Does collaboration induce spurious learning and overconfidence?  
Evidence from independent vs. collaborative entry in the global aerospace industry, 1944-2000

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Abstract

We examine the performance of firms’ first independent forays into a new business domain, comparing the performance of firms that enter directly into independent activity to those that first collaborate with other firms through either pre-entry licenses or pre-entry alliances. We argue that experience gathered through pre-entry collaborations – particularly through pre-entry licensing – provides firms with spurious learning and a false sense of confidence, thereby damaging the performance of subsequent autonomous operations. Evidence from the aircraft industry shows that, although licensing and alliances may initially help competitors overcome entry barriers, these pre-entry collaborative strategies inhibit longer term independent performance. We discuss how our study contributes to the literature on the benefits and downsides of collaboration.
1. Introduction

Firms sometimes use collaborative entry modes, including both arm’s length licensing and hands on alliances, before undertaking independent business activity in a new business domain. Such pre-entry collaboration can help firms gather resources needed to operate in a new domain (Arora and Gambardella 1990, Mitchell and Singh 1992) and may provide firms with experience that contributes to the performance of subsequent independent ventures (Baum, Calabrese, and Silverman 2000, Singh and Mitchell 2005). However, research on pre-entry collaboration has two limits. First, the work does not distinguish between licensing and alliances as differential modes of pre-entry collaboration. Second, existing research has not fully addressed the issue that pre-entry collaboration provides firms with only limited access to knowledge about the resources needed to independently operate in a business context (Park and Russo 1996), where such limits may be especially pronounced in the case of licensing (Mowery, Oxley, and Silverman 1996, Penner-Hahn 1998). More generally, scholars such as Zollo and Reuer (2009) have begun to develop the long standing idea that firms face substantial limits and potential biases when they attempt to transfer experiential learning to subsequent activities (Levitt and March 1988). This view could suggest that relying on pre-entry collaboration to gain a first foothold in a new business domain might, in fact, undermine a firm’s subsequent independent performance in the domain.

This study examines the performance of firms’ first independent forays into a new business domain, comparing the performance of firms that enter directly into independent activity to those that first collaborate with other firms through pre-entry licenses or pre-entry alliances. We draw upon the behavioral theory of the firm (Cyert and March 1963) to argue that experience gathered through pre-entry collaboration – particularly through pre-entry licensing – provides firms with spurious learning and a false sense of confidence, thereby limiting the performance of subsequent autonomous operations. We propose that, although licensing and alliances may initially help competitors overcome entry barriers, these pre-entry collaborative strategies may inhibit longer term independent performance.

The empirical context of the study is the population of firms that entered one of the four business domains of the international aircraft industry between 1944 and 2000. Recognizing that
resource-poor and resource-rich firms may favor different entry strategies (Masten, Mehan, and Snyder 1991, Shaver 1998, Singh and Mitchell 2005), we investigate the influence of alternative entry mechanisms on post-entry performance while controlling for the endogeneity of entry strategy choice. The results demonstrate that entry strategy has both an endogenous and an exogenous impact on post-entry performance. Most strikingly, firms entering a new business domain through pre-entry collaboration achieve a lower post-entry success than firms entering the domain independently. The research helps advance the understanding of the benefits and downsides of collaboration and has broad implications in terms of a firm’s dynamic capabilities, which are the processes through which the firm creates resources that it needs to operate in new environments (Teece, Pisano, and Shuen 1997, Capron, Dussauge, and Mitchell 1998).

2. Background

A central theme of research in strategic management for more than thirty years has been the relationship between the modes firms use to enter into new business domains and subsequent performance in the domain. One approach has been to distinguish between entry through corporate acquisition and greenfield entry (Simmonds 1990, Sharma and Kesner 1996, Sharma 1998). Corporate acquisition entails the purchase of an existing operation in which the required resources have already been combined by the previous owner (Vermeulen and Barkema 2001), while greenfield entry occurs when a firm sets up a new operation in the targeted domain by allocating and bundling elementary resources, such as employees, capital, physical assets, and technology (Penrose 1959). Within research focusing on greenfield entry, a further refinement contrasts independent entry whereby firms autonomously bring together all the resources needed to operate in the targeted domain with collaborative entry whereby firms enter the targeted new business domain by pooling their own resources with those of external partners (Mitchell and Singh 1992, Ingham and Thompson 1994, Baum, Calabrese, and Silverman 2000, Singh and Mitchell 2005).

To date, research concerning greenfield entry has led to ambiguous conclusions on how entry mode choice influences firms’ subsequent performance in the new domain. One view suggests that collaboration contributes to post-entry performance because it helps a firm gather the resources required to successfully operate in the targeted business (Baum, Calabrese, and Silverman 2000),
through either joint learning or inter-partner learning (Inkpen and Tsang 2007). A second view emphasizes the downsides of collaboration: while providing initial experience, this view argues that collaboration provides only incomplete access to resources and can create a dependence on partners (Hamel, Doz, and Prahalad 1989, Balakrishnan and Koza 1993, Park and Russo 1996). Moreover, several scholars have shown that collaboration can also be difficult and costly to manage (Gulati and Singh 1998, White and Lui 2005). Traditionally, much of the performance debate has focused on trying to determine whether collaborative entry offers sufficient access to new resources that benefits tend to exceed collaboration costs or, instead, whether the constraints of collaborative entry modes tend to dominate.

More recently, several scholars have highlighted the idea that choices of expansion mode are endogenous and that factors that drive firms to expand through a given expansion mode may also have a direct impact on the expansion performance (Shaver 1998, Hamilton and Nickerson 2003). Building on this view, in the parallel literature on international entry modes, Brouthers (2002) and Brouthers, Brouthers, and Werner (2003) found that entry through collaboration makes it easier to compensate for firm weaknesses or to overcome high entry barriers, but that the entry mode itself does not significantly influence performance. In contrast, a recent study on firm diversification by Singh and Mitchell (2005) found that, even when controlling for the endogeneity of entry choices, entry into new business domains through collaboration with industry incumbents significantly affected the entrants’ performance, initially enhancing their business growth but then later constraining growth. Despite such studies, there is still only limited understanding of how entry strategies and initial resources jointly contribute to firm performance.

Even taking endogeneity into account, the entry literature has several limits. First, most research on entry modes has considered collaborative entry as a homogeneous mode of entry. However, a parallel literature on technology sourcing distinguishes between two external sourcing modes: arm’s length license agreements and more actively managed cooperative arrangements (Mowery, Oxley, and Silverman 1996, Anand and Khanna 2000, Schilling and Steensma 2002). Research in strategic management has examined licensing as a means of gaining access to new resources, but has not considered such a strategy as a mode to enter into new business domains and
Thus has underemphasized its impact on the licensee’s subsequent performance in the targeted business domain.

Second, most studies of entry strategies have focused on the first foothold that firms establish in the new business domain (Simmonds 1990, Pennings, Barkema, and Douma 1994, Baum, Calabrese, and Silverman 2000). Consequently, scholars that examined how entry mode influences performance have compared the performance of wholly-owned operations to that of collaborative ventures in the targeted domain, without determining whether the collaborative ventures eventually led to an autonomous presence in the new business domain. In doing so, studies have not distinguished between collaborations that firms create as first steps towards autonomous presence, and collaborations that firms create to implement a short-term project, without pursuing subsequent independence. Thus, the studies have not determined the extent to which entry through collaboration influences firms’ ability to compete independently; instead, the studies compare the performance of single-firm operations to that of collaborations.

A study by Mitchell and Singh (1992) is among the few that explicitly examine the use of pre-entry collaboration by firms that later undertook autonomous activities within emerging technical sub-fields of their industry. This approach shifts the definition of what is considered wholly-owned versus collaborative operations. Rather than focusing on ownership of the business unit carrying out the new activity, the study examines the governance of pre-entry operation; the study does so by comparing firms that first collaborated in the new area before fully entering, with firms that entered on their own without prior collaboration. In this perspective, entry into a new business domain is achieved only once a firm begins to operate on a standalone basis in this new domain. Such entry marks the attempt to compete independently in the business domain.

Building upon this definition of entry, we distinguish three main strategies through which a firm can move toward independent operations: independent entry, alliance entry, and licensing entry. First, firms may choose initial independent entry. In this case, they develop, acquire, and bundle the necessary elementary resources needed to operate in the targeted domain on a standalone basis, without prior collaboration with another firm (Mitchell and Singh 1992). Second, firms may opt for alliance entry in which they initially combine their resources with those of a partner to put together
the necessary bundle of resources before internalizing all the required resources and undertaking subsequent independent activities. In defining alliance entry, our definition of alliances includes both the joint ownership of a stand-alone business unit (e.g., forming an equity joint venture) and the joint operation of activities in the new business domain (e.g., conducting joint R & D, product development, manufacturing, or marketing) without creating a separate alliance unit (Inkpen and Tsang 2007). Third, firms may enter a new business domain by initially acquiring a license by which they gain access to some of the critical resources required to operate in the targeted domain without having been involved in their development. Licensing entry occurs when a firm’s first product or service in a new business domain is an existing product or service licensed from an incumbent, which usually restricts the focal firm’s ability to compete through exclusivity clauses or territorial restrictions (Anand and Khanna 2000, Zahra, Keil, and Maula 2005).

We next develop hypotheses on how entry strategy will influence post-entry success, when controlling for the endogeneity of entry strategy choice. Based on our definition of entry, we compare the performance of firms that operate on their own following either independent, alliance, or licensing entry. Note that, contrary to independent entry, both licensing and alliance entry provide a firm with experience before it starts operating on its own in the new business domain. Organizational learning theorists argue that, along with the experience of others in the industry (Ingram and Baum 1997, Baum and Ingram 1998), one’s own experience is a prime source of learning (Cyert and March 1963, Argyris and Schon 1978, Huber 1991). However, the performance impact on later similar endeavors of such learning-by-doing, also referred to as experiential learning, remains unclear.

3. Hypotheses

3.1. Benefits and limits of experiential learning

The traditional argument in studies of organizational experience is that prior experience helps enhance subsequent performance (Cyert and March 1963, Argote, 1999). The underlying idea is that experience may enable firms to make inferences about the effectiveness of various past processes. Experienced firms might avoid processes that proved harmful in the past, correct past errors, implement specific actions more rapidly, remove redundant routines, and achieve scale economies (Levitt and March 1988, Greve 1998).
In part, the empirical literature supports these arguments. Several studies show that production costs and production time per unit often decrease as manufacturing organizations gain experience in producing a given good (e.g., Lieberman 1989, Argote, Beckman, and Epple 1990, Darr, Argote, and Epple 1995). In addition to experience related to manufacturing processes, studies have also reported evidence that product or market experience increases technical capabilities, which also translates into more valuable new products (Moorman and Miner 1997). For example, Nerkar and Roberts (2004: 781) found that firms with previous product-market participation enhance the chances of success of their new products, concluding that “experience leads to a better understanding of market conditions and customer needs”. More generally, this stream of research suggests that experience improves the ability to combine disparate knowledge elements into valuable new combinations and thus increases the performance of later endeavors (Kogut and Zander 1992, Henderson and Cockburn 1994).

By contrast, another stream of the organizational experience literature suggests that the impact of experience on subsequent performance may be more complicated. Two potential limits of experience arise: task dissimilarity and causal ambiguity.

First, consider task dissimilarity. Cyert and March (1963) and Tversky (1977) suggest that success in transferring prior knowledge from one task to another is highly dependent on the similarity of the tasks. In this view, experience needs to relate to prior activities that are sufficiently similar to current activities to be conducive to useful learning. When prior and current activities are dissimilar, experience can actually be misleading because inferences from past actions often do not apply to the new settings (Levitt and March 1988).

Drawing upon this argument, studies of corporate development activities show that learning-by-doing does not necessarily improve the performance of later endeavors and can even be detrimental when differences are too great. Zollo, Reuer, and Singh (2002) found that alliance experience has a positive performance impact on subsequent alliances primarily when firms have prior partner-specific experience. In a similar vein, Zollo and Reuer (2009) showed that prior alliance experience reduces the performance of later corporate acquisitions, when such acquisitions require high levels of integration, because prior alliance experience provides only a limited understanding of
integration processes. Also, several studies of acquisition experience suggest that acquirers often mistransfer learning from their prior acquisitions to subsequent but different acquisitions, in turn damaging the performance of subsequent acquisitions rather than enhancing acquisition performance (Haleblian and Finkelstein 1999, Hayward 2002, Finkelstein and Haleblian 2002, Nadolska and Barkema 2007).

Second, causal ambiguity can cancel many of the benefits traditionally assigned to experience or even make such prior experience detrimental to future success. Levitt and March (1988) argued that when firms gather experience in situations characterized by high levels of causal ambiguity (Lippman and Rumelt 1982, Reed and DeFillippi 1990), they tend to draw false or inadequate inferences on what factors are responsible for specific outcomes because they do not fully comprehend the causal linkages between inputs and outputs (Levitt and March 1988: 325). Consequently, for subsequent endeavors, they often take inappropriate actions based upon erroneous assumptions about the causal determinants of prior performance, in turn causing current performance to suffer.

A few studies have further explored this argument. For example, Szulanski (1996) found that causal ambiguity was a major barrier to organizational learning and thus hindered the transfer of best practices within a firm. This study echoed prior work by Reed and DeFillippi (1990: 90-91) who suggested that “where ambiguity is so great that managers do not understand intrafirm causal relationships, it may be impossible to utilize competencies for advantage”. In parallel, Mosakowski (1997: 422) put forth the idea that “the causal ambiguity facing the decision maker in the future will be negatively related to the extent that he understands the causal structure of the past”. According to this view, a firm’s ability to benefit from a prior action is hindered when it is unable to discern and understand without ambiguity the causal linkages between inputs and outputs that led to its success or failure.

Overall, this literature on the limits of experience highlights boundary conditions on the benefits of experiential learning. It suggests that when prior and current tasks are highly dissimilar and/or when experience is gathered in situations characterized by high levels of causal ambiguity, firms tend to overestimate the extent to which they are able to solve the challenges they face in a new
context. In such conditions, experience causes spurious learning that, in turn, produces overconfidence within a firm.

Spurious learning, which Zollo (2009) labels superstitious learning, refers to the erroneous assumption that prior experience has provided a firm with knowledge that enables it to undertake a new endeavor successfully (Lounamaa and March 1987: 119). Such an erroneous assumption can stem from the fact that managers underestimate or overlook differences between prior and current activities, as well as from the fact that the causal relationships between actions and outcomes in prior activities are mis-specified. Hence, the firm does not recognize that what it has learned from prior activities has only limited relevance for the implementation of new activities, such that the apparent learning is actually spurious with reference to the new context.

Overconfidence, in turn, occurs as a result of spurious learning. Overconfidence prevails when firms develop false assumptions about their actual capabilities (Lichtenstein, Fischhoff, and Phillips 1982). In this view, overconfident firms are likely to make decisions and take actions based on capabilities they do not actually possess. As a result, firms that have developed a false sense of confidence tend to implement organizational activities that they actually are not capable of undertaking successfully (Neale and Bazerman 1985). Drawing upon similar arguments, studies have shown that highly confident decision-makers tend to overestimate the market value of target companies in acquisitions (Hayward and Hambrick 1997) and to underestimate the risks associated with launching pioneering new products (Simon and Houghton 2003). In a similar vein, Tyler and Steensma (1998) found that managers that have had success with past alliances tend to overemphasize the opportunities provided by new alliances and to underestimate the risks associated with such ventures.

Thus, spurious learning and the resulting prevalence of overconfidence create potential drawbacks of experiential learning. When firms attempt to apply lessons derived from experience gathered in contexts characterized by high levels of causal ambiguity, especially when such lessons are applied to settings involving significantly dissimilar tasks, they will often make inappropriate decisions and take inadequate actions. As a result, the new activity will often achieve disappointing levels of performance. In contrast, managers in inexperienced firms have fewer cognitive biases,
notably regarding the drivers of performance, as they engage in a new activity. Because decision-makers in such firms lack experience, they are more likely to recognize that they need to develop new skills that suit the new context. They tend to adopt a more humble and cautious approach to the new activity, which leads them to better understand and assess the factors that affect performance. Hence, inexperienced firms may actually achieve better performance than experienced firms in contexts involving high levels of task dissimilarity and causal ambiguity. As we next discuss, these ideas concerning the limits of experience have implications for how entry strategy choices affect post-entry performance.

3.2. Pre-entry collaboration

By nature, collaboration entails only partial experience in the tasks required to implement the venture. In both licensing and alliances, the focal firm carries out only a sub-set of all tasks necessary to introduce a new product (Gerwin and Ferris 2004, Zahra, Keil, and Maula 2005). In alliances, tasks are shared with one or more partner firms along functional lines (e.g., one partner may be responsible for design and manufacturing, the other for marketing) or, within a given function, on sub-sets of tasks (e.g., design and manufacturing of various sub-systems or marketing in different markets can be allocated to each partner). Similarly, in licensing, the licensor undertakes most critical tasks (e.g., technology development or product design) relevant to the focal product-market. Because of the partial nature of such experience, firms entering a new business domain after pre-entry collaboration commonly face high levels of task dissimilarity and causal ambiguity.

First, consider the importance of task dissimilarity in collaborative ventures. Firms attempting entry after either licensing or alliances need to gather all the resources required to autonomously operate in the targeted business domain. Thus, they need to develop new resources, skills, and routines they did not need when they were collaborating with an ally or licensor. Firms that opted for a licensing entry strategy need to acquire specific technology development and product design abilities. Firms that used an alliance entry strategy need to complement their resources with those previously provided by their partners. In both cases, firms need to make new decisions and to perform new activities for which they have no experience.
Second, consider how causal ambiguity arises in collaboration. Firms that enter new business domains through pre-entry collaboration gather experiential learning on only a sub-set of all required tasks. While some types of learning may occur on the activities falling under the partner’s or licensor’s responsibility, the experience is indirect (Zollo and Singh 2004, Kale, Dyer, and Singh 2002). Thus, the understanding of the causal relationships between actions and outcomes will be limited to tasks the focal firm was entrusted with, and as a result the causal drivers of performance for other tasks will be highly ambiguous. Hence, the causal determinants that drive the performance of the collaborative endeavors will be incompletely specified.

In turn, because of high levels of task dissimilarity and causal ambiguity, firms attempting independent entry after pre-entry collaboration will often develop spurious learning and overconfidence. Spurious learning from pre-entry collaboration arises because firms using collaborative entry often draw inappropriate inferences from their past incomplete experience about the drivers of performance in the relevant business domain. Firms opting for pre-entry collaboration face difficulties in attributing the reasons for the success of their first foothold in a business domain to their own activities or to contributions from their allies or licensors. Zollo (2009) argues that, because of this, firms will tend to use the stock of accumulated experience as an approximation of their competence levels, which will cause them to assign the success of their first foothold in the business domain to their own capabilities without fully acknowledging the partner’s contributions.

Moreover, because licensing and alliance experience generate substantial spurious learning, firms using pre-entry collaboration often hold unfounded beliefs about their own abilities and competencies, thereby developing overconfidence. When developing their first independent product, they will often attempt to perform specific actions they are not capable of, based on skills that they do not actually possess. Thus, they will make poor decisions and carry out inadequate actions, causing them to achieve limited independent success.

Such outcomes will be particularly common in industries in which environmental, technical, and competitive conditions for success change substantially from one product generation to the next and thus demand fine-tuned adaptation. These settings are common contexts for firms to undertake initial collaborative ventures, with the belief that they lack the skills needed for immediate
independent entry. However, the initial collaborative ventures may actually breed problems if the firms undertake subsequent independent entry.

The problems will be even more substantial in business domains with high levels of product complexity and in which incumbents must possess sophisticated systems integration skills. Indeed, prior work has highlighted that complex products are systemic (Singh, 1997). This means that “the performance of each subsystem [that composes complex products] is dependent on the performance of its components, while itself influencing and being dependent on the performance of higher-order systems” (Singh, 1997: 340). In this view, minor faulty actions in a single subsystem might cause catastrophic system failure. Complex products are, therefore, highly sensitive to the detrimental impacts of collaborative learning. Hence, firms that develop spurious learning and overconfidence in business domains characterized by complex products are likely to subsequently unveil product designs that have serious technical flaws.

In sum, because of substantial task dissimilarity associated with high levels of causal ambiguity, experience gathered through pre-entry collaboration is likely to cause spurious learning and overconfidence for later autonomous endeavors. As a result, some of the inferences that firms draw from past actions are likely to be erroneous, thereby fostering inappropriate actions. We argue that, even when accounting for entry strategy endogeneity, both licensing and alliance entry have detrimental impact on the performance of subsequent autonomous endeavors, such that accumulated experience may be worse than no experience at all.

*Hypothesis 1. Firms entering a new business domain independently will achieve greater post-entry performance than independent ventures by firms that initially engaged in pre-entry licenses or alliances.*

We next argue that experience gathered through licensing presents even greater drawbacks than alliance experience. Partial learning differs in nature in alliances and licensing. Firms entering a new business domain through licensing typically acquire the services of a bundle of resources critical to success in the targeted domain – often the most critical resources, such as technology development or product design resources – from the licensor “off the shelf” via an arm’s length transaction. Thus, firms entering a new business domain via licenses have little or no involvement in product design and development but, in contrast, operate autonomously in those functions for which they are primarily
responsible, notably manufacturing, marketing and sales. Firms entering a new business domain through pre-entry alliances commonly undertake hands on involvement in a subset of the tasks pertaining to all essential functions such as product design, production, and commercialization, and need to coordinate closely with their partner at all the different stages of the project.

Because of these significant differences in the forms of task distribution and inter-partner coordination in licensing and in alliances, we argue that licensing is even more subject to spurious learning than alliances. Indeed, licensees have no involvement in what is an essential – and often the single most important – activity, particularly in the case of complex products, namely product design and development, but are entirely in charge of marketing and sales. Commercial success of the licensed product results directly from the licensee’s efforts, even if, obviously, it is also attributable to the quality of the product design provided by the licensor. It is therefore likely that the causal ambiguity surrounding the success of licensed production, associated with the licensor’s autonomy in all activities downstream from product design are particularly conducive to spurious learning and to high levels of overconfidence.

In alliances, in contrast, firms coordinate more closely with their partners on a much wider range of activities. They are therefore in a better position to witness the difficulties associated with those tasks they are not directly in charge of and to better estimate the true value of their partner’s contribution. As a result, firms in alliances are less likely to develop the same level of spurious learning and of overconfidence as those producing under license. Hence, the following hypothesis:

_Hypothesis 2. Firms entering a new business domain independently after pre-entry alliances will achieve greater post-entry performance than firms entering independently after pre-entry licenses._

4. Empirical analysis

4.1. Data

We tested our predictions on a sample of firms that operated in the global aircraft industry between 1944 and 2000. We examined the performance impact of the entry strategies selected by firms to enter into one of the four business domains of this industry: fighter aircraft, turboprop aircraft, rotorcraft (i.e., helicopters), and jet transport aircraft (which include airliners, jet cargo aircraft, and business jets). Our sample comprises 159 cases, including 84 first entries into the aircraft
industry and 75 diversification entries by aircraft industry incumbents into one of the four above mentioned business domains.

Firms used all three entry strategies in the sector. Manufacturers chose independent entry for 93 (59%) of the 159 cases, alliance entry for 16 (10%) of the cases, and licensing entry for 50 (31%) of the cases. Independent entry occurs when the firm’s first aircraft project in the new business domain is developed on a standalone basis, without prior collaboration with another firm. Alliance entry occurs when, before developing and producing an aircraft on an independent basis, a firm first shares the design, development, and manufacturing tasks related to a new aircraft project with another firm, which may or may not be an incumbent in the considered business domain (25% of the firms in the sample undertaking initial alliances subsequently entered independently). Licensing entry occurs when a firm first acquires the right to manufacture an aircraft model that was originally designed and developed by another firm (32% of the firms undertaking initial licenses subsequently entered independently).

We drew the data from an extensive archival study of secondary sources, particularly the Jane’s All the World’s Aircraft yearbooks for each year between 1944 and 2000. Jane’s All the World’s Aircraft yearbooks have been annually published since 1909. The yearbooks describe, for all aircraft manufacturers in the world, the aircraft models in production or in development, and provide technical characteristics and sales information. The information provided in the Jane’s All the World’s Aircraft yearbooks makes it possible to unambiguously identify the production mode of all aircraft produced in the world and thus to identify firms’ entry strategies by tracking their production of various types of aircraft over the years.

For any given year, all aircraft models under development or being produced are listed by nationality and under the heading of the prime contractor. All aircraft projects produced through co-development alliances are listed either in a separate “international cooperation” section of the yearbooks when the allied firms originate from different countries, or are listed multiple times under the headings of each ally when these originate from the same country. For example, the V22-Osprey rotorcraft, a joint development of Boeing and of Bell, is listed under the heading of both companies in all Jane’s yearbooks since 1983. All licensing agreements for a given aircraft are listed under the
heading of the original manufacturer (i.e., the licensor), while licensed production is specified again under the heading of the licensee.

4.2. Method

We used a two-stage treatment effect model (Shaver 1998, Greene 2003, Hamilton and Nickerson 2003) to test the hypotheses on the influence of entry strategy on the success of subsequent autonomous operations, while accounting for the endogeneity of entry strategy choice. In the first stage of the treatment model, we analyzed the entry strategy that the firms selected (licensing vs. alliance vs. independent entry). In the second stage, we analyzed the post-entry performance of the businesses that eventually turned to autonomous production, controlling for the unobservable factors leading firms to choose a specific entry strategy.

The multiple observations for some firms (159 entries for 84 unique firms) are not fully independent, raising a concern of possible heteroscedasticity. To address this issue we clustered the data by firm (Wooldridge 2002, § 13.8.2). This approach provides a robust estimator where observations are assumed to be independent across firms but not independent within firms (Leiblein, Reuer, and Dalsace 2002).

4.3. Entry Strategy Model

In the first step of our analysis we analyzed the factors driving the choice of entry strategies. This enabled us to build a self-selection variable that acts as an independent variable in the second step of the model and takes the endogeneity of entry strategy into account (Greene 2003, Hamilton and Nickerson 2003). Drawing upon the extant research on entry mode, we considered entry strategy choices to be ordered, from licensing entry to alliance entry to independent entry. Prior research argues that an alliance is selected over both a market-based arrangement and an autonomous venture when factors influencing governance mode choices are at intermediate levels (Williamson 1991). Therefore, we used an ordered probit regression to examine the factors leading firms to establish a new operation in a given business domain through licensing, alliance, or independent entry.

An ordered categorical variable denoted the entry strategy. This variable takes the value 1 when a firm sets up a new operation in one of the four business domains of the aircraft industry through independent entry, the value 2 when an entrant opted for alliance entry, and the value 3 when
it selected licensing. We considered a firm to have chosen licensing or alliance entry when its first listing in the Jane’s All the World’s Aircraft yearbooks (1944-2000) in any of the four above mentioned lines of business (fighter, jet, turboprop, and helicopter) was described as having been carried out through either licensing or cooperation.

Prior research suggests several variables that influence the choice of a specific entry strategy. We estimated all time-varying control variables in the year before the first flight of the prototype aircraft in the focal program.

We first estimated the firm’s resource endowment by recording the technical complexity of the most complex aircraft that the focal firm had ever produced in any other business domain of the aircraft industry. In doing so, our variable “Firm Resource Endowment” captured the industry-wide resources, which can be redeployed from one aircraft line of business to another. Such resources encompass basic technical skills and assets, some market knowledge, product development capabilities, production, and sales capabilities. Drawing upon works by Saviotti and Metcalfe (1984) and Frenken and Leydesdorff (2000), we measured the technical complexity of an aircraft by recording its range (in kilometers), its weight (in kilograms), and its speed (in kilometers/hour). We multiplied the three figures to build a composite index. Because the distribution is skewed, the resource endowment measure used a log transformation.

Second, larger firms may favor independent entry because they have easier access to resources. We included a variable estimating the size of the firm (“Firm Size”), which we assessed by estimating its aircraft sales in the year before it entered into the new business domain. To do so, we first computed the average annual production for a given model by dividing the cumulative number of units sold over its entire life cycle by the number of years during which the model was manufactured. We then determined the annual sales of each model by multiplying its average annual volume of production by its price (in 2000 US dollars), as estimated by FI/DMS (2000). We obtained our revenue measure for each year by summing the annual sales for all aircraft models of any type (fighter, jet, turboprop, and helicopter) the firm manufactured that year. We used this measure
because it was impossible to obtain annual aircraft sales figures covering a 56-year period and more than 21 countries.

Third, we considered the “Size of the Potential Market” that a given entrant can target. We expect firms with a larger market base to be more confident that they can, on their own, achieve sufficient sales volumes to break-even and are therefore more prone to attempt independent entry into a new business domain. Because many aircraft projects are initially developed for military purposes (for example, the Boeing B-707 airliner was initially developed as the Boeing KC-135 military tanker). In addition, because national preference is a major driver not only of military aircraft sales but also of commercial sales, we assessed the size of a firm’s market base through the GDP of its home country in constant US dollars (Maddison 2003).

Several variables addressed other issues. “Year of Entry” recorded the firm’s first year in the new business domain in order to assess any trend effects. Following prior research (e.g., Gulati, 1999), we included a cardinal measure rather than 56 year dummies. We also created a categorical variable that records the four business domains (“Fighter”, “Turboprop”, “Helicopter”, and “Jet” business domains) to capture differences between product types. We coded this variable with mean effects dummies as there is no conceptually motivated base case to compare the other cases to. To control for the influence of possible differences between commercial and military markets and products on entry strategy, a dummy variable also recorded whether the first product in the business domain was exclusively designed for military use (“Military Design”). We expect military aircraft to be primarily developed on a standalone basis because of national security concerns. We included a variable recording whether the firm was state-owned (“State-owned”), although the direction of the effect is unclear. On the one hand, state-owned companies may enjoy government subsidies that help them overcome a lack of resources needed to independently develop aircraft. On the other hand, state-owned companies may be compelled to enter into collaborative ventures for political reasons. Finally, we controlled for the “Technical Complexity” of the new aircraft, based on the measure combining

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1 Entries by country: Argentina (2), Australia (4), Belgium (1), Brazil (3), Canada (6), Chile (1), China (1), Egypt (3), Finland (4), France (11), Germany (10), India (3), Indonesia (2), Israel (2), Italy (8), Japan (14), South Korea (3), Netherlands (4), Singapore (2), South Africa (2), Spain (4), Sweden (2), Switzerland (3), Taiwan (1), Turkey (1), United Kingdom (19), and United States (43).
weight, range, and speed which we described earlier. Complexity is likely to have a direct effect on entry strategy choice, by increasing the likelihood of collaboration for technically sophisticated and thus costly programs (Arora and Gambardella 1990, Masten, Meehan and Snyder 1991, Mitchell and Singh 1996, Singh 1997).

For statistical reasons, the first stage of a treatment effect model needs at least one instrumental variable that will predict the entry strategy but not performance (Shaver 1998, Hamilton and Nickerson 2003). Consequently, the entry strategy model included a variable that captures the number of autonomously developed products commercialized in the focal business domain. This variable “Number of Competitors” will take into account any potential bandwagon effects. We computed this variable one year before the focal aircraft prototype’s first flight.

4.4. Independent Entry Success Model

We now turn to the second stage of our model. This analysis examines the influence of entry strategy (licensing, alliance, or independent entry) on independent performance, while controlling for the endogeneity of entry strategy choice.

Sample

Our performance sample includes 113 cases in which firms eventually achieved independent entry in one of the four business domains composing the aircraft industry (fighter, jet, turboprop, and helicopter). Based on our definition of entry, each of these firms independently developed and commercialized at least one aircraft in the relevant area of business, either as their first foothold in the business domain (93 cases) or after having initially operated through pre-entry licensing (16 cases) or pre-entry alliances (4 cases). The sample excluded the 46 cases in which firms undertook collaborative entry but did not subsequently develop an independent model of their own (12 firms that opted for an alliance entry and 34 firms that chose a licensed entry strategy); 37 of the 46 firms disappeared from the industry before creating independent operations in the new business domain while nine were still operating only through collaborations at the end of the study period in 2000. We will discuss factors that influenced such left-censoring below.
Dependent variable

We estimated post-entry success by the cumulative production of the first autonomously developed aircraft in the new line of business (the cumulative number of units sold over their entire life cycle). In doing so, we assessed post-entry success by estimating the firms’ ability to bundle the capabilities required to operate on their own in the considered line of business.

To avoid mid-program bias, we estimated the cumulative production for the aircraft projects (27 projects) for which production had not been terminated by the end of the study period (in 2000). This involved estimating the average yearly cumulated production (in percentage) on aircraft projects for which the required information was available in Jane’s All the World’s Aircraft yearbooks. Thus, we found that, on average, aircraft projects reached 6% of their total production at the end of the first year of production. Similarly, we found that those programs reached 13% at the end of Year 2, 68% at the end of Year 10, and 86% at the end of Year 15. This enabled us to estimate a total production figure for the 27 programs that had not reached the end of their production life by 2000. Overall, the cumulative production for our 113 programs ranges from 12 to 16,853 with a mean of 899.

Independent variables

As the core independent variables, we used categorical measures that recorded the entry strategy a firm used to enter the business domain (Licensing entry, Alliance entry, or Independent entry). We coded these variables with mean effect dummies, so that the effect of a variable differs significantly from the mean of the set of variables, rather than from a single omitted base case variable (Dussauge, Garrette, and Mitchell 2004).

Control variables

The analysis includes several control variables. Several variables from the entry strategy choice model capture factors that might drive performance. Firms with greater resource endowments are likely to achieve greater sales. Firms with a greater size may reach greater sales on any given new project. The four business domains will differ in sales opportunities. Firms with larger home markets may have privileged access to greater sales opportunities. State-owned firms might achieve greater sales because of easier access to government contracts. Technical complexity may increase costs and price (Schoonhoven, Eisenhardt, and Lyman 1990), which could, in turn, limit sales (Kessler and
Chakrabarti 1996). Military aircraft may be more sensitive to functional obsolescence than civil programs leading to shorter life cycles and thus smaller production runs, while sales of military aircraft are also often restricted to specific countries for political reasons. Potential market size may also vary over time, so that year of entry may influence sales. Finally, the selection λ obtained from the first stage is a covariate in the second stage and controls for the endogeneity of entry strategy choice.

5. Results

Tables 1a and 1b report correlation matrix and the descriptive statistics of the variables we used in the first and second steps of the treatment effects model. No variable exhibits distribution or correlation problems. While several variables exhibit significant levels of correlation, the displayed pattern does not reveal a tendency towards collinearity among the measures. Tables 2a and 2b present the regression results of the first and second steps of the treatment effects model.

5.1. Entry strategy model

The first stage model in Table 2a highlights several factors that affected the choice of entry strategy. Firms with stronger resource endowments, firms with access to a large market base, and firms entering a new business domain with a product designed for an exclusively military use tended to select independent entry. By contrast, product complexity, state ownership, and a greater number of competitors in the industry favored collaborative entry. “Firm Size” and “Year of entry” had no influence on entry mode choice.

In sensitivity analysis, we also examined ten factors that might influence whether the 66 firms that initially began with collaborative pre-entry (either through licensing or alliances) eventually achieved subsequent independent entry (note that it is not possible to use a Heckman-type analysis of ultimate independent entry as a first-stage in the performance model, because firms that chose initial independent entry would by definition also achieve subsequent independent entry). Both univariate t-tests and multivariate logit analyses identified two factors that increased the likelihood of independent entry following initial collaboration (p < 0.05): greater sales of the collaborative product and earlier entry into the considered business domain. By contrast, eight other factors did not have a significant influence on achieving subsequent independent entry following pre-entry collaboration: “Pre-
licensing vs. Pre-alliance”, “Firm Size”, “Firm Resource Endowment”, “State-owned”, “Product Complexity”, “Military Design”, “Number of Competitors”, or “Size of the Potential Market”. The key result here is that both types of pre-entry collaboration are equally likely to lead to subsequent independent entry, so that studying how entry mode affects long term success should produce unbiased interpretations.

5.2. Hypothesis tests: Performance of independent activities

The results in Table 2b support hypotheses 1 and 2. Firms that enter a new business domain via initial independent activity achieve greater post-entry success ($\beta = 0.851, p < 0.010$) than firms using alliance entry ($\beta = 0.472, p < 0.100$), or licensed entry ($\beta = -1.323, p < 0.010$). The results demonstrate that independent entry leads to the greatest independent performance, while alliance entry is the second best choice and licensed entry the worst case.

Thus, entry strategy influences performance. When a firm has adequate resources that it can deploy in the new business domain, it is better off entering independently. The large proportion of independent entries in our data (93 cases of independent entry versus 66 cases of collaborative pre-entry) reflects this conclusion. In contrast, firms that believe they lack resources they need to enter independently can attempt to overcome their deficiencies by using pre-entry collaboration (alliances or licensing). However, such firms will pay a price for this by exhibiting poorer subsequent performance of their independent endeavor, especially in the case of licensing entry.

We used the estimated values of the coefficients to calculate the independent performance that firms would have achieved had they used an alternative entry strategy (Shaver 1998). For computational power, this analysis combined alliance and licensing entry into a single category of collaborative entry. Two estimations stood out. First, firms that chose independent entry would have achieved lower sales, had they undertaken pre-entry collaboration (coefficient = 0.38 had they chosen collaboration vs. 1.03 given their choice of independent entry); hence, firms tended to be “correct” in their choice of independent entry strategy. Second, firms that chose collaboration would have achieved higher sales (coefficient = 2.84 had they chosen independent entry vs. 0.28 given their choice of collaboration) if they had entered through an independent entry strategy. The second point is intriguing, because it suggests that most collaborative entries were mistakes. Although the point
estimates of the magnitude of the mistake may be somewhat unreliable owing to the limited cases of firms that chose collaborative entry, the direction of the effect is unambiguous. Of course, the analysis may omit factors that provided strong barriers to independent entry, but the core point is that firms need to look hard for avenues to independent entry before settling for collaborative pre-entry.

Three control variables affected performance. First, programs with later entry years achieved lower sales, suggesting that the market became more competitive over time and/or that demand for aircraft decreased over time, at least in per unit terms. Second, firms that had already commercialized a complex aircraft in another business domain achieved weaker performance for their first autonomous project in the focal business domain, possibly because industry leaders may initially enter new business domains with limited exposure, without devoting to the new venture as many resources as smaller firms for which success in the domain is critical for their survival in the industry. This result concerning the impact of complex experience is consistent with the arguments concerning overconfidence, in this case arising from experience with complex technology. It is also consistent with prior results by Mitchell and Singh (1992) who found that incumbents adopt a more cautious approach than newcomers when entering into emerging sub-fields within the industry.

Third, the variable that captures the technical complexity of the first autonomously developed aircraft has a positive influence on post-entry success. One explanation for this result is that, in the jet aircraft industry, technical complexity does not harm the production of any given product as it might be the case in other industries in which market demand decreases with technical complexity (e.g., computer or car industries).

Overall, the results suggest that experience gathered through pre-entry collaboration does not increase subsequent independent performance, even if pre-entry collaboration may help a firm overcome entry barriers. Instead, firms that enter a new business domain through collaboration – particularly pre-entry licensing – achieve poorer subsequent autonomous performance. The pattern is consistent with the argument that experience gathered through licensing or alliances generates spurious learning and causes overconfidence in a firm’s own capabilities, because of the incomplete specification of causal relationships and of unacknowledged task dissimilarity.
5.3. Sensitivity analyses

Several sensitivity analyses explored the robustness of the results. We calculated a survival model, to ensure that the apparent performance impact of independent entry did not mask a risk of early failure for independent entrants. Instead, we found that firms that entered via initial independent entry survived at least as long as the independent ventures of firms that undertook pre-entry collaboration. We also replaced our dependent variable by a variable that captures the sales achieved with the first autonomously developed product. Indeed, firms that initially opted to use a collaborative entry strategy might focus on the most lucrative aircraft projects, leaving other aircraft models to inexperienced firms. To estimate the sales achieved by each aircraft project, we multiplied its cumulated production by its price, as specified by FI/DMS (2000). Results remain unchanged. Independent entry leads to the greatest independent sales, licensed entry the worst ones, and cooperation lies between the two.

In addition, prior work indicated than complexity is a prime driver of causal ambiguity (e.g., Simonin, 1999), which we argue is in turn a key source of spurious learning. As a result, complex products developed through collaborations should produce even more spurious learning than more simple products. Therefore, firms that established a first foothold in a given domain with a highly complex product should achieve lower post-entry success than firms that collaborated pre-entry on less complex product. We computed the correlation between the complexity of the very first collaborative product and the cumulated production of the first autonomously developed product. As expected, this coefficient is negative ($r = -0.064$). We also computed the correlation between the highest complexity of any collaborative products undertaken before entry and the performance of the first autonomous product. This coefficient also is negative but even larger ($r = -0.1249$). Overall, the pattern shown by these correlations provides additional support to our argument that pre-entry collaboration produces spurious learning, which in turn will cause overconfidence and thus faulty actions in subsequent autonomous operations.

6. Discussion

This study contributes to the literature on collaborative entry (Baum, Calabrese, and Silverman 2000, Singh and Mitchell 2005). We show that even if collaboration allows weaker firms to
establish a presence in a given business domain, the accumulated experience may well undermine the success of subsequent autonomous operations. Moreover, licensing pre-entry, which has the potential to generate greater spurious learning and overconfidence than alliance pre-entry, has a particularly negative impact on independent performance.

The entry into the turboprop domain by Saab (Sweden) offers a compelling example of spurious learning and subsequent problems (FI/DMS, 2000). In 1984, Saab introduced its first turboprop aircraft, the SF 340, through an alliance with the American aircraft manufacturer Fairchild. The jointly-developed regional aircraft achieved substantial sales. Saab then decided to unveil its own design, the SAAB 2000, in the early nineties. During flight testing in 1993, a longitudinal instability problem was discovered that appeared under high power/low airspeed conditions, causing Saab to redesign the elevator control system, which had been designed by Fairchild in the SF 340. Deliveries of the SAAB 2000 started in 1994 but orders never took off. In 1997, losses were so high that the Saab board of directors decided to discontinue production of the firm’s two regional aircraft. Saab eventually produced 63 SAAB 2000s, over half of which were delivered to one customer, Crossair. This figure compares to the 450 SF 340s produced by Saab and Fairchild.

The research suggests that firms that enter a new business domain through pre-entry alliances or pre-entry licensing may develop a false sense of confidence that will in turn foster inadequate independent actions during subsequent endeavors. This illusion of control causes the firm to trip over unexpected hurdles that may cancel out the benefits the firm acquired through initial collaboration. Moreover, the study indicates that pre-entry licensing presents even greater drawbacks than more actively managed alliances, at least in dynamic environments. While licensing may enable firms to enter new business domains, it does not provide them with the resources necessary to successfully compete independently at a later stage. This finding extends prior work suggesting that inward licensing provides few opportunities for knowledge transfer (Mowery, Oxley, and Silverman 1996).

The research adds to the more general literature on organizational learning. We provide evidence that attempts to gain experiential learning do not necessarily improve performance of later endeavors. Experiential learning might actually be misleading when inferences from past actions
generate spurious learning that does not apply to new settings, which will be particularly common in contexts characterized by high levels of causal ambiguity and task dissimilarity. In such situations, experience may lead firms to develop a false sense of confidence and to overestimate the extent to which they can solve the challenges they face and, ultimately, to take inadequate actions. Our study on the performance impact of pre-entry collaboration thus extends recent work indicating that experience often does not improve performance in corporate acquisitions (Haleblian and Finkelstein 1999, Hayward 2002, Finkelstein and Haleblian 2002, Nadolska and Barkema 2007), collaborative ventures (Zollo, Reuer, and Singh 2002), and across varying corporate development activities (Zollo and Reuer 2009).

In turn, the study contributes to the literature on dynamic capabilities. This emerging literature is extending the resource-based theory by identifying means by which firms create new resources (Teece, Pisano, and Shuen 1997, Eisenhardt and Martin 2000, Helfat and Raubitschek 2000, Karim and Mitchell 2000). In the context of dynamic capabilities, the choice of alliance, licensed, or independent entry is a mode choice that is part of the process by which firms create resources that they need to operate in a new environment. Licensing and alliance entry provide mechanisms by which weaker firms can gain access to other firms’ resources and eventually enter a new business domain. Collaborative entry offers benefits in the form of establishing a presence in a given domain but may inhibit the understanding and control that a firm needs to develop a full suite of resources required for long term success. By contrast, independent entry forces a firm to develop new resources through its own efforts, leading both to greater understanding of the resources and greater control over them. The most direct implication of this comparison is that collaboration provides a jump start in resource creation but may inhibit a firm’s ability to create a full set of the new resources, if a firm does not already have sufficient understanding of the resource base on which it is building (Cohen and Levinthal 1990, Lane and Lubatkin 1998).

The study has several limitations that suggest avenues for future research. First, as in all single-industry studies, the work raises the issue of generalizability, which calls for extending the findings to other settings. Second, while the first stage of the model controls for many sources of endogeneity that will influence choices of entry strategy, further work could explore this issue more
deeply. Third, additional research could dig more deeply into firms’ entry choices. One plausible argument is that firms with a limited resource endowment do not have a “real” choice of entry strategy. To choose independent entry, firms need to be able to develop, acquire, and bundle the elementary resources needed to operate in the targeted domain. For firms that do not possess these capabilities, the actual choice is not between collaborative entry and independent entry but between opting for collaborative entry and not entering at all. Future research could investigate what happens to those firms that chose not to enter independently because they believe they lack capabilities and do not want to undertake initial collaborative entry.

Overall, the study suggests that pre-entry alliances may help weaker firms overcome entry barriers that would otherwise have been insurmountable, but may inhibit subsequent independent performance. Pre-entry licensing has a particularly negative effect. We interpret this as the consequence of spurious learning and a false sense of confidence produced by experience gained through collaboration. Thus, experience does not substitute for careful autonomous development of the resources required to operate successfully in dynamic environments.
REFERENCES


Table 1a. First Stage Correlation Matrix and Descriptive Statistics (N=159)

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Table 1b. Second Stage Correlation Matrix and Descriptive Statistics (N=113)

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31
### Table 2a. First Stage Estimates (ordered probit)

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<td>Turboprop</td>
<td>-0.488</td>
<td>0.205</td>
<td>-2.380</td>
<td>***</td>
</tr>
<tr>
<td>_cut1</td>
<td>16.390</td>
<td>22.382</td>
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<tr>
<td>_cut2</td>
<td>16.827</td>
<td>22.372</td>
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</tbody>
</table>

Number of obs: 159

Pseudo R2: 0.304

\( \chi^2 (11) \): 73.73***

Log pseudo-likelihood: -100.551

Number of cluster: 84

* significant at 10%; ** significant at 5%; *** significant at 1% - one-tailed tests

Entry strategy is coded 1 for independent entry, 2 for alliance entry, and 3 for licensing entry.

### Table 2b. Second Stage Estimates (OLS regression)

<table>
<thead>
<tr>
<th>Post entry performance</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>t</th>
<th>Sig.</th>
<th>Coef.</th>
<th>Std. Err.</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm Size</td>
<td>0.137</td>
<td>0.258</td>
<td>0.530</td>
<td></td>
<td>0.282</td>
<td>0.280</td>
<td>-1.010</td>
<td></td>
</tr>
<tr>
<td>Firm Resource Endowment</td>
<td>-0.150</td>
<td>0.086</td>
<td>-1.700</td>
<td>**</td>
<td>-0.216</td>
<td>0.104</td>
<td>-2.030</td>
<td>**</td>
</tr>
<tr>
<td>Technical Complexity</td>
<td>0.153</td>
<td>0.026</td>
<td>7.40</td>
<td></td>
<td>0.455</td>
<td>0.279</td>
<td>1.630</td>
<td></td>
</tr>
<tr>
<td>Size of the Potential Market</td>
<td>0.222</td>
<td>0.114</td>
<td>1.960</td>
<td>**</td>
<td>0.103</td>
<td>0.098</td>
<td>1.060</td>
<td></td>
</tr>
<tr>
<td>Year of Entry</td>
<td>-0.039</td>
<td>0.015</td>
<td>-2.660</td>
<td>***</td>
<td>-0.031</td>
<td>0.014</td>
<td>-2.130</td>
<td>**</td>
</tr>
<tr>
<td>Military Design</td>
<td>0.675</td>
<td>0.354</td>
<td>1.220</td>
<td></td>
<td>0.359</td>
<td>0.333</td>
<td>1.060</td>
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</tr>
<tr>
<td>State-owned</td>
<td>0.120</td>
<td>0.253</td>
<td>-0.480</td>
<td></td>
<td>0.472</td>
<td>0.429</td>
<td>1.100</td>
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<tr>
<td>Fighter</td>
<td>-0.526</td>
<td>0.649</td>
<td>-0.810</td>
<td></td>
<td>-0.297</td>
<td>0.647</td>
<td>-0.460</td>
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<tr>
<td>Helicopter</td>
<td>0.973</td>
<td>0.901</td>
<td>1.080</td>
<td></td>
<td>1.574</td>
<td>1.014</td>
<td>1.550</td>
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<tr>
<td>Jet</td>
<td>-0.047</td>
<td>0.322</td>
<td>-0.150</td>
<td></td>
<td>-0.624</td>
<td>0.478</td>
<td>-1.310</td>
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</tr>
<tr>
<td>Turboprop</td>
<td>-0.400</td>
<td>0.257</td>
<td>-1.560</td>
<td></td>
<td>-0.653</td>
<td>0.317</td>
<td>-2.060</td>
<td></td>
</tr>
<tr>
<td>Independent Entry</td>
<td>0.851</td>
<td>0.446</td>
<td>1.910</td>
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<td>0.472</td>
<td>0.296</td>
<td>1.590</td>
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<tr>
<td>Alliance Entry</td>
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<td>0.606</td>
<td>-2.180</td>
<td>**</td>
<td>-1.073</td>
<td>0.541</td>
<td>-1.980</td>
<td>**</td>
</tr>
<tr>
<td>Licensing Entry</td>
<td>-1.073</td>
<td>0.541</td>
<td>-1.980</td>
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<tr>
<td>Selection Lambda</td>
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<td>77.903</td>
<td>29.056</td>
<td>2.680</td>
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<tr>
<td>_cons</td>
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<td>59.627</td>
<td>28.201</td>
<td>2.110</td>
<td>**</td>
</tr>
</tbody>
</table>

Number of Obs: 113

R-squared: 0.1867

Number of Cluster: 70

F value: 1.83**

* significant at 10%; ** significant at 5%; *** significant at 1% - one-tailed tests