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Alliance Portfolio Complexity, Market Entry Timing, and Alliance Formation in the Global Airline Industry

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Abstract

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Recent studies suggest that the average number of alliances per firm has increased over the years, and their scope extends to various stages of the value chain. As firms face greater challenges coordinating multiple simultaneous alliances across various value chains and functions, this new phenomenon has encouraged scholars and practitioners to shift their attention to understanding the strategic complexity and the impact of alliance portfolios. Possessing an alliance portfolio is an inevitable consequence for all firms because it naturally occurs when managing a set of multiple alliances. Investigating the continuous evolution of an alliance portfolio is very important to better understand alliance dynamics because it heavily influences firms' value creation activities through its functional focus, the depth of collaboration, the mode of governance, partner selection, and

so on. These influences of an alliance portfolio may critically affect future decisions regarding whether a specific firm should add an additional alliance or terminate an existing alliance. This approach calls for attention from scholars to further examine existing alliances as a structural portfolio of interlinkages rather than simply counting the total number of alliances.

Nevertheless, most of the prior research on alliances has not paid sufficient attention to the fact that firms in fact evaluate the value of their new alliances based on the continuously evolving context of their alliance portfolios. Contrary to the traditional alliance research, the alliance portfolio-based view considers multiple existing alliances not as a simple set of aggregated individual alliances and but as an evolving portfolio of inter-related relationships. Therefore, alliance portfolio approach goes beyond the single-alliance evaluation approach and can explain why firms decide to form less efficient alliances or give up certain beneficial alliances to maximize the overall gains from their existing alliance portfolios. Particularly when adding volume and diversity to their existing alliance portfolio, firms are challenged to address the unintentional consequences of a state of increased complexity associated with alliance portfolio management. It is important for firms to understand the level of complexity at which firms can maximize the overall gains of their alliance portfolios. The main objective of this study is to advance the alliance literature by developing a new theoretical concept as well as a construct measurement for alliance portfolio complexity.

The first study investigates the various theoretical drivers of alliance formation to extend the existing literature on alliance formation, with special attention paid to the moderating effect of alliance portfolio complexity and alliance termination. I show how the bounded pattern of alliance formation can be stronger when the focal firm's alliance portfolio complexity is low or its alliance termination experience is high. The second study advances international alliance formation and alliance portfolio research by highlighting the role of alliance portfolio complexity and order-of-entry learning effects in international alliance formation. This study sheds light on the various theoretical drivers of alliance formation to extend the existing literature on alliance formation, with special attention paid to order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity. The results show that early entry order learning exists for direct international alliance experience in both local and global markets. However, indirect entry order learning effects of international operations are limited to only the local market. The implications of this research are substantive with regard to predicting what alliances firms will form and what benefits and costs their cooperative strategies entail.

Keywords: Alliance Portfolio, Alliance Complexity, Entry Timing, International Alliance Formation, Airline Industry

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CHAPTER Ⅰ. INTRODUCTION

1. RESEARCH OBJECTIVE

While prior research on alliance formation has made significant advances in identifying the drivers and patterns of alliance formation, current theoretical understanding of alliance formation often overlooks several critical assumptions. Notably, traditional alliance studies have mainly concentrated on the characteristics of a single alliance or the dyadic relationship embedded in it, paying less attention to the problems that can arise from managing a set of aggregated, multiple alliances. These studies implicitly assume that because each alliance is independent of any others, the impact of adding an additional alliance mainly depends on the number of existing alliances. However, in real business situations, depending on the structure and composition of the existing alliances, each additional alliance may have a heterogeneous impact on future alliance dynamics. For example, when two firms have the same number of existing alliances, depending on the structure and composition of their alliance portfolios, one additional alliance may create entirely different alliance dynamics in terms of learning, resource allocation, coordination costs, information search, and governance choices.

I advance the existing alliance formation studies by relaxing the above assumption. I assume that depending on the focal firm's alliance portfolio, the costs and benefits of adding one alliance may have a heterogeneous impact on its current alliance portfolio. An alliance portfolio generally refers to the collection of a focal firm's existing alliances, of which the most critical dimensions consist of their functional types, the scope of resource sharing, the modes of governance, the types of partners, and the interlinkages among existing alliances (e.g., Hoehn-Weiss & Karim, 2014; Hoffmann, 2005, 2007; Wassmer, 2010). Recent studies suggest that the average number of alliances per firm has increased over the years, and their scope extends to various stages of the value chain (Lavie, 2007; Powell, Koput, & Smith-Doerr, 1996). As firms face greater challenges coordinating multiple simultaneous alliances across various value chains and functions, this new phenomenon has encouraged scholars and practitioners to shift their attention to understanding the strategic complexity and the impact of alliance portfolios (Hoehn-Weiss & Karim, 2013; Wassmer, 2010). Possessing an alliance portfolio is an inevitable consequence for all firms because it naturally occurs when managing a set of multiple alliances. Investigating the continuous evolution of an alliance portfolio is very important to better understand alliance dynamics because it heavily influences firms' value creation activities through its functional focus (Eisenhardt & Schoonhoven, 1996; Lavie, 2007), the depth of collaboration, the mode of governance, partner selection, and so on (Zander & Kogut, 1995). These influences of an alliance portfolio may critically affect future decisions regarding whether a specific firm should add an additional alliance or terminate an existing alliance. This approach calls for attention from scholars to further examine existing alliances as a structural portfolio of interlinkages rather than simply counting the total number of alliances.

Despite some recent efforts to link alliance portfolio characteristics such as portfolio size (e.g., Deeds & Hill, 1996; Shan, Walker, & Kogut, 1994), portfolio diversity (e.g., Baum, Li, & Usher, 2000b; Lavie, 2007), and partners' network positions and structure (e.g., Ahuja, 2000a; Stuart, 1998) to alliance formation and performance (e.g., Jiang, Tao, & Santoro, 2010; Lavie, 2007), limited contributions have been made to capture the impact of the complexity issues that arise from simultaneously managing multiple functional alliances across a firm's value chain. Unlike working with only a few alliances, the simultaneous use of resources by multiple alliance partners creates challenges such as the inefficient use of resources (Lahiri & Narayanan, 2013; Lavie, 2006) and contract enforcement and monitoring issues (Mowery, 1989), thus increasing the complexity of coordinating multiple tasks (Gulati & Singh, 1998). Following previous studies (Closs et al., 2008), I define alliance portfolio complexity as the state of processing difficulty that results from a multiplicity of and relatedness among the architectural elements of existing alliances. The inherent nature of complexity provides a reasonable foundation to investigate a set of existing alliances as an alliance portfolio because a marginal change in alliance portfolio complexity is not purely proportional to the total number of existing alliances.

The main objective of this study is to advance the alliance literature by developing a new theoretical concept as well as a construct measurement for alliance portfolio complexity. In doing so, I use various theoretical approaches to explain how a firm's existing alliance complexity can moderate the firm's propensity to form new alliances. I also study how firms can leverage learning opportunities to address alliance portfolio complexity. Drawing on organizational and first-mover advantage theories, I test how market entry timing and different types of learning experiences can allow firms to better manage alliance portfolio complexity, especially in the international market.

2. EMPIRICAL SETTING

This study used comprehensive panel data on the alliance portfolios of 47 major global airlines. Over the years, the global airline industry has engaged in various types of extensive and dynamic alliance activities for the following reasons. First, alliances enable global airlines to enter global markets without obtaining that right through bilateral agreements (Oum & Yu, 1998). Second, because regulations restrict cross-border acquisitions and stand-alone overseas expansion for global airlines, alliances are commonly used for global expansion (Oum, Taylor, & Zhang, 1993; Pustay, 1980). Third, alliances are beneficial for firms in terms of providing better route network service to customers and reducing marketing costs by offering shared information and loyalty services such as frequent flier mileage programs (Oum & Yu, 1998). The practice of engaging in multiple simultaneous alliances in the global airline industry enhances the meaningfulness and variability of alliance portfolio characteristics. Additionally, the industry features a well-defined set of reliable data with alliance announcements, detailed descriptions of various functional information, and termination information.

For each of the 47 airlines, I collected annual alliance data from January 1982 to December 2010 (the study period) while controlling for earlier alliances and alliances of other major global airlines up to 1945. Annual observations allowed me to obtain precise estimates of the total number of alliances in a portfolio in a given time period. I used multiple sources, including annual reports, company publications, international newspapers, and leading industry sources such as *Airline Business*, *Flight International* and the *World Airline Directory* as well as *Lexis/Nexis* to collect the data. Each of the alliances was classified by functional type, modified based on Rhoades' (2008) alliance activity by type. The final sample contains 1,328 airline-year alliance records.

3. OVERVIEW OF CONTENT

The first study investigates the various theoretical drivers of alliance formation to extend the existing literature on alliance formation, with special attention paid to the moderating effect of alliance portfolio complexity and termination experience. I show how the bounded pattern of alliance formation can be stronger when the focal firm's alliance portfolio complexity is low or its alliance termination experience is high. The second study advances international alliance formation and alliance portfolio research by highlighting the role of alliance portfolio complexity and order-of-entry learning effects in international alliance formation. This study sheds light on the various theoretical drivers of alliance formation to extend the existing literature on alliance formation, with special attention paid to order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity. The results show that early entry order learning exists for direct international alliance experience in both local and global markets. However, indirect entry order learning effects of international operations are limited to only the local market. The implications of this study are substantive with regard to predicting what alliances firms will form and what benefits and costs their cooperative strategies entail. Further research on alliance formation with a particular focus on refined portfolio characteristics is well warranted for various forms of inter-firm cooperation strategies.

CHAPTER Ⅱ.

REVISITING ALLIANCE FORMATION: THE MODERATING EFFECT OF ALLIANCE PORTFOLIO COMPLEIXTY AND ALLIANCE TERMINATION

1. INTRODUCTION

How do a firm's alliance portfolio characteristics affect its propensity to form new alliances? Different theoretical perspectives have been applied to understand the fundamental question of why and when firms form new alliances. Transaction cost economists have argued that alliance formation is a hybrid arrangement that occurs when the transaction costs associated with a specific exchange are intermediate between market exchange and vertical integration (Hennart, 1988; Williamson, 1985). Strategic management scholars have argued that through alliance formations, firms can access and accumulate resources that can be critical sources of competitive advantage (Hamel, 1991; Hamel, Doz, & Prahalad, 1989). Institution and network theories have explored how social processes such as competitive pressures or isomorphic behaviors underlie the formation of alliances (Garcia-Pont & Nohria, 2002; Gulati, 1995a).

Notably, traditional alliance studies have mainly concentrated on the characteristics of a single alliance or the dyadic relationship embedded in it, paying less attention to the problems that can arise from managing a set of aggregated, multiple alliances. However, recent studies suggest that the average number of alliances per firm has increased over the years, and their scope extends to various stages of the value chain (Lavie, 2007; Powell, Koput, & Smith-Doerr, 1996). As firms face greater challenges coordinating multiple simultaneous alliances across various value chains and functions, this new phenomenon has encouraged scholars and practitioners to shift their attention to understanding the strategic complexity and the impact of alliance portfolios (Hoehn-Weiss & Karim, 2013; Wassmer, 2010).

Despite some recent efforts to link alliance portfolio characteristics such as portfolio size (e.g., Deeds & Hill, 1996; Shan et al., 1994), portfolio diversity (e.g., Baum et al., 2000b; Lavie, 2007), and partners' network positions and structure (e.g., Ahuja, 2000a; Stuart, 1998) to alliance formation and performance (e.g., Jiang et al., 2010; Lavie, 2007), limited contributions have been made to capture the impact of the complexity issues that arise from simultaneously managing multiple functional alliances across a firm's value chain. Unlike working with only a few alliances, the simultaneous use of resources from multiple alliance partners creates challenges such as the inefficient use of resources (Lahiri & Narayanan, 2013; Lavie, 2006), contract enforcement and monitoring issues (Mowery, 1989), and increased complexity in coordinating multiple tasks (Gulati & Singh, 1998). Following previous studies (Closs et al., 2008), I define alliance portfolio complexity as the state of processing difficulty that results from the multiplicity of and relatedness among the architectural elements of existing alliances. The inherent nature of complexity provides a reasonable foundation to investigate a set of existing alliances as an alliance portfolio because a marginal change in alliance portfolio complexity is not purely proportional to the total number of existing alliances. The impact of alliance portfolio complexity can critically affect future decisions with regard to whether a specific firm decides to add new alliances.

Another portfolio effect that the existing studies have not fully captured is the dynamic nature of an alliance portfolio. One of the key features of an alliance portfolio is that it is generally not static in nature; instead, it evolves and changes over time through both the formation of new alliances as well as the termination of existing alliances (Makino, Chan, Isobe, & Beamish, 2007; Reuer & Zollo, 2005). Because most alliances are known for short-term arrangements and termination rates are typically over 50% (Kale & Singh, 2009; Koza & Lewin, 2000), setting alliance termination aside in alliance formation research may provide a significantly limited understanding of alliance formation. Additionally, prior studies have mainly viewed alliance termination as a consequence rather than a cause of sequential changes in alliance dynamics. For instance, existing studies have found that firms terminate their existing alliances when an alliance is considered a failure or the alliance has successfully achieved its goal (Reuer & Zollo, 2005). In other cases, firms are likely to terminate alliances when they change firm strategies (Cui, Calantone, & Griffith, 2011), attempt to adapt to the environment (Koza & Lewin, 1998), and when there is severe competition among partners (Park & Russo, 1996). However, there is a growing recognition that alliance termination can reduce the risk of contractual hazards, increase a firm’s cognitive capacity, provide critical learning opportunities, and significantly affect alliance portfolio complexity (Kale & Singh, 2007; Simon, 1963). These studies clearly imply that alliance termination is equally important in examining alliance dynamics as alliance formation. However, except for a few studies (e.g., Hoffman, 2007), most research has treated alliance formations and terminations as independent phenomena.

This paper attempts to fill these gaps in the existing studies on alliance portfolios. Building on theories on alliance formation and alliance portfolio studies, I investigate how a focal firm's alliance portfolio complexity and alliance termination accelerate or decelerate its propensity to form new alliances. It sheds further light on the implications of alliance portfolios by taking into account the nature of the functional relationships between the focal firm and its partners as well as the dynamic nature of an alliance portfolio. These ideas are tested empirically using a comprehensive panel data analysis of the alliance portfolios of 47 global airlines during the period from 1945–2010. The findings suggest that the bounded pattern of alliance formation is stronger when the focal firm's alliance portfolio complexity is low or the number of alliance terminations is high. This study extends the alliance formation literature by suggesting the boundary conditions in which firms' propensity to form alliances are accelerated or decelerated. Although multiple theoretical lenses explain the formation of individual alliances, a broader view assessing how firms build and configure their alliance portfolios is necessary for scholars to advance the current understanding of strategic alliances.

2. THEORY AND HYPOTHESES

2.1. Alliance Portfolios and Alliance Formation

Alliances are often defined as voluntary arrangements initiated by independent firms to exchange or share resources and engage in the co-development of products, services, or technologies (Gulati, 1995a; Gulati & Gargiulo, 1999). Firms often strategically form alliances to acquire complementary resources (e.g., Chung, Singh, & Lee, 2000; Eisenhardt & Schoonhoven, 1996), share costs and risks (e.g., Kogut, 1991), facilitate learning (e.g., Gulati, 1999; Khanna, Gulati, & Nohria, 1998; Powell et al., 1996), and build capabilities (e.g., Kale, Dyer, & Singh, 2002; Kale & Singh, 2007). Over the years, alliances have become an important strategic device and an essential part of firm strategies in many key industries such as software, telecommunications, pharmaceuticals, and air transportation (Kale & Singh, 2007). As a consequence of its popular usage, the average number of alliances that firms engage in has significantly increased since the 1990s (Lavie, 2007). Firms now simultaneously participate in multiple alliances with different partners and face the challenge of maximizing the benefits of their alliance portfolios (Hoffmann, 2007; Jiang et al., 2010; Lahiri & Narayanan, 2013).

An alliance portfolio generally refers to the collection of a focal firm's alliances in which the firm is involved (Hoffmann, 2005; Wassmer, 2010). A typical alliance portfolio is inclusive of all of the different functional forms of alliances, such as collaborative R&D arrangements, production agreements, or joint marketing activities. Recent alliance studies have mainly tried to answer two central questions about alliance portfolios: (1) how firms can utilize their existing alliance portfolios for better firm performance, and (2) how firms can effectively build and configure their alliance portfolios. To answer the first question, scholars have mainly focused on examining the relationship between alliance portfolio characteristics such as portfolio size (Lahiri & Narayanan, 2013), portfolio composition of alliance partners (Jiang et al., 2010), and firm performance. For example, Jiang et al. (2010) found that in the automobile industry, alliance portfolios with greater organizational and functional diversity and lower governance diversity were related to higher firm performance, whereas industry diversity showed a U-shaped relationship with firm performance. By analyzing the patents of 367 software firms, Lavie (2007) showed how the level of resource complementarity and the bargaining power of partners can contribute to value creation and appropriation among alliance participants.

Although these studies show somewhat clear evidence of high-performing portfolios, research on the second question of how firms actually form and configure these portfolios remains relatively under-explored (Ozcan & Eisenhardt, 2009). Indeed, the extensive literature on alliances has explained why firms form individual alliances and who they choose as partners (e.g., Gulati, 1995a; Gulati, 1998; Gulati & Gargiulo, 1999). Nevertheless, the question of why firms build alliance portfolios goes beyond the singular purpose of forming an alliance

(Wassmer, 2010). Recent studies on alliance portfolios provide several theoretical reasons for firms to build such portfolios. From a real options point of view, simultaneously engaging in multiple alliances can be beneficial in overcoming the risks and costs associated with technological uncertainty (Santoro & McGill, 2005). The competition strategy point of view suggests that firms can shape their alliance portfolios over time by strategically forming alliances as strategic reactions to industry-level competitive dynamics (Gimeno, 2004). The resource-based view suggests that building alliance portfolios can be similar to the process of accumulating a stock of non-imitable resources, which can create a sustainable competitive advantage (Barney, 1991; Lavie, 2006).

While these studies provide ample explanations as to why firms build alliance portfolios, they provide little insight into alliance configuration issues, such as how a focal firm's alliance portfolio characteristics affect its propensity to form additional alliances (Hoffmann, 2005). One of the topics that is central to alliance configuration is finding the optimal number of alliances in an alliance portfolio. This question is directly related to finding the relationship between the accumulated number of a firm's past alliances and the firm's propensity to form new alliances. So far, scholars have reached different conclusions on this issue. Some scholars have argued that firms continue to form alliances because it yields better performance (e.g., Ahuja, 2000a; Baum et al., 2000b). For instance, in high-tech industries, having more ongoing alliances serves as a useful channel for startups to quickly access external knowledge and know-how (Baum et al., 2000b). Other scholars have argued that at some point, additional alliances incur more costs than benefits, consequently discouraging firms from forming new alliances (e.g., Chung et al., 2000; Gulati, 1995a). For example, Gulati (1995a) found that beyond a certain point, the marginal benefit of acquiring new information diminishes in repeated relationships between two firms.

This study endeavors to advance these existing findings in several ways. First, prior studies have mainly focused on the different types of single alliances, such as joint ventures or R&D agreements (e.g., Santoro & McGill, 2005; Shan et al., 1994; Vassolo, Anand, & Folta, 2004). Considering that firms generally engage in multiple types of alliances (i.e., marketing, production, distribution and R&D) across their value chain, focusing on single type of alliance may not fully reflect the complex nature of an alliance portfolio (Hoehn-Weiss & Karim, 2013). I address the above issue by examining the fundamental issue of complexity, which increases with an increased number of alliances of different functional compositions. Second, most studies have focused on alliances in a few high-tech industries, where firms are highly motivated to acquire external knowledge and facilitate innovation and learning through alliances (e.g., Mowery, Oxley, & Silverman, 1998; Rothaermel & Deeds, 2004). To increase the generalizability of the findings, this study designed a different context where value creation and strategic positioning – acquiring resources and reducing costs – through alliances is more critical than learning. Third, the existing studies have not fully examined the boundary conditions of when alliance formation is more encouraged or discouraged. Only a few studies have offered insights into boundary conditions such as the level of repeated relationships with certain partners (e.g., Chung et al., 2000; Gulati, 1995b), the number of indirect relationships of the focal firm (e.g., Ahuja, 2000b), or the level of strategic interdependence between partners (Gulati, 1995a). This study further extends this line of argument by testing the boundary conditions of alliance portfolio characteristics such as portfolio complexity and alliance termination.

In the following section, I formulate the baseline hypothesis, relating the number of accumulated alliances in a focal firm's alliance portfolio and its propensity to form new alliances. I then hypothesize the interaction between boundary conditions (level of alliance portfolio complexity and alliance termination) and the number of accumulated alliances in the focal firm's alliance portfolio and their impact on the propensity to form new alliances.

2.2. Impact of Alliance Portfolio Size

When resources are not internally available, firms can utilize different strategies to build an alliance portfolio to maximize its benefits (Hoffmann, 2005, 2007). Firms engage in multiple alliance activities to create value (Lavie, 2007), enhance their strategic position (Eisenhardt & Schoonhoven, 1996), and gain learning experience (Powell et al., 1996). Firms can create value by forming functional alliances across their value chains (Hoehn-Weiss & Karim, 2013). For instance, forming production-related alliances enables immediate access to complementary resources that can support the commercialization of a focal firm's products or enhance its service offerings (Mowery et al., 1998). Through the formation of marketing alliances, firms can utilize alliance partners' sales force or marketing investments and campaigns to reduce costs (Das, Sen, & Sengupta, 1998). R&D alliances provide opportunities for firms to absorb and acquire information and knowledge or reduce the risks associated with developing new technologies (e.g., Kogut, 1991; Powell et al., 1996; Stuart, 1998). As a result, the strategic building of alliance portfolios can create isolating mechanisms (Rumelt, 1984) and causal ambiguity (Dierickx & Cool, 1989), which are the fundamental basis of firms' competitive advantages. From a portfolio management capability-building perspective, firms can gain additional learning experience by adding more alliances to their portfolios (Hoffmann, 2007).

However, as the number of alliances increase in an alliance portfolio, firms may face challenges of diminishing benefits and exponentially increasing costs. Unlike working with a few alliances, the simultaneous use of resources from multiple alliance partners can cause problems (Lahiri & Narayanan, 2013; Vassolo et al., 2004). From a resource management perspective, the most significant challenges firms might face include (1) redundancy or overlap of existing resources across partners, (2) internal resource constraints, and (3) pooling and coordinating the most efficient combination of resources (Lahiri & Narayanan, 2013; Lavie, 2006). For instance, Vassolo et al. (2004) found that when a firm built an alliance portfolio of multiple competing projects, the value of the portfolio decreased because the investment options overlapped. From a transaction cost point of view, simultaneously managing multiple alliances can incur additional costs. Traditionally, one of the main issues of managing alliances is addressing the behavioral uncertainty of alliance partners (Williamson, 1985). The risk of partners' appropriation – the focal firm's concern about its ability to capture a fair share of the rents from the alliance in which it is engaged (Gulati & Singh, 1998: p 788) – is highly likely to substantially increase when the number of alliance partners increases. This appropriability concern requires firms to constantly invest in contractual monitoring and enforcement (Oxley, 1997). Another cost that is likely to increase is coordination costs. Decomposing tasks and allocating the division of labor across multiple alliances requires extensive communication and decision-making procedures (Gulati & Singh, 1998; Thompson, 1967; Van de Ven, 1976). For these reasons, at a certain point, firms will be discouraged to increase the number of alliances in their portfolios.

The above arguments provide a strong theoretical foundation to develop general predictions about the relationship between the number of alliances in a focal firm's alliance portfolio and its propensity to form new alliances. Therefore, I predict the following base hypothesis:

Hypothesis 1 (H1): There will be an inverted U-shaped relationship between the number of alliances in a focal firm's alliance portfolio and the firm's propensity to form new alliances.

2.3. Moderating Role of Alliance Portfolio Complexity

In this paper, alliance complexity refers to the breadth and depth of a focal firm's functional alliance portfolio. Prior work suggests that alliance portfolio heterogeneity can be commonly observed (Wassmer, 2010). Moving beyond portfolio characteristics such as vertical (i.e., upstream or downstream) versus horizontal alliances (Kotabe & Swan, 1995) and exploration versus exploitation alliances (Lavie & Rosenkopf, 2006; Rothaermel & Deeds, 2004), recent studies are paying more attention to the functional composition of alliance portfolios (Hoehn-Weiss & Karim, 2013). Understanding functional alliance composition is important because the functional focus of alliances heavily influences firms' value creation activities across value chains (Eisenhardt & Schoonhoven, 1996; Lavie, 2007) and boundaries of learning (Zander & Kogut, 1995) and even their financial performance (Jiang et al., 2010).

When the number of alliances increases with high alliance portfolio complexity, it can cause greater challenges for a firm than for firms with low complexity. Increased complexity worsens the problem of appropriability concerns and coordination costs. For instance, when a firm engages in multiple functional alliances across various value chains with certain partners, the alliances may evolve into co-specialized alliances, or alliances that involve investments in partner-specific assets and activities and the sharing of sensitive or proprietary information and knowledge (Gimeno, 2004; Santoro & McGill, 2005; Williamson, 1985). When co-specialization occurs, firms are exposed to a greater risk of appropriation and opportunism through hold-up or haggling (Oxley, 1997; Williamson, 1985), in turn increasing the cost of contractual monitoring and enforcement. Additionally, coordination costs will be higher for more complex portfolios, as more time and effort is required to negotiate the division of labor, task allocation, goals, and joint decision making (Gulati & Singh, 1998; Hennart, 1988).

Nevertheless, a counter argument can be made that possessing an alliance portfolio with greater breadth and depth in functions can benefit firms in several ways. First, firms can draw diverse resources from partners, which can help firms create more value by increasing their access to supplementary and complementary resources, improving their strategic position, and utilizing their partners' strengths to maximize efficiency (Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996; Jiang et al., 2010; Lavie, 2006). For example, a biotechnology firm can utilize alliance partners' strengths by forming a joint R&D agreement with a university while raising financial resources through a joint venture and commercializing a product through marketing alliances with a pharmaceutical company (Powell et al., 1996). Second, increased complexity can serve as an isolating mechanism, thus creating a competitive advantage that is more difficult for competitors to imitate (Barney, 1991; Rumelt, 1984). Although competitors can identify the complexity of a focal firm's alliance portfolio, it will be extremely difficult for them to replicate it (Dierickx & Cool, 1989). Finally, increased complexity can facilitate learning from multiple partners and their functions. R&D alliances allow firms to learn about their partners' information and knowledge, production alliances allow firms to learn about their partners' manufacturing skills and know-how, and marketing alliances allow firms to learn about how their partners perceive the market. However, it is important to note that while the realization of these benefits is difficult, and not all firms will be able to fully achieve them, firms cannot avoid the inevitable consequences of the exponential increases in cost due to increased alliance portfolio complexity.

For the reasons stated above, the propensity to form new alliances for firms with high alliance portfolio complexity will be weaker than for firms with low alliance portfolio complexity, which suggests the following hypothesis:

Hypothesis 2 (H2): A focal firm's alliance portfolio complexity will moderate the relationship between the number of alliances in the focal firm's alliance portfolio and the firm's propensity to form new alliances.

2.4. Moderating Role of Alliance Termination

Alliances are generally considered unstable in nature, as there is a constant in-and-out flow through alliance formation and termination. Existing studies on alliance termination have generally treated alliance termination as an independent phenomenon from alliance formation (Wassmer, 2010). Firms terminate their existing alliances when an existing alliance is considered a failure, or the alliance has successfully achieved its goal (Reuer & Zollo, 2005). In other cases, firms are likely to terminate alliances when they change their firm strategies (Cui, Calantone, & Griffith, 2011), attempt to adapt to the environment (Koza & Lewin, 1998), and when there is severe competition among partners (Park & Russo, 1996). While these findings provide important explanations for alliance termination, the extant research has not yet paid sufficient attention to the issue of how alliance termination affects the configuration of alliance portfolios.

When a firm's number of alliances increases with its alliance termination experience, it can alleviate the costs associated with managing a large number of alliances in its portfolio. First, the termination of existing alliances reduces monitoring and coordination costs by reducing the risk of contractual hazards and the level of interdependencies among tasks. Second, alliance termination increases firms' cognitive capacity (i.e., bounded rationality; Simon, 1963) to manage the challenges that arise from alliance portfolio complexity. Third, firms can build alliance management capabilities through their alliance termination experiences, such as choosing better partners and establishing efficient alliance management processes. For example, leveraging its alliance termination experience, the Lotus Corporation has created “35 rules of thumb” to manage each procedural stage of an alliance, from formation through termination (Kale & Singh, 2007).

For the reasons stated above, the propensity to form new alliances for firms with high alliance termination experience will be stronger than that for firms with low alliance termination experience, which suggests the following hypothesis:

Hypothesis 3 (H3): A focal firm's alliance termination experience will moderate the relationship between the number of alliances in the focal firm's alliance portfolio and the firm's propensity to form new alliances.

3. METHOD

3.1. Research Setting

The hypotheses for this study were tested using comprehensive panel data on the alliance portfolios of 47 major global airlines. Over the years, the global airline industry has experienced various types of dynamic and extensive alliance activities for the following reasons. First, alliances enable global airlines to enter global markets without obtaining that right through bilateral agreements (Oum & Yu, 1998). Second, because regulation restricts cross-border acquisitions and stand-alone overseas expansion for global airlines, alliances are commonly used for global expansion (Oum, Taylor, & Zhang, 1993; Pustay, 1980). Third, alliances are beneficial for firms in terms of providing better route network service to customers and reducing marketing costs by offering shared information and loyalty services such as frequent flier mileage programs (Oum & Yu, 1998).

Historically, there were very few airline alliances before the 1980s, as was the case in various other industries (Gulati, 1995; Harrigan, 1985). Since 1987, however, airlines have significantly increased the frequency of forming multiple alliances with their competitors. For example, American Airlines has established more than 40 cross-border alliances with 22 foreign airline companies during the last two decades. Among the top 65 airline companies in terms of annual revenue, the total number of strategic alliances increased to over 1,200 before 2000. Particularly since the late 1990s, the typical bilateral characteristics of cross-border airline alliances significantly shifted to complex multi-lateral arrangements among multiple partners, such as Oneworld, Sky Team, and Star Alliance.

The practice of engaging in multiple simultaneous alliances in the global airline industry enhances the meaningfulness and variability of alliance portfolio characteristics. In addition, the industry features a well-defined set of reliable yearly data about alliance announcements, detailed descriptions of various functional information, and termination information.

3.2. Data

For each of the 47 airlines, I collected annual alliance data from January 1982 to December 2010 (the study period) while controlling for earlier alliances and those of other major global airlines up to 1945. Annual observations allowed me to obtain precise estimates of the total number of alliances in a portfolio during a given time period. The data were collected in the following manner. First, to ensure that the sample was representative of the industry's firm size, regional distribution, and industry-wide historical evolution, I selected major airlines ranked by size. The sample includes 14 airlines from the Americas; 19 from Europe, the Middle East, and Africa; and 14 from Asia and Oceania. The final sample approximately reflects each region's share of worldwide traffic, although a few well-known airline companies may be excluded due to the random sampling process. Twenty-four of the 47 airlines had international operations before 1945, while the other eight started international operations during the study period. Second, I used multiple sources, including annual reports, company publications, international newspapers, and leading industry sources such as *Airline Business*, *Flight International* and the *World Airline Directory*, and *Lexis/Nexis* to collect the data. I excluded a few reports of potential alliances that never materialized in practice. International Air Transport Association (IATA) lists 64 airlines with substantial international operations at the end of the study period. All are scheduled international passenger carriers, ensuring comparability among firms. The data included 47 international passenger carriers, or half the total, in a total of 28 countries and a comprehensive historical record for up to 1945. Both horizontal and vertical alliances (i.e., car rental or credit card companies) were included in the sample. To avoid any left censoring in computing the independent variables, I collected data on each sample airline's alliances all the way back to 1945. Alliance information was mainly collected from *Airline Business* and *Lexis/Nexis*. Each alliance was classified by its functional type based on Rhoades' (2008) alliance activity by type. All other airline-specific data were collected from the International Civil Aviation Organization (ICAO).

3.3. Measures

3.3.1. Dependent Variable

I used count variables as dependent variables for this study. New Alliances counts all international or domestic alliances, without distinction by alliance type, formed by a focal airline that became effective in a given year.

3.3.2. Independent Variable and Moderators

Focal Firm's Alliances. The variable Focal Firm's Alliances was created by summing the number of alliances formed by a focal airline preceding the focal year. This number represents a cumulative count of all past alliances involving a focal airline regardless of its type. To examine non-monotonic effects, I computed squared terms of the variable. The variable was lagged by one year to avoid modeling the dependent variable as a function of its own current value.

Focal Firm's Alliance Portfolio Complexity. In this paper, alliance portfolio complexity is defined as the depth and breadth of the focal firm's alliance portfolio. Following Fernhaber and Patel (2012), I consider alliance portfolio complexity in relation to competitors' portfolio of alliances within a firm's industry. Operationalized alliance portfolio complexity not only measures the depth and breadth of a firm's alliance portfolio, but using vector algebra, it also adjusts the resulting measure in the context of other industry firms' alliance portfolio complexity. In other words, the greater the number of alliances in a given alliance function type and the more diverse the categories are, the greater the alliance portfolio complexity will be. Also following Fernhaber and Patel (2012), I undertook a pairwise comparison by calculating cosine values between the vectors of two firms across all product classes in an industry and the number of product classes in each industry:

$$Complexity\ index\ (f_x,\ c_j) = \frac{\overrightarrow{f_x}\ ,\ \overrightarrow{c_j}}{|\overrightarrow{f_x}||\overrightarrow{c_j}|} = \frac{\sum_{i=1}^{n} w_{i,x}\, w_{i,j}}{\sqrt{\sum_{i=1}^{n} w_{i,x}^2}\sqrt{\sum_{i=1}^{n} w_{i,j}^2}}$$

where (1) f_x= Vector of number of alliances (w) in each alliance type category (i) for focal firm x, (2) c_j= Vector of number of alliances (w) in each alliance function category (i) for other industry firm c_j, and (3) Type category (i)= Marketing, Operations, R&D, and Other alliances.

Starting with the focal firm f_x, the vector of the number of alliances (w) in each product alliance function category (i) was compared with another firm, c_j, which had a vector of a number of alliances in the same product category. As the angle between the vectors shortens, the cosine value approaches 1, indicating that the vector of products produced by the two firms is more similar. I then added the vectors to create a total similarity index. To control for industry size and enhance interpretability, I divided the total by K firms. When a focal firm had no overlapping alliance function category with another firm, normalizing the sum of the similarity scores further penalized a high dissimilarity score. Continuing from the nature of complexity, the current measure developed an unbiased estimate of the extent to which a firm's alliances were similar to its competitors' alliances at the industry level. The weights in the vector are indicative of the depth, or of the number of alliances in a given alliance function category. The variable was lagged by one year.

Focal Firm's Alliance Termination. Focal firm's alliance termination was measured by the accumulated number of the focal firm's alliance termination event. The variable was lagged by one year.

3.3.3. Control Variables

The following control variables are included in this study. First, the capacity utilization rate, the experience with international operations, the distinct number of alliance partners, and the size of the focal airline's home market, which are all potential indicators of a firm's attractiveness as an alliance partner, as well as the focal airline's exposure to alliance opportunities and congestion effects were controlled. Together with fixed firm effects described below, these variables help to control for firms' propensities to form alliances and their (and their environment's) alliance-carrying capacity (Baum & Oliver, 1992). A standard measure of the capacity utilization rate was used, which was calculated as total seat kilometers performed divided by the total seat kilometers available for sale by the firm in a given year. Firm profit was also included to control for a firm's financial and managerial resource endowment, and was lagged by one year.

Controlling for a firm's international experience is also relevant because a firm's own experience may act as a substitute for (or complement) experience obtained through alliances (Eisenhardt & Schoonhoven, 1996). I proxied an airline's international experience by the year elapsed since it started international route services. Controlling for the size of an airline's domestic market is also relevant because growth in alliances may simply reflect increasing demand rather than alliance formation momentum. The primary international market for an airline, under the bilateral arrangements regime, consisted of travelers into or out of the airline's home country. I used another standard indicator to measure this (Keeler & Formby, 1994): total passenger kilometers performed by all airlines into and out of that country in a given year, expressed in millions, log-transformed, and lagged by one year. Replacing that variable with a measure including domestic passenger kilometers performed did not change results. To control for environmental factors, I included mega alliance membership, world demand, and period-based year dummies. Controlling for mega alliance membership is important because, the emergence of so-called “mega-alliances” such as Star Alliance, Oneworld, and SkyTeam, the nature of alliances significantly changed the dynamics of airlines’ alliance formation behaviors. For each airline for each year, if the airline was a member of Star Alliance, Oneworld, or SkyTeam, I coded it as 1. World Demand was measured as the sum of total passenger kilometers performed by all airlines into and out of all countries in a given year. Three period dummy variables were created to control for major external events in the airline industry. The period from 1982 to 1995 is considered a fast-growing era for global airlines that accelerated alliance formation. The period from 1996 to 2000 is when mega alliances emerged. During the period from 2001 to 2010, the global airline industry was heavily affected by a substantial decline in world demand, triggered by the 9.11 terror attack in New York. Finally, I included the number of industry-level alliances to control for industry-level factors (i.e., bandwagon effect), which can influence the focal firm to form alliances (Baum & Oliver, 1992; Gulati, 1995b). To examine non-monotonic effects, I computed squared terms of this variable. The variable was lagged by one year to avoid modeling the dependent variable as a function of its own current value.

3.4. Analysis

Using the number of new alliances as the dependent variable raises econometric issues that are common to studies of count variables. Following

Hausman, Hall, and Griliches (1984), I specify a Poisson regression to model the probability that a firm will form n alliances in a given year (with n = 0, 1, 2, ...) as follows: $\text{Prob}(Y = y_j) = e^{-\lambda j} \lambda_j^{Yj}/Y_j!$, (A) where Y_j is the count of alliances for the entries of the j^{th} firm. To incorporate exogenous variables, lambda can be expressed as a function of the covariates: $\lambda_j = \exp(\Sigma B_i X_{ij})$, (B) where B's are the coefficients, X's are the covariates (with $X1$ set to one), i indicates the i^{th} variable, and j is the j^{th} firm. The exponential function ensures non-negativity.

The Poisson distribution contains the strong assumption that the mean and variance of the explained variable are equal to lambda. Below, I report the results of the diagnostic tests used to examine this assumption. To address the potential problem of overdispersion, whereby the mean differs from the variance, a firm-specific error term can be specified. Equation (B) then becomes: $\lambda_j = \exp(\Sigma B_i X_{it})\exp(u_j)$; (C) where λ_j is no longer determined but is itself a random variable. As u_j is unobserved, it is integrated out of the expression by specifying a gamma distribution for the error term, whereupon the now compound Poisson reduces to the negative binomial model (Johnson & Kotz, 1970). Only the scale of the distribution is permitted to vary as a function of the covariates. The variance of Y_j is parameterized to equal $(1 + \alpha)\, E(Y_j)$, yielding a constant variance-mean ratio. This specification is a standard method of accounting for overdispersion. Because each firm figures into the data multiple times, a fixed or random effects specification can be used to control for unobserved firm-specific effects that may otherwise bias negative binomial estimates (Greene, 2002).

I successfully replicated the results to address two potential estimation problems. First, some firms may not be at risk of forming alliances, at least initially. This is a lesser concern in this case because all firms were clearly active in alliance formation soon after entering the sample, if not before. Nevertheless, to address this possibility, I ran analyses while including only firms that had already entered into at least one alliance (see Gulati, 1995b). Second, some alliance observations were represented twice in the data if both partners were among the 47 focal airlines. To address possible oversampling, I also ran a maximum likelihood estimation where the weight of such observations was reduced (Baum & Korn, 1996).

4. RESULTS

4.1. Descriptive Statistics

The final sample contains 1,328 airline-year records. Descriptive statistics are shown in Table 1. The number of alliances formed by an airline in a given year varies from 0 to 27. High correlation between the number of alliances in the focal firm's portfolio and alliance termination, and between the number of alliances in the focal firm's portfolio and other firms' alliances is an inherent feature of the cumulative data. Below, I carefully examine the extent to which this variation should affect the interpretation of the results.

Insert Table 1 about here

4.2. Regression Analysis

I conducted Cameron and Trivedi's (1990) Topt test to examine whether the mean and variance of λ are equal, and found evidence of overdispersion in the regression models ($p < .01$ in each model). Furthermore, based on the Vuong (1989) test, a zero-inflated model does not improve model fit ($p > .10$ in each model). Accordingly, I report results of negative binomial regressions that conservatively account for overdispersion. I replicated the results with Poisson and zero-inflated models and with a binary dependent variable to indicate the formation of at least one alliance per period and found no substantial difference. Hausman tests indicate that a fixed effects specification is more suitable than random effects. The fixed effects specification is a powerful way to control for unobserved factors such as any residual heterogeneity in alliance opportunities and capabilities not explained by the independent and control variables (Cameron & Trivedi, 1990; Greene, 2002).

For all of the analysis, based on Aiken and West (1991), I mean centered the independent and moderating variables. The results of testing the moderating effect of alliance portfolio complexity are shown in Table 2. Hypothesis 1 predicted an inverted U-shaped relationship between the number of alliances in a focal firm's alliance portfolio and its propensity to form new alliances. These models have substantial explanatory power, as indicated by their overall $\chi 2$ statistics. The $\chi 2$ for model (1) is 689.6, the $\chi 2$ for model (2) is 810.0 the $\chi 2$ for model (3) is 680.9, the $\chi 2$ for model (4) is 848.6, and the $\chi 2$ for model (5) is 748.4. Each model is statistically significant as a whole ($p < .01$). Model (1) is a base model that investigates the influence of control variables only. Model (2) examines the effect of firm-level alliance formation pattern that is inverted U-shaped. Therefore, Hypothesis 1 is supported. Hypothesis 2 predicted that the focal firm's alliance portfolio complexity will moderate the relationship between the number of alliances in the focal firm's alliance portfolio and the firm's propensity to from new alliances. Model (3) shows the negative effect of alliance portfolio complexity on the focal firm's propensity to form new alliances. Model (4) and (5) shows the moderating effect of alliance portfolio complexity on the focal firm's propensity to form new alliances. The negative moderating effect of alliance portfolio complexity is well demonstrated in Figure 1. As shown in Figure 1, high level of portfolio complexity attenuates the inverted-U shaped relationship between the focal firm's number of alliances and its propensity to form new alliances. Therefore, the results support Hypothesis 2.

Insert Table 2 about here

Insert Figure 1 about here

The results of testing the moderating effect of alliance termination experience is shown in Table 3. The $\chi 2$ for model (6) is 689.6, the $\chi 2$ for model (7) is 810.0 the $\chi 2$ for model (8) is 561.7, the $\chi 2$ for model (9) is 830.2, and the $\chi 2$ for model (10) is 929.4. Each model is statistically significant as a whole ($p < .01$). Model (6) is a base model that investigates the influence of control variables only. Model (7) examines the effect of firm-level alliance formation pattern that is inverted U-shaped. Again, Hypothesis 1 is supported. Model (8) shows the positive effect of alliance termination experience on the focal firm's propensity to form new alliances. Model (9) and (10) shows the moderating effect of alliance termination experience on the focal firm's propensity to form new alliances. The positive moderating effect of alliance portfolio complexity is well demonstrated in Figure 2. As shown in Figure 2, high level of alliance termination experience accelerate the inverted-U shaped relationship between the focal firm's number of alliances and its propensity to form new alliances. Therefore, the results support Hypothesis 3.

Insert Table 3 about here

Insert Figure 2 about here

4.3. Robustness Check

I also checked the robustness of the findings to possible omitted variables. Statistically, fixed effects stand to absorb many plausible forms of unobserved heterogeneity among firms (Cameron & Trivedi, 1990; Greene, 2002). For completeness of analysis, I examined several possible sources of heterogeneity. One possible source consists of a time effect. When I included a clock variable measuring calendar time in the analyses, its effect was very low and non-significant, and the remaining effects were essentially unchanged. Another source may be the possibility that recently applied actions may be more salient in driving future momentum than those utilized in the more distant past (Gulati, 1995). To test the effect of organizational short memories, I used narrow windows of both 3 and 5 years to count the alliance-related independent variables. Finally, I examined whether equity-based alliances might exhibit different results than non-equity-based alliances. I found no evidence of such an effect. This result may occur because airline regulators impose severe limits on international equity transactions.

5. DISCUSSION & CONCLUSION

5.1. Contributions

This research attempts to fill the gaps in existing studies on alliance portfolios. Building on theories of alliance formation and alliance portfolio studies, I investigate how a focal firm's alliance portfolio complexity and alliance termination experience accelerate or decelerate its propensity to form new alliances. The findings suggest that the bounded pattern of alliance formation is stronger when a focal firm's alliance portfolio complexity is low or its alliance termination experience is high.

The results refine the previous research on alliance portfolio management, inter-firm networks, and performance research (see Hoffmann, 2007; Ozcan and Eisenhardt, 2009). Although previous alliance portfolio studies have applied only monotonic specifications in viewing alliance portfolios as simply the sum of a firm's existing alliances (e.g., Powell et al., 1996; Stuart, 1998; Gulati and Gargiulo, 1999), I have argued that the aggregated impact will differ for firms depending on the composition and structure of their alliance portfolio. Thus, this study may extend alliance portfolio concepts by redefining the characteristics of alliance portfolios and their potential influence on a firm's strategic decisions. Although multiple theoretical lenses can explain the formation of individual alliances, a broader view that assesses how firms build and configure their alliance portfolios is necessary for scholars to advance the current understanding of strategic alliances. Overall, from the alliance portfolio perspective, adding or terminating an alliance becomes a crucial decision because building an efficient alliance portfolio contributes to a firm's overall competitive advantage. As a firm builds and develops a more complex alliance portfolio, it becomes increasingly difficult to efficiently manage it. Thus, a complex alliance portfolio and alliance termination experience can accelerate or decelerate investments in the development and enhancement of alliance management capabilities, which eventually creates strong momentum for alliance formation. Therefore, this study extends the alliance formation literature by indicating the boundary conditions in which firms' propensity to form alliances are accelerated or decelerated.

This study also extends the current understanding of the role of alliance termination. As observed in the results, firms may benefit from alliance termination by alleviating the costs of management issues in their current alliance portfolio. Traditionally, alliance termination was considered a consequence of failure and the unsuccessful completion of an alliance contract (e.g., Lunnan & Haugland, 2008; Park & Ungson, 2001; Reuer & Zollo, 2005; Wassmer, 2010). However, this study suggests that alliance termination can be viewed as an alliance formation decision-making process that can actually have a positive impact on a firm, rather than simply a consequence of a bad alliance decision. This finding can open up a new avenue for alliance termination research, as the concept of alliance termination can be re-conceptualized as a strategy implementation tool for firms that can be used and interpreted differently in existing alliance studies regarding alliance formation, alliance portfolio management, and network studies.

This study implies that managers should select alliances with complexity and termination effects in mind. Initial alliance activity, especially its functional focus, may determine not only what learning opportunities the firm obtains but also what strategic constraints it will face in subsequent alliances. Thus, early alliances should be chosen carefully, with planned future partnerships in mind. Firms should add alliances cautiously, as their optimal number is bounded, especially within a limited scope of a single function. Furthermore, managers who recognize alliances as learning devices (e.g., Hamel et al., 1989) or as real options should understand the potential benefits and constraints of successive alliances, which may not transfer across functions as much as expected. In addition, managers in other industries where alternative entry modes are readily available should make sure that they compare each alliance opportunity with these alternatives, and firms should be expected to opt to engage in alliances more selectively.

5.2. Limitations and Future Research

There are several limitations of this study that future research could improve and further extend in several new directions. First, although membership in a mega alliance was controlled, the impact of the emergence of a mega alliance can be substantial. It is possible to speculate that the emergence of the mega alliance may have reshaped the competitive landscape of alliance formation by forcing airlines to strategically react to the coalition of their competitors (Gimeno, 1999, 2004). Testing whether a complex alliance portfolio or extensive alliance termination experience can increase the likelihood of forming cooperative strategies either through a mega alliance or bilateral alliances may be one way to examine how the emergence of the mega alliance created inter-network competition between the mega alliance participants and non-participants. A further extension of this research could also examine global airlines' path-dependent evolutionary process of forming competition and cooperation strategies, as airlines can seek membership in a mega alliance in the early stage and later move on to forming bilateral alliances with other airlines to seek complementary resources (Rothaermel, 2001).

Second, this study did not consider the different motivations for alliance termination. Prior research on alliance termination has identified several different strategic motivations for firms to terminate alliances (Cui et al., 2011; Makino et al., 2007) that can have different impacts on subsequent alliance formation decisions. For example, if airline A is not satisfied with its partner B, A can terminate its alliance with B and find a better partner. In this case, alliance termination to find a substitute or replace an existing partner will have little impact on the existing alliance portfolio. However, if airline A is terminating its relationship with B because it is facing difficulties managing its limited resources or its strategic flexibility, alliance termination can have a more substantial impact on the existing alliance portfolio. Therefore, future research could examine how different alliance termination motivations such as contractual failure, strategic change, and successful completion of the alliance contract can have different impacts on a focal firm's subsequent alliance formation.

Third, future research could explore the concept of alliance portfolio complexity in other domains. This study only focused on alliance portfolio complexity using functional scope and depth. However, as in alliance portfolio diversity studies (e.g., Jiang et al., 2010; Parkhe, 1991; Zahra, Ireland, & Hitt, 2000), alliance portfolio complexity can be measured and theoretically tested in regional, partner, or governance structure domains. For example, possessing an alliance portfolio with a different number of larger, similar-sized, or smaller partners in terms of operational size can result in different levels of alliance portfolio complexity. Prior research has also suggested that engaging in international alliance portfolios with different levels of cultural difference or geographical distances can result in different levels of alliance portfolio complexity (Lavie & Miller, 2008). Thus, using the concept and measure of alliance portfolio complexity in various theoretical and empirical contexts may enrich and extend the findings of this study.

Finally, while marketing and operational alliances represent the overwhelming majority of partnerships among global airlines, in other industries, different categories of alliances may prevail, such as R&D alliances (e.g., Baum, Calabrese, & Silverman, 2000a; Sampson, 2007; Silverman & Baum, 2002). In such contexts, researchers should examine whether alliance portfolio complexity and alliance termination experience also moderate the relationship between alliance portfolio size and new alliance formation. Because this study focused on the global service industry, the generalizability of this study may be increased by replicating the study's findings in the manufacturing and high-tech sectors.

5.3. Conclusion

This study reintegrate various theoretical drivers of alliance formation to extend the existing literature on alliance formation, with special attention to the moderating effect of alliance portfolio complexity and termination experience. I show how bounded pattern of alliance formation can be stronger when the focal firm's alliance portfolio complexity is low or alliance termination experience is high. The implications are substantive when it comes to predicting what alliances firms will form, and what benefits and costs their cooperative strategies entail. Further research on alliance momentum, especially with a refined portfolio characteristics focus, is well warranted for various forms of inter-firm cooperation strategies.

TABLE 1. Descriptive Statistics and Correlation Matrix†

	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1) New Alliances	2.6	3.0	0	27	1.00											
(2) Focal Firm's Alliances	32.7	33.6	0	219	0.36***	1.00										
(3) Alliance Portfolio Complexity	1.0	0.51	0	4.34	0.04	0.02	1.00									
(4) Alliance Termination	2.71	3.42	0	20	0.36***	0.70***	0.06*	1.00								
(5) Other Firms' Alliances	935.5	678.7	29	2141	0.12***	0.67***	-0.06*	0.37***	1.00							
(6) Capacity Utilization (%)	65.2	17.0	0	88.7	0.13***	0.32***	0.00	0.33***	0.32***	1.00						
(7) Home Demand	262.1	481.9	0	3978	0.19***	0.37***	0.06*	0.48***	0.25***	0.19***	1.00					
(8) Mega Alliance Membership	0.21	0.41	0	1	0.09***	0.61***	-0.00	0.38***	0.57***	0.27***	0.33***	1.00				
(9) World Demand	1378	697	473	2786	0.13***	0.67***	-0.05	0.35***	0.97***	0.32***	0.26***	0.59***	1.00			
(10) Number of Alliance Partners	11	13	0	62	0.21***	0.89***	0.02	0.62***	0.75***	0.34***	0.38***	0.66***	0.77***	1.00		
(11) Profit	79.6	478.0	-3743	10361	0.07**	0.08**	0.04	0.11***	0.02	0.08**	0.09**	0.04	0.04	0.05	1.00	
(12) Age	42	19	0	91	0.07**	0.33***	0.03	0.27***	0.35***	0.26***	0.05	0.29***	0.35***	0.40***	-0.01	1.00

† N= 1,328
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 2. Negative Binominal Analysis of Alliance Formation: Alliance Portfolio Complexity

	(1) Number of New Alliances	(2) Number of New Alliances	(3) Number of New Alliances	(4) Number of New Alliances	(5) Number of New Alliances
Focal Firm's Total Alliances **-(A)**		0.043^{**}		0.043^{**}	0.041^{**}
		(0.004)		(0.004)	(0.004)
(Focal Firm's Total Alliances)^2 **-(B)**		-1.315^{**}		-1.313^{**}	-1.266^{**}
		(0.214)		(0.212)	(0.219)
Focal Firm's Relative Alliance Portfolio Complexity (Function) **-(C)**			-0.145^{*}	0.130^{+}	-0.552^{+}
			(0.062)	(0.076)	(0.327)
(A)*(C)					-0.056^{**}
					(0.020)
(B)*(C)					4.422^{+}
					(2.485)
Other Firms' Total Alliances	0.273^{**}	0.084^{+}	0.264^{**}	0.090^{*}	0.065
	(0.031)	(0.044)	(0.031)	(0.044)	(0.045)
(Other Firms' Total Alliances)^2	-0.022^{**}	-0.012^{**}	-0.022^{**}	-0.012^{**}	-0.011^{**}
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Capacity Utilization	-0.001	0.001	0.000	0.001	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Home Demand	-0.048	-0.002	-0.049^{+}	-0.005	0.009
	(0.029)	(0.015)	(0.030)	(0.015)	(0.017)
Mega Alliance Membership	-0.048	-0.144	-0.055	-0.138	-0.136
	(0.090)	(0.117)	(0.090)	(0.116)	(0.118)
World Demand	0.001^{**}	0.001^{**}	0.001^{**}	0.001^{**}	0.001^{**}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Alliance Partners	-0.018^{**}	-0.036^{**}	-0.019^{**}	-0.035^{**}	-0.036^{**}
	(0.004)	(0.007)	(0.005)	(0.007)	(0.008)
Profit	-0.000^{+}	-0.000	-0.000^{+}	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year- 1982~1995	0.171	0.486^{*}	0.176	0.477^{*}	0.508^{*}
	(0.168)	(0.222)	(0.167)	(0.222)	(0.223)
Year- 1996~2000	-0.425^{**}	-0.273^{+}	-0.417^{**}	-0.282^{+}	-0.244
	(0.124)	(0.164)	(0.124)	(0.164)	(0.165)
Year- 2001~2010	-0.518^{**}	-0.330^{*}	-0.505^{**}	-0.342^{*}	-0.326^{*}
	(0.095)	(0.134)	(0.094)	(0.135)	(0.134)
Firm Age	0.025^{**}	0.001	0.024^{**}	0.001	0.002
	(0.005)	(0.002)	(0.005)	(0.002)	(0.002)
N	1328	1328	1328	1328	1328
Model χ^2	689.6	810.0	680.9	848.6	748.4
Degrees of Freedom	12	14	13	15	17

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

TABLE 3. Negative Binominal Analysis of Alliance Formation: Alliance Termination

	(6) Number of New Alliances	(7) Number of New Alliances	(8) Number of New Alliances	(9) Number of New Alliances	(10) Number of New Alliances
Focal Firm's Total Alliances **-(A)**		0.043^{**}		0.040^{**}	0.043^{**}
		(0.004)		(0.005)	(0.005)
(Focal Firm's Total Alliances)^2 **-(B)**		-1.315^{**}		-1.244^{**}	-1.722^{**}
		(0.214)		(0.221)	(0.284)
Focal Firm's Number of Termination **-(C)**			0.052^{**}	0.022^{+}	0.061^{**}
			(0.017)	(0.016)	(0.020)
(A)*(C)					-0.005^{**}
					(0.001)
(B)*(C)					0.299^{**}
					(0.062)
Other Firms' Total Alliances	0.273^{**}	0.084^{+}	0.232^{**}	0.081^{+}	0.070
	(0.031)	(0.044)	(0.035)	(0.044)	(0.044)
(Other Firms' Total Alliances)^2	-0.022^{**}	-0.012^{**}	-0.020^{**}	-0.011^{**}	-0.011^{**}
	(0.002)	(0.003)	(0.002)	(0.003)	(0.003)
Capacity Utilization	-0.001	0.001	-0.001	0.000	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Home Demand	-0.048	-0.002	-0.048	-0.006	-0.007
	(0.029)	(0.015)	(0.029)	(0.015)	(0.015)
Mega Alliance Membership	-0.048	-0.144	-0.062	-0.139	-0.075
	(0.090)	(0.117)	(0.099)	(0.116)	(0.116)
World Demand	0.001^{**}	0.001^{**}	0.001^{**}	0.001^{**}	0.001^{**}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Alliance Partners	-0.018^{**}	-0.036^{**}	-0.023^{**}	-0.037^{**}	-0.029^{**}
	(0.004)	(0.007)	(0.005)	(0.007)	(0.008)
Profit	-0.000^{+}	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year- 1982~1995	0.171	0.486^{*}	0.133	0.491^{*}	0.599^{**}
	(0.168)	(0.222)	(0.182)	(0.222)	(0.224)
Year- 1996~2000	-0.425^{**}	-0.273^{+}	-0.457^{**}	-0.270	-0.147
	(0.124)	(0.164)	(0.136)	(0.164)	(0.168)
Year- 2001~2010	-0.518^{**}	-0.330^{*}	-0.467^{**}	-0.308^{*}	-0.288^{*}
	(0.095)	(0.134)	(0.105)	(0.135)	(0.136)
Firm Age	0.025^{**}	0.001	0.018^{**}	0.001	-0.000
	(0.005)	(0.002)	(0.005)	(0.002)	(0.002)
N	1328	1328	1328	1328	1328
Model χ^2	689.616	810.061	561.795	830.211	929.455
Degrees of Freedom	12.000	14.000	13.000	15.000	17.000

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

FIGURE 1. Moderating Effect of Alliance Portfolio Complexity

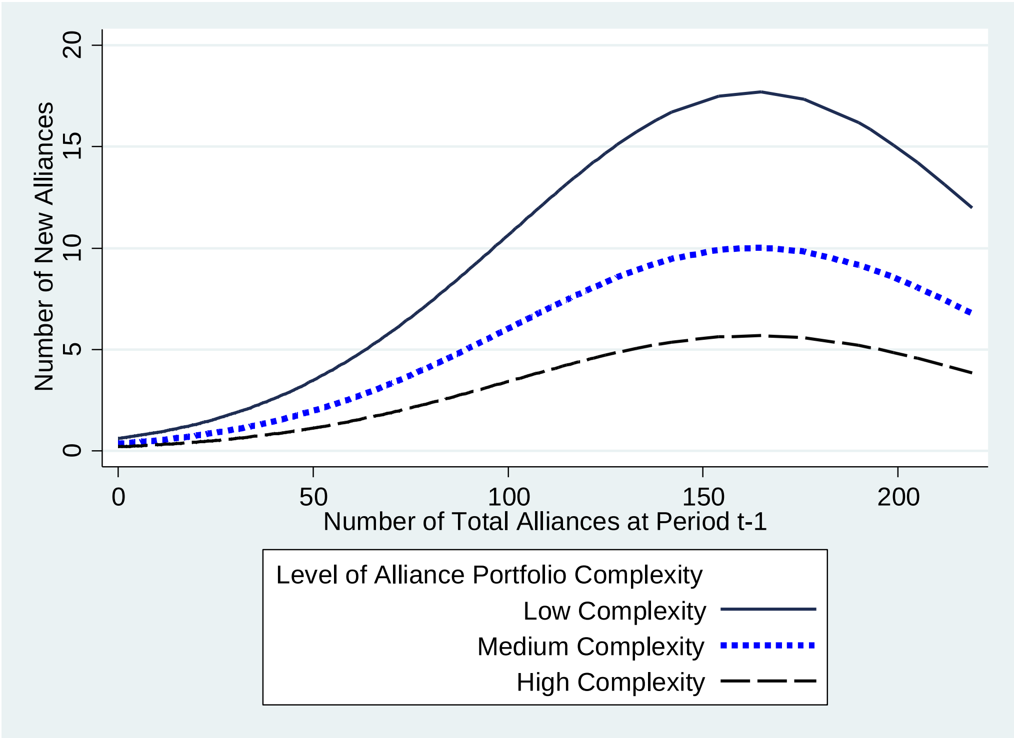
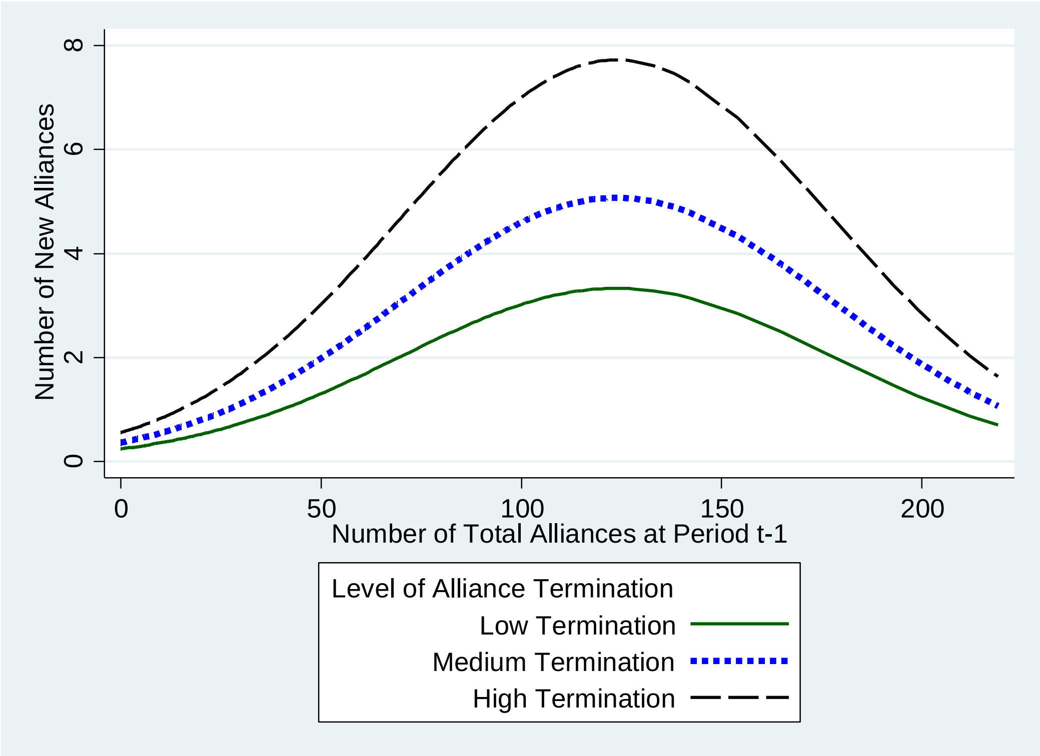


FIGURE 2. Moderating Effect of Alliance Termination



CHAPTER Ⅲ.

ALLIANCE PORTFOLIO COMPLEXITY AND ORDER-OF-ENTRY LEARNING EFFECTS IN INTERNATIONAL ALLIANCE FORMATION

1. INTRODUCTION

In recent years, international strategic alliances have become a popular strategic device used for sharing resources (e.g., Eisenhardt & Schoonhoven, 1996; Harrigan, 1985; Lavie, 2006; Rothaermel, 2001), learning (e.g., Hamel, 1991; Inkpen, 1998; Mayer & Argyres, 2004), reducing uncertainty and risk (e.g., Kogut, 1991; Reuer & Tong, 2005; Tong & Reuer, 2007), and market entry (e.g., Gulati, 1999; Yeniyurt, Townsend, Cavusgil, & Ghauri, 2009; Zahra, Ireland, & Hitt, 2000) across a wide range of industries. While alliances are recognized as a market growth engine in both domestic and global markets, the effective management of alliances is necessary for their benefits to be realized. For effective alliance management, firms engaging in international alliances typically must address two major issues. First, firms have to manage the costs of coordinating and doing business in the global market (Hamel, 1991; Khanna, Gulati, & Nohria, 1998; Lavie & Miller, 2008). Second, as firms form more alliances, they face greater challenges in managing their alliance portfolio across various value chains and functions (Lavie, 2007; Powell, Koput, & Smith-Doerr, 1996). Traditional alliance studies have focused more on the first issue and have paid less attention to the second one. Only recently have scholars begun to recognize that alliance portfolios are not a collection of independent dyadic alliances but rather a collection of interdependent sets of existing alliances (Lavie, 2007; Ozcan & Eisenhardt, 2009; Wassmer, 2010). This paper addresses the issue of managing alliance portfolio complexity and provides a refined perspective for understanding the fundamental underpinning of international alliance formation.

In this paper, the analysis of alliance portfolio complexity is based on the breadth and depth of a focal firm’s functional alliances. When an alliance portfolio is viewed as systems of individual alliances related to certain functional tasks, complexity emerges because the addition of one alliance results in an exponential increase in its impact through its interdependencies with other alliances (Lahiri & Narayanan, 2013; Vassolo, Anand, & Folta, 2004). Alliance portfolio complexity makes it more difficult for managers to grasp and anticipate the consequences of forming new additional international alliances. Therefore, alliance portfolio complexity limits the cognitive ability of managers to rationally collect and process information and decision factors during the alliance formation decision-making process (Anderson, 1999; Park & Ungson, 2001; Reuer & Arino, 2007). This limitation implies that there exists a certain threshold level of alliance portfolio complexity beyond which firms are discouraged to form new international alliances. However, the implications of alliance portfolio complexity remain largely underexplored. How do firms address alliance portfolio complexity? What are the factors that explain the capabilities of some firms that cope better than others with alliance portfolio complexity?

Drawing from the literature on the first-mover advantage (Lieberman & Montgomery, 1988; Makadok, 1998; Suarez & Lanzolla, 2007) and organizational learning (Khanna et al., 1998; Levitt & March, 1988; Mody, 1993), I address these questions and provide new insight into how firms can effectively manage alliance portfolio complexity by utilizing experience as a learning mechanism. In particular, I focus on the order-of-entry learning effects of a focal firm's international operations and international alliance experience in both the local and global market. I refer to order-of-entry learning effects as the realization of differential learning benefits that are enjoyed by the early entrants in an industry. I propose that the differing experiential learning effects of early and late entrants partially account for the heterogeneity in how firms manage alliance portfolio complexity issues. These ideas are tested empirically in the context of the global airline industry using comprehensive panel data on the alliance portfolios of 47 global airlines during the period from 1945–2010.

This study advances international alliance formation and alliance portfolio research by highlighting the role of alliance portfolio complexity and order-of-entry learning effects in international alliance formation. Focusing on order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity is important for several reasons. First, although prior work acknowledges the presence of trade-offs in possessing a complex alliance portfolio, very limited empirical evidence exists on how firms engaging in international alliances can mitigate the effects of increased communication and coordination costs through experiential learning. Second, there is limited theoretical exposition on how firms can better manage their alliance portfolio complexity. Because there are increasing numbers of international alliances, there is a great need for researchers to better understand how alliance portfolio complexity can be managed, especially in the international alliance context (Lavie & Miller, 2008). Thus, I offer insight into how organizational learning mechanisms mitigate coordination and communication costs and increased managerial complexity (Gomes-Casseres, 1993, 2001). Such mechanisms can also enhance the benefits of increased alliance portfolio complexity by identifying new alliance formation opportunities (Cohen and Levinthal, 1990) and addressing competitive pressures (Garcia-Pont & Nohria, 2002; Yeniyurt et al., 2009). Third, this study also advances the first-mover advantage literature by demonstrating how firms can maximize early entry opportunities in local and global markets to gain from two different types of experiential learning.

2. THEORY AND HYPOTHESES

Most of the prior research on alliances has not paid sufficient attention to the fact that firms in fact evaluate the value of their new alliances based on the continuously evolving context of their alliance portfolios. Contrary to the traditional alliance research, the alliance portfolio-based view considers multiple existing alliances not as a simple set of aggregated individual alliances and but as an evolving portfolio of inter-related relationships (Vassolo et al., 2004). Thus, it is important to note that firms with an alliance portfolio make rational choices to maximize the overall benefits of their alliance portfolios rather than to make choices to fulfill the purpose of a single alliance (Gulati & Singh, 1998; Lavie, 2007; Wassmer, 2010). Therefore, alliance portfolio approach goes beyond the single-alliance evaluation approach and can explain why firms decide to form less efficient alliances or give up certain beneficial alliances to maximize the overall gains from their existing alliance portfolios. Particularly when adding volume and diversity to their existing alliance portfolio, firms are challenged to address the unintentional consequences of a state of increased complexity associated with alliance portfolio management. It is important for firms to understand the level of complexity at which firms can maximize the overall gains of their alliance portfolios. I proceed in this section by reviewing the benefits and costs associated with alliance portfolio complexity and then examine how the overall gain varies depending on the level of complexity.

2.1. Benefits of Building a Complex Alliance Portfolio

Prior research has suggested that having a complex alliance portfolio can benefit a firm in several ways. First, a complex alliance portfolio can facilitate shared learning both within and across alliances, eventually enhancing the likelihood of synergy creation and the achievement of economies of scope and scale (Hoehn-Weiss & Karim, 2013; Khanna et al., 1998; Powell et al., 1996). For example, increased complexity can facilitate learning from multiple the functions of partners. R&D alliances allow firms to learn about their partners' information and knowledge, production alliances allow firms to learn about manufacturing skills and know-how, and marketing alliances allow firms to learn about how their partners perceive the market. Particularly in the international context, firms can be more flexible, responsive, and adaptable to global market conditions as well as minimize the risk and uncertainty of operating in foreign markets through learning from functionally complex portfolios (Eisenhardt & Schoonhoven, 1996; Lavie, 2006). Second, the continuous adjustment and coordination of complex alliance portfolios can increase the overall efficiency of resource utilization (Das & Teng, 2000; Vasudeva & Anand, 2011). Complex portfolios with a wide range of functional scopes and partners can provide non-redundant distinct advantages that can enable firms to bring about the complementary and compatible alignment of their resources (Doz & Hamel, 1998; Parkhe, 1991). Third, a complex alliance portfolio can improve a firm's alliance management capabilities. Organizational capabilities are developed by recombining and/or integrating the knowledge within a firm (Grant, 1996). Firms with complex alliance portfolios will likely be more effective at alliance management capability development when they establish mechanisms or routines that are designed to accumulate, store, integrate, and diffuse a more diverse range of alliance-related knowledge acquired through past alliance experiences (Kale, Dyer, & Singh, 2002; Kale & Singh, 2007).

2.2. Costs of Building a Complex Alliance Portfolio

Despite the benefits described above, alliance portfolio complexity beyond a certain level may create more costs then benefits. Coordination costs, which are the primary concern in alliance management, mainly arise from the complexity of the ongoing coordination of decomposing and allocating tasks within and across organizational boundaries (Gulati & Singh, 1998; Ireland, Hitt, & Vaidyanath, 2002). Such a coordination process may lead to conflicts and time-consuming negotiations across multiple functional departments, thereby incurring exponential negotiation and communication costs when adding additional alliances to an existing alliance portfolio. Therefore, a complex alliance portfolio increases not only the related costs of making a decision to form new alliances but also the costs of effectively managing the existing alliances. Additionally, as resource constraints exist for every firm at any given moment, expanding an alliance portfolio can become a major challenge (Das & Teng, 2000; Eisenhardt & Schoonhoven, 1996). Finally, complex alliance portfolios can create information overload, which can be challenging for managers to address. Increasing complexity creates difficulties for decision makers to accurately grasp and anticipate the effects of the interdependencies among existing alliances. Therefore, complexity limits the ability of managers to rationally gather and evaluate important information and decision factors (Simon, 1955). In the end, complexity can increase the risk for managers to overlook certain performance-detrimental consequences or to decrease the efficiency of entire alliance portfolios by making sub-optimal decisions (Levinthal, 1997). Overall, when alliance portfolio complexity reaches a certain point, it is highly likely that the cost of managing the alliance portfolio will exponentially increase and will exceed the benefits of having a complex portfolio. Therefore, I predict the following:

Hypothesis 1 (H1): There will be an inverted U-shaped relationship between a firm's alliance portfolio complexity and the firm's propensity to form new international alliances.

2.3. Moderate Role of Order-of-Entry Learning Effects

Learning through international market experience is important for global firms to effectively operate in a global environment (Johanson & Vahlne, 1977). Conceptually, learning can be described as the development of insights, knowledge and associations between past actions, the effectiveness of those actions and future actions (Fiol & Lyles, 1985) that will take place to adapt to changing environmental conditions (Volberda & Lewin, 2003). Many studies indicate that the main source of learning is experience (Cyert & March, 1963; Levinthal & March, 1993; Levitt & March, 1988). Depending on the types of learning experiences and their timing, firms can draw different learning benefits. For instance, by operating in other countries, firms can learn develop diverse country-specific local knowledge about culture, customer preferences, and legal or political systems. Additionally, by operating in other countries, firms can benefit from learning-by-doing: the process by which a firm becomes more efficient at doing what it was already doing through trial-and-error and practice (Levitt & March, 1988). Therefore, firms can become more efficient and effective at processing information and coordinating business activities across borders. Additionally, through learning, firms can identify how to utilize their current functional alliance composition to benefit more from engaging in additional international alliances for global expansion (Inkpen, 1998; Tsang, 2002). In this way, firms can find ways to more effectively manage and configure their complex alliance portfolios.

I also argue that early entrants will enjoy the benefits order-of-entry leaning effects of international operations more than late entrants for the following reasons. First, early entrants simply have more time for learning. Empirical findings suggest that learning does indeed accelerate fairly rapidly for some period of time (Lieberman, 1984). Second, early entrants can create learning-based preemptive advantages such as establishing a more efficient operational routine or a cross-border coordination system (Lieberman & Montgomery, 1988). Third, firms can create preemption of input factors by using their superior local market knowledge. In principle, a first mover may be able to appropriate rents that accrue to assets that require superior information (Lieberman & Montgomery, 1988).

Thus, I predict the following:

Hypothesis 2 (H2): The order of international operation entry within the global market will moderate the relationship between a firm's alliance portfolio complexity and the firm's propensity to form new alliances.

Hypothesis 3 (H3): The order of international operation entry within the local market will moderate the relationship between a firm's alliance portfolio complexity and the firm's propensity to form new alliances.

By engaging in international alliances, firms can benefit from learning different types of alliance management-specific knowledge, such as contracting, monitoring, synergy creation among alliance partners (Gulati, 1999; Kale & Singh, 2007; Lane & Lubatkin, 1998). Specifically, past alliance experiences can enhance alliance portfolio management capabilities (Kale et al., 2002; Kale & Singh, 2007). Such capabilities include reducing redundancy, increasing strategic flexibilities, exploiting the existing portfolio, and exploring new opportunities to create complementarity among existing alliances. They can also enhance a firm's ability to effectively manage the coordination and communication costs that are incurred exponentially through increased alliance portfolio complexity.

Early entrants will enjoy greater order-of-entry leaning effects from international alliances than late entrants for the following reasons. First, the relative absorptive capacity of early entrants will be greater than that of late entrants (Cohen and Levinthal, 1990). Therefore, the ability to identify and assimilate knowledge through alliance experience will be much greater (Lane & Lubatkin, 1998). Second, early entrants will be better able to detect and identify the need for specific routine development and will be more effective in their actual implementation of alliance management capabilities development (Kale & Singh, 2007). Third, through their multiple alliance partners, early entrants can benefit from vicarious learning about their alliance partners' strategies, capabilities, and actions (Baum & Korn, 1996; Silverman & Baum, 2002).

Thus, I predict the following:

Hypothesis 4 (H4): The order of international alliance entry within the global market will moderate the relationship between a firm's alliance portfolio complexity and the firm's propensity to form new alliances.

Hypothesis 5 (H5): The order of international alliance entry within the local market will moderate the relationship between a firm's alliance portfolio complexity and the firm's propensity to form new alliances.

3. METHOD

3.1. Research Setting

The hypotheses for this study were tested using comprehensive panel data on the alliance portfolios of 47 major global airlines. Over the years, the global airline industry has experienced various types of dynamic and extensive alliance activities for the following reasons. First, alliances enable global airlines to enter global markets without obtaining that right through bilateral agreements (Oum & Yu, 1998). Second, because regulation restricts cross-border acquisitions and stand-alone overseas expansion for global airlines, alliances are commonly used for global expansion (Oum, Taylor, & Zhang, 1993; Pustay, 1980). Third, alliances are beneficial for firms in terms of providing better route network service to customers and reducing marketing costs by offering shared information and loyalty services such as frequent flier mileage programs (Oum & Yu, 1998).

Historically, there were very few airline alliances before the 1980s, as was the case in various other industries (Gulati, 1995; Harrigan, 1985). Since 1987, however, airlines have significantly increased the frequency of forming multiple alliances with their competitors. For example, American Airlines has established more than 40 cross-border alliances with 22 foreign airline companies during the last two decades. Among the top 65 airline companies in terms of annual revenue, the total number of strategic alliances increased to over 1,200 before 2000. Particularly since the late 1990s, the typical bilateral characteristics of cross-border airline alliances significantly shifted to complex multi-lateral arrangements among multiple partners, such as Oneworld, Sky Team, and Star Alliance.

The practice of engaging in multiple simultaneous alliances in the global airline industry enhances the meaningfulness and variability of alliance portfolio characteristics. In addition, the industry features a well-defined set of reliable yearly data about alliance announcements, detailed descriptions of various functional information, and termination information.

3.2. Data

For each of the 47 airlines, I collected annual alliance data from January 1982 to December 2010 (the study period) while controlling for earlier alliances and those of other major global airlines up to 1945. Annual observations allowed me to obtain precise estimates of the total number of alliances in a portfolio during a given time period. The data were collected in the following manner. First, to ensure that the sample was representative of the industry's firm size, regional distribution, and industry-wide historical evolution, I selected major airlines ranked by size. The sample includes 14 airlines from the Americas; 19 from Europe, the Middle East, and Africa; and 14 from Asia and Oceania. The final sample approximately reflects each region's share of worldwide traffic, although a few well-known airline companies may be excluded due to the random sampling process. Twenty-four of the 47 airlines had international operations before 1945, while the other eight started international operations during the study period. Second, I used multiple sources, including annual reports, company publications, international newspapers, and leading industry sources such as *Airline Business*, *Flight*

International and the *World Airline Directory*, and *Lexis/Nexis* to collect the data. I excluded a few reports of potential alliances that never materialized in practice. International Air Transport Association (IATA) lists 64 airlines with substantial international operations at the end of the study period. All are scheduled international passenger carriers, ensuring comparability among firms. The data included 47 international passenger carriers, in a total of 28 countries. Both horizontal and vertical alliances (i.e., car rental or credit card companies) were included in the sample. To avoid any left censoring in computing the independent variables, I collected data on each sample airline's alliances all the way back to 1945. Alliance information was mainly collected from *Airline Business* and *Lexis/Nexis*. Each alliance was classified by its functional type based on Rhoades' (2008) alliance activity by type. All other airline-specific data were collected from the International Civil Aviation Organization (ICAO).

3.3. Measures

3.3.1. Dependent Variable

I used count variables as dependent variables for this study. New International Alliances counts all international alliances, without distinction by alliance type, formed by a focal airline that became effective in a given year.

3.3.2. Independent Variables and Moderators

Focal Firm's Alliance Portfolio Complexity. In this paper, alliance portfolio complexity is defined as the depth and breadth of the focal firm's alliance portfolio. Following Fernhaber and Patel (2012), I consider alliance portfolio complexity in relation to competitors' portfolio of alliances within a firm's industry. Operationalized alliance portfolio complexity not only measures the depth and breadth of a firm's alliance portfolio, but using vector algebra, it also adjusts the resulting measure in the context of other industry firms' alliance portfolio complexity. In other words, the greater the number of alliances in a given alliance function type and the more diverse the categories are, the greater the alliance portfolio complexity will be. Also following Fernhaber and Patel (2012), I undertook a pairwise comparison by calculating cosine values between the vectors of two firms across all product classes in an industry and the number of product classes in each industry:

$$Complexity\ index\ (f_x,\ c_j) = \frac{\overrightarrow{f_x}\ ,\ \overrightarrow{c_j}}{|\overrightarrow{f_x}||\overrightarrow{c_j}|} = \frac{\sum_{i=1}^{n} w_{i,x}\, w_{i,j}}{\sqrt{\sum_{i=1}^{n} w_{i,x}^2}\sqrt{\sum_{i=1}^{n} w_{i,j}^2}}$$

where (1) f_x= Vector of number of alliances (w) in each alliance type category (i) for focal firm x, (2) c_j= Vector of number of alliances (w) in each alliance function category (i) for other industry firm c_j, and (3) Type category (i)= Marketing, Operations, R&D, and Other alliances.

Starting with the focal firm f_x, the vector of the number of alliances (w) in each product alliance function category (i) was compared with another firm, c_j, which had a vector of a number of alliances in the same product category. As the angle between the vectors shortens, the cosine value approaches 1, indicating that the vector of products produced by the two firms is more similar. I then added the vectors to create a total similarity index. To control for industry size and enhance interpretability, I divided the total by K firms. When a focal firm had no overlapping alliance function category with another firm, normalizing the sum of the similarity scores further penalized a high dissimilarity score. Continuing from the nature of complexity, the current measure developed an unbiased estimate of the extent to which a firm's alliances were similar to its competitors' alliances at the industry level. The weights in the vector are indicative of the depth, or of the number of alliances in a given alliance function category. The variable was lagged by one year.

Order of Global Market Entry: International Operations. For each airline, its initiation year of international operations was identified, and based on the year, the order of entry among the 47 airlines was ranked. For example, the first airline to initiate international operations was ranked 1.

Order of Local Market Entry: International Operations. I defined local markets into 5 regions: the Americas, Asia, Europe, the Middle East & Africa, and Oceana. In each region, the initiation year of international operations was identified, and based on the year, the order of entry among airlines in each region was ranked.

Order of Global Market Entry: International Alliance. For each airline, its initiation year of entering into international alliances was identified, and based on the year, the order of entry among the 47 airlines was ranked. For example, the first airline to form international alliance was ranked 1.

Order of Local Market Entry: International Alliance. I defined the local markets into 5 regions: the Americas, Asia, Europe, the Middle East & Africa, and Oceana. In each region, the initiation year of entering into international alliances was identified, and based on the year, the order of entry among the airlines in each region was ranked.

3.3.3. Control Variables

The following control variables are included in this study. First, the capacity utilization rate, the distinct number of alliance partners, and the size of the focal airline's home market, which are all potential indicators of a firm's attractiveness as an alliance partner, as well as the focal airline's exposure to alliance opportunities and congestion effects were controlled. Together with the fixed firm effects described below, these variables help to control for firms' propensities to form alliances and their (and their environment's) alliance-carrying capacity (Baum & Oliver, 1992). A standard measure of the capacity utilization rate was used, which was calculated as the total seat kilometers performed divided by the total seat kilometers available for sale by the firm in a given year. Controlling for the size of an airline's domestic market is also relevant because growth in alliances may simply reflect increasing demand rather than alliance formation momentum. The primary international market for an airline, under the bilateral arrangements regime, consists of travelers into or out of the airline's home country. I used another standard indicator to measure this variable (Keeler & Formby, 1994): total passenger kilometers performed by all airlines into and out of that country in a given year, expressed in millions, log-transformed, and lagged by one year. Replacing that variable with a measure that included domestic passenger kilometers performed did not change the results. To control for environmental factors, I included mega alliance membership, world demand, and period-based year dummies. Controlling for mega alliance membership is important because with the emergence of so-called "mega alliances" such as Star Alliance, Oneworld, and SkyTeam, the nature of alliances significantly changed the dynamics of airlines' alliance formation behaviors. For each airline for each year, if the airline was a member of Star Alliance, Oneworld, or SkyTeam, I coded it as 1. World Demand was measured as the sum of the total passenger kilometers performed by all airlines into and out of all countries in a given year. Three period dummy variables were created to control for major external events in the airline industry. The period from 1982 to 1995 is considered a fast-growing era for global airlines that accelerated alliance formation. The period from 1996 to 2000 is when mega alliances emerged. During the period from 2001 to 2010, the global airline industry was heavily affected by a substantial decline in world demand triggered by the

9.11 terror attack in New York. I also included number of industry-level alliances to control for industry-level factors (i.e., the bandwagon effect), which can influence the focal firm to form alliances (Baum & Oliver, 1992; Gulati, 1995). To examine non-monotonic effects, I computed squared terms of this variable. The variable was lagged by one year to avoid modeling the dependent variable as a function of its own current value. Finally, number of alliances formed by a focal airline preceding the focal year was included. This number represents a cumulative count of all past alliances involving a focal airline regardless of its type. To examine non-monotonic effects, I computed squared terms of the variable. The variable was lagged by one year to avoid modeling the dependent variable as a function of its own current value.

3.4. Analysis

Using the number of new alliances as the dependent variable raises econometric issues that are common to studies of count variables. Following Hausman, Hall, and Griliches (1984), I specify a Poisson regression to model the probability that a firm will form n alliances in a given year (with n = 0, 1, 2, ...) as follows: Prob(Y = y_j) = $e^{-\lambda j}\ \lambda_j^{Yj}/Y_j!$, (A) where Y_j is the count of alliances for the entries of the j^{th} firm. To incorporate exogenous variables, lambda can be expressed as a function of the covariates: $\lambda_j = \exp(\Sigma B_i X_{ij})$, (B) where B's are the coefficients, X's are the covariates (with $X1$ set to one), i indicates the i^{th} variable, and j is the j^{th} firm. The exponential function ensures non-negativity.

The Poisson distribution contains the strong assumption that the mean and variance of the explained variable are equal to lambda. Below, I report the results of the diagnostic tests used to examine this assumption. To address the potential problem of overdispersion, whereby the mean differs from the variance, a firm-specific error term can be specified. Equation (B) then becomes: $\lambda_j = \exp(\Sigma B_i X_{it})\exp(u_j)$; (C) where λ_j is no longer determined but is itself a random variable. As u_j is unobserved, it is integrated out of the expression by specifying a gamma distribution for the error term, whereupon the now compound Poisson reduces to the negative binomial model (Johnson & Kotz, 1970). Only the scale of the distribution is permitted to vary as a function of the covariates. The variance of Y_j is parameterized to equal $(1 + \alpha)$ E(Y_j), yielding a constant variance-mean ratio. This specification is a standard method of accounting for overdispersion. Because each firm figures into the data multiple times, a fixed or random effects specification can be used to control for unobserved firm-specific effects that may otherwise bias negative binomial estimates (Greene, 2002).

I successfully replicated the results to address two potential estimation problems. First, some firms may not be at risk of forming alliances, at least initially. This is a lesser concern in this case because all firms were clearly active in alliance formation soon after entering the sample, if not before. Nevertheless, to address this possibility, I ran analyses while including only firms that had already entered into at least one alliance (see Gulati, 1995b). Second, some alliance observations were represented twice in the data if both partners were among the 47 focal airlines. To address possible oversampling, I also ran a maximum likelihood estimation where the weight of such observations was reduced (Baum & Korn, 1996).

4. RESULTS

4.1. Descriptive Statistics

The final sample contains 1,328 airline-year records. Descriptive statistics are shown in Table 4. The number of alliances formed by an airline in a given year varies from 0 to 22. Below, I carefully examine the extent to which this variation should affect the interpretation of the results.

Insert Table 4 about here

4.2. Regression Analysis

I performed Cameron and Trivedi's (1990) T_{opt} test to examine whether the mean and variance of λ are equal and found evidence of overdispersion in the regression models ($p < .01$ in each model). Furthermore, based on the Vuong (1989) test, a zero-inflated model does not improve the model fit ($p > .10$ in each model). Accordingly, I report the results of negative binomial regressions that conservatively account for overdispersion. I replicated the results with Poisson and zero-inflated models and with a binary dependent variable to indicate the formation of at least one alliance per period and found no substantial difference. Hausman tests indicate that a fixed effects specification is more suitable than random effects. The fixed effects specification is a powerful way to control for unobserved factors such as any residual heterogeneity in alliance opportunities and capabilities not explained by the independent and control variables (Cameron & Trivedi, 1990; Greene, 2002).

For all of the analysis, based on Aiken and West (1991), I mean centered the independent and moderating variables. The results of testing the main effect of alliance portfolio complexity and the moderating effect of international operation order-of-entry are shown in Table 5. Hypothesis 1 predicted an inverted U-shaped relationship between the focal firm's alliance portfolio complexity and its propensity to form new international alliances. These models have substantial explanatory power, as indicated by their overall χ^2 statistics. The χ^2 for model (1) is 438.8, the χ^2 for model (2) is 514.8, the χ^2 for model (3) is 437.7, the χ^2 for model (4) is 492.0, the χ^2 for model (5) is 448.0, and the χ^2 for model (6) is 451.8. Each model is statistically significant as a whole ($p < .01$). Model (1) is a base model that investigates the influence of the control variables only. Model (2) examines the effect of the firm's alliance portfolio complexity on its propensity to form new international alliances, which is inverted U-shaped. Therefore, Hypothesis 1 is supported. Hypothesis 2 predicted that the focal firm's global market entry order in international operations would moderate the relationship between the firm’s alliance portfolio complexity and its propensity to form new international alliances. Model (4) shows that the interaction effect is not significant. Therefore, Hypothesis 2 is not supported. However, Model (3) indicates that the main effect of global market entry order in international operations is significant. Hypothesis 3 predicted that the focal firm’s local market entry order in international operations would moderate the relationship between the firm’s alliance portfolio complexity and its propensity to form new international alliances. Model (5) indicates that the main effect of the local market entry order in international operations is significant. Model (6) shows the moderating effect of the local market entry order in international operations on the focal firm’s propensity to form new international alliances. The negative moderating effect of local market entry order in international operations is well demonstrated in Figure 3. As shown in Figure 3, if an airline enters international operations early compared to other local competitors, the inverted U-shaped relationship between the firm’s alliance portfolio complexity and its propensity to form new alliances is enhanced. Therefore, the results support Hypothesis 3.

Insert Table 5 about here

Insert Figure 3 about here

The results of testing the moderating effect of international alliance order-of-entry are shown in Table 6. The χ^2 for model (7) is 377.6, the χ^2 for model (8) is 455.9, the χ^2 for model (9) is 384.4, the χ^2 for model (10) is 458.2, the χ^2 for model (11) is 383.7, and the χ^2 for model (12) is 406.7. Each model is statistically significant as a whole ($p < .01$). Model (7) is a base model that investigates the influence of the control variables only. Model (8) examines the effect of a firm's alliance portfolio complexity on its propensity to form new international alliances, which is inverted U-shaped. Again, Hypothesis 1 is supported. Hypothesis 4 predicted that the focal firm's global market entry order in international alliances would moderate the relationship between the firm's alliance portfolio complexity and its propensity to form new international alliances. Model (10) shows that the interaction effect is significant. Therefore, Hypothesis 4 is supported. Hypothesis 5 predicted that the focal firm's local market entry order in international alliances would moderate the relationship between the firm's alliance portfolio complexity and its propensity to form new international alliances. Model (12) shows the moderating effect of the local market entry order in international alliances on the focal firm's propensity to form new alliances. The negative moderating effect of global and local market entry order in international alliances is well demonstrated in Figures 4 and 5. As shown in Figures 4 and 5, if an airline enters international alliances early compared to other global and local competitors, the inverted U-shaped relationship between the firm's alliance portfolio complexity and its propensity to form new alliances is enhanced. Therefore, the results support Hypotheses 4 and 5.

Insert Table 6 about here

Insert Figure 4 about here

Insert Figure 5 about here

4.3. Robustness Check

I also checked the robustness of the findings to possible omitted variables. Statistically, fixed effects stand to absorb many plausible forms of unobserved heterogeneity among firms (Cameron & Trivedi, 1990; Greene, 2002). For completeness of analysis, I examined several possible sources of heterogeneity. One possible source consists of a time effect. When I included a clock variable measuring calendar time in the analyses, its effect was very low and non-significant, and the remaining effects were essentially unchanged. Another source may be the possibility that recently applied actions may be more salient in driving future alliance formation momentum than those utilized in the more distant past

(Gulati, 1995). To test the effect of organizational short memories, I used narrow windows of both 3 and 5 years to count the alliance-related independent variables. Finally, I examined whether equity-based alliances might exhibit different results than non-equity-based alliances. I found no evidence of such an effect. This result may occur because airline regulators impose severe limits on international equity transactions.

5. DISCUSSION & CONCLUSION

5.1. Contributions

This study advances international alliance formation and alliance portfolio research by highlighting the role of alliance portfolio complexity and order-of-entry learning effects in international alliance formations. Focusing on order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity is important for several reasons. First, although prior work acknowledges the presence of trade-offs in possessing a complex alliance portfolio, very limited empirical evidence exists on how firms engaging in international alliances can mitigate the effects of increased communication and coordination costs through experiential learning. Second, there is limited theoretical exposition on how firms can better manage their alliance portfolio complexity. As there is growing number of international alliances, there is a need for researchers to better understand how alliance portfolio complexity can be managed, especially in the international alliance context (Lavie & Miller, 2008). Thus, I offer insight as to how organizational learning mechanisms mitigate coordination and communication costs and increased managerial complexity (Gomes-Casseres, 1993, 2001). Such mechanisms can also enhance the benefits of increased alliance portfolio complexity by identifying new alliance formation opportunities (Cohen and Levinthal, 1990) and addressing competitive pressures (Garcia-Pont & Nohria, 2002; Yeniyurt et al., 2009). Third, I also advance the first-mover advantage literature by demonstrating how firms can maximize early entry opportunities in local and global markets to gain from two different types of experiential learning.

This study advances international alliance formation and alliance portfolio research by highlighting the role of alliance portfolio complexity and order-of-entry learning effects in international alliance formation. This study sheds light on the various theoretical drivers of alliance formation to extend the existing literature, with special attention on order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity. The results show that early entry learning exists in gaining direct international alliance experience in both the local and global markets. However, indirect early entry learning effects of international operations are limited to only local markets.

5.2. Limitations and Future Research

The limitations of this study may provide future research opportunities.

First, this study also indicates the importance of alliance heterogeneity. This study design allows the effect of each alliance to vary based on its functional focus and order relative to other alliances. However, data limitations prevented us from incorporating all of the other dimensions of alliances. For instance, the relative scale of various alliances may affect the magnitude of alliance portfolio complexity, resulting in some type of influence in alliance formation strategies. Furthermore, research could examine the distinctions between horizontal cooperative strategies among industry participants (as studied here), vertical cooperative strategies between buyers and suppliers, and cross-cutting ties (Bae, Wezel, & Koo, 2011; Hennart, 1988; Kotabe, Martin, & Domoto, 2003).

Second, future research could explore the concept of alliance portfolio complexity in other domains. This study only focused on alliance portfolio complexity using functional scope and depth. However, as in alliance portfolio diversity studies (e.g., Jiang et al., 2010; Parkhe, 1991; Zahra, Ireland, & Hitt, 2000), alliance portfolio complexity can be measured and theoretically tested in regional, partner, or governance structure domains. For example, possessing an alliance portfolio with a different number of larger, similar-sized, or smaller partners in terms of operational size can result in different levels of alliance portfolio complexity. Prior research has also suggested that engaging in international alliance portfolios with different levels of cultural difference or geographical distances can result in different levels of alliance portfolio complexity (Lavie & Miller, 2008). Thus, using the concept and measure of alliance portfolio complexity in various theoretical and empirical contexts may enrich and extend the findings of this study.

Third, while marketing and operational alliances represent the overwhelming majority of partnerships among global airlines, in other industries, different categories of alliances may prevail, such as R&D alliances (e.g., Baum, Calabrese, & Silverman, 2000a; Sampson, 2007; Silverman & Baum, 2002). In such contexts, researchers should examine whether alliance portfolio complexity and alliance termination experience also moderate the relationship between alliance portfolio size and new alliance formation. Because this study focused on the global service industry, the generalizability of this study may be increased by replicating the study's findings in the manufacturing and high-tech sectors.

Finally, the findings suggest opportunities for research on alliance portfolio management and the performance implications of alliances (and, by extension, other forms of strategic actions subject to alliance portfolio complexity). Given that a firm already possesses a heterogeneous functional portfolio of alliances, the potential impact of additional alliances may be affected by the order of an alliance relative to the previous alliance portfolio of the firm and by industry participants, together with alliance types. Relevant performance indicators include financial returns (Anand & Khanna, 2000; Park & Mezias, 2005) and firm growth and longevity (Singh & Mitchell, 1996).

5.3. Conclusion

This study sheds light on the various theoretical drivers of international alliance formation, with special attention on order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity. Evidence from the global airline industry from the 1982 to 2010 period shows that the order-of-entry of a focal firm moderates the relationship between the focal firm's alliance portfolio complexity and the firm's propensity to form new international alliances. Findings of this study suggest that the differing experiential learning effects of early and late entrants partially account for the heterogeneity in how firms manage alliance portfolio complexity.

TABLE 4. Descriptive Statistics and Correlation Matrix†

Variables	Mean	S.D.	Min	Max	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
(1) New Int'l Alliances	2.15	2.68	0	22	1.00													
(2) Focal Firm's Alliances	27.4	28.	0	172	0.33***	1.00												
(3) Alliance Portfolio Complexity	1.02	0.51	0	4.34	0.05	0.03	1.00											
(4) Global Market Entry : International Operation	14.7	7.94	1	30	-0.02	-0.11***	-0.12***	1.00										
(5) Local Market Entry : International Operation	3.26	1.63	1	7	-0.00	-0.05	-0.12***	0.77***	1.00									
(6) Global Market Entry : International Alliance	8.97	4.11	1	17	-0.15***	-0.25***	-0.35***	0.39***	0.22***	1.00								
(7) Local Market Entry : International Alliance	4.27	2.79	1	11	-0.12***	-0.16***	-0.19***	0.11***	0.32***	0.61***	1.00							
(8) Other Firms' Alliances	697	505	25	1598	0.11***	0.66***	-0.06*	0.06*	0.03	0.05	0.01	1.00						
(9) Capacity Utilization (%)	65.2	17.1	0	88.7	0.10***	0.30***	0.00	-0.15***	-0.14***	0.01	-0.01	0.32***	1.00					
(10) Home Demand	262.1	481.9	0	3978	0.17***	0.36***	0.06*	-0.08**	-0.08**	-0.16***	-0.11***	0.24***	0.19***	1.00				
(11) Mega Alliance Membership	0.21	0.41	0	1	0.08**	0.62***	-0.00	-0.06*	-0.02	-0.10***	-0.05*	0.57***	0.27***	0.33***	1.00			
(12) World Demand	1378	697	473	2786	0.12***	0.66***	-0.05	0.05	0.03	0.03	0.00	0.97***	0.32***	0.26***	0.59***	1.00		
(13) Number of Alliance Partners	11	13	0	62	0.18***	0.87***	0.02	-0.12***	-0.04	-0.22***	-0.12***	0.75***	0.34***	0.38***	0.66***	0.77***	1.00	
(14) Firm Size	0.53	057	0	3.12	0.37***	0.54***	0.07**	0.05	0.10***	-0.21***	-0.27***	0.20***	0.35***	0.48***	0.33***	0.21***	0.46***	1.00

† N= 1,328, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

TABLE 5. Negative Binominal Analysis of Int'l Alliance Formation: International Operation Order-of-Entry

	Dependent Variable= Number of New International Alliances					
	(1)	(2)	(3)	(4)	(5)	(6)
Alliance Portfolio Complexity- (A)		1.391^{**}		1.353^{**}		1.448^{**}
		(0.228)		(0.234)		(0.246)
(Alliance Portfolio Complexity)^2- (B)		-0.464^{**}		-0.464^{**}		-0.549^{**}
		(0.083)		(0.090)		(0.101)
Order of Entry (Int'l Operation: Global)-(C)			-0.019^{*}	-0.013^{+}		
			(0.008)	(0.008)		
(A) * (C)				0.016		
				(0.030)		
(B) * (C)				-0.006		
				(0.011)		
Order of Entry (Int'l Operation: Local)-(D)					-0.073^{+}	-0.097^{*}
					(0.040)	(0.043)
(A) * (D)						0.279^{*}
						(0.134)
(B) * (D)						-0.145^{*}
						(0.060)
Other Firms' Total Alliances	0.001^{**}	0.001^{**}	0.002^{**}	0.001^{**}	0.002^{**}	0.001^{**}
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
(Other Firms' Total Alliances)^2	-0.008^{**}	-0.005^{*}	-0.008^{**}	-0.005^{**}	-0.008^{**}	-0.005^{**}
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Capacity Utilization	-0.011^{**}	-0.009^{**}	-0.012^{**}	-0.010^{**}	-0.012^{**}	-0.011^{**}
	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.003)
Home Demand	0.017	0.011	0.002	0.001	0.005	-0.008
	(0.022)	(0.019)	(0.023)	(0.020)	(0.023)	(0.023)
Mega Alliance Membership	-0.170	-0.143	-0.164	-0.143	-0.170	-0.154
	(0.122)	(0.123)	(0.121)	(0.123)	(0.122)	(0.123)
World Demand	0.001^{**}	0.000	0.001^{**}	0.000	0.001^{**}	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Alliance Partners	-0.024^{**}	-0.020^{*}	-0.027^{**}	-0.021^{**}	-0.025^{**}	-0.020^{*}
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Year- 1982~1995	0.172	0.390^{+}	0.224	0.444^{*}	0.196	0.504^{*}
	(0.209)	(0.219)	(0.210)	(0.220)	(0.212)	(0.220)
Year- 1996~2000	-0.466^{**}	-0.239	-0.436^{**}	-0.209	-0.456^{**}	-0.174
	(0.161)	(0.170)	(0.161)	(0.170)	(0.162)	(0.169)
Year- 2001~2010	-0.536^{**}	-0.435^{**}	-0.496^{**}	-0.404^{**}	-0.517^{**}	-0.395^{**}
	(0.126)	(0.131)	(0.126)	(0.131)	(0.127)	(0.129)
Focal Firm's Total Alliances	0.014^{**}	0.017^{**}	0.011^{*}	0.014^{**}	0.014^{**}	0.012^{*}
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
(Focal Firm's Total Alliances)^2	-0.480^{*}	-0.561^{*}	-0.346	-0.437^{+}	-0.463^{*}	-0.370
	(0.234)	(0.230)	(0.238)	(0.236)	(0.235)	(0.237)
Firm Size	0.657^{**}	0.537^{**}	0.712^{**}	0.589^{**}	0.683^{**}	0.603^{**}
	(0.097)	(0.090)	(0.099)	(0.095)	(0.097)	(0.099)
N	1328	1328	1328	1328	1328	1328
Model χ^2	438.8	514.8	437.7	492.0	448.0	451.8
Degrees of Freedom	13	15	14	18	14	18

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

TABLE 6. Negative Binominal Analysis of Int'l Alliance Formation: International Alliance Order-of-Entry

	Dependent Variable= Number of New International Alliances					
	(7)	(8)	(9)	(10)	(11)	(12)
Alliance Portfolio Complexity- (A)		1.483**		1.389**		1.517**
		(0.224)		(0.285)		(0.251)
(Alliance Portfolio Complexity)^2- (B)		-0.497**		-0.620**		-0.601**
		(0.083)		(0.133)		(0.112)
Order of Entry			-0.040*	-0.032*		
(Int'l Alliance: Global)-(C)			(0.019)	(0.016)		
(A) * (C)				0.273**		
				(0.064)		
(B) * (C)				-0.098**		
				(0.023)		
Order of Entry					-0.040^{+}	-0.056*
(Int'l Alliance: Local)- (D)					(0.025)	(0.025)
(A) * (D)						0.295**
						(0.087)
(B) * (D)						-0.118**
						(0.037)
Other Firms' Total Alliances	0.145**	0.089^{+}	0.195**	0.068	0.161**	0.105*
	(0.046)	(0.047)	(0.046)	(0.049)	(0.046)	(0.048)
(Other Firms' Total Alliances)^2	-0.017**	-0.010**	-0.018**	-0.010**	-0.017**	-0.011**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Capacity Utilization	-0.007**	-0.005*	-0.008**	-0.004^{+}	-0.008**	-0.006*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Home Demand	-0.018	-0.021	-0.031	-0.020	-0.018	-0.031
	(0.023)	(0.019)	(0.025)	(0.020)	(0.023)	(0.022)
Mega Alliance Membership	-0.164	-0.133	-0.122	-0.128	-0.146	-0.140
	(0.120)	(0.122)	(0.118)	(0.123)	(0.120)	(0.122)
World Demand	0.001**	0.001^{+}	0.001**	0.001*	0.001**	0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Number of Alliance Partners	-0.015*	-0.009	-0.016*	-0.009	-0.015*	-0.009
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)
Year- 1982~1995	-0.161	0.121	-0.112	0.134	-0.160	0.162
	(0.205)	(0.217)	(0.202)	(0.218)	(0.204)	(0.216)
Year- 1996~2000	-0.622**	-0.356*	-0.593**	-0.323^{+}	-0.632**	-0.338*
	(0.156)	(0.166)	(0.153)	(0.167)	(0.155)	(0.164)
Year- 2001~2010	-0.644**	-0.527**	-0.631**	-0.495**	-0.646**	-0.502**
	(0.123)	(0.129)	(0.121)	(0.129)	(0.122)	(0.127)
Focal Firm's Total Alliances	0.026**	0.028**	0.019**	0.026**	0.024**	0.022**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
(Focal Firm's Total Alliances)^2	-0.000**	-0.000**	-0.000*	-0.000**	-0.000**	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
N	1328	1328	1328	1328	1328	1328
Model χ^2	377.6	455.9	384.3	458.2	383.7	406.7
Degrees of Freedom	12	14	13	17	13	17

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

FIGURE 3. Local Market Order-of-Entry Effect: Int'l Operation

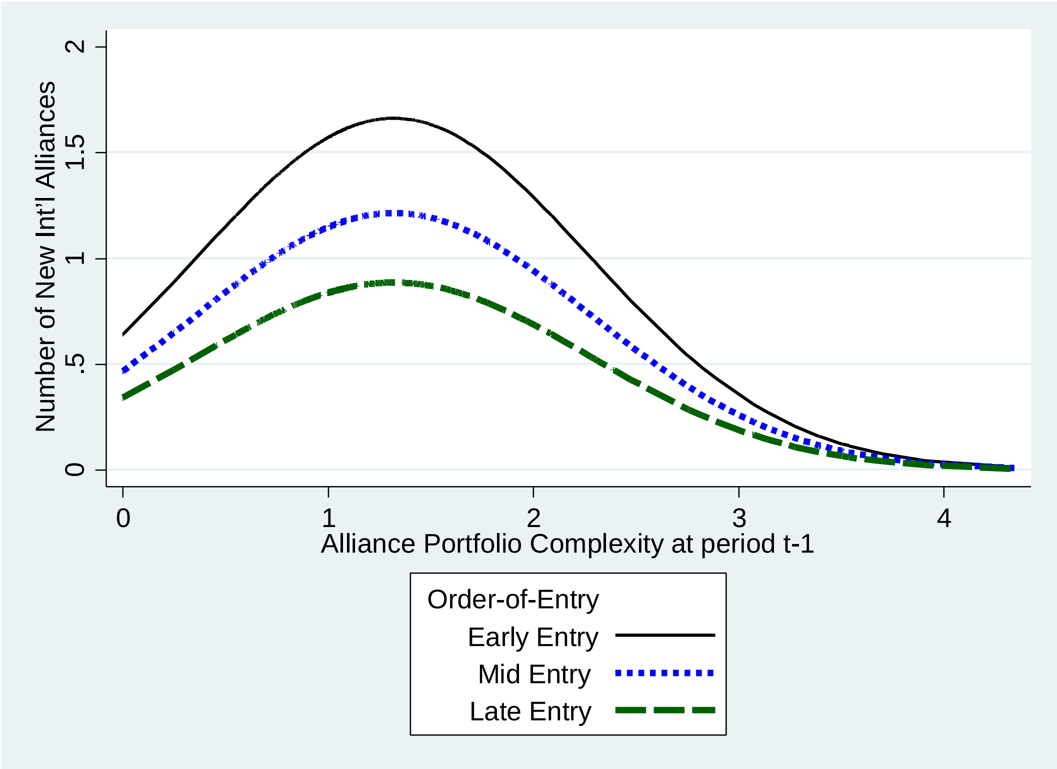


FIGURE 4. Global Market Order-of-Entry Effect: Int'l Alliance

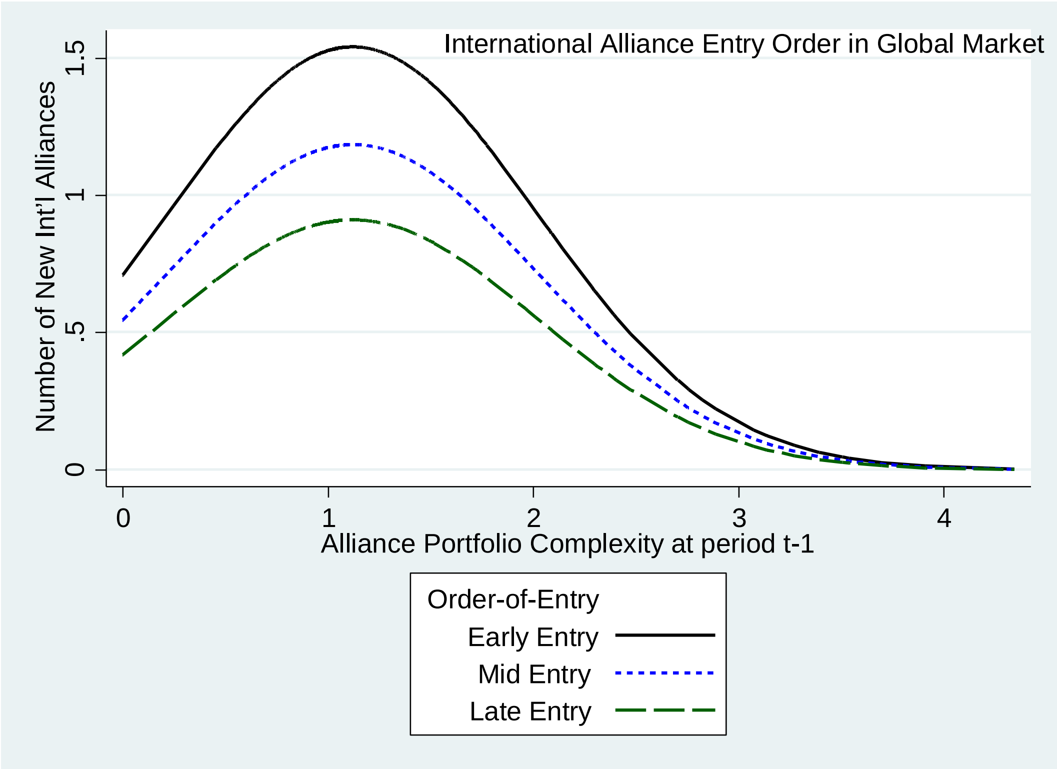
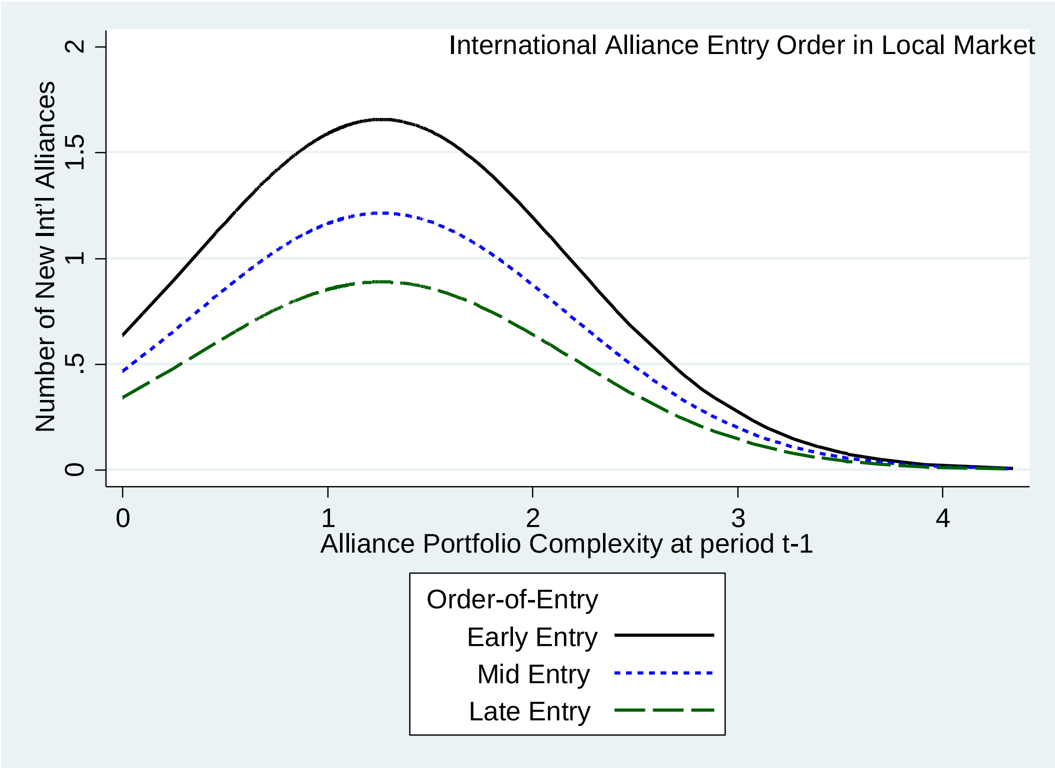


FIGURE 5. Local Market Order-of-Entry Effect: Int'l Alliance



CHAPTER Ⅳ. OVERALL CONCLUSION

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This research attempts to fill the gaps in existing studies on alliance portfolios and alliance formation. In the first study, building on theories of alliance formation and alliance portfolio studies, I investigate how a focal firm's alliance portfolio complexity and alliance termination experience accelerate or decelerate its propensity to form new alliances. The findings suggest that the bounded pattern of alliance formation is stronger when a focal firm's alliance portfolio complexity is low or its alliance termination experience is high. Although previous alliance portfolio studies have applied only monotonic specifications in viewing alliance portfolios as simply the sum of a firm's existing alliances (e.g., Powell et al., 1996; Stuart, 1998; Gulati and Gargiulo, 1999), I have argued that the aggregated impact will differ for firms depending on the composition and structure of their alliance portfolio. Thus, this study may extend alliance portfolio concepts by redefining the characteristics of alliance portfolios and their potential influence on a firm's strategic decisions. Although multiple theoretical lenses can explain the formation of individual alliances, a broader view that assesses how firms build and configure their alliance portfolios is necessary for scholars to advance the current understanding of strategic alliances. Overall, from the alliance portfolio perspective, adding or terminating an alliance becomes a crucial decision because building an efficient alliance portfolio contributes to a firm's overall competitive advantage. As a firm builds and develops a more complex alliance portfolio, it becomes increasingly difficult to efficiently manage it. Thus, a complex alliance portfolio and alliance termination experience can accelerate or decelerate investments in the development and enhancement of alliance management capabilities, which eventually creates strong momentum for alliance formation. Therefore, this study extends the alliance formation literature by indicating the boundary conditions in which firms' propensity to form alliances are accelerated or decelerated.

Second study advances international alliance formation and alliance portfolio research by highlighting the role of alliance portfolio complexity and order-of-entry learning effects in international alliance formations. Focusing on order-of-entry learning effects in increasing the benefits and mitigating the costs of alliance portfolio complexity is important for several reasons. First, although prior work acknowledges the presence of trade-offs in possessing a complex alliance portfolio, very limited empirical evidence exists on how firms engaging in international alliances can mitigate the effects of increased communication and coordination costs through experiential learning. Second, there is limited theoretical exposition on how firms can better manage their alliance portfolio complexity. As there is growing number of international alliances, there is a need for researchers to better understand how alliance portfolio complexity can be managed, especially in the international alliance context (Lavie & Miller, 2008). Thus, I offer insight as to how organizational learning mechanisms mitigate coordination and communication costs and increased managerial complexity (Gomes-Casseres, 1993, 2001). Such mechanisms can also enhance the benefits of increased alliance portfolio complexity by identifying new alliance formation opportunities (Cohen and Levinthal, 1990) and addressing competitive pressures (Garcia-Pont & Nohria, 2002; Yeniyurt et al., 2009). Third, I also advance the first-mover advantage literature by demonstrating how firms can maximize early entry opportunities in local and global markets to gain from two different types of experiential learning.

Overall, these two studies sheds light on the various theoretical drivers of alliance formation to extend the existing literature, with special attention on several alliance portfolio characteristics. This study implies that managers should select alliances with complexity, termination, order-of-entry learning effects in mind. Initial alliance activity, especially its functional composition, may determine not only what learning opportunities the firm obtains but also what strategic constraints it will face in subsequent alliances. Thus, early alliances should be chosen carefully, with planned future partnerships in mind. Firms should add alliances cautiously, as it is important for firms to understand the level of complexity at which firms can maximize the overall gains of their alliance portfolios. Furthermore, managers who recognize alliances as learning devices (e.g., Hamel et al., 1989) or as real options should understand the potential benefits and constraints of entry-of-order learning effect. In addition, managers in other industries where alternative entry modes are readily available should make sure that they compare each alliance opportunity with these alternatives, and firms should be expected to opt to engage in alliances more selectively. The implications of this study are substantive with regard to predicting what alliances firms will form and what benefits and costs their cooperative strategies entail.

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APPENDIX A

List of 47 Global Airlines Included in the Sample

Ansett Australia, American Airlines, Asiana Airlines, Air Canada, Aeroflot, Air France, Air India, Aeromexico, All Nippon Airways, Air New Zealand, Aerolineas Argentinas, Alaska Air Group, Austrian Airlines, America West Airlines, Alitalia, British Airways, British Midland, China Airlines, Air China, Canadian Airlines Corp., Continental Airlines, Cathay Pacific Airways, Delta Air Lines, Lufthansa, Aer Lingus, El Al, Finnair, Gulf Air, Garuda Indonesia, Iberia, Japan Airlines, Korean Air, KLM, Malaysia Airlines, Mexicana, Northwest Airlines, Qantas, South African Airways, Sabena Group, SAS Group, Singapore Airlines, Swissair, Turkish Airlines, United Airlines, US Airways, Virgin Atlantic, Varig

APPENDIX B

Classification of Alliance Activities by Functional Types

	Purpose	Examples
Operation Alliance	▪ To expand route networks ▪ Increase passenger carrying capacity ▪ To improve operational efficiencies	Joint service, joint baggage handling service, and shared aircraft maintenances
Marketing Alliance	▪ To increase marketing exposure and sales-related resource efficiency	Joint promotions, shared sales offices, and cross selling of partners' tickets
R&D Alliance	▪ Development of technologies to increase the efficiency of service and system management	Technology consulting service, development of reservation systems
Other Alliances	▪ Other alliances that are not categorized as marketing, operation, or R&D alliances	

* Classification based on Rhoades' (2008) alliance activity by type

APPENDIX C

Alliance Portfolio Complexity (Example)

	Marketing Alliance	Operation Alliance	R&D Alliance	Other Alliance	Vector	Relative Complexity	Normalized Complexity
Firm X	0	0	2	0	f_x=[0,0,2,0]	1.16	0.83
Firm C1	4	5	6	2	c_1= [4,5,6,2]	1.61	1.14
Firm C2	1	1	1	1	c_2= [1,1,1,1]	1.44	1.02

$$Relative\ Complexity\ of\ Focal\ firm\ i's\ Alliance\ Portfolio =$$

Firm x= $\sum[(f_x,\ c_1),\ (f_x,\ c_2)] = 0.66 + 0.5 = 1.16$

Firm c1= $\sum[(f_x,\ c_1),\ (c_1,\ c_2)] = 0.67 + 0.94 = 1.61$

Firm c2= $\sum[(f_x,\ c_2),(c_1,\ c_2)] = 0.5 + 0.94 = 1.44$

$$Relative\ Complexity\ of\ Focal\ firm\ i's\ Alliance\ Portfolio\ (Normalized) = \frac{Relative\ Complexity\ of\ Focal\ firm\ i's\ Alliance\ Portfolio}{Industry\ Average\ at\ Given\ Period}$$

국문초록

글로벌 항공산업에서 제휴 포트폴리오 복잡성, 시장진입 시기가 신규 제휴 형성에 미치는 영향

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최근 다양한 산업에서 기업들이 제휴를 전략적 수단으로 활발하게 활용하면서 제휴 포트폴리오의 형성과 관리 전략이 주목 받고 있으며, 이에 따라 포트폴리오 단위의 제휴 연구들이 늘어나고 있다. 기존 연구들이 제휴 포트폴리오의 다양한 구성적 요소와 특성이 기업의 제휴 전략과 성과에 어떤 영향을 미치는지에 대해 중점적으로 연구했지만, 대다수의 연구가 제휴 포트폴리오는 그 안에 포함된 개별 제휴들의 독립적인 합으로 정의된다는 가정 하에 진행해 왔다. 하지만 최근 제휴 포트폴리오를 구성하고 있는 개별 제휴들의 상호관계가 존재한다는 것을 입증한 연구들이 발표되면서, 그 영향에 대한 이론적, 실증적 검증에 대한 필요성이 대두되고 있다. 본 연구는 후자의 관점을 기반으로 제휴 포트폴리오의 다양한 구조적 특성들이 향후 기업의 신규 제휴 형성 의사결정에 어떤 영향을 미치는 지에 대한

이론적, 실증적 탐구를 목적으로 하고 있다. 이를 위해 총 47개의 글로벌 항공사를 표본으로 선정하여 해당 항공사들의 1945년-2010년 제휴 데이터를 기반으로 두 개의 실증 연구를 실시하였다.

첫 번째 실증연구는 기업이 일반적으로 제휴 포트폴리오 규모를 확장 할 때 나타나는 역 U자형 관계에 제휴 포트폴리오 복잡성과 제휴 해제가 미치는 조절 효과에 대해 연구하였다. 제휴 포트폴리오 복잡성이 낮은 경우, 포트폴리오 규모 확장과 신규 제휴 형성에 대한 역 U자형 관계가 더 강화되는 것으로 나타났다. 이는 포트폴리오 복잡성이 높아질수록, 일정규모 이상의 포트폴리오가 갖는 제휴 포트폴리오 관리 비용이 더욱 급격하게 증가하는 효과가 나타나기 때문이다. 즉, 제휴 포트폴리오 복잡성이 낮은 기업들의 경우 이러한 비용 증가의 영향을 덜 받기 때문에 신규 제휴 형성이 더 많이 일어나는 구간에서 역 U자형 관계가 나타났다. 또한 제휴 해제 경험이 많은 경우, 포트폴리오 규모 확장과 신규 제휴 형성에 대한 역 U자형 관계가 더 강화되는 것으로 나타났다. 이는 제휴 해제가 기존 제휴 포트폴리오가 갖고 있는 활용가능 자원의 부족함을 극복하고 제휴 관리 비용을 줄여주는 효과를 창출하기 때문이다. 이와 같은 결과는 제휴 포트폴리오의 성장과 관리의 관점에서 기업이 제휴 포트폴리오의 복잡성과 제휴 해제를 전략적으로 활용할 수 있음을 시사한다.

두 번째 실증 연구는 제휴 포트폴리오 복잡성이 해외 신규 제휴 형성에 미치는 영향과 시장 진입 시기의 조절효과에 대해 연구하였다. 먼저 제휴 포트폴리오 복잡성과 신규 해외 제휴 형성은 역 U자형 관계를 갖는 것으로 나타났다. 제휴 포트폴리오 복잡성이 일정 수준 이상이 되면, 제휴 포트폴리오 복잡성이 증가하면서 발생하는 이익은 점점 감소하는 반면, 제휴 포트폴리오 관리 비용이 큰 폭으로 증가하기 때문이다. 하지만 기업들이 해외 시장에 제휴나 서비스 운영으로 먼저 진출한 경우, 선점적 학습효과가 발생하여, 제휴 포트폴리오 복잡성의 영향을 약화 시켜주는 것으로 나타났다. 해외 시장에 먼저 진입한 경우, 현지 시장에 대한 학습기간이 길어지고, 경험에 의한 제휴 관리 능력이 향상되며, 경쟁사들보다 선점적인

전략적 대응과 적응이 가능하기 때문이다. 또한 경쟁주체에 따른 선점 효과의 차이를 살펴보면, 글로벌 시장 경쟁자들에 대한 상대적 선점 효과보다, 지리적으로 근접한 경쟁자들에 대한 상대적 선점 효과가 더 크게 나타났다. 이와 같은 결과는 향후 제휴를 통한 해외시장 진출 및 해외 제휴 포트폴리오 관리 관점에서 해외 시장 진입시기 결정이 중요한 전략적 수단이 될 수 있음을 시사하고 있다.

주요어 : 제휴 포트폴리오, 제휴 복잡성, 시장진입 시기, 신규 제휴, 제휴 해제, 글로벌 항공산업

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