrong technology often stuck with it for too long and were ultimately less likely to survive. The uncertainty regarding the value of a new technology can be split further into technological uncertainty and revenue uncertainty. Murto (2007) showed that the uncertainty of revenue, rather than uncertainty on the technology itself, makes investing in new technology less attractive than waiting.

Many technology-enabled product markets – such as personal computers or video games – have two characteristics: they are characterized by generational technology change, and they are platform-based markets (Zhu and Iansiti, 2012). When the providers of enabling technologies (such as Intel for microprocessors or Sony for a gaming platforms) release a new, improved version of their technology, product providers (such as PC manufacturers and game developers) must decide whether and when they will start making products based on the new technology. The same general uncertainty regarding the value of the new technology applies also to generational technologies, but in addition, in generational technologies, firms have incentives to delay the adoption of a new generation of technology until that technology is sufficiently advanced compared with previous generations and potential following generations (Doraszelski, 2004; Farzin, Huisman, and Kort, 1998). A platform technology ecosystem consists of a core element (such as a video game platform) and a group of complementary products (such as video games) that together provide value for the customer. Without complementary products, there is very little value in the platform product. For example, a new wireless
telecommunication network needs wireless phones and mobile applications to create a meaningful new consumer experience. Thus, to succeed, platform providers must have both consumers and complementary product providers on board (Zhu and Iansiti, 2012). Thus, platform adoption is driven by the availability and users of complementary products (Cenamor, Usero, and Fernández, 2013), which, indeed, may often form the greatest uncertainty regarding the commercial success of the new technology.

2.4 The literature on organizational learning

Organizational learning is often defined as change in an organization that occurs as a function of its experience (e.g., Argote and Todorova, 2007). It can be change in knowledge, routines, or potential behavior. Learning should reduce uncertainty and improve routines such that firm performance improves (Cyert and March, 1963; Huber, 1991; Levitt and March, 1988). In this context, the results of organizational learning could result as a change in market-entry timing so that it improves firm’s post-entry performance. For example, Simon and Lieberman (2010) investigated consumer magazines’ adoption of new internet technologies and creation of online editions. They showed that the more experience a publisher had on adopting internet technologies for its magazines, the shorter was the time for the subsequent adoption.

An organization’s own experience is not the only mode of learning. Baum, Li, and Usher (2000) described how organizations also learn vicariously from the experiences of other organizations. When decision-makers have insufficient information from their own experience they try to reduce uncertainty by looking what others are doing and trying to interpret the outcomes of the actions. Experiential learning often leads organizations to replicate their own prior actions, and vicarious learning from others’ actions often leads organizations to imitate others’ actions (Baum et al., 2000). That is, learning reduces uncertainty and confirms the viability of the new market. However, learning from failures can sometimes be even more valuable than learning from success (Popper, 1959). Organizations learn vicariously so that they can avoid competitors’ specific strategies or actions instead of just automatically imitating what competitors do (Baum and Dahlin, 2007).

Organizational learning may have different levels of rationality. Greve (2013) describes four main behavioral strategies. Those following momentum strategies tend to repeat their actions without consideration for outcomes. Those following feedback strategies continue and extend their own actions that are associated for positive feedback and reduce actions that are associated for negative feedback. Inferential strategies interpret signals from other organizations’ activities. The simplest form of this is mimicking others’ actions – the wide adoption of a new practice can be seen as a positive signal of its value. The fourth level of behavior, anticipatory strategies predict others’ actions and own actions are chosen based on this prediction. In this dissertation, I assume managers followed at least feedback strategies.
One of the key organizational learning processes is learning feedback, whereby organizations observe the outcomes of their (or others’) actions and adjust their behavior accordingly (Cyert and March, 1963; Greve, 2003). However, the feedback can be biased, such as when there is a long lead time from the action to the outcome. For example, Schwab (2007) describes how baseball teams introduced a new practice of maintaining a farm team network. Many industry insiders considered that it would have positive impact but that it would take up to four years until the performance improvement would be visible. However, baseball teams did not let sufficient time pass before assessing the effects of prior changes; they adjusted the size of their farm team network based on early perception on performance (Schwab, 2007).

March and Olsen (1975) presented a model on how the organizational learning feedback loop can be biased. A complete feedback loop spans from an individual’s cognition (e.g., a manager’s view of growth opportunities) to an individual’s action (e.g., a manager’s initiative taking), to organizational action (e.g., investment in new technology), to environmental feedback (e.g., sales of new products), and back to an individual’s cognition (e.g., a manager’s view of growth opportunities). All four of these links can be disconnected. The link between an individual’s cognition and behavior is broken if the change in cognition does not change behavior. This can be case if one’s behavior is role constrained. If changes in an individual’s action no longer affect organizational action, the learning is called audience learning. If the connections between actions and outcomes are misspecified, learning is superstitious such that an individual’s subjective learning is compelling but based on the observed outcomes that are wrongly credited to be result of prior actions. Finally, if the link between environmental outcomes and individual beliefs is disconnected, the learning can be ambiguous such that individuals are “operating under conditions in which (a) what happened is not immediately obvious, (b) why it happened is obscure, and (c) whether what happened is good is unclear” (March and Olsen, 1975, p. 161).

Organizational learning in multinational companies has an additional challenge: an organization’s prior actions and experience may have accumulated in one unit, country, or context, but the lessons learned must be applied in another. Thus, the knowledge has to be transferred between the subsidiaries or between the subsidiaries and the headquarters. This transfer is most effective if the receiver and sender are similar enough so that they have similar enough prior knowledge and when the knowledge would be useful both for the sender and the receiver (Kostova, 1999). For example, Perkins (2014) found that telecommunication operators that entered Brazil performed better if their parent company had prior experience in markets whose telecommunication markets were institutionally similar to Brazil’s.

### 2.5 The literature on opportunity costs

Only a new firm that enters its first geographical market with its first product can decide on its entry without considering its existing business. All other firms
have to decide how to balance their existing and new businesses. Cooper, Edgett, and Kleinschmidt (1999) described how product portfolio decisions are considered resource allocation choices in product management literature.

“Portfolio management is about making strategic choices — which markets, products, and technologies our business will invest in. It is about resource allocation—how you will spend your scarce engineering, R&D, and marketing resources. It focuses on project selection—on which new product or development projects you choose from the many opportunities you face. And it deals with balance—having the right balance between numbers of projects you do and the resources or capabilities you have available.” (Cooper, Edgett, & Kleinschmidt, 1999, p. 333).

A similar question, also concerning the allocation of scarce resources to different business units, has been studied in the corporate portfolio management literature (e.g., Nippa et al., 2012). More generally, opportunity cost theory, one of the key concepts of microeconomics, asserts that when one makes a choice between mutually exclusive alternatives, one must consider not only the profitability of the selected alternative itself but also the loss of potential benefits from other alternatives. In other words, if one selects the second-best alternative, which itself may be beneficial and profitable, the opportunity cost represents the missed value of the best alternative, and thus, the overall outcome is negative.

As far as firms’ investment decisions are concerned, opportunity costs are particularly valid when the alternative investments rely on the same non-scale-free resources. Resources are considered scale-free if they can be used in alternative activities so that their value elsewhere is not reduced. Examples may include things such as brands or patents. However, many of firms’ valuable resources and capabilities are scarce and cannot be scaled. They are thus subject to opportunity costs, and their use for one product or project precludes their use for another product or project (Levinthal and Wu, 2010). Examples may include things such as efficient management teams, product development expertise, or prime retail locations.

Levinthal and Wu (2010) also argued, based on Penrose’s (1959) resource-based reasoning on firms’ growth, that future growth opportunities in the existing markets determine when a firm should diversify to a new market. Penrose (1959) argued that firms diversify to new industries when they have excess capabilities that cannot be utilized in the current industry. These excess capabilities may be under-utilized discrete investments, such as physical plants, or results from managerial learning. Levinthal and Wu (2010, p. 782) argued that “complete account of excess capacity of capabilities should take into account not only internal growth in firm-specific capabilities but also the change in external opportunities across different markets” and examined how the demand dynamics influence a firm’s resource allocation and performance. They concluded that
“Underutilized capacity becomes available when the growth opportunities in the current market cannot keep pace with the internal growth of capabilities. The maturity of the current market relative to other potential markets could either reduce the value of applying non-scale-free capabilities in the current market or raise the opportunity cost of not applying some of these capabilities in related product markets. It is in this sense that resources become ‘underutilized’ or ‘excess.’ Alternatively, if the current market continues to offer sufficiently favorable opportunities, it will not be economically rational to divert non-scale-free resources into other industries as long as there is any imperfect fungibility in the value of capabilities when applied to other domains.” (Levinthal and Wu, 2010, p. 782).

Capabilities’ fungibility refers to how valuable capabilities are when they are transferred from their original context to a new context. Levinthal and Wu’s (2010) conclusion indicates that if there are non-scale-free assets or capabilities that cannot be used elsewhere without a loss of value, the firm should not enter a new industry (or new market) unless it has an excess of those assets or capabilities. However, according to Levinthal and Wu (2010), at least in the diversification literature, firms’ resources are often (implicitly and often mistakenly) treated as being scale-free.

For the Essay #2 I reviewed same 105 articles that Zachary and colleagues (2015) considered as forming the core body of the entry-timing literature. I concluded that in these articles the researchers had paid very little attention to the trade-off between the growth opportunities in existing and new markets. With the exception of few cannibalization studies, researchers do not usually consider firms’ existing products and markets, and none of the 105 core studies explicitly investigated the opportunity cost of forgoing other growth opportunities.

A typical example of a market entry effect study is Hawk and colleagues’ (2013) prominent article on entry timing in the Atlantic Basin liquefied natural gas (LNG) submarket. They recognize that Atlantic Basin LNG is not the only gas and oil field construction project that the firms have and that talent for LNG projects is limited and firms have to decide how to allocate their rare talent to different projects. Thus, the firm level performance (such as cumulative abnormal stock-market returns that Hawk and colleagues (2013) apply) does not only reflect if the selected new project is profitable itself but also how profitable if it is compared to firm’s other investment opportunities. The stock market reaction to market entry to Atlantic Basin LNG should thus be positive for a firm that forgoes less-promising investment opportunities and negative for a firm that forgoes a more promising investment opportunity. However, this is something that Hawk and colleagues (2013), or any other entry-timing researcher, does not take in account. Empirically this is somewhat understandable given that for an outside observer it is often difficult to identify forgone investment opportunities.
However, there is one situation in which firm’s investment options should be clearly identifiable: when a firm has to decide its allocation of investments between its existing and new markets. This shall especially be a case for generational products, such as computers, where both legacy products and new products are likely to utilize same R&D resources, marketing and sales channels, etc. Thus, in this dissertation I focus to investigate one specific opportunity costs, the trade-off between investing in existing and new markets or products.

2.6 The summary of the dissertation’s theoretical basis

In this chapter, I summarize my theoretical predictions for my four research questions.

Research Question 1: How does the uncertainty concerning the new market potential influence new market entry timing?

Hoppe (2002) argued that uncertainty regarding the value (or viability) of a new technology favors those who wait longer until the uncertainty has reduced. Decision makers are usually risk averse, so everything else held constant, they would prefer an option with less uncertainty. Thus, the higher the uncertainty, the more likely the firm is to wait until uncertainty reduces and the less likely it is to enter the market. The change in the level of uncertainty should thus influence a firm’s entry timing. When uncertainty reduces and the new practice or technology is perceived favorably, a firm is more likely to enter the market and vice versa.

Empirical research faces a challenge how to measure uncertainty. To overcome this challenge, I derive from organizational learning literature that poses that learning from either from own or others’ prior experience reduces uncertainty and thus advances organization’s adoption of a new technology or a new practice (e.g., Baum et al., 2000; Simon and Lieberman, 2010).

Thus, I predict that operators will learn from their experience and more they have learnt the more they will adjust their entry timing. However, the main difference to previous studies is that the uncertainty regarding the viability of the new market was very high and remained very high for several years. (Next chapter 3.1. discusses more about this.) In prior studies, the new practices or new technologies have been valuable and thus learning on them has advanced the further adoption. What happens when environment seems ambiguous and it is not obvious if the new technology is good or bad? In ambiguous environments, connections between actions and their outcomes easily become unclear, especially if there is long lead-time and mixed signals. In this situation, biased performance feedback can happen, as described by March and Olsen (1975).

In Essay #3, I present an elaborated model that also considers how uncertainty changes differently over the time for experiential and vicarious learning. I predict that when uncertainty is high, learning from own experience will accelerate the action but – in contrast to prior research – learning from
others’ experience will delay the action because, under these conditions, firms will perceive competitors’ outcomes negatively but own outcomes positively.

Research Question 2: How does the timing in relation to the uncertainty concerning the new market potential influence new market entry performance?

Deriving from Hoppe’s (2002) conclusions, I expect that in Essay #1 I will find that the performance of new technology adoption is dependent both on timing in relation to competitors’ actions and timing in relation to market uncertainty. I predict that these two mechanisms will have different performance effects. Those who enter the market earlier than competitors should enjoy early-mover advantages, as suggested by majority of entry-timing studies. However, simultaneously, those who enter late in relation to market uncertainty should also enjoy improved performance. I expect that in most of the earlier research, the uncertainty regarding the new market has been reasonably low, and thus, the latter sub-effect – late-mover advantages because of uncertainty – has been negligible or small. However, sometimes, such as in my research context, that effect should have a significant influence on combined entry-timing effects.

Research Question 3: How does growth in existing market (i.e., opportunity costs) influence new market entry timing?

Research Question 4: How does the timing in relation to the growth in existing market (i.e., opportunity costs) influence new market entry performance?

Based on the discussion on opportunity cost, particularly on Levinthal and Wu’s (2010) research on demand dynamics and diversification performance, I predict in Essay #2 that the fast growth in an existing market will reduce post-entry performance in the new market. In Essay #3, I predict that firms also adjust their behavior accordingly: the faster the existing market growth is, the less likely they are to enter to the new market.

A product based on a new technology generation is likely to rely on the same non-scale-free assets and competences as earlier product generation. It is probably managed by the same management team, uses the same R&D resources, is marketed and sold through same channels, etc. Although the assets and competences can be allocated more easily from an old product to support a new product generation than to support an entirely new industry, they are still not perfectly fungible. Engineers need to learn the new technology, sales personnel need to learn to sell the new product, etc. Thus, following Levinthal and Wu’s (2010) arguments, I predict that firm-level post-entry performance is worse when the existing market growth is fast.

I furthermore predict that this effect is stronger for early movers than for late movers. In Essay #2, I present a model that complements Suarez and Lanzolla (2007), who argued that that fast growth is a disabler for first-mover
advantages. I argue that fast growth is enabler for late-mover advantages. In particular, early movers’ investments in buyer education have a greater impact when market growth is fast and thus increase late movers’ advantages from free-riding.

For the behavioral part, I expect that firms are aware of this issue and that they adjust their entry timing accordingly without any major biases. The faster the existing market grows, the later the firm enters the new market if all other things are the same.

I expect that the importance of opportunity costs varies between different types of market entries depending on how much entries rely on the same non-scale-free imperfectly fungible resources and competences. For example, I would not expect that a retail chain’s expansion to new countries (e.g., Gielens and Dekimpe, 2007) would have significant resource allocation and opportunity cost issues. The retail chain would have separate staff, marketing channels, etc. in both new and old countries. However, I would expect that this issue would be more relevant, e.g., when an oil and gas company allocates its rare talent to constructing new drilling operations (e.g., Hawk et al., 2013). In that case, the different options would be mutually more exclusive. In my context, both the old product and the new product rely on the same resources and are to some extent targeted to the same customers. Thus, the resources allocation dilemma should be particularly relevant.
3. Data and Methods

3.1 Industry context

All three essays are based on the same quantitative data on wireless telecommunication operators’ adoption of 3G WCDMA technology and launch of fast data services enabling “mobile internet” from 2000–2012. Wireless telecommunication is particularly good setting to study entry-timing effects in multinational companies for several reasons.

First, the data availability and quality are particularly good. There is a limited amount of radio frequencies that can be allocated to wireless telecommunication, which means that the industry is regulated everywhere and that regulators collect a considerable amount of operative and financial data – such as market shares, prices and technologies used – to supervise the oligopolistic competitive situation. This means that selection and survival biases that are often problematic in entry-timing research should not be an issue. Telecommunication services are also based on standardized generational platforms, which means that defining where a new market begins and when each firm entered the new market is easier than in industries where the changes in products are more gradual1.

Second, although each individual wireless telecommunication operator is limited to operating in only one market, local operators, such as Vodafone Spain or T-Mobile USA, are often part of larger group, such as Vodafone or Deutsche Telekom. The wireless telecommunication industry consolidated quickly in the 1990s and 2000s; for example, British Vodafone had stakes in 61 operators worldwide and Norwegian Telenor had stakes in 38 operators during the period studied. The availability of detailed subsidiary-level information on market entry timing and performance makes it possible to study organizational learning and multi-level effects in MNC. Furthermore, the dataset has altogether 236 countries – although a smaller subset of 60-80 countries is used in the essays – which makes this sample remarkably more international than most prior studies on entry timing, where researchers have used mostly North American samples.

Third, the entry-timing effects of 3G WCDMA were not simply “the earlier the better” but the industry had three clearly different periods. The 2000–02 period witnessed high initial investment and high expectations on returns. From 2002–

1 However, the industry borders and product lines will become more complex also in this industry if the market definition is expanded such that, e.g., open WIFI- services and internet telecommunication service providers such as Skype are included.
a lack of smartphones and mobile applications delayed consumer adoption, which caused huge uncertainty regarding the viability of 3G and massive losses to operators. However, finally, from 2007 and onwards, the introduction of iPhone and Android eventually fulfilled the early promises. The brief development of the industry will be described later.

The wireless telecommunication industry also has some challenges in studying entry timing. As the number of radio frequency bands allocated to telecommunication systems is limited, the number of operators is also limited and regulated. The national telecommunication regulators thus allocated 3G wireless telecommunication operation licenses either through auctions or by a beauty-contest. Thus, in some countries, entry became a two-staged process where the operator should decide whether to apply for a license and, if it got the license, when to construct a network. The licensing process led to competition especially in the UK, where 13 bidders competed for 5 licenses, and in Germany, where seven bidders showed up to bid for 4-6 licenses. However, in most other countries, there was remarkably less competition. For example, France chose to allocate four licenses, but its market attracted only two qualified applicants in 2000. Then, the third 3G license was allocated in 2002, and finally, the fourth 3G operator entered in 2009. While it is technically possible to allocate spectrum to at least six operators, most countries have three or four 3G operators. Thus, while there were undeniable regulatory entry barriers in at least some markets, the issue was not very widely spread: in most markets, all operators who wanted a license got one. Furthermore, it should be noted that in this study, I am interested not in new entrants but in the timing decisions of incumbent operators to adopt the new technology generation. Almost all incumbent 2G operators in the included countries launched 3G networks, and very few incumbent operators who applied for a 3G license failed to get one. These rare exceptions included, e.g., Telenor’s Sonofon in Denmark, which later acquired a competitor with a 3G license. Thus, I do not see that the license application process itself would have biased the research set-up significantly. In addition, the licenses often established some time limits by which the new networks had to be constructed. However, in reality, given the concerns on the viability of 3G, these deadlines were not strictly enforced. For example, in Spain licenses would have required networks to be operational in 2003, but three operators launched their networks in 2004 and Sonera’s Yoigo in 2006. Furthermore, if enforced, the deadlines applied similarly to all operators within a country and would not explain within-country variation in timing or performance. Thus, I do not consider that these regulatory aspects can introduce significant bias into my analysis.

Commercial radiotelephone systems have existed since the 1940s, but the modern industry is seen to start when the automated first generation (1G) analogical wireless telecommunication systems were launched first in Japan by NTT in 1979, followed by Scandinavian countries in 1981 and the USA in 1983. These systems were used only for voice communication. The industry got a major boost in the 1990s when the second generation (2G) digital networks were introduced, which included digital cellular telephony and high-speed data transmission.

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2 These 1G technologies included, e.g., AMPS, TACS, ETACS, NMT and C-450.
introduced first in Finland in 1991 and soon thereafter elsewhere. The 2G networks were significantly more efficient than earlier networks. At the same time, the telecommunication industry was deregulated in many countries, and together, these factors drove down the price, which increased demand and enabled further efficiencies of scale. Out of the many 2G standards\(^3\), GSM and CDMA emerged as dominant standards. These 2G networks had some data transmission capabilities, but they were still mostly used for voice communication. The explosive growth of (2G) mobile phones and (fixed) internet during the 1990s created a vision of “mobile internet”, and around the millennium, technology vendors introduced new third generation (3G) network technologies\(^4\), which enabled fast data communication and thus “mobile internet.” Industry expectations were very high for the new era of mobile services. Nokia (2000) marketed 3G infrastructure by forecasting that 3G would double operators’ average revenue per user (ARPU); Merrill Lynch (2000) forecasted a similar increase in ARPU from approximately $37 in 2000 to $66 in 2010, and industry participants overwhelmingly agreed with these views (UMTS Forum, 2000). For example, Spanish Telefonica (2001, p. 7) considered that “the launch […] of new technologies and the design of new services is […] a tremendous opportunity”, and similarly, Finnish Sonera (2001, p. 5) predicted that “the next generation mobile networks […] represent significant new earnings potential.” Dutch KPN (2001, p. 13) described its 3G strategy simply as its intent “to supply UMTS services as soon as possible”, which is not surprising given that the telecommunications industry is considered to have strong first-mover advantages (e.g., Jakopin and Klein, 2012). In the UK, operators spent £22 billion when bidding for 3G licenses in April 2000, and huge investments for the new technology followed globally. For example, British Vodafone spent £18 billion buying licenses and building networks in Europe between 2000 and 2006 (O’Brien, 2006), and in total, the industry investment was in the ballpark of 200€ billion (Economist, 2004).

The first 3G WCDMA network was launched by NTT DoCoMo in Japan in 2001. However, despite NTT’s moderate success, 3G’s early outcomes were largely disappointing. The early infrastructure had reliability problems, devices did not attract consumers, and mobile applications were “embryonic.” Thus, many operators postponed their 3G launches first from 2002 to 2003 and then to 2004 and later (Economist, 2004). Eventually, when the networks were launched, consumer adoption remained slow. For example, in the first quarter of 2006, more than half of subscribers in my sample’s operators’ networks could have used 3G, but only three percent did so. At that point, Vodafone received only 3.8 percent of revenue from 3G, and rather than increasing, its ARPU had dropped by 25 percent. Hutchison from Hong Kong posted a total loss of $11 billion on its 3G operations between 2003 and 2005, and both Deutsche Telecom of Germany and KPN wrote down 5.4€ billion of 3G investments (O’Brien, 2006). Investments in 3G significantly increased operators’ debt level,

\(^3\) 2G standards included, e.g., GSM, TDMA, cdmaOne, PHS, PDC and iDen.

\(^4\) There are three 3G standards: WCDMA, CDMA 1xEV-DO, and TDSCDMA. In this study, I analyze only the adoption of WCDMA, which is by far the most popular standard.
forcing them to refocus and restructure (van Kranenburg and Hagedoorn, 2008). It is no surprise that The Economist (2004) called the situation “the biggest ever gamble on the introduction of a new technology.” The New York Times was equally skeptical in July 2006: “the modest gains 3G has made do not begin to justify the massive costs of the technology, which has strapped some mobile operators financially” (O’Brien, 2006). Operators that did not invest in 3G claimed to be the winners: “Not getting that 3G license was […] the best thing that could have ever happened for [Debitel in Germany]. Not only was the technology bought for way too much money, the operators still don’t really know what to do with it.” Industry observers had similar comments. One venture capitalist considered “a 3G license to be a liability, not a plus,” in agreement with one professor who stated that “3G has still not found a reason to be” (O’Brien, 2006).

However, at that same point in time when outsiders and less experienced operators were still pessimistic, the perception of 3G among the most experienced operators was already changing. “It was overhyped at the beginning, and we foundered for a few years, but we are now seeing light at the end of the tunnel,” said the CTO of French Orange. “Yes, 3G was worth it, it is the technology platform of the future,” asserted a strategy director in Vodafone, and the CEO of German T-Mobile concluded, “if I had the chance to do it over again, I would still get a 3G license” (O’Brien, 2006). Eventually, these more optimistic visions became fulfilled. Apple introduced the iPhone in 2007, and the first smart phone based on Google’s Android operating system was launched in 2008.

3.2 Data, variables, and methods

Sample

My data source is the wireless telecommunication operator industry association GSMA’s statistics5, covering almost the whole industry. The full dataset consists of quarterly observations from 2000 to 2012, with 977 wireless telecommunication operators in 236 countries. The dataset includes financial and operational data including e.g. operators’ wireless revenue, subscriber numbers, technologies used, and ownership information. The data used in different essays varies to some extent and variables are described more in detail in each essay. The data originate from operators’ quarterly public reporting, which in most countries is required by telecommunication regulators and should thus cover the whole industry and be relatively correct. The whole sample is not used in any of the studies, but the countries and operators included are limited so that the smallest (under 200,000 3G subscribers at the end of 2012) and non-competitive markets (with only one 2G or 3G operator) are excluded. Similarly, the countries where technologies other than 2G GSM and 3G WCDMA were widely used are sometimes excluded, as the new

5 See: https://gsmaintelligence.com/
technology adoption there may have been subject to different technological
development. The number of countries in Essays #1 and #3 is less than that in
Essay #2. This is because in those essays, I use Perkins’ (2014)
telecommunication regulatory dimensions to measure related and non-related
experiences, and those dimensions are available only for 80 countries. This
means that the number of countries included in the essays varies from 64 to 81.
(See Table 1).

I include operators from these countries that had a 2G GSM network at the
beginning of 2000 or entered the market with 2G GSM during the study period.
That is, the operators that used different 2G and 3G technologies are not
included because their entry dynamics may have been quite different.
Additionally, so-called greenfield operators that entered a market with a 3G
technology are excluded because their market entry decision was slightly
different, “when to enter the focal country” rather than “when to adopt the new
technology generation in the local country”. In addition, niche operators that
never reached a 5% market share are excluded because operators that focus on
a small segment (say, business users) or smaller areas (say, remote rural areas)
may also have quite different dynamics. In performance studies, I include only
the operators that launched 3G during the study period so that I can measure
their performance. The number of operators included varies from 179 to 218
across essays. (See Table 1).

In the behavioral model of Essay #1, the number of observations is less than
the number of firms because some firms lacked observations on revenue. Essay
#3 also includes ten operators that had a 2G network and were “at risk of
launching 3G” but exited the market before their 3G launch. Usually these
operators were acquired by another local operator, such as Dutch Telford by
KPN, Orange in Denmark by Telenor, or BellSouth by Telefonica in many South
American countries. As these operators do not have 3G market entry time or
post-entry performance, they are not included in the other essays.

**Dependent variables**

My essays include both behavioral and performance-related dependent
variables. The behavioral dependent variable is timing, which refers to the time
at which the operator launched its 3G services. In Essay #3, I follow a typical
event-history approach (e.g. Beck, Brüderl, and Woywode, 2008) so that the
dependent variable is operator’s 3G launch during the quarter and the variable
is coded with a value of 1 for the quarter wherein the operator reported its first
3G customers, and all other periods (in which the operator existed) have been
coded with a value of 0. After the operator has launched 3G, it does not remain
at risk and is therefore removed from the sample.

In the performance models (Essays #1 and #2) I use change in the total market
share as a dependent variable. Market entry performance could be measured as
profitability, market share, or survival (Fosfuri et al., 2013). Although
profitability would be theoretically the most correct measure (e.g., Lieberman
and Montgomery, 1998), it is unfortunately not reliably available to all
subsidiary operators in the sample. However, telecommunication business has notable scale benefits. Initial investments to network are big, but the marginal costs of providing service to a new subscriber are modest. Thus, prior research has noted a strong correlation between market share and profitability in the wireless telecommunications industry (e.g., Gomez and Maicas, 2011).

There has been lot of discussion in social sciences how the change should be measured of if the change can be used dependent variable at all (e.g. Allison, 1990; Bergh and Fairbank, 2002; Cronbach and Furby, 1970). Two most common change measures are change score method and regressor variable method. In both measures the variable Y is measured at different time points and the difference Y2-Y1 is regressed on independent variables X in both methods, and also on Y, in regressor variable method. I have followed Allison’s (1990) suggestion that regressor variable method is preferable when Y1 has true causal effect on Y2 and the reliability of component variables is high. This issue is discussed more in the methods part of Essay #2.

Product-level market-entry timing studies use often market share in the new product category as a dependent variable. This approach, however, fails to recognize the trade-off between the new products and existing products, which is discussed more deeply in Essay #2 and Research Question 4. A firm that enters a new product category may succeed in obtaining a high market share in that category, but if it has allocated a remarkable part of its resources from its other businesses to the new market or the new product cannibalizes the existing products, the market share gain in the new business may come at the expense of the market share lost in old businesses. Thus, I apply the market share in the total market of both new 3G and older generation wireless telecommunication services.

**Time measures**

I have applied different timing measure in different essays. (See also the section 2.2 of the introduction.) The passage of time itself does not cause the change, but time is a proxy for an underlying (complex) change process. While the continuous linear time (i.e. “clock time”) is most common time measure in the entry-timing literature (Zachary et al., 2015), it would be unrealistic to assume that change process in business would always be linear. Indeed, in business changes are often punctuated, meaning that a long period of relative calmness is followed by a rapid period of change (Loch and Huberman, 1999; Tushman and Anderson, 1986). Typical example is the s-curve pattern that is typically observed in technology adoption (Geroski, 2000). In this kind of cases the same amount of clock time (e.g. six months) may have very different impact during the period of calmness and during the period of intense change.

Thus, I argue that it is not always appropriate to apply a linear time measure in entry-timing research. The impact of entering the market six months after the first entrant may have only a small effect if the consumer demand has not yet taken off, but six months entry delay could be critical if the consumers demand
is high from the beginning. Thus, I argue that the timing measure should be always aligned to what we expect to be underlying change process.

For example, in the performance model of Essay #1, I apply three different timing measures:

- Focal operator’s launch period, which is mathematically equivalent to the time from the first launch in the market (i.e. focal operator’s launch period – first operator’s launch period). This is a continuous time variable.
- Time in relation to competitors’ entries. This is the rarely used ordinal measure. This is scaled so that in each market the first entrant gets value zero and last entrant gets value 1.
- Time in relation to the technology adoption among the consumers. I.e. the time between the two entries is not measured by clock time, but by how much consumer penetration of new products increased between the entries. This is continuous but non-linear measure. Compared to continuous linear time it is stretched at the beginning and at the end, and condensed in the middle.

In the Essay #2, I apply commonly used linear continuous time by measuring the entry time as quarters from the first entry. In the Essay #3, I have two different timing measures: the baseline hazard model is quadratic, i.e. continuous but non-linear measure of time, that approximates the typical s-curve adoption pattern. On top of that the experience, measured as a count of previous launches, forms a stepwise event timing function.

**Independent variables**

In Essay #1, I have separate behavioral and performance models. In the behavioral model, I investigate how operator’s size (measured as its total market size) and its experience (measured as a number of its parent group’s prior 3G launches) influence operator’s entry-timing decisions. In the performance model, I investigate how the entry timing – measured by the three different timing measures described above – influence the entry performance.

In Essay #2, I investigate again how entry timing (measured simply as a clock-time) influences entry performance when the opportunity cost (measured as growth in the existing market) and operator’s focus after the market entry are taken in account.

In Essay #3, I study how operators adjusted their entry timing based learning from their own operator group’s and other operators’ experience. Following common practice experience is operationalized as number of prior 3G launches.

**Control variables**

All essays have control variables to control operator (e.g. average revenue per user, subscriber, market share, age in the market), operator’s parent group (e.g. subsidiaries, connections, debt), and market (e.g. competition, penetration, growth, subscribers) related factors.
Unfortunately, the archival data sets limit also for control variables, and it has not been possible to control e.g. technological capabilities (Franco et al., 2009) or speed capabilities (Hawk et al., 2013) that prior research has suggested to moderate entry-timing advantages. I have controlled knowledge-based capabilities that Gaba, Pan, and Ungson (2002) suggest to moderate entry-timing performance, especially knowledge related to the new technology itself and international experience.

**Table 1**: Summary of data, key variables and methods in all three essays.

<table>
<thead>
<tr>
<th></th>
<th>Essay #1</th>
<th>Essay #2</th>
<th>Essay #3</th>
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<td># of observations (firm-time)</td>
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<td>Total market share change</td>
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<td>Entry timing, prior market growth, operators’ focus after the market entry</td>
<td>Parent group’s and competitors’ prior 3G launches in related and non-related markets</td>
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<tr>
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<td>Stepwise event time</td>
<td>An event time measure, linear clock time, non-linear time measure</td>
<td>Linear clock time</td>
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<tr>
<td>Method</td>
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<td>Cross-sectional time-series Feasible Generalized Least Squares</td>
<td>OLS and IV regressions</td>
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4. Results

In this chapter, I describe what I found regarding my four research questions in my essays. The implications of these findings are discussed in the chapter 5.

4.1 Findings on uncertainty of the new market and new market entry timing (RQ1)

Essay #3 investigates how environmental uncertainty influences market-entry timing. The question poses an empirical challenge on how to measure uncertainty. The use of archival data limits that I cannot measure e.g. managers perceptions on uncertainty at different points of time. To solve this, I draw from organizational learning literature which poses that organizations reduce uncertainty by learning from their own and other's prior actions and the outcomes of those actions. Thus, I investigate how operators “navigated in a fog” by learning from their peers in the same operator group and from their competitors. The assumption is that the more experience operators have gained, less there is uncertainty about the viability of the new market and the new technology. The prior research (e.g., Baum et al., 2000; Simon and Lieberman, 2010) had found that all learning, both from own experience and vicariously from others, had advanced firms’ market entry or new practice adoption timing. This is aligned either with what Greve (2013) describes as “momentum strategy” in which repetition occurs without considering consequences, or with what Greve (2013) describes as “feedback strategy” or “inferential strategy” in which future actions are adjusted based on perceived positive feedback. My empirical findings, however, provide a more complex view. The key difference to earlier studies is that my environment had very high uncertainty regarding the viability of the new business. Similar to prior research, also I find that operators whose parent group had more experience in 3G launched their own 3G networks earlier than operators whose parent group had less experience. This finding suggests that they learned about the viability of the new technology through their peers. However, contrary to prior findings, operators that relied on competitors’ experiences and learned vicariously from them delayed their 3G launches, which indicates that they learned the non-viability of the new technology. This thus confirms that firms attempt to reduce environmental uncertainty by learning and they adjust their entry-timing decisions according what is their perception on the viability of the market/technology.

What would explain why operators learnt differently by observing different actors in my study? During the period when most operators launched 3G, it was
remarkably uncertain whether the new technology and the new service would ever be successful. For example, in 2006, five years after the first 3G launched, the New York Times wondered, “3G cost billions. Will it ever live up to its hype?” (O’Brien, 2006). In that environment, operators that had not launched 3G and could not accrue first-hand experience from the new technology might have been equally skeptical. However, operators that had launched 3G, such as French Orange, were “now seeing light at the end of the tunnel” (O’Brien, 2006). Retrospectively, we can speculate that by that time, operators with 3G had already learned something about Apple’s and Google’s plans to introduce iPhone and Android in coming years. It is likely that this type of positive learning was passed from one subsidiary to other subsidiaries that had not yet launched 3G and that this information influenced operators’ behavior.

4.2 Findings on uncertainty of the new market and new market entry performance (RQ2)

Essay #1 investigates telecommunication operators’ entries to a new 3G telecommunication services market when there was considerable uncertainty regarding the viability of the new 3G technology and business. Based on Hoppe’s (2002) framework, I suggest that entry to a new technology-enabled product category has two entry-timing anchors that have opposite performance effects. Interaction in a product market often favors early entrants, but uncertainty regarding the viability of the new technology and the new market would suggest waiting until uncertainty has reduced.

Similar to the first research question also this question has an empirical challenge on how to measure uncertainty. I decided to apply market penetration of the new technology as a proxy for that. (I.e. percentage of all wireless telecommunication users using the 3G technology in the country.) Rationale for that is that immature technology would not attract users and uncertainty remains high, but when the technology has been proven viable end-users will adopt it. The more widely the technology is used, the less uncertainty there should be regarding its value.

My findings in Essay #1 supported my theorization. Operators’ post-entry performance had two timing anchors: timing in relation to competitors and timing in relation to the uncertainty of the new market. Those that launched the new services early in relation to competitors improved their performance, but so did those operators that launched late in relation to technology penetration. Together, these opposite, but not very strong, entry-timing sub-effects formed a slightly U-shaped but relatively flat total entry-timing effect. Contrary to some earlier views, in this case, it was worst to be a fast follower. Those operators that entered soon after the first entrant were stuck in the middle, so they both failed to benefit from first-mover advantages and also suffered from the immature technology.

I conclude from these findings that environmental uncertainty matters for post-entry performance. Those that entered when the market was less uncertain and more mature performed better than those that took a risk by entering the
market early. Those that entered early may have had to invest more in developing and implementing the new technology, selecting the right complementary product partners, educating customers, and exploring different service offerings and business models, etc. Latecomers could skip this exploration and free-ride by copying the successful technical implementation and business models.

Most importantly, my findings demonstrated that multiple entry-timing anchors matter and can co-exist. Sometimes, performance may depend mostly on an anchor other than competitors’ market entry order. In some cases, there may be multiple anchors that impact performance, and these effects may be opposite such that the total entry-time effect, which is a sum of these sub-effects, may be flat. Part of the inconclusiveness in prior literature could be explained by a myopic focus on entry timing in relation to competitors, while entry timing, e.g., in relation to the industry stage (as a proxy for uncertainty) could have significant and different performance effects.

4.3 Findings on growth in the existing market and new market entry timing (RQ3)

The influence of opportunity costs to entry performance was investigated only very briefly. The existence of alternative growth opportunities, which in this case means fast growth in an operator’s existing 2G market, delays the operator’s entry timing to the new 3G market. This is similar to what prior literature on opportunity costs (e.g., Levinthal and Wu, 2010) has suggested and is thus nothing new as such.

4.4 Findings on growth in the existing market and new market entry performance (RQ4)

Research question four asked whether the growth in existing market influences market entry performance. Essay #2 provides a clear answer that growth in firm’s existing market reduces firm’s new market entry performance. This is what I predicted based on the opportunity cost theory. I investigated a situation where wireless telecommunication operators had to decide whether to invest in the new 3G wireless technology when their existing 2G wireless market was still growing. An introduction of a new generation product is a good context to study the opportunity cost for a couple of reasons. First, a firm’s options are clear – either to invest in growth in an existing product market or invest in a new product generation – unlike e.g., when entering a new country when there could have potentially been dozens of other countries in which the firm did not yet sell its products. Second, both new and old product generations require usually many of the same resources: the same management team usually oversees both products, similar technical skills are required, marketing and sales channels are the same, etc. Wireless telecommunication operators had to decide, e.g., whether they would invest money and technical resources to build a completely new 3G infrastructure or to expand their capacity and coverage of the existing
2G network. They had to decide whether their marketing would target (upgrade) customers who wanted to buy expensive new 3G products and services or target (new) customers who wanted more affordable older 2G services.

Essay #2 finds that the growth speed of the existing market had a clear negative relation to post-entry performance, which was measured as the market share change two years after the operator’s 3G launch. If an operator introduced 3G services when the 2G market was still growing fast, its performance suffered. It is worth of noticing that the performance measure is relative to other firms in the same market. I.e. it does not necessarily mean that the absolute performance, for example profits, would have been negative. This indicates that an operator who invested in 3G while 2G was still growing fast was not able to keep growing as fast as its competitors who focused only on 2G. I argue that this happened because when the operator invested in 3G, it could not simultaneously pay enough attention to the still rapidly growing 2G market. Furthermore, I find that this relationship is moderated by the entry time. Keeping the 2G market growth constant, those operators that launched 3G early (measured in clock time since the technology’s global introduction) suffered more from the fast 2G market growth than those operators that introduced 3G later. This further confirms that opportunity costs are likely to play a role here. The introduction of a brand-new technology may require more technical personnel than the introduction of a more matured technology. Similarly, when the 3G services are new and potential customers are not familiar with them, an operator must move large pieces of the marketing budget from 2G to 3G services to educate consumers on the new services. When the services have already long existed in (focal or other) markets, the marketing investment needed for consumer education on 3G will be smaller, and larger shares of the marketing budget can be devoted to supporting the sales of old 2G services.

Essay #2 also demonstrates that ignoring the opportunity cost could lead to a false impression of first-mover advantages. This is especially important for selecting the performance measure for market entry. Performance could be measured at the level of the new product or at the firm level. In Essay #2, the firm-level performance measure shows no entry-time advantages when market growth and other factors are controlled, but the product-level performance measure shows strong first-mover advantages. That is, those that introduced 3G early performed better than late movers in the 3G service category itself but not differently than others in the combined 2G and 3G market. Similarly, the opportunity cost due to the growth in the old product market has a strong negative performance effect if measured at the firm level but no effect if measured at new product category level. That is, 2G growth did not influence performance in the 3G category at all, but the performance in the combined 2G and 3G market was worse if 2G was growing fast when the operator introduced 3G services.

My review of the core body of literature shows that researchers do not usually control for opportunity costs in their set-up. This omitted variable bias may partly explain inconsistent findings in the entry-timing literature. Another warning from these findings is that more attention may be needed to align the
level of performance measures to theorization. The entry-timing literature usually measures performance at either the product level or the firm level (Zachary et al., 2015). These measures do not always point in the same direction: although entry to a new category could be successful per se at the product level, this success may have been achieved by allocating too many resources from the firm’s other markets where performance has suffered; thus, the firm’s total performance impact may even become negative.
5. Discussion

I start by summarizing the findings to research questions, and I follow that with a discussion on theoretical and practical implications, limitations of this study and recommendations for further research.

Research Question 1: *How does the uncertainty concerning the new market potential influence new market entry timing?*

This study found that wireless telecommunication operators attempted to solve ambiguity by learning about market potential both from competitors and from other operators in the same telecommunication group. I found that these two different learning processes had different impacts on timing. Learning from the group’s other subsidiaries’ experiences advanced the market-entry time, and learning vicariously from competitors delayed the market-entry timing. This finding contradicts prior research literature (e.g., Baum and Dahlin, 2007; Simon and Lieberman, 2010), where learning both from own experience and from others’ experience advanced the timing.

Research Question 2: *How does the timing in relation to the uncertainty concerning the new market potential influence new market entry performance?*

I found that uncertainty regarding market potential had a negative impact on post-entry performance. Those that entered market when there was considerable uncertainty regarding the viability of the new market performed worse than those that entered when the uncertainty had been reduced and the market had been proven to be viable. This mechanism favoring late movers existed simultaneously with another mechanism, interaction at the product market, which favored first movers. In other words, the market simultaneously had two different mechanisms that produced opposite performance effects whose combined effect was a weakly U-shaped relationship between entry timing and post-entry performance.

Research Question 3: *How does the growth in existing market (i.e., opportunity costs) influence new market entry timing?*

This research question was studied only briefly because the findings were simple and aligned with expectations: If operators’ existing business was growing fast,
operators delayed their entries to a new business (and probably invested in further growth in the existing market).

Research Question 4: How does the timing in relation to the growth in existing market (i.e., opportunity costs) influence new market entry performance?

If market-entry performance was measured at the firm level, the growth in existing market had a remarkable impact on it. The faster the existing market was growing when a firm entered a new market, the worse the firm’s post-entry performance was. Firms’ old and new markets rely partly on the same non-scale-free resources, which are not fully fungible. Thus, I argue, entry to the new market is disruptive, and although the entry may be successful per se, it decreases performance in the old market and may thus harm overall performance. However, it shall be noted, that if the market-entry performance was measured at product-level the opportunity cost did not have impact on it.

5.1 Theoretical implications

This study has a few key theoretical implications for the literature on market entry timing and its performance effects.

Entry-timing effects have multiple co-existing timing anchors

All three essays confirmed that market entry performance depends on several other timing anchors in addition to timing in relation to competitors. In Essay #1, which focused on this question, I observed entry-timing effects not only in relation to competitors but also in relation to ecosystem maturity or ecosystem uncertainty. The first effect favored early movers, the later effect favored late movers, and in total, the effects of these two sub-effects almost cancelled each other out, and the result was a slightly U-shaped curve.

The key implication of this is that researchers should, as Zachary and colleagues (2015, p. 1404) put it, identify the anchors from a “broader context, including entrants’ resources and capabilities, incumbents’ strength, market attributes, and industry dynamics.” The research on entry-timing effects has so far identified few “empirical regularities” but is still somewhat unclear on when and why there are entry-timing effects (Fosfuri et al., 2013). My suggestion is that researchers might find more “empirical regularities” if they decompose the total entry-timing effect into smaller sub-effects. This is similar to Lieberman and Montgomery's (2013, p. 322) view that researchers should “elucidate particular mechanisms impacting performance in relation to entry order”.

My humble suggestion is that one reason why the research has been so inconclusive and has identified only a few empirical regularities is that it has studied market entry at too high a level. Market entry is more complex than simply being first, second or late in relation to competitors; therefore, so are its performance effects. Decomposing the total effect into smaller sub-effects might
be one way to address this complexity. Ultimately, the overall research question might be a question on what entry-timing sub-effects are important in a particular case, rather than a generic high-level question regarding what would be the best entry time in relation to competitors.

**Entry-timing effects should not be investigated in isolation from firm’s other business**

The earlier research had identified that characteristics of the firm itself (e.g. Franco et al., 2009; Hawk, Pacheco-De-Almeida, and Yeung, 2013) and the new market (e.g. Suarez and Lanzolla, 2007) influence post-entry performance. My finding shows that also the characteristics of firms’ existing business influence post-entry performance. Essay #2 demonstrated that entering a new product category when the existing market grows fast reduces performance. This happens because fast growth in the existing market means that there are fewer excess resources that could be allocated from the old business to the new business without costs. I also demonstrated that if this opportunity cost had not been controlled, we would have had a biased impression of first-mover advantages.

The direct implication is that researchers must control the opportunity costs. One particular point is to control the growth speed of existing markets as a measure of the opportunities that the current business provides. The other, and perhaps even more important, implication is that performance measures need to be carefully aligned with research question. If a firm allocates remarkable part of its resources to entering a new market (product category, country, etc.) early, it may gain first-mover advantages and improve its performance in that particular market; however, this may come at the expense of the firm’s overall performance. Thus, if the research question is a firm-level question such as “when a firm should enter a new market (in order to maximize its performance)”, the performance measure should also be firm-level performance, which shall take into account the opportunity costs. Only if the research question is specific to the new market should product-level performance measures be used. This performance measure issue should have a particular impact on data collection. Researchers often use – for the understandable reason of convenience – product category data and apply category market shares as an entry performance measure. Indeed, approximately one third of entry-timing studies analyzed only product-level outcomes (Zachary et al., 2015). While this approach is easy, it must be seriously questioned whether it systematically biases the results and incorrectly identifies early-mover advantages.

**The measures for entry-timing should be aligned to underlying phenomena**

I argued in the chapter 2.2 that the purpose of timing measures is to be a proxy for complex underlying phenomena for which we do not have direct data. This
study demonstrated that different timing measures could and should be used in different situations. There is no universal rule that a certain measure, such as linear continuous clock-time, would be always better. Rather the timing measure should be aligned to the dynamics of underlying phenomena. I believe that the current practice of using either linear clock-time (e.g. months since the pioneer’s entry) or nominal time measures (e.g. dummy for first-entrants) without much theoretical justification for the choice of measures is leading to biased findings or at least inadequate understanding of all entry-timing effects.

I demonstrated in my essays the application of several different timing measures. I applied linear (Essay #2) and curvilinear (Essay #3) clock time. The reason for applying curvilinear, inverted U-shaped clock time in the Essay #3 was the typical s-curve pattern of new technology adoption, which means that one month (or other period of time) in the middle of the change is more important than one month at the early or late in the adoption curve. In Essay #2 I did not have better theory so I applied the linear clock time as a “default option”.

I demonstrated that can have different function types. In Essay #1, I applied entry-timing in relation to competitors in two ways: the linear clock time (i.e. time from first launch) was not statistically significant, but the launch position (measured as a rarely used ordinal variable, which was scaled so that first launch was always zero and last launch always 1) was statistically significant.

I demonstrated also that timing can be related also to other anchors, not only to competitors’ entries. This is probably the most controversial finding as we do not necessary consider e.g. existing market growth as a timing variable. However, it is a relevant question to ask if one should enter a new market when the existing market growth is fast or slow. We know also that changes in market growth are not random, but follow somewhat predictable patterns over the time – such as the familiar s-curve pattern in technology adoption (Geroski, 2000) – that essentially becomes a more classic question of timing: should one enter now when the growth is fast, or later when the growth is slow. Or if one still feels uncomfortable with advises such as “right time to enter new market is when the existing market growth has dropped below x%”, one could always apply clock time measures where the clock time starts not from first competitor entry, but e.g. from the point of time when the growth in existing market dropped below certain point.

Nevertheless, I demonstrated in Essay #1 that timing in relation to technology adoption among consumers matters. I.e. the time between the two entries is not measured by clock time, but by how much consumer penetration of new products increased between the entries. This is continuous but non-linear measure. In Essay #2 I demonstrated that the new market entry performance was influenced by the timing in relation to the growth in existing market, which is also continuous non-linear measure. Essay #3 I demonstrated that the timing in relation to firm’s prior experience influenced new market entry behavior. The experience, measured as a count of previous launches, forms a stepwise event timing function.
Entry timing is a multi-level phenomenon

I found that operators’ entry-timing decisions were impacted by organizational learning from the other subsidiaries in the same telecommunication group. This echoes Zachary’s and colleagues’ (2015) conclusion that researchers should more often implement multi-level research designs to fully understand how different levels influence entry-timing decisions and post-entry performance. In particular, I would encourage researchers to pay attention to different entry-timing advantages at the different levels. A subsidiary that is first to introduce a new product in its focal market may suffer from early-entrant disadvantages, but through organizational learning, its parent group and thus the group’s other subsidiaries may gain valuable information that helps them improve the product and adjust their own entry timing. Thus, the first-entrant subsidiary has focal early-mover disadvantages, but it simultaneously enables its group to have global early-mover advantages. Which one should we pay attention to in entry research? Indeed, Miller and Folta (2002) suggest that especially when there is considerable uncertainty about a new product, firms often make initial foothold investments in one market and, based on what they learn, decide whether and when they will introduce the product in other markets. This means that if this kind of real option thinking were applied more widely, the purpose of all market entries would be not to maximize short-term profitability in that market but rather to learn from the market and pass on these lessons learned elsewhere. How would that influence our traditional ways of defining market-entry timing and entry performance? Should we measure entry order from the foothold investments or from “real entries”? (And how can we identify “foothold investments” and “real entries”?) How can we measure entry performance if the purpose of the first product is not to maximize the firm’s short-term profits but, e.g., to collect lessons learned for the next product generation?

5.2 Practical implications

First-mover advantage is an intuitive and attractive concept that continues to be used among practitioners, often somewhat naively, as demonstrated by Lieberman and Montgomery’s (2013) example of the headlong rush into investments during the dot-com frenzy at the turn of the millennium. Instead of simply thinking of performance advantages as first movers’ birthright, practitioners should also examine more particular mechanisms and additional timing anchors that impact post-entry performance.

This study identifies two mechanisms, uncertainty and growth in existing market, that influence entry-timing effects. This study does not provide a direct answer regarding whether a firm should enter a new promising but uncertain market if its old market is still growing fast. In general, the fast growth and the uncertainty regarding the potential of the new market make an early market entry less attractive. However, even then, early entry could still be better than waiting. Practitioners who face this this type of situation should consider, for example, the following factors:
• How strong are the first-mover advantages in the product market vs. late-mover benefits from reduced risk? Could the first entrant establish isolating mechanisms so strong that late entrants cannot overcome them? Or would the first mover be stuck if it chose the wrong technology?
• How much do old and new markets rely on the same resources, and how fungible are the resources? That is, how badly could new market entry disrupt the old business?
• Can a firm have staged entry with a small initial investment that can be used to establish isolating mechanisms and scale up later if the market is considered viable? How easily can resources be allocated from one growth option to another?

Practitioners could also benefit from multi-level approach to market entries. For example, a multi-national company that introduces a new product to multiple markets should not sub-optimize its entry timings for each market. Rather it should design a global entry program, where the purpose of the first entries would not be short-term profit maximization but rather learning which could be used to plan the optimal entry timing (and e.g., entry methods) in subsequent markets.

5.3 Limitations and future research

In this chapter, I highlight the limits of this study and two areas that I believe warrant more research.

Validating findings beyond the limits of this study

The scope of this study is limited, as described in Chapter 1.3. This research is limited to one industry and one – quite special – event in it, and my sample consists of large incumbent firms that are often part of a multinational group. I examined only one type of new market entry – a new technology adoption and subsequent entry to a new product segment. I believe that the logic behind my key findings would be valid also beyond the strict scope of this study, but further validation might be needed. Research could test these findings in other contexts, such as entry to other geographical markets and to new non-related product categories. I consider it particularly important to test these findings in contexts that have clearer early- or late-mover advantages.

Research on market entry programs

This dissertation is written from the perspective of a subsidiary firm, and the unit of research is a single market entry. This perspective is similar to that of many other entry-timing studies. However, it could also be interesting and useful to apply a group-level or market-entry program perspective. For example,
in this study, Vodafone group had stakes in 61 operators, and most of them eventually adopted the new technology and entered in 3G services market. Did Vodafone manage the timing of its subsidiaries 3G technology adoption? International business research has studied, e.g., the pacing and rhythm of international expansions (e.g. Vermeulen and Barkema, 2002). If that approach could be combined with the perspective of entry-timing effects (i.e., entry timing in relation to local competitors), it might provide valuable information on the dynamics of internal and external entry-timing anchors. It could also shed new light on organizational learning and the management of initiative programs.

Furthermore, market entries are not the only initiatives firms take. For example, in my sample, operator groups’ adaptation of 3G WCDMA overlapped initially with the industry consolidation wave in which the largest global operator groups acquired independent operators, and later 3G adoption overlapped with cost-cutting programs. The program perspective of market entry timing and entry performance could be expanded also by studying how different types of programs are combined.

**Behavioral aspects of entry decisions**

Finally, and perhaps most importantly, all my essays rely on ideas what happens inside a firm when it enters a new market. For example, my findings in Essay #1 hinted that wireless telecommunication operators may not have paid enough attention to the uncertainty of the market in their entry timing decision, even though that was one of the key performance drivers. When this question was investigated more in detail in Essay #3, it was found that market uncertainty was interpreted differently depending on whether operators learned from other subsidiaries in the same multi-national telecommunication group or from their competitors. Indeed, as e.g. Hoppe (2002) described the entry-timing decisions are based on beliefs and perception on benefits and risks in the new market. These observations point that there could be interesting possibilities to integrate findings from behavioral decision-making theories into entry-timing research.

However, the challenge here is that entry-timing research usually relies only on externally observable data. For example, in this study, the idea that firms use multiple decision-making anchors is deduced only from externally observed actions and not from the decision-making process itself. Similarly, I have not observed whether managers really decided how to allocate non-scale-free assets between two product generations. This calls for more research that goes inside firms to observe how market-entry timing decision were made. What anchors did managers use? Did they learn from others’ prior experience? How did their perception of market opportunities and performance develop? How did they manage the conflict between the old and new products? This echoes Zachary’s and colleagues’ (2015, p. 1402) call for more qualitative studies to “understand the causal mechanisms on the managerial decision of when to enter a particular market.”
References


The idea of first-mover advantages has a long history in economics and management research and it appeals also to practitioners. However, even after decades of academic research it remains somewhat unclear when and why first-mover advantages exist.

It has been suggested that researchers have too myopically measured entry-timing only in relation to competitors and ignored other potential timing anchors. In this dissertation, I study wireless telecommunication operators' adoption of 3G WCDMA – "the biggest ever gamble on the introduction of a new technology." My results suggest that it would be better to enter a new market late when the new market is uncertain or old market grows fast.

I argue that entry-timing effects depend on multiple dynamic anchors, which can co-exist, interact and even have opposite effects, and the timing should not only be measured from pioneer's entry to the market. Furthermore, I argue that some ways of measuring entry performance can seriously bias our impression of entry-timing advantages.