Time and space in business: dynamic geographic concentration and localized industry life cycle

> *"Where should geographic boundaries lie … when an industry is moving between phases of a life cycle?" (McGahan et al., 2004, p. 17)*
> *"What is the shape of the relationship between time and agglomeration externalities?" (McCann and Folta, 2008, p. 560)*

Both time and place matter to business. The industry life cycle literature suggests temporal dynamics, i.e., a higher entry rate when an industry is growing and a higher exit rate as an industry shakes out (Peltoniemi, 2011). Conversely, the economic agglomeration literature suggests regional heterogeneity, i.e., there is a higher entry rate and a lower exit rate within an industry cluster in which firms engaged in the same business are located together as a result of economic agglomeration (McCann and Folta, 2008).

Despite their powerful insights, the two bodies of literature on the effects of time and place on firm entry and exit have developed from divergent theoretical roots and the gap between them has thus seldom been bridged. This critical research gap has been acknowledged by both sides. In a review of the industry life cycle literature, McGahan *et al.* (2004, p. 17) explicitly call for an examination of geographic boundaries in research on the industry life cycle: "*questions inevitably arise about … where geographic boundaries should lie … when an industry is moving between phases of a life cycle*." Similarly, McCann and Folta's review of the agglomeration literature (2008, p. 560) outlines the temporal dynamics of agglomeration externalities as one key area containing unanswered questions in agglomeration research and call to examine "*the shape of the relationship between time and agglomeration externalities*."

Accordingly, a few pioneering empirical studies have begun cross-fertilizing the two bodies of literature (e.g., Potter and Watts, 2011). Agglomeration economists have attempted to empirically determine the conditions under which the mechanisms underlying agglomeration and industry clustering are more salient. For example, Wang *et al.* (2014) found that agglomeration benefits contribute to higher firm survival rates in industry clusters only in the mature stage of an industry life cycle, whereas Kukalis (2010) found no significant differences in financial performance

between clustered and isolated firms during the early stages of industry life. Potter and Watts (2011) reexamined Marshall's agglomeration economies in the city-region in which he discovered them and found that the latter stages of the industry life cycle exhibited the opposite results. Klepper's (2007, 2010) seminal work on spinoff dynamics as an alternative explanation of industry clustering inherently incorporates temporal dynamics as it attributes the clustering of new entrants to the heritage advantages enjoyed by spinoffs from existing firms, primarily during the early stages of an industry's life cycle (for a summary, see Agarwal *et al.*, 2015; Boschma, 2015). However, the role of geography has also been increasingly recognized in industry evolution and life cycle studies. For example, Wezel (2005) noted that industry evolution patterns are subject to both spatial and temporal heterogeneity and empirically demonstrated that the effects of density-dependent legitimation and competition on firm founding (Hannan and Freeman, 1987) decrease as an industry ages, although more strongly within agglomerated populations. Boschma and Wenting (2007) found that agglomeration attracted more entries in the first phase of the development of the British automobile industry but that the high density of firms in a region negatively affected the survival of new entrants in the later stages of the industry's life cycle.

Despite the insights generated from these empirical studies, the literature review shows that the dialogue between the two bodies of literature has no overarching framework integrating insights from both sides and providing a theoretical bridge articulating the co-evolution of temporal and spatial heterogeneities. Although the pioneering industry life cycle studies have considered that firm entry and exit may differ across regions at the same industry life cycle stage, they have mostly treated the existent agglomeration as a given exogenous variable and have thus assumed away the possibility that the spatial distribution of an industry can also change over time. By contrast, although agglomeration researchers have acknowledged that the effects of agglomeration forces can vary over time, the consequences of these effects on the spatial distribution of an industry have not been systematically revealed. Thus, the question remains open as to how an industry will see itself more or less geographically concentrated at a particular stage of its life cycle, particularly as "hot spots" in which firms are clustered turn into "blind spots" as the economies of agglomeration erode over time (Pouder and St. John, 1996).

This paper seeks to expand the theoretical dialogue between the economic agglomeration literature and the industry life cycle literature. In so doing, it first reviews the agglomeration literature's treatment of temporal dynamics and the industry life cycle literature's treatment of regional heterogeneity. A theoretical interplay between the two sets of literature follows and leads to propositions regarding the patterns of place and time. Sitting at the intersection of the two bodies of literatures (i.e., the area of overlap as shown in the shaded areas in Figure 1), the dialogue leads to both a dynamic geographic concentration model and a localized industry life cycle model. On the one hand, the dynamic geographic concentration model suggests that the relationship between time and geographic concentration follows a cyclical pattern such that the degree of an industry's geographic concentration will fluctuate as the industry moves between stages in its life cycle. On the other hand, the localized industry life cycle model suggests a geographic divide between the industry's center and its periphery such that the two different types of regions will experience temporal dynamics differently, even in the same stage of an industry's life cycle. The insights obtained from the dialogue contribute to both the agglomeration literature and the industry life cycle literature. Contributions to the former are made by theorizing the temporal dynamics of economic agglomeration and a nonlinear relation between time and agglomeration externalities, In addition, contributions to the industry life cycle literature are made by theorizing regional heterogeneity and the economic boundaries of the forces underpinning an industry's life cycle.

Insert Figure 1 about here
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1. TEMPORAL DYNAMICS IN THE AGGLOMERATION LITERATURE

It has been well documented that location matters to business (McCann and Folta, 2008), and the role of geography in business has enjoyed a resurgence as a research frontier in management (Baum and Sorenson, 2003). The economics of agglomeration, a concept coined by Alfred Marshall in the classic *Principles of Economics* (1920), serves as a paradigmatic theme in the emerging cross-disciplinary research on geography and management (Porter, 1990). In particular, management researchers have begun to evaluate the vital impact of agglomeration on competitive advantage (Canina *et al.*, 2005), firm performance (Chung and Kalnins, 2001), location decisions (Kalnins and Chung, 2004), entrepreneurship (Sorenson and Audia, 2000), and innovation (Whittington *et al.*, 2009).

A key question in this literature is why geographic industry concentration persists. A growing body of research literature has accumulated that attributes the persistence of industry geographic concentration to both lower firm exit rates and higher firm entry rates in industry clusters (Wang *et al.*, 2014). The exit mechanism essentially posits that the mortality rate is lower in industry clusters because co-located firms perform better than isolated firms as a result of agglomeration externalities such as labor pooling and supplier and knowledge spillovers (Krugman, 1991a; Marshall, 1920). The entry mechanism essentially posits that the founding rate is higher in industry clusters because these regions attract more investment than other regions as a result of agglomeration externalities (Baum and Haveman, 1997; Gordon and McCann, 2000; Rosenthal and Strange, 2003; Sorenson and Audia, 2000).

For the pattern of geographic concentration to persist, either a lower exit rate or a higher entry rate can help sustain an industry cluster. Given the two mechanisms, which is more salient? Previous empirical studies exhibit mixed results. For example, in a study of the US footwear industry, Sorenson and Audia (2000) do not find lower mortality rates in regions in which firms cluster but do find higher entry rates in those regions. Thus, it appears that firm entry, not exit, drives agglomeration. From the industry life cycle perspective, temporal dynamics can be a conditioning factor because the driving force of geographic concentration likely changes over time. Accordingly, the reason that Sorenson and Audia (2000) do not find that industry clusters have a sustaining capability (i.e., that their firms are more likely to survive) is likely because of their observation time window, which spanned from 1940 to 1989. The US footwear industry experienced rapid growth with the opening of many manufacturing plants between 1940 and 1968, and footwear production steadily increased from 424 million pairs in 1939 to 642.4 million pairs in 1968 (U.S. Congress Hearing, 1984). After 1968, however, the industry experienced a sharp decline because of a dramatic increase in foreign imports. Production dropped to 342.4 million pairs and the number of footwear manufacturers decreased from 990 in 1965 to approximately 450 in 1984. However, this fundamental change is ignored by Sorenson and Audia (2000) because they limit their examination to the entire period. Given that most firms entered the industry before 1968 and most exits occurred after 1968, it is questionable whether Sorenson and Audia's (2000) results hold once the dataset is divided into two periods. In particular, there may be a lower mortality rate in industry clusters after the industry entered its shakeout after 1968, a time in which many firms were driven out of business; moreover, the sustaining capability of industry clusters matters the most. In other words, the researchers may draw different conclusions if they study the same context but in a different period.

This conditioning factor has been overlooked in the agglomeration literature in general. Table 1 summarizes the review of the empirical studies in the agglomeration literature (please refer to Table 1). I first reviewed the empirical studies that are cited in major literature reviews of the agglomeration theory (Baum and Sorenson, 2003; McCann and Folta, 2008), and then used the Web of Science search engine to find additional articles using the keywords "geographic concentration," "agglomeration," "geographic proximity," and "industry cluster." My literature review reveals that most of the previous empirical studies of agglomeration do not explicitly control for the effects of temporal dynamics across the industry life cycle.

Insert Table 1 about here

More generally, the economic agglomeration literature has focused little on the *time* factor (for exceptions, see (Menzel and Fornahl, 2010; Van Klink and De Langen, 2001; Wang *et al.*, 2014)). The geographic concentration literature has focused almost exclusively on the persistence of geographic concentration; however, understanding the time factor may be crucial to explaining *changes* in geographic concentration: how an industrial cluster begins, grows, and perhaps declines. Thus, the previous agglomeration literature applies a *static* perspective to the phenomenon of geographic concentration. This literature implicitly assumes that once a geographic concentration pattern is established, it will persist unless exogenous factors are changed. Thus, although the theory is suitable to explain the persistence of geographic concentration, its ability to explain the dynamics of geographic concentration is limited. To understand the dramatic geographic shifts witnessed in many industries, it is important to understand the geographic concentration phenomenon over an industry's life cycle. New industrial clusters have emerged from nothing (for example, consider the emergence of Taiwan's Hsinchu industrial park in the early 1980s), whereas old clusters have declined (for example, consider the decline of Detroit as the center of automobile manufacturing since the 1970s). These changes in geographic concentration impact not only regional economic development but also individual firms' performance. However, overlooking the *time* factor, the current literature cannot satisfactorily explain the mechanisms underlying these changes.

Certainly, it is beyond the scope of a single study to fully incorporate temporal dynamics into the economic agglomeration literature. In attempting to illuminate this issue, this study asks how the pattern of an industry's economic agglomeration may change over time. The question embraces the reality that the spatial distribution of

business activities evolves; in addition, the question implicitly challenges the assumption that an industry's geographic concentration will persist ad infinitum.

2. REGIONAL HETEROGENEITY IN THE INDUSTRY LIFE CYCLE LITERATURE

The industry life cycle theory posits that – as with living creatures – an industry has a life cycle of birth, growth, and death (Cox, 1967; Dean, 1976; Levitt, 1965; Rice and Galvin, 2006; Vernon, 1966). The theory was established by business researchers in the 1960s to explore pricing policies for new products (Dean, 1976), marketing strategies at different stages of the product life cycle (Cox, 1967; Levitt, 1965), and the patterns of international investment and trade (Vernon, 1966). Today, this theory is "*so widely accepted and its basic premises so taken for granted that it has become conventional wisdom in business*" (McGahan *et al.*, 2004, p. 2).

Despite being a fundamental theory in business research, however, the industry life cycle literature has not sufficiently addressed the question of where the proposed life cycle patterns are more salient. For example, Klepper's early works on the industry life cycle (Klepper, 1996; Klepper and Graddy, 1990; Klepper and Miller, 1995; Klepper and Simons, 1997) center on the evolution of industries over time. In these studies, however, "*we are accustomed to treating industries as homogeneous*" (Klepper and Thompson, 2006, p. 875) and thus overlook the possibility that the general pattern of industry life cycle can be confounded by a heterogeneous collection of submarkets, which can be "*differentiated along numerous dimensions, such as the technology they use, the services they provide, the customer segments they target, or the geographic areas in which they operate*" (Klepper and Thompson, 2006, p. 862). From a geographical perspective, it might be argued that different regions – with geographically bounded, distinct economic and societal backgrounds – represent different customer segments and/or foster different technological solutions (e.g., the Route 128 region in Massachusetts vs. Silicon Valley). As such, an industry cluster can be theorized as a submarket. This argument is consistent with Klepper's subsequent seminal works on the spin-off based "heritage theory" of industry clustering (Buenstorf and Klepper, 2009; Klepper, 2007, 2010), which posits that heritage – the tendency of new entrants in the form of spin-offs to locate near their parent firms – can lead to a self-reinforcing mechanism that results in the geographic concentration of industries even in the absence of agglomeration economies. Based on the same logic, it might be argued that regional heterogeneity, as

examined in this study, confounds the pattern of the industry life cycle. As Krafft (2004, p. 1688) notes, "*global patterns of evolution differ from local patterns*."

This possibility has not been a focal point of investigation in the industry life cycle literature in the past, as highlighted by McGahan *et al.* (2004). For example, although Klepper and Thompson (2006) first proposed that the existence of submarkets can confound industry life cycle patterns, they defined submarkets in the laser industry NOT in terms of geographic boundaries but instead in terms of particular applications serviced by specific lasers. However, as interest in the role of geography has increased in the social sciences, industry evolution researchers have begun to focus on the presence of spatial heterogeneity in industry life cycles and to investigate how firms in different regions are likely to experience temporal market dynamics differently as an industry moves through its life cycle. For example, Wezel (2005) empirically compared the agglomerated and scattered populations of the British motor industry in terms of its capability to attract new entries over time and found a stronger positive impact of density-dependent legitimation on firm founding rates in the industry center during the mature stage of the industry. Lomi (2000) found that the patterns of density dependence in the founding rates of Danish banks differed between the industry center in Copenhagen and the rest of the country. Boschma and Wenting (2007) argued that agglomeration economies have the greatest impact on the emerging spatial patterns of a new industry during the industry's early days and that conversely, the spinoff effects are more important in the later stages of the industry life cycle. Moreover, Murmann and Homburg (2001) found that the evolutionary patterns of the synthetic dye industry differed significantly across national contexts and highlighted the need to incorporate differences in institutional environments in analyses of industry life cycles. These pioneering studies showed that it is critical to account for the conditioning effects of regional heterogeneity in analyzing the industry life cycle.

Table 2 summarizes the previous empirical studies of the industry life cycle and indicates whether geography was considered. Given the rich body of the industry life cycle literature, I examined those studies that investigate firm entry/exit. To do so, I first reviewed the empirical studies cited in literature reviews of industry life cycle theory (Agarwal *et al.*, 2002; McGahan *et al.*, 2004; Peltoniemi, 2011). I then used the Web of Science search engine to

find additional articles that either include the keywords "industry life cycle" or that cite seminal studies (e.g., Gort and Klepper, 1982; Klepper, 1996; Utterback and Abernathy, 1975).

Insert Table 2 about here

In Table 2, I summarize the major findings and the empirical contexts of each study, whether the study has considered geography, and how a missing geographic concentration might possibly confound the results. In so doing, I want to find both whether geographic concentration should be accounted for in industry life cycle studies and how it has (or has not) been accomplished. The literature review finds that the industry life cycle literature on the effects of time on firm entry and exit has developed without considering the effects of geography, albeit with the exception of a few pioneering studies in this regard (Boschma and Wenting, 2007; Lomi, 2000; Murmann and Homburg, 2001; Wezel, 2005). Most empirical studies of the industry life cycle have treated an entire industry as the unit of analysis and have not accounted for geographic distribution.

Because most industry life cycle studies set the level of analysis at the industry level, "*treating industries as homogeneous*" (Klepper and Thompson, 2006, p. 875), the industry life cycle literature in general assumes away the fact that most industries are geographically concentrated in a small number of places. Although this assumption helps researchers theorize and identify general life cycle patterns (e.g., growth and shakeout), it risks assuming away the possibility that an industry's life cycle pattern can vary in different regions. In other words, it is possible that a region experiences a life cycle pattern that varies from that of the overall industry.

For example, Silicon Valley is widely acknowledged as the current center of the US information technology industry. Market fluctuation in Silicon Valley may represent overall industry trends. Similarly, the industry's life cycle may be concurrently experienced in Silicon Valley. However, as Saxenian (1994) documented in a seminal study, the US information technology industry was once located in regions other than Silicon Valley, such as on Route 128 in and around Boston. If we trace the development of the industry in the two regions – Silicon Valley and Route 128 – we find that the life cycle differs even though the industry is the same. Although overshadowed by Route 128 in the early days of information technology development, since the 1980s, Silicon Valley has emerged as the unquestionable center of the industry. In comparison, the Route 128 region has never been as successful as it once

was. In other words, the rapid growth experienced by Silicon Valley in the 1990s was not experienced in the same way or on the same scale by Route 128. The two regions did not experience the same temporal dynamics. Another example is the auto industry. Although Detroit has been the center of US automotive production for decades, the industry was first located elsewhere. "*Initially firms entered the automobile industry throughout the eastern seaboard and the Midwest, but by 1909, Detroit was the center of the industry*" (Klepper, 2007, p. 616). If we trace the history of the automotive industry, again we will find that the same industry evolved along a different path in Detroit than in other regions.

The above two examples show that an industry's life cycle can take different paths across regions. Consequently, a theory of the industry life cycle that assumes away geographic heterogeneity can lead to misleading predictions, particularly if a region experiences a different development path. In light of the foregoing, pioneering researchers on this topic have called for industry life cycle research to conduct evaluations of industries' geographic boundaries (McGahan *et al.*, 2004).

3. THEORY AND PROPOSITIONS

3.1 Definitions and Assumptions

Thus far, the literature review has revealed that it is critical for economic agglomeration theorists to consider the conditioning factor of time and for industry life cycle researchers to account for the conditioning factor of geography; however, such a cross-disciplinary task remains unfulfilled. In the dialogue between the two literatures, I attempt both to propose a dynamic geographic concentration model by injecting the factor of time into the economic agglomeration literature and to propose a localized industry life cycle model by injecting the factor of geography into the industry life cycle literature. The results and insights of that dialogue are summarized in Figure 2.

Insert Figure 2 about here

The dialogue is based upon the following critical assumptions and definitions. First, I assume regional heterogeneity, i.e., that some regions have more potential for particular businesses because of a variety of factors, including transportation, labor, natural resources, and historical, institutional, cultural, or legal environments. Consequently,

an industry's business activities are not likely to be evenly distributed geographically at any given time. Some regions receive pronounced industry agglomeration in terms of either business establishments or number of employees, whereas other regions receive only scattered or isolated activities. By "region", I refer to a geographic area that has characteristics that distinguish it from other areas in terms of the development of an industry. Empirical studies have used a variety of geographic units to measure agglomeration at different regional levels, including US zip code (Chung and Kalnins, 2001), US metropolitan statistical area (Folta *et al.*, 2006), US state (Shaver and Flyer, 2000), Canadian Census Subdivision (Wang *et al.*, 2014), UK standard region (Baptista and Swann, 1998), and a radius of a particular mileage (Rosenthal and Strange, 2003). These geographic units of agglomeration may correspond to formal administrative regions (e.g., cities or towns) or may cross administrative borders. As Porter (1998) observed, industry clusters can be identified at several geographic levels (e.g., nations, states, metropolitan regions, and cities) and can even expand into neighboring countries. As a result, the present paper does not explicitly clarify the geographic scope of the regions (e.g., cities, states, or any other geographical/administrative areas) but leaves this operational challenge to empirical studies. Additionally, to facilitate discussion, I refer to the region in which firms cluster the most as the center of an industry and other regions as peripheral to the industry. Certainly, the center-periphery dichotomy represents two opposite ends of a continuum, and a particular region will lie somewhere between these two ends based on its endowment of business activities. For ease of discussion, I assume that an industry has one center rather than multiple centers, and I believe that the logic developed based on this assumption also applies to industries with multiple centers. The center-periphery dichotomy is consistent with extant empirical evidence, e.g., the Midwest region in the US as the geographic center of the auto industry (Bigelow *et al.*, 1997), the city of Copenhagen as the core of the Danish commercial bank industry (Lomi, 2000), and the Coventry-Birmingham-Wolverhampton agglomeration as the center of the British motorcycle industry (Wezel, 2005).

Second, to facilitate theoretical discussion, it is critical to first define the industry life cycle because multiple industry life cycle models have been proposed. For example, Hill and Jones (1998) suggest five stages: fragmentation, growth, shake-out, maturity, and decline. Alternatively, Kotler and Cunningham (2004) suggest four stages: fragmentation, shake-out, maturity, and decline. These models are variations of the industry life cycle model developed from empirical works by Gort and Klepper (1982), who assembled data for 46 new products beginning

with the date of the initial commercial introduction of the product through 1972. Following that groundbreaking article, Klepper and Graddy (1990) later defined industry life cycles in terms of the number of firms and proposed a refined three-stage model, which is basically an abbreviated version of the five-stage model established by Gort and Klepper (1982). In a more parsimonious fashion, Agarwal et al. (2002) propose a two-stage model of industry life cycle: growth and maturity. They find that the industry life cycle theory is rooted in apparently divergent bodies of the literature, including evolutionary economics (Gort and Klepper, 1982; Klepper, 1996; Klepper and Graddy, 1990), technology management (Abernathy and Utterback, 1978; Anderson and Tushman, 1990; Tushman and Anderson, 1986; Utterback and Abernathy, 1975), and organizational ecology (Hannan and Freeman, 1977, 1987, 1988). A common theme across these theoretical approaches is that an industry will likely experience (1) a growth stage that is between the commercialization of an industry and the start of significant decline in entry due to the transformation of entry barrier, and (2) a mature stage that is after that point, including the period of suppressed entry and the subsequent resurgence in entry. Changes in the competitive dynamics in an industry's evolution exhibit a discontinuous transformation at a particular point in time, which distinguishes the two stages. Essentially, the two-stage model (Agarwal *et al.*, 2002) is a simpler version of the three-stage model (Klepper and Graddy, 1990): the shakeout stage and the decline stage are categorized as one maturity stage because the shakeout and decline stages both imply intensified competition in the market, high barriers to entry and a low entry rate. For the sake of simplicity, this study adopts the two-stage model of the industry life cycle (Agarwal *et al.*, 2002) and assumes a two-stage industry life cycle: a growth stage during which firms increasingly enter into an industry until reaching a tipping point, followed by a mature stage during which the industry begins to shake out and less-competitive firms are driven out of business. Such a parsimonious two-stage model is simpler than the more complex models; it also reflects the core argument of the industry life cycle theory: a tipping point in time that divides the pattern of firm entry and exit.

Third, as discussed later in more detail, I assume that the two stages will manifest in a cyclical pattern such that an industry will become resurgent with new technologies and enter into a new life cycle after the period of shakeout and decline. In other words, certain theoretical arguments apply solely to industries that experience resurgence and a new growth stage instead of extinction.

Fourth, to facilitate the discussion regarding how an industry is geographically concentrated or dispersed along its life cycle, I define the degree of geographic concentration as the extent to which an industry's economic activities take place in a small number of locations. Notably, different measures of geographic concentration have been used in empirical studies, such as the location quotient (Hoover, 1936), the locational Gini coefficient (Krugman, 1991b), and the Ellison-Glaeser index of geographic concentration (Ellison and Glaeser, 1997, 1999). Despite differences among these measures, the measure of geographic concentration should increase when more firms in an industry are located in fewer regions for all these measures. Because it is beyond the scope of this paper to compare and contrast different measures, this paper instead defines the degree of geographic concentration to reflect the key logics of these measures and does not endorse a particular empirical measure. The choice of an empirical measure is thus subject to factors such as data availability.

Finally, industry characteristics should not be omitted in agglomeration research as different industries place different demands on location[1]. In particular, the agglomeration literature has already differentiated demand-side and supply-side agglomeration. As McCann and Folta (2009) note, manufacturing industries (e.g., consumer electronics production) are predominantly shaped by supply-side agglomeration externalities involving the pooling of labor and supplier and knowledge spillover, whereas service industries (e.g., hotels) are mostly affected by demand-side agglomeration externalities, i.e., the agglomeration of service providers leads to more choices and reduces buyer search costs. The theoretical model developed in this paper focuses only on supply-side agglomeration.

3.2 The Growth Stage

The growth stage consists of the period during which the number of firm entries grows (Klepper and Graddy, 1990). During this period, a new technology is discovered and commercialized by pioneering entrepreneurs and investors; subsequently, the population of startup firms grows rapidly to capitalize on the market opportunity. The industry as a whole is fragmented because pioneering firms experiment extensively with their business models, which are often associated with similar but different technologies, in the hope of arriving at the best solution for the market's needs. As McGahan *et al.* (2004, p. 2) states, "*Industries begin in a period of fragmentation as companies experiment with different approaches. With time, a scalable approach emerges as a dominant model, often because it yields greater*

[1] I thank an anonymous reviewer for bringing this point to my attention.

efficiencies than available alternatives." Notably, pioneering firms are not equally capable of reaching the dominant design because "*the dominance of the model also depends on the abilities of those invested in it to promulgate the model among key customers, suppliers, and other vital constituents*" (McGahan *et al.*, 2004, p. 2).

From a geographic perspective, regions with the blessing of superior input factors have greater potential for their firms to develop a better business model, to generate a better value proposition, and consequently to earn a larger market share. The superior input factors can be, but are not limited to, lower transportation costs, lower labor costs, more natural resources, more talent, and a better cultural, sociological and legal environment that is more suitable for the business (Alcácer and Chung, 2014). These regions have a much higher likelihood of evolving into the industry center in the future. With such potential, these regions will receive more investments, given that pioneering firms experiment not only with technologies but also with different locations with the goal of placing their business in the right place. Conversely, those regions with fewer superior input factors will likely receive less investment because of their regional disadvantage.

Consequently, some regions will emerge as industry "hot spots" (Pouder and St. John, 1996), whereas others will receive less attention and less investment in the growth stage. The hot spots will eventually evolve into the industry's center (e.g., Detroit in the early days of the US auto industry), and the other regions will become the industry's periphery. The agglomeration of businesses in the hot spot will also produce an identity for that region that then attracts more entries in the same business (McKendrick *et al.*, 2003). As Wezel (2005) found, a region will have a more developed local institutional environment if more firms cluster in the region, and it will subsequently attract additional new entries. Similarly, Boschma and Wenting (2007) found that agglomeration economies contribute to the clustering of new entries in an industry, particularly in the early stage of an industry's life cycle. The temporal dynamics of the industry life cycle – such as a high entry rate during the growth stage – thus varies among regions, being stronger in the center and weaker in the periphery. Notably, the causality here reflects the seminal notions from Arthur (1989, 1990) involving increasing return and lock in. A minor advantage or seemingly inconsequential events in time $_{t}$ may lead to irreversible consequences in time $_{t+1}$, such as technology standards and – as argued herein – the spatial distribution of an industry.

Proposition 1a: During the growth stage, despite the sporadic presence of startups in multiple regions, the temporal dynamics of an industry are localized such that a region with more startups at time $_t$ will be more likely to have a higher firm entry rate at time $_{t+1}$ than regions with fewer startups at time $_t$ and is thus more likely to become the center of the industry.

On the surface, the above proposition appears consistent with what the economic agglomeration literature describes: the more firms cluster, the more benefits (and subsequently, the more investment) they realize. Economies of agglomeration can be regarded as an input factor that is critical for choosing a business location. However, the above discussion does not exclude the possibility that peripheral regions may receive reasonable investment, albeit in a smaller amount. Indeed, in the most geographically concentrated industries, firms in the industry located outside of industry hubs almost always continue to exist. For example, more than a quarter of the biotechnology firms studied by Folta *et al.* (2006) are located in regions with fewer than eight firms. Similarly, Microsoft, a giant of the information technology (IT) industry, was founded and continuously headquartered in Seattle, Washington, not in northern California's Silicon Valley.

In other words, although it is likely true that an industry center has greater potential for providing more benefits to its local firms, firms will be established in the periphery for a variety of reasons. First, pioneers may be unaware of the superior prospects of the right place due to a lack of information (Hoover, 1948). There may be many reasons for the lack of information: lack of interpersonal ties with industry insiders and lack of an entrepreneurial personality to explore different places. Whatever the reasons, people have different understandings of which place is best-suited for their business. Second, although entrepreneurs do have sufficient information, they may not always locate their business in the industry center because of artificial constraints, such as immigration restrictions (Hoover, 1948) or because of personal reasons such as family ties. For example, as noted by Saxenian (1994), Silicon Valley's origin can be traced to the founding of the Hewlett-Packard Company (HP) in 1937, when a small number of firms grew alongside HP. When Messrs. Hewlett and Packard established HP in Mr. Packard's garage, it is highly arguable that they knew that many years later that garage would become the genesis of Silicon Valley. It was only after Silicon Valley's pioneering firms found commercial success that its position as an emerging center of electronics production was consolidated.

Essentially, the growth stage is a *pre-cluster* period in which the emerging industry center is waiting to be established. Given the experimental nature of entrepreneurs' location decisions, it is difficult to foresee the existence of an industry center at the time when the first several firms are established. As pioneering entrepreneurs experiment with business locations, startup establishments are likely to be relatively scattered instead of being geographically concentrated. Although the inchoate industry center indeed attracts more investment, as found in empirical studies (e.g., Sorenson and Audia, 2000), many new-firm births are located in remote areas. An industry will thus become geographically more dispersed as more new firms enter the industry; thus, the net impact of entry will be negative in terms of geographic concentration. Indeed, Dumais *et al.* (2002) have found that the location choice of new firms generally runs counter to agglomeration and reduces geographic concentration.

Moreover, in the growth stage, supply falls short of demand as the booming industry provides a seemingly ever-enlarging market to all firms (Agarwal *et al.*, 2002), and the market competition mechanism has not yet begun to deselect firms that are located in inferior regions. Wang *et al.* (2014) find that economies of agglomeration contribute to only firm survival during the mature stage of an industry life cycle. In sum, in the growth stage, the birth rate of firms in the industry center is higher than in the periphery, but the exit rate may not be significantly different. The establishment and existence of firms at the periphery will make the young industry as a whole appear to be geographically dispersed rather than concentrated, which contrasts with the high degree of geographic concentration in a well-established industry. Thus, from the industry life cycle perspective, the degree of geographic concentration (i.e., the extent to which an industry agglomerates) varies over time. In the growth stage, as a large number of entries experiment with business locations, the industry will tend to become geographically less concentrated (please refer to the dotted line in Figure 2).

Proposition 1b: The degree of geographic concentration of an industry decreases during the growth stage.

3.3 The Mature Stage

The mature stage consists of the period during which the number of firms declines as incompetent firms are driven out of business because of the industry-wide shakeout (Klepper and Graddy, 1990). Empirically, the mature stage begins when the number of firms peaks, and the entry rate declines sharply due to heightened entry barriers (Agarwal *et al.*, 2002). The shakeout is triggered by the emergence of a dominant design that subsequently raises the

entry barriers for newcomers and places stronger competitive pressure on other firms. A few firms champion the dominant design that leads to economies of scale in production, marketing, etc., when they discover those methods of operating the business and producing products that are acceptable to most customers (Murmann and Frenken, 2006; Suarez, 2004). Consequently, the firm exit rate will be significantly higher in the mature stage than in the growth stage (Agarwal and Gort, 1996; Klepper, 1996; Suarez and Utterback, 1995). In particular, those firms that do not adopt the dominant design will experience strong competitive pressure and eventually exit the market during the shakeout. As McGahan *et al.* (2004, p. 2) state, "*As the dominant model develops, an industry goes through a shakeout as unaligned firms are forced to exit. Eventually, firms find it difficult to improve their productivity on the dominant model at high rates, volume growth hits a point of diminishing returns, and the industry enters maturity*." In other words, the beginning of the mature stage signifies the coming of fierce competition for the entire industry. As the market becomes saturated due to increased supply, firms that earn minimum financial returns but have previously managed to remain in the market eventually will be forced to leave the market because of shrinking profit margins.

From the geographical perspective, location is part of the "dominant model." Given heterogeneity among locations, some locations provide local firms with competitive advantages, including access to key resources, a more suitable cultural, sociological, and legal environment, and most importantly, economies of agglomeration (Krugman, 1991a). As discussed above, these regions will eventually evolve into the industry's geographic center, and firms co-located there are more likely to discover and/or converge to the dominant model and thus survive the market-selection process. Conversely, firms located in the periphery will suffer from competitive disadvantage and thus exit at a higher rate. In other words, the wrong location decision is part of a firm's weakness and results in punishment during the mature stage (although it was tolerable during the growth stage). Although firms in the center engage in the same fierce competition among themselves (Baum and Mezias, 1992), they generally maintain a competitive advantage over firms in the periphery because of location-exclusive economic gains from their geographic concentration.

In sum, all other things equal, the isolated firms in the periphery are subject to a higher risk of exiting the industry than their co-located counterparts. The apparent universal industry life cycle thus unfolds differently across regions.

The industry life cycle theory predicts that firms that fail to converge to the dominant design will be more likely to be driven out of the market. Because a firm's business location constrains its ability to access resources, knowledge, and talents, those firms located in the "wrong" places, as a geographically defined subgroup, are less likely to survive. Thus, the industry center can help firms located inside to defer the temporal dynamics of the industry life cycle. The temporal dynamics of the industry life cycle, i.e., a high exit rate during the mature stage, are weaker in the industry center in which firms are clustered, and these regions will thus experience a lower exit rate than other regions. By contrast, the periphery will experience stronger temporal dynamics because the exit rate is higher there.

Proposition 2a: During the mature stage, the temporal dynamics of an industry are localized such that the established center has a lower firm exit rate than the periphery despite the overall trend toward an industry-wide shakeout.

Given that isolated firms are forced to exit one at a time, the industry will become increasingly geographically concentrated in a small number of places in which firms cluster. The degree of industry geographic concentration will increase as a result (please refer to the dotted line in Figure 2). Such a trend is clearly demonstrated in the process through which the US auto industry became geographically concentrated in the Detroit region. Klepper (2007) documents the evolution of the US auto industry and finds that firms initially entered the automobile industry on the Eastern seaboard and in the Midwest, but the industry went through a prolonged and severe shakeout of producers after 1909. Subsequently, the industry evolved into an oligopoly dominated by three well-known Detroit-based firms: General Motors, Ford, and Chrysler. In other words, the industry became increasingly concentrated in Detroit as other regions were deselected from the industry's evolution. Such a trend is also observed in other industries. Dumais *et al.* (2002) analyze 134 manufacturing industries in the US from 1972 to 1992 and find that firms in industry centers are less likely to exit, and the pattern of geographic concentration is reinforced as a result.

Proposition 2b: The degree of an industry's geographic concentration increases during the mature stage.

3.4 The New Industry Life Cycle

Among the 46 industries examined by Gort and Klepper in their seminal study (1982), most continue to exist. Because Gort and Klepper (1982) had previously found a full industry life cycle in those industries, it is unclear whether those industries have remained in the same life cycle stage since then. Given the rapid change of technology in recent decades, it is reasonable to assume that at least some of these industries have experienced the beginning of

a new life cycle triggered by technological changes. If so, it might be asked what happens when these industries enter into a new life cycle, such as when "*fundamental changes in technology launch a new product cycle*" (Gort and Klepper, 1982, p. 631). The possibility of industry resurgence has been acknowledged by organizational population ecologists (Ruef, 2004). For example, Carroll and Hannan (1995) showed that the population density of the American automobile industry declined from the 1910s to 1930s and then remained stable until the 1970s and 1980s, when it experienced growth. Carroll and Hannan (2000, p. 239) thus posited that "*organizational densities decline sharply after an extended period of early proliferation; and they sometimes rise again*".

However, industry life cycle researchers have focused insufficient attention on the insights generated in the field of organizational population ecology. For example, Peltoniemi's (2011) remarkably comprehensive review of the industry life cycle literature does not discuss industry resurgence at all. Similarly, McGahan *et al.* (2004) acknowledge that the US brewing industry was in its mature stage during the 1980s and 1990s, during which time the top three brewing companies enjoyed approximately 80 percent market share. Using the brewing industry as an example of an industry entering into the mature stage of its life cycle, however, McGahan *et al.* (2004) overlook the emergence of craft beer as a new market segment championed by microbreweries across the country (Swaminathan, 1998). The rise of craft beer has been consistently strong since the 1990s, evidenced by the ever-growing market share of craft beer despite the decline of the overall beer market.

The emergence of craft beer in the mature beer industry demonstrates how technology innovation, often pioneered by startup companies, can challenge incumbent firms and even disrupt an apparently mature industry. When this type of disruption occurs, the mature industry will witness a surge of new entries. According to resource partitioning theory (Carroll, 1985), these new entries are mostly likely specialists that are qualitatively different from the generalists that dominate a mature industry. For example, the number of breweries in the US declined from more than 900 to approximately 40 during the mature stage spanning the period from the 1930s to the 1980s (Swaminathan, 1998); however, this number has since begun to rise. The number of breweries is currently more than 2,800, and most of these are microbreweries, according to the *Brewery Association*. This example supports the view that particular industries can resurge during maturity upon the introduction of new technologies and enter into a new

life cycle following the period of shakeout and decline. The resurgence of a mature industry differs from the birth of a new industry, although a new industry may be built upon the resources generated by another industry. For example, the birth of the British automobile industry benefitted from the bicycle-making industry, which supplied the new industry with potential entrepreneurs, skilled labor and relevant knowledge (Boschma and Wenting, 2007). However, the emergence of the automobile industry should be not considered the resurgence of the bicycle industry because the products of the two industries are fundamentally different in terms of their technological designs and methods of serving consumer needs. By contrast, the emergence of microbreweries can be treated as the resurgence of the US brewing industry as the product, draft beer, belongs to the same product category.

The sudden rise in the entry rate in a mature industry signifies a new life cycle for the industry. Which regions will attract more new entries during the new life cycle? Where will the temporal dynamics of the new life cycle be stronger? It may be the case that without technological disruption, an industry will persistently be concentrated in its traditional centers. As discussed above, given the economies of agglomeration, the incumbent firms that survive a market shakeout are more likely to be located within their industry center. After surviving the industry shakeout, these firms likely enjoy oligopoly or monopoly profits in addition to the economic gains from geographic concentration; thus, they hold dominant positions in the saturated market. It is extremely difficult for newly established firms to compete with them unless the new firms come with disruptive technology and innovation. However, if newcomers from other regions do join the market with the blessing of either disruptive technology or innovation, the incumbents' prosperity and survival may be at risk, and the industry may experience a radical shift in its geographic distribution. For example, Portland has more microbreweries dedicated to craft beer production than any other city in the US, despite that fact that in the past, this city was never a major center of beer production. Conversely, traditional centers of beer production such as Milwaukee have witnessed a continuing decline. Thus, the survival and prosperity of traditional industry centers can be at risk, and some previously unknown regions can emerge as the new center of the industry.

This observation echoes the arguments of Pouder and St. John (1996) that a "hot spot" in which competing firms cluster and enjoy economies of agglomeration can turn into a "blind spot" in which innovation is suppressed and

firm performance is adversely affected. The reason for such a downward shift is that the benefiting forces of agglomeration may help create a homogeneous macroculture or an institutionalized field that is resistant to change and innovation. Consequently, it is likely that the commercialization of new ideas will emerge at the periphery of an industry rather than in its center. When an industry enters into a new life cycle, the temporal dynamics, i.e., a high entry rate in the new growth stage, is stronger in regions other than the traditional industry center. Unless a traditional industry center maintains innovation, it will not receive as many new entries as other regions and instead may experience a downfall.

> *Proposition 3a: When an industry experiences a new growth stage as a result of technological disruption, the temporal dynamics of the industry will be localized such that the traditional center will receive fewer new entries than other emerging regions and may experience a shakeout.*

From the perspective of geography, it is interesting to ask whether the traditional geographic center of these industries survived and continued to thrive in the new industry life cycle. For the US auto industry, although Detroit, the traditional hub of US auto production, is in decline, other regions are experiencing success. For example, South Carolina has emerged as a key center of auto design and production, with the city of Charleston as the industry's top location. Similarly, Tesla Motors, the leader of the electronic car revolution, intentionally located its headquarters and manufacturing plants in the San Francisco Bay area. The changes in the industry lead people to question whether Detroit will continue to be the center of the US auto industry. Whereas it is arguable that Detroit will cease to be the center of US auto production, it is undeniable that the industry as a whole is now less centered in Detroit and that other regions now have the ability to challenge Detroit's dominance.

In accordance with the terminology of Pouder and St. John (1996), the beginning of a new industry life cycle is a period during which an industry center becomes a "blind spot" (e.g., Detroit); however, other regions that are traditionally viewed as the periphery of an industry will witness mushrooming new startups and become the new "hot spots" (e.g., witness the production of electric cars in the San Francisco Bay area). Unless the traditional industry center can defy the erosion of the economies of agglomeration and maintain a highly innovative environment, these regions will be "out of luck" during the new wave of fragmentation in the new industry life cycle. For example, in 1945, HP had only 130 employees, whereas East Coast producers such as GE and Westinghouse employed thousands each (Saxenian, 1994). Considering that these pioneering West Coast firms had minuscule sales and employment in 1940 relative to their counterparts on the East Coast, the former center, it was difficult to

ascertain (or predict) the existence of an electronics industry cluster in the region that was later dubbed Silicon Valley.

Therefore, the industry life cycle aspect makes it obvious that during the same period, although auto production in Detroit experienced a downfall (a signal of a shakeout), another region such as South Carolina experienced an industry boom, occasionally at Detroit's expense. This occurrence leads to the conclusion that the era of a new industry life cycle can be particularly turbulent in terms of the industry's geographic distribution because different regions experience different dynamics. Given the emergence of the periphery and the gradual decline of the center, I predict that an industry's geographic distribution will become more geographically dispersed during the emergence of new industry clusters (please refer to the dotted line in Figure 2).

Proposition 3b: The degree of an industry's geographic concentration decreases during the new growth stage.

4. CONCLUSION

This conceptual paper attempts to forge a dialogue between the economic agglomeration literature and the industry life cycle literature. A literature review finds that insights generated in the two areas are rarely combined, despite the explicit call from industry life cycle researchers to examine geographic boundaries (McGahan *et al.*, 2004) and the call from economic agglomeration researchers to investigate the temporal dynamics of agglomeration externalities (McCann and Folta, 2008). As a consequence, the industry life cycle literature generally overlooks the possibility that the temporal dynamics of firm entry and exit in the same industry life cycle stage may differ across regions. Conversely, the economic agglomeration literature overlooks the possibility that agglomeration-based regional advantages may vary over time in terms of attracting and sustaining firms.

With the objective of filling such a theoretical gap, my paper advances the literature by theorizing how the industry life cycle likely unfolds differently across regions and how the benefits of economic agglomeration likely vary over time. The theorization leads to a dynamic geographic concentration model: an industry's degree of geographic concentration will drop in the growth stage, rise in the mature stage, and drop again in a possible new growth stage (please refer to the dotted line in Figure 2). Conversely, the theorization also leads to a localized industry life cycle model (please refer to the table in Figure 2); the temporal dynamics as described by the industry life cycle theory

will be stronger in the industry center during the growth stage (as the emerging center attracts more investment) but weaker in the industry center during the mature stage because the firm exit rate is lower in the center. Additionally, as an industry enters into a new life cycle, the industry center can become a "blind spot" and the majority of new entries likely will occur in the periphery, which becomes the new "hot spot."

4.1 Contribution to the Economic agglomeration Literature

By neglecting temporal dynamics, the previous economic agglomeration literature implicitly assumes a static view of the phenomenon of the geographic concentration of business activities. The literature explains well why the geographic concentration pattern will persist once established, but it says little regarding how and why industry clusters emerge, evolve, and possibly decline. The dynamic geographic concentration model, as revealed in this paper, suggests that an industry will witness a low degree of geographic concentration in its early days, and it will become highly concentrated in particular regions only during the mature stage. This model contributes to the literature by providing an answer to the question, "*What is the shape of the relationship between time and agglomeration externalities?*" (McCann and Folta, 2008, p. 560). The model demonstrates that the explanatory power of the previous economic agglomeration literature applies more to the mature stage than to the growth stage. In other words, the existing economic agglomeration applies more to the cluster-persistence stage than to the pre-cluster stage. Additionally, the previous literature is particularly unprepared to explain geographic patterns when an industry enters into a new life cycle and as new regions begin to attract more new investment and the industry begins to spread geographically. In sum, my paper contributes to the economic agglomeration literature by demonstrating that its applicability may vary over time, and there is a great need for future research to explain geographic patterns when an industry's degree of geographic concentration is lower than expected.

4.2 Contribution to the Industry Life cycle Literature

Despite some pioneering empirical studies (Boschma and Wenting, 2007; Klepper, 2007; Murmann and Homburg, 2001; Wezel, 2005), the industry life cycle literature, by "*treating industries as homogeneous*" (Klepper and Thompson, 2006, p. 875), overlooks the possibility that an industry's geographic distribution is heterogeneous and thus excludes the possibility that different regions may experience different temporal dynamics. The finding of a localized industry life cycle model, as discussed above, provides an answer to the question "*where should*

geographic boundaries lie … when an industry is moving between the phases of a life cycle?" (McGahan *et al.*, 2004, p. 17). Geographic boundaries likely lie between the industry center and the industry periphery. When an industry booms during the growth stage, the emerging industry center will attract more firm entries. When a shakeout occurs during the mature stage, the center will help local firms endure the general shakeout. Therefore, the shakeout occurs at a faster speed outside the center. The geographic boundaries will blur when an industry enters into a new life cycle because the former "hot spot" may become a "blind spot", and the periphery may emerge as new centers. The theorization confirms the need to account for the geographic boundaries of an industry life cycle because both entry and exit patterns differ between the center and the periphery. In sum, although firm entry is concentrated at the early stage of industry evolution and firm exit occurs during the mature stage, my theory suggests that regional heterogeneity conditions the industry life cycle. Accordingly, the apparently universal pattern of an industry's evolution over time can vary across regions. It is thus likely that although some regions experience an industry boom, other regions witness stagnation or industry decline. Thus, "*global patterns of evolution differ from local patterns*" (Krafft, 2004, p. 1688). As suggested in this paper, whether a region is blessed or cursed with a suitable number of existing firms at least partly determines how the industry life cycle will be experienced locally. As a small step toward fully discovering the geographic boundaries of the industry life cycle, this paper calls for future research to examine how an industry's life cycle possibly unfolds differently across different regions.

4.3 Limitations and Future Research

Given the ambition of this paper to propose a theoretical framework that bridges two extensive bodies of literature (i.e., the industry life cycle and agglomeration literatures), it certainly has some limitations. First, although this paper limits itself to the supply-side agglomeration, it does not incorporate industry characteristics as a key factor in its theoretical framework and does not thus address directly whether and how temporal and spatial heterogeneities may differ across industries in which supply-side agglomeration is present. As discussed above, the paper explicitly excludes demand-side agglomeration (affecting primarily the service sector, e.g., hotels) and focuses only on supply-side agglomeration (affecting primarily the manufacturing sector, e.g., consumer electronics production). However, it is reasonable to argue that different industries may have different characteristics in the manufacturing sector to the extent that they differ from one another in terms of life cycle and/or agglomeration. For example, if the

cost of shipping the end product to the market is low, an industry may locate its manufacturing facilities in a more distant region rather than remaining close to the market; such relationships can complicate the spatial distribution process of an industry. Similarly, firms will have fewer location choices in an industry if the operational processes depend more on geographically bounded natural resources; the spatial distribution pattern in such an industry might be more stable than the patterns of other industries. Additionally, technology changes occur more frequently and dramatically in some industries such that these industries can experience shorter life cycles than other industries. Industry characteristics such as ease/cost of transportation, distribution of natural resources and technological advances play important roles in determining the temporal and spatial heterogeneities of an industry and warrant consideration. Nonetheless, it is beyond the scope of a single paper to incorporate all these elements. Future research should explicitly theorize industry characteristics in the interplay between industry life cycle and agglomeration.

Second, by assuming that an industry has only growth and maturity stages (Agarwal *et al.*, 2002), this paper posits a parsimonious version of other industry life cycle models, including the five-stage model (Hill and Jones, 1998), the four-stage model (Kotler and Cunningham, 2004), and the three-stage model (Klepper and Graddy, 1990). As such, the differences between these additional life cycle stages as conceptualized in such models are overlooked. For example, although the shakeout and the decline stages (which are combined in the maturity stage in this study) are similar in terms of their low entry rates, the two stages can differ in terms of their exit rates. The number of firm drops in the shakeout stage as the exit rate is high, but in the decline stage, an industry may see no or little change in firm numbers. In other words, a drop in the number of firms does not indicate that an industry is in decline in terms of output or turnover. Therefore, a more fine-tuned investigation of the other versions of the industry life cycle might be another direction for future research.

Finally, although the primary focus of this paper is to develop a conceptual framework rather than to discuss empirical methodologies, it is also important to note the manner in which the propositions presented in the paper should be empirically examined. More specifically, there are two challenges for future empirical studies: how to incorporate temporal effects into empirical agglomeration research, on the one hand, and how to incorporate

locational effects into the empirical industry life cycle research, on the other. In addition, the existing measures of geographic concentration – such as the location quotient (Hoover, 1936), the locational Gini coefficient (Krugman, 1991b), and the Ellison-Glaeser index of geographic concentration (Ellison and Glaeser, 1997, 1999) – should be exploited in future empirical studies to test the propositions in this study regarding how the degree of geographic concentration in an industry changes over time. Furthermore, empirical agglomeration studies can benefit from using longitudinal data because these data can enable a sophisticated empirical analysis of the temporal variation of agglomeration forces to be undertaken. When the observation window is long enough to include different stages of an industry's life cycle, the agglomeration effects on firm entry and exit rates across different stages can be directly compared and contrasted. When such a comparison is not possible, a longitudinal design of empirical analysis (e.g., fixed-effect, etc.) should at least be adopted to control for the possible temporal effects. When only cross-sectional data are available, one should contextualize the empirical setting and clarify which stage the industry is in at the time of observation and utilize the contextualization information to explain the empirical findings. Conversely, industry life cycle researchers should compare and contrast the likely different evolutionary paths across different regions to empirically verify how firm entry and exit rates may differ between an industry's geographical center and periphery, as posited in this paper. Notably, this paper assumes a simplistic dichotomy between center and periphery to facilitate discussion, but in reality it is altogether likely that the spatial distribution of an industry exhibits a more complex hierarchy of clusters. To empirically determine the hierarchy, or the center-periphery dichotomy, the agglomeration literature can be followed and quantitative data can be used to measure the degree of agglomeration in different regions (e.g., population density, pool of labor, etc.) to set up thresholds. It might then be interesting to see the possible interaction between agglomeration (as a continuous variable) and industry life cycle – or to compare the life cycle measures between center and periphery (as a dummy variable). Some qualitative data can also be useful for fine-tuning the analysis. For example, Kukalis (2010) employed interview data to classify three tiers of the regions of semiconductor production: the main cluster, the secondary cluster and the noncluster. In sum, the conceptual dialogue between place and time, as proposed in this study, warrants empirical verification.

REFERENCES

Abernathy, W.J. and Utterback, J.M. (1978), "Patterns of industrial innovation", *Technology Review*, Vol. 80 No. 7, pp. 40-47.

Agarwal, R. (1997), "Survival of firms over the product life cycle", *Southern Economic Journal*, Vol. 63 No. 3, pp. 571-584.

Agarwal, R. (2001), "First-mover advantage and the speed of competitive entry, 1887-1986". *The Journal of Law and Economics*, Vol. 44 No.3, pp. 161-177.

Agarwal, R., Buenstorf, G., Cohen, W.M. and Malerba, F. (2015), "The legacy of Steven Klepper: Industry evolution, entrepreneurship, and geography". *Industrial and Corporate Change*, Vol. 24 No. 4, pp. 739-753.

Agarwal, R. and Gort, M. (1996), "The evolution of markets and entry, exit and survival of firms", *Review of Economics and Statistics*, Vol. 78 No. 3, pp. 489-498.

Agarwal, R. and Gort, M. (2002), "Firm and product life cycles and firm survival", *American Economic Review*, Vol. 92 No. 2, pp. 184-190.

Agarwal, R., Sarkar, M. and Echamebadi, R. (2002), "The conditioning effect of time on firm survival: An industry life cycle approach", *Academy of Management Journal*, Vol. 45 No. 5, pp. 971-994.

Alcácer, J. and Chung, W. (2014), "Location strategies for agglomeration economies", *Strategic Management Journal*, Vol. 35 No. 12, pp. 1749-1761.

Anderson, P. and Tushman, M.L. (1990), "Technological discontinuities and dominant designs: A cyclical model of technological change", *Administrative Science Quarterly*, Vol. 35 No. 4, pp. 604-633.

Argyres, N. and Bigelow, L. (2007), "Does transaction misalignment matter for firm survival at all stages of the industry life cycle?", *Management Science*, Vol. 53 No. 8, pp. 1332-1344.

Audretsch, D.B. (1995), "The propensity to exit and innovation", *Review of Industrial Organization*, Vol. 10 No. 5, pp. 589-605.

Baptista, R. and Swann, P. (1998), "Do firms in clusters innovate more? ", *Research Policy*, Vol. 27 No. 5, pp. 525-540.

Barteisman, E., Scarpetta, S. and Schivardi, F. (2005), "Comparative analysis of firm demographics and survival: Evidence from micro-level sources in OECD countries", *Industrial and Corporate Change*, Vol. 14 No. 3, pp. 365-391.

Baum, J.A.C. and Haveman, H.A. (1997), "Love thy neighbor? Differentiation and agglomeration in the Manhattan hotel industry, 1898-1990", *Administrative Science Quarterly*, Vol. 42 No. 2, pp. 304-338.

Baum, J.A.C. and Mezias, S.J. (1992), "Localized competition and organizational failure in the Manhattan hotel industry, 1898-1990", *Administrative Science Quarterly*, Vol. 37 No. 4, pp. 580-604.

Baum, J.A.C. and Sorenson, O. (2003), "Geography and strategy", Baum J.A.C. and Sorenson O., *Advances in Strategic Management*, Vol. 20. Oxford: Elsevier Science Ltd.

Bayus, B.L., Kang, W. and Agarwal, R. (2007), "Creating growth in new markets: A simultaneous model of firm entry and price", *Journal of Product Innovation Management*, Vol. 24 No. 2, pp. 139-155.

Berchicci, L., King, A. and Tucci, C.L. (2011), "Does the apple always fall close to the tree? The geographical proximity choice of spin-outs", *Strategic Entrepreneurship Journal*, Vol. 5 No. 2, pp. 120-136.

Bigelow, L.S., Carroll, G.R., Seidel, M.D.L. and Tsai, L. (1997), "Legitimation, geographical scale, and organizational density: Regional patterns of foundings of American automobile producers, 1885-1981", *Social Science Research*, Vol. 26 No. 4, pp. 377-398.

Bonaccorsi, A. and Giuri, P. (2000), "When shakeout doesn't occur. The evolution of the turboprop engine industry", *Research Policy*, Vol. 29: 847-870.

Boschma, R. (2015), "Do spinoff dynamics or agglomeration externalities drive industry clustering? A reappraisal of Steven Klepper's work", *Industrial and Corporate Change*, Vol. 24 No. 4, pp. 859-873.
Boschma, R.A. and Wenting, R. (2007), "The spatial evolution of the British automobile industry: Does location matter?", *Industrial and Corporate Change*, Vol. 16 No. 2, pp. 213-238.
Buenstorf, G. (2007), "Evolution on the shoulders of giants: Entrepreneurship and firm survival in the German laser industry", *Review of Industrial Organization*, Vol. 30 No. 3, pp. 179-202.
Buenstorf, G. and Klepper, S. (2009), "Heritage and agglomeration: The Akron tire cluster revisited", *Economic Journal*, Vol. 119 No. 537, pp. 705-733.
Buenstorf, G. and Klepper, S. (2010), "Why does entry cluster geographically? Evidence from the US tire industry", *Journal of Urban Economics*, Vol. 68 No. 2, pp. 103-114.
Canina, L., Enz, C.A. and Harrison, J.S. (2005), "Agglomeration effects and strategic orientations: Evidence from the US lodging industry", *Academy of Management Journal*, Vol. 48 No. 4, pp. 565-581.
Cantner, U., Dressler, K. and Kruger, J.J. (2006), "Firm survival in the German automobile industry", *Empirica*, Vol. 33 No. 1, pp. 49-60.
Carree, M.A. and Thurik, A.R. (2000), "The life cycle of the U.S. tire industry", *Southern Economic Journal*, Vol. 67 No. 2, pp. 254.
Carroll, G.R. (1985), "Concentration and specialization: Dynamics of niche width in populations of organizations", *American Journal of Sociology*, Vol. 90 No. 6, pp. 1262-1283.
Carroll, G.R. and Hannan, M.T. (1995), *Organizations in Industry: Strategy, Structure and Selection*, Oxford University Press, New York, NY.
Carroll, G.R. and Hannan, M.T. (2000), *The Demography of Corporations and Industries*, Princeton University Press, Princeton, NJ.
Chang, S.J. and Park, S. (2005), "Types of firms generating network externalities and MNCs' co-location decisions", *Strategic Management Journal*, Vol. 26 No. 7, pp. 595-615.
Chung, W. and Kalnins, A. (2001), "Agglomeration effects and performance: A test of the Texas lodging industry", *Strategic Management Journal*, Vol. 22 No. 10, pp. 969-988.
Cox, W.E. (1967), "Product life cycles as marketing models", *Journal of Business*, Vol. 40 No. 4, pp. 375-384.
De Figueiredo, R.J.P., Meyer-Doyle, P. and Rawley, E. (2013), "Inherited agglomeration effects in hedge fund spawns", *Strategic Management Journal*, Vol. 34 No. 7, pp. 843-862.
Dean, J. (1976), "Pricing policies for new products", *Harvard Business Review*, Vol. 54 No. 6, pp. 141-153.
DeCarolis, D.M. and Deeds, D.L. (1999), "The impact of stocks and flows of organizational knowledge on firm performance: An empirical investigation of the biotechnology industry", *Strategic Management Journal*, Vol. 20 No. 10, pp. 953-968.
Dinlersoz, E.M. and MacDonald, G. (2009), "The industry life cycle of the size distribution of firms", *Review of Economic Dynamics*, Vol. 12 No. 4, pp. 648-667.
Dumais, G., Ellison, G. and Glaeser, E.L. (2002), "Geographic concentration as a dynamic process", *Review of Economics and Statistics*, Vol. 84 No. 2, pp. 193-204.
Ellison, G. and Glaeser, E.L. (1997), "Geographic concentration in US manufacturing industries: A dartboard approach", *Journal of Political Economy*, Vol. 105 No. 5, pp. 889-927.
Ellison, G. and Glaeser, E.L. (1999), "The geographic concentration of industry: Does natural advantage explain agglomeration?", *American Economic Review*, Vol. 89 No. 2, pp. 311-316.
Fein, A.J. (1998), "Understanding evolutionary processes in non-manufacturing industries: Empirical insights from the shakeout in pharmaceutical wholesaling", *Journal of Evolutionary Economics*, Vol. 8 No. 3, pp. 231.
Folta, T.B., Cooper, A.C. and Baik, Y. (2006), "Geographic cluster size and firm performance", *Journal of Business Venturing*, Vol. 21 No. 2, pp. 217-242.

Funk, J. (2015), "Industry architecture, the product life cycle, and entrepreneurial opportunities: The case of the US broadcasting sector", *Industrial and Corporate Change*, Vol. 24 No. 1, pp. 65-91.
Gilbert, B.A., McDougall, P.P. and Audretsch, D.B. (2008), "Clusters, knowledge spillovers and new venture performance: An empirical examination", *Journal of Business Venturing*, Vol. 23 No. 4, pp. 405-422.
Gordon, I.R. and McCann, P. (2000), "Industrial clusters: Complexes, agglomeration and/or social networks?", *Urban Studies*, Vol. 37 No. 3, pp. 513-532.
Gort, M. and Klepper, S. (1982), "Time paths in the diffusion of product innovations", *Economic Journal*, Vol. 92 No. 367, pp. 630-653.
Hannan, M.T. and Freeman, J. (1977), "Population ecology of organizations", *American Journal of Sociology*, Vol. 82 No. 5, pp. 929-964.
Hannan, M.T. and Freeman, J. (1987), "The ecology of organizational founding: American labor unions, 1836-1985", *American Journal of Sociology*, Vol. 92 No. 4, pp. 910-943.
Hannan, M.T. and Freeman, J. (1988), "The ecology of organizational mortality: American labor unions, 1836-1985", *American Journal of Sociology*, Vol. 94 No. 1, pp. 25-52.
Hill, C. W.L. and Jones, G.R. (1998), *Strategic Management: An Integrated Approach*, Houghton Mifflin Co., Boston, MA.
Hoover, E.M. (1936), "The measurement of industrial localization", *The Review of Economics and Statistics*, Vol. 18 No. 4, pp. 162-171.
Hoover, E.M. (1948), *The Location of Economic Activity*, McGraw-Hill Book Co., New York, NY.
Horvath;, M., Schivardi;, F. and Woywode, M. (2001), "On industry life cycles: Delay, entry, and shakeout in beer brewing", *International Journal of Industrial Organization*, Vol. 19 No. 7, pp. 1023-1052.
Jovanovic, B. and Macdonald, G.M. (1994), "The life cycle of a competitive industry", *Journal of Political Economy*, Vol. 102 No. 2, pp. 322-347.
Kalnins, A. and Chung, W. (2004), "Resource-seeking agglomeration: A study of market entry in the lodging industry", *Strategic Management Journal*, Vol. 25 No. 7, pp. 689-699.
Klepper, S. (1996), "Entry, exit, growth, and innovation over the product life cycle", *American Economic Review*, Vol. 86 No. 3, pp. 562-583.
Klepper, S. (2007), "Disagreements, spinoffs, and the evolution of Detroit as the capital of the U.S. automobile industry", *Management Science*, Vol. 53 No. 4, pp. 616-631.
Klepper, S. (2010), "The origin and growth of industry clusters: The making of Silicon Valley and Detroit", *Journal of Urban Economics*, Vol. 67 No. 1, pp. 15-32.
Klepper, S. and Graddy, E. (1990), "The evolution of new industries and the determinants of market structure", *Rand Journal of Economics*, Vol. 21 No. 1, pp. 27-44.
Klepper, S. and Miller, J.H. (1995), "Entry, exit, and shakeouts in the United States in new manufactured products", *International Journal of Industrial Organization*, Vol. 13 No. 4, pp. 567-591.
Klepper, S. and Simons, K.L. (1997), "Technological extinctions of industrial firms: An inquiry into their nature and causes", *Industrial and Corporate Change*, Vol. 6 No. 2, pp. 379-460.
Klepper, S. and Thompson, P. (2006), "Submarkets and the evolution of market structure", *Rand Journal of Economics*, Vol. 37 No. 4, pp. 861-886.
Kotler, P. and Cunningham, M.H. (2004), *Marketing Management*, Pearson/Prentice Hall, Toronto, ON.
Krafft, J. (2004), "Entry, exit and knowledge: Evidence from a cluster in the info-communications industry", *Research Policy*, Vol. 33 No. 10, pp. 1687-1706.
Krugman, P. (1991a). "Increasing returns and economic geography", *Journal of Political Economy*, Vol. 99 No. 3, pp. 483-499.
Krugman, P. (1991b). *Geography and Trade*, MIT Press, Cambridge, MA.
Kukalis, S. (2010), "Agglomeration economies and firm performance: The case of industry clusters", *Journal of Management*, Vol. 36 No. 2, pp. 453-481.
Levitt, T. (1965), "Exploit the product life cycle", *Harvard Business Review*, Vol. 43 No. 6, pp. 81-94.

Lomi, A. (2000), "Density dependence and spatial duality in organizational founding rates: Danish commercial banks, 1846-1989", *Organization Studies*, Vol. 21 No. 2, pp. 433-461.
Marshall, A. (1920), *Principles of Economics: An Introductory Volume*,Macmillan, London, UK.
Mazzucato, M. (2003), "Risk, variety and volatility: Growth, innovation and stock prices in early industry evolution", *Journal of Evolutionary Economics*, Vol. 13 No. 5, pp. 491-512.
McCann, B.T. and Folta, T.B. (2008), "Location matters: Where we have been and where we might go in agglomeration research", *Journal of Management*, Vol. 34 No. 3, pp. 532-565.
McCann, B.T. and Folta, T.B. (2009), "Demand- and supply-side agglomerations: Distinguishing between fundamentally different manifestations of geographic concentration", *Journal of Management Studies*, Vol. 46 No. 3, pp. 362-392.
McCann, B.T. and Vroom, G. (2010), "Pricing response to entry and agglomeration effects", *Strategic Management Journal*, Vol. 31 No. 3, pp. 284-305.
McGahan, A.M., Argyres, N. and Baum, J.A.C. (2004), "Context, technology and strategy: Forging new perspectives on the industry life cycle. Baum J.A.C. and McGahan A.M., *Business Strategy over the Industry Life cycle, Advances in Strategic Management*, Vol. 21, pp. 1-21, Elsevier Science Ltd., Oxford.
McKendrick, D.G., Jaffee, J., Carroll, G.R. and Khessina, O.M. (2003), "In the bud? Disk array producers as a (possibly) emergent organizational form", *Administrative Science Quarterly*, Vol. 48 No. 1, pp. 60-93.
Menzel, M.P. and Fornahl, D. (2010), "Cluster life cycles: Dimensions and rationales of cluster evolution", *Industrial and Corporate Change*, Vol. 19 No. 1, pp. 205-238.
Mesquita, L.F. and Lazzarini, S.G. (2008), "Horizontal and vertical relationships in developing economies: Implications for SMEs' access to global markets", *Academy of Management Journal*, Vol. 51 No. 2, pp. 359-380.
Murmann, J.P. and Frenken, K. (2006), "Toward a systematic framework for research on dominant designs, technological innovations, and industrial change", *Research Policy*, Vol. 35 No. 7, pp. 925-952.
Murmann, J.P. and Homburg, E. (2001), "Comparing evolutionary dynamics across different national settings: The case of the synthetic dye industry, 1857–1914", *Journal of Evolutionary Economics*, Vol. 11 No. 2, pp. 177-205.
Pe'er, A. and Keil, T. (2013), "Are all startups affected similarly by clusters? Agglomeration, competition, firm heterogeneity, and survival", *Journal of Business Venturing*, Vol. 28 No. 3, pp. 354-372.
Peltoniemi, M. (2011), "Reviewing industry life cycle theory: Avenues for future research", *International Journal of Management Reviews*, Vol. 13 No. 4, pp. 349-375.
Porter, M.E. (1990), *The Competitive Advantage of Nations*, Free Press, New York, NY.
Porter, M.E. (1998), "Clusters and the new economics of competition", *Harvard Business Review*, Vol. 76 No. 6, pp. 77-90.
Potter, A. and Watts, H.D. (2011), "Evolutionary agglomeration theory: Increasing returns, diminishing returns, and the industry life cycle", *Journal of Economic Geography*, Vol. 11 No. 3, pp. 417-455.
Pouder, R. and St. John, C.H. (1996), "Hot spots and blind spots: Geographical clusters of firms and innovation", *Academy of Management Review*, Vol. 21 No. 4, pp. 1192-1225.
Rice, J. and Galvin, P. (2006), "Alliance patterns during industry life cycle emergence: The case of Ericsson and Nokia", *Technovation*, Vol. 26 No. 3, pp. 384-395.
Rosenthal, S.S. and Strange, W.C. (2003), "Geography, industrial organization, and agglomeration", *Review of Economics and Statistics*, Vol. 85 No. 2, pp. 377-393.
Ruef, M. (2004), "For whom the bell tolls: Ecological perspectives on industrial decline and resurgence", *Industrial and Corporate Change*, Vol. 13 No. 1, pp. 61-89.
Saxenian, A. (1994), *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge, MA.
Shaver, J.M. and Flyer, F. (2000), "Agglomeration economies, firm heterogeneity, and foreign direct investment in the United States", *Strategic Management Journal*, Vol. 21 No. 12, pp. 1175-1193.

Sorenson, O. and Audia, P.G. (2000), "The social structure of entrepreneurial activity: Geographic concentration of footwear production in the United States, 1940-1989", *American Journal of Sociology*, Vol. 106 No. 2, pp. 424-461.
Suarez, F.F. (2004), "Battles for technological dominance: An integrative framework", *Research Policy*, Vol. 33 No. 2, pp. 271-286.
Suarez, F.F. and Utterback, J.M. (1995), "Dominant designs and the survival of firms", *Strategic Management Journal*, Vol. 16 No. 6, pp. 415-430.
Swaminathan, A. (1998), "Entry into new market segments in mature industries: Endogenous and exogenous segmentation in the U.S. brewing industry", *Strategic Management Journal*, Vol. 19 No. 4, pp. 389-404.
Tushman, M.L. and Anderson, P. (1986), "Technological discontinuities and organizational environments", *Administrative Science Quarterly*, Vol. 31 No. 3, pp. 439-465.
U.S. Congress Hearing. (1984), *State of the U.S. footwear industry: Hearing before the Subcommittee on International Trade of the Committee on Finance*, United States Senate, Ninety-eighth Congress, second session, May 25, 1984, U.S. G.P.O., Washington, DC.
Utterback, J.M. and Abernathy, W.J. (1975), "Dynamic model of process and product innovation", *Omega International Journal of Management Science*, Vol. 3 No. 6, pp. 639-656.
Van Klink, A. and De Langen, P. (2001), "Cycles in industrial clusters: The case of the shipbuilding industry in the Northern Netherlands", *Tijdschrift Voor Economische En Sociale Geografie*, Vol. 92 No. 4, pp. 449-463.
Vernon, R. (1966), "International investment and international trade in product cycle", *Quarterly Journal of Economics*, Vol. 80 No. 2, pp. 190-207.
Wang, L., Madhok, A. and Li, S. X. (2014), "Agglomeration and clustering over the industry life cycle: Toward a dynamic model of geographic concentration", *Strategic Management Journal*, Vol. 35 No. 7, pp. 995-1012.
Wennberg, K. and Lindqvist, G. (2010), "The effect of clusters on the survival and performance of new firms", *Small Business Economics*, Vol. 34 No. 3, pp. 221-241.
Wezel, F.C. (2005), "Location dependence and industry evolution: Founding rates in the United Kingdom motorcycle industry, 1895-1993", *Organization Studies*, Vol. 26 No. 5, pp. 729-754.
Whittington, K.B., Owen-Smith, J. and Powell, W.W. (2009), "Networks, propinquity, and innovation in knowledge-intensive industries", *Administrative Science Quarterly*, Vol. 54 No. 1, pp. 90-122.

Figure 1. A Dialogue between Economic Agglomeration and Industry Life Cycle

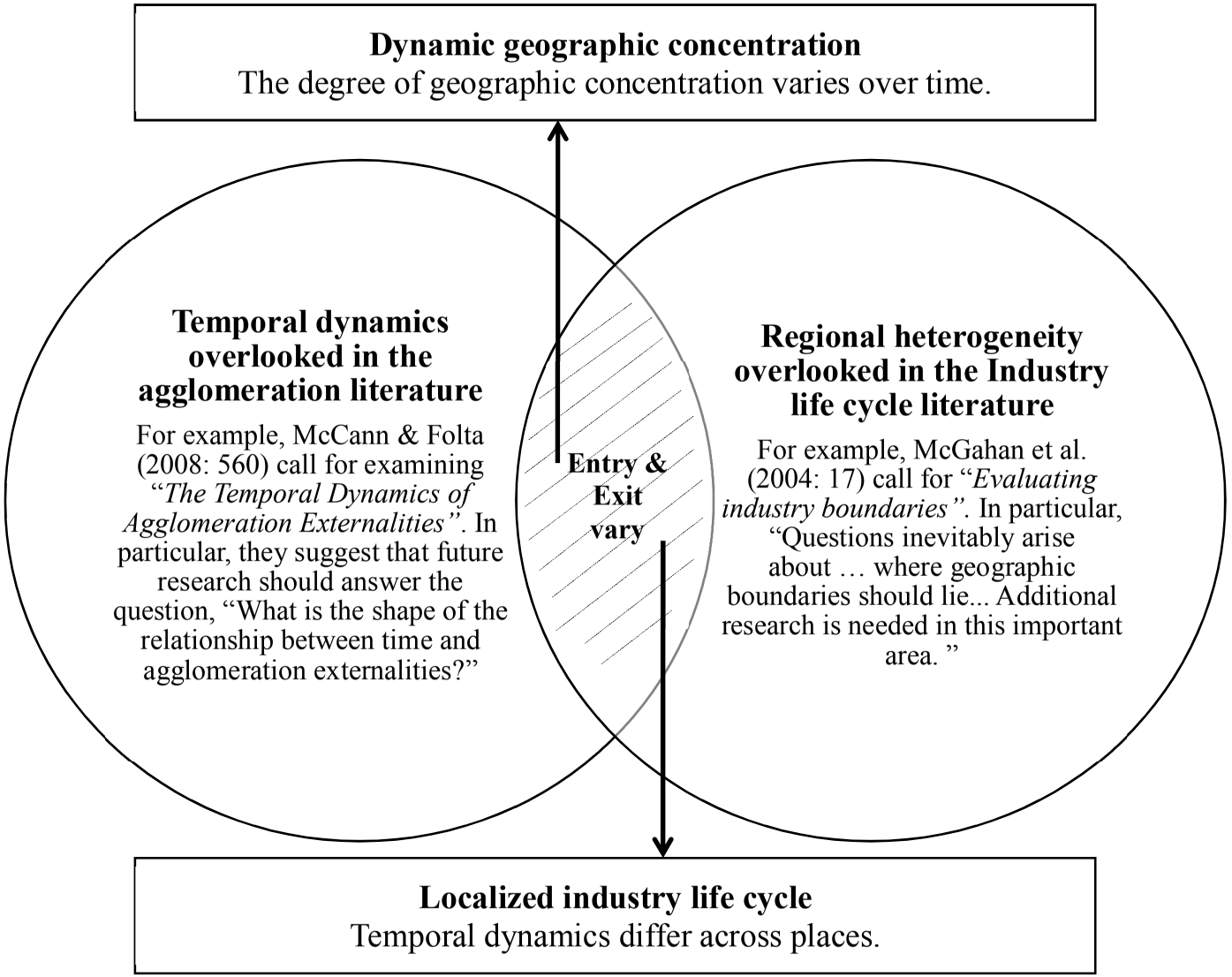


Table 1. The Overlooked Factor of Temporal Dynamics in the Agglomeration Literature

Article	Major findings	Empirical setting	Industry life cycle
Canina *et al.* (2005)	Co-located firms benefit from the differentiation of competitors by avoiding making similar differentiating investments.	US lodging industry; monthly data from 2000	Not controlled, monthly data
Chung and Kalnins (2001)	Agglomeration heightens demand but firms gain heterogeneously.	Texas lodging industry; quarterly data from 1992	Not controlled, quarterly data
DeCarolis and Deeds (1999)	Locating in geographic areas with a high concentration of similar firms is positively related to the market value of a firm's initial public offering (IPO).	Publicly held companies in the biotechnology industry; survey data from 1992	Not controlled, survey data
Rosenthal and Strange (2003)	The positive impact of agglomeration attenuates rapidly along geographic distance.	Six industries; quarterly data from 1996 to 1997	Not controlled, quarterly data
Mesquita and Lazzarini (2008)	Collaboration among small-to-medium-sized enterprises (SMEs) helps them achieve greater collective efficiencies	Furniture making industry in the province of Buenos Aires, Argentina	Not controlled, survey data
Baptista and Swann (1998)	Firms located in clusters that are strong in their own industries are more likely to innovate.	Ten UK industries; 1975–1982	Longitudinal design without specifying industry life cycle
Sorenson and Audia (2000)	Concentrated regions attract more new investments.	US shoe-making industry; annual data from 1940-1989	Longitudinal design without specifying industry life cycle
Wennberg and Lindqvist (2010)	Geographic concentration positively contributes to the performance and survival of new entrepreneurial firms.	Five Swedish industry groups from 1993 to 2002	Longitudinal design without specifying life cycle of each industry group
Klepper (2007)	Geographic concentration of the automobile industry is a result of successful spinoffs spawned in the Detroit area but not because of conventional agglomeration economies.	US automobile industry, 1895-1966	Longitudinal design identifying different stages of the industry development but without examining the effect across the life cycle
Buenstorf and Klepper (2009, 2010)	The Akron, Ohio tire cluster grew through a process of spinoffs from leading firms rather than through agglomeration economies.	US tire industry, 1905-1980	Longitudinal design identifying different stages of the industry growth but without examining the

			effect across the life cycle
Klepper (2010)	The Silicon Valley semiconductor cluster and the Detroit automobile cluster were formed because of organizational reproduction and heredity.	US automobile industry, 1895-1966; the US semiconductor industry, 1949-1987	Longitudinal design identifying different stages of the industry growth but without examining the effect across the life cycle
Shaver and Flyer (2000)	Agglomeration may be characterized by adverse selection, i.e., firms that choose to agglomerate will tend to have poorer technologies.	All foreign direct investment in the US in the manufacturing sector during 1987	Not controlled, one-year data
Chang and Park (2005)	Agglomeration externalities attract new investment, but the relationship is curvilinear.	Korean firms' direct investments in China, 1988-2002	Longitudinal design without specifying life cycle of different industries
Kalnins and Chung (2004)	Low-resource firms will prefer to be located with high-resource firms than with other low-resource firms.	Location decisions of 570 new hotels in Texas between 1992 and 2000	Longitudinal design without specifying industry life cycle
McCann and Vroom (2010)	New entries enhance performance of incumbents when the agglomeration benefits from new entrants outweigh their competitive effects.	Texas hotel industry, 1999-2005	Longitudinal design without specifying industry life cycle, although time dummies are included to control time-varying factors
Gilbert *et al.* (2008)	New ventures located within clusters absorb more knowledge from the local environment, but technological spillovers are not the contributing cause of higher performance observed for these firms.	US information technology industry, 1996-2000	Longitudinal design without specifying industry life cycle
Whittington *et al.* (2009)	Geographic proximity positively contributes to a firm's innovation.	Life science firms in the US, 1988–1999	Longitudinal design without specifying industry life cycle
Wang *et al.* (2014)	Agglomeration attracts more new entries only during the growth stage, and it contributes to firm survival only during the mature stage.	Ontario wine production, 1865-1974	Longitudinal design with specifying industry life cycle
Kukalis (2010)	There are no significant differences between clustered and isolated firms during the early stages of the industry life cycle, but isolated firms outperformed clustered firms during the late stages.	The semiconductor and pharmaceutical industries, 1976-2006	Longitudinal design with specifying industry life cycle
McKendrick *et al.* (2003)	A place in which firms agglomerate generates a regional identity, with a higher entry rate and a lower mortality rate.	Disk array producers in the US, 1986-1998	Longitudinal design without specifying industry life

			cycle. Do the findings hold after the burst of the dot.com bubble?
Alcácer and Chung (2014)	Larger firms are less attracted to the pool of skilled labor and specialized suppliers and more attracted to sources of potential knowledge spillover	Foreign entrants in US manufacturing, 1985-1994	Longitudinal design without specifying industry life cycle; multiple industries
De Figueiredo *et al.* (2013)	Human capital that individuals acquire while working in an industry hub can be transferred to a spinoff, leading to better performance.	US Hedge fund firms, 1978-2006	Longitudinal design without specifying industry life cycle. Do the findings hold over different time periods?
Berchicci *et al.* (2011)	A spin-off with more advanced technologies tends to stay away from industry clusters.	Hard disk drive makers, 1976-1995	Longitudinal design without specifying industry life cycle. Do the findings hold after the burst of the dot.com bubble?
Pe'er and Keil (2013)	The agglomeration effects on the survival of new entries depend on firm resources and capabilities	Canadian manufacturing startups, 1984-1998	Longitudinal design without specifying industry life cycle; multiple industries

Table 2. The Overlooked Factor of Regional Heterogeneity in the Industry Life cycle Literature

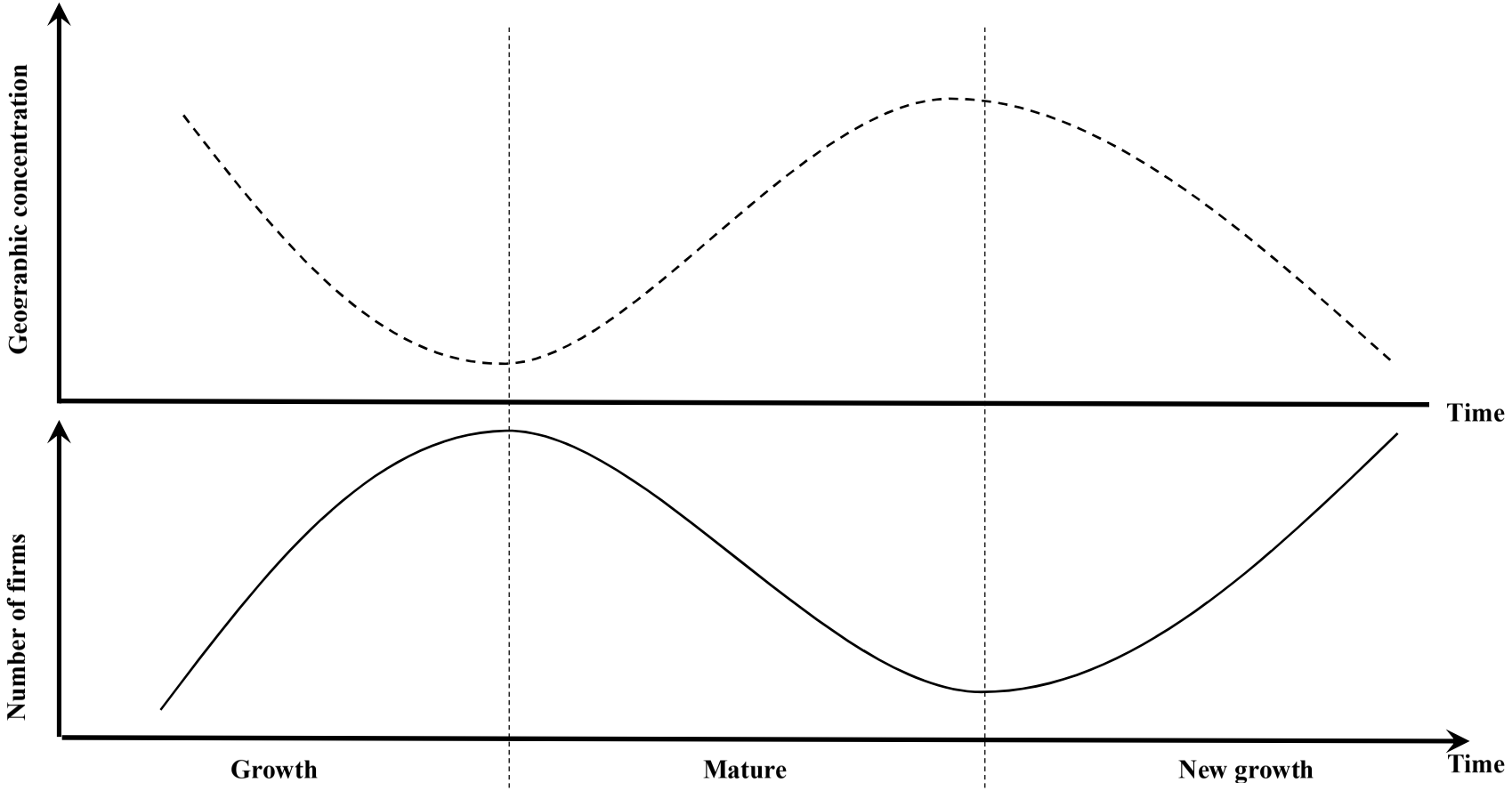
Article	Major findings	Empirical settings	Is the factor of geography considered? Why does geographic concentration matter?
Klepper and Graddy (1990)	A three-stage model of industry life cycle is found: the number of firms grows in stage 1, declines in stage 2, and stabilizes in stage 3.	The development of 46 new products in the US, 1887-1981	Not examined. Could the life cycle pattern differ across regions?
Klepper and Miller (1995)	In the shakeout phase, entry falls sharply but firm exit remains steady.	Sixteen new manufacturing product markets in the US from the introduction of the product to 1980	Not examined. Which location do firms choose to launch a new establishment? Could the exit rate of firm differ across regions?
Klepper (1996)	Firm entry is concentrated at the early stage of industry evolution and the number of firms drops sharply during shakeout.	Conceptual work without empirical data	Not examined. Could the life cycle pattern differ across regions?
Klepper and Simons (1997)	After a buildup in the number of firms, new industries commonly experience a shakeout in which the number of firms declines sharply. Technological innovation contributes to the dominance by some early-entering firms.	Qualitative study of 4 industries: automobile (1895-1966), tire (1905-1981), television (1945-1989) and penicillin (1942-1992)	Not examined. The dimension of geography (e.g., the concentration of the automobile industry in Detroit) is not incorporated. Will industry clusters attract more entry and help more survival?
Klepper and Thompson (2006)	Firms enter to explore opportunities as new submarkets arise and exit when submarkets vanish.	US laser industry, 1965-1994	Not examined. Can each of the submarkets be geographically bounded?
Agarwal *et al.* (2002)	The effects of population density, liability of smallness, liability of newness, and time of entry on firm survival vary across the industry life cycle.	Quantitative study of 33 industries from 1908 to 1991, as the first year that an industry listing appears in the *Thomas Register* as the introduction of the innovation.	Agglomeration not examined. Density defined as the entire population of an industry. Given that density can be different across regions, will the results be different between industry

			clusters and other regions?
Argyres and Bigelow (2007)	Transaction alignment affects survival more during the shakeout stage than during the growth stage of industry life cycle.	US automobile industry, 1917-1933	Not controlled. Given the well-documented effect of geographic proximity on trust relationship, will the results be different across regions?
Cantner *et al.* (2006)	Early entry in the life cycle and prior experience are associated with a lower risk of exit	German automobile industry 1886-1939	Not controlled. Does where the firm was founded matter, even at the same industry life cycle?
Mazzucato (2003)	Firm growth rates are more volatile in the period in which innovation is the most radical.	US automobile industry, 1900-1930, and the US PC industry, 1974-2000	Not examined. Why did industry clusters such as Silicon Valley continuously attract entry while other regions did not?
Horvath *et al.*, (2001)	Shakeout is due to exit by the most recently entered firms; entry rates increase prior to shakeout.	US beer brewing industry, 1880-1890	Not examined. Do clusters exhibit different entry and/or exit patterns than nonclusters?
Swaminathan (1998)	The formation of niche markets explains firm entry in the mature stage	US beer brewing industry, 1933-1995	Not examined. If niche markets are not evenly distributed across regions, some regions will observe more entries.
Bonaccorsi and Giuri (2000)	The shakeout can be prevented if there are no increasing returns in research and development (R&D), manufacturing, or marketing activities	A case history of the turboprop engine industry, 1948-1997	Not examined.
Buenstorf (2007)	There is sustained entry into the industry, and neither a shakeout nor first-mover advantages	German laser industry, 1964-2003	Not examined.

	of early entrants are observed.		
Fein (1998)	The same shakeout pattern found in manufacturing industry (i.e., a sharp drop in the number of firms, a virtual cessation of entry) is found in a service industry.	US pharmaceutical wholesaling industry, 1886-1996	Yes. A wholesaler typically competes in a given geographic region, whereas in manufacturing industries each firm is considered to be in competition with all other firms in the industry.
Krafft (2004)	Non-shakeout evolution is observed at the local level within industry clusters, although the entire industry is characterized by a shakeout process.	The French info-communications industry, 1982-2002	Yes. The qualitative study provides evidence that the shakeout pattern can differ across regions. The qualitative evidence is consistent with our findings.
Murmann and Homburg (2001)	The industry evolution patterns at the global level can differ from patterns at the country level.	The synthetic dye industry at the global level and in the five major producer countries, 1857-1914	Yes. Is evolution heterogeneity across countries found in this study also applicable at the regional level (e.g., industry cluster)?
Barteisman *et al.*, (2005)	Approximately 20-40% of new entries exit within 2 years, with variance across countries.	Forty industry sectors in 10 OECD countries, 1989-1994	Yes. The exit pattern of new entries varies across countries.
Jovanovic and Macdonald (1994)	As an industry evolves, the number of firms first rises and then falls during the shakeout.	The US automobile tire industry, 1906-1973	Not examined. Could the overall pattern differ across regions?
Agarwal and Gort (2002)	Hazard rate is higher in later phases of industry cycle due to market maturity and increased competition.	Thirty-three product markets in the US from the introduction of the new product to 1991.	Not examined. Could hazard rate differ across regions even in the same phase of industry life cycle?
Gort and Klepper (1982)	Industries generally pass through a stage in which the number of firms declines significantly	The development of 46 new products in the US, 1887-1960	Not examined. Could the life cycle pattern differ across regions?
Suarez and Utterback (1995)	Firms entering an industry prior to the establishment of dominant design have a higher probability of survival.	The US automobile, typewriter, transistor, electronic calculator, television, and picture tube industries, 1874-1988.	Not examined. Could there be any geographic boundary of the diffusion of dominant design?

Agarwal (1997)	Firm survival rate drops as competition intensifies along a product life cycle.	Thirty-three US product markets from the first introduction of the product to 1991.	Not examined. Could the effect of life cycle on survival rate differ across regions?
Agarwal (2001)	The time interval between the introduction of a new product and the entry of imitators shrinks after World War II.	Forty-six US product markets, 1887-1986	Not examined. Where would imitators most likely locate their businesses and enter into the market?
Audretsch (1995)	Most new entrants that are unsuccessful ultimately exit within a few years after entry.	Four hundred and two four-digit SIC industries in the US	Not examined. Could new firms in industry clusters be more competitive?
Bayus *et al.*, (2007)	The attractiveness of a new industry eventually diminishes (i.e., prices drop) as more firms enter.	Thirty new markets in the US, 1849-1985	Not examined. As profit margin becomes thinner, which firm has a better chance of survival? Does location matter?
Carree and Thurik (2000)	The shakeout of the US tire industry is due to price competition resulting from many new entrants, not dominant design.	US tire industry, 1913-1973	Not examined. Would firms in certain locations have a better chance of survival?
Dinlersoz and MacDonald (2009)	The distribution of firm size changes across industry life cycle.	Three hundred and twenty-two four-digit SIC US manufacturing industries, 1963-1997	Not examined. Would size distribution differ across regions as well?
Funk (2015)	The evolution of entrepreneurial opportunities depends on the number of submarkets.	The broadcasting sector, 1920s to the 1990s	Not examined. Could submarkets be geographically bounded?

Figure 2. Dynamic Geographic Concentration and Localized Industry Life Cycle



Localized Industry Life Cycle

P1a: A region with more startups at time $_t$ will be more likely to have a higher firm entry rate at time $_{t+1}$.

P2a: The established center has a lower firm exit rate than does the periphery.

P3a: The traditional center receives fewer new entries than do the other emerging regions.

Dynamic Geographic concentration

P1b: The degree of geographic concentration of an industry drops.

P2b: The degree of geographic concentration of an industry rises.

P3b: The degree of geographic concentration of an industry drops.