Community Ecology of Organizational Populations:

The Evolution of Producers and Distributors in the U.S. Feature Film Industry, 1912-1970

by

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A dissertation submitted in partial satisfaction of the requirements

for the degree of Doctor of Philosophy

in

Business Administration and Management

in the

Graduate Division

of

Università Bocconi, Milano

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Spring 2004

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Abstract

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This dissertation applies organizational ecology's theory of density dependence evolution to the study of two organizational populations, feature film producers and distributors in the United States. This study initially evaluates the original formulation of the theory and its main extensions, finding that the decline and resurgence stages in industry evolution that are observed in the populations studied here are difficult to reconcile in a systematic way with predictions based on density dependence. The study also extends existing theory by examining whether the interaction between populations helps explain the complex trajectories of industry evolution by affecting their vital rates. This community ecology framework focuses on the role that vertical interdependence between buyers and suppliers plays in the evolution of the two populations. I theorize that not only populations may be influenced by the legitimating and competitive processes shaping the evolution of other populations they interact with, but they also develop different types of responses to community interactions. These different responses in turn affect the evolution of populations.

I examine these hypotheses of community-level processes on the entry and exit rates of firms producing and distributing in the U.S. motion picture industry from 1912 to1970. The study finds that the interaction between the two populations generates effects that are distinct from intra-population density dependence and have an impact on their vital rates. The empirical analyses also find that the interaction affects the two populations asymmetrically.

By examining the interaction of different organizational populations through the lenses of community ecology, this dissertation aims at making a contribution to research in strategic management, and organizational theory, and industry evolution.

Dedication

To the memory of Claudio Dematté

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Acknowledgments

I would like to begin with a personal note. I became interested in studying the motion picture industry during the last year of my undergraduate studies, when I decided to work on my final thesis on a historical analysis of industry structure and evolution of film production, distribution, and exhibition in the United States. That experience gave me the opportunity to develop knowledge about the economic and institutional environment surrounding the industry, and also of the intricate, fascinating relationships that exist among its main sectors. At that time Fabrizio Perretti was my supervisor on the project, and Claudio Dematté my referee. Since then Fabrizio and I have been doing a lot of work together on motion pictures and other entertainment industries, and Claudio has always contributed his ideas, feedback and support to our efforts. I like to reserve my first thought to them whom I am indebted for constant guidance and support over the years; now that Claudio has left us this thought is followed by a sad whisper. To his memory I dedicate this study. I wish he could be proud of it.

I want to acknowledge my dissertation committee, Giorgio Brunetti, Alessandro Lomi, Edoardo Mollona, and Olav Sorenson. At various stages and to different extent, they all helped me to focus more clearly my research questions, provided diverse suggestions and invaluable guidance. Giorgio Brunetti sponsored this project at Bocconi's ISEA Institute of Strategic Management and I am grateful for the encouragement he provided. Edoardo is my tutor on this project and I thank him for his constant advice, for his patience, support, and the recommendation to keep things simple. I am not sure I was always able to succeed. Alessandro has provided the wisest counsel, constructive advice and had a significant influence on the project in its crucial moments. I thank him also for his personal encouragement and very direct thoughts. Olav has been providing painstaking advice, rigorous guidance and constant support. I am very grateful for all the help, input and time he put into my work. I finally thank both Alessandro and Olav for introducing me to the wider community of researchers in organizational ecology.

Some colleagues at Bocconi University deserve special mention. The collaborative research and closest friendship with Fabrizio Perretti have been and are a crucial resource in my activity. In a word, he simply merits all my gratitude. Stefano Basaglia and Daniela Cristofoli are the classmates I want to acknowledge for their support, the time spent in discussing each others' research and the encouragement. I want to thank the ISEA Institute and the SDA Bocconi's Strategic Management Department who provided financial support for my doctoral scholarship. I want to thank Fondazione IRI for the financial support that allowed the completion of this project, Claudio Dematté, Anna Grandori and Olav Sorenson for presenting my application to the Fondazione IRI Research Scholarship Program, and the Policy Department at the Anderson Graduate School of Management at UCLA for inviting me as visiting scholar. I thank the Fondazione IRI's academic tutors for my scholarship, Alfonso Gambardella and Gianni Lorenzoni. Over the past two years I benefited from helpful comments, suggestions and criticisms of many scholars. For that I would like to acknowledge Howard Aldrich, Francesco Billari, Jonathan Jaffee, Steven Klepper, Luigi Orsenigo, Elaine Romanelli, Martin Ruef, Luca Solari, Arjen van Witteloostuijn, the participants at the 2003 Doctoral Consortium of the Academy of Management's OMT Division and the Tenth Organization Science Winter Conference.

This dissertation is largely based on an archival work that I have been conducting over the years at different locations. I would like to praise the work of various people and institutions that made it possible: the staff and librarians of the Baker Library at Harvard Business School, the UCLA Arts Library and Rosenfeld Library, Patricia Hanson King at the American Film Institute.

I want to complete the list of acknowledgment with the inclusion of my family. They followed my studies all these long years with patience and backing every decision I have made. I want to thank my parents for all the sacrifices they made to allow me pursuing my interests, as well as their unconditional love and support. This dissertation or any research of mine would not exist had they not make it possible. Thank you from the deepest.

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1.1 INTRODUCTION AND RESEARCH QUESTIONS

Industry evolution represents one major area of research in organization theory and strategic management. The long term structural dynamics of this evolution, however, remains problematic both theoretically and empirically (Carroll 1997, Jovanovic and McDonald 1994, Klepper 1996, Malerba and Orsenigo 1996, McGahan 2000). Research in organizational ecology has developed a general framework of density-dependent evolution that has found remarkably consistent empirical support in diverse contexts (Carroll and Hannan 2000). The theory is based on two complementary processes of legitimation and competition that drive population dynamics in connection with the utilization of resources in the niche. When resources are limited, the vital rates of a population are non-monotonically related to the number of organizations operating in the population, i.e. population density. The empirical trajectory observed in many organizational populations is such that it grows slowly initially, and then increases rapidly to a peak. Once the peak is reached, there is usually a sharp decline and occasionally stabilization (Carroll and Hannan 1989). Mature populations, however, show more complicated trajectories (Carroll 1997, Ruef 2004). In some cases, decline is persistent and does not lead to stabilization; in other cases, decline is followed by fluctuations, or by reviving density. Finally, evolutionary trajectories may oscillate in cycles.

The basic theory of density-dependence argues that forces of social legitimation and competition drive changes in vital rates of populations over time (Hannan 1986). Social legitimation is the process by which social actors perceive and support a certain organizational form as a natural, taken-for-granted way (Meyer and Rowan 1977) to perform some kind of action.[1] Legitimation indicates the degree of social and institutional acceptance of a certain organizational form. Increasing legitimation implies more resources available in the organizational niche, that is the environmental space in which the population's growth in non-negative. The theory posits that the number of organizations operating in a population is a proxy measure for legitimation. Increasing initial density enhances a form's legitimation and the population that embodies the structural characteristics of such form. The capacity to mobilize resources and members by organizations increase when those who control resources take a form as the default solution to perform certain activities, so the founding rate is proportional to the level of constitutive legitimation (Carroll and Hannan 2000). The great returns to legitimation for new organizations decline as density continues to increase. Assuming fixed resources, the environment can support only a limited number of organizations doing the same thing. The presence of one or more actors generates positive returns on the life chances of an organization. However, because all organizations in a niche depend on common, finite, resources, density also indicates the process of competition existing among organizations – the more organizations, the less resources are available. Additional entry lowers life chances. Diffuse competition increases at increasing rates with density - as the number of organizations increases linearly, the possible competitive relations increase geometrically. Therefore, growing density in organizational populations triggers

[1] Hannan and Carroll (1992: 36-7) argue that: "...a taken for granted social form can be more readily visualized by potential organizers than one with dubious or unknown standing. Variations in the strength of institutional rules endorsing rational organization as the appropriate vehicle for attaining collective goals affect the case of founding organizations. The capacity to mobilize potential members and resources increases greatly when those who control resources take the organizational form for granted. Reducing the need for such justifications lowers the cost of organizing...Legitimation cases the problem of maintaining flows of resources from the environment and enhances the ability of organizations to fend off challenges."

opposing processes of legitimation and competition resulting in an inverted U-shaped relationship between the number of organizations and organizational founding rates and in a U-shaped relationship with disbanding rates (Hannan 1986, Hannan and Carroll 1992, Carroll and Hannan 2000).

The main extensions of the density dependence model are evaluated in this study. Mass dependence (Barnett and Amburgey 1990, Barnett 1997, Barron 1999) integrates density dependence by proposing that organizations do not exercise equal competitive effects. A general hypothesis of this theory is that increasing aggregate size of the population implies more intense competition resulting in a negative relationship with founding rates. A refined version of this argument posits that the effects of size can be less potent and provide a better explanation when they are combined with the effects of age - larger and older organizations do not generate the same competition as small and young organizations.

The second extension is temporal variation. Hannan (1997) introduced temporal heterogeneity in the context of the density dependence model to account for population decline and late resurgence in advanced phases of industry evolution. Hannan argues that legitimation and competition are not timeless functions of population density; instead, as industries mature, these two processes are less dependent on density and more on the position that the population develops within a network of external relationships, or alternatively the microstructure the develops within the population due to partitioning processes (Carroll 1985, Carroll and Swaminathan 2000).

The third extension is community ecology (Ruef 2000, 2004). The approach based on community ecology argues that the system of relationships involving suppliers, buyers, consumers, intermediaries, and institutions affects directly the evolution of organizational populations. A community perspective extends the key insight of ecology according to which other organizations in a population form the critical element of the environment faced by organizations. Organizations interact regularly with their environment outside the boundaries of the population, and in most cases that same environment is made up of other organizational populations. How do the interactions between different populations matter? Although community ecology represented a foundational element within the formulation of the ecological theory to explain organizational diversity and evolution (Hannan and Freeman 1977: 942-44), researchers have less frequently addressed this issue in analyzing vital rates of populations (Rao 2002). The present study adds to the growing literature of community ecology by focusing on a specific set of relationships existing between populations, namely vertical interdependence between buyers and suppliers, and develops hypotheses about the effects of vertical interdependence on entry and exit rates of interacting populations.

The main research question of this study is very simple: how vertical interdependence between populations affects their vital rates? We rely on the general model of density dependence to investigate this question. Chapter 2 applies organizational ecology's theory of density dependence evolution by evaluating the original formulation of the theory and its main extensions in the empirical context of two populations, feature film producers and distributors in the United States. We find that the predictions based on intra-population density dependence have limited explanatory power in explaining decline and resurgence stages in industry evolution that have been observed in the populations studied here.

Chapter 3 makes an attempt to extend existing theory by examining whether the interaction between populations affects their entry rates, and eventually helps explain the complex trajectories of industry evolution. This community ecology framework focuses on the role that vertical interdependence between buyers and suppliers plays in the evolution of the two populations. We theorize that not only populations may be influenced by the legitimating and competitive processes shaping the evolution of other populations they interact with, but they also develop different types of responses to community interactions. We combine organization theory addressing social structure and organizational ecology with strategic management theory to develop some general hypotheses on how density may affect both interacting populations. We incorporate ecological theory on predatory-prey interactions to generate additional hypotheses how different responses may affect entry rates. Theories on predatory-prey systems posit explicitly that the interaction between the two populations is responsible for complex evolutionary trajectories including cycles and oscillations. Chapter 4 replicates the research strategy of Chapter 3 and investigates the relationships between vertical interdependence and exit rates.

1.2 THE RESEARCH SETTING

The evolution of the motion picture industry in the United States

The economic development of the American motion picture industry can be defined by three phases. In the first phase, from the emergence until 1915, production and distribution of motion pictures were integrated with the manufacturing and distribution of equipment, and then organized into specialized activities in a separate business. In the second phase, from 1915 to the late 1940s, motion picture production, distribution and exhibition were industrialized by a group of five vertically integrated firms within an oligopolistic system. In the third phase, which continues to the present, the industry is organized around a semi-integrated system. Production is fragmented and managed trough specialized firms, while distribution continues to be controlled by the former integrated companies.

From the emergence to the Trust (1895-1915)

In the United States, the market for motion picture projectors was built upon the Kinetoscope business, of which it represented a natural extension. The Kinetoscope was developed in 1894 by T. Edison as a visual parallel to the phonograph, and consisted of a peephole-viewing machine for individual entertainment. The projections of pictures presented significant advantages, both for the viewers and the exhibitors. Viewers would enjoy larger and better image reproduction, while exhibitors could reduce their costs of operation by servicing more spectators simultaneously with one machine. The possibility for a public exploitation of motion picture projection was developed by Raff & Gammon, Edison's sales agents for the Kinetoscope business, which included distribution of equipment and films. In 1896 Raff & Gammon signed a contract with Armat for the right to manufacture and distribute his projector, initially called Phantoscope and then renamed Vitascope, which was patented on 28 August 1895. At the same time, Raff & Gammon reached agreement with Edison Manufacturing Company to manufacture the projecting machines, and to supply motion pictures for exhibition (Musser 1991: 44.47).

The initial development of the industry therefore came to a close resemblance of the monopolistic concentration that regulated the Kinetoscope business. The Edison Manufacturing Company was responsible for the production of both the "hardware" and "software". In fact, motion picture production was not considered a business separated from that of recording and projecting machines. The "hardware" consisted of two components: the Kinetograph camera, which was the same one used for the Kinetoscope, and maintained compatibility with motion pictures previously sold to the Kinetoscope exhibitors, and the projector, which adopted the same 35 mm film standard used by the Kinetoscope. While Edison owned a patent for the Kinetograph, he relied on Armat's patent to manufacture the Vitascope.

Motion pictures were produced in Edison's studio facilities in West Orange, known as Black Maria. They consisted of short subjects representing real life scenes or comedies, without narrative form. Production was characterized by a process of very limited division of labor. The conception and the implementation of the product were not separated, and could well be managed by an individual worker, the cameraman-director (Bordwell et al. 1985: 113-120). The production of raw film was initially undertaken by the same Edison Company, but in 1896 insufficient quality results shifted the manufacturing of the 35 mm film to Eastman Kodak, leader in the photography industry who became also the largest supplier of materials for motion pictures.

The commercialization of the Vitascope, which premiered on 23 April 1896 in New York, was managed by Raff & Gammon through a series of "states rights owners", who purchased the exclusive right to sell the apparatuses within a territorial market, and obtained the option to further sub-license every state. Prices for motion pictures varied from $10 to $25, depending on the subject, and machines were rented to right owners in return for monthly fees. State right businesses included former partners of Raff & Gammon in the phonograph and Kinetoscope business, several theatrical companies, and also new entrepreneurs with interests in electricity. Screen exhibition of the Vitascope took place in already established entertainment venues, integrating vaudeville and storefront theaters, but also itinerant amusement shows.

After the introduction of the Vitascope, the market for equipment and motion pictures grew rapidly, and despite the strict control exerted through patents and exclusive distribution, it allowed the emergence of competitors either copying Edison's technologies, or providing alternative standards. Between 1896 and 1897 the first "clones" of the Vitascope were introduced in the market, primarily in New York.[2] Even though they did not replace the existing standard, they weakened the economic organization of the license system managed by Raff & Gammon. The manufacturers of non-Edison projectors were able to offer equivalent technology at lower prices and

[2] Among them was the Vidiscope, produced by competitors of Edison in the phonograph business. Latham's redesigned eidoloscope proved to be a weak competitor, since critical organizational difficulties were affecting its producing company that ceased film production in mid-1896. The Eidoloscope Company suffered the departure of the Lathams and was finally sold to Raff & Gammon in the fall of the same year (Musser 1990: 135).

without territorial restrictions. This not only harmed the interests of states rights owners, but the need of supplying the non-licensed exhibitors also favored the duplication of Edison's motion pictures and the production of clones of the Edison's camera, which created an independent market for motion pictures.

The diffusion of the Vitascope, though successful, was associated with major commercial and technical problems: a substantial shortage of motion pictures' supply; a limited availability of local training required to operate the machine; the need for electricity for the functioning of the projector. Such drawbacks enabled the emergence of two competing standards on the American market: the Lumières' Cinematographe and Biograph's projector.[3] Both solutions, however, aimed at supplying largely the high-end vaudeville exhibition segment, and were initially considered partial direct competitors of the Vitascope.

The Cinematographe was presented to the public in the United States on 29 June 1896. The Cinematographe would not need electricity to work, and could be used either as a camera or as projector. The Lumières' organization also provided a complete exhibition service that included a skilled operator for the vaudeville houses, to which the program's supply was intended. The Lumières were using the same film format as Edison's, but a different film perforation. The Lumière brothers, originally manufacturers of photographic equipment, established an agency in New York in November 1896, offering territorial distribution rights for the lease of their machines. Nonetheless, the moderate possibilities associated with the self-financed initiatives of the French inventors, and their limited product supply, unable to satisfy the increasing demand for

[3] The company's name was American Mutoscope Company, and in 1899 was renamed American Mutoscope & Biograph Company, more commonly Biograph.

films and shows from exhibitors and the public, determined a rather quick exit of the Cinematographe from the American market.

Biograph's projector adopted a standard based on a 70 mm, and like the Lumières offered an integrated distribution service. Yet, unlike the French enterprise, a strong financial backing from the New York Security and Trust Company enabled the American Mutoscope and Biograph Company to start a regular film production activity in a large New York studio. Biograph's differentiation effort was based not only on the technical superiority of the projector, but also on the quality of its motion pictures, which were more focused on local content. The first motion pictures produced by Biograph consisted of panoramic views, as well as actualities and studio subjects. Two units, the first in New York, and the second in Boston but itinerant, were responsible for the production operations. This organization gave Biograph an important advantage over the competition and the initial possibility to offer a profitable, complementary option to Edison's solution.[4] Between 1896 and 1897, the company established its own national exhibition network, and began exhibition overseas. With the production of over 200 subjects in 1897, Biograph became the largest producer in the United States.

The emergence of imitators and alternative systems of production and exhibition responded to an increasing demand for products and equipment in the industry. The proliferation of new entrants in the market was in fact a two-sided process: on the one side, of several manufacturers of equipment, which increased competition for Edison's

[4] Despite its increasing success, the integrated approach to exhibition service limited the possibility that Biograph be completely substituted for Edison's technology. The integrated approach perceived motion pictures as an autonomous innovation of vaudeville's modular system of production. By keeping technology strictly proprietary, the complete motion picture service limited the possibilities for the development of motion pictures as a medium independent of vaudeville and the theater. In addition to that, the franchised distribution, however, proved to be a better solution than the integrated service of Biograph to penetrate into a decentralized and growing market.

technology by imitating the strategy of his company; on the other side, of independent producers of motion pictures, not affiliated with hardware producers and therefore not under their sphere of influence. The dominant position of Edison was weakened in both hardware and software components. The manufacturing of non-proprietary projectors and the unauthorized duplication of motion pictures prevented Edison from obtaining a direct protection for his business. In addition, the commercial exploitation of Edison's motion pictures, which were generating more profits than equipment's sales, was associated with the territorial restrictions under the states rights distribution scheme, preventing the company to supply the emerging market of non-licensed exhibitors.[5]

In late 1896 Edison broke his agreement with Raff & Gammon under the Vitascope Company, started the production of his own projector machine that would be patented in 1897, and began copyrighting his own and his licensees' films. Edison was thus able to start an intensive legal battle against many rivals, including Biograph, claiming patent infringement.[6] Such measures helped Edison to curb the expansion of the "clones", and to increase his output, that was managed partly by his company, and partly by a group of licensees. By the end of May 1897, Edison's output totaled 160 motion pictures. Within a year, the number reached 200, although Biograph remained the most important producer with 350 motion pictures.

Edison's attempt to drive competitors out of the market caused a delay in the development of the "clones", but was not able to stop it. By the turn of the century, strong demand for motion pictures induced a new flood of competitors in the 35 mm market,

[5] In the 1896-1897 season, respectively, $ 24,000 and $ 5,000 (Musser 1991).
[6] The projector was sold to the market for $ 100, and distributed through the Maguire & Baucus sales company.

threatening again the operation of his company (Huettig 1944: 11-12). The Manufacturing Company distributed only 90 motion pictures in 1899, and Edison seriously considered the possibility of divesting his interests in the business.[7] Growing demand not only induced entry of new competitors, but also implied a substantial obsolescence of subjects. Motion pictures lost their appeal on the public very quickly. Around 1901 Biograph was no longer able to charge higher fees on its special programs, and the business incurred losses. The impossibility to balance lower fees with constant costs induced Biograph to reduce the output (volume decreased from 500 in 1899 to 437 in 1900 and 412 in 1901) and to seek new markets. This meant the abandonment of its exclusive 70 mm format and the release of 35 mm reductions of its existing catalogue.

Steady demand also led to a progressive specialization of activities in the main stages of production, distribution and exhibition. When the industry witnessed the emergence of rental exchanges and of regular exhibitors, motion pictures were already a permanent entertainment attraction in theaters. Around 1903, in order to allow more widespread exhibition, theater owners and managers began to regularly lease films instead of selling them. Motion pictures distribution transferred by the manufacturers of hardware components to specialized companies called exchanges. At the same time, exhibitors progressively stopped combining motion pictures to other entertainment performances, and began delegating to producers creative competence for assembling of the product, extending further the process of specialization in the industry (Briggs 1960: 16-17). The organization of film exchanges, and the expanding market for motion pictures favored the emergence of exclusive theaters for film shows, and cinema as a mass consumption

[7] In April 1900 in fact Biograph purchased for 2,500 dollars an option to buy his company's business.

medium (Donahue 1987: 8). By 1908, approximately 8,000 "nickelodeon" theaters showed regular programs of 3 one-reel films changed daily.[8]

The creation of a permanent and autonomous retail outlet for motion pictures, generating higher output turnover and obsolescence, put significant pressure on producers in terms of production capacity: Biograph and Edison failed to meet the new demand and to enhance their processes timely, while companies like Vitagraph, Selig and Lubin emerged along with them as the principal producers.[9] In particular, Vitagraph made investments in a large studio in New York that increased the scale and the quality of output, and became the largest firm in 1905. The demand opened opportunities for foreign producers in the American market. The French company Pathé Frères, capable of producing twelve pictures every week through its multiple production units, succeeded in gaining as much as a 30 per cent share of the American market at the end of 1907. In addition to providing new reusable output for exhibition, foreign films often looked innovative and very different from those made by domestic companies, and this contributed significantly to their success. Filmmaking technique advanced toward the adoption of story films and narrative structures, which made their organization more elaborate. The transition to story films allowed a certain stabilization and regularization of production activities, creating also an incentive for differentiation on creative terms.[10]

[8] The first cities to witness the proliferation of nickelodeons in 1905 were Pittsburgh and Chicago, and not New York, the legitimate capital of the industry. This was due to the significance acquired by exchanges in Chicago and to the limited openness of traditional theater market to motion pictures (Musser, 1990: 418.

[9] At the same time, turnover in theaters could not be too high, since a too rapid change would affect the influence of word of mouth, which represents a sort of free adverting for distributors. This point is underlined Lewis (1939:234).

[10] Balio (1985: 21) argues that: "Stories could be made to conform to the limitations of the studio and the surrounding locale. Production could be scheduled to utilize personnel efficiently and to operate at capacity".

Motion pictures were by 1907 a business autonomous from that of hardware components. The role of equipment manufacturers as regulators of the market was redefined. Edison made a last attempt to recreate the monopolistic concentration that originally characterized the industry in its early development. In 1908 a trust under the name of Motion Picture Patents Company (MPPC) was formed, with participation of the owners of the sixteen key patents, but also of the largest film producers and importers: Edison Manufacturing Company, Biograph, Armat, Essanay, Kalem, Kleine, Lubin, Pathé Frères, Selig, Vitagraph, and Eastman-Kodak. Under the new organization, which was intended to reproduce in different form the initial system based on patents and states rights distribution, each member was allowed to release from 4 to 6 one reelers every week, and only to licensed theaters through licensed exchanges. Prices were fixed to 10 cents per foot supplied, and within such constraint, producers would compete on product quality. Theaters were classified according to their locations, and the payment of weekly royalties was imposed on every licensed exhibitor. In the new system, the role played by Eastman-Kodak was essential, because it represented the major raw film supplier, and its affiliation with the trust producers prevented non-members from access to its supply; the company also managed the collecting of commercial royalties to be paid to members.

The main objective of the patent-pooling organization was the controlled rationalization of film and equipment supply in the industry, but also the exclusion of non-licensed companies from the market through the creation of barriers to entry associated with patents. From production, the Trust in 1910 organized its activities also in the distribution sector with a separate entity, the General Film Company that came to control 57 of the 58 exchanges existing in the country. The consolidation process of the trust, however, lasted only until February 1911, when Eastman-Kodak modified the agreement with the MPPC to allow the supply of film also to unlicensed manufacturers (Pathe 1970). Unable to isolate independent producers from access to raw materials, the rigid organizational and operational solution displayed by the MPPC could no more regulate the volume and flow of output produced and distributed in the industry.

While the control of the trust over the business was weakening, independent producers like Famous Players and Feature Play Company introduced an innovation that differentiated their products and challenged the distribution system organized by the MPPC: the feature film, long, elaborate and expensive multi-reelers. Given the considerable economic risk of the new production, the first feature films were imported from Europe around 1911. Great successes like "Queen Elizabeth", however, convinced of their profitability and were systematically adopted in the industry. Feature films replaced short films that represented the exclusive output of Edison and his affiliates, and introduced a structural reorganization of the business. Not only were feature films complex products compared to standardized one-reelers, but also they required individually designed promotional campaigns and longer runs in theaters (Lewis 1939, Staiger 1983).

The MPPC companies were unable to adapt. They had organized their film operations as an offer integrated, and not separated, of motion pictures and equipment. Motion pictures were considered to be mass-produced and distributed at the lowest cost in standard format. In addition, producers like Edison or Biograph controlled only semi-specialized competence and expertise in motion picture production and distribution: they were able to coordinate the production and commercialization of films as long as the process remained relatively simple. In 1915 a verdict from a New York district court declared illegal the practices implemented by MPPC, and identified the trust as a combination aimed at monopolizing film production and distribution, pursuing the limitation of competition in the industry (Staiger 1983). The licensing agreements were nullified and the Trust itself was dissolved. The decision, however, confirmed through legal means a radical economic change that was already taking place in the market.

The transition to the studio system (1915-1926)

With the innovation of the feature film, motion pictures were transformed into an independent and exclusive spectacle form. On the one side, such a change reinforced the dependence of the exhibitors on the creative competence developed by producers; on the other side, it favored the transfer of management models from the stage theatre, which motion picture production closely came to resemble. Other than favoring new entrants in the industry, the introduction of the feature film was a factor that changed radically the economic structure of the business. To produce, distribute and exhibit feature films, in fact, new strategies and resources became necessary.

The new type of product, requiring higher investments in development and making, made necessary a more rational organization and coordination: the feature film was very similar to a stage production, and adopted the mechanisms of division of labor employed in that business.[11] The increased complexity determined indeed a need for higher level of specialization that brought to the institution of the producer as the economic coordinator

[11] Clearly, a fundamental difference from stage theater, motion pictures could be reproduced mechanically at a minimal marginal cost.

of diverse technical and artistic inputs. Between the 1910s and the 1920s, producers replaced directors as managers of the production activity in the studios (Staiger 1979).

As demand for motion pictures continued to grow, producers and distributors were required to supply a regular output of product throughout the year. This factor, but also the longer shooting period and the higher costs associated with production of feature films are probably the major reasons for the relocation of productive operations from New York to Hollywood, whose warm climate and relative lack of seasons represented favorable environmental conditions to organize film production (Huettig 1944). Legal suits by the MPPC may have stimulated many independent producers to migrate to Hollywood, but Trust members were themselves attracted by the climate and diversity of outdoor settings available in southern California (Gomery 1986). By 1922, around 85 per cent of total production projects were filmed in Hollywood.

In the distribution sector, the feature film modified price and promotion policies, and generally the marketing strategy. Since in the early development of the industry motion pictures were considered as undifferentiated or semi-differentiated goods, prices were determined according to their subject matter or simply footage, rather than to their quality. Following the introduction of more elaborate and differentiable products, distributors managed to transfer the difference in value of the film on its price. Such difference in value was linked to production costs.

A systematic reorganization process took place in the second half of the 1910s, and specific mechanisms to manage the product, notably the continuity script, were introduced into production studios (Bordwell et al. 1985: 128-141). The necessity to make perceivable to the public the increase in actual value of the product urged distributors to adopt some signaling elements, primarily actors and directors, in a way that was similar to what occurred in the theater business. The star system was introduced (Bowser 1990: 102-119). The feature film generated also a series of transformations in the exhibition sector, since it made possible a more definite differentiation in specialized theaters, sustaining different price policies and program run release for each film.

Considering the increased costs and risks associated with the production and marketing of feature films, coordination between the process of production and distribution was essential. Since 1918 several firms adopted a vertically integrated structure, and film production, distribution and exhibition were progressively internalized within hierarchical organizations. In 1919 producer-importers Famous Players and Feature Plays Company combined with distributor Paramount Pictures to organize Paramount Pictures Corporation, the first significant example of firm that undertook a vertically integrated process. Paramount came to control a substantial share of the national distribution market, marketing 220 of the 840 features released in 1918, and was able to exert a strong pressure on the contractual terms negotiated with exhibitors, thus introducing tying commercial practices like the *block booking* and the *blind bidding.*[12] The dispute that opposed the exhibitors to Paramount had two important consequences: the first was that the exhibition sector underwent a rapid process of concentration. The most important circuit, First National, strengthened its position to control over 630

[12] Conant (1960: 77) defined block booking as "the practice of licensing, or offering to licence, one feature or group of featured upon condition that the exhibitor shall also licence another feature or group released by the same distributor in a given period.". Donahue (1987: 121) defined the blind bidding as "the practice whereby exhibitors bid against each other for the opportunity to play a motion picture without having viewed the film."

theaters.[13] Moreover, in order to secure the access to a regular flow of products the theater group signed several popular stars, including C. Chaplin, to long-term contracts for the production and distribution of films.[14]

A second consequence was the decision of Paramount to move into the exhibition business, in order to overcome potential barriers in the exhibition of its films.[15] A first public offering of securities financed through Kuhn, Loeb and Company made possible the aggressive theater acquisition operation that allowed Paramount to acquire over 300 theaters. In 1926 Paramount succeeded in acquiring Chicago's Publix Theaters, a 96 first run theater circuit controlled by First National. Such transformation produced a series of merger and acquisition operations, the most important of which created the Loew's MGM group (formed in 1924 by production companies Metro and Goldwyn, and Loew's theater circuit).

With direct control over exhibition outlets, producers were able to expand their activities to guarantee steady supply to the market. Between 1925 and 1926 the industry was organized around a group of totally integrated firms - Paramount, Loew's, and First National - that were the largest producers and distributors, and other competitors like Fox, Warner Bros, Universal, and United Artists that were partially integrated (Koszarski 1994: 69-94). The introduction of sound consolidated further the process of vertical integration and concentration that characterized this phase of evolution of the business.

[13] The control was either direct or operated through franchise. Of the total number, over 220 theaters were of first run category.

[14] First National, however, organized distribution activities for independently produced films, and did not centralize its projects. That decision did not provide the necessary level of internal control and coordination, which was the basis for the stabilization of the integrated strategy of Paramount and other major companies.

[15] The process of vertical integration never involved Paramount, for example, showing its films entirely or even largely through Paramount theaters.

The introduction of sound and the mature studio system (1926-1948)

Experiments with sound in motion pictures had been conducted in several countries, both in recording and reproduction methods. In the United States, in 1895 Edison had presented a talking Kinetoscope, the Kinetophone, which attempted to synchronize pictures with phonograph records. In 1899 in Germany Berthon, Dussaud, and Jaubert patented another apparatus with phonograph and projector functions, and subsequent patents included loudspeakers attached by electronic wires. In France, in 1901 a patent was secured by film producer Gaumont for the synchronization of phonograph and a projecting machine. In England, Lauste was granted in 1906 a patent for a device that employed photoelectric cells, where sound and action were imprinted on sensitive film.

The first sound systems were in general created by individual inventors, but their efforts proved either technically non reliable, or commercially non marketable. Only when large companies like Western Electric and General Electric adapted solutions developed in other industries, notably radio and telephone, sound could be introduced in motion pictures on an industrial basis. In 1925-26 in the United States three systems proved viable and were initially distributed with some success: the "Vitaphone", the "Movietone", and the "Photophone". The first system, which utilized either sound on disc or sound on film devices, had been developed by Western Electric Company through Bell Telephone Laboratories and was licensed exclusively in 1926 to Warner Bros. Company, a second rank production and exhibition company that acquired Vitagraph's studio and exchange structure. The second system, which used sound on film, had been designed by Case in de Forest's laboratory, and was incorporated by Fox Film Corporation and first exhibited in early 1927. The third, a sound on film system, was presented in late 1927 by RCA. Innovation in sound was indeed channeled in the industry through minor or external companies.

Until 1925 Warner Bros. represented a film studio producer without a distribution network and exhibition outlet. Production was generally financed through franchise advance from exhibitors, in return for exclusive run in their theaters. The purchase of Vitagraph assets in 1925 and the backing of New York's National Bank of Commerce, allowed the company to invest in production of talking pictures under exclusive agreement with Western Electric with great success.[16] After 1926 Warner Bros expanded considerably, constructing sound-equipped studios, negotiating contracts with star talents, and purchasing Stanley Company's 250-theater circuit. The group's assets grew from 6 million dollars before 1928 to over 230 millions in 1930.[17]

While Warner Bros. was taking advantage of its early move in the sound business with talking pictures like "The Jazz Singer", another secondary player, Fox Film Corporation, could develop a rival system with similar fortune.[18] In Fox's case, it was the investment firm Halsey, Stuart that supported the expansion strategy of the group. Fox specialized initially in the production of newsreels, but in 1928 announced it would convert its feature production to sound and began the construction of the Fox Movietone City studio; at that time the largest sound plant in the world.

[16] The financing plan was managed by Waddill Catching of Goldman, Sachs, who entered Warner's board of directors in 1925.
[17] Substantial losses due to the greatness of investments until 1928 turned into significant profits of 17 million dollars in 1929 (Crafton 1999).
[18] Films like Don Juan or the Jazz Singer, costing both less than 500,000 dollars, grossed together around 4 million dollars in domestic revenues only.

Between 1927 and 1928 competition among sound systems became strong. Western Electric broke its exclusive agreement with Warner Bros, created a special subsidiary to conduct its non-telephone business, ERPI, and cross-licensed its patents with Movietone's. At the same time ERPI's standard was challenged by RCA system for recording and reproduction that had been presented late in 1927 (Crafton 1999: 129-130). The industry was debating whether and how to make conversion to sound. A first reason for uncertainty was that previous attempts to market sound films had proven unsuccessful, and before adopting the innovation, producers wanted it to have a sufficient economic potential. A second reason was related to the selection of the system, because the three standards were incompatible and regulated through exclusive license.

The Vitaphone system was commonly chosen by all main producers in May 1928. Despite its technical superiority, RCA proposed to Paramount, Loew's, and First National to create a joint company for the manufacturing and the distribution of apparatuses through exclusive agreements. In addition, RCA asked an 8 per cent royalty on gross revenues from sound pictures. On the other side, ERPI's system, though providing an inferior technology, adopted non exclusive agreements, demanded a fixed $500 dollar fee per reel of negative film, and offered cleared rights for the use of music and songs with ASCAP association of authors.[19] Losing the contract with producers, RCA set up its own motion picture operation, Radio Keith Orpheum Corporation (RKO). RKO was formed as an integrated combination of production and distribution (Film Box Office and what was left of Pathé's interests), and exhibition (the Keith-Albee-Orpheum circuit). The organization joined the small group of major companies along with Paramount, Loew's-

[19] This factor needs not to be underestimated, since musical features represented a significant share of film production after the introduction of sound.

MGM, Warner Bros, and Fox, but compared to the others, RKO "was run from the start by financial men [RCA management group], rather the old-line showmen" (Hueltig 1944: 48). In addition to the five major companies, other companies were integrated in production and distribution (Universal, Columbia, and United Artists), but did not own theaters.

The introduction of sound required heavy investments to convert studios, and affected radically the filmmaking process. Equipment became more sophisticated and elaborate. Incandescent lighting substituted for arc lamps, cameras had to be silenced. Film companies became more dependent upon specialized hardware manufacturers and technical personnel needed more training. On the creative side, the integration of image and sound transformed scripting technique; many actors were not able to adapt their competence to talking performance, and editing required new specific capabilities. It was estimated that in 1929 over 65 million dollars were invested in the construction of more than 100 new sound stages, with the addition of more than 5,000 new employees to the studios.[20] Production costs tended to rise sharply. In 1920 the average silent film had a production budget that ranged from $40,000 to $80,000, while in 1929, the average cost rose from $200,000 to $400,000 (Conant 1960: 29).

ERPI and RCA competed also for the conversion of theaters. Until mid-1928 ERPI apparatus on film or disc serviced mostly theaters affiliated with major companies, while RCA manufacturing schedule lagged behind. In the second half of the year compatibility between the two rival systems was assured and ERPI allowed that licensed producers

[20] Major producers' reluctance to adopt the new technology seems justified by the cost of conversion. The estimated 65 million dollars invested in 1929 were significant when compared with 110 millions of total studio investments estimated for the period 1925-1930. In *Motion Picture Almanac* 1931, 71.

could furnish products to any theater. ERPI's solution was more expensive than RCA's; if in 1929 theaters wired by ERPI totaled more than 4,400, in 1930 growth would slow down to 4,900, due to the fact that the system was mainly offered to high-end theaters, a segment that was quickly saturated. In 1930, theaters wired by systems other than ERPI were more than 8,200 on a total of 18,000, in rapid increase from the 4,800 of the previous year.

The effects of the economic depression struck the industry in late 1930, at a time when the transition to sound was not yet completed. Weekly attendance declined over 30 per cent to less than 60 millions: more than 4,000 theaters were closed in three years, and ownership became more concentrated. The reorganization process that followed the crisis was characterized by two important elements: increased level of debt of major organizations, and strengthened financial control by investment banks; financial support was made possible mainly because major companies could claim significant insurance value through exhibition's real estates. The financial institutions that managed the recovery process, moreover, entered many board of directors of motion picture companies. The composition of Paramount's board in early 1930s, for example, reflected more than a corporation dedicated to simple production of motion pictures. The board included: bankers like Harvey D. Gibson, affiliated with the New York Trust Company, and Maurice Newton, partner in Hallgarten and Company; industrialists like A. Conger Goodyear, and John D. Hertz (Balio 1993). The professional background of the president and vice president, respectively Barney Balaban and Frank Freeman, was in the exhibition business.[21]

The industrial structure in which major companies dominated production and distribution activities developed, during the thirties, into an oligopolistic system. The inauguration of the National Industrial Recovery Act was accompanied by the definition of a Code of Fair Competition for the industry. Major companies played an essential role in administering the code authority: in fact, the use of unfair commercial practices like *block booking* and *blind bidding* was legitimized, weakening the position of independent exhibitors and favoring collusion in the different branches of the industry.[22]

As distributors, the majors agreed to respect the exclusive status assigned to theaters, then acknowledging the dominance of each local circuit. Non-competing theaters were for the most part the largest downtown and neighborhood theaters in the country. The majors gained control of key first run theaters and allocated definite areas of influence in the national market. For example, Paramount's 1,200 theaters were concentrated in New England, the south and the Northern Midwest; Fox's chain was concentrated in the Pacific and Rocky Mountain states; Loew's in Ohio, New Jersey, the New York City area where also RKO interests were focused; Warner Bros., that in 1930 had acquired First National, prevailed in Central Atlantic states. Any attempts to modify the *status quo* in a certain market could result in retaliating moves in other markets (Conant 1960: 82).

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[21] Huettig (1944: 67) writes that: "Capital assets of the dominant companies are so largely land, buildings, and real estates. It is not surprising that the executive personnel should consist of men skilled primarily in the art of selecting theater sites, managing real estate, and financing operations, rather than talented producers".

[22] Briefly, entry on the market was subject to control of the major companies by selection of the exhibitors. This created barriers to the distribution of films because it selected the access of audience to specific output. Independently owned theaters were assigned later runs, and longer clearance periods between runs.

Preferential access in each affiliated circuit was given to its own major distribution organization, and then to other major distributors.[23] Majors produced or distributed almost 50 percent of domestic releases. Since the market could absorb around 400 films per year, not every major was large enough to produce internally sufficient output to saturate their distribution organization and the capacity of its own theater circuit, and depended on the external supply mostly from other majors.

The system created by Hollywood integrated firms depended on strong barriers to entry due not to cost advantage or differentiation, but to economies of scale in distribution and exhibition operations. Collusive behavior excluded non-integrated producer-distributors from a large share of the exhibition market. In the period 1935-1939, Receipts obtained by the affiliated theaters collected roughly 70 per cent of total national revenues of the industry, though they represented about 15 percent of the total of operating screens (Balio 1985: 254-255). Distribution by the first eight companies (the five majors, Universal, Columbia and United Artists) generated around 95 per cent of rentals paid to national distributors.

The cooperative allocation of the market ended up in preventing also producers independent from the majors to access the first run theatrical market, unless their films were distributed by the same integrated firms. Although marketing patterns were dictated by the five majors, the control over the industry was not absolute. Some of the major distributors and the minors were rivals to distribute the few independent productions. All the distributors vied against each other to license their films in later runs, and

[23] This means that extended runs for films produced within the same organizations might have contributed to maximize profits even though films produced by other producers could obtain higher revenues (Conant 1960: 83).

independent theaters.[24] Some competition, though limited by the dominance of long-term contracts, existed also in the production sector, and studio departments competed for stories and stars. Their large output allowed integrated companies to organize production activities with increasing levels of specialization. Production schedule was divided into two categories: "A" features, high budget films costing on average more than one million dollars; and cheaper "B" films that contributed to saturate production capacity and screen time, but also to develop and test new talent (Balio 1993: 313-350).

The studio plant represented the essential element of centralization and standardization process (Gomery 1986: 15). New management roles were introduced to coordinate efficiently the economic administration of filmmaking operations. Every studio was organized in multi functional departments (photography, art, costume, research, etc.), new professions were created in script writing, casting, etc. A studio executive producer supervised several unit producers that replaced the role of the single central producer, unable to control the entire output. On an operational level, directors functioned as creative supervisors reporting to producers (Caves 2000: 96). Few directors, who owned successful records, could be given authority over the pictures they directed, then retaining more creative autonomy.[25]

Increased standardization in production, however, needed to be combined with the need for differentiation that represented a natural creative component of film production. While several trends developed and were adopted by the entire industry, each major

[24] Even in that case, the bargaining power of major distributors was determinant. Major companies distributed a large amount of pictures, and independent exhibitors depended from them for the supply of product. In addition to that, the success of majors-produced pictures allowed extensive runs, but also gave the distributors more power for subsequent bookings.
[25] Leo C. Rosten (1941) described around thirty such producer-directors in 1941: among them John Ford, Frank Capra, Ernst Lubitsch.

company showed a distinctive style in the assembling of various inputs (Schatz 1999: 329-352). MGM specialized in prestige, sophisticated star films. Paramount in comedies with talent recruited from vaudeville, radio and stage. Warner Bros., lacking a unique roster of stars, diversified its output with genre dramas. Fox designed products using stereotyped formula plots. RKO introduced musicals, and distributed successful animated films created by Walt Disney (Rosten 1941: 231-259).

The flexible decentralized system (1948-present)

The growth of the Hollywood majors continued in the 1940s, but in the postwar years two events changed radically the economic organization of the industry (Gomery 1986: 22-23). In 1948, a decision by the Supreme Court in the "Paramount case" found the eight largest producer-exhibitors guilty of reducing competition in the market, and forced them to end the use of commercial tying practices. More importantly, the court decision imposed the separation of the five majors into production/distribution business on the one side, and exhibition on the other side. Approximately one half of the over 3,100 theaters they owned had to be divested. In early 1950s the commercial success of television as an alternative entertainment medium had negative effects on the consumption of motion pictures in theaters.

Since 1948, the demand for motion pictures decreased regularly. Attendance from 98 millions in 1946 dropped to 65 millions in 1950 and to 44 in 1955. In the same period, box office receipts decreased to 717 million dollars, with a reduction of 26 per cent. Releases by major companies diminished over 50 per cent. The economic stability of the activities and process was interrupted. The impossibility to secure a market for their output, and the reduction of demand caused a general decentralization of the production sector. Independent producers and specialized service firms have replaced the operation once controlled by the major studios, who have retained part of their production in their studios, but have concentrated on controlling the distribution and the financing function. The organization of the filmmaking activity that was managed and coordinated through the central and unit producers have been transferred to the market (Christopherson and Storper 1989). The coordination of production is more flexible and fragmented, based on individual initiatives. Producers finance and manage projects like packages: inputs, including creative talents, are not under long term contracts with producers, but are available on the market and assembled for single deals through the coordination of agents. The process of decentralization has increased the variety of output and product differentiation.

Initially television represented a threat to the motion picture industry, but by mid-1950s became an important secondary market for distribution of films, later joined by the emergence of other "ancillary" markets like cable-TV and home video (Hilmes 1990). In the new environment the theatrical market diminished its economic relevance, because it did not represent the only source of revenue, however maintained a strategic value because box office revenues are likely to affect the subsequent performance of the film. Second and lower runs in exhibition disappeared, determining a concentration of distribution, but exports played a more and more important role. Major companies lost their control of access to the market of creative inputs and films, but their investments in international distribution networks and marketing activities still represented a barrier to entry associated with scale that gave them a substantial advantage over competitors (Caves 2000: 96).

After the reorganization of the industry, the Majors have been involved in diversification operations. A first cycle was characterized by operations in non-correlated businesses; a second cycle was characterized mostly by mergers and acquisitions in correlated business, and brought to the creation of multimedia organizations, in which the motion picture business represent an integrated but autonomous component within the group (Warner Bros within Time Warner, Paramount within Viacom, etc.). The creation of multimedia conglomerates is a process in which the majors have been both active players and targets, whereby they maintained the independence of each business, and determined a potential for synergy in production and distribution activities. A motion picture product could be developed into a television product, a publishing product, a recording product, a multimedia product, or vice versa. The actual effectiveness of synergy, however, is very difficult to determine, because it does not necessarily reduce market risk (for example, a product unsuccessful in one market is very likely to not succeed in other markets or increase the rents that can be captured from the firm's film assets).

1.3 RESEARCH DESIGN

This study makes use of an original database of event histories of motion picture producers and distributors in the United States from 1912 to 1970. This section discusses the data sources used for longitudinal, quantitative analyses of producers' and distributors' entries and exits, and describes the motives for studying this particular context.

A first point to discuss is the definition of organizational populations analyzed in the dissertation. Organizational populations are the instantiation of forms. Forms are primarily identified by a specific combination of core attributes: goals, authority relations, technologies and marketing strategies (Hannan and Freeman 1984, 1989). Research in organizational ecology generally utilizes one of two possible types of classification of populations (Rao and Singh 1999). A special classification groups objects together on the basis of attributes of interest to researchers. This approach distinguishes between an essentialist rule, whereby a small set of essential, unchanging taxonomic characters corresponds to a particular population, and a nominalist rule, whereby populations are identified according to characters of research purpose. A general classification group objects on the basis of all attributes, and in turn distinguishes between a numerical, whereby all known characters of a form are recognized, and an evolutionist rule, whereby a population is a set of organizations sharing dominant competencies.

This dissertation employs a special classification and an essentialist rule. The approach is consistent with prevalent research in organizational ecology (Hannan and Carroll 1992) and with previous studies conducted on the same empirical context (Mezias and Mezias 2000, Jones 2001, Mezias and Kuperman 2001, Mezias and Boyle 2002). If the core features of populations operating in the same industry are related because of their interdependence, nonetheless they are different and distinct. The two populations included in the organizational community under study are producers and distributors of feature films. Their identification is justified by the fact that they carry out the basic functional activities of the community, from the organization of creative and technical inputs to the commercialization of film copies to theaters. The goal of producers is to effectively create a complex creative work based on team organization, while distributors stimulate consumer awareness and commercialize efficiently reproductions of the same work

The events under study in this dissertation are vital events in organizational populations. Entry and exit patterns are the observed events. No available source provides systematic information about founding and disbanding dates for this industry. The definition of relevant entry and exit events centres on the dates in which films are released. Producers enter the population when their first film is released in the market and exit when their last film is released. Likewise, distributors enter when the first film they commercialize is released and exit when the last film they commercialize is released. Dates are recorded on a monthly basis. The general approach is consistent with previous research in organizational ecology (Hannan and Freeman 1989, Hannan and Carroll 1992, Carroll and Hannan 2000), and with existing studies made in the same industry (Mezias and Mezias 2000, Mezias and Boyle 2002). The period of observation is from 1912, the year when the first U.S. feature film was released in its domestic market, to the end of 1970, the last year covered by the main data sources. The main source used in this study – the *American Film Institute Catalog*, discussed below – reports release dates for all motion pictures commercialized in the United States. In most cases dates provide the day, month and year of production and distribution, and in remaining cases month and year or year are given. Release and production dates are very accurate estimates for the distributors and producers populations, respectively; however, production dates are not always available. In these cases, I follow procedures used in previous studies - Mezias and Mezias (2000) establish the activity of producers using distribution dates.[26] For records missing exact dates, we conducted research on the Internet Movie Database, an authoritative web site that has been used in previous research (Zuckerman et al. 2003).

A related problem relates to coding of names. Mezias and Mezias (2000) note that uncertainty in the early years of the industry's development produces inadequate documentation on the identity of organizations. Entries with personal names are in fact problematic. In the attempt to tackle this difficulty, I follow and adapt the heuristics used in Mezias and Mezias (2000: 311). Their study assesses that: "*First, in the same or consecutive years, company names that were identical except the ending of Co., Inc., or Corp. were combined into a single record. Secondly, in the same year, company names that were proper names or proper names followed by anything, e.g. Thomas H. Ince, were combined with any entities that were called by that same proper name followed by anything. Finally, in consecutive years, company names that were proper names were combined with any entities that were called by that same proper name regardless of what other words were included in the title of the company.*" I apply these rules for organizations in the distributors' and producers' population yet with some simple extensions: releasing organizations like Tiffany Pictures and Tiffany Pictures of California are in fact the same company founded in 1920, but do not have any suffix like

[26] In a research conducted in 2003 on archives by the larger film studios at the Academy of Motion Picture Arts and Sciences in Beverly Hills CA, we had access to production and distribution schedules compiled annually by Columbia and Fox executives during the 1930's and 1940's. These notes informed us that the average production process lasted about 30 days and the time elapsed between the end of production and the release date averaged 40 days. As biased as a generalization from this source can be, it does not seem unrealistic to base entry and exit dates of producers on release dates as well.

Co. or Inc. to justify merging. The same simple extensions used in the distributors' populations are applied also to producers: non-proper names like Chesterfield Motion Picture Corp., Chesterfield Motion Pictures, Chesterfield Motion Pictures Corp. represent the same company founded in 1925, merged with Invincible in 1932 and disbanded in 1937.

However, I argue that some caution is advisable. In particular the third rule can generate some oversimplification in the distributors' population. Alexander Film Corp., active from 1920, Alexander Film Releasing (from 1947), J. Alexander Film Associates (from 1962), Alexander Beck (from 1968) would be merged into a single record, but are different organizations. Similarly, The first rule can present problems for the producers' population. I find cases like Continental Pictures, founded in 1919 and for which records are available until 1923. However, in 1949 Continental Pictures, Inc. resurfaces as a name for a producing company. From secondary sources, the former Continental Pictures disbanded in 1940 and most likely is not the same organization as the latter, whose history is not traceable. I treat similar cases as different organizations, as also the prolonged inactivity seems to suggest – producing organization can in fact team up to produce a film and disband immediately after.

The motion picture industry seems to be an ideal context to set the research, for substantive and practical reasons. The populations analyzed in this study are motion picture producers and distributors. Consistent with previous research in the same industry (Mezias and Mezias 2000, Jones 2001, Mezias and Kuperman 2001) they identify distinct organizational forms and a bounded, self-contained industry system (Hannan and Carroll 1992). The organizational populations studied here have been systematically interacting with each other. Producers supply their most important output to distributors, and distributors use producers' output as their primary input for their activities. Other important interactions include production financing on the part of distributors and the allocation of the box office obtained through exhibition or secondary markets. Industry historians and analysts have repeatedly noted that the performance of organizations, as well as the diversity of products is directly connected to the interactions between the main branches of the industry (Huettig 1944: 58, Balio 1985: 254, Conant 1960: 6).

A second reason for studying these populations relates to the growing interest of ecological research in the industry. Recent studies include: 1) the analysis of: the segregating processes of resource partitioning of generalist and specialist producing organizations in post-feature film evolution, where specialist producers are found to be more innovative in experimenting with new genres relative to specialists (Mezias and Mezias 2000); 2) a social systems view on the collective processes of entrepreneurship between 1895 and 1929, where Mezias and Kuperman (2001) argue that entrepreneurial initiatives are embedded in larger aggregates of populations engaging in similar activities; 3) an investigation of how ecological and institutional influence administered by the trust organizations affected competition dynamics (Mezias and Boyle 2002), whose main findings are that participants to the cartel reduced their mortality but increased general mortality between 1909 and 1912, and that trust participants were less likely to adapt to the transition to features; 4) an historical case analysis again on early development, where Jones (2001) theorizes that a wave of entrepreneurs during initial industry evolution are focused on gaining regulatory legitimacy by solving technological problems and the ensuing competition is based on technical capabilities, while later entrepreneurs focus their efforts on cultural legitimacy and competition is based on creative capabilities. Mezias and Kuperman (2001) and Jones (2001) also show that the study of evolutionary dynamics in the motion picture industry requires an approach integrating multiple levels of analysis, consistent with the community-level analysis of vital rates employed in this study.

A third reason for choosing this context is practical. I could rely on the same sources to provide accurate records of both populations of producers and distributors. Multipopulation studies present drawbacks related to ability to measure key industrial and institutional variables and covariates (Carroll and Hannan 2000). Since I am focusing on a single industry while retaining the multipopulation perspective, some of these problems might be attenuated. Moreover, community studies suffer from a trade off between organizational diversity and time coverage. Again, a single-industry multipopulation study allows for acceptable scores on both dimensions.

The period of observation for this study is from 1912, when the first American feature film is released on the domestic market, and the end of 1970 the last year covered by the main data sources. From 1893 to 1910 the industry produced and commercialized only short pictures, while from 1911 onwards feature films emerged as the dominant format. After the introduction of features, however, organizations did not cease to produce shorts. Short films became secondary products to be associated with features in theatrical presentations, or were grouped to package feature-like products in the form of serials. It has been argued that feature films are more complex products than shorts and the two cannot be really compared (Balio 1985, Bowser 1990, Jones 2001). Moreover, sources are not available that records systematically histories of organizations engaged in the exclusive production or distribution of short films. When producers or distributors operated in both segments, we only have information about their feature activities. All of these reasons convinced us to focus the study on the feature film period.

To conduct my study, I follow established practice in organizational ecology (Carroll and Hannan 2000) and adopt a combination of sources: industry directories, which enumerate the membership of the organizational population at regular intervals (once a year); encyclopaedic compilations that aggregate information on products and the organizations associated with its production and commercialization and provide detailed accounts on the product; government registries on copyright entries to triangulate information on companies' identity. Three main sources have been used in the process of data collection and entry. The first source is the *American Film Institute Catalog of Motion Pictures* (AFI), which collects reviews of all motion pictures distributed in the US between 1893 and 1970 and provides detailed information - including name of producer, distributor, release date, length, genre, sound system, color process, production credits and creative credits - about each film using the same compiling methodology. The AFI Catalog is considered a source of high quality and comprehensiveness (Mezias and Mezias 2000); however it presents two problems: it comprehensively lists all short films released between 1893 and 1910, and all feature films released in the periods 1911-1950 and 1960-1970, but has not yet documented feature films produced between 1951 and 1960. To overcome the problems in the AFI catalog[27], we relied on: *Feature Films 1950-1959: A United States Filmography*, a reference text edited by A. G. Fetrow reviewing 3069 features from the previously missing period; the *Motion Picture Catalog of the*

[27] I want to graciously acknowledge the advice provided by Patricia King Hanson, Executive Director of the AFI Catalog Project, for clarifying dubious entries and interpretation of unclear or missing data.

Library of Congress 1950-1959, which provides a list of films receiving copyright protection along with production entities and copyright entry dates; and the *Motion Picture Guide 1927-1982*, a 12 volume reference set edited by J. R. Nash and Stanley R. Ross. These three publications combined provide accurate information that complements nicely the data unavailable from AFI for the decade 1951-1960.

Additional sources of data have been used: the *Motion Picture Year Book*, an annual industry almanac with directories published from 1917 to 1972 that lists all feature releases since 1915; the *Motion Picture Almanac*, a similar publication circulating since 1929; the *New Historical Dictionary of the American Film Industry*, by A. Slide, and *American Film Personnel and Company Credits, 1908-1920*, edited by P. C. Spehr and G. Lundquist, represent additional sources that help determine the identity of obscure production and distribution firms with similar names. The *Motion Picture Year Book* and *Motion Picture Almanac* provide also the data for the calculation of density in the exhibitors' population. I believe that combining information from these sources generates a complete dataset of films and firms. Trade journals like *Moving Picture World* (published between 1907 and 1972 under such name and later as *Exhibitors Herald* and *Moving Picture World and Exhibitors Herald World*) and *Motion Picture News* (published between 1908 and 1930) have been employed to supplement information when unclear.

Films produced and released for non-commercial purposes like those managed by government institutions, as well as imported films, are excluded from the dataset. When pictures are international co-productions, I included only those in which an American producer was majority stakeholder.[28] I also eliminated pictures whose foreign title was not accompanied by any other information, suggesting they are either alternate versions for specialized audiences of otherwise released domestic titles, or imported products. Finally, films from the late 1960's to 1970 that provided no information on genre were omitted. In these cases, from their titles and the fictitious names of producing and releasing companies whose identity I could not reconstruct, I presume that they consist of pornographic pictures that are not rated and represent unauthorized or illegal duplications or re-editions of previously released material. The final dataset consists of 4,091 organizations in the population of producers, and 1,260 organizations in the population of distributors.

[28] This information could be inferred in two ways: the review mentioned how the production was organized, and the nationality of the company investing more in the film is ranked first.

INDEX

Chapter 2
Density-dependent processes: evaluation and empirical investigation of main formulations

2.1 INTRODUCTION

Industry evolution represents one major area of research in organization theory and strategic management. The long term structural dynamics of this evolution, however, remains problematic both theoretically and empirically (Carroll 1997, Jovanovic and McDonald 1994, Klepper 1996, Malerba and Orsenigo 1996, McGahan 2000). Research in organizational ecology has addressed the problem of industry evolution by relying mainly on demographic and ecological processes at the population level, as best represented by the model of density dependence (Hannan and Freeman 1989, Hannan and Carroll 1992, Carroll and Hannan 2000). Numerous empirical studies on a variety of populations and industries concluded that the curvilinear predictions of the density-dependence model hold generally (Carroll and Hannan 2000). Yet, there is variation to support further theoretical development leading to reformulation. In particular, the basic formulation of the density dependence theory does not fully explain commonly observed late stages of population development, when the industry experiences decline or resurgence (Carroll 1997).

The efforts to reconcile the basic logic of density dependent mechanisms with articulate dynamics in industry evolution have generated new specifications in models that identify various possible sources of heterogeneity, and empirical evidence supports such refinements. Some of the mechanisms identified by augmented models of density dependence are analyzed here and applied to the evolution of motion picture producers and distributors in the U.S. To a certain extent, this chapter follows the comparative scheme developed by Ruef on his study of population growth of U.S. medical schools (2004). Ruef (2004) considers arguments concerning competitive intensity, temporal heterogeneity, population inertia, and community ecology to explain the evolution of U.S. medical schools between 1765 and 1999. This chapter revises the basic model of density dependence, and the extensions of mass dependence and temporal variations, although with partially different specifications from Ruef's. Specifically, I introduce additional mechanisms that can be associated with density dependent processes, in particular temporal heterogeneity analyzed in evolutionary and not chronological time (Hannan 1997), as developed by Sorenson (2000). Also, I compare mass dependent specifications as modeled by Barnett (1997) and Barron (1999). At the empirical level, this study analyzes entry and exit patterns of 4,091 producers and 1,620 distributors of feature films in the United States during the period 1912-1970. The findings demonstrate that mechanisms incorporating more detailed specifications of density dependent evolution increase the explanatory power of the model, but not systematically. In the following chapters, I will focus on the fourth mechanism evaluated by Ruef (2004) to explain long term population dynamics in maturity and resurgence stages, i.e. community ecology. This chapter is organized as follows: the next section reviews the basic model of density dependence with its subsequent revisions. Next, I present a historical description of the evolution of the motion picture industry in the United States. Subsequently, the methods section describes the different measures and statistical estimation technique used to analyze vital rates of feature film producers and distributors. The next section reports the findings of the empirical analysis. In the same section, discussion and suggestions for further research conclude the chapter.

2.2 THE THEORY OF DENSITY-DEPENDENT EVOLUTION

The basic theory of density-dependence argues that forces of social legitimation and competition drive changes in vital rates of populations over time (Hannan 1986, Carroll and Hannan 1989a). Social legitimation is the process by which social actors perceive and support a certain organizational form as a natural, taken-for-granted way (Meyer and Rowan 1977) to perform some kind of action.[1] Legitimation indicates the degree of social and institutional acceptance of a certain organizational form. Increasing legitimation implies more resources available in the organizational niche, that is the environmental space in which the population's growth is non-negative. The theory posits that the number of organizations operating in a population is a proxy measure for legitimation. Increasing initial density enhances a form's legitimation and the population that embodies the structural characteristics of such form. The capacity to mobilize resources and members by organizations increase when those who control resources take a form as the default solution to perform certain activities, so the founding rate is proportional to the level of constitutive legitimation (Carroll and Hannan 2000). The great returns to legitimation for new organizations decline as density continues to increase. Assuming fixed resources, the environment can support only a limited number of organizations doing the same thing. The presence of one or more actors generates positive returns on the life chances of an organization. However, because all organizations in a niche depend on common, finite, resources, density also indicates the process of competition existing among organizations – the more organizations, the less resources are available. Additional entry lowers life chances. Diffuse competition increases at increasing rates with density - as the number of organizations increases linearly, the possible competitive relations increase geometrically. Therefore, growing density in organizational populations triggers opposing processes of legitimation and competition resulting in an inverted U-shaped relationship between the number of organizations and organizational

[1] Hannan and Carroll (1992: 36-7) argue that: "...a taken for granted social form can be more readily visualized by potential organizers than one with dubious or unknown standing. Variations in the strength of institutional rules endorsing rational organization as the appropriate vehicle for attaining collective goals affect the ease of founding organizations. The capacity to mobilize potential members and resources increases greatly when those who control resources take the organizational form for granted. Reducing the need for such justifications lowers the cost of organizing...Legitimation eases the problem of maintaining flows of resources from the environment and enhances the ability of organizations to fend off challenges."

founding rates and in a U-shaped relationship with disbanding rates (Hannan 1986, Hannan and Carroll 1992, Carroll and Hannan 2000).

It is useful to add that the study of disbanding, or mortality or exit, rates implies additional complexity than the study of foundings, because demographic processes based on aging, size and other organizational characteristics must be addressed alongside density dependence and environmental conditions. The risk set for foundings is unknown therefore this process is approximated with analysis of arrival events at the population level. Mortality is instead both an organizational- and a population-level event.

The relationship between organizational age and organizational mortality has been of particular interest to ecological research, and two conflicting views exist. Based on Stinchcombe's (1965) concept of liability of newness, whereby old organizations will fail less often than younger organizations because they can rely on established routines and successful rules of action, one view proposes negative age dependence. A modified version of this account stresses that newly founded organizations often have a stock of initial resources. This stock helps them to survive for some time during which they can establish their new structures (this early stage of the organizational life cycle is named adolescence by Fichman and Levinthal (1991)). At the end of the adolescence phase, when initial resources are eventually used up mortality increases dramatically. Afterwards, the usual arguments for a declining rate apply.

Another view reinforces the argument based on resource depletion by pointing out how requirements of reliability and accountability induce organizations to develop and maintain reproducible structures. In turn, this process causes inertia, which is detrimental when the environment changes (Hannan and Freeman 1984). Related to this, many of the routines and capabilities developed by organizations over time become ineffective and increase dysfunctions

(Carroll and Hannan 2000). In this perspective, the consequences of inertia vis-à-vis environmental change represent a source of positive age dependence in mortality.

Orthogonal to age dependence, Carroll and Hannan (1989) argue that the analysis of mortality has to incorporate imprinting effects of density at founding: organizations founded during periods of high density have higher age-specific failure rates because resources are scarcer and the available positions peripheral to the niche. Swaminathan (1996) refined the density delay hypothesis considering evolutionary dynamics. He reasons that only resource scarcity produces this initial effect, while tight niche packing may force organizations founded in those circumstances to exploit inferior regions of the resource space, generating a permanent risk.[2] A Survivors of the initial selection may prove to be stronger competitors, perhaps because weaker organizations fail in larger numbers when environmental founding conditions are more adverse. This final interpretation, named trial-by-fire, suggests that organizations founded in the face of adverse conditions engage in considerable collective learning and are more likely to develop successful strategies for survival. The trial-by-fire hypothesis received empirical support against the competing permanent risk hypothesis in a study of American breweries and Argentine newspapers (Swaminathan 1996).

Previous research highlighted that age dependence is strongly correlated with size dependence, and size has consequences for organizational survival. Small organizations tend to perform worse than large organizations, and consequently have higher failure rates, due to problems of raising capital, recruiting and retaining their workforce, higher relative administrative costs, legitimacy problems with external actors and weaker political power (Aldrich and Auster 1986, Barron et al. 1994). The liability of smallness however can be reversed

[2] This difference arises because resource scarcity hampers the initial development of organizational capabilities, while tight niche packing permanently affects the competitive position of organizations within a population.

when organizations are bigger compared to the optimal scale required to operate in a market. Being large is ecologically better than being small, but being too large relative to effective operation can be a source of dysfunctionality (Ranger-Moore 1997).

Until now, most theoretical and empirical work has focused on explaining the striking similarity of growth trajectories of different organizational populations, varying from banks and breweries to labour unions and voluntary social-service organizations (for a review on studies of density dependence, see Carroll and Hannan 2000). The number of organizations in a population typically grows slowly initially, and then increases rapidly to a peak. Once the peak is reached, there is usually a sharp decline and occasionally stabilization (Carroll and Hannan 1989a). The problem is that this historical trajectory implied by the baseline model of density dependent selection is not found in studies of mature organizational populations (Carroll 1997, Ruef 2004). Research often shows that the number of organizations in mature populations declines sharply from its peak, oscillates for a variable period of time and then stabilizes at a permanently lower level (Carroll and Hannan, 2000). In other cases, after a sustained period of decline and fluctuation the number of organizations in a population increases again experiencing resurgence. In yet other cases, the evolutionary trajectories of organizational populations have been observed to follow cycles of varying period and amplitude (Dobrev 2001, Wezel and Lomi 2003).

The basic model of density dependence has been modified to take into account the fact that organizational populations evolve simultaneously at multiple scales and across different boundaries (Hannan et al. 1995). In operational terms, organizational populations have been segmented along different dimensions in order to observe clearer patterns of evolution. Measures of weighted density based on industry and organizational size (Barnett and Amburgey 1990, Barnett 1997, Barron 1999), temporal variation in the key processes of legitimation and competition (Hannan 1997), population and organizational age (Barnett 1997), and asymmetric competitive experience within populations (Barnett and Sorenson 2002) have been used to obtain better specifications of the model.[3] A different avenue of research has investigated sources of spatial heterogeneity as factors affecting legitimation and competition processes, and in turn population dynamics (Lomi 1995, Sorenson and Audia 2000). What all these studies suggest is that the definition of proper units of analysis of density-dependence is primarily important. By treating organizational populations as homogenous entities and disregarding sources of heterogeneity, the original formulation of the theory underestimates the magnitude of legitimization and competition (Baum and Amburgey 2002). Legitimation, for instance, is found to operate at larger scope than competition, e.g. populations emerging in one country can benefit from the legitimation of the same population established in another country (Hannan et al. 1995).

2.3 MASS DEPENDENCE

A first extension of the basic density dependence model argues that although the number of organizations in a population may follow the general trajectory of increase to a peak and subsequent decline, such a pattern is not necessarily associated with a decline in population mass, i.e. industry capacity, or average size of all organizations surviving in the population. Typically, in fact, researchers have observed consolidation processes in mature industries where larger organizations develop leading positions (Hannan and Carroll 1992, Jovanovic and MacDonald 1994, Klepper 1996). Larger organizations can also be more durable, and both size and longevity

[3] Legitimation, for instance, is a complex concept with potentially ambiguous dimensions (Baum and Powell 1995), and some ecological studies have utilized non-density based measures of legitimation to complement the basic model. In a study on commercial bank founding in Denmark, Lomi (2000) employed variables of value of foreign assets held by Danish commercial banks, value of shares and bonds held in portfolio, total value of assets to capture institutional embeddedness of organizations and dependence of the economy on services provided by banks. These additional specifications, however, did not show to improve substantially over the density-dependent argument.

may increase organizational fitness and produce separate or additional effects on density-dependent processes. Barnett and Amburgey (1990) and Barnett (1997) argue that competitive effects are not simply a question of how probable competitive interactions are in a given market, i.e. a function of crowding in the population, but also how potent organizations are as rivals. Competitive intensity defines the magnitude of this effect. Competitive strength can vary among organizations, in particular as a function and combination of organizational size and age. Larger organizations can benefit from economies of scale or scope, develop higher bargaining power and be more visible in their institutional environment.

If large and older organizations are more potent competitors, Barnett (1997) theorizes that larger organizations can survive longer but in reality are likely to exercise weaker competition. In an evolutionary context where selection rewards only optimal configurations, larger organizations are complex, bureaucratic institutions whose mean technical fitness can be lower when compared to smaller organizations; instead, compensatory fitness associated with higher institutional conformation makes possible prolonged survival despite lower efficiency. Thus, larger organizations may be weaker competitors than smaller organizations. The competitive intensity hypotheses produces predictions whereby founding rates in a population are affected negatively by the presence of long-lived organizations, and positively by the presence of large organizations and that of large and old organizations. Regarding mortality rates, Barnett argues that the strongest competitors are more likely to survive when organizations are small, but viability and competitive strength diverge when organizations are large, leading to the survival of weak competitors. Therefore, increasing size and older age should increase death rates of rivals, while increasing size combined with older age should improve survival.

In a different vein, Barron (1999) contends that mass dependence can help explain population trajectories in later stages of the evolution when combined with density dependence. When density nears peak levels, competitive processes produce declines in the number of operating organizations by reducing founding rates and increasing mortality. When density declines the effects of density dependence are attenuated. In turn, this can stimulate new foundings and reduce failures. The cyclical pattern that may follow post-peak evolution of populations is however affected by mass dependence. After the initial decline in density occurs, founding rates can in fact not increase because of mass. When new organizations are founded, they need various resources (capital, workers, customers, etc.). Here the way in which resources are utilized is critical, especially when density reaches its maximum levels. If surviving organizations grow larger by consuming the resources made available following the failure of rivals, mass increases but founding rates are not (positively) affected. The availability of resources for the organization of new ventures is scarcer. If concentration in the population starts to increase also, the number of organizations alone is not able to capture the process of resource consumption in the niche. Therefore, after controlling for factors that affect variations in the population niche, the increasing aggregate size of the population should negatively affect founding rates. A second relevant concept is the average size of established organizations. In industries where economies of scale are important, the size of incumbents represents a barrier for new entrants in the form of minimum efficient scale to acquire. But also in industries where scale economies are less relevant, large incumbents can have privileged access to resources and more established links with their economic and institutional environments, making new attempts of entry less successful. Controlling for factors influencing fluctuations in population niche, increasing average size of existing organizations should negatively affect founding rates.

The consequences of mass dependence on the survival of organizations have been systematized by Barron (1999). Basic density dependence posits that mortality decreases initially at low densities and increases when density rises closer to the peak due to competition as a cause of failure. When density increases, however, competition should be stronger, and with it selective forces. The organizations that survive the toughest times will have indeed developed an evolutionary advantage. Relying on the argument that small size constitutes a liability for organizations, Barron proposes that large organizations have an increasing survival advantage as competition intensifies and therefore population mass may not decline. Rather, it may even increase. Controlling for factors influencing fluctuations in population niche, the positive effect of organizational size on survival should increase with increasing density.

Empirical evidence on mass dependence is weak. Barnett and Amburgey (1990) found effects contrary to predictions for Pennsylvania telephone companies. Hannan and Carroll (1992) found no statistically significant effects in several populations they studied. Barnett (1997) found evidence of both strong and weak survivor hypotheses, respectively, in the two populations of American breweries and Pennsylvania telephone companies. Barron (1999) found results consistent with expectations in his analysis of credit unions in New York.

2.4 TEMPORAL VARIATION

The original elaboration of the density dependence model treats legitimation and competition processes as time independent mechanisms that drive population dynamics through density. Hannan (1997) revised this formulation by introducing hypotheses and testing temporal heterogeneity. First, when populations mature, legitimation becomes less sensitive to variations in density because simple persistence generates constitutive legitimation, i.e. socially taken for granted character, in a way that makes organizing activities easier. Second, actors involved in performing related activities progressively structure ties to the existing populations, increasing its institutionalization. In this context, however, changes in density are less likely to affect vital rates because they come to reflect an industry's social structure more than its simple internal dynamics (Carroll and Hannan 2000). As networks linking organizational populations develop competition also is less affected by density, mainly because rivalry becomes more focused and dependent on the differentiated positions and roles of organizations than on diffuse crowding. By interacting the standard density terms with the first and second order of industry age, Hannan (1997) finds that density dependence declines in importance as the population ages in affecting founding rates of European automobile producers. In addition, the portion of the model employing second order terms of industry age posits that low density in aged populations favors resurgence. When populations age and density is low, the effects are different relative to when density is low early in industry development: the presence of a reduced number of organizations in later stages of the evolution is often coupled with increased concentration, so that generalist sub-forms leave open spaces in the niche that new specialist forms can occupy. A partitioning mechanism (Carroll 1985) stimulates founding rates and density dependence re-acquires relevance in conditioning population dynamics.

Sorenson (2000) points out that temporal asymmetry expressed by the interaction between industry age and density do not actually affect density dependence. This approach does not consider the way in which evolutionary processes occur within populations, namely population level learning through systematic selection and retention. If evolutionary processes are sources of asymmetry in population dynamics, chronological time does not provide an appropriate metric; rather, evolutionary time is a better measure to investigate changes in the nature of density dependence. In the model developed by Sorenson (2000), new organizational foundings generate variation mechanisms. Evolutionary time is a function of the total number of trials in the population, i.e. the unique combination of routines that come with new foundings measured by the inverse of the cumulative number of foundings in the industry. The selection process can operate on variation in two different ways: on the one hand, by eliminating less fit organizations from the population, and producing increased average fitness of the population over time; on the other hand, selection can also reduce competition, because the organizations removed from the environment are presumably those that occupy more crowded positions in the resource space, and retention measures the effects of population pressure. The use of this different perspective allows interpreting the interaction between density and the inverse of cumulative foundings as a retention rate of members by the population. If retention rates are high, few organizations fail implying that the niche is particularly attractive for new initiatives. Finally, if selection operates on most crowded regions of the resource space, second term density interacted with evolutionary trials should describe how spacing among organizations is reorganized to reduce competitive interaction among survivors.

Sorenson supported the alternative model of temporal variation in evolutionary scale with empirical investigation in the population of American automobile producers. His findings show that interactions between density terms and evolutionary time fit the data better than the interactions with chronological time.[4] High retention rates then signal an attractive niche, while the interaction between retention rates and density proves that competitive interactions among surviving organizations after spacing are less intense.

[4] The two models are not nested, therefore cannot be directly compared, the evolutionary time specification has lower root mean square error with fewer degrees of freedom. Also, when both sets of interactions are included in the same model, its fit does not improve.

A different approach to temporal heterogeneity in density-dependent population dynamics focuses on the process of entrepreneurial response to opportunities. Lomi, Freeman, and Larsen (2003) theorize that not only do delays exist between the time entrepreneurs enter pre-production and actual production stages (Hannan and Carroll 2000), but also foundings reflect the framework that exist when entrepreneurs make the initial commitment to organize their activity.[5] This dynamic does not reflect the evolution of resource availability, and in turn, the process generates inertia and resistance to efficient change at the population level, which can be responsible for fluctuations in population growth. Ruef (2004) adopts a simplified version of this delayed adjustment hypothesis to explain that organizational forms associated with complexity of creation and institutionalization processes require longer founding processes. When entrepreneurs commit to creating new organizations, however, they develop forecasts about the future competitive situation that are not modified. Conceptually, this extension of density dependence elaborates predictions of non monotonic relationships between the number of organizations and populations' vital rates that are qualitatively analogous to the original formulation.

The empirical study conducted by Ruef (2004) in the U.S. health care industry indicates that the social organization of activities in medical schools took longer periods to complete. The introduction of 5 and 10 year lags in density measures increases statistical significance of population growth models compared to basic density dependence results. However, when the model of population growth is decomposed into separate models for foundings and disbandings, results are affected asymmetrically. Forecasting seems to influence founding activities more than

[5] Not only, but a different dynamic is responsible for the perception of opportunities relative to resource mobilization. In a study on founding rates in the U.S. television broadcasting industry, Sørensen and Sorenson (2003) find that while application requests for new stations reacted sensitively to the growth in syndicated advertising revenue and the interest rate environment, these factors do not affect the speed at which grantees of Construction Permits go on-air and actual entry. Similarly, changes in national density and the size of the local broadcast market do not influence mobilization rates. These results indicate that additional factors can be responsible for temporary or systematic deviations from basic density-dependent processes.

exit decisions. The latter can in fact requires less investment of time and probably also a lower degree of deliberateness. Empirically as well, the dynamics of foundings of medical schools analyzes by Ruef are more consistent with delayed adjustments than that of disbandings, which fit better with a basic density dependence specification.

A more articulated expression of population inertia and its relevance for founding processes has been developed by Lomi et al. (2003) in a study employing computer simulation in a series of virtual experiments. The general inference made from these simulations, which used the same parameters for densities as Hannan and Carroll's (1992) based on empirical studies in labor unions (Hannan and Freeman 1989), indicate that under conditions of dynamic resource constraints, the presence of population-level inertia can generate a variety of historical trajectories during population maturity. The possible trajectories emerging as outcomes of simulations include sustained oscillations, resurgence and population extinction populations.

2.5 AN EMPIRICAL ANALYSIS OF DENSITY DEPENDENCE IN THE U.S. MOTION PICTURE INDUSTRY

2.5.1 The motion picture industry in the United States

In this section I present a brief description of the industry where the empirical investigation of density dependence models is applied. Chapter 1 contains a more detailed account of the historical evolution of the industry.

The Pre-feature film period

Motion picture cameras were available since 1889 and the Kinetoscope – a peephole-viewing machine for individual entertainment – was commercialized around 1893; however, the movie industry is considered to begin in 1895[6], the year when projection machines - Edison Manufacturing Company's Vitascope - were used for the first public screenings of motion pictures (Huettig 1944, Musser 1990). Initially, Edison was responsible for the production of both the hardware (recording and projecting machines) and software (pictures) components of the industry, which concentrated in New York. Motion pictures consisted of short subjects representing real life scenes or comedies, without narrative form. Pictures were sold on a territorial basis and screen exhibition took place in already established entertainment venues, integrating vaudeville and storefront theaters, but also itinerant amusement shows (Musser 1991).

After the introduction of the Vitascope, the market for equipment and motion pictures grew rapidly, and despite the strict control exerted through patents and exclusive distribution, it allowed the emergence of competitors, the strongest of which was American Mutoscope and Biograph Company that by 1898 became the most important motion picture producer with 300 films (Edison's output totaled about 160) (Musser 1990). Intense demand not only caused the entry of new competitors, but also implied a substantial obsolescence of film subjects. Motion pictures lost their appeal on the public very quickly.

The steady increase in demand led to a progressive specialization of activities in the main stages of production, distribution and exhibition. When the industry witnessed the emergence of rental exchanges and of regular exhibitors, motion pictures were already a permanent entertainment attraction in theaters. Around 1903, in order to allow more widespread exhibition, theater owners and managers began to regularly lease films instead of buying and selling them.

[6] The first "official" premiere of motion pictures was as the final act of a vaudeville program at Koster and Bial's Music Hall, 23 April 1896 in New York (Musser 1990).

Motion picture distribution transferred from the manufacturers of hardware components to specialized companies called exchanges. At the same time, exhibitors progressively stopped combining motion pictures with other entertainment performances, and began delegating to producers creative responsibility for assembling of the product, extending further the process of specialization in the industry (Lewis 1939, Huettig 1944).

The demand also opened opportunities for foreign producers in the American market. In addition to providing reusable output for exhibition, foreign films often looked innovative and very different from those made by domestic companies, and this contributed significantly to their success (Abel 1999). Filmmaking techniques advanced toward the adoption of story films and narrative structures, which made their organization more elaborate. The transition to story films allowed a certain stabilization and regularization of production activities, creating an incentive for differentiation on creative terms (Balio 1985). By 1907, motion pictures were a business autonomous from that of hardware components. Edison made an attempt through a patent-pooling organization to regain control of the industry. In 1908, a trust under the name of Motion Picture Patents Company (MPPC) was formed, uniting the owners of the sixteen key patents, as well as the largest film producers and importers: Edison Manufacturing Company, Biograph, Armat, Essanay, Kalem, Kleine, Lubin, Pathé Frères, Selig, Vitagraph, and Eastman-Kodak. When in February 1911 Eastman-Kodak modified its agreement with the MPPC to allow the supply of film to unlicensed manufacturers, the trust found itself unable to isolate independent producers from access to raw materials (Staiger 1983). A lawsuit was filed in 1912 claiming the organization had engaged in illegal trust building. In 1915 the U.S. District Court for the Eastern District of Pennsylvania ruled against the company, which was dissolved about a year later. By then, however, the trust was already incapable of maintaining strict control over the coordination of the industry.

The feature film period

Producers independent of the trust like Famous Players and Feature Play Company introduced an innovation that differentiated their products and challenged the distribution system organized by the MPPC: the feature film, long, elaborate and expensive multi-reel pictures. The development of the feature film in the United States was influenced in part by the appearance of longer European films on American screens and the differing strategies of independents and Patents members (Bowser 1990). Feature films replaced short films (that represented the exclusive output of Edison and his affiliates), and engendered a structural reorganization of the business. Not only were feature films complex products compared to standardized one-reelers, but also they required individually designed promotional campaigns, and longer runs in theaters (Lewis 1939, Staiger 1983). As demand for motion pictures continued to grow, producers and distributors were required to supply a regular output of product throughout the year. This factor, but also the longer shooting period and the higher costs associated with production of feature films are probably the major reasons for the relocation of productive operations from New York to Hollywood, whose warm climate and relative lack of seasons represented favorable environmental conditions to organize film production (Huettig 1944). Legal suits by the MPPC may have stimulated many independent producers to migrate to Hollywood, but Trust members were themselves attracted by the climate and diversity of outdoor settings available in southern California (Gomery 1986).

The feature film was a more differentiated product than shorts, and such a differentiation modified price and promotion policies in the distribution sector. The necessity to make perceivable to the public the increase in the actual value of the product urged distributors to adopt some signaling elements, primarily actors and directors -in a way that was similar to what occurred in the theater business (Bordwell et al. 1985). The star system was introduced (Kerr 1990). The feature film also generated a series of transformations in the exhibition sector, since it made possible a more definite differentiation in specialized theaters, sustaining different price policies and program run releases for each film (Koszarski 1990).

Considering the increased costs and risks associated with the production and marketing of feature films, coordination between the process of production and distribution was essential. Since 1918 several firms adopted a vertically integrated structure, and film production, distribution and exhibition were progressively internalized within hierarchical organizations. During the second half of the 1920's a group of integrated firms, called majors (Paramount, Loew's, Fox, Warner Bros, RKO) became dominant players in the industry. In the same period sound was introduced, affecting especially film production and exhibition. The first sound systems were in general created by individual inventors, but their efforts proved either technically non reliable, or commercially non marketable. Only when large companies like Western Electric and General Electric adapted solutions developed in other industries, notably radio and telephone, sound could be introduced in motion pictures on an industrial basis. In 1925-26 in the United States three systems proved viable and were initially distributed with some success: the "Vitaphone", the "Movietone", and the "Photophone". The first system, which utilized either sound on disc or sound on film devices, had been developed by Western Electric Company through Bell Telephone Laboratories and was licensed exclusively in 1926 to Warner Bros.

Company, a second rank production and exhibition company that acquired Vitagraph's studio and exchange structure. The second system, which used sound on film, had been designed by Case in de Forest's laboratory, and was incorporated by Fox Film Corporation and first exhibited in early 1927. The third, a sound on film system, was presented in late 1927 by RCA. Innovation in sound was indeed channeled in the industry through minor or external companies (Crafton 1997).

The introduction of sound required heavy investments to convert studios, and affected radically the filmmaking process. Equipment became more sophisticated and elaborate. Incandescent lighting substituted for arc lamps, cameras had to be silenced. Film companies became more dependent upon specialized hardware manufacturers and technical personnel needed more training. On the creative side, the integration of image and sound transformed scripting technique; many actors were not able to adapt their competence to talking performance, and editing required new specific capabilities. It was estimated that in 1929 over 65 million dollars were invested in the construction of more than 100 new sound stages, with the addition of more than 5,000 new employees to the studios.[7] Production costs tended to rise sharply. In 1920 the average silent film had a production budget that ranged from $40,000 to $80,000, while in 1929, the average cost rose from $200,000 to $400,000 (Conant 1960).

The Western Electric (now organized as ERPI) and RCA standards competed as well for the conversion of theaters. Until mid-1928 ERPI apparatus on film or disc serviced mostly theaters affiliated with major companies, while RCA manufacturing schedule lagged behind. In the second half of the year compatibility between the two rival systems was assured and ERPI allowed that licensed producers could furnish products to any theater. ERPI's solution was more

[7] Major producers' reluctance to adopt the new technology seems justified by the cost of conversion. The estimated 65 million dollars invested in 1929 were significant when compared with 110 millions of total studio investments estimated for the period 1925-1930. In *Motion Picture Almanac*, 1931, 71.

expensive than RCA's; if in 1929 theaters wired by ERPI totaled more than 4,400, in 1930 growth would slow down to 4,900, due to the fact that the system was mainly offered to high-end theaters, a segment that was quickly saturated. In 1930, theaters wired by systems other than ERPI were more than 8,200 on a total of 18,000, in rapid increase from the 4,800 of the previous year (Crafton 1997).

The effects of the economic depression struck the industry in late 1930. Weekly attendance declined over 30 per cent to less than 60 millions: more than 4,000 theaters were closed in three years, and ownership became more concentrated. The inauguration of the National Industrial Recovery Act was accompanied by the definition of a Code of Fair Competition for the industry. The Majors played an essential role in administering the code authority: in fact, the use of unfair commercial practices favored collusion in the different branches of the industry (Conant 1960). Overall, the Majors produced and distributed about 65 per cent of all domestic features. Since the market could absorb around 400 films per year, a single organization was not large enough to produce internally sufficient output to saturate their distribution organization and the capacity of its own theater circuit, and depended on the external supply of other majors and independent producers. Competition continued in the distribution of independent productions for the first-run market, for later-runs and for inputs (primarily stories and stars) (Balio 1985).

In the postwar years, two events affected the organization of the industry (Gomery 1986). In 1948, a decision by the Supreme Court in the "Paramount case" found the eight largest organizations guilty of reducing competition in the market, and forced them to end the use of commercial tying practices. The court decision imposed the separation of the five majors into production/distribution business on the one side, and exhibition on the other side. Approximately one half of the over 3,100 theaters they owned had to be divested (Conant 1960). Second, in early

1950s the commercial success of television as an alternative entertainment medium had negative effects on the consumption of motion pictures in theaters.

Since 1948, the demand for motion pictures decreased regularly. Attendance from 98 million in 1946 dropped to 65 million in 1950 and to 44 million in 1955. In the same period, box office receipts decreased to 717 million dollars (-26%) (Izod 1988). Releases by major companies diminished over 50 per cent. The impossibility of securing a market for their output, and the reduction of demand caused a general decentralization of the production sector (Storper 1989). Independent producers and specialized service firms proliferated, while majors retained part of their production in their studios, but have focused on controlling distribution and film financing. The organization of production is more flexible and fragmented, based on individual initiatives (Bordwell et al. 1985). Producers finance and manage projects like packages: inputs, including creative talent, are not under long term contracts with producers, but are available on the market and assembled for single deals through the coordination of agents (Paul and Kleingartner 1994).

By the mid-1950s television has become an important secondary market for the distribution of films, later to be joined by the emergence of other "ancillary" markets like cable-TV and home video (Hilmes 1990). In this environment the theatrical market diminished in economic relevance, because it did not represent the only source of revenue; however it maintained a strategic value because box office receipts are likely to affect the subsequent performance of the film. Second and subsequent runs in exhibition disappeared, also affecting distribution. The Majors lost their clout in the market for creative inputs and films, but their investments in international distribution networks and marketing activities represent a powerful source of advantage (Caves 2000).

2.5.2 Research design and data

This dissertation makes use of an original database of event histories of motion picture producers and distributors in the United States from 1912 to 1970. This section discusses the data sources used for longitudinal, quantitative analyses of producers' and distributors' entries and exits, and describes the motives for studying this particular context. Section .2 in Chapter 1 provides detailed account of the research design used in this study, and justifies why the period between 1895 and 1911 when only short films were produced, is excluded from the current analysis.

The main activities of the motion picture industry are three: production, distribution and exhibition. Production is defined by the operations aimed at the actual making and delivering of the first copy of the film. The making of the first copy of the film is the necessary requisite for the reproduction process which generates the product's copies that are marketed on the screens. Production involves the deployment of several inputs, either of creative or of technical nature, and also the sinking of considerable capital investment. Distribution is defined by the reproduction of the first copy of the film destined to be screened in movie theaters. In such activity, distributors are responsible for the management of the physical output, but also of the marketing initiatives, revenues collection and the allocation of payments to the producer and other possible profit participants. Exhibition is defined by the showing in front of an audience of a reproduced copy of the film. This activity requires that the exhibitor makes use of a space purposely destined to film playing, and possibly to a bundle of complementary services (ticket selling, concession stands, etc.): the activity is aimed at selling seats for each show. Each main activity defines the boundaries of different specialized but interdependent organizational populations (Mezias and Mezias 2000, Mezias and Kuperman 2001).

No source provides systematic information about founding and disbanding dates for this industry, therefore entry and exit patterns are the observed events in this study. The definition of relevant entry and exit events centres on the dates in which films are released. Producers enter the population when their first film is released in the market and exit when their last film is released. Likewise, distributors enter when the first film they commercialize is released and exit when the last film they commercialize is released. Dates are recorded on a monthly basis. The general approach is consistent with previous research in organizational ecology (Hannan and Freeman 1989, Hannan and Carroll 1992, Carrol and Hannan 2000), and with existing studies made in the same industry (Mezias and Mezias 2000, Mezias and Boyle 2002). The period of observation is from 1912, the year when the first U.S. feature film was released in its domestic market, to the end of 1970, the last year covered by the main data sources.

To conduct my study I follow established practice in organizational ecology (Carroll and Hannan 2000) and adopt a combination of sources: industry directories, which enumerate the membership of the organizational population at regular intervals based on film release data; encyclopaedic compilations that aggregate information on products and the organizations associated with its production and commercialization and provide detailed accounts of the products; government registries on copyright entries to triangulate information on companies' identities. Three main sources have been used in the process of data collection and entry. The first source is the *American Film Institute Catalog of Motion Pictures* (AFI), which collects reviews of all motion pictures distributed in the US between 1893 and 1970 and provides detailed information about each film using the same compiling methodology. The AFI Catalog is considered a source of high quality and comprehensiveness (Mezias and Mezias 2000); however it presents two problems: it comprehensively lists all short films released between 1893 and 1910, and all feature films released in the periods 1911-1950 and 1960-1970, but has not yet documented feature films produced between 1951 and 1960.

To overcome the problems in the AFI catalog, additional sources of data have been used: *Feature Films 1950-1959: A United States Filmography*, a reference text edited by A. G. Fetrow reviewing 3069 features from the previously missing period; the *Motion Picture Catalog of the Library of Congress 1950-1959*, which provides a list of films receiving copyright protection along with production entities and copyright entry dates; and the *Motion Picture Guide 1927-1982*, a 12 volume reference set edited by J. R. Nash and Stanley R. Ross. These three publications combined provide accurate information that complements nicely the data unavailable from AFI for the decade 1951-1960. Additional sources including industry almanacs (*Motion Picture Year Book, Motion Picture Almanac, The New Historical Dictionary of the American Film Industry* edited by A. Slide, *American Film Personnel and Company Credits, 1908-1920* edited by P. C. Spehr and G. Lundquist), trade journals (*Moving Picture World, Exhibitors Herald, Moving Picture World and Exhibitors Herald World, Motion Picture News*), copyright registries issued by the Library of Congress every decade have been employed to supplement information when unclear, e.g. repeated titles in the same or next year.

Consistent with previous studies (Mezias and Mezias 2000, Mezias and Boyle 2002), I excluded from the database films produced and released for non-commercial purposes, like those managed by government institutions, and imported films. When pictures are international coproductions, I included only those in which an American producer was majority stakeholder.[8] I also eliminated pictures whose foreign title was not accompanied by any other information, suggesting they are either alternate versions for specialized audiences of otherwise released

[8] This information could be inferred in two ways: the review mentioned how the production was organized, and the nationality of the company investing more in the film is ranked first.

domestic titles, or imported products. Finally, films from the late 1960's to 1970 that provided no information on genre were omitted. In these cases, from their titles and the fictitious names of producing and releasing companies whose identity I could not reconstruct, I presume that they consist of pornographic pictures that are not rated and represent unauthorized or illegal duplications or re-editions of previously released material. The final dataset consists of 4,091 producers, 1,260 distributors for over 28,000 films. Figures 2.1 and 2.2 show the density of feature film producers and distributors over the observation period.

Insert Figures 2.1 and 2.2 about here

To study exit rates in the two populations, a modification of the sample populations was necessary. Entry and exit events are based on the same date, the release of films. When producers and/or distributors engaged in the realization of only one film over their organizational life, the two dates coincide. This simultaneity can create a bias in the estimation or make it impossible. To overcome this problem, we decided to limit the analysis to firms that either produced or distributed at least two films so that the time they spent in the industry cannot be equal to zero. Still, some cases remain problematic. In 24 cases of producing companies and 21 cases of distributing companies we found that entry and exit dates overlapped despite the fact that they released more than one film. In these cases, we decided to carry over their exit date to the following month, artificially extending their organizational life across two observations. The summary statistics for the two populations indicate that the distribution of mean, median, and percentile duration time in the risk set are not significantly affected (the inter-quartile survival time for producers are: 2.91, 7.72, and 17.88 for producers; the 25th, median, and 75th values for distributors are 2.66, 7.83, and 18.37). The final dataset comprises 1,451 producers and 658 distributors.

The motion picture industry seems to be an ideal context in which to set the research, for substantive and practical reasons. The populations of producers, distributors (and exhibitors) define a bounded and self-contained industry system (Hannan and Carroll 1992). Their interactions are constant and intense to the point where blending mechanisms have been followed by the emergence of a hybrid population of integrated organizations. The organizational populations studied here have been systematically interacting with each other but have experienced different selective pressures over time as well: the emergence of ancillary markets benefited primarily distributors and producers, because new markets opened for products, but have weakened the exhibition sector. Industry historians and analysts have repeatedly noted that the performance of organizations, as well as the diversity of products is directly connected to the interactions between the main branches of the industry (Huettig 1944: 58, Balio 1985: 254, Conant 1960: 6). The observed period allows us to capture the process of functional specialization of organizational populations, as well as the development and the long-term consequences of their interactions.

A second reason for studying these populations relates to the growing interest of ecological research in the industry. My research questions can complement existing analyses of resource partitioning processes of production and distribution activities (Mezias and Mezias 2000), and coevolutionary dynamics of entrepreneurial activities, competences and strategies (Jones 2001), extending population dynamics to community-level relations (Mezias and Kuperman 2001). A third reason for choosing this context is practical. I could rely on the same sources to provide accurate records of populations of both producers and distributors. Multipopulation studies present drawbacks related to the ability to measure key industrial and institutional variables and covariates (Carroll and Hannan 2000). Since I am focusing on a single industry while retaining the multipopulation perspective, some of these problems might be attenuated. Moreover, community studies suffer from a trade off between organizational diversity and time coverage. Again, a single-industry multipopulation study allows for acceptable scores on both dimensions.

2.5.3 Methods

The analysis of vital rates of the two populations of producers and distributors begins with entry. Following common strategies in ecological research, I use event-count models to estimate entry rates of feature film producers and distributors in the United States. For these analyses, the entire population represents the unknown risk set for entries, and count models provide estimates of entry rates. Entries occur throughout the year and are recorded every month. The number of producers and distributors which entered each month is the dependent variable of the models. Stata 8 is the statistical package used for this study. Figures 2.3 and 2.4 provide a graphical representation of the distributions of entry in the populations of producers and distributors over the observation period.

Insert Figures 2.3, 2.4 about here

Entry processes can be seen as arrival processes of new organizations into the population. Poisson regression with maximum likelihood estimation offers a clear solution to the study of arrival processes because it is consistent with the fact that negative counts cannot occur.

Preliminary analysis on entry patterns of the two populations shows that the fitted Poisson distribution under-predicts or over-predicts several counts in a significant way. The pattern is characteristic of fitting a count model that does not take into account heterogeneity among sample members in their rate (Long 1997). I employ a formal goodness of fit test comparing the observed empirical distribution with the distribution predicted by the Poisson regression model. The null hypothesis (H_0) is that there is no difference between the observed data and the modeled data, indicating that the model fits the data. The results of the test (for producers: chi2=3310,224, Prob > chi2(707)=0.000; for distributors: chi2=1789.592, Prob > chi2(707)=0.000) suggest that we can in fact reject the null and that the Poisson model does a poor job in representing the data.

Under the assumption that the process of founding follows a Poisson distribution, some rules can be violated. For example, Poisson processes assume that no unobserved heterogeneity exists; the independent variables completely describe the rate. Poisson regression also assumes the rate at which events occur to be constant (Yamaguchi 1991). Empirical research on organizational populations shows instead that it is uncommon that the mean of the time series of arrivals analyzed equals the variance (Carroll and Hannan 2000); rather, the variance of counts often exceeds the mean. This phenomenon is defined as overdispersion. To correct for overdispersion, we estimate a negative binomial regression model including a disturbance term (ε_{it}) whose exponential function follows a gamma distribution, $\Gamma\,[1,\alpha]$ in which the parameter alpha captures overdispersion from the data. As expected, there is evidence of overdispersion (respectively, alpha=.0959876 and alpha=.1843606 for counts of producers distributors). Therefore I estimate entry processes via negative binomial regression with maximum likelihood estimation.[9]

[9] Maximum likelihood estimation in negative binomial regression still assumes independence of observations over time (and not only). Longitudinal data often violate this assumption, for example because there is autocorrelation in

To analyze empirically the population ecology of exit rates of feature film producers and distributors, we follow the conventional strategy in ecological research of employing event history modeling techniques (Allison 1984, Blossfeld and Rohwer 2002, Cleves et al. 2004). Each organization in the population has some chance of exiting at any time during its tenure, i.e. from the moment it entered the market, so the clock regulating the occurrence of the event is the tenure itself. The occurrence of the event of interest, in this case exit from the market, is controlled by an instantaneous hazard rate. The hazard rate is defined as

$$\lambda(t) = \lim_{dt \to 0} \frac{\Pr\{t < T \leq t + dt | T > t\}}{dt}$$

where T is a random variable for the time of the event of interest, t is the time that an organization in the focal population has existed, and P(.) is the probability of the event occurring over the interval [t, t+t] given that the firm existed at the beginning of the interval.

There are different solutions in estimating hazard rates. A basic distinction involves the definition of parametric and non-parametric models. The former specify the relation between hazard rates and the explanatory variables including time. The latter do not specify such relation (Yamaguchi 1991). Parametric models make strong assumptions about the shape of the hazard function, while non-parametric models make none. Sometimes an in between approach is more appealing, in which models fit a semi-parametric hazard. Among semi-parametric models, the piecewise constant exponential model is the model most commonly used in a continuous time framework. The hazard is assumed constant within pre-specified survival time intervals but the constants may differ for different intervals. The piecewise-exponential specification is estimated

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the counts (Barron 1992). Quasi-likelihood estimation procedures can be a solution to this problem; no assumption about the underlying probability distribution needs to be made. My analysis currently employs maximum likelihood estimation in negative binomial regression models and it is appropriate to consider its limitations. Future research will be extended to alternative statistical techniques to improve the efficiency of estimation.

by maximum likelihood, and shows advantages over other semi-parametric specifications because it accommodates non-proportionality of the effects of tenure and covariates, does not require strong assumptions about the exact forms of duration dependence but provides information about duration dependence (Hannan et al 1998, Carroll and Hannan 2000). Although past research strongly supports age-dependence in organizational mortality rates, the form of age-dependence varies widely. The use of a piecewise exponential model represents a flexible strategy for modeling duration-dependence in mortality/exit models.

The piecewise constant exponential model estimates the transition rate from entry to exit as:

$$r(t) = \exp\{\alpha_l + A\alpha\}$$

where α_l is a constant coefficient associated with the l_{th} time period, A is a vector of covariates measuring firm-specific variables other than age, and also population and environmental characteristics, and α is the associated vector of coefficients. For the analyses of exit rates, the time axis is based on industry tenure of organizations, and the exact time pieces were determined for each of the two populations according to exploratory study of best-fitting baseline models. The estimation of the model uses maximum likelihood techniques is implemented with user-defined routine for *STATA*, Release 6 (Sørensen 1999). To estimate rate models with time-varying covariates, we constructed split-spell data breaking observed durations in year quarter-long periods with the values of covariates updated every year. The number of organization-spell observations is 21762 for producers and 10326 for distributors. Figures 2.5 and 2.6 provide descriptive histograms of the distributions of exits for the populations of producers and distributors in the observation period.

Insert Figures 2.5, 2.6 about here

2.5.4 Variables

Entry

The dependent variables for entry processes are monthly counts of new organizations entering the populations of producers and distributors. All covariates are updated yearly. For the basic density dependence specification, I use the first and second order term of number of organizations in each population as the main explanatory variables. I use moving averages of 12 month lag to measure density because I recognize that it is hard to motivate that entry is exactly explained by the competitive situation of 12 months before. I chose to average values between 6 and 18 month lags over more prolonged value as the production and distribution processes in the motion picture industry require set up and organization prior to actual operation, but this interval is generally shorter than in technology intensive industries like automobiles or institution-dependent industries like health care. An average 12 month of pre-entry organization is also indicated by industry experts as an appropriate time span (Vogel 1998, Squire 1992). It is also true that the time and costs associated with starting activities in the motion picture industry have changed over the observation period, e.g. starting up in silent production was generally faster than a sound production because studios did not need more sophisticated equipment for soundproofing, and casting also did not need to evaluate the actors' voices (Bordwell et al. 1985). In accordance with the general statement of density dependence model, I expect population density to affect positively foundings and squared density to affect it negatively.

The mass dependence hypotheses add several variables to the preceding specification. A first set of mass dependent models include the weak vs. strong survivor test together with size, population mass, and age effects (Barnett 1997). To do so, I calculated the log of the sum of the product between organizational size and age. A positive relationship is expected in entry rates. Organizational size is measured as the number of films produced or released by each firm, while age is measured in number of years of continuous operation.[10] Population mass is measured as the total number of films released in the market every year. The weak survivor hypothesis (Barnett 1997) is consistent with a positive relationship between mass and entries. Population age is calculated as the sum of ages of living organizations every year. A negative relationship is expected. A second set of models include the test of the model developed by Barron (1999). The same measure of population mass just described is included, this time predicting a negative relationship with entry rates. A measure of mean organizational size is included, with the expectation of a negative effect on entry.

The temporal heterogeneity specification is again split in two sets. A first set analyzes Hannan's (1997) extension of density dependence in chronological time. Interaction measures between first and second order density terms with first and second order terms of population age are included. Population age and population age squared measures are also added. A second set evaluates the extension made by Sorenson (2000). Density measures interact here with the evolutionary time. Evolutionary time is calculated as the inverse of cumulated entries in each population, and is updated monthly. A final set includes both specifications, but collinearity problems may generate inconclusive results making direct comparison impossible.

[10] Producers (and if less likely also distributors) can spend time of apparent inactivity in the industry not releasing new films in the market. In that period they can redistribute existing products or organize for new initiatives. I fixed a 3 year inactivity as a threshold to declare the exit of the organizations. The data suggest that in most cases where inactivity was recorded it lasted only 1 year. Exit however still occurred and was recorded when the last product was released to the market.

Control variables were included in all models and are discussed below.

Concentration. I included a measure of industry concentration to control in part for the alternative explanation of resource partitioning in the two populations (Carroll 1985, Carroll and Swaminathan 2000). According to resource partitioning theory, under certain market conditions, fierce competition among generalist firms causes the failure of smaller generalists due in particular to the competitive advantage of scale economies. The failure of these smaller generalists frees resources, of which the more contiguous resources are subsumed by the large surviving generalists into their existing market segments, making these firms even larger. However, more peripheral resources, which are both less lucrative and more difficult to reach for surviving generalists, are filled by more specialized firms, the latter of which tend to be small due to the lack of resources in these peripheral areas. In this manner, resource-partitioning theory accounts for the simultaneous increase in market share of large generalist firms and the proliferation of specialist ones (through the latter's increased founding and reduced failure). I calculated a Hirschman-Herfindahl index (HHI) of concentration, a commonly accepted measure obtained by squaring the market share of each firm operating in the market and then summing the resulting numbers. The HHI takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases (Shy 1995). Markets in which the HHI is between 1000 and 1800 points are considered to be moderately concentrated and those in which the HHI is in excess of 1800 points are considered to be highly concentrated (U.S. Department of Justice 1992). Figures 2.7 and 2.8 describe the pattern of industry concentration in the two populations (Figure 2.8 is an expansion of Figure 2.7 on a smaller scale excluding the years 1912-1914) and indicate a moderate level of concentration throughout the observation period. The resource partitioning hypothesis predicts a positive relationship between concentration and entry. A negative or non significant effect is expected if segregating mechanisms do not affect the populations under study here.

Insert Figures 2.7, 2.8 about here

Admission cycles and seasonality. There is the belief, derived from depression-resistant performance of motion picture ticket sales, that the movie business has countercyclical characteristics (Vogel 1998). Indeed, it may be that as the economy enters a recessionary phase, the leisure-time spending preferences of consumers shift toward lower-cost, closer to home entertainment activities than when the economy is robust and expansionary. In addition, the depression periods reduce the opportunity cost of leisure time relative to best alternative uses. If so, this would explain why ticket sales tend to remain steady during the early to middle stages of a recession, decreasing only near the recession's end. By that time, many people's budgets are apt to be severely stretched, and long-postponed purchases of essential goods and services will take priority over spending on entertainment. Previous efforts to assess the countercyclicity of ticket demand do not find conclusive statistical significance (Nardone 1982, Vogel 1998). Therefore, I do not introduce techniques to detect and eliminate cyclical effects in entry patterns based on market releases. Seasonal demand patterns seem to be more unequivocal. Moviegoers find it most convenient to see films in vacation periods such as Christmas, Thanksgiving, and Easter, while children out of school during the summer months have more time to frequent theaters. On the contrary, in the fall, when school begins and new television programs are introduced, audiences tend to be distracted from going to the movies. Then, the industry tends to concentrate most of its releases in specific time intervals over the year. Figure 2.9 presents a graphical representation of the average distribution of total box office receipts over the year.

Insert Figures 2.9 about here

To account for seasonal effects, I introduce eleven dummy variables corresponding to the different months of the year when entry is observed. A typical regression equation contains a constant vector of ones associated with the intercept coefficient. Now, if there is a dummy variable for each of the 12 months, summing all the dummy variables together equals one. The problem of perfect collinearity is avoided by not adding a dummy variable for December. The December effect is measured by the intercept, while the effect of other seasons is measured by the difference between the intercept and the estimated regression coefficient for the season's dummy variable.

Ticket prices. Ticket sales for movies generally do not show very responsive changes in box office prices per se, rather there is sensitivity to the total cost of movie-going, which can include fees for babysitters, restaurant meals, and parking (Donohue 1987). Although demand for movies, especially for those backed by strong word of mouth, advertising and reviewer support is essentially price inelastic, exhibitors are often able to stimulate admissions by showing older features at lower prices during off-peak times. Some segments of the audience can take advantage of such second-type price discrimination (Varian 1992), and so can exhibitors. Average dollar prices adjusted for inflation and year to year variations are included as a first control for this indirect measure of carrying capacity, following recent ecological studies that include long-term and short-term adjustment of population dynamics to carrying capacity (Ruef 2000). Increasing average prices may reveal more differentiable consumption patterns that stimulate entry, while short term price variations could still have the opposite effect.

A second control for the level and variation of carrying capacity is related to screen capacity. Screens in theaters were the exclusive commercial outlet for motion pictures from the birth of the industry until secondary markets like television or home video emerged. Annual statistics on the exhibition sector published by *Motion Picture Almanac* and *Motion Picture Year Book* provide data on the number of operating screens in the country. Absolute number of screens and yearly variations are the measures included in the analysis. Some caution with respect to these variables is advisable. Screen capacity can possibly show a relationship with the number of films or organizational size rather than entry rates. Moreover, industry historians and analysts remark that it is the number, location and ownership of first run theaters as primary sources of profits that often mattered more than capacity in influencing industry structure (Huettig 1944, Conant 1960, Gomery 1986). Such data, however, are unavailable in a systematic way.

A third measure of carrying capacity included in the models is the weekly attendance in theaters. When released to the market, films compete for audiences. Total attendance calculated in millions and year to year variations are the measures included in the analysis to represent long and short dynamics of social demand for movie going. In the observed period, motion pictures went from a widely popular entertainment form to a less relevant amusement alternative. After 1946 attendance declined systematically despite the growth trend showed by statistics on U.S. population. Alternative forms of outdoor and home entertainment like spectator sports or television gained popularity reducing consumption for motion pictures in theaters (Dimmick and Rothembuhler 1984). The same sources that provide information about number of screens inform us on what the average attendance of moviegoers in each year.

A final measure of capacity accounts for possible mutualistic relationships with related industries. Television broadcasting proved its commercial viability after the Second World War. Between 1945 and 1960 the number of commercial television stations grew from 9 to 440, and by 1960 85% of U.S. households had a television set (Walker and Ferguson 1998). In the United States, the historical relationship between the motion picture and the television broadcasting industries is intricate (Hilmes 1990). Before film producers and distributors recognized the potential of the new market, television was considered as a competitive threat, responsible for the decline of movie attendance in theaters after 1946 (Monaco 2000). Essentially, the diffusion of television among households coincides with the progressive retrenchment of motion picture consumption. The success of television, on the other hand, is associated with an increasing demand for programs. At the beginning of 1950's major producers and distributors decided not to sell television rights to their feature films, particularly the most recent ones. Films that are broadcast are mostly minor or independent productions made before 1948. After 1955, film companies loosened their restrictive policies, began to distribute intensely the rights to their libraries, and organized production initiatives targeted exclusively to the television audience (telefilms and series). In this way, they had a larger market for the amortization of their investments in film production and a higher utilization rate for their facilities. The percentage of national TV households provides a measure of additional capacity for feature film producers and distributors.

Economic indicators. Using the *Daily Variety* end-of-quarter production start figures Vogel (1998) demonstrates that the number of feature productions started in any year may be sensitive to changes in interest rates and the availability of credit. His results show that there is a moderate to weak inverse lagged correlation between real interest rates and borrowed resources, and the number of production starts. Interest rates are subject to endogeneity - their level correlates strongly with the strength of the economy. Inflation can also introduce noise into the meaning of the level of interest rates because the nominal rate may not reflect the real cost of capital. We follow previous studies analyzing organizational vital rates (Sørensen and Sorenson 2003) and include a variable of year to year changes in the interest rate to capture the effects of the cost of capital on entry. Interest rates are used as a level in monetary policy, i.e. rates go up when the economy is doing well; thus, we may expect their increase to affect positively entries. Rates are supposed to be more relevant for entrepreneurial initiatives when the government intervenes with acts of reform. In 1962 a 7 per cent investment tax credit on domestic production was introduced as a means of stimulating the economy, and was eliminated by the Congress in 1969 (and subsequently reintroduced into the Revenue Act of 1971). In the motion picture industry, tax shelters and other tax-leveraged investment became a mode of production finance until 1976. Limited partners holding limited recourse or nonrecourse loans (loans without personal liability exposure) could write down losses against income several times the original amount invested in film production (Cook 2000). We include in the models an interaction variable between interest rates and the period in which tax shelters were allowed, expecting a negative relationship with entry rates- when tax savings are available, low interest rates stimulate entry.

Periods. We included dummy variables to control for periods of change in the economic environment of the industry, which may in turn affect entry and exit rates. Two contextual variables were created for the years of World War I and II. Three other variables are more industry-specific. The first two are aimed at capturing the effects of antitrust intervention. Beginning in late 1930's, the Justice Department began to issue court orders to reduce the pattern of vertical integration that major organizations had undergone for more than a decade. The constructed variables cover the years 1938-1940, and the years between 1948 and 1970. These variables consider the influence that the most important antitrust litigations - the so called "Paramount Case 1" and "Paramount Case 2" - may have produced effects on the industry's structure (Litman 1998). In particular, in 1948 the second Paramount court case ended with an order enforcing vertical divestiture of exhibition from production and distribution; actual divestiture would not be completed until 1957 but was enforced until the end of the observation period (Conant 1960). Finally, a dummy variable controls for periods of different technological standards, silent and talking. The introduction of sound had a significant impact from 1927 with the release of successful pictures like "The Jazz Singer" and in few years the whole industry converted to the new standard (Bordwell et al 1985). In general, the production and distribution of talking pictures was more elaborate and costly, and entry in the industry should have been easier ceteris paribus with the silent standard.

Finally, we included two variables that control for population dynamics. The yearly number of prior entries and exits are added to account for effects on current entry rates. Prior entries can signal attractive niches to potential entrepreneurs and stimulate further entry, just like prior exits can imply that environmental resources are freeing up (Delacroix et al. 1989). These positive effects can reverse at higher numbers, when organizations compete for resources or the environment shows hostility. The influence of population dynamics is distinct from that of density dependence, but empirical support is weaker. This is especially true when the two effects are modeled together, with density dependence proving more robust and systematic. I drop quadratic specifications of population dynamics due to their sensitivity to outliers (Baum 1996). Tables 2.1.a to 2.1.d contain the descriptive statistics of the covariates used in the models, while Tables 2.2.a to 2.2.d provide the bivariate correlation matrices of the two main sets of models, density dependence including mass dependence and density dependence with temporal variation.

Insert Tables 2.1, and 2.2 about here

For the analyses of firm exit, the "dependent variable" is the hazard rate, or the limit probability that an organization exits the industry in a given year-quarter conditional on the fact that has survived until that time since its entry. Firms can exit industries in different ways, including disbanding, bankruptcy, merger, acquisition, etc. In this study we were able to control the actual exit from the product market and its cause for most cases. For instance, Metro Pictures was founded in 1915 and we record its entry in the market in the same year. In 1919 Metro was acquired by exhibitor Loew's and we do not record exit. In 1924 Metro-Goldwyn-Mayer Inc. was created, after that Loew's-Metro had merged its activities with the production companies Goldwyn Pictures Corp. and Louis B. Mayer Pictures. In this case, the merger implies that the three pre-existing firms exit the market and a new one enters the market. In the analyses, however, we do not treat the different destination states of the exit process differently and record only exit and re-entry if it occurs.

The key explanatory variables for the analyses of exit rates are measures of density and mass similar to those described for the analysis entry processes, essentially combining population level and firm level covariates. In addition, the study of mortality/exit event requires the introduction of specific mechanisms of age and size dependence. The debate concerning the effects of aging on organizational mortality is still open and rather than positing a particular type of liability, we include in all models specifications for firm tenure in the industry. We chose to represent temporal variation in transition rates breaking the time dimension of age into five pieces: the first ranges from zero to the minimum stay in the industry (zero to one quarter); the second ranges from the minimum stay to a season presence in the market (one to four quarters);

the third goes from the minimum season presence to a minimum continuous presence (four to eight quarters); the fourth ranges from the minimum continuous presence to a minimum sustained presence (eight to twenty quarters); the fifth includes all tenures superior than the minimum sustained presence (more than twenty quarters). Concerning size-related liabilities, we follow a similar but simpler approach. Research on age-varying size and life chances has conceptualized and measured organizational size in two ways: capacity and scale of operations (Barron et al. 1994, Carroll and Hannan 2000). We follow the previous research on these populations and concentrate on scale of operations, and we measure it in terms of a firm's annual production or distribution of feature films automobiles. This measure is available more regularly than accounting measures of performance, and it proves more reliable. Producers and distributors engaged in more projects diversify the market risks and reduce part of the uncertainty that characterize the industry (De Vany 2004). By adopting a portfolio strategy organizations may survive longer. Moreover, distributors may benefit from a more efficient use of their commercial network when grow larger. The general prediction here is that exit has a negative size-dependence. Finally, we include the measure of density at entry to account for density delay effects (Carroll and Hannan 1989b, Swaminathan 1996). Higher density at the time of entry implies a resource-scarcer environment with deleterious consequences on the life chances of organizations, either during all its tenure or at different points in time.

In estimating the exit models, we incorporated several but not all of the controls described for the entry models. To capture unmeasured temporal changes that may affect the failure of producers and distributors, we include dichotomous variables that represent the war periods, the two Paramount cases and the standard silent vs. sound. We expect a positive relation between these variables and exit rates. Among the capacity measures, we selected the long term measures of screen capacity, attendance, ticket price and penetration of TV in households. We expect negative effects of these variables on exit rates. Finally, we include the HH index of market concentration to control for alternative processes of segregation in the populations. We expect a positive effect of concentration on exit rates. Tables 2.4.a and 2.4.b contain the descriptive statistics of the covariates used in the models, while Tables 2.5.a and 2.5.b provide the bivariate correlation matrices.

2.6 FINDINGS AND DISCUSSION

Entry

Table 2.3.a presents the estimates obtained from negative binomial regression on entry of feature film producers. The two sets of specifications included here are density and mass dependence. The first model in Table 2.3.a contains only control variables and period effects. The seasonality effects are significant according to the pattern indicated in Figure 2.9, where variation in consumption observed across vacation periods also influences entries in the production sector. The period effect, however, do not show statistical significance. Coefficients for the war years are negative, possibly indicating that resource rationalization generally associated with war events might have reduced entries in the industry, but the absence of statistical significance does not allow interpretation. Surprisingly, the period effects addressing specific environmental changes in the motion picture industry also are not significant. Particularly, the post-Paramount case variable even shows a negative effect on entry, suggesting that the antitrust intervention might have reduced the introduction of organizational diversity in the population of producers, rather than promoting it. Due to the lack of significance, however, we limit this interpretation to mere speculative terms. Finally, sound shows a positive, but non significant impact on entries. Lack of

data does not allow us determining whether finer-grained measures of diffusion of technological standards can provide support for our hypothesis.

Model 1 in Table 2.3.a also indicates that the general economic conditions do not seem to produce effects on entry patterns. The interaction term of tax shelter reform and level of interest rates is positive as expected but not significant, and so is the short term measure of variation in interest rates. Finally, producers' entries show limited significant relationship with the industry measures of carrying capacity. Screen capacity has negative coefficients and no statistical significance, while price has positive coefficients and again no significant effect. Weekly attendance has a negative and significant effect on entries. Despite the constraints of resources related to decline in film consumption in the theatres after 1946, entries increased in the same period. Indeed, organizations involved in film production do not seem to be discouraged by shrinking audiences. The level and variation of ticket prices have a positive but not significant effect. The diffusion of television in the market shows a negative and significant effect, indicating a competitive effect of the new medium on motion picture producers. The synergistic effect of secondary markets may be actually absent, or the observation period may not be extended enough to capture the development of successful distribution strategies for films in the secondary markets. Vogel (1998) implies that non-significant effects of secondary markets can be explained by the fact that what is gained in one market may be lost in another. The ancillary profits are often substitutional and do not necessarily lead to increments in aggregate profits. In addition, production and releasing costs seem to have risen faster than revenues generated in the markets. The variables measuring population dynamics indicate that prior entries stimulate new entry in the population of producers, whereas prior exit does not have a significant impact on the dependent variable. Finally, the concentration level has a negative and significant effect on entry of producers, indicating that partitioning processes may not be in place within the population.

We can anticipate that the results of period effects on entry by producers will be systematically confirmed in the further specifications of the models. Theoretical and empirical motivations recommend not eliminating the non significant variables from the other estimations. First, the history of legitimation and competition for any organizational population depends partially on the conditions under which it evolved (Carroll and Hannan 2000). Therefore, omitting industry specific controls would provide an incomplete representation of the institutional environment surrounding the evolution of the focal population. Second, it is useful to remind that we want to estimate the effect of some variables net of the effects of other variables, including those that are non-significant.

The second model in Table 2.3.a provides a test the basic hypotheses of density dependence. The effects of controls and period effects have close results to those obtained under the first model. Exceptions include the significant positive effect of WWI and the negative effect of screen capacity. Population dynamics is significant and negative only for prior exits, indicating the limited attractiveness of the niche; these results, however, seem difficult to reconcile with other effects like attendance capacity. By using a likelihood ratio test (LRT) as a relative goodness-of-fit test we can compare pairs of models (Greene 2003).[11] The LRT is only valid if used to compare hierarchically nested models. That is, the more complex model must differ from the simple model only by the addition of one or more parameters. The LRT begins with a comparison of the likelihood scores of the two models:

[11] An alternative to LRT for models fitted by maximum likelihood is the Wald test. Wald testing requires fitting only one model (the unrestricted model). Hence, it can be computationally more attractive than likelihood-ratio testing. Most statisticians, however, favor using likelihood ratio testing whenever feasible since the null-distribution of the LR test statistic is often "more closely" chi-square distributed than the Wald test statistic (Long 1997).

$LR = 2*(lnL1 - lnL2)$

This LRT statistic approximately follows a chi-square distribution. To determine if the difference in likelihood scores among the two models is statistically significant, we next must consider the degrees of freedom. In the LRT, degrees of freedom are equal to the number of additional parameters in the more complex model.

Overall, the second model with density dependence fits the data better than the model with only controls and periods ($\chi^2 = 2[L2 - L1] = 24.74$ with p-value < .001 for 2 degrees of freedom). In support of the decision to include also non-significant variables in more complex specifications, it also fits data better than a density dependence specification without seasonality ($\chi^2 = 2[L2 - L1] = 352.0531$ with p-value < .001 for 11 d.f.) and a density dependence specification without the period variables seasonality ($\chi^2 = 2[L2 - L1] = 4.77$ with p-value = .31 for 4 d.f.). The first and second order terms of density show only partial support and contrary to expectations. Increasing numbers of producers when density is low have a negative effect on new entries, but the effect is non-significant. The second term of density has a significant positive effect, indicating a mutualistic rather than competitive effect on entries. This result might not surprise if considered in the light of the strong resurgence experienced by the industry, yet it is contradicting the general prediction of density dependence theory.

Models of mass dependence improve on the fit of the density dependence specification. Model 3 presents the specification as developed by Barnett (1997). When density and mass effects are included in the same models, both density variables are significant and in the expected direction. Mass has a negative impact on entries, and so does the age effect of living organizations. Industry capacity and competitive experience of existing organizations reduce entries, supporting a strong survivor hypothesis. Moreover, the interaction term between age and size is positive even if non significant. This result can be surprising in an industry where solutions to improve fitness prove ineffective due to high uncertainty about rules of success. Model 3 fits the data better than the basic density dependence (χ^2 = 2[L2 - L1] = 49.70 with p-value <.001 for 3 d.f.). Mass dependence as developed by Barron (1999) is described in Model 4. In this case, the density terms are again non significant and contrary to expectations. The mass term turns positive and the average size term has a negative effect as predicted. This result is difficult to interpret as research in motion picture production has argued the absence of efficient scale in this activity (Conant 1960). Overall, Model 4 does not produce better fit than the basic density dependence (χ^2 = 2[L2 - L1] = 3.66 with p-value = .1602 for 2 d.f.). The two mass dependence specifications are not nested and cannot be compared using LRT. For this purpose, we decided to estimate a full mass model including estimates of Barnett (1997) and Barron (1999). Model 5 shows results consistent with Barnett's specification while Barron's average size term becomes non-significant. This model does not fit the data better than the mass dependence by Barnett (χ^2 = 2[L2 - L1] = .31 with p-value = .5774 for 1 d.f.), but fits the data better than the model developed by Barron (χ^2 = 2[L2 - L1] = 46.35 with p-value <.001 for 2 d.f.). The comparison between the two specifications is still indirect. A more direct way to evaluate fit for non nested models is provided by AIC (Akaike 1973) and BIC (Schwartz 1978) measures. The conventional interpretation of AIC is as an estimate of the loss of precision (or, increase in information) that results when θx, the MLE, is substituted for the true parametric value, θt, in the likelihood function. Thus, by selecting the model with minimum AIC, the (estimated) loss of precision is minimized. While AIC intends to minimize the divergence between the true distribution and the estimate from a candidate model, BIC rests upon Bayesian modeling and tries to select a model that maximizes the posterior model probability. BIC evaluates fit and model complexity and leans toward simpler models (Greene 2003, ch.8). The AIC for Barron's mass dependence is 4.768, while for Barnett's is 4.706. BIC's values provide similar results: BIC for Model 4 is = -1124.270, and for Model 4 is = -1163.746. If the difference between the BIC of two models is <0, then the first model is preferred. A rule of thumb is that if differences are larger than 10 the support for this decision is very strong (Long 1997).

Table 2.3.b presents the results of the estimation of negative binomial regression for the population of distributors. General results of the analysis of producers' entries are confirmed in the models for distributors. We focus indeed on additional or different findings. In the controls and basic density specifications, the variables for war and antitrust interventions have higher significance than in the previous set of models, yet the effects are negative. Producers and distributors seem to react differently to environmental processes. Particularly, distributors benefited most from the integrated relationships existing with producers and exhibitors, and antitrust action could have discouraged new ventures that would take advantage of possible synergistic effects. At the same time, the effects of population dynamics reveal a positive relationship between entries and prior exits, to indicate a higher sensitivity to niche unpacking than to signal of niche attractiveness. Interestingly, the concentration index has a non-significant effect, even if its sign is negative as expected.

Differently from the case of producers, density terms are significant when modeled without including mass dependence. Barnett's specification fits the data better than simple density dependence ($\chi^2 = 2[L2 - L1] = 27.62$ with p-value $<.001$ for 3 d.f.). Distributors may enjoy scale or scope economies in marketing and promotion activities because they can spread sunk costs over many products and markets. Increasing mass should reduce entries. The aggregate mass measure, however, has a negative but non-significant. The aggregate age of living organizations instead has a negative and significant relationship with entries. The weak vs. strong hypothesis favors again the stronger competitive effects of large and old organizations. In Model 4, Barron's mass dependence performs poorly in the model for distributors. Model 5 combines the two specifications for mass dependence. The main result here confirms the results obtained with Barnett's specification, with the second term density lacking statistical significance. In reality, the model does not fit the data better than the constrained version of Model 3: $\chi^2 = 2[L2 - L1] = -.59$ with p-value = 1 for 1 d.f. If we compare Model 3 with Model 4, both AIC and BIC for Barnett's specification provide better fits than Barron's, respectively 2166.407 vs. 2185.151 and 2335.711 vs. 2321.53.

Table 2.3.c contains the results of regression analysis of producers' entries for density dependence and temporal variation. Here, the time-constant density dependence is compared with specifications including time-varying density dependence.[12] Model 1 and Model 2 are the same as in Table 2.3.a. Model 6 introduces temporal variation in density-dependent processes as developed by Hannan (1997). Temporal heterogeneity in chronological time fits the data better than the basic density dependence model ($\chi^2 = 2[L2 - L1] = 38.30$ with p-value < .001 for 6 d.f.). First and second term density variables are significant at < .01 level and with the expected sign. The interaction terms between density variables and industry age test the population inertia hypothesis. Here we find weak support. The first order interaction is significant only at the .10 level and in the opposite direction relative to the theoretical prediction, while the second order is positive but non-significant. We do not seem to find evidence for stickiness in the legitimation and competition processes. The industry age variable is significant but has a negative sign. The feature film industry was born on the ashes of the short film industry; therefore first order

[12] To replicate the empirical analysis of Ruef (2004), we performed exploratory analyses of the effects of population inertia by including 2,3,4, and 5 year lagged density measures. The results revealed a general lack of significance of these specifications. Due to the large amount of information summarized in this section, we do not present models that include such specifications. The results from these exploratory analyses are available from the author upon request.

industry age may in reality capture not the early development but a more mature evolutionary phase. The interaction terms between density and age squared test the resurgence hypothesis. The first order density interaction has a significant but negative effect on entries, failing to find evidence for late legitimation effects. The second order density interaction is negative but non significant. The idea that the evolution of population structure is mainly responsible for driving resurgence in mature phases of industry history does not seem to find a strong support in this setting because the control for market concentration obtains a significant negative effect. This finding seems to suggest that alternative explanations should be responsible for the resurgence phenomenon. The squared industry age term is, again in contrast with Hannan (1997), positive and significant. This result may hint at the possibility that the industry experiences cyclical evolutionary patterns, or that the source for late increase in density and entries may reside outside the population.

Model 7 presents the results of the estimation of temporal variation expressed in evolutionary time. This model fits the data better than the basic density dependence ($\chi^2 = 2[L2 - L1] = 42.92$ with p-value $< .001$ for 3 d.f.). We find that all three variables measuring evolutionary time scale significant, but with signs opposite to predictions. The inverse of cumulative entries has a positive effect, maybe because the industry did not lack legitimation when feature films were introduced because a pre-existing industry could have discounted it in its history. The interaction between density and the inverse of trials show a negative effect. In the population of feature film producers, higher retention rates do not increase entries. This result does not necessarily disconfirm the hypothesis of population level learning theorized and supported by Sorenson (2000). Rather, different populations may develop different degrees of learning. It may also be that minimum thresholds exist that trigger learning mechanisms at the population level. The result, however, seems to be consistent with the previous finding about competitive intensity, which did not support the weak survivor hypothesis. Density squared divided by cumulative entries yields a positive effect and does not suggest a decrease in competitive interaction among surviving firms. It should be stressed that the specification of temporal variation in evolutionary time scale does not find support for the main effects of density and density squared. A final specification, Model 8, includes both time scales as previously estimated by Sorenson (2000). This full model is found to fit the data better than Model 6 (χ^2 = 2[L2 - L1] = 27.44 with p-value < .001 for 6 d.f.) and Model 7 (χ^2 = 2[L2 - L1] = 32.06 with p-value < .001 for 3 d.f.). The results confirm the weak support for chronological time scale and support contrary to predictions for evolutionary scale. The main effects of density are not significant. Finally, comparison between the two non-nested time scale models provides support in favor of the evolutionary specification -AIC and BIC are, respectively, 3337.311 and 3487.871 for evolutionary time, and 3347.926 3512.174 for chronological time. The specification for temporal variation in evolutionary time scale is strongly superior (Long 1997) to the mass dependence developed by Barnett (AIC= 3337.412).

Table 2.3.d presents the regression results of models of temporal variation for the population of distributors. Model 6 analyzes the temporal variation specification in chronological time scale. Differently from the case of producers, the introduction of interactions between density and industry age leave the effects of basic density-dependent processes non-significant. All interactions, however, are significant and with the predicted sign. Therefore, we find general evidence for weak density dependence in the population of distributors; at the same time legitimation and competition processes play a role in the evolutionary history of this population but their relationship with density seem overall diminished when compared to the case of

producers. The first and second order density terms interacting with age indicate support for the population inertia hypothesis. The interactions with squared age support the late resurgence hypothesis, but the negative effect of concentration does not suggest an explanation for a mechanism based on partitioning. The chronological time scale model fits the data better than the density dependence based on a LRT (χ^2 = 2[L2 - L1] = 41.37 with p-value < .0001 for 6 d.f.). Model 7 in Table 2.3.d contains the specification of temporal variation expressed in evolutionary time scale. This model fits the data better than the basic density dependence (χ^2 = 2[L2 - L1] = 39.27 with p-value <.0001 for 3 d.f.), and its results indicate a general consistency with density dependence arguments, but weaker support of population level learning effects. Of the variables containing the evolutionary time scale, the inverse term measuring lack of legitimacy is non significant but in the expected direction, while the interaction term with simple density is only significant at the .10 level and in the direction contrary to predictions. This finding confirms what we found in the population of producers. The second terms density interaction with density is positive and highly significant, suggesting that competitive interaction among surviving organizations does not decrease. As in the previous case, Model 8 combines the two estimations of temporal heterogeneity together. This specification has better fit than the separate specifications (LRT to chronological time scale is χ^2 = 2[L2 - L1] = 23.41 with p-value <.0001 for 6 d.f.; LRT to evolutionary time scale is χ^2 = 2[L2 - L1] = 21.31 with p-value <.0001 for 3 d.f.). Despite problems of high collinearity, general statistical significance of coefficients does improve. The main density terms have the expected sign but lack significance. The interaction terms between density and age are all significant at the .05 level, but the first order interaction has a positive sign indicating stickiness only in competitive processes within the population. The inverse of trials variable is significant and negative capturing the positive effect of early legitimation, which indeed was not necessarily absorbed by the pre-existing short film industry.

Both interaction terms of density and the inverse of cumulative entries show similar results as Model 6 did.

Between the two unconstrained versions of the temporal variation models, the evolutionary time scale seems strongly preferable (AIC is 2161.107, while the value for chronological time scale specification is 2165.009; BIC is 2311.668, and 2327.632 for chronological time scale). If we look at the temporal variation relative to mass dependence specifications, we find that AIC and BIC do not agree on the selection of a single better model. What the replication and comparison strategy seems to suggest is that it might be effective to combine multiple time scales and more elaborate definitions of density dependence when analyzing complex historical patterns like those we observed in the motion picture industry. The concept of a more complex dependence of vital rates on population density and the implications derived from Hannan (1997) about the relevance of population evolution in association with its relations to other actors hint at the possibility that multiple levels of analysis or specialized interactions between populations and their environment might be partly responsible for organizational evolution.

Exit

Table 2.6.a presents the results from the piecewise regression estimations of exit rates of feature film producers. Model 1 contains the baseline specification of age and size dependence, in addition to industry controls and periods. The results of age dependence support the idea of a negative relationship with exit rates, i.e. longer tenure reduces the hazard of exit. The relationship is also monotonic. We also find evidence of negative and statistically significant size dependence. Larger producers are less likely to exit than smaller producers. The period variables do not

provide evidence that antitrust intervention affected exit rates. The war period has a weak negative effect on the rate, perhaps implying a more protected environment for established organization or even a more intense interest in movies – Koppes and Black (1990) analyze the influential role that politics and propaganda played in the industry during the WWII years, accompanied by the effort of producers to promote the war campaigns. The capacity measures provide mixed evidence. Attendance has a non-significant effect on the exit rate, while price has a positive significant effect. Remember that price also stimulated entry. Price is probably an ineffective signal of opportunity in the industry, increasing entry but also exit from the market. The diffusion of television reduces the exit rate, evidence of a mutualistic relationship existing between the two industries. If the emergence of new distribution markets for motion pictures did not increase entry rates at least granted existing producers better survival chances. The concentration index has a negative effect on exit rates, contrary to expectation, but is non-significant. Population dynamics has significant impact: prior exits increase the exit rate, contrary to expectation, while prior entries reduce the rate. Exits do not seem to have the resource freeing effect posited by Delacroix et al. (1989), rather they signal limited opportunities in the niche. Prior entries may reduce competition over resources reflecting differentiation in the resource requirements of existing organizations.

Model 2 adds to the baseline specification the first and second population density measures. When density is included, age dependence systematically loses significance while size retains it. This result seems to support the notion that portfolio strategies favour survival in the industry, while previous experience alone provides little guidance on what are the successful projects to produce. The role of uncertainty in shaping industry structure receives further evidence, consistent with previous studies developed by De Vany (2004). The control for war years and the television households variable remain significant in reducing the exit rate. The curvilinear effects of density dependence receive strong support, with first order density reducing the exit rate due to legitimating processes, and second order density increasing the rate because of competition. Model 2 improves the fit of the data over the baseline, as the likelihood ratio test indicates (χ^2 = 2[L2 - L1] = 22.07 with p-value <.0001 for 2 d.f.).

Model 3 incorporates the density delay effect as proposed by Carroll and Hannan (1989). The model fits the data better than the simple density dependence model (LRT χ^2 = 2[L2 - L1] = 14.25 with p-value <.0001 for 1 d.f.) The hypothesized effect of delay on exit rates is positive, while our results show a negative and significant relationship. This unusual result deserves attention and might hint at the existence of a time varying relationship between density delay and exit rates. This possibility has been investigated by Swaminathan (1996) who suggests the existence of population-level learning processes affecting organizations founded in more adverse environments. When conditions at founding are hostile, initial mortality for organization is high. Beyond a certain age, however, surviving organizations can develop selective learning on the processes and routines to adopt to succeed. The initial negative effect is reversed and survivors will experience lower mortality. We make an attempt at incorporating this view in Model 4, which allows the density-at-founding variable to produce effects varying with industry tenure. The results show that negative relationship does not vary and is slightly increasing only between the one to four quarters interval. It seems difficult to argue the existence of almost instantaneous learning among film producers, and the result remains hard to explain. Swaminathan develops a different estimation strategy, employing the Makeham extension of the Gompertz parametric model, and results are difficult in any case to compare directly. In Model 4 the density and size measures remain significant, while fit improves over Model 2 (LRT: $\chi^2 = 2[L2 - L1] = 688.04$ with p-value <.0001 for 5 d.f).

The next two specifications introduce mass dependence. Model 5 include the interaction between density and size as developed by Barron (1999), expecting a negative relationship with exit rates. The results indicate instead a positive significant effect of density x size on exit rates. The advantage that large organizations should develop when selective pressures become more intense, as hypothesized by Barron, is not produced in our data. The logic according to which effects of mass dependence and density dependence decouple over time to explain decline patterns in industrial evolution receives weak support. Model 5 improves fit over model 3 (LRT $\chi^2 = 2[L2 - L1] = 11.12$ with p-value =.0009 for 1 d.f) but adds another piece of evidence difficult to reconcile with existing theory. Model 6 estimates mass dependence in mortality rates as developed by Barnett (1997). While the model fits the data better than Model 3 ($\chi^2 = 2[L2 - L1] = 11.60$ with p-value =.0089 for 3 d.f), the estimates show that only the variable capturing the effects of aggregate age on exit rates is significant and positive (as expected). The use of information measures suggest that this model specification performs worse than Model 5 (AIC for Model 6 is 4540.021 and 4536.5 for Model 5; BIC for Model 6 is 4704.246 and 4723.743 for Model 5).

The last estimation, included in Model 7, makes an exploratory attempt to further investigate the odd results of Model 5 and also some previous empirical inconsistencies, for instance the significant negative effect of concentration on exit rate. The motion picture industry is subject to a structurally uncertain environment, and the location of organizations in the niche may affect their opportunities and constraints. This would imply that producers can utilize resources in different ways, as posited by niche width theory (Freeman and Hannan 1983). In this theory, organizations are classified in terms of generalism (wide niche) and specialism (narrow niche) of their competitive strategies. Firms with wider niches, independent of their size, have higher chances of survival. To explore the potential relationship between niche width and exit rates, we introduce the number of film genres in which producers have been active as a measure of variance in resource utilization (more genres = generalism). We expect that an increasing number of genres reduces exit from the market, controlling for size. The estimates of Model 7 find a negative significant relationship between genre and exit rates. Size alone is still significant, but its sign is reversed. Large producers have higher probability to exit the market than small producers, probably due to negative consequences of inertia, but generalist producers have a lower exit rate than specialists. The model improves fit over Model 3 (LRT χ^2 = 2[L2 - L1] = 192 with p-value <.0001 for 1 d.f), but we should be careful about the interpretation of its results. First, we do not propose a theory that explains fluctuations in population density that is linked to niche width theory. Second, the empirical treatment of the generalism-specialism configuration is simplistic and speculative. Third, measures of size and genre in the industry are highly correlated (.93), a fact that can create problems of estimation, for example high sensitivity to changes in the number of observations (Greene 2003). Despite all these limitations, we believe that future research may incorporate niche width theory to better explain population evolution in mature stages.

Table 2.6.b presents the results for the estimation of piecewise constant exponential regression for exit rates of distributors. As in the case of producers, Model 1 includes estimates of controls, periods, age and size dependence. The results are very close to those obtained for the previous population, and in this section we will focus more on the differences between the two populations to avoid redundant discussion. Model 2 contains the specification for density

dependence. The first and second order density measures are significant and in the expected direction. Among the other variables, the war years are only weakly significant, evidence of asymmetric relationships between vital rates of populations and environmental processes emanating from the external environment. In general, capacity measures and other periods have lower impact on exit rates of distributors than producers. Population dynamics is significant only in the prior exit variable, again with a positive sign possibly indicating limited attractiveness of the niche. Model 2 improves fit on the baseline model (LRT $\chi^2 = 2[L2 - L1] = 22.58$ with p-value $< .0001$for 2 d.f.). Model 3 introduces density delay in the estimation. With some surprise, we find that founding conditions have a positive relationship with exit rates but such relationship is not statistically significant. Distributors seem to be insensitive to the ecological properties of the niche when they entered the population; however, the density-dependent mechanisms are fully operating. In fact, this specification fails to improve statistical fit over the simple density dependence model ($\chi^2 = 2[L2 - L1] = .71$ with p-value = 39.82 for 1 d.f.). Model 4 makes an attempt to specify more finely the density delay hypothesis with the trial by fire logic, but fails as well. Tenure has a fluctuating effect on exit rates, shifting from negative to positive coefficients twice and remaining positive in the last time piece. None of the coefficients, however, is significant. The model does not fit the data better than the basic density dependence of Model 2 ($\chi^2 = 2[L2 - L1] = 3.70$ with p-value = 44.80 for 4 d.f.

Model 5 and Model 6 estimate mass dependence. Model 5 introduces the specification developed by Barron. As in the analyses of producers, the coefficient for the interaction between density and size is positive, but here is not even significant. We do not find evidence for density-dependent processes that subside to mass dependence. The model does not show fit improvement over Model 2 ($\chi^2 = 2[L2 - L1] = .62$ with p-value = 43.18 for 1 d.f.). Model 6 obtains equally disappointing estimates with the mass dependence developed by Barnett. Coefficients for the age and age x size interaction variables are in the expected direction (respectively, positive and negative). The aggregate size measure would support the strong survivor hypothesis (negative sign), but fails to obtain statistical significance. Overall, the model does not improve fit ($\chi^2 = 2[L2 - L1] = 4.95$ with p-value = 17.55 for 3 d.f.). Model 7 replicates the exploratory analysis of niche width processes affecting exit rates. We obtain again a negative and significant coefficient linking presence in genres to exit rates. In this specification, however, the coefficient of size turns positive but is non-significant. The fit of the model improves relative to the basic density dependence, with or without density delay effects ($\chi^2 = 2[L2 - L1] = 42.29$ with p-value < .0001 for 1 d.f. relative to Model 3). Information measures indicate that this would be the best performing model in this set of estimations (AIC for Model 7 is 1958.52, 1997.519 for Model 2 and 1998.806 for Model 3; BIC value for Model 7 is 2110.611, 2135.125 for Model 2 and 2143.654 for Model 3).

Although comparative evaluation of studies conducted in different contexts over different observation periods is difficult to establish, we find evidence that supports Ruef's claim for models incorporating more articulate versions of density dependence (2004). In addition to the main extensions of mass dependence and temporal variations considered by Ruef, in the next two chapters we will investigate another mechanism that may help explain irregular dynamic of organizational evolution, community ecology. We will depart from Ruef's framework that addresses community ecology in the logic of competing forms to focus on the association of vertically interdependent populations.

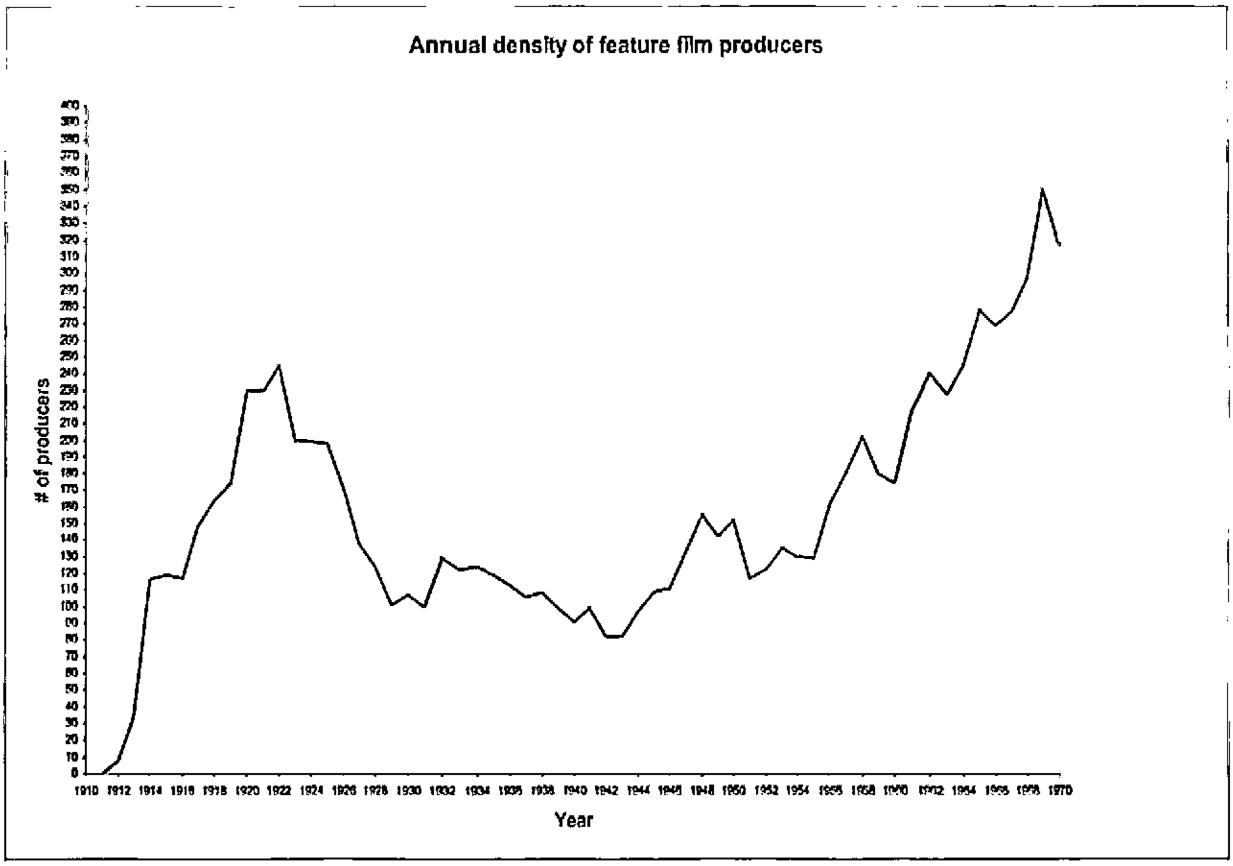

Figure 2.1 Density of feature film producers

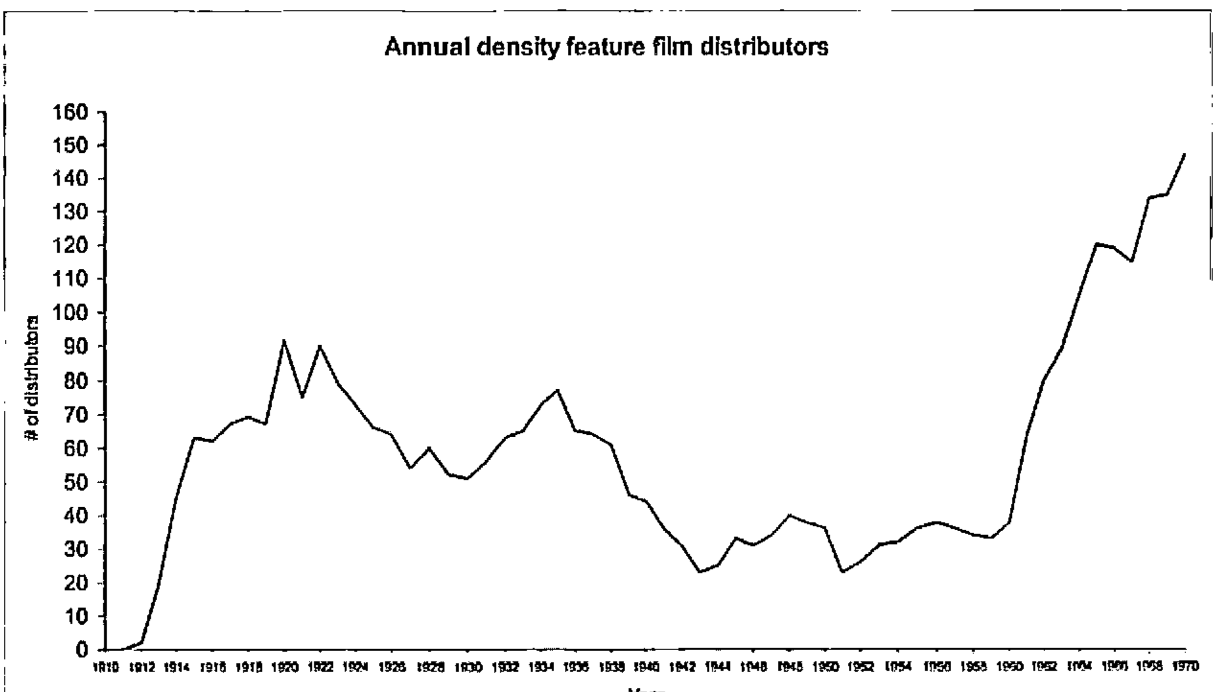

Figure 2.2 Density of feature film distributors

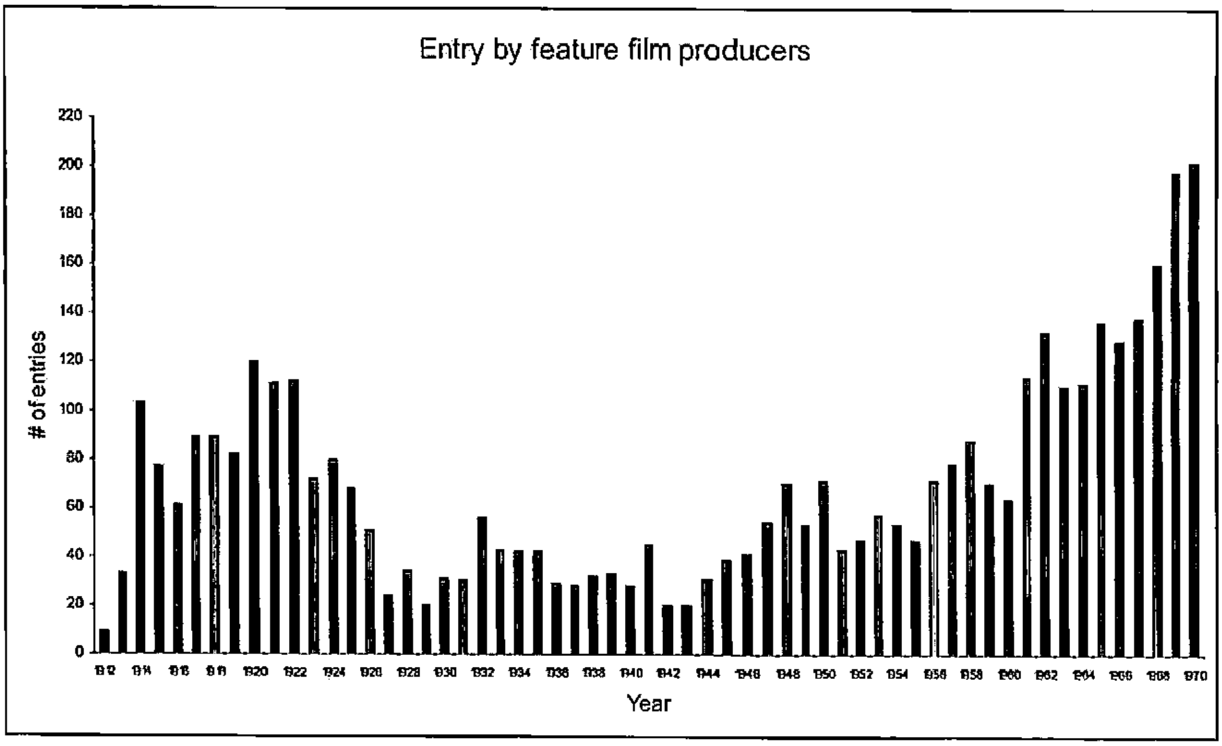

Figure 2.3 Annual entries of producers

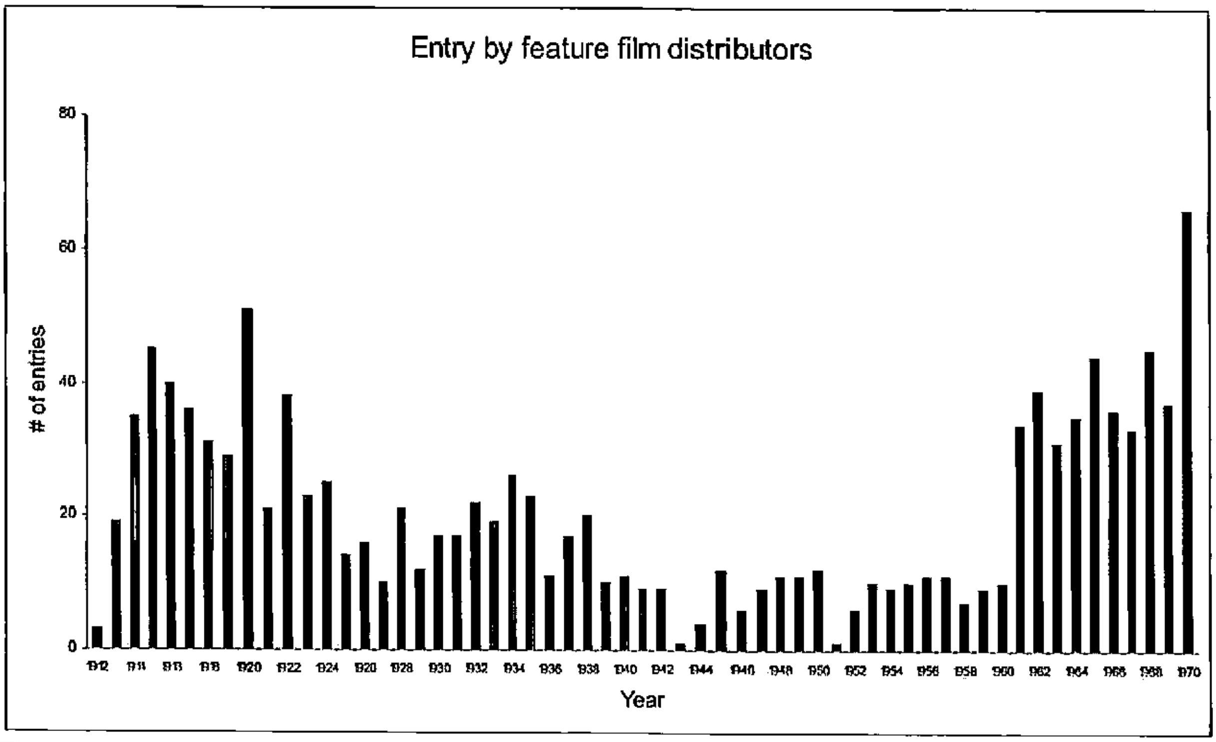

Figure 2.4 Annual entries of distributors

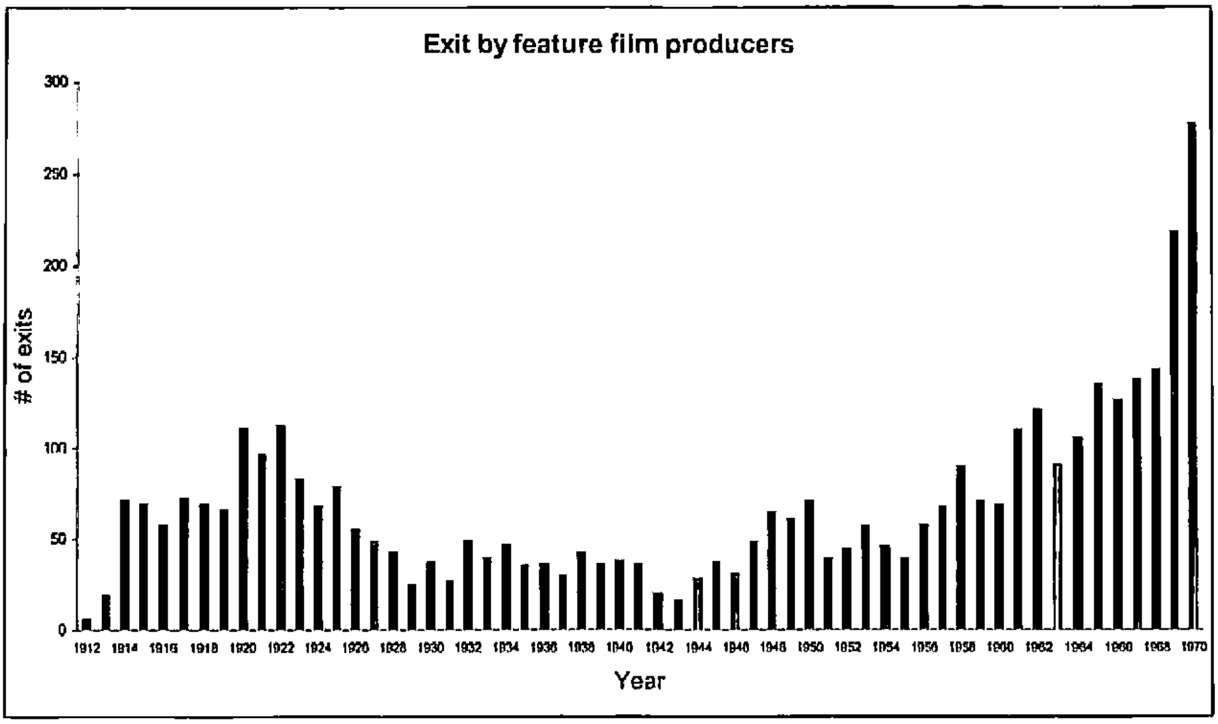

Figure 2.5 Annual exits of producers

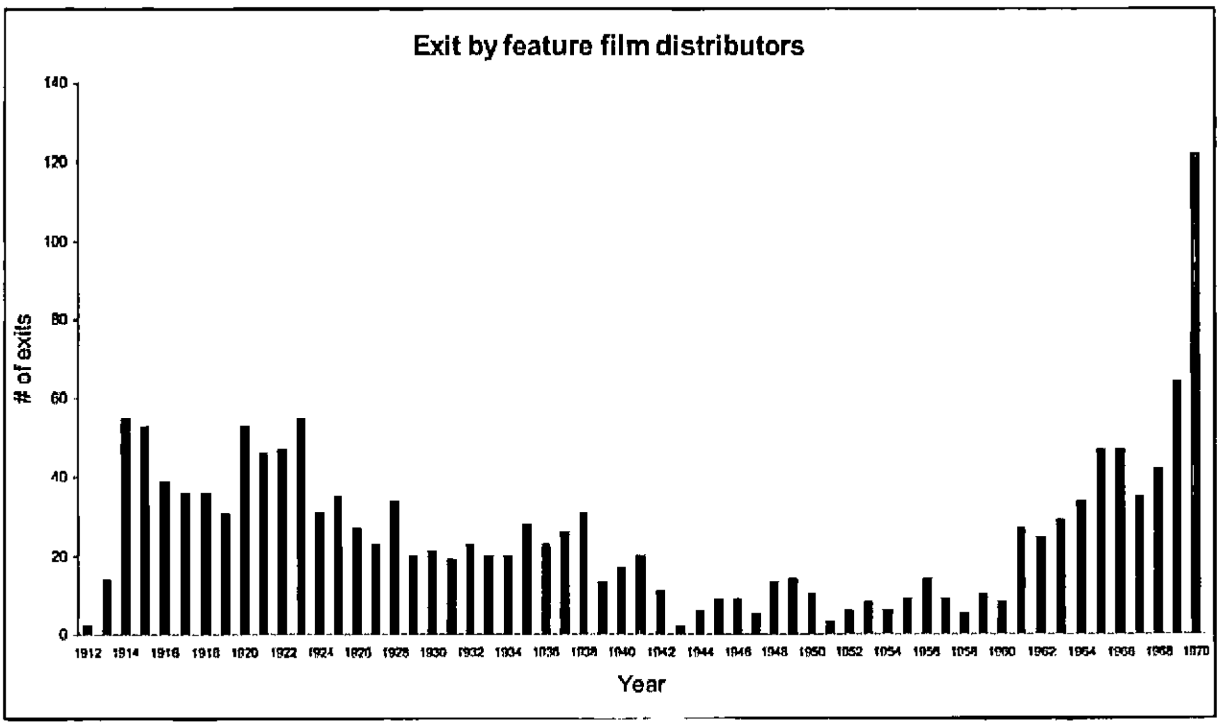

Figure 2.6 Annual exits of distributors

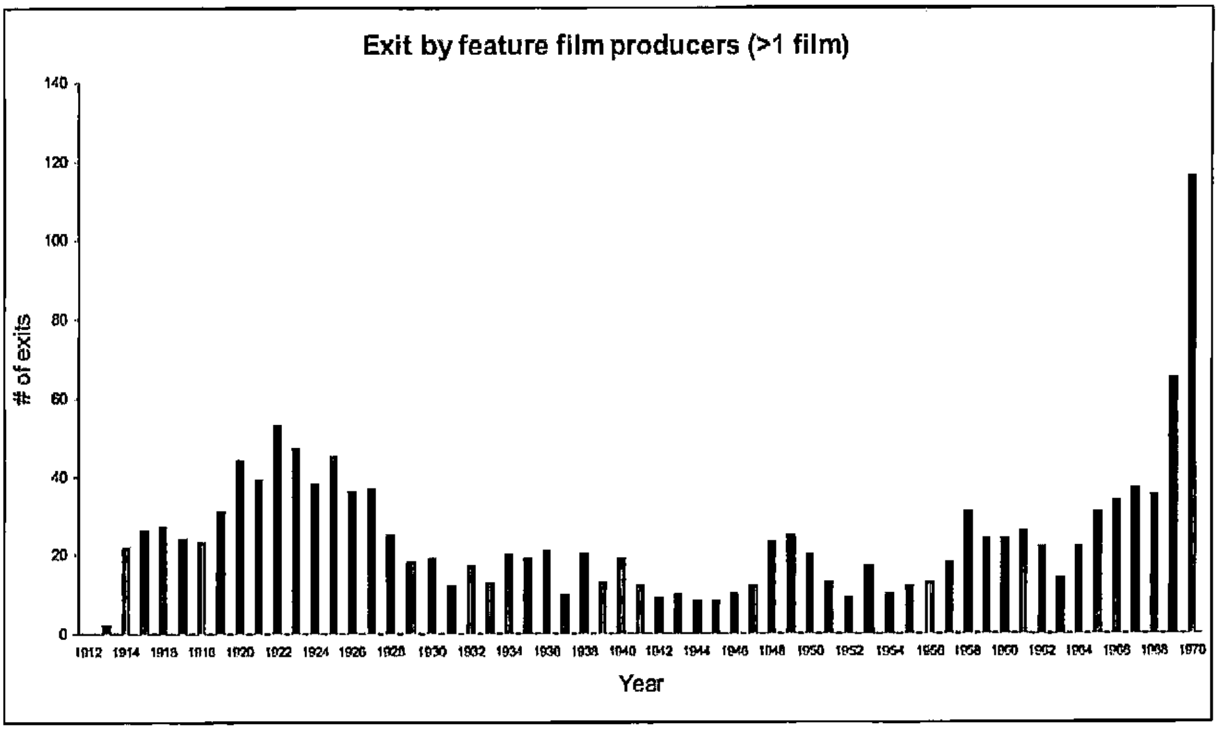

Figure 2.5.2 Annual exits of producers (of more than one feature film)

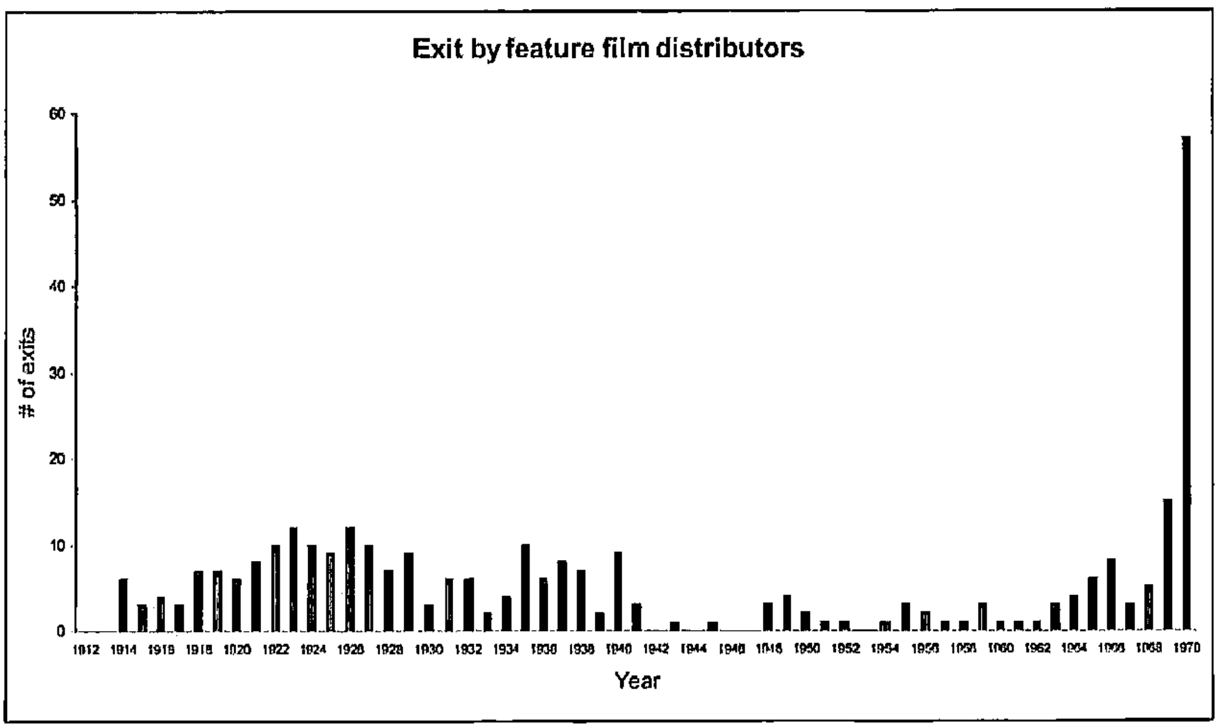

Figure 2.6.2 Annual exits of distributors (of more than one feature film)

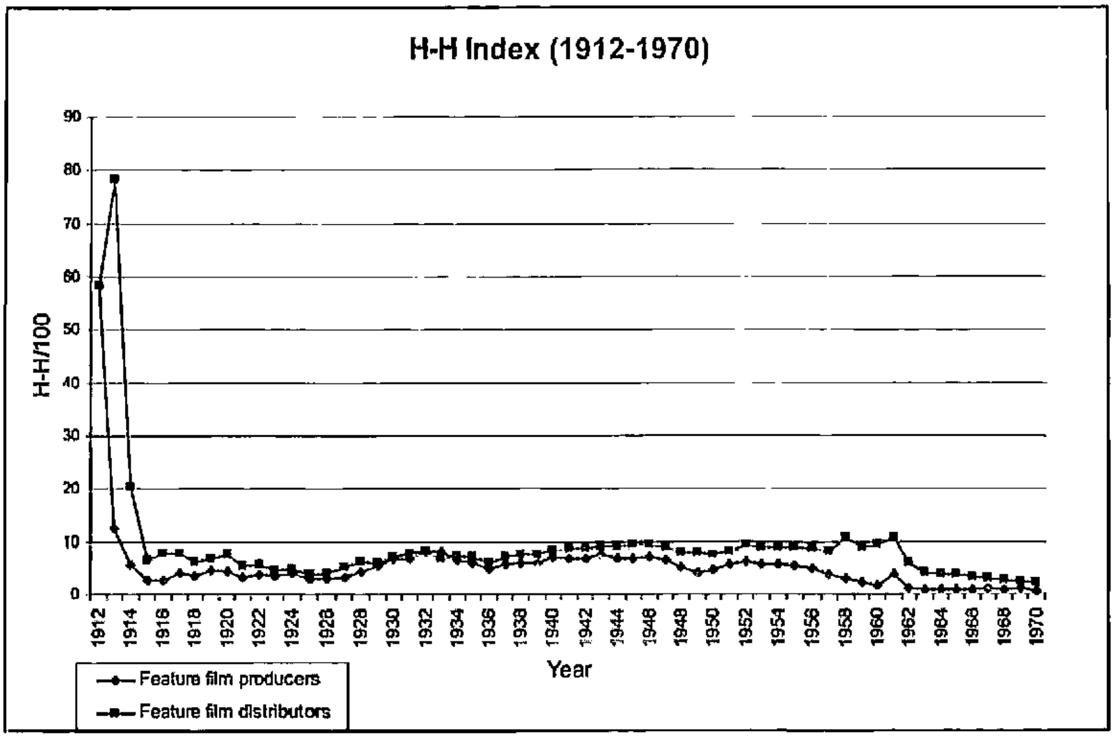

Figure 2.7 Concentration in the populations of feature film producers and distributors

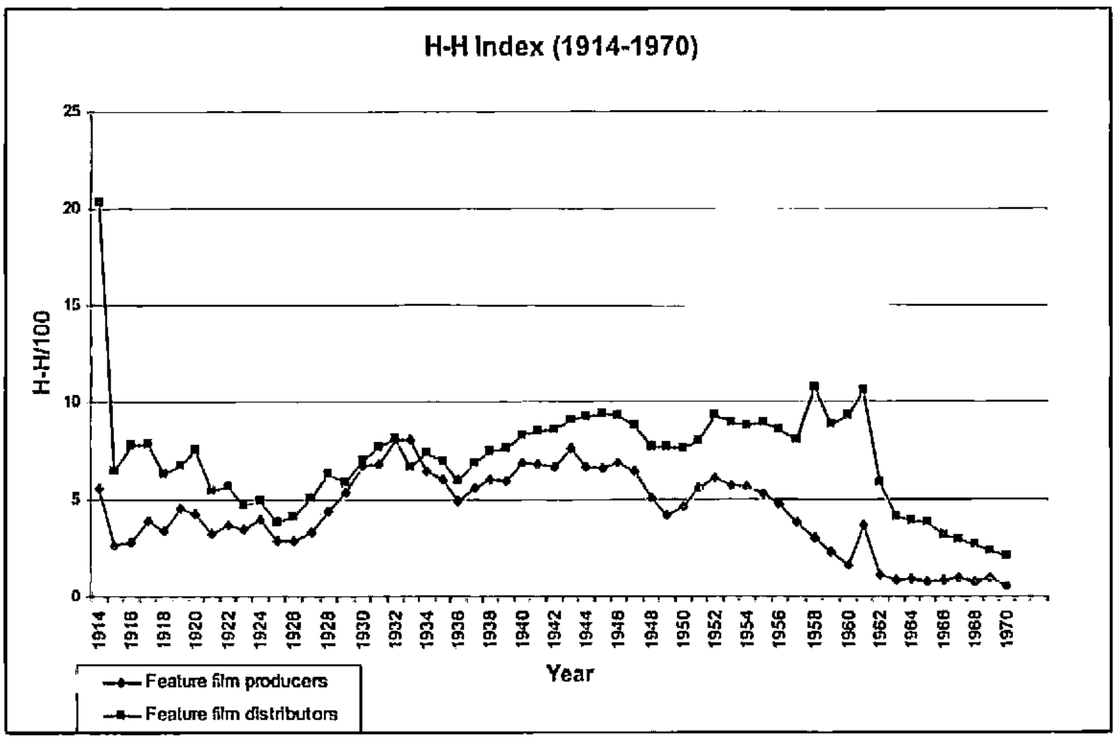

Figure 2.8 Concentration in the populations of feature film producers and distributors (detail)

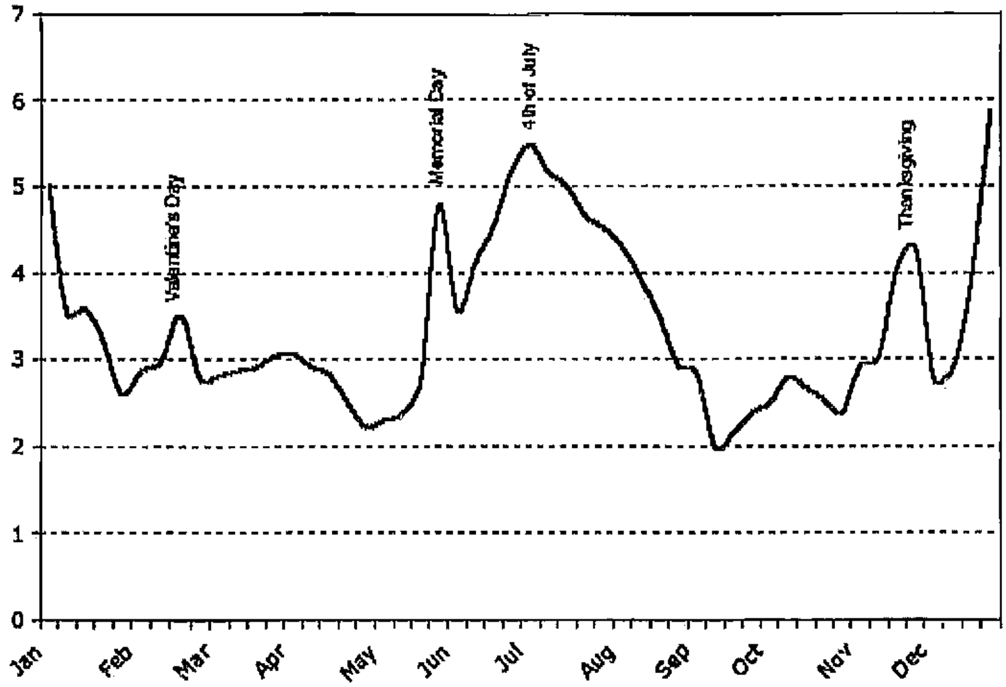

Figure 2.9 Seasonality in U.S. box office receipts. Source: Sorenson and Waguespack (2003).

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
January	708	.0833333	.2765808	0	1
February	708	.0833333	.2765808	0	1
March	708	.0833333	.2765808	0	1
April	708	.0833333	.2786999	0	1
May	708	.0833333	.2744381	0	1
June	708	.0833333	.2765808	0	1
July	708	.0833333	.2765808	0	1
August	708	.0833333	.2765808	0	1
September	708	.0833333	.2765808	0	1
October	708	.0833333	.2765808	0	1
November	708	.0833333	.2765808	0	1
WWI	708	.0677966	.2515743	0	1
WWII	708	.0847458	.2786999	0	1
Paramount I	708	.0508475	.2198414	0	1
Paramount II	708	.3898305	.4880565	0	1
Sound	708	.7288136	.4448864	0	1
Shelter	708	.626483	1.747533	0	7.105
Int. Rate var.	708	.0182901	.1241425	-.2047619	.3069106
Screens	708	17.46224	2.639156	12	23.172
Screens var.	708	.0081047	.0913538	-.3904762	.2473868
Tick. Price	708	3.23673	1.167959	1.167983	7.119297
T. Price var.	708	.0515695	.1030056	-.255	.4
Attendance var.	708	-.0064454	.0797748	-.2	.1666667
Attendance	708	51.58316	23.36308	17.6205	88
Prior entry	708	66.42373	40.22421	1	198
Prior exit	708	65.0339	41.06185	2	238
HH	708	5.396582	7.358745	.5075153	58.5
TV Households	708	23.69381	36.18575	0	94.45
Density	708	156.7514	67.20587	5.5	334.5
Density^2	708	29.2171	24.60936	.0425	112.1625
Mass	708	4.455268	1.883176	.06	8.77
Mean mass	708	3.372008	1.631579	.9444444	6.72887
Age x size	708	4.017746	2.236434	.004	7.9575
Age living orgs.	708	.7248164	.3142706	.009	1.331

Table 2.1.a Descriptive statistics for entry models of density and mass dependence, producers

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
January	708	0.0833	0.27658	0	1
February	708	0.0833	0.27658	0	1
March	708	0.0833	0.27658	0	1
April	708	0.0833	0.2787	0	1
May	708	0.0833	0.27444	0	1
June	708	0.0833	0.27658	0	1
July	708	0.0833	0.27658	0	1
August	708	0.0833	0.27658	0	1
September	708	0.0833	0.27658	0	1
October	708	0.0833	0.27658	0	1
November	708	0.0833	0.27658	0	1
WWI	708	0.0678	0.25157	0	1
WWII	708	0.0847	0.2787	0	1
Paramount I	708	0.0508	0.21984	0	1
Paramount II	708	.3898305	.4880565	0	1
Sound	708	.7288136	.4448864	0	1
Shelter	708	0.6265	1.74753	0	7.105
Int. Rate var.	708	0.0183	.1241425	-.2047619	.3069106
Screens	708	17.462	2.63916	12	23.172
Screens var.	708	0.0081	.0913538	-.3904762	.2473868
Tick. Price	708	3.23673	1.167959	1.167983	7.119297
T. Price var.	708	0.0516	0.10301	-0.255	0.4
Attendance var.	708	-0.0064	0.07977	-.2	.1666667
Attendance	708	51.583	23.363081	7.6205	88
Prior entry	708	0.5585	0.63323	0.001	2.601
Prior exit	708	18.39	11.2872	2	54
HH	708	9.1762	11.555	2.0738	78.125
TV Households	708	23.69381	36.18575	0	94.45
Density	708	59.505	30.0108	2.5	142
Density^2	708	4.4653	4.48548	0.0065	20.2
Mass	708	4.4553	1.88318	0.06	8.77
Mean mass	708	8.9006	3.73362	1.833333	17.2436
Age x size	708	6.5457	2.70566	0.004	10.482
Age living orgs.	708	0.3993	0.20193	0.002	0.943

Table 2.1.b Descriptive statistics for entry models of density and mass dependence, distributors

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
January	708	0.083333	0.276581	0	1
February	708	0.083333	0.276581	0	1
March	708	0.083333	0.276581	0	1
April	708	.0833333	0.2787	0	1
May	708	.0833333	0.274438	0	1
June	708	0.083333	0.276581	0	1
July	708	0.083333	0.276581	0	1
August	708	0.083333	0.276581	0	1
September	708	0.083333	0.276581	0	1
October	708	0.083333	0.276581	0	1
November	708	0.083333	0.276581	0	1
WWI	708	0.067797	0.251574	0	1
WWII	708	0.084746	0.2787	0	1
Paramount I	708	0.050848	0.219841	0	1
Paramount II	708	.3898305	.4880565	0	1
Sound	708	.7288136	.4448864	0	1
Shelter	708	0.626483	1.747533	0	7.105
Int. Rate var.	708	0.01829	-0.12414	0.204762	0.306911
Screens	708	17.44106	2.605931	11.875	22.998
Screens var.	708	0.008105	-0.09135	0.390476	0.247387
Tick. Price	708	3.23673	1.167959	1.167983	7.119297
T. Price var.	708	0.05157	0.103006	-0.255	0.4
Attendance	708	51.69231	23.13286	17.89925	87.25
Attend. Var.	708	-0.00645	0.079775	-0.2	0.166667
Prior entry	708	66.42373	40.22421	1	198
Prior exit	708	65.0339	41.06185	2	238
HH	708	5.396582	7.358745	0.507515	58.5
TV Households	708	23.69381	36.18575	0	94.45
Density	708	131.0992	55.76779	13.75	288.75
Density^2	708	28.28394	23.32289	0.34775	109.0825
Density x age	708	5219.173	4678.42	17.25	19440.5
Density x age^2	708	22625.62	28486.86	1.725	114699
Density^2 x age	708	1053.136	1405.501	0.6955	6435.868
Density^2 x age^2	708	4932.649	8304.965	0.080625	37971.62
Industry age	708	29.99859	17.0408	1	59
Industry age^2	708	1189.894	1054.869	1	3481
Trials	708	0.005867	0.029463	0	0.514706
Density/Trials	708	0.212765	0.394572	0	5.014706
Density^2/Trials	708	0.248044	0.265998	0	1.806424

Table 2.1.c Descriptive statistics for entry models of density and temporal variation, producers

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
January	708	0.083333	0.276581	0	1
February	708	0.083333	0.276581	0	1
March	708	0.083333	0.276581	0	1
April	708	.0833333	0.2787	0	1
May	708	.0833333	0.274438	0	1
June	708	0.083333	0.276581	0	1
July	708	0.083333	0.276581	0	1
August	708	0.083333	0.276581	0	1
September	708	0.083333	0.276581	0	1
October	708	0.083333	0.276581	0	1
November	708	0.083333	0.276581	0	1
WWI	708	0.067797	0.251574	0	1
WWII	708	0.084746	0.2787	0	1
Paramount I	708	0.050848	0.219841	0	1
Paramount II	708	.3898305	.4880565	0	1
Sound	708	.7288136	.4448864	0	1
Shelter	708	0.626483	1.747533	0	7.105
Int. Rate var.	708	0.01829	0.124143	-0.20476	0.306911
Screens	708	17.44106	2.605931	11.875	22.998
Screens var.	708	0.008105	0.091354	-0.39048	0.247387
Tick. Price	708	3.23673	1.167959	1.167983	7.119297
T. Price var.	708	0.05157	0.103006	-0.255	0.4
Attendance	708	51.69231	23.13286	17.89925	87.25
Attend. Var.	708	-0.00645	0.079775	-0.2	0.166667
Prior entry	708	19.76271	12.96847	1	51
Prior exit	708	18.38983	11.2872	2	54
HH	708	9.1762	11.55496	2.0738	78.125
TV Households	708	23.69381	36.18575	0	94.45
Density	708	58.52436	28.89712	7	138.75
Density^2	708	4.306031	4.223247	0.1055	19.28025
Density x age	708	1879.604	1894.738	14	8186.25
Density x age^2	708	8025.079	11625.53	1.4	48298.88
Density^2 x age	708	153.388	252.4754	0.211	1137.535
Density^2 x age^2	708	716.7502	1488.926	0.0422	6711.455
Industry age	708	29.99859	17.0408	1	59
Industry age^2	708	1189.894	1054.869	1	3481
Trials	708	0.011742	0.047765	0	0.535714
Density/Trials	708	0.207484	0.344508	0	2.498016
Density^2/Trials	708	0.10589	0.116681	0	0.709053

Table 2.1.d Descriptive statistics for entry models of density and temporal variation, distributors

	January	February	March	April	May	June	July	August	September	October	November	WWI	WWII	Paramount I	Paramount II	Shelter
January	1.0000															
February	-0.0909	1.0000														
March	-0.0909	-0.0909	1.0000													
April	-0.0917	-0.0917	-0.0917	1.0000												
May	-0.0901	-0.0901	-0.0901	-0.0909	1.0000											
June	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	1.0000										
July	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	1.0000									
August	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	1.0000								
September	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	1.0000							
October	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	1.0000						
November	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	-0.0909	1.0000					
WWI	0.0000	0.0000	0.0000	-0.0014	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000				
WWII	0.0000	0.0000	0.0000	0.0187	-0.0189	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0821	1.0000			
Paramount I	0.0000	0.0000	0.0000	-0.0012	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0624	-0.0704	1.0000		
Paramount II	0.0000	0.0000	0.0000	-0.0023	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.1218	-0.1375	-0.1046	1.0000	
Shelter	0.0000	0.0000	0.0000	-0.0018	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0987	-0.1092	-0.0830	-0.1621	1.0000
Int. Rate var.	0.0000	0.0000	0.0000	-0.0011	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1488	-0.0941	-0.1300	0.1887	0.1538
Screens	-0.0003	0.0000	0.0000	0.0058	-0.0058	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2837	0.3133	0.1008	0.2075	-0.3821
Screens var.	0.0000	0.0000	0.0000	-0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0169	-0.0501	0.0515	-0.1006	0.0137
Tick. Price	-0.0004	0.0000	0.0000	-0.0016	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2206	-0.0940	-0.1282	0.1524	0.8445
T. Price var.	0.0247	-0.0022	-0.0022	-0.0010	-0.0035	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	0.0645	0.0808	-0.0801	-0.0959	0.2251
Attendance	0.0000	0.0000	0.0000	0.0004	-0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0923	-0.0383	0.0223	-0.3910	-0.0662
Attend. Var.	0.0010	-0.0001	-0.0001	0.0072	-0.0075	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.1699	0.4267	0.3148	-0.0713	-0.5057
Prior entry	0.0000	0.0000	0.0000	-0.0059	0.0059	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0844	-0.2682	-0.2040	-0.0834	0.7076
Prior exit	0.0000	0.0000	0.0000	-0.0061	0.0062	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0162	-0.2761	-0.1487	-0.0951	0.7495
HH	0.0000	0.0000	0.0000	0.0009	-0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0641	0.0616	0.0359	-0.0339	-0.2254
Density	0.0010	0.0000	0.0000	-0.0050	0.0051	0.0000	0.0000	0.0000	0.0000	-0.0007	0.0000	-0.0477	-0.2782	-0.1998	-0.0719	0.7179
Density2	0.0008	0.0000	0.0000	-0.0043	0.0044	0.0000	0.0000	0.0000	0.0000	-0.0011	0.0000	-0.0850	-0.2464	-0.1827	-0.1353	0.8290
Mass	0.0002	0.0002	0.0002	-0.0004	0.0008	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.5259	-0.0109	0.0922	-0.2852	-0.2604
Mean mass	-0.0003	0.0000	0.0000	0.0044	-0.0044	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.4071	0.2570	0.2905	-0.2796	-0.4398
Age x size	0.0000	0.0000	0.0000	0.0058	-0.0059	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2214	0.3958	0.3268	0.3933	-0.3697
Age living orgs.	-0.0007	0.0000	0.0000	-0.0010	0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.4119	-0.0283	-0.0055	0.1979	0.5894

	Int. Rate var.	Screens	Scr. var.	Tick. Pr.	T. Pr. var.	Attend.	Att. Var.	Prior entry	Prior exit	HH	Density	Density2	Mass	Mean mass	Age x size	Age living orgs.
Int. Rate var.	1.0000															
Screens	-0.0484	1.0000														
Screens var.	-0.0273	-0.0851	1.0000													
Tick. Price	0.2152	-0.1364	-0.1306	1.0000												
T. Price var.	0.2447	0.0069	0.0241	0.2621	1.0000											
Attendance	-0.2323	-0.1331	0.0638	-0.3272	-0.0679	1.0000										
Attend. Var.	-0.2270	0.6353	-0.0020	-0.5320	-0.1034	0.1546	1.0000									
Prior entry	0.1031	-0.4566	-0.1519	0.6903	0.1344	-0.0637	-0.7298	1.0000								
Prior exit	0.0618	-0.3724	-0.1223	0.7411	0.1639	-0.0166	-0.6638	0.5689	1.0000							
HH	-0.0271	-0.1393	0.0698	-0.3119	-0.1139	0.0428	0.1133	-0.4828	-0.4441	1.0000						
Density	0.1227	-0.2939	-0.0889	0.7318	0.1490	-0.0632	-0.6504	0.9309	0.9292	-0.5419	1.0000					
Density2	0.1242	-0.3852	-0.0766	0.7928	0.1653	-0.0484	-0.6837	0.9301	0.9434	-0.3971	0.9877	1.0000				
Mass	-0.1439	0.1142	0.0513	-0.4717	-0.0340	0.4333	0.3641	-0.0300	-0.0368	-0.2741	-0.0144	-0.1237	1.0000			
Mean mass	-0.1848	0.3476	0.0459	-0.6335	-0.0388	0.3577	0.7349	-0.4948	-0.4769	-0.0381	-0.5099	-0.5637	0.7888	1.0000		
Age x size	-0.0755	0.8489	-0.0629	-0.1706	-0.0595	-0.1415	0.7894	-0.5277	-0.4654	-0.0570	-0.4298	-0.5011	0.1721	0.4574	1.0000	
Age living orgs.	0.1197	0.1722	-0.1409	0.8362	0.1163	-0.3521	-0.2526	0.5230	0.5900	-0.4477	0.6824	0.6466	-0.3787	-0.5238	0.1284	1.0000

Table 2.2.a Bivariate correlations for models of density and mass dependence, producers

	January	February	March	April	May	June	July	August	September	October	November	WWI	WWII	Paramount I	Paramount II	Shelter
January	1.0000															
February	-0.0909	1.0000														
March	-0.0909	-0.0909	1.0000													
April	-0.0917	-0.0917	-0.0917	1.0000												
May	-0.0901	-0.0901	-0.0901	-0.0909	1.0000											
June	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	1.0000										
July	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	1.0000									
August	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	1.0000								
September	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	1.0000							
October	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	1.0000						
November	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	-0.0909	1.0000					
WWI	0.0000	0.0000	0.0000	-0.0014	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000				
WWII	0.0000	0.0000	0.0000	0.0167	-0.0169	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0821	1.0000			
Paramount I	0.0000	0.0000	0.0000	-0.0012	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0624	-0.0704	1.0000		
Paramount II	0.0000	0.0000	0.0000	-0.0023	0.0023	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.1218	-0.1375	-0.1046	1.0000	
Shelter	0.0000	0.0000	0.0000	-0.0018	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0967	-0.1092	-0.0830	-0.1621	1.0000
Int. Rate var.	0.0000	0.0000	0.0000	-0.0011	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1488	-0.0941	-0.1300	0.1887	0.1538
Screens	-0.0003	0.0000	0.0000	0.0056	-0.0058	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2837	0.3133	0.1008	0.2075	-0.3821
Screens var.	0.0000	0.0000	0.0000	-0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0169	-0.0501	0.0515	-0.1006	0.0137
Tick. Price	-0.0004	0.0000	0.0000	-0.0016	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2208	-0.0940	-0.1282	0.1524	0.8445
T. Price var.	0.0247	-0.0022	-0.0022	-0.0010	-0.0035	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	0.0845	0.0808	-0.0801	-0.0959	0.2251
Attendance	0.0000	0.0000	0.0000	0.0004	-0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0923	-0.0363	0.0223	-0.3910	-0.0682
Attend. Var.	0.0010	-0.0001	-0.0001	0.0072	-0.0075	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.1699	0.4287	0.3148	-0.0713	-0.5057
Prior entry	0.0000	0.0000	0.0000	-0.0045	0.0045	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3887	-0.2375	-0.1288	-0.3312	0.4997
Prior exit	0.0000	0.0000	0.0000	-0.0074	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3493	-0.2985	-0.0012	-0.3601	0.5449
HH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0476	-0.0025	-0.0218	-0.0204	-0.1965
Density	-0.0008	0.0002	0.0002	-0.0058	0.0061	0.0002	0.0002	0.0002	0.0002	-0.0012	0.0002	0.0652	-0.2984	-0.0952	-0.3794	0.7746
Density2	-0.0008	0.0003	0.0003	-0.0041	0.0047	0.0003	0.0003	0.0003	0.0003	-0.0023	0.0003	-0.0001	-0.2403	-0.1128	-0.3288	0.8955
Mass	0.0002	0.0002	0.0002	-0.0004	0.0008	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.5259	-0.0109	0.0922	-0.2652	-0.2604
Mean mass	0.0009	-0.0001	-0.0001	0.0113	-0.0118	-0.0001	-0.0001	-0.0001	-0.0001	-0.0002	-0.0001	0.2554	0.5029	0.1659	0.1470	-0.5405
Age x size	0.0000	0.0000	0.0000	0.0032	-0.0032	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.3942	0.2161	0.1994	0.4522	0.2034
Age living orgs.	0.0005	0.0001	-0.0001	-0.0008	0.0005	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.3647	-0.0108	0.0344	0.1090	0.7489

	Int. Rate var.	Screens	Scr. var.	Tick. Pr.	T. Pr. var.	Attend.	Att. Var.	Prior entry	Prior exit	HH	Density	Density2	Mass	Mean mass	Age x size	Age living orgs.
Int. Rate var.	1.0000															
Screens	-0.0484	1.0000														
Screens var.	-0.0273	-0.0851	1.0000													
Tick. Price	0.2152	-0.1364	-0.1306	1.0000												
T. Price var.	0.2447	0.0069	0.0241	0.2621	1.0000											
Attendance	-0.2323	-0.1331	0.0638	-0.3272	-0.0679	1.0000										
Attend. Var.	-0.2270	0.6353	-0.0020	-0.5320	-0.1034	0.1546	1.0000									
Prior entry	0.0254	-0.5206	-0.1357	0.3002	0.1079	0.1245	-0.5379	1.0000								
Prior exit	-0.0506	-0.4178	-0.0064	0.2841	0.0495	0.2714	-0.3660	0.8446	1.0000							
HH	0.0079	-0.3083	0.1377	-0.2725	-0.0877	0.0212	-0.0876	-0.2794	-0.4034	1.0000						
Density	0.0192	-0.3864	-0.0768	0.5654	0.1350	0.1893	-0.4437	0.7508	0.8469	-0.4796	1.0000					
Density2	0.0583	-0.4308	-0.0699	0.6951	0.1670	0.1268	-0.5120	0.7146	0.7888	-0.3405	0.9648	1.0000				
Mass	-0.1439	0.1142	0.0513	-0.4717	-0.0340	0.4383	0.3641	0.2454	0.4339	-0.4481	0.1968	0.0224	1.0000			
Mean mass	-0.0726	0.5287	0.0272	-0.4952	0.0029	0.1009	0.8922	-0.3586	-0.2794	-0.2350	-0.4973	-0.5615	0.5772	1.0000		
Age x size	0.0859	0.4855	-0.1532	0.5196	0.0812	-0.3780	0.2633	-0.3272	-0.2349	-0.4374	-0.0205	0.0220	-0.2318	0.1962	1.0000	
Age living orgs.	0.1272	0.0700	-0.1412	0.8953	0.1251	-0.2944	-0.2304	0.1737	0.2481	-0.4572	0.5633	0.8355	-0.3587	-0.3728	0.7315	1.0000

Table 2.2.b Bivariate correlations for models of density and mass dependence, distributors

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	WWI	WWII	Param I	Param II	Shelter	Int. rt. var.	Scrns
January	1.0000																	
February	-0.0909	1.0000																
March	-0.0909	-0.0909	1.0000															
April	-0.0917	-0.0917	-0.0917	1.0000														
May	-0.0901	-0.0901	-0.0901	-0.0909	1.0000													
June	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	1.0000												
July	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	1.0000											
August	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	1.0000										
September	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	1.0000									
October	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	1.0000								
November	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	-0.0909	1.0000							
WWI	0.0000	0.0000	0.0000	-0.0014	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000						
WWII	0.0000	0.0000	0.0000	0.0167	-0.0169	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0821	1.0000					
Paramount I	0.0000	0.0000	0.0000	-0.0012	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0624	-0.0704	1.0000				
Paramount II	0.0000	0.0000	0.0000	-0.0041	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2156	-0.2432	-0.1850	1.0000			
Shelter	0.0000	0.0000	0.0000	-0.0018	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0967	-0.1092	-0.0830	0.4488	1.0000		
Int. Rate var.	0.0000	0.0000	0.0000	-0.0011	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1488	-0.0941	-0.1300	0.2522	0.1538	1.0000	
Screens	-0.0003	0.0000	0.0000	0.0057	-0.0057	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2958	0.3157	0.0861	-0.0248	-0.3588	-0.0242	1.0000
Screens var.	0.0000	0.0000	0.0000	-0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0169	-0.0501	0.0515	-0.1031	0.0137	-0.0273	-0.2462
Tick. Price	-0.0020	0.0002	0.0002	-0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	-0.2160	0.0059	-0.0357	0.7008	0.7999	0.1830	-0.0102
T. Price var.	0.0247	-0.0022	-0.0022	-0.0010	-0.0035	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	0.0645	0.0808	-0.0801	0.0910	0.2251	0.2447	-0.0126
Attendance	0.0010	-0.0001	-0.0001	0.0072	-0.0075	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.1780	0.4307	0.3235	-0.5384	-0.5090	-0.2131	0.6454
Attend. Var.	0.0000	0.0000	0.0000	0.0004	-0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0923	-0.0363	0.0223	-0.5090	-0.0662	-0.2323	-0.1835
Prior entry	0.0000	0.0000	0.0000	-0.0059	0.0059	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0844	-0.2682	-0.2040	0.4887	0.7076	0.1031	-0.4233
Prior exit	0.0000	0.0000	0.0000	-0.0061	0.0062	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0162	-0.2761	-0.1487	0.4931	0.7495	0.0618	-0.3542
HH	0.0000	0.0000	0.0000	0.0009	-0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0641	0.0616	0.0359	-0.2633	-0.2254	-0.0271	-0.1468
Density	0.0007	0.0000	0.0000	-0.0052	0.0052	0.0000	0.0000	0.0000	0.0000	-0.0004	0.0000	-0.0440	-0.2804	-0.1748	0.4832	0.7341	0.0996	-0.2691
Density^2	0.0008	0.0000	0.0000	-0.0045	0.0046	0.0000	0.0000	0.0000	0.0000	-0.0006	0.0000	-0.1004	-0.2517	-0.1795	0.4980	0.8224	0.1029	-0.3489
Density x age	0.0004	0.0000	0.0000	-0.0026	0.0026	0.0000	0.0000	0.0000	0.0000	-0.0003	0.0000	-0.2481	-0.1366	-0.1138	0.7891	0.8317	0.1969	-0.1336
Dens. x age^2	0.0002	0.0000	0.0000	-0.0023	0.0024	0.0000	0.0000	0.0000	0.0000	-0.0005	0.0000	-0.2066	-0.1306	-0.1169	0.7673	0.8606	0.2114	-0.1878
Dens.^{2} x age	0.0005	0.0001	0.0001	-0.0027	0.0029	0.0001	0.0001	0.0001	0.0001	-0.0011	0.0001	-0.1721	-0.1607	-0.1262	0.6633	0.9145	0.1786	-0.2581
Dens.^{2} x age^2	0.0003	0.0001	0.0001	-0.0024	0.0026	0.0001	0.0001	0.0001	0.0001	-0.0010	0.0001	-0.1556	-0.1433	-0.1145	0.6470	0.9261	0.1819	-0.2638
Ind. Age	-0.0003	0.0000	0.0000	0.0009	-0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.3721	0.0536	-0.0136	0.8448	0.5560	0.1930	0.1962
Ind. Age^2	-0.0003	0.0000	0.0000	-0.0005	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2933	-0.0285	-0.0765	0.8779	0.6786	0.2304	0.0040
Trials	0.0055	-0.0008	-0.0126	0.0885	0.0183	0.0011	-0.0023	-0.0061	-0.0113	-0.0114	-0.0323	0.1483	-0.1135	-0.0829	-0.2638	-0.1107	-0.0077	-0.4958
Dens./trials	0.0348	0.0269	0.0161	0.0199	0.0126	-0.0010	-0.0049	-0.0102	-0.0161	-0.0167	-0.0285	0.3765	-0.2179	-0.1594	-0.2814	-0.0107	-0.0102	-0.5912
Dens.^{2}/trials	-0.0263	-0.0286	-0.0333	0.1204	0.0183	0.0024	0.0012	0.0000	-0.0019	-0.0019	-0.0238	0.0094	-0.0546	-0.0409	-0.1491	-0.0635	-0.0054	-0.3143

	Scrns var.	Tick. Price	Tick. Price var.	Attend	Attend. Var.	Prior entry	Prior exit	HH	Dens.	Dens.^{2}	Dens. x age	Dens. x age^2	Dens.^{2} x age	Dens.^{2} x age^2	Ind. Age	Ind. Age^2	Trials	Dens./trials	Den. /tr.
Screens var.	1.0000																		
Tick. Price	-0.1775	1.0000																	
T. Price var.	0.0241	0.2560	1.0000																
Attendance	-0.0203	-0.3176	-0.1086	1.0000															
Attend. Var.	0.0638	-0.3509	-0.0679	0.0769	1.0000														
Prior entry	-0.1519	0.5542	0.1344	-0.7318	-0.0637	1.0000													
Prior exit	-0.1223	0.6095	0.1639	-0.6696	-0.0166	0.9669	1.0000												
HH	0.0698	-0.2871	-0.1139	0.1141	0.0428	-0.4628	-0.4441	1.0000											
Density	-0.0833	0.5739	0.1361	-0.6154	-0.0102	0.9239	0.9361	-0.5181	1.0000										
Density^2	-0.0624	0.6340	0.1537	-0.6716	-0.0123	0.9199	0.9482	-0.3972	0.9724	1.0000									
Density x age	-0.1250	0.9052	0.1881	-0.5677	-0.3067	0.7375	0.7780	-0.3540	0.7852	0.8322	1.0000								
Dens. x age^2	-0.1190	0.9125	0.2093	-0.6014	-0.3060	0.7379	0.7721	-0.3101	0.7593	0.8229	0.9928	1.0000							
Dens.^{2} x age	-0.1077	0.8759	0.2083	-0.6189	-0.2010	0.8049	0.8448	-0.3119	0.8276	0.8969	0.9673	0.9797	1.0000						
Dens.^{2} x age^2	-0.1046	0.8893	0.2181	-0.6047	-0.2019	0.7798	0.8227	-0.2842	0.7908	0.8704	0.9577	0.9771	0.9969	1.0000					
Ind. Age	-0.1600	0.8699	0.1326	-0.2516	-0.4903	0.4242	0.4659	-0.3462	0.5049	0.5157	0.8754	0.8435	0.7406	0.7306	1.0000				
Ind. Age^2	-0.1368	0.9026	0.1719	-0.4595	-0.4644	0.5619	0.5904	-0.3136	0.5985	0.6379	0.9483	0.9360	0.8522	0.8459	0.9693	1.0000			
Trials	0.1463	-0.3417	-0.0076	-0.2465	0.1663	-0.1247	-0.1792	0.3132	-0.3141	-0.2050	-0.3173	-0.2476	-0.2078	-0.1822	-0.4921	-0.3613	1.0000		
Dens./trials	0.1016	-0.3645	0.0598	-0.4310	0.2625	0.3385	0.2235	-0.1446	0.1414	0.1365	-0.2383	-0.1911	-0.0898	-0.0930	-0.5389	-0.3853	0.5944	1.0000	
Dens.^{2}/trials	0.0938	-0.1947	0.0058	-0.1419	0.0784	-0.1486	-0.1751	0.4504	-0.2691	-0.1779	-0.1969	-0.1462	-0.1326	-0.1102	-0.2918	-0.2065	0.6224	0.3088	1.000

Table 2.2.c Bivariate correlations for models of density dependence and temporal variation, producers

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	WWI	WWII	Param I	Param II	Shelter	Int. rt. var.	Scrns
January	1.0000																	
February	-0.0909	1.0000																
March	-0.0909	-0.0909	1.0000															
April	-0.0917	-0.0917	-0.0917	1.0000														
May	-0.0901	-0.0901	-0.0901	-0.0909	1.0000													
June	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	1.0000												
July	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	1.0000											
August	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	1.0000										
September	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	1.0000									
October	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	1.0000								
November	-0.0909	-0.0909	-0.0909	-0.0917	-0.0901	-0.0909	-0.0909	-0.0909	-0.0909	-0.0909	1.0000							
WWI	0.0000	0.0000	0.0000	-0.0014	0.0014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000						
WWII	0.0000	0.0000	0.0000	0.0167	-0.0169	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0821	1.0000					
Paramount I	0.0000	0.0000	0.0000	-0.0012	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0624	-0.0704	1.0000				
Paramount II	0.0000	0.0000	0.0000	-0.0041	0.0041	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2156	-0.2432	-0.1850	1.0000			
Shelter	0.0000	0.0000	0.0000	-0.0018	0.0018	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0967	-0.1092	-0.0830	0.4188	1.0000		
Int. Rate var.	0.0000	0.0000	0.0000	-0.0011	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1488	-0.0941	-0.1300	0.2522	0.1533	1.0000	
Screens	-0.0003	0.0000	0.0000	0.0057	-0.0057	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2958	0.3157	0.0861	-0.0248	-0.3588	-0.0242	1.0000
Screens var.	0.0000	0.0000	0.0000	-0.0002	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0169	-0.0501	0.0515	-0.1031	0.0137	-0.0273	-0.2462
Tick. Price	-0.0020	0.0002	0.0002	-0.0002	0.0005	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	-0.2160	0.0059	-0.0357	0.7008	0.7999	0.1830	-0.0102
T. Price var.	0.0247	-0.0022	-0.0022	-0.0010	-0.0035	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	-0.0022	0.0645	0.0808	-0.0801	0.0910	0.2251	0.2417	-0.0126
Attendance	0.0010	-0.0001	-0.0001	0.0072	-0.0075	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.0001	-0.1780	0.4307	0.3235	-0.5384	-0.5090	-0.2131	0.6454
Attend. Var.	0.0000	0.0000	0.0000	0.0004	-0.0004	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0923	-0.0363	0.0223	-0.5090	-0.0662	-0.2323	-0.1835
Prior entry	0.0000	0.0000	0.0000	-0.0073	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3795	-0.2997	-0.1089	0.0173	0.4947	0.0210	-0.4700
Prior exit	0.0000	0.0000	0.0000	-0.0074	0.0075	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.3493	-0.2965	-0.0012	-0.0554	0.5449	-0.0506	-0.4304
HH	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.0476	-0.0025	-0.0216	-0.1723	-0.1965	0.0079	-0.3273
Density	-0.0009	0.0001	0.0001	-0.0055	0.0059	0.0001	0.0001	0.0001	0.0001	-0.0005	0.0001	0.0605	-0.2911	-0.0610	0.1384	0.7687	0.0146	-0.3296
Density^2	-0.0007	0.0002	0.0002	-0.0041	0.0046	0.0002	0.0002	0.0002	0.0002	-0.0011	0.0002	-0.0032	-0.2394	-0.0897	0.2338	0.8879	0.0499	-0.4031
Density x age	-0.0002	0.0001	0.0001	-0.0026	0.0028	0.0001	0.0001	0.0001	0.0001	-0.0006	0.0001	-0.2070	-0.1387	-0.0499	0.5879	0.9355	0.1481	-0.2061
Dens. x age^2	0.0000	0.0001	0.0001	-0.0022	0.0025	0.0001	0.0001	0.0001	0.0001	-0.0012	0.0001	-0.1781	-0.1256	-0.0828	0.6311	0.9397	0.1736	-0.2447
Dens.^{2} x age	0.0000	0.0002	0.0002	-0.0024	0.0029	0.0002	0.0002	0.0002	0.0002	-0.0023	0.0002	-0.1325	-0.1481	-0.0824	0.4807	0.9719	0.1266	-0.3103
Dens.^{2} x age^2	0.0002	0.0002	0.0002	-0.0020	0.0025	0.0002	0.0002	0.0002	0.0002	-0.0023	0.0002	-0.1266	-0.1273	-0.0338	0.5085	0.9752	0.1439	-0.3090
Ind. Age	-0.0003	0.0000	0.0000	0.0009	-0.0009	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.3721	0.0536	-0.0136	0.8448	0.5560	0.1930	0.1962
Ind. Age^2	-0.0003	0.0000	0.0000	-0.0005	0.0005	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-0.2933	-0.0285	-0.0765	0.8779	0.6786	0.2304	0.0040
Trials	0.0155	0.0045	-0.0056	0.0319	0.0357	0.0047	0.0037	-0.0017	-0.0123	-0.0126	-0.0286	0.1808	-0.1372	-0.0862	-0.3007	-0.0909	-0.0173	-0.5357
Dens./trials	0.0307	0.0225	0.0129	0.0092	0.0149	0.0013	-0.0005	-0.0053	-0.0134	-0.0152	-0.0256	0.4338	-0.2388	-0.1397	-0.3179	0.1128	-0.0227	-0.6317
Dens.^{2}/trials	-0.0317	-0.0351	-0.0379	0.0554	0.0531	0.0072	0.0071	0.0056	0.0022	0.0022	-0.0156	-0.0243	-0.0581	-0.0439	-0.1569	-0.0720	-0.0007	-0.3677

	Scrns var.	Tick. Price	Tick. Price var.	Attend	Attend. Var.	Prior entry	Prior exit	HH	Dens.	Dens.^{2}	Dens. x age	Dens. x age^2	Dens.^{2} x age	Dens.^{2} x age^2	Ind. Age	Ind. Age^2	Trials	Dens./ trials	Den. /tr.
Screens var.	1.0000																		
Tick. Price	-0.1775	1.0000																	
T. Price var.	0.0241	0.2560	1.0000																
Attendance	-0.0203	-0.3176	-0.1086	1.0000															
Attend. Var.	0.0638	-0.3509	-0.0679	0.0769	1.0000														
Prior entry	-0.1447	0.2047	0.1019	-0.5321	0.1662	1.0000													
Prior exit	-0.0064	0.2203	0.0495	-0.3940	0.2714	0.8927	1.0000												
HH	0.1377	-0.2888	-0.0877	-0.0881	0.0212	-0.3660	-0.4084	1.0000											
Density	-0.0577	0.4810	0.1123	-0.4187	0.2185	0.7863	0.8507	-0.4805	1.0000										
Density^2	-0.0417	0.6049	0.1505	-0.4953	0.1532	0.7260	0.7968	-0.3408	0.9657	1.0000									
Density x age	-0.1067	0.8888	0.1876	-0.4834	-0.1464	0.4704	0.4976	-0.3134	0.7728	0.8604	1.0000								
Dens. x age^2	-0.1036	0.9003	0.2142	-0.5533	-0.1895	0.4585	0.4617	-0.2482	0.7197	0.8291	0.9905	1.0000							
Dens.^{2} x age	-0.0857	0.8359	0.2062	-0.5219	-0.0594	0.5477	0.5856	-0.2502	0.8189	0.9194	0.9780	0.9754	1.0000						
Dens.^{2} x age^2	-0.0820	0.8545	0.2196	-0.5340	-0.0920	0.5154	0.5535	-0.2211	0.7783	0.8941	0.9740	0.9800	0.9968	1.0000					
Ind. Age	-0.1600	0.8699	0.1326	-0.2516	-0.4903	-0.0317	-0.0465	-0.3447	0.2521	0.3369	0.7402	0.7476	0.6067	0.6245	1.0000				
Ind. Age^2	-0.1368	0.9026	0.1719	-0.4595	-0.4644	0.1099	0.0714	-0.2616	0.3487	0.4594	0.8244	0.8507	0.7220	0.7438	0.9693	1.0000			
Trials	0.1565	-0.3488	0.0157	-0.2643	0.2035	0.0988	0.0021	0.6248	-0.1982	-0.1177	-0.2672	-0.2052	-0.1469	-0.1303	-0.5336	-0.3909	1.0000		
Dens./trials	0.0926	-0.2590	0.1033	-0.4157	0.3147	0.6106	0.5241	0.0757	0.2654	0.2556	-0.0694	-0.0354	0.0767	0.0703	-0.5293	-0.3610	0.7333	1.0000	
Dens.^{2}/trials	0.1234	-0.2208	-0.0629	-0.1577	0.0831	-0.1864	-0.2253	0.8185	-0.2857	-0.1673	-0.1879	-0.1343	-0.1159	-0.0955	-0.3165	-0.2188	0.7165	0.1853	1.000

Table 2.2.d Bivariate correlations for models of density dependence and temporal variation, distributors

Table 2.3.a

Negative binomial regression models for entry rates of feature film producers, 1912-1970

Density and Mass dependence [13]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
January	0.186*	.192**	.179*	.162*	.179*
	(.08)	(.10)	(.09)	(.09)	(.09)
February	-0.337**	-.334**	-.336**	-.356**	-.336**
	(.11)	(.10)	(.10)	(.10)	(10)
March	-0.181*	-.178*	-.182*	-.196*	-.182*
	(.10)*	(.10)	(.10)	(.10)	(.10)
April	-0.293**	-.292*	-.299**	-.324**	-.299**
	(.11)	(.10)	(.10)	(.10)	(.10)
May	-0.142	-.139	-.138	-.156	-.138
	(.10)	(.10)	(.10)	(.10)	(.10)
June	0.564***	.566***	.571***	.553***	.571***
	(.09)	(.09)	(.09)	(.09)	(.09)
July	-0.421***	-.419***	-.418***	-.431***	-.418***
	(.11)	(.11)	(.10)	(.10)	(.10)
August	-0.167	-.166	-.174*	-.180*	-.174*
	(.10)	(.10)	(.10)	(.10)	(.10)
September	-0.121	-.121	-.126	-.129	-.126
	(.10)	(.10)	(.10)	(.10)	(.10)
October	-1.518***	-1.516***	-1.519***	-1-530***	-.1519***
	(.14)	(.14)	(.14)	(.14)	(.14)
November	0.573***	.574***	.569***	.573***	.569***
	(.09)	(.09)	(.09)	(.09)	(.09)
WWI	-0.042	.165*	.193	.250	.207
	(.09)	(.10)	(.18)	(.17)	(.18)
WWII	-0.125	-.099	.013	-.019	.028
	(.12)	(.12)	(.13)	(.12)	(.14)
Paramount I	0.060	.091	.359**	.204	.360**
	(0.13)	(.13)	(.15)	(.13)	(.15)
Paramount II	-.030	.072	-.117	-.073	-.143
	(.07)	(.08)	(.13)	(.09)	(.14)
Sound	.096	.094	.089	.088	.087
	(.19)	(.19)	(.18)	(.19)	(.20)

Fixed effects

[13] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Shelter	.004	-.063*	-.0441	-.021	-.032
	(.03)	(.04)	(.04)	(.04)	(.05)
Int. Rate var.	.082	-.109	-.085	-.124	-.087
	(.19)	(.19)	(.19)	(.19)	(.19)
Screens	-.018	-.029*	-.027	-.032	-.021
	(.02)	(.02)	(.02)	(.02)*	(.02)
Screens var.	-.041	-.154	-.331	-.398*	-.373
	(.24)	(.24)	(.24)	(.24)	(.25)
Tick. Price	.000	.097	1.570***	.196	1.528***
	(.23)	(.23)	(.42)	(.26)	(.44)
T. Price var.	.388	.485**	-.201	.256	-.200
	(.22)*	(.22)	(.24)	(.23)	(.24)
Attendance	-.010***	-.008***	-.000	-.010**	.000
	(.00)	(.00)	(.00)	(.00)	(.00)
Attend. Var.	-.720*	-.912**	-1.21	-.944**	-.1.248**
	(.38)	(.37)	(.01)**	(.39)	(.39)
Prior entry	.007**	.002	-.001**	-.004	-.009**
	(.00)	(.03)	(.00)	(.00)	(.00)
Prior exit	-.002	-.005*	.002	-.002	.002
	(.00)	(.02)	(.00)	(.00)	(.00)
HH	-.031***	-.034***	-.023***	-.023***	-.024***
	(.01)	(.00)	(.00)	(.01)	(.01)
TV Households	-.007**	-.012***	-.005	-.014***	-.0001
	(.00)	(.00)	(.00)	(.00)	(.40)
Density		.001***	.025***	-.005	.024***
		(.00)	(.00)	(.00)	(.00)
Density^2		-.009	-032***	.016*	-.030***
		(.00)	(.01)	(.09)	(.01)
Mass			-.149**	.158**	-.119***
			(.05)	(.05)	(.07)
Mean mass				-.174**	-.037
				(.06)	(.06)
Age x size			.047		.049
			(.05)		(.05)
Age living orgs.			-2.580**		-2.496***
			(.39)		(.42)
Constant	2.588	2.588	1.301	.2649	1.350
	(.32)	(.32)	(.38)	(.32)	(.40)
Log-likelihood	-1661.1884	-1648.8207	-1626.4396	-1643.83	-1626.2706

Main effects

Table 2.3.b

Negative binomial regression models for entry rates of feature film distributors, 1912-1970

Density and Mass dependence[14]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
January	.391**	.394**	.397***	.397***	.397***
	(.15)	(.15)	(15)	(15)	(15)
February	-.410**	-.407**	-.405**	-.407**	-.403**
	(.18)	(.18)	(.18)	(.18)	(.18)
March	-.426**	-.424**	-.419**	-.419**	-.417**
	(.18)	(.18)	(.17)	(.18)	(.17)
April	-.309*	-.310*	-.310*	-.309*	-.309*
	(.17)	(.17)	(.17)	(.17)	(.17)
May	-.323*	-.321*	-.320*	-.320*	-.319*
	(.17)	(.17)	(.17)	(.17)	(.17)
June	.780***	.779***	.782***	.782***	.783***
	(15)	(.15)	(.14)	(.15)	(.14)
July	-.484***	-.482***	-.483***	-.480***	-.484***
	(.18)	(.18)	(.18)	(.18)	(.18)
August	-.419**	-.418**	-.418**	-.416**	-.416**
	(.18)	(.18)	(.17)	(.18)	(.17)
September	-.363**	-.363**	-.363**	-.361**	-.364**
	(.17)	(.17)	(.17)	(.18)	(.17)
October	-2.185***	-2.186***	-2.193***	-2.186***	-2.192***
	(.32)	(.32)	(.32)	(.32)	(.32)
November	.561***	.563***	.567***	.565***	.567***
	(.15)	(.15)	(.15)	(.15)	(.15)
WWI	.022	.023	.002	.012	-.165
	(.15)	(.18)	(.25)	(.25)	(.27)
WWII	-.647***	-.568**	-.005	-.293	-.195
	(.22)	(.24)	(.26)	(.29)	(.29)
Paramount I	-.422*	-.443*	.022	-.337	.096
	(.22)	(.23)	(.25)	(.23)	(.25)
Paramount II	-.731***	-.699***	-.295	-.529***	-.269
	(.15)	(.16)	(.20)	(.18)	(.20)
Sound	.078	.076	.079	.078	.077
	(.18)	(.19)	(.18)	(.20)	(.19)

Fixed effects

[14] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
Shelter	.063	.090	-.035	.076	-.083
	(.06)	(.08)	(.09)	(.09)	(.09)
Int. Rate var.	-.344	-.340	-.216	-.304	-.253
	(.32)	(.33)	(.33)	(.33)	(.33)
Screens	-.000	-.009	-.044	-.014	-.053
	(.03)	(.03)	(.03)	(.03)	(.03)*
Screens var.	-.796**	-.822**	-.046	-.584	.025
	(.40)	(.41)	(.44)	(.44)	(.45)
Tick. Price	-.557	.373	3.61***	.167	4.025***
	(.37)	(.41)	(.91)	(.55)	(.94)
T. Price var.	.658	.709	-.136	.520	-.223
	(.37)*	(.41)	(.39)	(.38)	(.39)
Attendance	-.013***	-.013***	-.007	-.007	.009*
	(.00)	(.00)	(.01)	(.00)*	(.00)
Attend. Var.	-.507	-.473	-.314	-.414	-.097
	(.57)	(.60)	(.58)	(.61)	(.60)
Prior entry	-.182	-.203	-.013	-.002	-.015*
	(.12)	(.12)*	(.09)	(.01)	(.01)
Prior exit	.023***	.026***	.010	.013	.014
	(.01)	(.01)	(.01)	(.01)	(.01)
HH	-.007	-.002	-.004	-.008	-.000
	(.00)	(.01)	(.01)	(.01)	(.01)
TV Households	.003	-.004	.015**	-.006	.061**
	(.00)	(.00)	(.01)	(.00)	(.05)
Density		.011***	.067***	.039**	.080***
		(.01)	(.02)	(.01)	(.02)
Density^2		-.092**	-.367*	-.069**	-.425*
		(.10)	(.12)	(.11)	(.13)
Mass			-.110	-.229	-.211**
			(.07)	(.07)	(.10)
Mean mass				.286	.074
				(.09)	(.05)
Age x size			-.117**		-.224*
			(.09)		(.12)
Age living orgs.			-3.817**		-3.092*
			(1.82)		(1.88)
Constant	1.238	.887	-.019	1.370	1.370
	(.45)	(.57)	(.63)	(.63)	(.63)
Log-likelihood	-1069.0439	-1068.5325	-1056.1573	-1067.7284	-1055.2211

Main effects

Table 2.3.c

Negative binomial regression models for entry rates of feature film producers, 1912-1970

Density dependence and temporal variation[15]

	Model 1	*Model 2*	*Model 6*	*Model 7*	*Model 8*
January	.186*	.192**	.186**	.105	.099
	(.08)	(.10)	(.09)	(.10)	(09)
February	-.337**	-.334**	-.332**	-.393***	-.398***
	(.11)	(.10)	(.10)	(.10)	(.10)
March	-.181*	-.178*	-.178*	-.233**	-.241**
	(.10)	(.10)	(.10)	(.10)	(.10)
April	-.293**	-.292*	-.288**	-.336**	-.336**
	(.11)	(.10)	(.10)	(.10)	(.10)
May	-.142	-.139	-.135	-.175*	-.174*
	(.10)	(.10)	(.10)	(.10)	(.10)
June	.564***	.566***	.571***	.540***	.540***
	(.09)	(.09)	(.09)	(.09)	(.09)
July	-.421***	-.419***	-.416***	-.442***	-.438***
	(.11)	(.11)	(.10)	(.10)	(.10)
August	-.167	-.166	-.167*	-.188*	-1.88*
	(.10)	(.10)	(.10)	(.10)	(.10)
September	-.121	-.121	-.121	-.134	-.131
	(.10)	(.10)	(.10)	(.10)	(.10)
October	-1.518***	-1.516***	-1.517***	-1.536***	-1.530***
	(.14)	(.14)	(.14)	(.14)	(.14)
November	.573***	.574***	.573***	.574***	.571***
	(.09)	(.09)	(.09)	(.09)	(.09)
WWI	-.042	.165*	-.228	-079	.237
	(.09)	(.10)	(.14)*	(.12)	(.16)
WWII	-.125	-.099	.235	-.068	.120
	(.12)	(.12)	(.18)	(.12)	(.18)
Paramount I	.060	.091	.391	-107	.323**
	(.13)	(.13)	(.16)*	(.13)	(.16)
Paramount II	-.030	.072	.026	-.091	-.049
	(.07)	(.08)	(.19)	(.12)	(.16)
Sound	.096	.094	.091	.089	.087
	(.19)	(.19)	(.18)	(.19)	(.19)

Fixed effects

[15] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	*Model 2*	*Model 6*	*Model 7*	*Model 8*
Shelter	.004	-.063*	-.013	-.064	.029
	(.03)	(.04)	(.05)	(.04)*	(05)
Int. Rate var.	.082	-.109	.039	-.053	.021
	(.19)	(.19)	(.19)	(.19)	(.19)
Screens	-.018	-.029*	-.013	-.021	-.010
	(.02)	(.02)	(.02)	(.02)	(.02)
Screens var.	-.041	-.154	-.484*	-.556**	-.601**
	(.24)	(.24)	(.25)	(.25)	(.25)
Tick. Price	.000	.097	.406***	.213***	.403***
	(.23)	(.23)	(.11)	(.06)	(.11)
T. Price var.	.388*	.485**	-.237	-.067	-.391
	(.22)	(.22)	(.27)	(.23)	(.26)
Attendance	-.010***	-.008***	.003	-.009**	-.006
	(.00)	(.00)	(.01)	(.00)	(.01)
Attend. Var.	-.720*	-.912**	-1.302**	-1.350***	-.1204***
	(.38)	(.37)	(43)	(.39)	(.42)
Prior entry	.007**	.002	-.008**	-.009**	-.015***
	(.00)	(.03)	(.00)	(.00)	(.00)
Prior exit	-.002	-.005*	.002	-.001	.005
	(.00)	(.02)	(.00)	(.00)	(.00)
HH	-.031***	-.034***	-.037***	-.025**	-.040***
	(.01)	(.00)	(.01)	(.01)	(.01)
TV Households	-.007**	-.012***	-.015**	-.007**	-.011
	(.00)	(.00)	(.01)	(.00)	(.01)*
Density		-.002	.015***	.002	-.014*
		(.00)	(.01)	(.00)	(.01)
Density^2		.023**	-.043***	.014	.011
		(.00)	(.01)	(.01)	(.02)
Density x age			.001*		.002**
			(.00)		(.00)
Density x age^2			-.001**		-.003**
			(.00)		(.00)
Density^2 x age			.005		-.001
			(.00)		(.00)
Density^2 x age^2			.001		.001
			(.00)		(.00)
Industry age			-.303***		-.179**
			(.08)		(.00)
Industry age^2			.006***		.003
			(.00)		(.00)
Trials				7.101***	16.192**
				(3.95)	(5.23)
Density/Trials				-1.009**	-2.245***
				(.42)	(.60)
Density^2/Trials				1.911***	3.167***
				(.41)	(.66)
Constant	2.588	2.588	-2.398	1.743	-2.542
	(.32)	(.32)	(.17)	(.17)	(.18)
Log-likelihood	-1661.1884	-1648.8207	-1637.9628	-1635.6554	-1621.933

Main effects

Table 2.3.d

Negative binomial regression models for entry rates of feature film distributors, 1912-1970

Density dependence and temporal variation[16]

	Model 1	*Model 2*	*Model 6*	*Model 7*	*Model 8*
January	.391**	.394**	.240**	.240	.258*
	(.15)	(.15)	(.15)	(.15)	(.15)
February	-.410**	-.407**	-.403**	-.531**	-.519**
	(.18)	(.18)	(.17)	(.17)	(.17)
March	-.426**	-.424**	-.416**	-.523**	-.511**
	(.18)	(.18)	(.17)	(.17)	(.17)
April	-.309*	-.310*	-.310*	-.377**	-.372**
	(.17)	(.17)	(.17)	(.17)	(.17)
May	-.323*	-.321*	-.316*	-.380**	-.365**
	(.17)	(.17)	(.17)	(.17)	(.17)
June	.780***	.779***	.782***	.727***	-.730***
	(15)	(.15)	(.14)	(14)	(.14)
July	-.484***	-.482***	.479***	-.524**	-.518**
	(.18)	(.18)	(.17)	(.17)	(.17)
August	-.419**	-.418**	-.417**	-.451**	.448**
	(.18)	(.18)	(.17)	(.17)	(.17)
September	-.363**	-.363**	-.355**	-.391**	.383**
	(.17)	(.17)	(.17)	(.17)	(.17)
October	-2.185***	-2.186***	-2.175***	-2.212***	-2.193***
	(.32)	(.32)	(.31)	(.31)	(.31)
November	.561***	.563***	.573***	.571***	.576***
	(.15)	(.15)	(.14)	(.14)	(.14)
WWI	.022	.023	-.096	.007	.305
	(.15)	(.18)	(.23)	(.18)	(.26)
WWII	-.647***	-.568**	-.232	-.041	-.385
	(.22)	(.24)	(.37)	(.24)	(.37)
Paramount I	-.422*	-.443*	.048	-.118	.003
	(.22)	(.23)	(.29)	(.23)	(.29)
Paramount II	-.731***	-.699***	-.056	-.167	-.138
	(.15)	(.16)	(.38)	(.27)	(.38)
Sound	.078	.076	.077	.076	.074
	(.18)	(.19)	(.19)	(.20)	(.19)

Fixed effects

[16] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	*Model 2*	*Model 6*	*Model 7*	*Model 8*
Shelter	.063	.090	-.071	-.075	-.180
	(.06)	(.08)	(.11)	(.08)	(.12)
Int. Rate var.	-.344	-.340	-.156	-.593*	-.324
	(.32)	(.33)	(.33)	(.32)	(.33)
Screens	-.000	-.009	.005	.060**	.049
	(.03)	(.03)	(.04)	(.03)	(.04)
Screens var.	-.796**	-.822**	-.146	.240	.145
	(.40)	(.41)	(.45)	(.41)	(.46)
Tick. Price	-.557	-.373	.419**	.319**	.181
	(.37)	(.41)	(.16)	(.09)	(.12)
T. Price var.	.658*	.709	.016	.008	.105
	(.37)	(.41)	(.39)	(.37)	(.38)
Attendance	-.013***	.-.013***	.001	-.012**	.005
	(.00)	(.00)	(.00)	(.00)	(.01)
Attend. Var.	-.507	-.473	-.725	-.740	-.797
	(.57)	(.60)	(.64)	(.58)	(.63)
Prior entry	-.182	-.203*	-.036***	-.386**	-.041***
	(.12)	(.12)	(.01)	(.12)	(.01)
Prior exit	.023***	.026***	.030**	.001	.015
	(.01)	(.01)	(.01)	(.00)	(.01)
HH	-.007	-.002	-.021**	-.034***	.011
	(.00)	(.01)	(.01)	(.01)	(.01)
TV Households	.001	-.004	.003	.003	.001
	(.00)	(.00)	(.01)	(.00)	(.01)
Density		.011	.014	.054***	.013
		(.01)	(.03)	(.01)	(.03)
Density^2		-.092	-.098	-.270***	-.019
		(.10)	(.21)	(.09)	(.22)
Density x age			-.002***		.004**
			(.00)		(.00)
Density x age^2			.004**		.020**
			(.00)		(.01)
Density^2 x age			.025**		.020**
			(.01)		(.01)
Density^2 x age^2			-.005**		-.004**
			(.00)		(.00)
Industry age			-.113		.024
			(.09)		(.09)
Industry age^2			.001		-.009
			(.00)		(.00)
Trials				-.430	-.002**
				(2.07)	(.00)
Density/Trials				-.783*	-.945*
				(.44)	(-56)
Density^2/Trials				5.945***	5.976**
				(1.44)	(1.90)
Constant	1.238	.887	.953	-3.447	-1.146
	(.45)	(.57)	(.89)	(.84)	(1.09)
Log-likelihood	-1069.0439	-1068.5325	-1046.5043	-1047.5536	-1035.8486

Main effects

Variable |	Obs	Mean	Std. Dev.	Min	Max
War	21762	0.115431	0.319548	0	1
Paramount case I	21762	0.034602	0.182773	0	1
Paramount case II	21762	0.455151	0.497996	0	1
Sound	21762	0.735686	0.440977	0	1
Screens	21762	17.39878	2.362261	11.875	22.998
Attendance	21762	48.37042	22.71837	17.89925	87.25
Price	21762	3.340926	1.237043	1.67983	7.119297
TV Households	21762	30.00678	38.96715	0	94.45
HH Index	21762	3.978292	2.325461	0.507515	58.5
Prior entries	21762	74.94265	39.12009	1	198
Prior exits	21762	72.96021	39.1091	2	238
Density at founding	21762	168.0879	57.48753	8	351
Density	21762	145.7628	52.95166	13.75	288.75
$Density^2$	21762	24.05067	17.47349	.189063	833.7656
Size	21762	118.6367	386.7943	2	1962
Genre	21762	9.768496	16.76005	1	79
Mass	21762	4.507428	1.823026	0.04	8.7625
Sum Age x size	21762	3.837715	2.048867	0.002	7.73
Sum age	21762	0.785873	0.288287	0.0165	1.28525
Density x size	21762	499.1847	185.0165	3.875	890.9368

Table 2.4.a Descriptive statistics for exit models, producers

Variable |	Obs	Mean	Std. Dev.	Min	Max
War	10326	0.115431	0.319548	0	1
Paramount case I	10326	0.034602	0.182773	0	1
Paramount case II	10326	0.455151	0.497996	0	1
Sound	10326	0.735686	0.440977	0	1
Screens	10326	17.39878	2.362261	11.875	22.998
Attendance	10326	48.37042	22.71837	17.89925	87.25
Price	10326	3.340926	1.237043	1.67983	7.119297
TV Households	10326	30.00678	38.96715	0	94.45
HH Index	10326	6.330416	4.515671	2.0738	78.125
Prior entries	10326	24.48431	12.8786	1	51
Prior exits	10326	22.26264	11.02844	2	54
Density at founding	10326	67.21102	27.56821	2	147
Density	10326	72.22406	30.64834	7	138.75
$Density^2$	10326	6.155545	4.977039	0.49	192.5156
Size	10326	323.0947	673.1018	2	2733
Genre	10326	17.94829	24.24176	1	76
Mass	10326	4.556967	1.832201	0.04	8.7625
Sum Age x size	10326	6.431672	2.31077	0.002	10.26875
Sum age	10326	0.457168	0.225387	0.00725	0.93375
Density x size	10326	516.4474	162.5741	14	917.5848

Table 2.4.b Descriptive statistics for exit models, distributors

	War	Part I	Par II	Sound	Scrn	Attend	Price	TV	HH	Pr en	Pr ex	Delay	Den	Den^2	Size	Gen	Mass	Age x sz	Age	D x sz
War	1.00																			
Paramount I	0.13	1.00																		
Paramount II	-0.33	-0.17	1.00																	
Sound	-0.16	0.11	0.55	1.00																
Screens	0.00	0.08	-0.10	0.46	1.00															
Attendance	0.22	0.30	-0.60	0.16	0.63	1.00														
Price	-0.16	-0.04	0.72	0.65	-0.13	-0.42	1.00													
TV Houses	-0.28	-0.15	0.84	0.46	-0.26	-0.77	0.78	1.00												
HH Index	0.19	0.21	-0.52	0.08	0.53	0.80	-0.44	-0.70	1.00											
Prior entries	-0.21	-0.21	0.46	-0.15	-0.62	-0.83	0.52	0.65	-0.81	1.00										
Prior exits	-0.25	-0.17	0.46	-0.09	-0.55	-0.78	0.56	0.65	-0.79	0.97	1.00									
Density delay	-0.29	-0.10	0.21	-0.04	-0.27	-0.44	0.35	0.41	-0.52	0.57	0.61	1.00								
Density	-0.36	-0.20	0.44	-0.10	-0.56	-0.78	0.53	0.66	-0.82	0.93	0.94	0.68	1.00							
Density^2	-0.31	-0.17	0.43	-0.04	-0.55	-0.75	0.61	0.67	-0.77	0.93	0.95	0.67	0.98	1.00						
Size	0.03	0.04	-0.03	0.04	0.06	0.09	-0.02	-0.05	0.07	-0.07	-0.07	-0.10	-0.08	-0.07	1.00					
Genre	0.05	0.06	-0.07	0.05	0.10	0.14	-0.04	-0.10	0.12	-0.13	-0.12	-0.11	-0.13	-0.12	0.95	1.00				
Mass	0.22	0.08	-0.79	-0.67	-0.03	0.38	-0.68	-0.76	0.28	-0.23	-0.23	-0.07	-0.19	-0.23	0.02	0.04	1.00			
Sum Age x size	0.15	0.29	-0.12	0.43	0.63	0.80	-0.11	-0.45	0.69	-0.72	-0.67	-0.45	-0.69	-0.67	0.08	0.13	0.07	1.00		
Sum age	-0.40	-0.05	0.81	0.67	-0.02	-0.45	0.84	0.86	-0.54	0.49	0.55	0.41	0.60	0.61	-0.03	-0.06	-0.73	-0.10	1.00	
Density x size	0.20	0.11	-0.82	-0.50	0.14	0.55	-0.65	-0.80	0.43	-0.36	-0.35	-0.13	-0.30	-0.33	0.03	0.06	0.96	0.22	-0.7	1.00

Table 2.5 a Bivariate correlations for models estimating exit rates, producers

	War	Part I	Par II	Sound	Scrn	Attend	Price	TV	HH	Pr en	Pr ex	Delay	Den	Den^2	Size	Gen	Mass	Age x sz	Age	D x sz
War	1.00																			
Paramount I	0.12	1.00																		
Paramount II	-0.29	-0.17	1.00																	
Sound	-0.21	0.12	0.53	1.00																
Screens	-0.03	0.10	-0.22	0.38	1.00															
Attendance	0.16	0.31	-0.68	0.12	0.65	1.00														
Price	-0.18	-0.06	0.77	0.62	-0.24	-0.52	1.00													
TV Houses	-0.26	-0.15	0.90	0.47	-0.33	-0.79	0.84	1.00												
HH Index	0.12	0.07	-0.22	-0.08	0.12	0.26	-0.34	-0.32	1.00											
Prior entries	-0.01	-0.16	0.22	-0.23	-0.62	-0.67	0.36	0.44	-0.45	1.00										
Prior exits	-0.02	-0.06	0.11	-0.26	-0.62	-0.53	0.35	0.33	-0.48	0.86	1.00									
Density delay	-0.17	-0.04	0.16	0.03	-0.27	-0.29	0.38	0.30	-0.39	0.41	0.48	1.00								
Density	-0.27	-0.13	0.36	0.04	-0.57	-0.62	0.63	0.59	-0.59	0.78	0.83	0.60	1.00							
$Density^2$	-0.24	-0.13	0.45	0.12	-0.57	-0.65	0.74	0.66	-0.53	0.73	0.80	0.60	0.98	1.00						
Size	0.07	0.05	-0.03	0.05	0.13	0.15	-0.07	-0.10	0.09	-0.19	-0.17	-0.21	-0.20	-0.18	1.00					
Genre	0.09	0.06	-0.03	0.07	0.17	0.19	-0.09	-0.13	0.12	-0.24	-0.22	-0.24	-0.26	-0.23	0.93	1.00				
Mass	0.24	0.08	-0.80	-0.64	0.07	0.44	-0.67	-0.77	-0.07	-0.04	0.12	-0.03	-0.15	-0.26	0.01	0.01	1.00			
Sum Age x size	-0.22	0.19	0.61	0.85	0.29	0.07	0.64	0.48	-0.16	-0.30	-0.24	0.07	0.03	0.14	0.09	0.12	-0.56	1.00		
Sum age	-0.33	-0.03	0.78	0.65	-0.21	-0.49	0.95	0.86	-0.43	0.33	0.35	0.42	0.68	0.77	-0.08	-0.10	-0.67	0.70	1.00	
Density x size	0.19	0.16	-0.72	-0.41	0.15	0.53	-0.56	-0.71	-0.08	-0.11	0.05	-0.03	-0.16	-0.26	0.03	0.04	0.94	-0.33	-0.55	1.00

Table 2.5 b Bivariate correlations for models estimating exit rates, distributors

Table 2.6.a

Piecewise constant exponential regression estimates of exit rates for feature film producers, 1912-1970[17]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Tenure u<1	-1.83***	0.241	0.378	0.180	1.097*	0.709	0.928
	(.43)	(.58)	(.58)	(.61)	(.63)	(.83)	(.58)
Tenure 1<u<4	-1.90***	0.179	0.308	0.384	1.026	0.637	0.896
	(.43)	(.58)	(.58)	(.58)	(.63)	(.83)	(.58)
Tenure 4<u<8	-2.04***	0.055	0.167	-0.057	0.879	0.490	0.796
	(.43)	(.58)	(.58)	(.60)	(.63)	(.83)	(.58)
Tenure 8<u<20	-2.18***	-0.064	0.010	-0.307	0.723	0.335	0.687
	(.43)	(.58)	(.58)	(.62)	(.63)	(.83)	(.58)
Tenure u>20	-2.37***	-0.263	-0.228	-0.386	0.491	0.103	0.585
	(.44)	(.58)	(.58)	(.64)	(.63)	(.83)	(.58)
War year	-0.18*	-0.357***	-0.387***	-.379***	-0.492***	-0.507***	-0.409***
	(.10)	(.12)	(.12)	(.12)	(.12)	(.13)	(.12)
Paramount I	0.22	0.215	0.233	0.231	0.229	0.203	0.177
	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)
Paramount II	-0.21	-0.082	-0.132	-0.131	0.117	0.124	-0.213
	(.14)	(.15)	(.15)	(.15)	(.17)	(.23)	(.15)
Sound	-0.25	-0.187	-0.196	-0.192	-0.209	-0.160	-0.153
	(.22)	(.23)	(.23)	(.23)	(.23)	(.24)	(.23)
Screens	-0.03	-0.003	0.008	0.008	0.003	0.001	0.005
	(.02)	(.02)	(.02)	(.02)	(.02)	(.01)	(.02)
Attendance	-0.01	-0.004	-0.005	-0.004	-0.004	-0.001	-0.007
	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Ticket price	0.26***	0.078	0.083	0.089	0.013	0.016	0.102
	(.05)	(.07)	(.07)	(.07)	(.08)	(.09)	(.07)
TV Households	-0.01***	-0.011***	-0.011***	-0.011***	-0.007*	-0.006	-0.012***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.01)	(.00)
HHI	-0.03*	-0.136***	-0.149***	-0.145***	-0.187***	-0.161**	-0.148***
	(.03)	(.04)	(.04)	(.04)	(.04)	(.05)	(.04)
Prior entry	-0.01***	-0.006	-0.008**	-0.007**	-0.006*	-0.005	-0.008***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Prior exit	0.01***	0.010***	0.011***	0.010***	0.009***	0.008***	0.011***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Size	-0.01***	-0.007***	-0.007***	-0.007***	-0.007***	-0.007***	.003***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)

[17] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	
Density		-0.023***	-0.021***	-0.020***	-0.033***	-0.032***	-.020***
		(.00)	(.00)	(.00)	(.01)	(.01)	(.00)
Density²		0.065***	0.068***	0.065***	0.097***	0.094***	.063***
		(.02)	(.02)	(.02)	(.02)	(.02)	(.00)
Density delay			-0.003***		-0.003***	-0.003***	-.004***
			(.00)		(.00)	(.00)	(.00)
Den del x tenure1				-0.002*			
				(.00)			
Den del x tenure2				-0.004***			
				(.00)			
Den del x tenure3				-0.002**			
				(.00)			
Den del x tenure4				-0.002*			
				(.00)			
Den del x tenure5				-0.002**			
				(.00)			
Density x size					.001***		
					(.00)		
Sum of age						.123**	
						(.06)	
Sum of size						-.023	
						(.06)	
Sum of age x size						.039	
						(.90)	
Genre							-.144***
							(.00)
Log-likelihood	-2274.1746	-2259.9357	-2252.8109	-2340.9224	-2247.2498	-2247.0105	-2156.8113

Table 2.6.b

Piecewise constant exponential regression estimates of exit rates for feature film distributors, 1912-1970[18]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Tenure u<1	-2.099***	1.032	1.007	1.385	0.840	1.119	1.263
	(.73)	(.99)	(.99)	(1.04)	(1.01)	(1.09)	(.99)
Tenure 1<u<4	-1.930***	1.202	1.183	1.119	1.017	1.298	1.457
	(.72)	(.98)	(.98)	(.99)	(1.00)	(1.09)	(.98)
Tenure 4<u<8	-2.294***	0.839	0.825	1.172	0.663	0.953	1.127
	(.73)	(.99)	(.99)	(1.01)	(1.00)	(1.09)	(.99)
Tenure 8<u<20	-2.300***	0.853	0.851	0.711	0.691	0.982	1.172
	(.72)	(.99)	(.99)	(1.01)	(1.00)	(1.09)	(.99)
Tenure u>20	-2.553***	0.569	0.589	0.492	0.430	0.733	0.929
	(.73)	(.99)	(.99)	(1.03)	(1.01)	(1.09)	(.99)
War year	-0.083	-0.309*	-0.307*	-0.303	-0.275	-0.395*	-0.353*
	(.15)	(.18)	(.18)	(.19)	(.19)	(.20)	(.18)
Paramount I	0.339	0.315	0.301	0.298	0.312	0.485*	0.220
	(.25)	(.25)	(.25)	(.25)	(.25)	(.26)	(.25)
Paramount II	-0.044	-0.490	-0.481	-0.455	-0.446	0.027	-0.365
	(.28)	(.32)	(.32)	(.32)	(.33)	(.42)	(.32)
Sound	-0.116	0.134	0.158	0.174	0.089	0.231	0.145
	(.31)	(.33)	(.33)	(.33)	(.34)	(.36)	(.33)
Screens	-0.022	-0.042	-0.044	-0.046	-0.034	-0.054	-0.037
	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)	(.03)
Attendance	-0.010	-0.008	-0.008	-0.008	-0.009	0.005	-0.009
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Ticket price	0.212***	-0.047	-0.049	-0.057	-0.037	-0.039	-0.030
	(.08)	(.13)	(.13)	(.13)	(.13)	(.16)	(.13)
TV Households	-0.014***	-0.008	-0.008	-0.008	-0.010	-0.005	-0.010*
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
HHI	0.008	-0.031*	-0.030*	-0.032**	-0.030*	-0.038*	-0.032*
	(.01)	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Prior entry	-0.025***	-0.011	-0.011	-0.011	-0.013	-0.014*	-0.012
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Prior exit	0.042***	0.040***	0.041***	0.041***	0.043***	0.042***	0.041***
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Size	-0.006***	-0.006***	-0.006***	-0.005***	-0.006***	-0.006***	.001
	(.01)	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)

[18] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
Density		-.061***	-.062***	-.061***	-.056***	-.069***	-.060***
		(.01)	(.01)	(.01)	(.01)	(.02)	(.01)
Density²		.352***	.347***	.346***	.323***	.370***	.339***
		(.09)	(.09)	(.09)	(.10)	(.11)	(.09)
Density delay			.002		.002	-0.002	-0.001
			(.00)		(.00)	(.00)	(.00)
Den del x tenure1				-0.002			
				(.00)			
Den del x tenure2				0.003			
				(.00)			
Den del x tenure3				-0.002			
				(.00)			
Den del x tenure4				0.004			
				(.00)			
Den del x tenure5				0.004			
				(.00)			
Density x size					.0001		
					(.00)		
Sum of age						1.013	
						(2.90)	
Sum of size						.053	
						(.08)	
Sum of age x size						-.190	
						(.12)	
Genre							-.088***
							(.01)
Log-likelihood	-991.04975	-979.75958	-979.40275	-977.55231	-979.09379	-976.92752	-958.25994

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Chapter 3
Community-level effects and entry rates in the U.S. motion picture industry

3.1 INTRODUCTION

Research in organizational ecology has developed a general theory of density-dependent evolution that has received wide empirical support for its predictions. This theory, posits that the processes of legitimation and competition regulating vital rates in an organizational population are internal to the population itself. Organizations, however, interact regularly with their environment, and in most cases the environment is made up of other organizational populations. It is difficult to think that interactions among organizations have negligible consequences on the dynamic of populations. How do such interactions matter? Community ecology deals with the interactions of different local populations and the effects that such interactions produce on organizational evolution. Although community ecology represented a foundational element within the formulation of the ecological theory to explain organizational diversity and evolution (Hannan and Freeman 1977: 942-44), researchers have less frequently addressed this issue in analyzing vital rates of populations (Rao 2002).

A community perspective extends the key insight of ecology according to which other organizations in a population form the critical element of the environment faced by organizations. Community ecology argues that the system of relationships involving suppliers, buyers, consumers, intermediaries, and institutions integrates intra-population processes to regulate the evolution of organizational populations. Early commentaries proposed a community ecology approach based on technological spillovers to explain the emergence of industry following radical innovations (Astley and Fombrun 1983a, 1983b, Astley 1985); no systematic empirical study exists to support this early theory. However, recent studies are bringing community ecology back in the macro theories of industry evolution. Ruef (2000) employs a community perspective built on the notion of similar identities to study the emergence of organizational forms in the U.S. health care field; in a related paper, Ruef (2004) reviews different perspectives, including community ecology, which could explain better than intra-population density dependence processes the trajectories of industry decline and resurgence observed in the population of U.S. medical schools. In a different direction, Sørensen (2004) investigates patterns of entrepreneurial activity in Denmark and argues that different populations located in the same area can compete not only for product markets but also for labor markets, and finds evidence of recruitment-based competition related to input resources in the economy.

The present study adds to the growing literature of community ecology by focusing on a specific set of relationships existing between populations, namely vertical interdependence between buyers and suppliers, and develops hypotheses about the effects of vertical interdependence on entry rates of interacting populations. The empirical analysis examines entry patterns of 4,091 producers and 1,620 distributors of feature films in the United States during the period 1912-1970. In this observation period, the two populations show a pattern of decline and resurgence for which the intra-population density dependence theory provides limited explanation. The findings demonstrate that mechanisms incorporating inter-population effects increase the explanatory power of the general density dependence model. Most importantly, the community-level effects considered here affect entries in an asymmetric way. This result is relevant to ecological theories because it addresses the main research question regarding organizational diversity; indeed, it suggests that the source of high diversity in a population can be a response to interactions with other populations. The paper is structured in the following way. The next two sections are devoted to reviewing existing theories of industry evolution in late stages and community ecology. The following section develops theory and hypotheses relating vertical interdependence between organizational populations and entry rates. The fifth section presents the empirical analysis. A final section describes and discusses findings together with limitations of the study and its implications for future research.

3.2 ORGANIZATIONAL ECOLOGY AND LATE STAGE POPULATION EVOLUTION

Ecological research has developed a general framework of density-dependent evolution that has found remarkably consistent empirical support in diverse contexts (Carroll and Hannan 2000). The theory is based on two complementary processes of legitimation and competition that drive population dynamics in connection with the utilization of resources in the niche. When resources are limited, the vital rates of a population are non-monotonically related to the number of organizations operating in the population, i.e. population density. The empirical trajectory observed in many organizational populations is such that it grows slowly initially, and then increases rapidly to a peak. Once the peak is reached, there is usually a sharp decline and occasionally stabilization (Carroll and Hannan 1989). Mature populations, however, show more complicated trajectories (Carroll 1997, Ruef 2004). In some cases, decline is persistent and does not lead to stabilization; in other cases, decline is followed by fluctuations, or by reviving density. Finally, evolutionary trajectories may oscillate in cycles.

If we focus our attention to founding rates, which are the main interest of the present study, ecological research has considered at least three main solutions to explain complex patterns of industry evolution. Hannan (1997) introduced temporal heterogeneity in the context of the density dependence model to account for population decline and late resurgence in advanced phases of industry evolution. Hannan argues that legitimation and competition are not timeless functions of population density; instead, as industries mature, these two processes are less dependent on density and more on the position that the population develops within a network of external relationships, or alternatively the microstructure the develops within the population due to partitioning processes (Carroll 1985, Carroll and Swaminathan 2000). However, when segregating processes are absent, as in the case of motion picture producers and distributors documented in the previous chapter it is less evident how temporal heterogeneity addresses later stages in the evolution of organizational populations. Another implicit assumption of this theoretical refinement is that relationships between populations become relevant only in industry maturity.

A second alternative that develops predictions on how populations are structured is mass dependence theory (Barnett and Amburgey 1990, Barnett 1997, Barron 1999). Mass dependence integrates density dependence by proposing that organizations do not exercise equal competitive effects. A general hypothesis of this theory is that increasing aggregate size of the population implies more intense competition resulting in a negative relationship with founding rates. An extension of this argument posits that the effects of size can be less potent and provide a better explanation when they are combined with the effects of age - larger and older organizations do not generate the same competition as small and young organizations. Barnett (1997) argues that larger organizations are more likely to survive due institutional fitness that compensates a lower technical fitness, and overall they are weaker competitors compared to smaller organizations. Instead, older organizations, as well as older organizations that are larger, have survived previous competitive challenges, and tend to generate higher competitive pressure.

Focusing directly on the discussion of how foundings, rather than survival, can be affected by mass dependence, Barron (1999) maintains that size provides scale benefits and more slack resources; consequently, larger organizations reduce new foundings. Among other factors that might influence the relationship between founding rates and size are: 1) the existence of internal labor market in larger firms that reduce the incentive for employees to start new businesses; 2) the higher number of contacts that employees of small firms have with external actors, increasing their ability to start new ventures.

Additional effects of size are relevant at the average: all else equal, an increasing average size of living organizations implies established access to inter-organizational networks and higher market power that discourage new foundings. In chapter 2 we have analyzed and compared mass dependence specifications for the populations of feature film producers and distributors, finding mixed results of mass dependence evolution, especially contrasting the weak survivor hypothesis developed by Barnett (1997). In his study of population growth of medical schools, Ruef also finds weak evidence for mass dependence effects. A possible reason that explains why we obtain weak support for these hypotheses may depend on what mass dependence is best suited to explain, namely cycling around equilibrium levels after density peaks or sustained decline.

A third alternative addressing articulate trajectories in the evolution of populations is community ecology. Community ecology studies the interaction and interdependence of different populations. It represents a perspective that mainly has been utilized to explain exceptional evolutionary phenomena, like emergence of populations following branching processes and extinction of populations (Astley 1985, Aldrich 1999). Recent studies, however, are extending the community approach to investigate industrial dynamics of ongoing populations across different evolutionary stages. Ruef (2004) builds an explanation for the empirical decline *and* resurgence observed in the history of medical schools based on the notion of oppositional identities. When organizational forms emerge competing with the established ones, as witnessed by the introduction of sectarian medical colleges against regular medical schools, the latter form may suffer from competition and experience decline. The competitive effect may transform into symbiotic relationships when the success of competing forms stimulate the development of complementary industries. Therefore, resurgence might occur in the established form as well.

3.3 THE COMMUNITY ECOLOGY OF ORGANIZATIONAL POPULATIONS

Community ecology deals with the interactions of different local populations and the effects that such interactions produce on organizational evolution. What is important to appreciate is that interactions among populations produce consequences at different levels. The first effect concerns the individual organizations involved in the interaction. Some competitive interactions may modify the survival chances of organizations, e.g. they may involve direct aggressive behavior that reduces resources required for operation. But interactions among individual units of populations have effects at higher level, notably at the population level. Competition among the individuals of a single population may result in a reduction in the growth rate of that population, likely reducing also founding rates. When one population is a superior competitor to another, it may eliminate its competitor from the niche, in a similar way as we observe in predator-prey systems analyzed in bio-ecology (Ricklefs and Miller 1999).

Brittain and Wholey (1988) identify several types of interactions between organizational populations - *i* and *j* - and the effects that such interactions produce on population size: full competition, designating a relation whereby the presence of *i* suppresses the growth of *j*; partial competition, whereby the growth of *i* is decreased by the presence of *j*, but *j*'s growth is not affected; predatory competition, if *i* expands at the expense of *j*; neutrality, when *i*'s and *j*'s growth is not affected by each other; commensalism (parasitism), if *i* benefits from the presence of *j*, and *j* is not affected by *i*; symbiosis, if *i* and *j* are positively affected by each other's presence. Two primary criteria that characterize communities are their boundaries and the role - or function - that each population plays within the community.

Early studies defined community boundaries in terms of the technological interdependence but did not address explicitly how the community is functionally structured. Astley (1985) argued that technological innovation external to populations blurs industry boundaries and creates an organic system where once distinct entities operated. After the emergence of interdependent relationships between populations, the core technology on which the community has been founded remains largely unchanged, locking populations into a given set of relationships that evolves to closure. In this context of reduced variation, the regulation and growth of populations is increasingly guided by density-dependent competitive processes within each population. Symbiotic relationships between populations remain important to fulfil activities that are ancillary to the main activity of each population. The evidence collected to support this view is limited to a series of historical case studies of single industries like telecommunications and financial services (Fombrun and Astley 1982, 1983, Astley and Fombrun 1983a, 1983b, Fombrun 1986), which did not analyze directly the effects of community relationships on vital rates in organizational populations.

Other studies favored a more articulate view of community interactions concerning the functional differentiation of distinct populations. A study by Nielsen and Hannan (1977), later extended by Carroll (1981) suggests that the expansion of one population may lead to a contraction of resources for other populations with which it interacts. Their investigation on growth rates of national enrollment in primary, secondary and tertiary education in rich and poor countries in 1950-1970, obtains evidence for hierarchical mutualism across different levels of education - an expansion in primary education is positively related to the expansion of secondary enrollment, and enrollment in both primary and secondary education is positively related to the expansion of tertiary enrollment.

More recently, Korn and Baum's (1994) focused on spatial boundaries defined at the national level in their analysis of employment dynamics in the 200 largest Canadian organizations between 1985 and 1992, but also addressed distinct functional roles of populations in the community. They argue that changes in the environment of one population usually mean changes in the resources, configuration, or activities of other spatially close and functionally interdependent populations. Particularly, population growth measured in number of jobs depends on the constraints and opportunities each population faces vis-à-vis its environment and other populations, and such constraints and opportunities are produced through the exchange of raw materials, labor, technology, and product markets. Underlying the structure of an organizational community is a pattern of resource interdependence that connects manufacturing, wholesale, financials, natural resources and transportation sectors through a complex pattern of competitive and symbiotic relationships. Similarly, Sørensen (2004) finds that increasing labor market overlaps between industries reduce founding rates in the Danish economy.

A final type of study that combines both functional differentiation and geographic scale is Stuart and Sorenson's (2003) analysis of founding rates of biotech firms in the United States from 1978 to 1995. In this study, community boundaries include spatial heterogeneity that may affect the creation of new ventures. Stuart and Sorenson argue that the creation of new ventures in high tech industries requires different types of resources – technology, capital, and specialized human capital. The main sources providing such resources are, respectively lead inventors and university departments engaged in biotech-related research, venture capital firms, and established biotech organizations. We expect that new organizations are more likely to emerge where these resources are physically located and concentrated. The position of sources providing key resources increases founding rates in the same area. As the industry matures, however, proximity effects are reduced because relevant information and knowledge diffuse more broadly, while the emergence of industry-level institutions creates an intermediating role connecting previously more isolated networks. This study finds evidence for symbiotic relationships between interdependent populations engaged in functionally complementary activities.[1]

A different specification of studies analyzing functional differentiation and community boundaries is Ruef's (2000) analysis of form emergence in U.S. health sector between 1965 and 1998. Various factors contribute to increase the likelihood of emergence of new organizational forms. The first is a higher carrying capacity for the form, i.e. an increase in demand as expressed by social discourse. A second factor is a cross-legitimation effect from the existence of similar predecessor forms. New forms have better chances of emerging when their identity conforms to existing values and norms of conduct, which are embodied in the established form. This density-dependent component has a positive first-order, but a negative second-order effect: when the density of similar forms increases significantly, a resource exhaustion issue arises and competitive interaction among forms occurs. Partially similar forms do not have spillover effects on emergence of new forms mainly because they do not ensure identity conformity and therefore show only competitive effects. Finally, highly dissimilar forms instead should have a neutral (no influence) on new form emergence because they operate in very different domains. Plausibly, environmental factors can moderate the relationship existing between forms - within the organizational community some interactions are more sensitive than others to institutional or technical variations. An important implication of Ruef's study is that the adoption of higher evolutionary levels of

[1] Other studies investigate the existence of community relationships among interacting populations as empirical controls of single population analyses. In a study of geographical concentration of the U.S. footwear industry, Sorenson and Audia (2000) test the possible effects of mutualism between the population of shoe producers and the tanning industry, including the number of tannery workers in the estimation of the founding rate of shoe manufacturers. Their findings show that the presence of complementary facilities does not influence entry once density at the state level is included.

analysis can be just as important as the specification of heterogeneity within populations to explain organizational diversity (Hannan and Freeman 1977, DiMaggio 1994).

A different approach to the study of community ecology considers the relationships between organizational sub-populations within the same population. Here the boundaries of the community are defined along the product market dimension of the niche, while functions for the different sub-populations are equivalent, i.e. there may be horizontal specialization in the niche resources that sustain them but there is little or no vertical specialization in the sense that they all perform the same function (e.g., automobile producers, beer producers). This group of studies relies on single population density dependence models to verify the existence of competitive or mutualistic relationships between sub-populations. Examples include Hannan and Freeman's (1989) analysis of vital rates of U.S. labor unions, which found that density of industrial unions had a negative but negligible effect on foundings of craft unions, and the reverse was also true - the founding rate of industrial unions was close to zero when its competitor's density reached its maximum. In their analysis of entry in the U.S. semiconductor industry from 1949 to 1981, Brittain and Wholey (1988) found evidence of symbiosis, full competition and predatory competition among r vs. K strategists and generalists vs. specialists producers. Variants of this type of study include multi-level studies that modify the spatial boundaries of populations and analyze the relationships between sub-populations at different geographical levels. An example of this line of research is Lomi's (2000) investigation of founding rates of commercial banks in Denmark. Following revisions of density dependence proposing that legitimation processes operate at a different, often larger, scale compared to competitive mechanisms (Hannan et al. 1995), Lomi finds evidence for diffuse competition and localized mutualism as population density at the national level affects negatively bank foundings in Copenhagen, while high local density increases founding in Copenhagen. He also finds that density at the national level affects positively bank founding in the rest of the country (non-Copenhagen), and that high density at the non-local level affects negatively founding in the rest of the country, respectively evidence of diffuse mutualism and localized competition.

Table 1 presents a schematization of empirical research in community ecology relevant for the study of founding events and growth rates (earlier reviews include Carroll 1984, Wholey and Brittain 1986, Baum 1996). As the table indicates, most of them focus on sub-population dynamics and bring only indirect evidence on influence exerted by organizations that interact but perform different functions in the community on population vital rates. Hence, the role of functional interdependence between populations and its relationship remains interestingly underspecified and less explored.

Table 3.1. Empirical studies in organizational communities

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for founding or growth rates
Nielsen and Hannan 1977, Carroll 1981	International education, 1950-1970	Sub-population dynamics across multiple populations in space	Growth rates of national enrollment in primary, secondary and tertiary education in rich and poor countries	Enrollment in primary education is positively related to the expansion of secondary enrollment and enrollment in both primary and secondary education is positively related to the expansion of tertiary enrollment. Evidence of *mutualism.*
Dimmick and Rothenbuhler, 1984*	U.S. media industries 1949-1980	Population dynamics across multi-population system	Niche breadth and niche overlap dynamics	Television lowered radio's niche breadth as a result of strong competition over national advertising, at a decreasing rate. Cable television has strong overlap with television; television has moderate niche overlap with radio; radio has low overlap with cable. Cable television specializes in resource use compared to broadcasting television and radio (that has more generalist resource use). Evidence of *predatory competition.*
Barnett and Carroll, 1987	Iowa telephone companies in three counties, 1900-1917	Sub-population dynamics within single population	1) Organizational mortality of aggregate population and mutual and commercial organizational forms, 2) growth rates of mutuals and commercials, 3) probability of offering long-service supply by mutuals and commercials	1) Local density (measured at county level) has non significant influence on death rates; non-local density affects positively death rates. *Diffuse competition* exists. When main forms of mutual and commercial companies are introduced in the models, commercial density has positive effect on mortality, both at local and non-local level; non-local mutual density has positive effect on mortality, while local mutual density shows U-shaped relationship with mortality. Therefore, non-local companies show *diffuse competition* over both forms. Local commercial companies show *direct competition.* Local mutuals show *mutualism* and *direct competition.* 2) Both local and non-local density of mutuals is negatively related to growth for each form. There is a non robust negative relationship between non-local commercials density and mutuals growth. There is evidence of *diffuse competition* of non local companies. 3) Mutuals increase commercials' probability of providing long distance service. Commercial companies increase probability that mutuals offered long distance service. Evidence of *mutualism.*
Brittain and Wholey, 1988	U.S. semiconductor industry, 1949-1981	Sub-population dynamics within single population	Growth rates	Growth rates of receiving tubes-generalists are positively affected by density of K-specialists discrete producers, and vice versa. Evidence of *symbiosis.* Growth rates of r-specialists are negatively affected by density of K-specialists, and vice versa. Evidence of *full competition.* Growth rates of r-specialists are positively affected by density of K-specialists discrete producers, while growth rates of K-specialists discrete producers are negatively affected by density of r-specialists. Evidence of *predatory competition.*
Hannan and Freeman, 1989	U.S. craft and industrial labor unions, 1836-1985	Sub-population dynamics within single population	Founding rates	Increasing density of craft unions reduces founding of industrial unions, but industrial union density does not affect craft union founding. Evidence of *partial competition.*
Hannan and Freeman, 1989	Semiconductor firms, 1947-1984	Sub-population dynamics within single population	Entry rates	Increasing density of subsidiary firms reduces entry of independent firms, but independent firms density does not affect subsidiary firms' entry. Evidence of *partial competition.*

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for founding or growth rates
Staber, 1989	Worker, marketing and consumer cooperatives in Atlantic Canada, 1900-1987	Sub-population dynamics within single population	Founding rates	Increasing density of worker coops increases founding of marketing coops; increasing density of marketing coops increases founding of consumer coops; increasing density of consumer coops increases founding of worker coops. Evidence of *commensalism*.
Ranger-Moore et al., 1991	Commercial and savings banks in Manhattan, 1792-1980	Sub-population dynamics within single population	Founding rates	Density of commercial and savings banks are unrelated to each other founding rates. Evidence of *neutrality*.
Carroll and Swaminathan 1992	U.S. brewers, 1975-1990	Sub-population dynamics within single population	Founding rates	Increasing density of brewpubs stimulates founding of microbreweries, but microbrewery density does not affect brewpub founding. Evidence of *commensalism*.
Aldrich et al., 1994	U.S. trade unions and trade associations, 1900-1982	Sub-population dynamics within single population	1) Founding rates, 2) Merger rates	Union density (and foundings) does not have significant effect on trade association foundings, but shows positive effect on merger rates of associations. Evidence of *mutualism*.
Barnett, 1994	Pennsylvania telephone companies, 1879-1934	Sub-population dynamics within single population	1) Growth rates, 2) failure rates	1) The growth of the Bell system increased growth of independent companies, but this *mutualistic* effect was more than offset by *diffuse competition* at the level of the whole industry. Companies using magneto systems lowered growth rates of the independent system; the operation of companies using common-battery systems increased growth rates of the independent system. 2) Failure rates of organizations changing technological system increase after the change, with this hazard falling over time.
Baum and Singh, 1994	Child care system in Metropolitan Toronto area, 1971-1989	Sub-population dynamics within single population	Growth rates	Density of day care centers decreases growth rates of nursing centers; density of nursing centers increases growth of day care centers. Evidence of *predatory competition*.
Brittain, 1994	U.S. electronics components producers, 1947-1981	Sub-population dynamics within single population	Entry rates	Entry rates of r-specialists are positively influenced by density of K-specialists and K-generalists, and negatively but not significantly affected by density of r-generalists; entry rates of K-specialists are positively influenced by density of r-specialists and K-generalists, and negatively affected by density of r-generalists; entry rates of r-generalists are positively affected by density of r-specialists and K-generalists, and negatively but not significantly influenced by density of K-specialists; entry rates of K-generalists are positively influenced by density of r-specialists and K-specialists, and positively but not significantly by density of r-generalists. Evidence of complex pattern of relationships, from *full competition* to *partial competition*, *predatory competition*, *neutrality*, *commensalism* and *symbiosis*.

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for founding or growth rates
Korn and Baum, 1994*	Largest 200 Canadian organizations, 1985-1992	Population dynamics across multi-population system	Employment growth rates	Employment density of manufacturing industry has positive effects on growth of wholesale industry and negative effects on growth of financials industry; wholesale industry employment density has positive effects over manufacturing growth (manufacturing and wholesale are then *symbiotic*); employment density of financials industry has positive effects over growth of natural resources and negative effects over growth of manufacturing (financials and manufacturing show *full competition* relationship); employment density of natural resources industry has positive effects over manufacturing and financials (natural resources and financials show *symbiotic* relationship); employment density of natural resources industry has negative effects on growth of wholesale and positive effects over transportation industry; transportation has mutualistic effects over wholesale and natural resources (transportation and natural resources are *symbiotic*).
Land et al., 1994	U.S. minor league baseball teams and leagues, 1883-1990	Sub-population dynamics within single population	Founding rates	Density-dependent processes between national teams and national leagues density vs. team and league foundings; league founding influences positively team founding. Evidence of *structural mutualism* and *diffuse competition*.
Wade, 1995	U.S. microprocessor industry, 1971-1989	Sub-population dynamics within single population	Entry rates	Entry rates by second source (imitating) producers are negatively influenced by density of other technological communities in the market, by density of other second sources supporting other technological communities. Entry rates by second source (imitating) producers are positively influenced by technological dominance of a focal community. Evidence of *diffuse competition*.
Wade, 1996	U.S. microprocessor industry, 1971-1989	Sub-population dynamics within single population	Entry rates	Entry rates by sponsor (original) producers shows curvilinear relationship with density of technological communities. Entry rates by sponsor (original) producers are negatively influenced by density of second sources supporting existing technological communities, by emergence of a dominant technological community. Entry rates by specialized sponsor (original) producers increase with the emergence of a dominant technological community. Evidence of *diffuse competition*.
Barnett, 1997	Early Pennsylvania telephone companies, 1879-1934, and U.S. breweries, 1633-1988	Sub-population dynamics within single population	Founding rates	Age of ancestor organizations decreases founding rates in breweries. Evidence of *negative age dependence*.
Lomi, 2000	Commercial banks in Denmark, 1846-1989	Sub-population dynamics within single population	Founding rates	Density at the national level affects negatively bank founding in Copenhagen; high local density increases founding in Copenhagen. Evidence of *diffuse competition* and *localized mutualism*. Density at the national level affects positively bank founding in the rest of the country (non-Copenhagen); high density at the non-local level affects negatively founding in the rest of the country. Evidence of *diffuse mutualism* and *localized competition*.

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for founding or growth rates
Sorenson and Audia, 2000	U.S. footwear producers, 1940-1989	Population dynamics across multi-population system	Founding rates	Founding rates of footwear producers is positively affected by the number of workers in the upward tannery industry. However, the relationship between the two industries becomes negative and not significant when state (and national) density terms are included in the analysis. Weak evidence of symbiosis.
Bonaccorsi and Giuri, 2001	International turboprop engine and aircraft industries (1948-1998), jet engine and aircraft industries (1958-1998)	Population dynamics across multi-population system	1) Density of producers in the upstream industry, 2) density of products in the upstream industry, 3) level of concentration in the upstream industry	Density of producers and products, and concentration in the upstream industry is positively affected by density of producers and products, and concentration in the downstream industry. The "transmission" process is contingent upon the structure of the network linking suppliers of engines and aircraft manufacturers. Turboprop network has partitioned structure and shows parallel structural dynamics in upward and downward industries, the jet industry has hierarchical structure and shows unrelated dynamics between upward and downward industries. Network density has significant negative effect on number of firms in the two industries.
Ruef, 2000	U.S. health care organizations, 1965-1994	Form dynamics within a field	Emergence of organizational forms	The probability of form emergence has an inverted U-shaped relationship with the number of organizations of another form having a similar identity. Forms with dissimilar identities have a negative effect on new form emergence. When period effects are incorporated in the analysis, the competitive effect of dissimilar forms is no longer significant. Evidence of symbiosis and inter-form competition.
McKendrick et al., 2003*	Disk arrays producers, 1986-1998	Form dynamics across multi-population system	Founding rates	Founding rates are positively related to density of geographically concentrated producers in related activities.
Stuart and Sorenson, 2003	U.S. biotech industry, 1978-1995	Population dynamics across multi-population system	Founding rates	Spatial proximity to venture capital firms, university research departments in biotech-relevant disciplines, lead inventors, and other biotechnology firms increases the founding rate of biotech firms in the same area. Evidence of *symbiosis*.
Ruef, 2004	U.S. medical schools, 1765-1999	Sub-population dynamics within single population	Growth rates	Density of nursing schools decreases growth of regular medical schools. Evidence of *direct competition*. Density of sectarian schools first increases then decreases growth rates of regular medical schools. Evidence of *mutualism* and *competition*.
Sørensen, 2004*	Danish economic system (84 industries), 1980-1991	Population dynamics across multi-population system	Founding rates	Founding rates in an industry are reduced by increasing labour market overlap. Evidence of recruitment based competition.

3.4 VERTICAL INTERDEPENDENCE BETWEEN ORGANIZATIONAL POPULATIONS

Among the various relationships that link organizations to their environments, the interaction between buyers and suppliers are of primary importance. This type of relationship defines a vertical interdependence association between buyers and suppliers, who need each other's presence to perform their activity in systematic way. Interdependence exists when actors do not control all conditions required to perform a function and obtain the relative outcome. Research in organization theory and strategy has developed relevant conceptualizations of vertical interdependence at the organizational level, while the implications of interactions between populations and their consequences on population vital rates remain underdeveloped.

The contingency theory elaborated by Thompson (1967) claims that all organizations are dependent on their environment, primarily suppliers and customers, and they can determine only in part what actors they can relate to or the terms of exchange with them. From a related power perspective, resource dependence theory argues that every organization needs resources that are not under its control and must acquire those resources by interacting with external groups or organizations that do control them (Pfeffer and Salancik 1978). The importance and scarcity of the resource determine the extent and nature of dependence. To secure higher and longer chances of survival, organizations need to protect their technical core by reducing dependencies from the external environment. To do so they develop various strategies like sealing off their core technologies, buffering environmental influences with "cushioning" components, smoothing of transactions, anticipation or adaptation, rationing.[2] Indeed, a crucial activity for organizations is to find ways to eliminate or reduce dependence on outside resources, or to achieve stability in its relationships with those on whom it depends for resources.

In related way, dependence can be seen as opposite as power (Emerson 1962). The effectiveness of organizational action depends on the degree of dependence, or power, that organizations develop in relation to their interaction with the environment. Structuralist theories of markets inform us on the effect that systems of relationships and the positions that organizations occupy in them may produce significant consequences at the individual as well the aggregate level. The analysis of transaction patterns and profitability among different industries in the U.S. economy conducted by Burt (1988, Burt and Carlton 1989) reveals that the position of markets relative to one another affects firm and industry performance. When markets show higher structural autonomy, profits increase. Structural autonomy is an expression of market oligopoly and constraints on the market's entrepreneurial opportunities in its transactions with suppliers and consumers – the less connected are suppliers and consumers, the higher the possibilities for successful entrepreneurial activities. When market concentration increases while constraints on transactions with suppliers and consumers decrease, structural autonomy and profitability increase. A similar structuration of market relations can be stable despite the possibility of massive turnover in the organizational populations transacting those relations (Burt 1988). This result is particularly important, because it is obtained as an industry-level, rather than organizational-, characteristic of the process.

[2] In a formalization of Thompson's main theoretical propositions, Kamps and Pòlos (1999) recognize that ecological thinking does not reject assumptions about the rational intentions of individual organizations; rather, it would argue that the relations between intentions and outcomes are weak because of inertia (Hannan and Freeman 1984). Thompson (1967) admits that intentions and outcomes are only in imperfect relation.

The examination of input-output tables for the U.S. manufacturing sector conducted by Burt (1980) also shows that for organizational populations some positions are more advantageous than others. Profits were high among firms in industries that were situated between disconnected sellers and buyers in the network of inter-industry economic exchanges, in other words the interconnecting function linking two distinct types of actors in vertical flow of exchanges provides structural advantages (Burt 1980, Stuart et al. 2004). This notion is familiar to ecological theory: Hawley (1950) proposed that certain functions are by their nature more influential than others as they are strategically placed in the division of labor and are naturally connected to a larger number of functions. At an aggregate level, populations occupying central locations are better positioned to play coordinating roles, for example when they control the flow of resources or coordinate their allocation (Aldrich 1999). Indeed, functional differentiation can be a source of asymmetric effects in the organizations and populations who share transaction patterns.

Theories in strategic management address as a main issue of their agenda firm and industry performance in connection with their external relationships. Porter's (1980) view on firm strategy argues that vertical relationships across the main activities of industries are crucial for competitive success. In this context, inter-population dynamic linked to buyer and supplier bargaining power is of particular interest. Bargaining power of interdependent actors affect rent appropriability, which in turn influences and survival within populations as well as new entries. Number and size of buyers and suppliers are among the basic factors to consider when evaluating the attractiveness of industries and the intensity of competitive action within them. Controlling at least for factors that affect the potential size of the industry, a higher the number of buyers implies lower barriers to entry associated with lower bargaining power of buyers and an easier access to the market for suppliers. This condition can in fact stimulate new organizations to enter an industry. For buyers, increasing numbers of suppliers reduce the latter's clout and attract new entries. Because buyers and suppliers perform different functions, however, the effects of these two similar processes can be asymmetric.

In the context of ongoing relationships between functionally interdependent actors the asymmetric outcomes can even be magnified. The social structure that develops among interacting actors actually reduces the availability of alternatives by putting restrictions on exchange partners (Stuart 2000). In turn, this leads to the formation of positions that allow its occupants to exert power and reciprocate to their exchange partners at a lower rate than they would have to absent the network restrictions. In a dyadic relationship, an actor will be powerful relative to another if the former has numerous alternatives, while the latter has very few (Marsden 1983).

The position of actors represents also a means to claim and gain membership and acceptance in a social community, granting access to resources that incumbents and claimants utilize to pursue their interests (Baker and Faulkner 1991). One obvious reason for structural interactions between interdependent actors has to do with access to resources or markets, but it is not the only one. In addition, under certain conditions, for example about uncertainty about the quality of products, some organizations can benefit from particular affiliations. In a study of strategic alliances in the biotech industry Stuart and colleagues (1999) find that small and young firms obtain better access to capital when they develop strong relationships with prominent organizations, but most importantly they gain benefit of the higher reputation of the latter. High status organizations transfer their reputation to less known partners, which in turn are more likely to obtain positive evaluation from external actors and improve their performance despite the lack of experience. The argument that explains this mechanism is that the characteristics, in this case high social prominence, of affiliates represents a reference point for resolving uncertainty about the quality of a young or unknown organization, but the more general implication is that actors' reputations and identities are constructed in part from the reputations and identities of their associates. In related study on the semiconductor industry, Stuart (2000) finds more evidence for asymmetric positive externalities based on status, young and small firms benefit more from large and innovative strategic alliance partners than do old and large organizations. Concomitantly, his study demonstrates that the effects of status transfer depend on the features of both parties to the association, particularly their resource profiles.

If we focus our attention to vertical interdependent relationships between populations, we are dealing with connections defined as input-output sequences within a broader economic system (Leontief 1966). In an input-output sequence, each population uses as input the output generated by another population and generates itself an output, while downstream other populations can use in turn this output as input for their processes. Between contiguous stages of the sequence, however, resource exchanges tend to be more frequent and intense; their interdependence is therefore stronger than with other links. At the socio-cognitive level, frames of comparability also exist (Leifer 1985) such that some entities are considered members of, say, a market while others are excluded from it. Often, these boundary-creating processes develop identities around "product ontologies" – e.g. organizations belong to "knitwear industry" despite its highly differentiable structure (Porac et al. 1995). Identities, in fact, relate insides to a whole, the whole to its insides, and both to the outside (White 1992). If identities of forms for interacting populations are dependent on each other, we can observe processes of cross-legitimation and cross-competition of the type described in the classic density-dependent arguments. But how can vertical interdependence between buyer and supplier populations really affect each other's evolution, particularly population-level events like entry rates?

An interesting way to elaborate an answer to this question brings us to consider theories and models developed in ecology, where the study of mutualism in plant-pollinator relationships (Pellmyr et al. 1996) and more so food web and community ecology address the very problem of associations of multiple populations performing specialized functions (Paine 1980, Pimm et al 1991, Martinez and Lawton 1995). Webs depict trophic interactions between species within a spatial unity. Trophic species define a set of organisms with identical preys and identical predators. Predator-prey systems are a special case of interactions involving different populations and the transfer-consumption of resources from one population to the other. In the domain of predator-prey systems, general questions concern the effects of interactions on population dynamics and community structure, and the same issues are appropriate in the study of organizational populations. Two general questions concerning population dynamics are: 1) do predators or consumers reduce the densities of prey populations?; and 2) do predator-prey interactions cause populations to oscillate in time and space?

The simplest models used to analyze predator-prey interactions utilize Lotka-Volterra systems of equations. Their basic representation for population growth models can be schematized as: $dH/dt = rH - cHP$ for the prey equation, where: r is the intrinsic prey growth rate, H is the density of prey, c is the capture efficiency of the predator, P is the density of predators; $dP/dt = aHP - dP$ for the predator equation, where: a is the reproduction rate of predators per 1 prey, and d is the predator death rate. Although these models are mathematically simple, they can produce complicated dynamics, some of which resemble real predator-prey cycles observed in nature and in experiments. Refinements of early predator-prey models incorporated results from empirical studies suggesting that predation rates increased with increasing prey population density (Holling 1959a, 1959b). Two processes can be responsible for this outcome: first, predators become more abundant with increasing prey density (numerical response); second, predators can increase their consumption rate when exposed to a higher prey density (functional response).

We can draw some implications from the review of organizational and strategic management theories in conjunction with the description of predator-prey interaction for the analysis of vertical interdependence between organizational populations. Let's begin with discussing the mechanisms that may affect the population of buyers. To develop predictions for entry rates, some distinctions associated with varying levels of density need to be introduced. When buyers are at low levels of density, the very presence of suppliers increases social acceptance of the main activities that are required to an industry to function. Buyers and suppliers engage in complementary functions and are necessary to each other, because they represent the building blocks of an industry's architecture. At the same time, we need organizations in both populations to allow connectance. Low and increasing number of suppliers can have a mutualistic effect on buyers' entry, because for instance capital is more available to buyers when financial institutions recognize that there are suppliers able to provide products (and demand exists). In this context, the populations of buyers and suppliers are integrated and their institutionalization is to a certain extent reciprocal.

Hypothesis 3.1: Buyers' entry is positively related to low density of suppliers (controlling for intra-population density dependence).

With increasing number of suppliers, their chance of being isolated from the structure of exchanges increases and their individual bargaining power should decrease, while the centrality and profitability of the mediating role of buyers should in turn increase - buyers can have more alternative partners to exchange transactions with. The consequence of the process is attracting new entries in the buyers' population. When density of suppliers increases, however, the connection between the two populations is beneficial but the marginal dependence of buyers decreases. Moreover, especially in service industries, when the required to suppliers to establish is shorter than buyers, the benefits of having more suppliers is reduced. On the one hand, the interdependence of the two populations can imply a certain degree of resource overlap so that when the number of suppliers increases substantially, a limited resource displacement between the two populations might occur. On the other, buyers might just need more time to mobilize resources or their processes are slower to set up. In predator-prey systems the numerical response logic assumes that predators or hosts can have generally lower reproductive rates than their preys or parasitoids. In addition to this, the initial increase in first order density of suppliers may interact with density-dependence processes in the population of buyers, whereby larger availability of suppliers stimulated new buyers' entry and that will have improved the exchange alternatives for the former and reduced the profitability for the latter. Indeed, we can expect that the mutualistic effect of density of suppliers will remain positive, but its magnitude is lower relative to the effect of first order density. Accordingly, we propose:

Hypothesis 3.2: Buyer's entry is positively related to high density of suppliers (controlling for intra-population density dependence), but the coefficient of second order density is inferior to the coefficient of first order density.

Let's consider now the process of functional response. Figure 3.1 shows that different types of responses can be alternatively present. A first type of functional response hypothesizes that consumption rates of predators do not change with prey density. In other words, according to Type I response predators do not become satiated and react in a perfectly efficient manner to their interaction with preys. In organizational populations, new entry in the buyers' population may be subject to adaptation relative to the dynamic in the suppliers' population. A Type I response hypothesis would suggest that the reaction of buyers to increasing numbers of suppliers is linearly efficient and the established organizations might limit the possibility of new entries in the populations they interact with – their efficiency reduce the attractiveness of the niche. The prediction we can develop is that, contrary to the previous hypotheses, density of suppliers has a monotonic negative relationship with new entries of buyers. Buyers use their bargaining power to offset potential rivals in their population by improving their use of suppliers (or maybe growing in size).

Hypothesis 3.3 – Functional response hypothesis: Buyers' entry is negatively related to first order density of suppliers (controlling for intra-population density dependence)

Hypothesis 3.4.a – Type I functional response hypothesis: Buyers' entry is negatively related to second order density of suppliers (controlling for intra-population density dependence)

In most cases, however the assumption that populations adapt perfectly in their interactions is unrealistic. Predators, for instance, need time to hunt and manage their captured prey. Similarly, parasitoids do not kill instantly their hosts. A Type II functional response proposes that here is a specific amount of handling time (T_h) associated with each prey item eaten or attacked that is invariant to the density of the prey (N). Consequently, while prey items are easier to find as their density increases, handling time per prey item is the same, and the maximum number of prey items eaten or attacked is determined by the ratio of total available searching time to handling time (T/T_h). In other words, at low prey densities (small N), a smaller proportion of a predator's time is spent handling prey, even if the predator attacks every prey item available. As prey density increases and more prey are attacked, the proportion of time spent handling prey increases. This proportion reaches a maximum when all available time is spent handling prey ($T = T_h$); at this point, handling time (T_h), rather than prey availability, limits the number of prey items that a predator can consume (and consequently determines the level of the plateau).

In our context, a Type II response would introduce different effects dependent upon density levels of suppliers. At low density of suppliers the relationship with buyers' entry is the same as Type I response. When density of suppliers is very high, however, buyers may be unable or do not need to interact with all suppliers. New buyers may indeed find easier to enter the population when suppliers are more abundant. The negative relationship between entry and density reverses.

Hypothesis 3.4.b – Type II Functional response hypothesis: Buyers' entry is positively related to second order density of suppliers (controlling for intra-population density dependence)

Finally, there may be still sources of heterogeneity in the behavior of predators versus preys. Different habitat conditions like environmental uncertainty, but also low rate of encounters between the two populations that reduces the efficiency of predation imply that at low density levels, predators can consume low numbers of preys, and preys are relieved of predation pressures. In other words, predators may not find preys or the right preys. A Type III response reprises the logic of satiation included in the type II response, but also incorporates learning effects. When prey populations are high in numbers, the efficiency of predators increases, followed by satiation. However, at high densities of preys, predators have more frequent experience of interaction, and develop search images that help them increase their efficiency in hunting and handling (Ricklefs and Miller 1999). We can expect that at very high densities, the effects of learning will improve efficiency despite satiation.

In our context, a Type III functional response would consider that the effects of density on entry vary across two, rather than one, thresholds. At low and high levels of density of suppliers, buyers would exert moderate exchange pressure, then released when enough suppliers entered the industry. At even higher levels of density, however, buyers will become more efficient in their interaction with suppliers due to high contemporaneous and cumulated encounters. Learning at the population level influences the search and handling behavior of buyers, whereby new entrants that have not been able to develop a specialized interaction with suppliers will find it more difficult to enter. Type III response predicts an initial negative relationship between suppliers' density and buyers' entry similar to the other functional responses. At high levels of density, buyers do not necessarily need more suppliers to service their market. At very high levels of density, the satiation effect that weakens the interdependence between the two populations may reverse due to learning effects at the community level. Established buyers have advantages in selecting suppliers. In accordance with the above discussion, we propose that:

Hypothesis 3.4.c Type III Functional response hypothesis: Buyers' entry is positively related to second order density ***and*** *negatively related to third order density of suppliers (controlling for intra-population density dependence and encounters between the two populations)*

We can also develop parallel observations about how the dynamic in the buyers' population affect entry of suppliers. From the point of view of suppliers, organizational ecology and strategy would suggest arguments equivalent to those made for buyers. The fact that different organizations engage in sequentially interdependent activities may induce legitimation externalities at the community level that benefit the interacting populations. With increasing number of buyers, the marginal dependence of suppliers on them decreases as well as buyers' bargaining power. New entrants are attracted to a niche that is proven viable by the availability of organizations that will deliver output to the market. This mutualistic association can either continue at higher levels of buyers' density, or be attenuated in relation to the degree of resource overlap and the dynamic of density dependence in the supply population itself. Strategic reasoning suggests that the more buyers on the market, the lower their bargaining power and the better the possibilities for suppliers to profit from their interaction. Accordingly, we provide the following:

Hypothesis 3.5: Suppliers' entry is positively related to low density of buyers (controlling for intra-population density dependence),

and

Hypothesis 3.6: Suppliers' entry is positively related to high density of buyers (controlling for intra-population density dependence), and the coefficient of second order density is superior to the coefficient of first order density.

Here we do not introduce distinctions in the nature of response to interaction, but one other specification might be useful. Because of the pivotal function that buyers carry on in a community, suppliers may be particularly sensitive to other structural properties of the buyers' population. Size of buyers, for instance, has high chance to affect vital rates of suppliers. Large buyers are able to take advantage of their size in bargaining with suppliers and appropriate most of the rents produced in the industry. First, increasing average size of buyers should discourage new suppliers from entering the population.

Second, mass dependence can also interact with density. The positive effects of inter-population mutualism can be reduced or offset by increasing size, because either resources for new initiatives are displaced by the expansion in size and density in the other buyer population, or large size in buyers worsen the dependence of suppliers from them and reduces their chances of success. Therefore we develop the following:

Hypothesis 3.7: Suppliers' entry is negatively related to mean size of buyers (controlling for intra-population density dependence)

Hypothesis 3.8: Suppliers' entry is negatively related to aggregate mass of buyers (controlling for intra-population density dependence).

We briefly comment on the second question concerning population dynamics and oscillations in populations, which is related to the first. *If* populations are influenced by the dynamics of other populations they interact with, then evolutionary trends reflect articulate responses to not only intra-population density dependence processes, but also the dynamic of interdependent populations. If predators' populations not respond instantaneously to the availability of preys and grow slower than predator populations, for example, they may be overshot by the number of prey that is able to support them. This leads to a late decline in the prey, followed by a rapid decline in the predator. Once the predator becomes rare, the prey population may begin growing again. This pattern can be further investigated by analyzing time-lag effects of predators and prey response.

3.5 VERTICAL INTERDEPENDENCE BETWEEN PRODUCERS AND DISTRIBUTORS OF FEATURE FILMS AND ITS EFFECTS ON ENTRY RATES IN THE U.S. MOTION PICTURE INDUSTRY[3]

3.5.1 The motion picture industry in the United States

In this section I present a brief description of the industry where the empirical investigation of vertical interdependence effects on entries is applied. The development of the feature film in the United States can be dated to 1912, following the appearance of longer European films on American screens. At the same time, the industry underwent a reorganization phase after the federal intervention that dismantled cartels controlling key patents. With the introduction of features, most of the companies involved in the production, distribution, and exhibition of short films went out of business. Feature films were long, elaborate multi-reel pictures that required longer production processes and higher investments (Staiger 1983). The feature film was a more differentiated product than shorts, and such a differentiation modified price and promotion policies in the distribution sector. The industry adopted the star system as a signaling strategy to make audiences aware of elements of differentiation and stimulate their interest in the products (Bordwell et al. 1985, Kerr 1990). The feature film also generated a series of transformations in the exhibition sector. First, it required longer runs in theaters to recoup their high production and distribution costs. Second, it induced a more definite differentiation in specialized theaters, sustaining different price policies and program run releases for each film (Koszarski 1990). In the same decade, the need to provide regular supply of products to a growing market arguably led to the relocation of productive

[3] This section is adapted from Section 2.5.

operations from New York to Hollywood, where favorable climatic conditions allowed a more efficient organization of film production (Huettig 1944).

Feature films are complex products that face uncertainty for two reasons. One is associated with the output of the production process involving sunk investments and sequential use of heterogeneous inputs (Caves 2000). The other is associated with the difficulty of predicting product performance (De Vany 2004). In the early history of the feature film industry costs and risks associated with the production and marketing of feature films were significant, and coordination between the process of production and distribution was essential. Since 1918 several firms adopted a vertically integrated structure, and film production, distribution and exhibition were progressively internalized within hierarchical organizations. During the second half of the 1920's a group of integrated firms, called majors (Paramount, Loew's, Fox, Warner Bros, RKO) became dominant players in the industry (Balio 1985).

Sound was the most important technological innovation in the industry following the introduction of features. In 1925-26 in the United States three systems proved viable and were initially distributed with some success: the "Vitaphone", the "Movietone", and the "Photophone". The first system, which utilized either sound on disc or sound on film devices, had been developed by Western Electric Company (WE) through Bell Telephone Laboratories and was licensed exclusively in 1926 to Warner Bros. Company, a second rank production and exhibition company that acquired Vitagraph's studio and exchange structure. The second system, which used sound on film, had been designed by Case in de Forest's laboratory, and was incorporated by Fox Film Corporation and first exhibited in early 1927. The third, a sound on film system, was presented in late 1927 by RCA.

Innovation in sound was indeed channeled in the industry through minor or external companies (Crafton 1997).

The introduction of sound required heavy investments to convert studios, and affected the filmmaking process. Equipment became more sophisticated and elaborate, for instance incandescent lighting substituted for arc lamps, cameras had to be silenced. Film companies became more dependent upon specialized hardware manufacturers and technical personnel needed more training. On the creative side, the integration of image and sound transformed scripting technique; many actors were not able to adapt their competence to talking performance, and editing required new specific capabilities. It was estimated that in 1929 over 65 million dollars were invested in the construction of more than 100 new sound stages, with the addition of more than 5,000 new employees to the studios.[4] Production costs tended to rise sharply. In 1920 the average silent film had a production budget that ranged from $40,000 to $80,000, while in 1929, the average cost rose from $200,000 to $400,000 (Conant 1960). In exhibition, theaters affiliated with the Majors initially adopted the more expensive WE apparatus. When at the end of 1928 the different systems were made compatible and WE allowed that licensed producers could furnish products to any theater, the conversion became very rapid and more competitive. In 1930, theaters wired by the WE were about 5,000, while theaters supplied by systems other than WE were more than 8,200 on a total of 18,000, in rapid increase from the 4,800 of the previous year (Crafton 1997).

[4] Major producers' reluctance to adopt the new technology seems justified by the cost of conversion. The estimated 65 million dollars invested in 1929 were significant when compared with 110 millions of total studio investments estimated for the period 1925-1930. In *Motion Picture Almanac*, 1931, 71.

The effects of the economic depression struck the industry in late 1930. Weekly attendance declined over 30 per cent to less than 60 millions: more than 4,000 theaters were closed in three years, and ownership became more concentrated. The inauguration of the National Industrial Recovery Act was accompanied by the definition of a Code of Fair Competition for the industry. The Majors played an essential role in administering the code authority: in fact, the use of unfair commercial practices favored collusion in the different branches of the industry (Conant 1960). During the 1930's, the Majors produced and distributed over 50 per cent of all domestic features. Since the market could absorb around 400 films per year, a single organization was not large enough to produce internally sufficient output to saturate their distribution organization and the capacity of its own theater circuit, and depended on the external supply of other majors and independent producers. Competition continued in the distribution of independent productions for the first-run market, for later-runs and for inputs (primarily stories and stars) (Balio 1985).

After the Second World War two main events affected the organization of the industry (Gomery 1986). In 1948, a decision by the Supreme Court in the "Paramount case" found the eight largest organizations guilty of reducing competition in the market, and forced them to end the use of commercial tying practices. The court decision imposed the separation of the five majors into production/distribution business on the one side, and exhibition on the other side. Approximately one half of the over 3,100 theaters they owned had to be divested (Conant 1960). Second, in early 1950s the commercial success of television as an alternative entertainment medium had negative effects on the consumption of motion pictures in theaters.

Since 1948, the demand for motion pictures decreased regularly. Attendance from 98 million in 1946 dropped to 65 million in 1950 and to 44 million in 1955. In the same period, box office receipts decreased to 717 million dollars (-26%) (Izod 1988). Releases by major companies diminished over 50 per cent. The impossibility of securing a market for their output, and the reduction of demand caused a general decentralization of the production sector (Storper 1989). Independent producers and specialized service firms proliferated, while majors retained part of their production in their studios, but have focused on controlling distribution and film financing. The organization of production is more flexible and fragmented, based on individual initiatives (Bordwell et al. 1985). Producers finance and manage projects like packages: inputs, including creative talent, are not under long term contracts with producers, but are available on the market and assembled for single deals through the coordination of agents (Paul and Kleingartner 1994).

By the mid-1950s television has become an important secondary market for the distribution of films (Hilmes 1990). In this environment, the primary market of theaters diminished in economic relevance, because it did not represent the only source of revenues; however, it maintained a strategic value because box office receipts are likely to affect the subsequent performance of the film. Second and subsequent runs in exhibition disappeared, also affecting distribution. The Majors lost part of their bargaining power in the market for creative inputs and films, but their investments in international distribution networks and marketing activities represent a powerful source of advantage (Caves 2000).

3.5.2 Research design and data

This study makes use of an original database of event histories of motion picture producers and distributors in the United States from 1912 to 1970. This section discusses the data sources used for longitudinal, quantitative analyses of producers' and distributors' entry rates, and describes the motives for studying this particular context. A more detailed account of the research design used in this study is given in Section 1.2.

The populations analyzed in this study are motion picture producers and distributors. Consistent with previous research in the same industry (Mezias and Mezias 2000, Jones 2001, Mezias and Kuperman 2001) they identify distinct organizational forms and a bounded, self-contained industry system (Hannan and Carroll 1992). The organizational populations studied here have been systematically interacting with each other. Producers supply their most important output to distributors, and distributors use producers' output as their primary input for their activities. Other important interactions include production financing on the part of distributors and the allocation of the box office obtained through exhibition or secondary markets. Industry historians and analysts have repeatedly noted that the performance of organizations, as well as the diversity of products is directly connected to the interactions between the main branches of the industry (Huettig 1944: 58, Balio 1985: 254, Conant 1960: 6).

Producers are responsible for the operations aimed at the actual making and delivering of the first copy of the film. The making of the first copy of the film is the necessary requisite for the reproduction process which generates the product's copies that are marketed on the screens. Production involves the deployment of several inputs, either of creative or of technical nature, and also the sinking of considerable capital investment.

Distributors are responsible for the reproduction of the first copy of the film destined to be screened in movie theaters. In this activity, distributors are responsible for the management of the physical output, but also of the marketing initiatives, revenues collection and the allocation of payments to the producer and other possible profit participants.

Entry in the market is the observed event in this study because no available source provides systematic information about foundings dates for this industry. The definition of relevant entry events centres on the dates in which films are released. Producers enter the population when their first film is released in the market. Likewise, distributors enter when the first film they commercialize is released. Dates are recorded on a monthly basis. The general approach is consistent with previous research in organizational ecology (Hannan and Freeman 1989, Hannan and Carroll 1992, Carroll and Hannan 2000), and with existing studies made in the same industry (Mezias and Mezias 2000, Mezias and Boyle 2002). The period of observation is from 1912, the year when the first U.S. feature film was released in its domestic market, to the end of 1970, the last year covered by the main data sources.

To conduct my study I follow established practice in organizational ecology (Carroll and Hannan 2000) and adopt a combination of sources. The first source is the *American Film Institute Catalog of Motion Pictures* (AFI), which collects reviews of all motion pictures distributed in the US between 1893 and 1970 and provides detailed information about each film using the same compiling methodology. The AFI Catalog is considered a source of high quality and comprehensiveness (Mezias and Mezias 2000); however it presents two problems: it comprehensively lists all short films released between 1893 and

1910, and all feature films released in the periods 1911-1950 and 1960-1970, but has not yet documented feature films produced between 1951 and 1960. To overcome the problems in the AFI catalog, we relied on: *Feature Films 1950-1959: A United States Filmography*, a reference text edited by A. G. Fetrow reviewing 3069 features from the previously missing period; the *Motion Picture Catalog of the Library of Congress 1950-1959*, which provides a list of films receiving copyright protection along with production entities and copyright entry dates; and the *Motion Picture Guide 1927-1982*, a 12 volume reference set edited by J. R. Nash and Stanley R. Ross. These three publications combined provide accurate information that complements nicely the data unavailable from AFI for the decade 1951-1960. Additional sources including industry almanacs like *Motion Picture Year Book*, trade journals like *Moving Picture World*, have been employed to supplement information when unclear, e.g. repeated titles in the same or next year.

Films produced and released for non-commercial purposes like those managed by government institutions, as well as imported films, are excluded from the dataset. When pictures are international coproductions, I included only those in which an American producer was majority stakeholder.[5] I also eliminated pictures whose foreign title was not accompanied by any other information, suggesting they are either alternate versions for specialized audiences of otherwise released domestic titles, or imported products. Finally, films from the late 1960's to 1970 that provided no information on genre were omitted. In these cases, from their titles and the fictitious names of producing and releasing companies whose identity I could not reconstruct, I presume that they consist of

[5] This information could be inferred in two ways: the review mentioned how the production was organized, and the nationality of the company investing more in the film is ranked first.

pornographic pictures that are not rated and represent unauthorized or illegal duplications or re-editions of previously released material. The final dataset consists of 4,091 producers, 1,260 distributors.

3.5.3 Methods

I use event-count models to estimate entry rates of feature film producers and distributors in the United States (Long 1997), a common strategy in ecological research (Hannan and Freeman 1989, Carroll and Hannan 2000). Entries occur throughout the year and are recorded every month. The number of producers and distributors which entered each month is the dependent variable of the models. Stata 8 is the statistical package used for this study. Figures 3.3 and 3.4 provide histograms of the distributions of entry in the populations of producers and distributors over the observation period.

Insert Figures 3.3, 3.4 about here

Entry processes can be seen as arrival processes of new organizations into the population. The previous chapter analyzing density dependence in the two populations revealed the presence of overdispersion in the data – the goodness of fit test for producers reported a chi2=3310,224, Prob > chi2(707)=0.000, while for distributors the chi2=1789.592, Prob > chi2(707)=0.000, indicating a poor performance of the Poisson specification to estimate the count variables. This constitutes a problem when using the standard Poisson regression models for estimation of arrival processes. Under overdispersion, the Poisson regression model estimates tend to be inefficient and the standard errors tend to be biased downward resulting in spuriously large *z*-values. To correct for overdispersion, we can employ negative binomial regression models, which relaxes the equidispersion assumption of the Poisson regression model by introducing a parameter that allows the conditional variance of count variable to exceed its conditional mean. The most common assumption is that the dispersion parameter has a gamma distribution, $\Gamma\ [1,\alpha]$, in which the parameter α captures overdispersion from the data (Cameron and Trivedi 1998). In conclusion, to analyze entry processes in the two populations we use negative binomial regression models via maximum likelihood estimation. The regression structure between entry rates, λ, and a vector of covariates, X_t is represented as follows:

$$\ln(\lambda_t) = \alpha + \beta Xt, + \varepsilon_t$$

where λ_t is the rate of founding, α is the regression model constant, β is a vector of unknown parameters to be estimated, Xt is a vector of covariates, and ε_t is the overdispersion parameter.

3.5.4 Variables

The dependent variables for entry processes are monthly counts of new organizations entering the populations of producers and distributors. All covariates are updated yearly. For the test of within- and inter-population density-dependent relationships, I use the first and second order population density measures constructed using moving averages of 12 month lag because it is hard to motivate that entry is exactly explained by the competitive situation of 12 months before. The choice of the lag interval is justified by the knowledge that the production and distribution processes in the motion picture industry require set up and organization prior to actual operation. An average 12 month of pre-entry organization is also indicated by industry experts as an appropriate time span (Vogel 1998, Squire 1992). It is also true that the time and costs associated with starting activities in the motion picture industry have changed over the observation period, e.g. starting up in silent production was generally faster than a sound production because studios did not need more sophisticated equipment for soundproofing, and casting also did not need to evaluate the actors' voices (Bordwell, Staiger and Thompson 1985). In accordance with the general statement of density dependence model, I expect population density to affect positively foundings and squared density to affect it negatively. The mass variables are calculated as the mean and total number of films released in the market every year.

A set of industry control variables is included in all models as discussed below.

Concentration. We included a measure of industry concentration to control for the partially alternative explanation of resource partitioning in the two populations (Carroll 1985, Carroll and Swaminathan 2000). According to resource partitioning theory, under certain market conditions, strong competition among generalist firms causes the failure of smaller generalists due in particular to the competitive advantage of scale economies. The Hirschman-Herfindahl index (HHI), a commonly accepted measure obtained by squaring the market share of each firm operating in the market and then summing the resulting numbers, is the concentration measure chosen for model estimation. The main advantage of the HHI over alternative measures of concentration is that the former takes into account the relative size and distribution of the firms in a market and approaches zero when a market consists of a large number of firms of relatively equal size. The HHI increases both as the number of firms in the market decreases and as the disparity in size between those firms increases (Shy 1995). The resource partitioning hypothesis predicts a positive relationship between concentration and entry. A negative or non significant effect is expected if segregating mechanisms do not affect the populations under study here.

Seasonality. The number of patrons that go to the movies varies dramatically over the course of the calendar year. A very large share of consumption of films is concentrated in vacation periods such as Christmas, Thanksgiving, and Easter, and summer months represent a long period of high sales because of school holidays that increase teenagers' demand. On the contrary, in the fall, when school begins and new television programs are introduced, audiences tend to be distracted from going to the movies. Therefore, the industry tends to concentrate most of its releases in specific time intervals. To control for seasonal effects, eleven dummy variables corresponding to the different months of the year when entry is observed are included in the estimated models. The December dummy is dropped because its effect is measured by the intercept.

Ticket prices. Ticket sales for movies generally do not show very responsive changes in box office prices per se, rather there is sensitivity to the total cost of movie-going, which can include fees for babysitters, restaurant meals, and parking (Donohue 1987). Although demand for movies, especially for those backed by strong word of mouth, advertising and reviewer support is essentially price inelastic, exhibitors are often able to stimulate admissions by showing older features at lower prices during off-peak times. Some segments of the audience can take advantage of such second-type price discrimination (Varian 1992), and so can exhibitors. Average dollar prices adjusted for inflation are included as a first control for this indirect measure of carrying capacity. Increasing average prices should reveal a more attractive niche for producers and distributors, or reveal more differentiable consumption patterns that stimulate entry.

Screens. Theaters have been the only outlet for motion pictures until secondary markets like television or home video emerged. Industry directories on the exhibition sector provide annual data on the number of operating screens in the country. Absolute number of screens is included as a capacity measure that may affect entry rates in the analyzed populations. This measure, however, is a rough proxy for actual capacity. The number of screens is more likely to show a relationship with the number of films released or organizational size, rather than entry rates. Industry experts suggest that the number, location and ownership of first run theaters as primary sources of profits matters more than general capacity in influencing industry structure (Huettig 1944, Conant 1960, Gomery 1986). Disaggregated data of that type, however, are not unavailable from the sources for this study.

Attendance. Total attendance calculated in millions of spectators is included as a measure to represent social demand for movies. Over the observed period motion pictures went from a widely popular entertainment form (1912-1946) to a less relevant amusement alternative. After the Second World War, attendance declined systematically despite the growth in population. Alternative forms of outdoor and home entertainment like spectator sports or television gained popularity reducing consumption for motion pictures in theaters (Dimmick and Rothembuhler 1984).

Television. Between 1945 and 1960 the number of commercial television stations grew from 9 to 440, and by 1960 85% of U.S. households had a television set (Walker and Ferguson 1998).[6] In the United States, the historical relationship between the motion picture and the television broadcasting industries is complex (Hilmes 1990). Before film producers and distributors recognized the potential of the new market, television was considered as a competitive threat, responsible for the decline of movie attendance in theaters after 1946 (Monaco 2000). The diffusion of television among households coincides with the progressive retrenchment of motion picture consumption; on the other hand the success of television implied an increasing demand for programs. After 1955, film companies began to distribute intensely the rights to their libraries, and organized production initiatives targeted exclusively to the television audience (telefilms and series). In this way, they had a larger market for the amortization of their investments in film production and a higher utilization rate for their facilities. The percentage of national households owning at least one TV set provides a measure of additional capacity for feature film producers and distributors.

Economic indicators. Previous research has shown that there is an inverse lagged correlation between real interest rates (and borrowed resources) and the number of new productions (Vogel 1998). Interest rates are subject to endogeneity - their level correlates strongly with the strength of the economy. Inflation can also introduce noise into the meaning of the level of interest rates because the nominal rate may not reflect the real

[6] In addition to technological development, the existence of ancillary distribution markets for motion pictures is justified by the principle of time decay and sequencing, made possible by price discrimination. The value of motion pictures for their audience is in fact dependent on time. As the film runs across its theatrical release, it loses part of its value because it is substitutable with newer films; however, it maintains a certain residual positive value for some consumers, specifically those who are not willing to pay the full ticket price to see the movie in theaters. The emergence of secondary markets for films satisfies the entertainment needs of such customers, and at the same time it allows producers and distributors to increase their earnings relative to traditional single-outlet commercialization patterns.

cost of capital. Following previous ecological studies analyzing organizational vital rates (Sørensen and Sorenson 2003) we include an additional variable of year to year changes in the interest rate to assess the effects of the cost of capital on entry rates. Interest rates are used as a level in monetary policy, i.e. rates go up when the economy is doing well, so we may expect positive variation to stimulate entries. The formation of new ventures is more sensitive to interest rates when favorable conditions apply. In 1962 a 7 per cent investment tax credit on domestic production was introduced as a solution to stimulate the economy (and was eliminated by the Congress in 1969). In the motion picture industry, tax shelters and other tax-leveraged investment became a mode of production finance until 1976. Limited partners holding limited recourse or nonrecourse loans (loans without personal liability exposure) could write down losses against income several times the original amount invested in film production (Cook 2000). We include in the models an interaction variable between interest rates and the period in which tax shelters were allowed and expect a negative relationship with entry. Low interest rates when tax savings are available should stimulate entry

Periods. We included additional dichotomous variables to control for changes in the industry environment, a fact that may influence entry and exit rates in the industry. Two contextual variables were created for the years of World War I and II. Three other variables capture more industry-specific effects. The first two address the consequences of antitrust intervention. Beginning in late 1930's, the Justice Department began to issue court orders to reduce the pattern of vertical integration that major organizations had undergone for more than a decade. The constructed variables cover the years 1938-1940, and the years from 1948 to 1970; these are the periods in which the antitrust litigations of the "Paramount" cases, in which the Majors were found guilty of anticompetitive behavior, may have produced effects on the industry's structure (Litman 1998). Particularly, in 1948 the second Paramount court case ended with an order enforcing vertical divestiture of exhibition from production and distribution; actual divestiture would not be completed until 1957 but was enforced until the end of the observation period (Conant 1960). Finally, a dummy variable controls for periods of different technological standards, silent and talking. In general, the production and distribution of talking pictures was more elaborate and costly, and entry in the industry should have been easier ceteris paribus with the silent standard. Tables 3.1 and 3.2 present the descriptive statistics of the covariates used in the models estimating entry rates in the two populations, while Tables 3.3 and 3.4 provide the bivariate correlation matrices.

Insert Tables 3.1, 3.2, 3.3, 3.4 about here

3.6 FINDINGS AND DISCUSSION

This section reports the results of the empirical analysis. Figures 3.2 and 3.3 depict the patterns of entries in year counts for distributors and producers during the observation period. From 1912 to 1970, 1,260 distributors and 4,091 producers entered the industry. Figure 3.4 illustrates the dynamic of density in the two populations.

Distributors

Table 3.5 presents the negative binomial regressions that estimate the effects of inter-population density dependence, numerical and functional response on entry rates of feature film distributors. Model 1 contains the seasonal effects, controls and periods. In general, the seasonal variation typical of product releases is reflected in the estimates, for example the positive coefficient of June and November and the negative coefficients of April, May and October. July is considered a popular season for movies, but the relationship in the model is negative. Release strategies of distributors, however, changed after the diffusion of blockbuster films in the 1970's, focusing massively on summer months (Squire 1992). The same strategy was not widely established in the period considered in this study. Only the variable of the second Paramount case is significant, and with a negative sign. This is an interesting result. The antitrust intervention ordered the divestiture of downstream activities of integrated companies with the purpose of increasing competition in the industry and facilitating the activities of independent actors. This does not seem to be the intended case. In the past, however, economists have argued that the federal intervention in the motion picture industry was counterproductive. The argument made is that vertical integration, like the use of often contested block booking policies, represented an efficient solution to the information and incentive problems that characterize this industry. Demand uncertainty, difficulty in monitoring the production processes are among the most evident of these problems. The Paramount case and its enforcement aimed at reinvigorating competition in the main sectors of the industry, but it may have contributed to decline in production and increase in prices (Stigler 1968, De Vany 2004). The economic indicators of interest rates do not have a significant effect on the entry rate. This result, however, is not completely surprising because the reform should have had a more important impact on production activities. Yet, entries decrease when rates increase.

The capacity measures do not have a significant impact on entries, except for attendance that has a negative sign. The years of lower frequency in attendance, however, correspond to the years for higher ticket prices (also when adjusted for inflation), for which we find a positive effect. The diffusion of television has a negative and weakly significant impact on entries. Overall, distributors do not show significant relationships with density-independent processes. Finally, the control for concentration shows the expected negative sign while the dichotomous variable for the sound period indicates a positive sign. Entry was more attractive after the introduction of talking movies made the industry very popular.

Model 2 is a baseline density dependence specification. The results improve the fit relative to the previous model - the Likelihood ratio test $\chi^2 = 2[L2 - L1]$ is equal to 14.15 with p-value < .001 for 2 degrees of .freedom. The density terms are both in the predicted sign and significant. This specification produces partially different results than the one used in the previous study on empirical comparison of density dependence models. This is probably due to dropping some of the short term density-independence measures (that might have caused collinerarity problems and less efficient estimates).[7] There is evidence of legitimating and competitive processes in the focal population. Finally, the inclusion of first and second order density makes the sound vs. silent distinction and concentration non-significant.

Model 3 attempts to improve on the baseline density dependence by introducing the first and second order density measures of the suppliers' population. Low density of

[7] The models presented in Table 3.5 do not include measures of population dynamics. Prior entries and exits do not always allow a clear interpretation and we decided to drop them to focus on cross-population relationships. We ran the same models including also population dynamics measures. The importance and significance of the main variables remain unaltered. These results are available upon request.

producers does not seem to produce mutualistic but competitive effects on entry rates of distributors, while high density of producers reverses this relationship. In addition, the coefficient for second order density has a larger value. Hypotheses 3.1 and 3.2 do not find support in the data. At the same time, the alternative hypotheses of functional response and Type II functional response find empirical support. However, the goodness of fit LRT produces a problematic result: Model 3 does not improve fit over the basic density dependence model ($\chi^2 = 2[L2 - L1] = 5.66$ with p-value = .059 with 2 d.f.). Figure 3.5 depicts the effects of double density dependence on the multiplier of the rate.

Insert Figure 3.5 about here

Because this double density dependence model has hinted at the presence of responses in the distributors' population that combines numerical and functional responses, we adopt the following strategy to test directly Hypotheses 3.3 and 3.4. We drop the simple first and second order density of producers from the subsequent model and introduce three density terms that allow testing Hp 3.4.c (Type III functional response) vs. Hp 3.4.b (Type II functional response), and also Hp. 3.4.c (Type III functional response) vs. Hp. 3.4.a (Type I functional response). Remember that including only first and second term density without the effect of encounters did not allow testing directly the presence of Type III functional response. In fact, the new specification requires also including explicit effect learning due to increased encounters between the two populations. We do so by interacting the first, second, and third order density terms of producers with a proxy for encounters, i.e. number of evolutionary trials in the community calculated as the inverse of cumulative entries in the two populations (Sorenson 2000). The results are presented in Model 4. This specification fits the data better than the basic density dependence model ($\chi^2 = 2[L2 - L1] = 20.83$ with p-value < .001 for 3 d.f.). To compare the fit of Model 4 relative to Model 3, which are not nested, we look at the statistics of information measures. A first measure is Akaike's (1974) information criterion (AIC), defined as:

$$AIC = \frac{-2\ln L(M_k) + 2p}{N}$$

where $L(M_k)$ is the likelihood of the model, p is the number of parameters and N is the number of observation in the model. Higher values in the likelihood indicate a better model, and $-2\ln L(M_k)$ ranges from 0 to $+\infty$, with smaller values indicating a better fit. Adding parameters make what is observed more likely, and dividing the expression by the number of observations gives the per observation contribution to the adjusted $-2\ln L(M_k)$ (Long 1997). The AIC value for Model 4 is 2175.917, while the value for Model 3 is 2189.084. Model 4 fits better. A second measure we can employ to compare non-nested models is the Bayesian Information Criterion (BIC) (Raftery 1996). This measure evaluates posterior odds of obtaining the two compared models (with the prior odds of the models =1). BIC is expressed as:

$$BIC = D(M_k) - df_k \ln N$$

where $D(M_k)$ is the deviance comparing models to the saturated model (one parameter for each observation). For BIC the term df_k is the degrees of freedom for the deviance. The BIC values are 2308.228 for Model 4 and 2316.832 for Model 3, with strong evidence in favor of Model 4. In this specification, controlling for density dependence within the population, the effects of the interaction between producers and distributors are all significant. The negative relationship between first order density/trials and entries supports the functional response hypothesis over the extension of legitimacy with numerical response alternative. Particularly, the results favor the Type II and Type III functional responses when the second order term of density is considered. Finally, the third order term suggests the possibility that learning effects induced by community-level interaction is present. This result can be more interesting if compared with the findings of the previous chapter, where learning at the population level seemed dubious. When industries are structured as webs of specialized relationships between populations, their interaction produces relevant consequences. Figure 3.6 depicts the combined effect of the interactions between density of producers and cumulative entries on the multiplier of the entry rate.

Insert Figure 3.6 about here

Model 5 estimates the main effects of the three density variables of the previous model controlling also for the inter-population density dependence of Model 3. While the simple density terms for suppliers reverse sign and are no more significant, the evolutionary specification obtain the same results of Model 4. Model 5 provides better fit than Model 3 with double density dependence ($\chi^2 = 2[L2 - L1] = 18.67$ with p-value < .001 for 3 d.f.), as well as Model 2 with single density dependence of distributors ($\chi^2 =$

2[L2 - L1] = 24.33 with p-value < .001 for 5 d.f.). However, Model 5 fails in improving the statistical fit of Model 4 (χ^2 = 2[L2 - L1] = 3.50 with p-value = .1737 for 1 d.f.). To further test the results, Model 6 introduces the temporal specification of density dependence developed by Hannan (1997) for single populations to see whether the interaction between the two populations is affected by chronological time. The results show an articulate picture. First, the density dependence effects of the suppliers' population are equivalent to the general ecological argument – positive first order and negative second order. This result would only support Hp 3.1 and not Hp. 3.2. The interaction terms between density and industry age are all significant and with the sign predicted by Hannan (1997) for single population models. The interaction between first order density of producers and time is negative, while a natural extension of the ecological argument made in Hp. 3.1 and 3.2 would posit a positive legitimating effect. The interaction of second order and time is positive and more pronounced. The interaction between density and time squared is positive, this time potentially consistent with density dependence theory. The interaction between second order density and time squared is negative, a finding that can be supportive of the interpretation of Model 4. Overall, this specification fits the data better than the double density dependence (χ^2 = 2[L2 - L1] = 38.65 with p-value < .001 for 8 d.f.). A comparison with the chronological time scale specification is made using the information measures. The BIC for Model 4 is 2308.228 and AIC is 2175.917; the BIC for Model 6 is 2323.213 and AIC is 2168.09. The two measures do not converge and the selection of the model seems difficult to determine.

In addition, conceptual problems with the specification defined in Model 6 may emerge. The first problem is similar to that recognized by Sorenson in his study of population level learning in the U.S. automobile industry (2000). Evolutionary processes may be correlated with chronological time scales, but are naturally defined in evolutionary time scales. We believe that although the number of encounters between the two populations increases with time, the effects of their interactions are best appreciated when the clock regulating them is internal and not external to the process. The second problem is the argument made by Hannan (1997) on the process driving the evolution of mature industries. He reasons that density is more relevant for legitimation and competition early in a population's industry. Later, the population develops a position in a network of relations that increases the role of factors in the external environment or micro-structures in the population itself as important determinants of legitimation and competition. What is missing, however, is why exactly interactions with the environment become salient only later in the evolution. We have seen that some interactions are in fact always necessary to perform the constitutive activities of organizations. This is the case of sequential interdependence between buyers and suppliers analyzed in this study. It seems therefore difficult to reconcile this view with the logic of parallel evolution proposed in this study.

Despite the interpretive intricacies, we estimated a saturated model containing a double process of density dependence, the evolutionary interaction hypotheses and the chronological specification. Model 7 shows that the temporal variation expressed in chronological time scale is still significant as predicted, while none of the evolutionary responses tested in Models 4 and 5 are significant. Likelihood ratio tests reveal that the saturated model does not improve fit over Model 6 (χ^2 = 2[L2 - L1] = 5.94 with p-value = .1144 for 3 d.f.), but fits the data better than Model 4 (χ^2 = 2[L2 - L1] = 23.77 with p-value < .01 for 8 d.f.) and Model 5 (χ^2 = 2[L2 - L1] = 20.27 with p-value < .01 for 6 d.f.). If we compare BIC values for Model 4 and Model 7, the former still possesses the best overall alternative of explanatory power and parsimony. The inclusion of the saturated model does not help solving in a conclusive manner the controversy in the scale definition of evolutionary processes.

Producers

Now we move to presenting and discussing the estimation results for entry rates for producers. Model 1 in Table 3.6 includes the regression estimation for controls and periods. Entry rates by producers exhibit a seasonal pattern analogous to that of distributors. The war years reduce entries probably because of resource scarcity in the environment, although entertainment usually may represent a convenient solution of escapism in such times. The interest rates variables fail to capture the potential effects on entrepreneurial activities, with some surprise. Even, film distributors seem to be more sensitive than producers to these variables. It is not possible, then, to compare results with previous research that addressed the same relationships (Vogel 1998). Among the capacity measures, only attendance and ticket price show strongly significant effects. High price stimulates entry, while attendance suppresses it. We may need segmented measures that account for diversity in the market to better capture density-independent processes. The diffusion of television shows a clearer pattern of competition than in the case of distributors. In the period covered by the study, television broadcasting did not produce the expected mutualism with the motion picture industry. The niche overlap between the two industries essentially damaged the population of film producers – in the post-war years motion pictures became a relatively more expensive entertainment alternative compared to television. The fact that more and more motion pictures were broadcast on television might have simply increased profits for existing organizations, rather than encouraging new ventures in the market. The last two effects we consider are sound and concentration. The introduction of sound did not constitute a barrier to entry per se, despite the rise in production costs. The control for possible segregating mechanisms in the population generates a negative relationship between the HH index and entry rates, contrary to predictions for resource partitioning arguments.

Model 2 adds to the previous the density dependence terms for the population of producers. All the previous controls produce the same outcomes, while the single density dependence performs quite poorly – we obtained similar results in the comparative study conducted in the previous chapter. We find evidence only of legitimating effects among producers because the second order term of density is in the predicted direction but statistically non-significant. In any case, the estimation improve the fit over the first model ($\chi^2 = 2[L2 - L1] = 17.25$ with p-value $< .001$ for 2 d.f.).

Model 3 includes a double density dependence specification for both populations to test Hp. 3.5 and 3.6. In this model, the first and second order terms of producers' density turn significant showing the common curvilinear association expected from ecological theory. Model 3 fits the data better than the basic density dependence model ($\chi^2 = 2[L2 - L1] = 11.10$ with p-value $< .001$ for 2 d.f.). The density terms for distributors produce results that partially reject the hypotheses developed according to the extension of density dependence. The first order density of distributors has a negative effect on entry rates of producers. This indicates that few distributors are in a better position to negotiate with suppliers and do not induce the intuitively expected mutualism. The second order density term turns positive as predicted, but is not statistically significant. The only other study that analyzed the effects of vertical interdependence on suppliers' evolution (Martin et al. 1998) finds opposite results. In their study of international expansion of Japanese automobile suppliers, Martin et al. find evidence of classic density dependence processes (positive first order and negative second order effects) from the buyers' population that influenced suppliers' likelihood and timing of international expansion. They argue that suppliers follow buyers when the latter move in low numbers. Problems associated with control over information and resource scarcity turn the mutualism between the two populations into a competitive relationship. Further research is needed to better understand the systematic role of vertical interdependence in the evolution of organizational populations.

Model 4 introduces a simple specification of mass dependence (Barnett and Amburgey 1990, Barnett 1997) to test the effect of buyers' mass on entry rates of producers. Introducing mass increases the explanatory power of density variables from the previous model except for second order density of distributors, which is statistically significant only at the .10 level. As predicted, population mass is negatively related to entry rates implying that increasing aggregate size of buyers generate competitive effects on producers. Model 4 improves fit over the double density dependence specification ($\chi^2 = 2[L2 - L1] = 5.96$ with p-value = .0146 for 1 d.f.). Finally, Model 5 tests Hp 3.8 by including a measure of mean size of distributors (Barron 1999). The prediction that increasing size reduces entry rates is respected, and moreover all four density measures are significant. The inclusion of mean size was a poor predictor of entry rates in single population models, but has a better explanatory power when vertical interdependence is modelled. The negative relationship between size and entry rates supports Hp 3.8 and also indicates that further specifications of mass dependence might consider the interaction between populations as a more appropriate locus of competitive interaction between organizations. In fact, size and the related bargaining power seem to matter most in the context transactions, and the most relevant transactions often involve buyers vis-à-vis suppliers. In terms of goodness of fit, the specification of mass dependence with mean size performs better than the double density dependence model ($\chi^2 = 2[L2 - L1] = 5.53$ with p-value = .0187 for 1 d.f.).

Model 6 combines the two mass specifications. The estimates provide weaker support for the cross-density effects, similar to what we found in Models 3 and 4. None of the two mass variables is statistically significant, although their sign is negative. Not surprisingly, the full model does not improve over the previous two models. LRT indicates $\chi^2 = 2[L2 - L1] = .85$ with p-value = .3578 for 1 d.f. for the comparison with Model 4, and $\chi^2 = 2[L2 - L1] = .41$ with p-value = .5199 for 1 d.f. for the comparison with Model 5. Information measures can help us select the better model between Model 4 and 5. AIC and BIC for Model 4 are, respectively 4.747 and -1152.357. AIC and BIC for Model 5 are 4.748 and -1152.788. The use of AIC suggests choosing Model 4, while BIC suggests that Model 5 is only weakly superior. Their values, however, are so close that a definite empirical evaluation is not possible (Raftery 1996). A useful general result of both models, however, is that we find evidence of asymmetric mass dependence and density dependence mechanisms on entry rates of organizational populations that interact with each other.

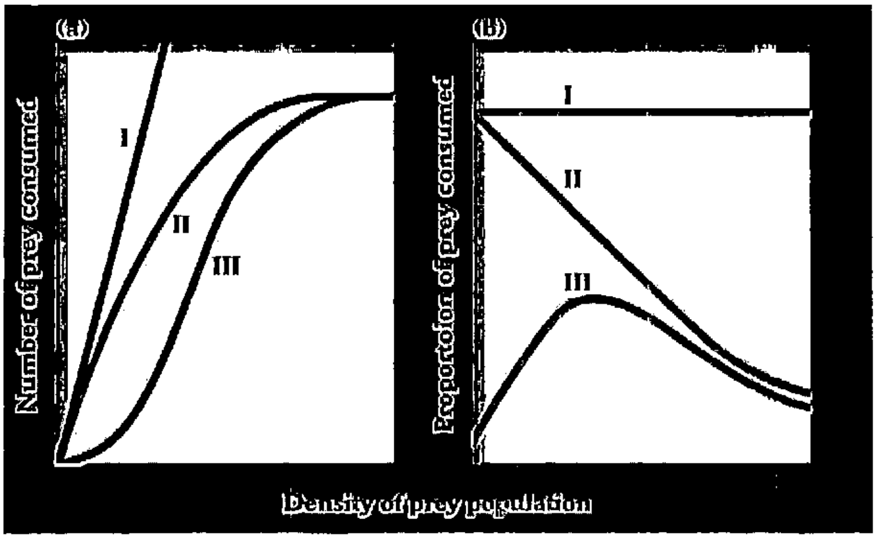

Figure 3.1. Functional response in predator-prey systems. Source: Ricklefs and Miller (1999)

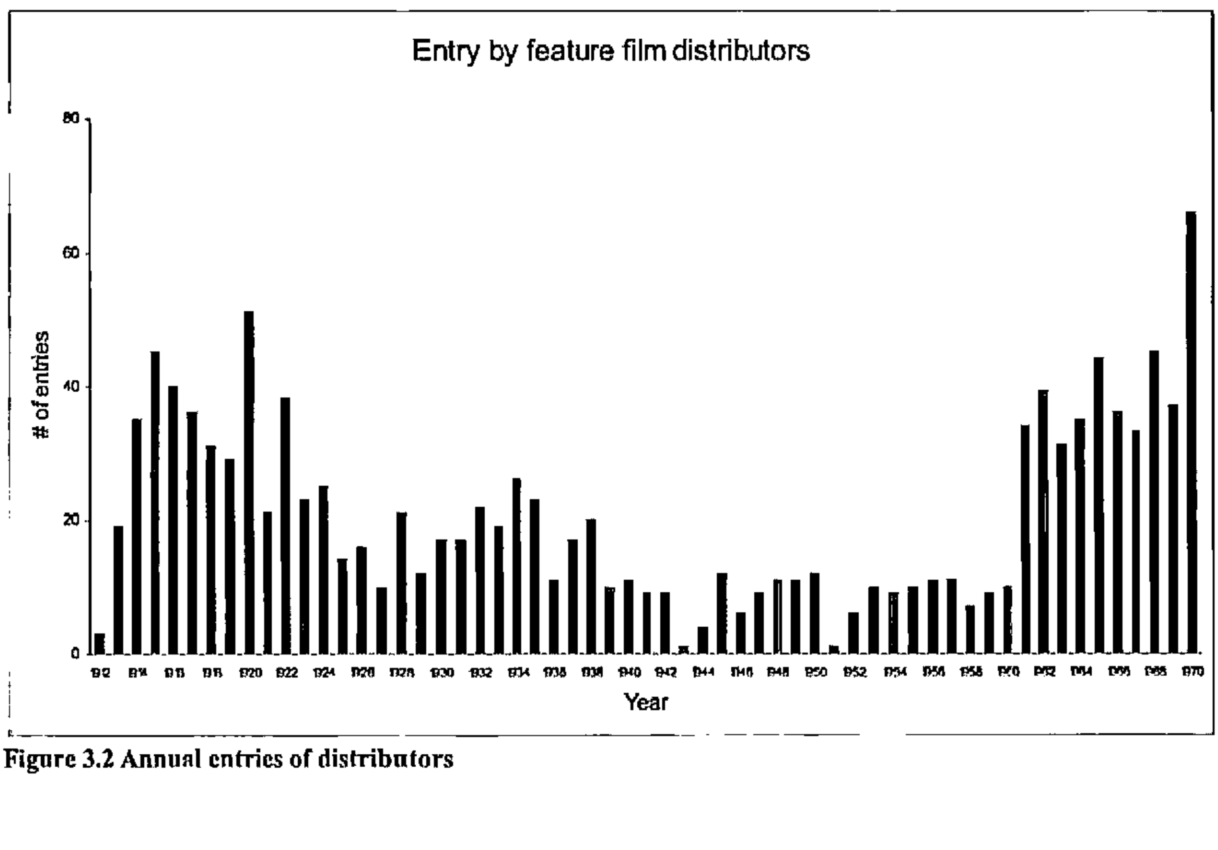

Figure 3.2 Annual entries of distributors

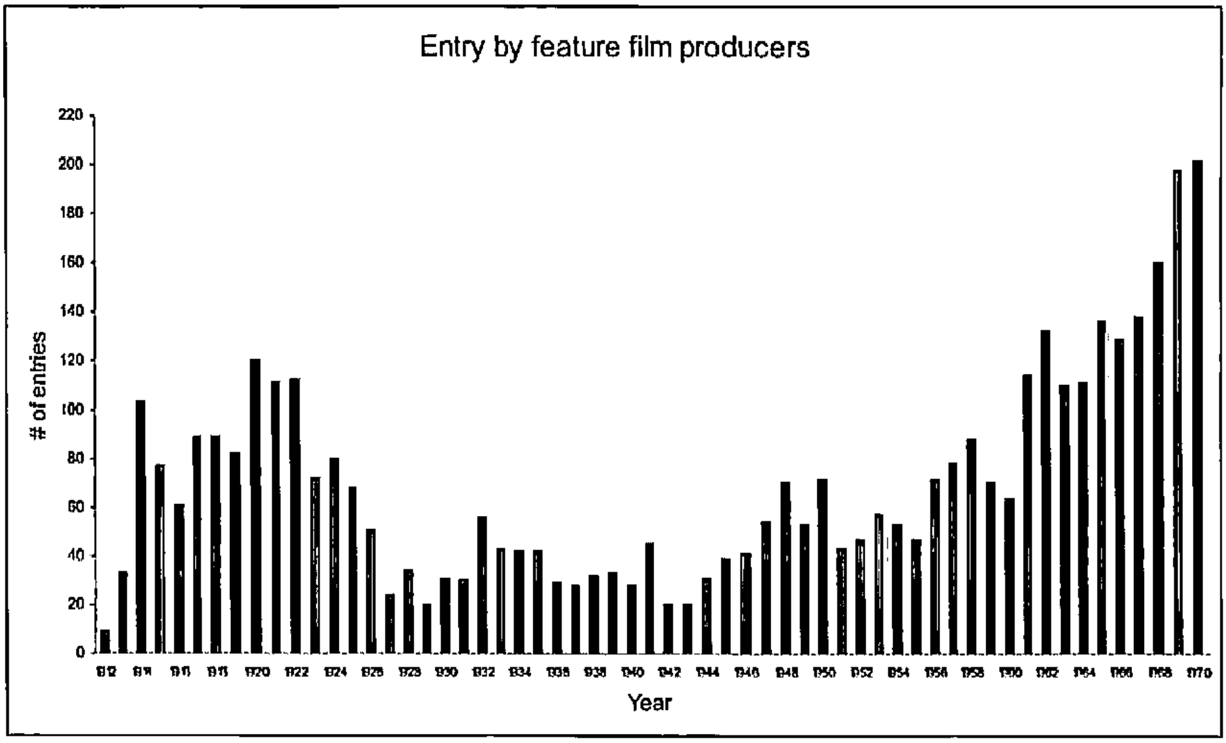

Figure 3.3 Annual entries of producers

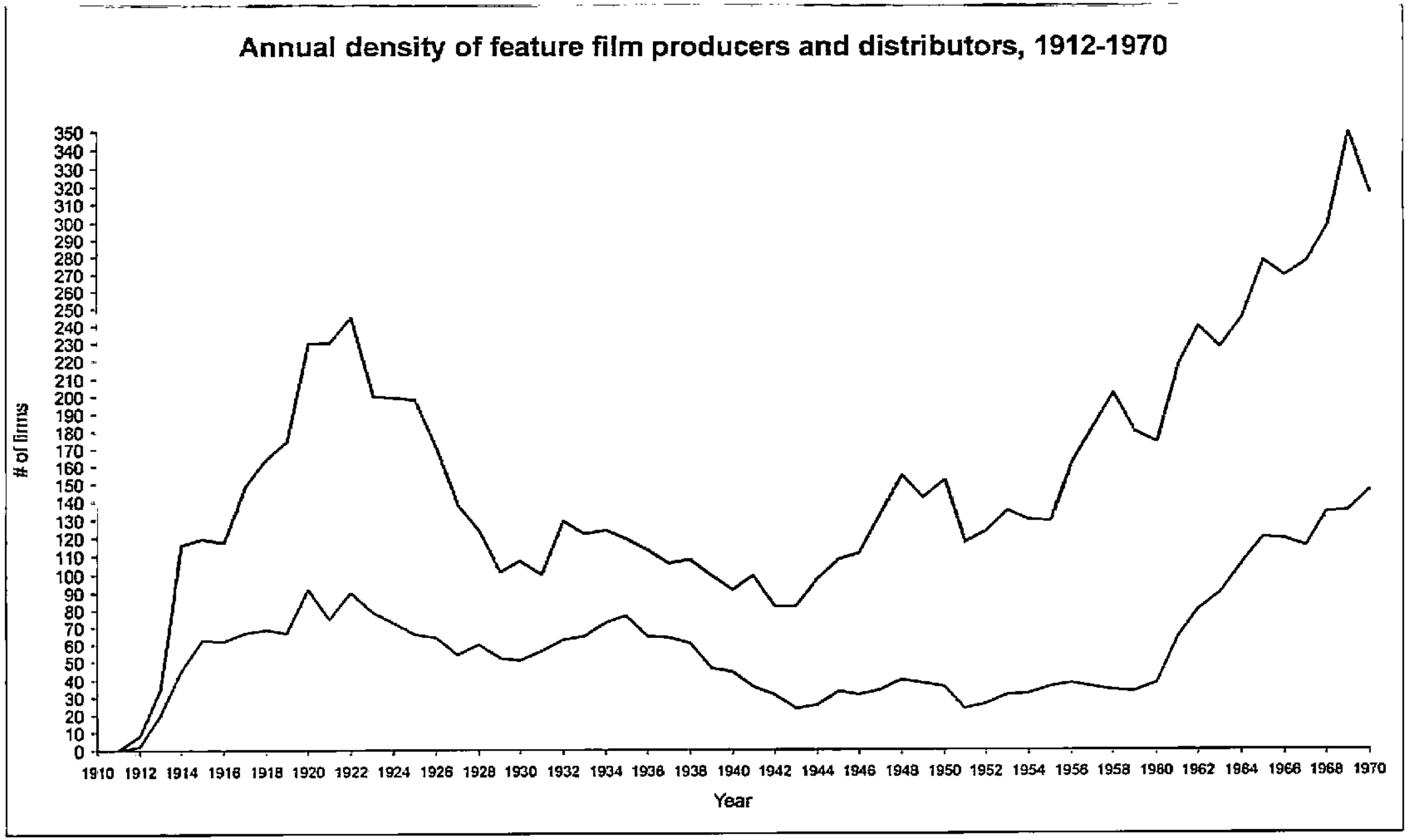

Figure 3.4 Density of feature film producers and distributors in the observation period

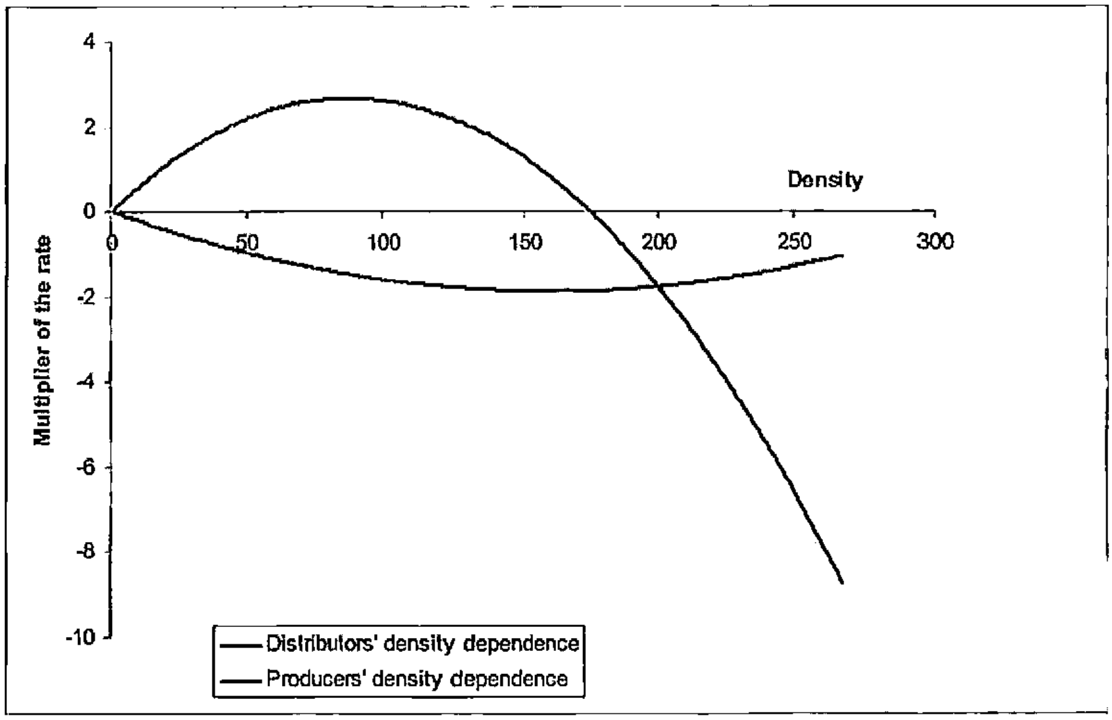

Figure 3.5 The effects of double density dependence mechanisms on the multiplier of the entry rate of distributors.

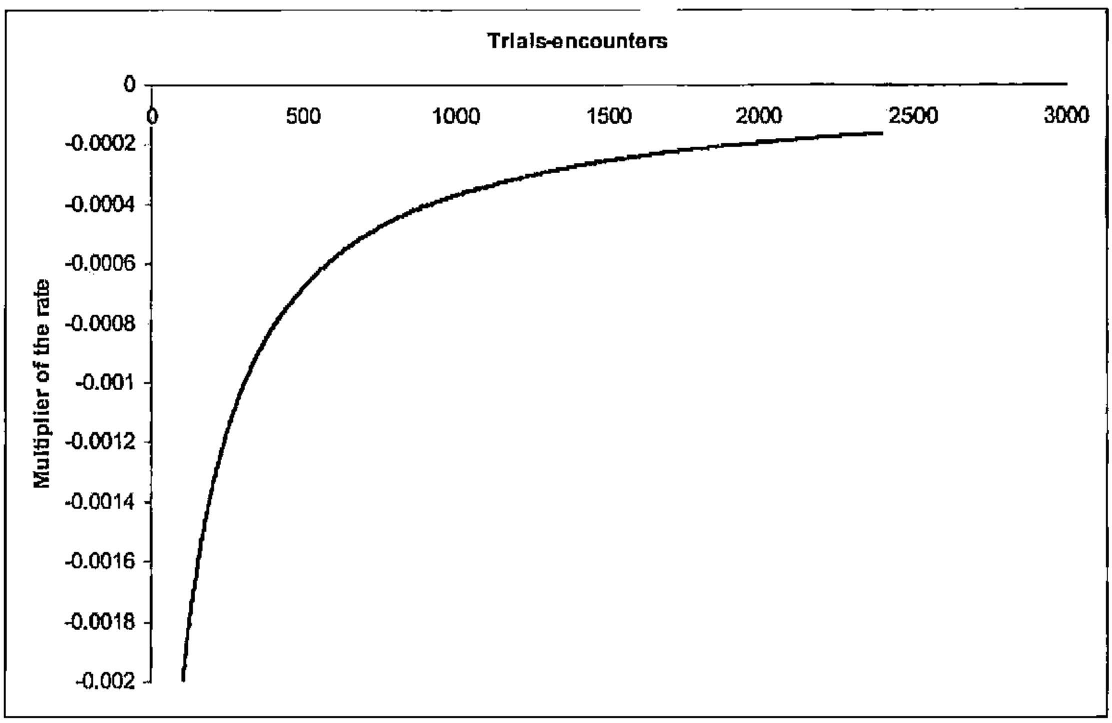

Figure 3.6 The effects of interaction between density of producers and cumulative entries in the community on the multipliers of the entry rate of distributors.

Variable	Obs	Mean	Std. Dev.	Min	Max
January	708	0.0833333	0.2765808	0	1
February	708	0.0833333	0.2765808	0	1
March	708	0.0833333	0.2765808	0	1
April	708	0.0847458	0.2786999	0	1
May	708	0.0819209	0.2744381	0	1
June	708	0.0833333	0.2765808	0	1
July	708	0.0833333	0.2765808	0	1
August	708	0.0833333	0.2765808	0	1
September	708	0.0833333	0.2765808	0	1
October	708	0.0833333	0.2765808	0	1
November	708	0.0833333	0.2765808	0	1
War years	708	0.1525424	0.3598	0	1
Paramount I	708	0.0508475	0.2198414	0	1
Paramount II	708	0.3898305	0.4880565	0	1
Shelter	708	0.626483	1.747533	0	7.105
Int. rate var.	708	0.0182901	0.1241425	-0.2047619	0.3069106
Attendance	708	51.69231	23.13286	17.89925	87.25
Screens	708	17.44106	2.605931	11.875	22.998
Tick. Price	708	3.23673	1.167959	1.67983	7.119297
TV Households	708	23.69381	36.18575	0	94.45
Sound	708	0.7288136	0.4448864	0	1
HH	708	9.1762	11.55496	2.0738	78.125
Density distrib.	708	58.52436	28.89712	7	138.75
Density distrib^2	708	4.258965	4.222835	0.049	19.25156
Density prod	708	131.0992	55.76779	13.75	288.75
Density prod^2	708	20.29266	17.30557	0.1890625	83.37656
Den prod x age	708	5219.173	4678.42	17.25	19440.5
Den prod x age2	708	22625.62	28486.86	1.725	114699
Den prod^{2}x age	708	1053.136	1405.501	0.6955	6435.868
Den prod^{2}x age^2	708	4932.649	8304.965	0.080625	37971.62
Indage	708	29.99859	17.0408	1	59
Indage^2	708	1189.894	1054.869	1	3481
Den prod evol. encont	708	35113.41	32480.57	3.1	154481.3
Den prod evol. encont^2	708	610.6735	875.6558	0.004805	4460.646
Den prod evol. encont^3	708	1208.468	2346.959	0.0007448	12880.12

Table 3.1 Descriptive statistics for models estimating community effects in entry rates of distributors

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
January	708	0.083333	0.276581	0	1
February	708	0.083333	0.276581	0	1
March	708	0.083333	0.276581	0	1
April	708	0.084746	0.2787	0	1
May	708	0.081921	0.274438	0	1
June	708	0.083333	0.276581	0	1
July	708	0.083333	0.276581	0	1
August	708	0.083333	0.276581	0	1
September	708	0.083333	0.276581	0	1
October	708	0.083333	0.276581	0	1
November	708	0.083333	0.276581	0	1
War years	708	0.152542	0.3598	0	1
Paramount I	708	0.050848	0.219841	0	1
Paramount II	708	0.389831	0.488057	0	1
Shelter	708	0.626483	1.747533	0	7.105
Int. rate var.	708	0.01829	0.124143	-0.20476	0.306911
Attendance	708	51.69231	23.13286	17.89925	87.25
Screens	708	17.44106	2.605931	11.875	22.998
Tick. Price	708	3.23673	1.167959	1.67983	7.119297
TV Households	708	23.69381	36.18575	0	94.45
Sound	708	0.728814	0.444886	0	1
HH	708	5.396582	7.358745	0.507515	58.5
Density prod	708	131.0992	55.76779	13.75	288.75
Density prod^2	708	2828.394	2332.289	347.75	10908.25
Dens. distr	708	58.52436	28.89712	7	138.75
Density distr^2	708	430.6031	422.3247	105.5	1928.025
Mass	708	4.422514	1.897357	0.04	8.7625
Mean size distr.	708	9.855395	4.546719	1	20.34476

Table 3.2 Descriptive statistics for models estimating community effects in entry rates of producers

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	War	Par I	Par II	Shelter	Int.rt.	Attend	Screens
Jan	1.00																	
Feb	-0.09	1.00																
Mar	-0.09	-0.09	1.00															
Apr	-0.09	-0.09	-0.09	1.00														
May	-0.09	-0.09	-0.09	-0.09	1.00													
Jun	-0.09	-0.09	-0.09	-0.09	-0.09	1.00												
Jul	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00											
Aug	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00										
Sep	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00									
Oct	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00								
Nov	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00							
War	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.00						
Par I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	1.00					
Par II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.34	-0.19	1.00				
Shelter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.15	-0.08	0.45	1.00			
Int.rt.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.08	-0.13	0.25	0.15	1.00		
Attend	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.32	-0.54	-0.51	-0.21	1.00	
Screens	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	-0.02	-0.36	-0.02	0.65	1.00
Tik Pr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.15	-0.04	0.70	0.80	0.18	-0.32	-0.01
TVs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.28	-0.15	0.82	0.67	0.23	-0.70	-0.18
Sound	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.17	0.14	0.49	0.22	0.09	0.31	0.58
HH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.04	-0.02	-0.17	-0.20	0.01	-0.09	-0.33
D. dis	0.00	0.00	0.00	-0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.20	-0.06	0.14	0.77	0.01	-0.42	-0.33
D dis^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.21	-0.09	0.23	0.89	0.05	-0.49	-0.40
D pr	0.00	0.00	0.00	-0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.30	-0.17	0.48	0.73	0.10	-0.62	-0.27
D pr^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.28	-0.17	0.47	0.84	0.10	-0.65	-0.36
D pr x age	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.30	-0.11	0.79	0.83	0.20	-0.57	-0.13
D pr x age2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.26	-0.12	0.77	0.86	0.21	-0.60	-0.19
D pr^2x age	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.26	-0.12	0.66	0.92	0.17	-0.62	-0.26
D pr^2x age^2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.23	-0.11	0.65	0.93	0.17	-0.60	-0.27
Indage	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.24	-0.01	0.84	0.56	0.19	-0.25	0.20
$Indage^2$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.24	-0.08	0.88	0.68	0.23	-0.46	0.00
D. Ev	-0.01	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	-0.29	-0.11	0.70	0.89	0.16	-0.56	-0.17
D. Ev^3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.24	-0.11	0.58	0.94	0.14	-0.59	-0.28
D. Ev^3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.20	-0.10	0.50	0.94	0.11	-0.55	-0.31

	Tik Pr	TVs	Sound	HH	D. dis	D dis^2	D pr	D pr^2	D pr x age	D pr x age2	D pr^{2}x age	D pr^{2}x age^2	Indage	Indage^2	D. Ev	D. Ev^2	D. Ev^3
Tik Pr	1.00																
TVs	0.77	1.00															
Sound	0.63	0.40	1.00														
HH	-0.29	-0.19	-0.28	1.00													
D. dis	0.48	0.44	-0.03	-0.48	1.00												
D dis^2	0.61	0.53	0.01	-0.35	0.97	1.00											
D pr	0.57	0.68	0.04	-0.53	0.87	0.86	1.00										
D pr^2	0.64	0.70	0.02	-0.37	0.87	0.92	0.97	1.00									
D pr x age	0.91	0.92	0.48	-0.31	0.60	0.70	0.79	0.82	1.00								
D pr x age2	0.91	0.92	0.45	-0.25	0.60	0.71	0.76	0.82	0.99	1.00							
D pr^{2}x age	0.87	0.86	0.33	-0.26	0.72	0.83	0.83	0.90	0.97	0.98	1.00						
D pr^{2}x age^2	0.89	0.85	0.34	-0.23	0.70	0.82	0.79	0.88	0.96	0.98	1.00	1.00					
Indage	0.87	0.82	0.77	-0.34	0.25	0.34	0.50	0.50	0.88	0.85	0.74	0.73	1.00				
Indage^2	0.90	0.92	0.63	-0.26	0.35	0.46	0.60	0.62	0.95	0.94	0.85	0.85	0.97	1.00			
D. Ev	0.90	0.87	0.41	-0.32	0.70	0.80	0.83	0.88	0.99	0.98	0.99	0.98	0.81	0.89	1.00		
D. Ev^2	0.85	0.80	0.27	-0.26	0.76	0.87	0.84	0.92	0.93	0.95	0.99	0.99	0.67	0.79	0.98	1.00	
D. Ev^3	0.83	0.72	0.22	-0.23	0.77	0.89	0.80	0.91	0.88	0.90	0.96	0.97	0.59	0.72	0.94	0.99	1.00

Table 3.3 Bivariate correlations for models of distributors' entry rates

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	War	Par I	Pr II	Shelt	Int.rt.	Att	Scrn	Pr	TV	Snd	HH	D pr	D pr²	D. dis	D dis²	Mss	Mn sz
Jan	1.00																											
Feb	-0.09	1.00																										
Mar	-0.09	-0.09	1.00																									
Apr	-0.09	-0.09	-0.09	1.00																								
May	-0.09	-0.09	-0.09	-0.09	1.00																							
Jun	-0.09	-0.09	-0.09	-0.09	-0.09	1.00																						
Jul	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00																					
Aug	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00																				
Sep	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00																			
Oct	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00																		
Nov	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	-0.09	1.00																	
War	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	1.00																
Par I	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.34	1.00															
Par II	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	-0.19	1.00														
Shelter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.15	0.45	-0.08	1.00													
Int.rt.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.08	0.25	-0.13	0.15	1.00												
Attend	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.20	-0.54	0.32	-0.51	-0.21	1.00											
Screens	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.09	-0.36	-0.02	0.65	1.00										
Tik Pr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.15	0.70	-0.04	0.80	0.18	-0.32	-0.01	1.00									
TVs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.28	0.82	-0.15	0.67	0.23	-0.70	-0.18	0.77	1.00								
Sound	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.17	0.49	0.14	0.22	0.09	0.31	0.58	0.63	0.40	1.00							
HH	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.26	0.04	-0.23	-0.03	0.11	-0.15	-0.29	-0.30	-0.18	1.00						
D pr	0.00	0.00	0.00	-0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.30	0.48	-0.17	0.73	0.10	-0.62	-0.27	0.57	0.68	0.04	-0.52	1.00					
D pr²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.30	0.50	-0.18	0.82	0.10	-0.67	-0.35	0.63	0.72	0.02	-0.40	0.97	1.00				
D. dis	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.11	0.10	0.01	0.49	-0.01	-0.17	-0.01	0.35	0.31	0.10	-0.64	0.79	0.67	1.00			
D dis²	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.21	0.23	-0.09	0.89	0.05	-0.50	-0.40	0.60	0.53	0.01	-0.31	0.86	0.90	0.74	1.00		
Mass	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	-0.59	0.10	-0.28	-0.14	0.38	0.15	-0.45	-0.57	-0.36	-0.26	0.04	-0.10	0.47	0.04	1.00	
Mn sz	0.00	0.00	0.00	0.01	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.38	-0.18	0.15	-0.52	-0.02	0.70	0.61	-0.21	-0.47	0.27	-0.08	-0.47	-0.57	-0.23	-0.60	0.39	1.00

Table 3.4 Bivariate correlations for models of producers' entry rates

Table 3.5

Negative binomial regression models for entry rates, feature film distributors 1912-1970[8]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*	*Model 7*
January	0.379**	0.387**	0.393**	0.331**	0.288*	0.390**	0.545**
	(.15)	(.15)	(.15)	(.15)	(.15)	(.15)	(.18)
February	-0.420**	-0.416**	-0.413**	-0.466***	-0.503***	-0.404**	-0.257
	(.18)	(.18)	(.18)	(.17)	(.18)	(.17)	(.20)
March	-0.436**	-0.429**	-0.426**	-0.471***	-0.503***	-0.416**	-0.288
	(.18)	(.18)	(.18)	(.18)	(.18)	(.17)	(.19)
April	-0.314*	-0.317*	-0.316*	-0.356**	-0.385**	-0.309*	-0.191
	(.17)	(.17)	(.17)	(.17)	(.17)	(.17)	(.19)
May	-0.332*	-0.335*	-0.330*	-0.366**	-0.392**	-0.321*	-0.213
	(.17)	(.17)	(.17)	(.17)	(.17)	(.17)	(.18)
June	0.774***	0.779***	0.780***	0.756***	0.736***	0.793***	0.869***
	(.15)	(.15)	(.15)	(.14)	(.14)	(.14)	(.15)
July	-0.493***	-0.490***	-0.485***	-0.506***	-0.525***	-0.479***	-0.411**
	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)	(.18)
August	-0.424**	-0.422**	-0.420**	-0.433**	-0.445**	-0.406**	-0.352**
	(.18)	(.18)	(.18)	(.17)	(.17)	(.17)	(.18)
September	-0.361**	-0.365**	-0.361**	-0.373**	-0.385**	-0.358**	-0.316*
	(.18)	(.18)	(.17)	(.17)	(.17)	(.17)	(.17)
October	-2.192***	-2.195***	-2.194***	-2.208***	-2.220***	-2.191***	-2.154***
	(.32)	(.32)	(.32)	(.32)	(.32)	(.32)	(.32)
November	0.556***	0.564***	0.566***	0.561***	0.558***	0.567**	0.579***
	(.15)	(.15)	(.15)	(.15)	(.15)	(.14)	(.14)
War Year	-0.164	-0.064	-0.081	-0.279*	-0.348**	-0.713***	-0.713***
	(.11)	(.14)	(.14)	(.15)	(.16)	(.20)	(.20)
Paramount I	-0.082	-0.138	-0.122	-0.207	-0.176	-0.416*	-0.444*
	(.23)	(.23)	(.08)	(.23)	(.23)	(.24)	(.25)
Paramount II	-1.332***	-0.980***	-0.601**	-0.054	-0.084	0.154	0.001
	(.23)	(.23)	(.29)	(.23)	(.31)	(.39)	(.40)
Shelter	0.001	0.029	-0.012	0.012	0.055	-0.018	-0.043
	(.05)	(.08)	(.03)	(.08)	(.09)	(.09)	(.10)
Int. Rate var.	-0.533*	-0.559*	-0.368	-0.581*	-0.778**	-1.037**	-0.736*
	(.29)	(.30)	(.32)	(.32)	(.34)	(.35)	(.38)
Attendance	-0.043***	-0.038***	-0.035***	-0.012	-0.003	-0.015	-0.020*
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)
Screens	-0.014	-0.005	-0.009*	-0.026	-0.041	-0.041	-0.026
	(.03)	(.03)	(.00)	(.03)	(.03)	(.03)	(.04)
Ticket price	0.163*	0.289***	0.207*	0.297**	0.461***	0.236	0.141
	(.09)	(.11)	(.12)	(.12)	(.16)	(.19)	(.22)
TV Households	-0.008*	-0.010**	-0.008*	0.007	0.013*	-0.007	-0.021
	(.00)	(.00)	(.00)	(.01)	(.01)	(.01)	(.01)
Sound	0.761**	0.522*	0.400	0.598**	0.896**	1.095**	0.990**
	(.27)	(.29)	(.32)	(.30)	(.34)	(.43)	(.48)
HH	-0.020***	-0.001	-0.013	-0.003	0.008	0.033**	0.039**
	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)

[8] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Density distrib		0.034***	.061***	0.059***	0.049***	0.050**	0.051**
		(.01)	(.02)	(.00)	(.02)	(.02)	(.02)
Density distrib²		-0.217**	-.402**	-0.430	-0.422***	-0.392**	-0.361*
		(.09)	(.16)	(.13)***	(.16)	(.17)	(.19)
Density prod			-.023**		0.020	0.077***	0.092***
			(.01)		(.02)	(.02)	(.03)
Density prod²			.072**		-0.046	-0.264***	-0.334***
			(.04)		(.05)	(.10)	(.11)
Den prod x age						-0.007***	-0.010***
						(.00)	(.00)
Den prod x age2						0.001***	0.002***
						(.00)	(.00)
Den prod²x age						0.022***	0.030***
						(.01)	(.01)
Den prod²x age²						-0.003***	-0.005***
						(.00)	(.00)
Indage						0.370**	0.487**
						(.17)	(.19)
Indage²						-0.004	-0.008*
						(.00)	(.00)
Den prod evol.				-0.001***	-0.001***		0.000
encont				(.00)	(.00)		(.00)
Den prod evol.				0.009***	0.014***		-0.012
encont ²				(.00)	(.00)		(.01)
Den prod evol.				-0.001**	-0.002***		0.003
encont ³				(.00)	(.00)		(.00)
Constant	.2783***	.7547795	1.727**	.094	-1.244	-3.575**	-4.267***
	(.47)	(.73)	(.83)	(.75)	(1.07)	(1.36)	(1.58)
Alpha	.1885252***	.1865839***	.1787787***	.1599564***	.1570933***	.1430862***	.1353639***
Log-likelihood	-1076.4471	-1069.372	-1066.5419	-1058.9583	-1057.2077	-1050.0448	-1047.0732

Table 3.6

Negative binomial regression models for entry rates, feature film producers 1912-1970[9]

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
January	0.188*	0.187*	0.184*	0.184*	0.182*	0.184*
	(.10)	(.10)	(.10)	(.10)	(.10)	(.10)
February	-0.333***	-0.333***	-0.335***	-0.334***	-0.335***	-0.335***
	(.11)	(.11)	(.10)	(.10)	(.10)	(.10)
March	-0.179*	-0.180*	-0.184*	-0.183*	-0.184*	-0.184*
	(.10)	(.10)	(.10)	(.01)	(.10)	(.10)
April	-0.291***	-0.292*	-0.293***	-0.292***	-0.292***	-0.292***
	(.11)	(.10)	(.10)	(.10)	(.10)	(.10)
May	-0.139***	-0.140	-0.143	-0.142	-0.144	-0.143
	(.10)	(.10)	(.10)	(.10)	(.10)	(.10)
June	0.573***	0.570***	0.565***	0.565***	0.564***	0.565***
	(.09)	(.09)	(.09)	(.09)	(.09)	(.09)
July	-0.418	-0.418***	-0.423***	-0.421***	-0.422***	-0.422***
	(.11)	(.11)	(.11)	(.11)	(.11)	(.11)
August	-0.165	-0.166	-0.172*	-0.172*	-0.172*	-0.172*
	(.10)	(.10)	(.10)	(.10)	(.10)	(.10)
September	-0.120	-0.120	-0.122	-0.123	-0.123	-0.123
	(.10)	(.10)	(.10)	(.10)	(.10)	(.10)
October	-1.513***	-1.513***	-1.521***	-1.518***	-1.520***	-1.519***
	(.14)	(.14)	(.14)	(.14)	(.14)	(.14)
November	0.575***	0.576***	0.573***	0.572	0.571***	0.571***
	(.09)	(.09)	(.09)	(.09)	(.09)	(.09)
War Year	-0.152**	-0.048	-0.094	-0.043	-0.013	-0.024
	(.07)	(.08)	(.08)	(.09)	(.09)	(.09)
Paramount I	0.202	0.200	0.265**	0.304**	0.283**	0.298**
	(.13)	(.13)	(.13)	(.13)	(.13)	(.13)
Paramount II	0.032	0.013	-0.282*	-0.317**	-0.286**	-0.306**
	(.11)	(.11)	(.15)	(.15)	(.15)	(.15)
Shelter	0.003	-0.052	-0.020	-0.028	-0.015	-0.023
	(.03)	(.04)	(.05)	(.05)	(.05)	(.05)
Int. Rate var.	0.106	0.171	0.095	0.137	0.161	0.152
	(.17)	(.18)	(.18)	(.18)	(.18)	(.18)
Attendance	-0.021***	-0.022***	-0.025***	-0.025***	-0.022***	-0.023***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Screens	0.008	-0.011	-0.011	0.0002	-0.005	-0.001
	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Ticket price	0.173***	0.177***	0.177***	0.191***	0.199***	0.196***
	(.06)	(.06)	(.07)	(.07)	(.07)	(.07)
TV Households	-0.006**	-0.008***	-0.009***	-0.011***	-0.010***	-0.010***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.00)
Sound	-0.140	0.095	0.233	0.127	0.207	0.153
	(.18)	(.20)	(.21)	(.21)	(.20)	(.21)
HH	-0.046***	-0.031***	-0.030***	-0.029***	-0.029***	-0.029***
	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)

9 * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*	*Model 6*
Density prod.		0.005	0.017***	0.023***	0.025***	0.025***
		(.00)**	(.00)	(.01)	(.01)	(.01)
Density prod.²		-0.004	-0.027**	-0.040***	-0.043***	-0.043***
		(.01)	(.01)	(.01)	(.01)	(.01)
Density distr.			-0.021**	-0.022***	-0.032***	-0.027**
			(.01)	(.01)	(.01)	(.01)
Density distr.²			0.102	0.127*	0.156**	0.143*
			(.08)	(.08)	(.08)	(.08)
Mass				-0.070**		-0.045
				(.03)		(.05)
Mean mass					-0.030**	-0.014
					(.01)	(.02)
Constant	2.505**	2.162***	2.214***	1.921***	2.004***	1.930***
	(.28)	(.01)	(.35)	(.37)	(.36)	(.37)
Alpha	.116424***	.106989***	.103859***	.1012077***	.1012326***	.1009938***
Log-likelihood	-1688.7133	-1660.086	-1654.5381	-1651.5557	-1651.7715	-1651.3487

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Chapter 4
Community-level effects and exit rates in the U.S. motion picture industry

4.1 INTRODUCTION

One of the main tenets of ecological theories of organizations maintains that processes of social legitimation and competition regulate the structure of organizational populations, mainly by affecting organizational vital rates (Hannan and Freeman 1989, Carroll and Hannan 2000). The theory of density-dependent evolution posits curvilinear relationships between density, i.e. the number of organizations operating in a population, and founding, mortality and growth rates. The theory of density dependence argues that an organizational form gains legitimation when it is taken for granted, and taken-for-grantedness is proxied by density. The more a population is abundant, the higher its legitimation. Legitimation increases survival of organizations belonging to a certain form because it makes easier to access resources necessary for operation. Assuming finite resources in the environment, however, high density levels will exercise a negative influence on survival chances of organizations because diffuse competition for limited resources reduces their viability. What results is a U-shaped relationship between density and mortality. Empirically, the predictions of density dependence hold across various contexts, especially when evolutionary trajectories reach a peak and then partially decline (Carroll 1997, Carroll and Hannan 2000).

Extensions of the basic dependence argument have been developed to address more articulated evolutionary patterns in organizational populations, including prolonged decline and resurgence. Main alternatives incorporate mass dependence and temporal heterogeneity and integrate the consolidated intra-population processes posited by density dependence. One of these extensions, community ecology, has received instead limited investigation (Ruef 2004, Sørensen 2004). The main assumption of this approach is that interactions between different populations affect organizational evolution in addition to within population processes of legitimation and competition. Organizations, in fact, are interdependent with their environment, particularly with populations that perform functionally related functions in the system of social and economic activities (Burt 1988). Community ecology deals with the interactions of different local populations and the effects that such interactions produce on organizational evolution. This study develops theory in the community ecology perspective that addresses interactions between vertically interdependent populations of buyers and suppliers. In a previous study we found that density, mass and temporal heterogeneity affect entry rates in both populations that interact with each other, and we also expect that exit rates may be influenced by interactions between populations. Empirically, we test the hypotheses developed within this framework on the exit rates of the populations of feature film producers and distributors in the United States from 1912 to 1970.

This study is organized as follows: the next section reviews research in community ecology addressing organizational mortality/exit. Next, we develop theory and hypotheses about the effect of vertical interdependence on mortality/exit. Then, we present a description of the empirical context where we test our hypotheses, the motion picture industry in the United States. Subsequently, the methods section describes the different measures and statistical estimation technique used to analyze exit rates of feature film producers and distributors. The next section reports the findings of the empirical analysis. In the same section, discussion and suggestions for further research conclude the study.

4.2 DENSITY DEPENDENT EVOLUTION, COMMUNITY ECOLOGY AND ORGANIZATIONAL MORTALITY

The theory of density dependent evolution has been developed to analyze competitive dynamics in the context of single populations. With respect to organizational mortality or exit, the theory posits that low density reduces exit because legitimacy of the form is enhanced by the proliferation of organizations in the population (and resources are available for survival). When density increases further, resources become scarcer and competitive interaction within the population overcomes the positive but marginally decreasing benefits of legitimation. Subsequent refinement of the theory includes at least the incorporation of one important source of heterogeneity in population-level processes: size. When organizations grow in size, the amount of resources utilized increases, thereby causing a general reduction in the chances of survival of those organizations that depend on them. Over time, the size of individual large organizations may competitively displace its population's number (Winter 1990). Consequently, larger organizations increase their competitors' mortality rates. If size assigns higher competitive intensity, density alone cannot capture this effect. Modified measures of density weighted by size that takes into account the effect of population mass (Barnett and Amburgey 1990, Barnett 1997). If larger organizations are stronger competitors, population mass should have a positive relationship with mortality; larger organizations, however, may be strong survivors but weak competitors overall. Barnett (1997) argues that larger organizations are complex, bureaucratic institutions whose mean technical fitness can be lower when compared to smaller organizations; instead, compensatory fitness associated with higher institutional conformation makes possible prolonged survival despite lower efficiency. As organizations age, large ones are more likely to survive, giving rise to industry concentration and decline. But if larger organizations are weaker competitors, late stage evolution of industries may experience resurgence. Barron (1999) counter-argues that smaller organizations have higher risks of failure, and over time higher survival of larger organizations may reduce density but not mass. Large organizations can in fact take up resources made available by the failure of small competitors.

A second modification of the traditional density dependence argument includes effects of historical density, particularly of density at founding time. Carroll and Hannan (1989) build on the idea developed by Stinchcombe (1965) about the influence of imprinting forces on organizational evolution and assume that density at the time of founding will affect future evolution. When organizations are founded in high density environments resources are scarcer, and such scarcity in turn translates into a constitutive weakness that delays its effect over organizational life. Indeed, density at founding has a positive effect on mortality. In a partially different vein, Swaminathan (1996) argues that the liability of density at founding may be temporary. Organizations founded in populations with high density have an initial higher mortality rate, but those who survive the initial selection will have overcome difficult evolutionary stages and show improved permanent fitness. Resource scarcity can in fact be circumvented by learning and capability development.

In the study of mortality or exit events, density dependence adds to processes of age and size dependence to influence demographic processes in a population. As organizations age, they tend to replicate processes, structures and activities they have initially developed (Hannan and Freeman 1984). This inertia may have different outcomes. On the one hand, older organizations accumulate useful routines, rules, structures that may benefit them by increasing their effectiveness; on the other, initial resources may become exhausted, routines may become dysfunctional or the same experience organizations have developed may impede ability to act in the face of environmental volatility. Older organizations become rigid and find it more difficult to make and carry out decisions in timely manner. Some changes therefore may increase an organization's chances of failure, whereas others may reduce them. A related argument considers the effects of size separately from those of age - age and size are usually positively correlated; so to get good estimates of age dependence, one needs complete age-varying measures of size for all organizations in a population. Large organizations have advantages over smaller competitors for various reasons: they have excess resources to utilize even in the case of environmental change; they can exercise both economic and political power (Aldrich and Auster 1986, Barron et al. 1994).

The density dependence model has been developed to address competitive dynamics within single populations rather than inter-population relations. Some studies, however, extend the basic density dependence logic and adopt a community ecology perspective that deals with interdependence between different organizational populations. Brittain and Wholey (1988) identify several types of interactions between organizational populations, ranging from competition (a relation whereby the presence of one population affect negatively the growth of another population) to mutualism (growth is positively affected by each other's presence), and including neutrality or asymmetric relationships (e.g. parasitism, whereby population A reduces growth of population B, but B is not affected by the presence of population A). We discussed in the previous study that the primary criteria that characterize the interaction of different populations in communities are community boundaries and the role - or function - that each population plays within the community.

Similar to what we observed in the review of community-level studies of entry rates, in most occasions researchers have focused their attention on the dynamics of sub-populations within the same population. In a study on the evolution of health management organizations in the United States between 1976 and 1991, Wholey et al. (1992) analyze the interaction between group and practice associations, and do not find evidence of cross-density effects on failure rates of either sub-population, though they find mutualism in merger rates. In a study on the evolution of trade unions in the U.S., Hannan and Freeman (1989) find asymmetric competitive relationships between density of industrial and craft unions and their failure. When industrial density was low, the high density of craft unions increased disbanding rates of industrial unions. Still, the competitive effect was overcome by the strong legitimating effect of increasing density within the population of industrial unions. In a study on exit rates of semiconductor firms, Hannan and Freeman (1989) find analogous asymmetric dynamics between independent and subsidiary firms, with only the latter influencing the former. In this case, however, the competitive effect reverses at high densities, with subsidiary firms reducing exit of independent. Hannan and Freeman hint at the possibility that members of the two competing sub-populations may have developed alliances to increase survival. Sub-populations develop structured interaction that reduces risks of exit.

A more articulate case in the analysis of sub-population interactions is a study of failure rates in minor league baseball teams and leagues between 1883 and 1990 (Land, Davis and Blau 1994). Land et al. develop a hypothesis of structured mutualism whereby major teams benefit from the presence of minor teams because they need them to play and organize schedules (p.793). At high density, however, market saturation or free-riding behaviours reverse the positive associations of different teams. Based on this notion of cooperation at the population level, we can anticipate a negative-positive relationship between linear and quadratic within-league density and team mortality. Mutualism within leagues adds to the basic density dependence mechanism that expects legitimation-diffuse competition to affect negatively-positively mortality rates outside leagues. A similar pattern of relations also influences league mortality.

When community ecology studies address effects of interaction between different forms, results are inconclusive. In a study of nine major sports leagues, Dobbs and Harrison (2001) find that specific-sport league mortality is not significantly affected by density of all sports' leagues, not supporting evidence of horizontal interdependence. Other studies incorporate explicitly the analysis of boundaries in addition to functional differentiation of activities in the community. In a study on performance of biotech firms in the U.S., Stuart and Sorenson (2003) argue that spatial heterogeneity affect organizational performance. Organizations need different resources to operate and the location of resource providers affects their vital rates. Specifically, the population of biotech firms develops a web of symbiotic, competitive, and parasitic relationships with other populations depending on the type of resources they provide. For instance, spatial proximity to scientific experts in a certain high tech domain improves performance, measured as time-to-IPO, of new organizations in the same domain. Spatial proximity to competing firms instead reduces performance of new ventures because firms recruit managers from the same set of organizations (when labor supply is constant at the local level). Finally, spatial proximity to venture capitalist reduces performance as well. As a matter of fact venture capitalists can harm new organizations by distracting resources through either the recruitment of managers or key personnel to form new firms, or the funding of competitors. Table 1 presents a schematization of empirical research in community ecology relevant for the study of mortality and growth rates (earlier reviews include Carroll 1984, Wholey and Brittain 1986, Baum 1996).

Table 4.1. Empirical studies in organizational communities

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for failure or growth rates
Nielsen and Hannan 1977, Carroll 1981	International education, 1950-1970	Sub-population dynamics across multiple populations in space	Growth rates of national enrollment in primary, secondary and tertiary education in rich and poor countries	Enrollment in primary education is positively related to the expansion of secondary enrollment and enrollment in both primary and secondary education is positively related to the expansion of tertiary enrollment. Evidence of *mutualism.*
Dimmick and Rothenbuhler, 1984*	U.S. media industries 1949-1980	Population dynamics across multi-population system	Niche breadth and niche overlap dynamics	Television lowered radio's niche breadth as a result of strong competition over national advertising, at a decreasing rate. Cable television has strong overlap with television; television has moderate niche overlap with radio; radio has low overlap with cable. Cable television specializes in resource use compared to broadcasting television and radio (that has more generalist resource use). Evidence of *predatory competition.*
Barnett and Carroll, 1987	Iowa telephone companies in three counties, 1900-1917	Sub-population dynamics within single population	1) Organizational mortality of aggregate population and mutual and commercial organizational forms, 2) growth rates of mutuals and commercials, 3) probability of offering long-service supply by mutuals and commercials	1) Local density (measured at county level) has non significant influence on death rates; non-local density affects positively death rates. *Diffuse competition* exists. When main forms of mutual and commercial companies are introduced in the models, commercial density has positive effect on mortality, both at local and non-local level; non-local mutual density has positive effect on mortality, while local mutual density shows U-shaped relationship with mortality. Therefore, non-local companies show *diffuse competition* over both forms. Local commercial companies show *direct competition.* Local mutuals show *mutualism* and *direct competition.* 2) Both local and non-local density of mutuals is negatively related to growth for each form. There is a non robust negative relationship between non-local commercials density and mutuals growth. There is evidence of *diffuse competition* of non local companies. 3) Mutuals increase commercials' probability of providing long distance service. Commercial companies increase probability that mutuals offered long distance service. Evidence of *mutualism.*
Brittain and Wholey, 1988	U.S. semiconductor industry, 1949-1981	Sub-population dynamics within single population	Growth rates	Growth rates of receiving tubes-generalists are positively affected by density of K-specialists discrete producers, and vice versa. Evidence of *symbiosis.* Growth rates of r-specialists are negatively affected by density of K-specialists, and vice versa. Evidence of *full competition.* Growth rates of r-specialists are positively affected by density of K-specialists discrete producers, while growth rates of K-specialists discrete producers are negatively affected by density of r-specialists. Evidence of *predatory competition.*
Hannan and Freeman, 1989	U.S. craft and industrial labor unions, 1836-1985	Sub-population dynamics within single population	Failure rates	Increasing density of craft unions increases failure of industrial unions, but industrial union density does not affect craft union failures. Evidence of *partial competition.*

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for failure or growth rates
Hannan and Freeman, 1989	Semiconductor firms, 1947-1984	Sub-population dynamics within single population	Exit rates	Increasing density of subsidiary firms increases exit of independent firms, but independent firms' density does not affect exit of subsidiary firms. Evidence of *partial competition.*
Barnett 1990	Pennsylvania telephone companies, 1877-1934, and Iowa telephone companies 1900-1930	Sub-population dynamics within single population	Failure rates of magneto vs. common battery technologies, and single and multi-exchange common battery companies	Increasing density of magneto companies increases failure of common battery companies; common battery density does not affect magneto company failure. Evidence of *partial competition.* Increasing density of magneto companies increases failure of all telephone companies. Evidence of *diffuse competition.* Among common battery companies, increasing density of multi-exchange and single-exchange populations each increased its own mortality but decreased the mortality of the other form. Evidence of *competition* and *mutualism.*
Baum and Oliver, 1991	Child care system in Metropolitan Toronto area, 1971-1987	Sub-population dynamics within single population	Failure rates	Increasing density of day care centers stimulates failure of nursery schools and increasing density of nursery schools stimulates failure of day care centers. Evidence of *full competition.*
Carroll and Swaminathan 1992	U.S. brewers, 1975-1990	Sub-population dynamics within single population	Failure rates	Increasing density of mass producers stimulates failure of microbreweries; microbreweries density does not influence mass producers' failures. Evidence of *partial competition.*
Wholey et al., 1992	Health Management Organizations in the U.S., 1976-1991	Sub-population dynamics within single population	Failure rates	Increasing density of group and practice associations organizations are unrelated to each other's failure rates. Evidence of *neutrality.*
Aldrich et al., 1994	U.S. trade unions and trade associations, 1900-1982	Sub-population dynamics within single population	Disbandings and merger rates	Union density (and foundings) does not have significant effect on trade association disbandings, but shows positive effect on merger rates of associations. Evidence of *mutualism.*
Barnett, 1994	Pennsylvania telephone companies, 1879-1934	Sub-population dynamics within single population	1) Growth rates, 2) failure rates	1) The growth of the Bell system increased growth of independent companies, but this *mutualistic* effect was more than offset by *diffuse competition* at the level of the whole industry. Companies using magneto systems lowered growth rates of the independent system; the operation of companies using common-battery systems increased growth rates of the independent system. 2) Failure rates of organizations changing technological system increase after the change, with this hazard falling over time.
Baum and Singh, 1994b	Child care system in Metropolitan Toronto area, 1971-1989	Sub-population dynamics within single population	Growth rates	Density of day care centers decreases growth rates of nursing centers; density of nursing centers increases growth of day care centers. Evidence of *predatory competition.*

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for failure or growth rates
Brittain, 1994	U.S. electronics components producers, 1947-1981	Sub-population dynamics within single population	Failure rates	Failure rates of r-specialists are positively influenced by density of r-generalists, negatively by density of K-specialists, and in a non significant (negative) way by density of K-generalists; failure rates of K-specialists are positively influenced by density of r-specialists and K-generalists, and negatively but not significantly affected by density of r-generalists; failure rates of r-generalists are positively influenced by density of r-specialists, and negatively but not significantly affected by density of K-specialists and K-generalists; failure rates of K-generalists are positively influenced by density of K-specialists and r-generalists, and negatively affected by density of r-specialists. Evidence of complex pattern of relationships, from *full competition* to *partial competition*, *predatory competition*, *neutrality*, *commensalism* and *symbiosis*.
Korn and Baum, 1994*	Largest 200 Canadian organizations, 1985-1992	Population dynamics across multi-population system	Employment growth rates	Employment density of manufacturing industry has positive effects on growth of wholesale industry and negative effects on growth of financials industry; wholesale industry employment density has positive effects over manufacturing growth (manufacturing and wholesale are then *symbiotic*); employment density of financials industry has positive effects over growth of natural resources and negative effects over growth of manufacturing (financials and manufacturing show *full competition* relationship); employment density of natural resources industry has positive effects over manufacturing and financials (natural resources and financials show *symbiotic* relationship); employment density of natural resources industry has negative effects on growth of wholesale and positive effects over transportation industry; transportation has mutualistic effects over wholesale and natural resources (transportation and natural resources are *symbiotic*).
Land et al., 1994	U.S. minor league baseball teams and leagues, 1883-1990	Sub-population dynamics within single population	Mortality rates	Density-dependent processes between outside-league density vs. team and league mortality; league death and age influence positively team mortality. League age has negative effect on team mortality. Evidence of *structural mutualism* and *diffuse competition*.
Barnett, 1997	Early Pennsylvania telephone companies, 1879-1934, and U.S. breweries, 1633-1988	Sub-population dynamics within single population	Failure rates	Age of ancestor organizations increases failure rates of breweries. Increasing density of magneto companies increases failure of all companies; common battery density increases failure of all companies if transmission technology is not complementary, whereas it reduces failure if transmission technology is complementary. Evidence of *diffuse competition* and *mutualism*.
Dobbs and Harrison, 2001	205 nine sports major league in U.S. and Canada, 1871-1997	Sub-population dynamics within single population	Mortality rates	Specific-sport league mortality is not significantly affected by density of all sports' leagues. Evidence of *neutrality*.

Study	Empirical setting	Level of analysis	Modeled events	Relationships observed for failure or growth rates
Bonaccorsi and Giuri, 2001	International turboprop engine and aircraft industries (1948-1998), jet engine and aircraft industries (1958-1998)	Population dynamics across multi-population system	1) Density of producers in the upstream industry, 2) density of products in the upstream industry, 3) level of concentration in the upstream industry	Density of producers and products, and concentration in the upstream industry is positively affected by density of producers and products, and concentration in the downstream industry. The "transmission" process is contingent upon the structure of the network linking suppliers of engines and aircraft manufacturers. Turboprop network has partitioned structure and shows parallel structural dynamics in upward and downward industries, the jet industry has hierarchical structure and shows unrelated dynamics between upward and downward industries. Network density has significant negative effect on number of firms in the two industries.
Stuart and Sorenson, 2003	U.S. biotech industry, 1978-1995	Population dynamics across multi-population system	Time to initial public offering of securities (IPO)	Spatial proximity to scientific experts in a certain high tech domain improves performance of new organizations in the same domain. Spatial proximity to competing firms reduces performance of new organizations. Spatial proximity to venture capitalists reduces performance of new organizations. Evidence of *symbiosis*, *competition*, and *parasitism*.
Ruef, 2004	U.S. medical schools, 1765-1999	Sub-population dynamics within single population	Growth rates	Density of nursing schools decreases growth of regular medical schools. Evidence of *direct competition*. Density of sectarian schools first increases then decreases growth rates of regular medical schools. Evidence of *mutualism* and *competition*.

4.3 COMMUNITY ECOLOGY, VERTICAL INTERDEPENDENCE AND EXIT RATES

Buyers and suppliers are actors that are bound together in mutually dependent relationships. The two populations need each other to perform their activities therefore they cannot control all the resources and processes they need to obtain their goals. The importance and scarcity of resources determine the extent and nature of dependence between organizations: suppliers provide their main output, products, as input to buyers' activity, while buyers return resources of different nature, mainly capital, which allows suppliers to continue their activity. Their interdependence emerges from such a tied system of exchange. The interdependence is also structural because actors in a population have similar tendencies to purchase inputs from each sector and have similar tendencies to sell outputs to each sector as a consumer. Similar patterns of market relations are the mechanism that generates structural interdependence (Burt 1988).

The population ecology's model of density dependence is based on two divergent mechanisms that explain organizational evolution. For mortality/exit rates in particular, when density is low growing number of organizations in a population increase its legitimation. Land et al. (1994) analyze the evolution of U.S. baseball leagues and find that teams belonging to different leagues develop a structured mutualism among one another for the purpose of coordinating schedules in addition to the evident need of having opponents with which to play games. There is evidence of mutual dependence reducing team and league mortality. When firms perform complementary activities, the interdependence between their functions can be recognized by social actors as well. Porac et al. (1995) describe the way organizations engaged in different activities in the Scottish knitwear industry are cognitively ordered and grouped to define socially constructed competitive boundaries in the market. The cognitive order, which is based on organizational attributes and typical forms, produces structural relationships connecting firms with each other and firms with the whole industry (White 1992).

Not only firms in different positions in the industry structure can find themselves categorized in ordered webs of competitive relationships, but they can also transfer socio-cognitive attributes to other firms they interact with. In a series of studies conducted in the biotech and semiconductor industries, Stuart and colleagues argue that organizations suffering from certain disadvantages like smaller size, young age or low status benefit from their association with larger, older or high status partners. When the structural interaction with other firms in an industry allows the access to the market or more in general the performance of typical activities, we can expect that a positive externality emerges between populations, reciprocally increasing their social acceptance and chances of survival. This is also the case for buyers and suppliers who perform sequential activities that require structural coordination to function. The presence of buyers should benefit suppliers, and vice versa. Accordingly, we propose:

Hypothesis 4.1 Density of suppliers is negatively related to exit rates of buyers (controlling for intra population density-dependence)

Hypothesis 4.2 Density of buyers is negatively related to exit rates of suppliers (controlling for intra population density-dependence)

The mutualism we expect to observe between buyers and suppliers may vary with density levels or some organizational attributes. Organizations in either population may not benefit from high density in the other population because of at least two reasons. First, in the presence of limited and partially overlapping resources, the proliferation of one population at the expenses of another interdependent population may produce community-level imbalance. Different populations in a community depend to a certain extent to common resources that need be allocated among them: there are resources that social actors are willing to give to an industry in relation to the actual or prospective relevance that it possesses. The different populations that engage in activities within this industry may saturate resources in ways that displace each other. The second reason for a varying relationship between cross-population density and organizational survival is related to the use of information. When the number of potential partners with which to interact in vertical transactions increases substantially, firms may be better off because they will have more potential alternatives to choose from. In reality, the development of a social structure of relationships between firms belonging to different populations tends to reduce the actual availability of alternatives (Stuart 2000). When firms develop positions in socio-economic relationships, they are at the same time restricted and protected by their networks. Higher density in the interdependent populations may not translate into actual options, and moreover time and resources need to be employed in searching and establishing new relationships. In addition to this, the structure of ties between populations can be weakened by the proliferation of firms in either population – for instance, key personnel may flow to new firms and generate uncertainty about what tie a firm should maintain. Together, these two reasons lead us to develop the following:

Hypothesis 4.3 High density of suppliers is positively related to exit rates of buyers (controlling for intra population density-dependence)

Hypothesis 4.4 High density of buyers is negatively related to exit rates of suppliers (controlling for intra population density-dependence)

The imperfect process of allocation of resources between populations can be reflected by variations not only in density, but also in mass. When a population grows in size relative to another with which it shares part of its resources, their competitive interaction can be affected. Barron (1999) argues that larger organizations have generally a survival advantage, making them more robust in the face of intense competition because they can reduce their dependence on the environment. Large firms possess slack resources, can have cheaper access to external resources, and exercise stronger bargaining power. If large organizations have a survival advantage, the increasing density of stronger organizations may reduce the viability of the organizations in interdependent populations. First, large organizations can take up resources freed by the failures of other (smaller) firms and exacerbate the displacement process described above. Second, the increase in density of larger organizations in the interdependent population also limits the possibility to find alternative partners or obtain better transacting terms, resulting in a reduced performance. Hence, we propose:

Hypothesis 4.5 Exit rates of buyers increase with the combined effect of density and average size of suppliers (controlling for intra population density-dependence)

Hypothesis 4.6 Exit rates of suppliers increase with the combined effect of density and average size of buyers (controlling for intra population density-dependence)

To explore more directly the contacts between buyers and suppliers and their effects on exit rates we focus now on three specific relationships. The first concerns the actual (rather than potential) number of suppliers that a buyer deals with. For buyers, increasing numbers of suppliers imply less specialized associations with each one of them (controlling for size): in general, this means less restrictions in transaction patterns and less dependence from single suppliers. Suppliers will in fact be less likely to exercise their economic power in the presence of actual alternative partners. Accordingly, we propose:

Hypothesis 4.7: The number of suppliers (with which they engage in transactions) shows a negative relationship with exit rates of buyers

However, the effects of buyers' relational density with suppliers are dependent on the characteristics of transacting partners (Stuart et al 2004). A simple way of looking at the different ways in which heterogeneity in organizational attributes may influence interactions between populations, and eventually their vital rates, includes information on scale and scope. We already started to analyze the relationship between size of suppliers and exit rates of buyers. Larger firms are more likely to survive longer, also because the expected success of a firm's product offer increases as the number of products increases (Sorenson 2000). The superiority of larger suppliers translates into stronger power they can impose on their partners. The larger are the suppliers, the weaker is the position of buyers. This is especially true when considering the partner that each buyer has engaged most transaction with. Hence, we hypothesize:

Hypothesis 4.8: The size (number of products) of the first most important supplier has a positive relationship with exit rates of buyers

Similarly, other advantages to suppliers do not come only from size. When their scope of products ranges wider, firms develop experience in more market segments. In principle a wider organizational scope reduces survival chances because entering new segments implies higher risk of failure (Sorenson, McEvily and Roy 2003). The adoption of a portfolio strategy that encompasses wider scope, however, may be beneficial in situations of environmental uncertainty. When demand is uncertain and/or volatile firms that attain a broader, more general scope can be protected from uncertainty – some of their products may fail, but the probability that all of them fail simultaneously decreases with the number of segments their products are targeted to. The advantage of generalism over specialism in the presence of environmental variation (Thompson 1967, Hannan and Freeman 1977, 1989) is justifiable when uncertainty concerns more the distribution of successes among segments than the absolute prevalence of one segment over the others - . This inter-segment allocation, finally, can be reversible. When a supplier firm operates with a wider scope against uncertain conditions, its survival advantage can be played against buyers it interacts with. In accordance with the evaluation of organizational scope and uncertainty relative to survival, we propose:

Hypothesis 4.9: Scope of the first most important supplier has a positive relationship with exit rates of buyers.

4.4 VERTICAL INTERDEPENDENCE BETWEEN PRODUCERS AND DISTRIBUTORS OF FEATURE FILMS AND ITS EFFECTS ON EXIT RATES IN THE U.S. MOTION PICTURE INDUSTRY[1]

4.4.1 The motion picture industry in the United States

In this section I present a brief description of the industry where the empirical investigation of vertical interdependence effects on entries is applied. The development of the feature film in the United States can be dated to 1912, following the appearance of longer European films on American screens. At the same time, the industry underwent a reorganization phase after the federal intervention that dismantled cartels controlling key patents. With the introduction of features, most of the companies involved in the production, distribution, and exhibition of short films went out of business. Feature films were long, elaborate multi-reel pictures that required longer production processes and higher investments (Staiger 1983). The feature film was a more differentiated product than shorts, and such a differentiation modified price and promotion policies in the distribution sector. The industry adopted the star system as a signaling strategy to make audiences aware of elements of differentiation and stimulate their interest in the products (Bordwell et al. 1985, Kerr 1990). The feature film also generated a series of transformations in the exhibition sector. First, it required longer runs in theaters to recoup their high production and distribution costs. Second, it induced a more definite differentiation in specialized theaters, sustaining different price policies and program run releases for each film (Koszarski 1990). In the same decade, the need to provide regular supply of products to a growing market arguably led to the relocation of productive operations from New York to Hollywood, where favorable climatic conditions allowed a more efficient organization of film production (Huettig 1944).

[1] This section is adapted from Section 2.5.

Feature films are complex products that face uncertainty for two reasons. One is associated with the output of the production process involving sunk investments and sequential use of heterogeneous inputs (Caves 2000). The other is associated with the difficulty of predicting product performance (De Vany 2004). In the early history of the feature film industry costs and risks associated with the production and marketing of feature films were significant, and coordination between the process of production and distribution was essential. Since 1918 several firms adopted a vertically integrated structure, and film production, distribution and exhibition were progressively internalized within hierarchical organizations. During the second half of the 1920's a group of integrated firms, called majors (Paramount, Loew's, Fox, Warner Bros, RKO) became dominant players in the industry (Balio 1985).

Sound was the most important technological innovation in the industry following the introduction of features. In 1925-26 in the United States three systems proved viable and were initially distributed with some success: the "Vitaphone", the "Movietone", and the "Photophone". The first system, which utilized either sound on disc or sound on film devices, had been developed by Western Electric Company (WE) through Bell Telephone Laboratories and was licensed exclusively in 1926 to Warner Bros. Company, a second rank production and exhibition company that acquired Vitagraph's studio and exchange structure. The second system, which used sound on film, had been designed by Case in de Forest's laboratory, and was incorporated by Fox Film Corporation and first exhibited in early 1927. The third, a sound on film system, was presented in late 1927 by RCA. Innovation in sound was indeed channeled in the industry through minor or external companies (Crafton 1997).

The introduction of sound required heavy investments to convert studios, and affected the filmmaking process. Equipment became more sophisticated and elaborate, for instance incandescent lighting substituted for arc lamps, cameras had to be silenced. Film companies became more dependent upon specialized hardware manufacturers and technical personnel needed more training. On the creative side, the integration of image and sound transformed scripting technique; many actors were not able to adapt their competence to talking performance, and editing required new specific capabilities. It was estimated that in 1929 over 65 million dollars were invested in the construction of more than 100 new sound stages, with the addition of more than 5,000 new employees to the studios.[2] Production costs tended to rise sharply. In 1920 the average silent film had a production budget that ranged from $40,000 to $80,000, while in 1929, the average cost rose from $200,000 to $400,000 (Conant 1960). In exhibition, theaters affiliated with the Majors initially adopted the more expensive WE apparatus. When at the end of 1928 the different systems were made compatible and WE allowed that licensed producers could furnish products to any theater, the conversion became very rapid and more competitive. In 1930, theaters wired by the WE were about 5,000, while theaters supplied by systems other than WE were more than 8,200 on a total of 18,000, in rapid increase from the 4,800 of the previous year (Crafton 1997).

The effects of the economic depression struck the industry in late 1930. Weekly attendance declined over 30 per cent to less than 60 millions: more than 4,000 theaters were closed in three years, and ownership became more concentrated. The inauguration of the National Industrial Recovery Act was accompanied by the definition of a Code of Fair Competition for the industry. The Majors played an essential role in administering the code authority: in fact, the use of unfair commercial

[2] Major producers' reluctance to adopt the new technology seems justified by the cost of conversion. The estimated 65 million dollars invested in 1929 were significant when compared with 110 millions of total studio investments estimated for the period 1925-1930. In *Motion Picture Almanac*, 1931, 71.

practices favored collusion in the different branches of the industry (Conant 1960). During the 1930's, the Majors produced and distributed over 50 per cent of all domestic features. Since the market could absorb around 400 films per year, a single organization was not large enough to produce internally sufficient output to saturate their distribution organization and the capacity of its own theater circuit, and depended on the external supply of other majors and independent producers. Competition continued in the distribution of independent productions for the first-run market, for later-runs and for inputs (primarily stories and stars) (Balio 1985).

After the Second World War two main events affected the organization of the industry (Gomery 1986). In 1948, a decision by the Supreme Court in the "Paramount case" found the eight largest organizations guilty of reducing competition in the market, and forced them to end the use of commercial tying practices. The court decision imposed the separation of the five majors into production/distribution business on the one side, and exhibition on the other side. Approximately one half of the over 3,100 theaters they owned had to be divested (Conant 1960). Second, in early 1950s the commercial success of television as an alternative entertainment medium had negative effects on the consumption of motion pictures in theaters.

Since 1948, the demand for motion pictures decreased regularly. Attendance from 98 million in 1946 dropped to 65 million in 1950 and to 44 million in 1955. In the same period, box office receipts decreased to 717 million dollars (-26%) (Izod 1988). Releases by major companies diminished over 50 per cent. The impossibility of securing a market for their output, and the reduction of demand caused a general decentralization of the production sector (Storper 1989). Independent producers and specialized service firms proliferated, while majors retained part of their production in their studios, but have focused on controlling distribution and film financing. The organization of production is more flexible and fragmented, based on individual initiatives (Bordwell et al. 1985). Producers finance and manage projects like packages: inputs, including creative talent, are not under long term contracts with producers, but are available on the market and assembled for single deals through the coordination of agents (Paul and Kleingartner 1994).

By the mid-1950s television has become an important secondary market for the distribution of films (Hilmes 1990). In this environment, the primary market of theaters diminished in economic relevance, because it did not represent the only source of revenues; however, it maintained a strategic value because box office receipts are likely to affect the subsequent performance of the film. Second and subsequent runs in exhibition disappeared, also affecting distribution. The Majors lost part of their bargaining power in the market for creative inputs and films, but their investments in international distribution networks and marketing activities represent a powerful source of advantage (Caves 2000).

4.4.2 Research design and data

The populations analyzed in this study are motion picture producers and distributors. Consistent with previous research in the same industry (Mezias and Mezias 2000, Jones 2001, Mezias and Kuperman 2001) they identify distinct organizational forms and a bounded, self-contained industry system (Hannan and Carroll 1992). The organizational populations studied here have been systematically interacting with each other. Producers supply their most important output to distributors, and distributors use producers' output as their primary input for their activities. Other important interactions include production financing on the part of distributors and the allocation of the box office obtained through exhibition or secondary markets. Industry historians and analysts have repeatedly noted that the performance of organizations, as well as the diversity of products is directly connected to the interactions between the main branches of the industry (Huettig 1944: 58, Balio 1985: 254, Conant 1960: 6).

Producers are responsible for the operations aimed at the actual making and delivering of the first copy of the film. The making of the first copy of the film is the necessary requisite for the reproduction process which generates the product's copies that are marketed on the screens. Production involves the deployment of several inputs, either of creative or of technical nature, and also the sinking of considerable capital investment. Distributors are responsible for the reproduction of the first copy of the film destined to be screened in movie theaters. In this activity, distributors are responsible for the management of the physical output, but also of the marketing initiatives, revenues collection and the allocation of payments to the producer and other possible profit participants.

Exit from the market is the observed events in this study because no available source provides systematic information about disbandings for this industry. The definition of relevant exit events centres on the dates in which films are released. Producers enter the population when their first film is released in the market and exit when their last film is released. Likewise, distributors enter when the first film they commercialize is released and exit when the last film they commercialize is released. Events are recorded at the exact dates. To study exit rates in the two populations, a modification of the sample populations was necessary. Entry and exit events are based on the same date, the release of films. When producers and/or distributors engaged in the realization of only one film over their organizational life, the two dates coincide.

This simultaneity can create a bias in the estimation or make it impossible. To overcome this problem, we decided to limit the analysis to firms that either produced or distributed at least two films so that the time they spent in the industry cannot be equal to zero. Still, some cases remain problematic. In 24 cases of producing companies and 21 cases of distributing companies we found that entry and exit dates overlapped despite the fact that they released more than one film. In these cases, we decided to carry over their exit date to the following month, artificially extending their organizational life across two observations. The summary statistics for the two populations indicate that the distribution of mean, median, and percentile duration time in the risk set are not significantly affected (the inter-quartile survival time for producers are: 2.91, 7.72, and 17.88 for producers; the 25^{th}, median, and 75^{th} values for distributors are 2.66, 7.83, and 18.37). The final dataset comprises 1,451 producers and 658 distributors.

The general approach is consistent with previous research in organizational ecology (Hannan and Freeman 1989, Hannan and Carroll 1992, Carroll and Hannan 2000), and with existing studies made in the same industry (Mezias and Mezias 2000, Mezias and Boyle 2002). The period of observation is from 1912, the year when the first U.S. feature film was released in its domestic market, to the end of 1970, the last year covered by the main data sources. To conduct my study I follow established practice in organizational ecology (Carroll and Hannan 2000) and adopt a combination of sources. The first source is the *American Film Institute Catalog of Motion Pictures* (AFI), which collects reviews of all motion pictures distributed in the US between 1893 and 1970 and provides detailed information about each film using the same compiling methodology. The AFI Catalog is considered a source of high quality and comprehensiveness (Mezias and Mezias 2000); however it presents two problems: it comprehensively lists all short films released between 1893 and 1910, and all feature films released in the periods 1911-1950 and 1960-1970, but has not yet documented feature films produced between 1951 and 1960. To overcome the problems in the AFI catalog, we relied on: *Feature Films 1950-1959: A United States Filmography*, a reference text edited by A. G. Fetrow reviewing 3069 features from the previously missing period; the *Motion Picture Catalog of the Library of Congress 1950-1959*, which provides a list of films receiving copyright protection along with production entities and copyright entry dates; and the *Motion Picture Guide 1927-1982*, a 12 volume reference set edited by J. R. Nash and Stanley R. Ross. These three publications combined provide accurate information that complements nicely the data unavailable from AFI for the decade 1951-1960. Additional sources including industry almanacs like *Motion Picture Year Book*, trade journals like *Moving Picture World*, have been employed to supplement information when unclear, e.g. repeated titles in the same or next year. Films produced and released for non-commercial purposes like those managed by government institutions, as well as imported films, are excluded from the dataset. When pictures are international coproductions, I included only those in which an American producer was majority stakeholder.[3]

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[3] This information could be inferred in two ways: the review mentioned how the production was organized, and the nationality of the company investing more in the film is ranked first.

cases remain problematic. In 24 cases of producing companies and 21 cases of distributing companies we found that entry and exit dates overlapped despite the fact that they released more than one film. In these cases, we decided to carry over their exit date to the following month, artificially extending their organizational life across two observations. The summary statistics for the two populations indicate that the distribution of mean, median, and percentile duration time in the risk set are not significantly affected (the inter-quartile survival time for producers are: 2.91, 7.72, and 17.88 for producers; the 25th, median, and 75th values for distributors are 2.66, 7.83, and 18.37). The final dataset comprises 1,451 producers and 658 distributors.

4.4.3 Methods

To test empirically the hypotheses of the effects of interactions between the two populations of producers and distributors on exit rates, we follow the conventional strategy in ecological research of employing event history modeling techniques (Allison 1984, Blossfeld and Rohwer 2002, Cleves et al. 2004). Each organization in the population has some chance of exiting at any time during its tenure, i.e. from the moment it entered the market, so the clock regulating the occurrence of the event is the tenure itself. The occurrence of the event of interest, in this case exit from the market, is controlled by an instantaneous hazard rate. The hazard rate is defined as

$$\lambda(t) = \lim_{dt \to 0} \frac{\Pr\{t < T \leq t + dt | T > t\}}{dt}$$

where T is a random variable for the time of the event of interest, t is the time that an organization in the focal population has existed, and P(.) is the probability of the event occurring over the interval [t, t+t] given that the firm existed at the beginning of the interval.

There are different solutions in estimating hazard rates. A basic distinction involves the definition of parametric and non-parametric models. The former specify the relation between hazard rates and the explanatory variables including time. The latter do not specify such relation (Yamaguchi 1991). Parametric models make strong assumptions about the shape of the hazard function, while non-parametric models make none. Sometimes an in between approach is more appealing, in which models fit a semi-parametric hazard. Among semi-parametric models, the piece-wise constant exponential model is the model most commonly used in a continuous time framework. The hazard is assumed constant within pre-specified survival time intervals but the constants may differ for different intervals. The piecewise-exponential specification is estimated by maximum likelihood, and shows advantages over other semi-parametric specifications because it accommodates non-proportionality of the effects of tenure and covariates, does not require strong assumptions about the exact forms of duration dependence but provides information about duration dependence (Hannan et al 1998, Carroll and Hannan 2000). Although past research strongly supports age-dependence in organizational mortality rates, the form of age-dependence varies widely. The use of a piece-wise exponential model represents a flexible strategy for modeling duration-dependence in mortality/exit models.

The piecewise constant exponential model estimates the transition rate from entry to exit as:

$$r(t) = \exp\{\alpha_l + A\alpha\}$$

where α_l is a constant coefficient associated with the l_{th} time period, A is a vector of covariates measuring firm-specific variables other than age, and also population and environmental characteristics, and α is the associated vector of coefficients. For the analyses of exit rates, the time axis is based on industry tenure of organizations, and the exact time pieces were determined for each of the two populations according to exploratory study of best-fitting baseline models. The estimation of the model uses maximum likelihood techniques is implemented with user-defined routine for *STATA*, Release 6 (Sørensen 1999). To estimate rate models with time-varying covariates, we constructed split-spell data breaking observed durations in year quarter-long periods with the values of covariates updated every year. The number of organization-spell observations is 21762 for producers and 10326 for distributors. Figures 4.1 and 4.2 provide descriptive histograms of the distributions of exits for the populations of producers and distributors in the observation period. Figures 4.3 and 4.4 depict the nonparametric estimates of, respectively, the cumulative hazard and survivor functions for distributors.[4] Consider, for instance, Figure 4.3: it can be observed that the cumulative hazard rises sharply at small durations and then flattens out. The duration dependence is negative (as the time since the previous exit increases, the exit rate declines).

Insert Figures 4.1-4.4 about here

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[4] We do not report the same estimates for the population of producers – their patterns are even more pronounced.

4.4.4 Variables

For the analyses of firm exit, the "dependent variable" is the hazard rate, or the limit probability that an organization exits the industry in a given year-quarter conditional on the fact that has survived until that time since its entry. Firms can exit industries in different ways, including disbanding, bankruptcy, merger, acquisition, etc. In this study we were able to control the actual exit from the product market and its cause for most cases.

The key explanatory variables for the analyses of exit rates are measures of density and mass similar to those described for the analysis of entry processes in the previous study. We use the first and second order population density measures constructed using moving averages of 12 month lag because it is hard to motivate that entry is exactly explained by the competitive situation of 12 months before. The choice of the lag interval is justified by the knowledge that the production and distribution processes in the motion picture industry require set up and organization prior to actual operation. An average 12 month of pre-entry organization is also indicated by industry experts as an appropriate time span (Vogel 1998, Squire 1992). It is also true that the time and costs associated with starting activities in the motion picture industry have changed over the observation period, e.g. starting up in silent production was generally faster than a sound production because studios did not need more sophisticated equipment for soundproofing, and casting also did not need to evaluate the actors' voices (Bordwell, Staiger and Thompson 1985). For the analysis of exit rates of distributors we add three variables addressing more direct observation of effects of interdependence. We include: a relational density measure of the number of independent (i.e. other than self) producers supplying films to each distributor; a measure of scale, calculated as the percentage of output volume supplied by the single most important producer (calculated in number of films); a measure of relative scope, calculated as the ration between the number of film genres in which the most important producer operated and the output volume supplied by the most important producer.

In addition, the study of mortality/exit event requires the introduction of specific mechanisms of age and size dependence. The debate concerning the effects of aging on organizational mortality is still open and rather than positing a particular type of liability, we include in all models specifications for firm tenure in the industry. We chose to represent temporal variation in transition rates breaking the time dimension of age into seven pieces: the first ranges from zero to the minimum stay in the industry (0 to 1 quarter); the second ranges from the minimum stay to a season presence in the market (1 to 4 quarters); the third goes from the minimum season presence to a minimum continuous presence (4 to 8 quarters); the fourth ranges from the minimum continuous presence to a minimum sustained presence (8 to 20 quarters); the fifth and sixth include tenures from five to ten years and from ten to twenty-five years (20 to 40 and 40 to 100 quarters); the seventh includes tenure longer than 25 years (more than 100 quarters).

Concerning size-related liabilities, we follow a similar but simpler approach. Research on age-varying size and life chances has conceptualized and measured organizational size in two ways: capacity and scale of operations (Barron et al. 1994, Carroll and Hannan 2000). We follow the previous research on these populations and concentrate on scale of operations, and we measure it in terms of a firm's annual production or distribution of feature films automobiles. This measure is available more regularly than accounting measures of performance, and it proves more reliable. Producers and distributors engaged in more projects diversify the market risks and reduce part of the uncertainty that characterize the industry (De Vany 2004). By adopting a portfolio strategy organizations may survive longer. Moreover, distributors may benefit from a more efficient use of their commercial network when grow larger. The general prediction here is that exit has a negative size-dependence. Finally, we include the measure of density at entry to account for density delay effects (Carroll and Hannan 1989b, Swaminathan 1996). Higher density at the time of entry implies a resource-scarcer environment with deleterious consequences on the life chances of organizations, either during all its tenure or at different points in time.

In estimating the exit models, we incorporated some control variables. We included a measure of industry concentration to control for the partially alternative explanation of resource partitioning in the two populations (Carroll 1985, Carroll and Swaminathan 2000). The Hirschman-Herfindahl index (HHI), a commonly accepted measure obtained by squaring the market share of each firm operating in the market and then summing the resulting numbers, is the concentration measure chosen for model estimation. The absence of partitioning would generate a positive relationship between concentration and exit rates.

Box office sales for movies generally do not show very responsive changes in ticket prices per se, rather there is sensitivity to the total cost of movie-going, which can include fees for babysitters, restaurant meals, and parking (Donohue 1987). Although demand for movies, especially for those backed by strong word of mouth, advertising and reviewer support is essentially price inelastic, exhibitors are often able to stimulate admissions by showing older features at lower prices during off-peak times. Average dollar ticket prices adjusted for inflation are included as a first control for this indirect measure of carrying capacity. Increasing average prices should reveal a more attractive niche for producers and distributors, or reveal more differentiable consumption patterns that stimulate entry.

Theaters have been the only outlet for motion pictures until secondary markets like television or home video emerged. Industry directories on the exhibition sector provide annual data on the number of operating screens in the country. Absolute number of screens is included as a capacity measure that may affect entry rates in the analyzed populations. This measure, however, is a rough proxy for actual capacity. The number of screens is more likely to show a relationship with the number of films released or organizational size, rather than entry rates. Industry experts suggest that the number, location and ownership of first run theaters as primary sources of profits matters more than general capacity in influencing industry structure (Huettig 1944, Conant 1960, Kindem 1982). Disaggregated data of that type, however, are not unavailable from the sources for this study.

Total attendance calculated in millions of spectators is included as a measure to represent social demand for movies. Over the observed period motion pictures went from a widely popular entertainment form (1912-1946) to a less relevant amusement alternative. After the Second World War, attendance declined systematically despite the growth in population. Alternative forms of outdoor and home entertainment like spectator sports or television gained popularity reducing consumption for motion pictures in theaters (Dimmick and Rothembuhler 1984).

Before film producers and distributors recognized the potential of the new market, television was considered as a competitive threat, responsible for the decline of movie attendance in theaters after 1946 (Monaco 2000). The diffusion of television among households coincides with the progressive retrenchment of motion picture consumption; on the other hand the success of television implied an increasing demand for programs. After 1955, film companies began to distribute intensely the rights to their libraries, and organized production initiatives targeted exclusively to the television audience (telefilms and series). In this way, they had a larger market for the amortization of their investments in film production and a higher utilization rate for their facilities. The percentage of national households owning at least one TV set provides a measure of additional capacity for feature film producers and distributors.

We include additional dichotomous variables to control for changes in the industry environment, a fact that may influence entry and exit rates in the industry. Two contextual variables were created for the years of World War I and II. Three other variables capture more industry-specific effects. The first two address the consequences of antitrust intervention. Beginning in late 1930's, the Justice Department began to issue court orders to reduce the pattern of vertical integration that major organizations had undergone for more than a decade. The constructed variables cover the years 1938-1940, and the years from 1948 to 1970; these are the periods in which the antitrust litigations of the "Paramount" cases, in which the Majors were found guilty of anticompetitive behavior, may have produced effects on the industry's structure (Litman 1998). Particularly, in 1948 the second Paramount court case ended with an order enforcing vertical divestiture of exhibition from production and distribution; actual divestiture would not be completed until 1957 but was enforced until the end of the observation period (Conant 1960). Finally, a dummy variable controls for periods of different technological standards, silent and talking. In general, the production and distribution of talking pictures was more elaborate and costly, and entry in the industry should have been easier ceteris paribus with the silent standard. Tables 2.1.a and 2.1.b contain the descriptive statistics of the covariates used in the models, while Tables 2.2.a and 2.2.b provide the bivariate correlation matrices.

Insert Tables 1.1 and 4.2 about here

4.5 FINDINGS AND DISCUSSION

This section presents the results of the empirical analysis. From 1912 to 1970, 1,417 producers and 600 distributors (each having produced or distributed more than one feature film) exited the industry. Table 4.3 contains the piecewise constant estimations of exit rates of feature film producers. Model 1 includes a baseline specification of age and size dependence, in addition to industry controls and periods. The results of age dependence indicate a negative relationship, decreasing only at very high tenures. We find evidence of negative and significant size dependence. An unexpected result is the negative impact of concentration on exit rates.[5] This would support the partitioning argument whereby higher concentration reduces mortality rates among specialist firms. We advise come caution on the interpretation of this relationship: De Vany (2004) argues that there is little theoretical and empirical justification in employing concentration measures to evaluate the competitive situation in the motion picture industry. In fact, market shares based on output or box office results are influenced by nonlinear dynamics based on information cascades that make it impossible to predict which movie or studio will be the winner and for how long. Market shares follow a Pareto-Levy distribution with infinite variance, where there are sudden reversals among the ranks of the leading firms and deep

[5] For the discussion of other controls and periods, for which we obtain analogous results, see Section 2.6.

plunges and extreme rises in shares over time. However, we are left with an asymmetric influence of concentration on vital rates of the two populations under analysis. Our previous study on entry rates indicates that concentration reduces entry, consistent with the absence of resource-partitioning processes. This result is reversed here. Future research will have to determine whether different mechanisms govern entry and exit rates in the industry, particularly whether density dependence and/or segregating processes interact to regulate organizational evolution.

Model 2 adds to the baseline specification the density variables including delay. The model fits the data better than the previous one ($\chi^2 = 2[L2 - L1] = 62.97$ with p-value < .001 for 3 d.f.), and shows the expected negative-positive relationship between linear and quadratic densities with exit rates. We find general support for the basic density dependence mechanisms; however, density delay has negative impact on exit rates. High density at founding does not reduce life chances of organizations but increases them. High density may reflect existing opportunities in the niche despite crowding. Model 3 incorporates community interactions in the form of cross-density relationships. While the intra-population processes are almost equivalent to those obtained under Model 2, producers do not seem to be significantly influenced by legitimation or competition emanating from the distributors' population. This result does not support Hypotheses 1 and 3, and although unexpected, sheds more interesting light on the complex systems of relationships that form around these populations. Community-level effects are in fact present for entry rates, but not for exit rates. Model 3, however, does not improve explanatory power relative to Model 2 ($\chi^2 = 2[L2 - L1] = 1.72$ with p-value = .4240 for 2 d.f.).

Model 4 adds a simple mass specification to double density dependence. Mass of distributors increases exit rates of distributors, despite the absence of inter-population effects based on density. The mass of a population appears to actually damage life chances of organizations in the other. Competitive intensity in the industry influencing exit rates may be based more on bargaining power dynamics than diffuse competition. This result is also interesting because the empirical study in Chapter 2 indicates the absence of mass dependence at the population level. Model 4 fits the data better than both Model 2 and 3 (respectively, $\chi^2 = 2[L2 - L1] = 22.21$ with p-value < .001 for 3 d.f., and $\chi^2 = 2[L2 - L1] = 20.50$ with p-value < .001 for 1 d.f.). The two final models include the extension at the community level of the main specifications of Barnett (1997) and Barron (1999). Model 5 adds to Model 4 the age and age x size effects to verify the possible effect between exit rates of producers and survival advantages of distributors. Model 5 obtains results very similar to those of Model 4, but sacrificing two more degrees of freedom – the LRT indicates that it fails in sufficiently improving explanatory power ($\chi^2 = 2[L2 - L1] = 2.32$ with p-value = .3142). Model 6 tests directly Hypothesis 6. The combined effect of density and size of distributors increases exit rates of producers. Larger and more distributors represent a potent population to deal with for producers, who do not seem to benefit from the availability of more buyers more than suffer from their increased power. While Model 6 fits the data better than Model 2 ($\chi^2 = 2[L2 - L1] = 20.87$ with p-value < .001 for 3 d.f.), a model evaluation based on information criteria, which accounts for both efficiency and parsimony, does not produce a similar result. BIC values for Models 2 to 6 are: 4718.74, 4737, 4726.492, 4744.153, and 4727.831.[6] A simple explanation of exit rates of producers based on intra-population processes is not more incomplete than one including the effects of interaction with distributors.

[6] Unreported values of AIC in Models 4-6 are better than AIC for Model 2.

Table 4.4 presents the piecewise constant estimations of exit rates of feature film distributors. Model 1 represents a baseline specification with periods and controls. Differently from the analysis of producers, the measures of carrying capacity show significant explanatory power. The number of screens has a negative effect on exit rates, indicating a mutualistic relationship between the distribution and the exhibition sectors. The mutualistic association of the two sectors is supported also by the negative relationship between ticket price and exit rate, indicating that higher prices support a longer survival of distributors by increasing their performance. A similar effect exists between television and distribution. Model 2 adds density dependence and density delay to the baseline specification. First order density reduces exit rates, while second order density increases it, as posited by the theory. The effect of density at founding is positive but non significant, and does not find support in the data. Despite this, we will retain the term in the next models based on theoretical terms (at least we control for it as a main explanation for decline in density). Overall, the specification improves the explanatory power over the baseline model ($\chi^2 = 2[L2 - L1] = 31.38$ with p-value $< .001$ for 3 d.f.).

Model 3 introduces the inter-population effects with the linear and quadratic density terms from the producers' population. When we include the terms for interdependence between populations in the model, density dependence dynamic within the population reverses. Linear density of distributors turns negative and quadratic density turns positive. The density terms of producers, instead, show a negative-positive relationship with exit rates of distributors. While the presence of suppliers may help legitimize the population of buyers, the presence of other distributors induces competitive processes – when suppliers are few, other buyers can "steal" them away. When density of suppliers increases, their proliferation may require search costs and time that actually reduces performance of buyers. An increase in the number of buyers themselves, however, may mitigate this expensive selection process by increasing actual matching between the two populations and contributing to the structuration of the community. Model 3 supports hypothesis 4 but not hypothesis 2, although the control for density dependence within the population has produced unexpected results. The specification fits the data better than simple density dependence $\chi^2 = 2[L2 - L1] = 36.89$ with p-value < .001 for 2 d.f.).

Models 4 and 5 introduce mass dependence in addition to inter-population density effects. Model 4 specifies Barnett's analysis of survival advantage. The results confirm the reversed mechanism of density dependence of the previous specification, while the inclusion of age and size effects of the producers' population only show a significant negative relationship between mass and exit rates. The result is similar to that obtained in Model 4 of Table 4.4. Increasing size of producers seems to reduce survival of distributors. Model 4, however, does not fit the data better than Model 3 ($\chi^2 = 2[L2 - L1] = 8.30$ with p-value = .0401 for 3 d.f.). Model 5 tests hypothesis 5, but estimates support very weakly the positive relationship between the interaction of density and size of producers and exit rates of distributors. Not surprisingly, Model 5 does not improve fit with respect to neither Model 4 ($\chi^2 = 2[L2 - L1] = 5.95$ with p-value = .0510 for 2 d.f.) nor Model 3 ($\chi^2 = 2[L2 - L1] = 2.35$ with p-value = .1253 for 1 d.f.). Mass dependence between populations does not seem to add to processes of density dependence found in Model 3.

Models 6 to 8 analyze the impact that actual interaction between organizations in the two populations should generate on exit rates of distributors. Model 6 focuses on relational density and add to the specification of Model 3 a variable capturing the effect of the number of independent (i.e. arm's length) producers that have supplied each distributor. Exit rates of distributors show a negative dependence on the number of producers, possibly implying that less specific associations with single suppliers reduce risks of exit from the population (controlling for size of distributors that is not significant anymore). Model 6 supports hypothesis 7 and improves statistical fit over Model 3 ($\chi^2 = 2[L2 - L1] = 30.27$ with p-value < .001 for 1 d.f.). Model 7 investigates a relationship complementary to relational density, how important is the scale of the first most important supplier. The higher the number of films supplied by this producer, the higher the exit rate of the distributor (still controlling for distributor's size). The scale effect is significant, but the model does not fit the data better than the inter-population density dependence specification ($\chi^2 = 2[L2 - L1] = 1.27$ with p-value = .2602 for 1 d.f.). In additional analyses we conducted, and for which we do not report results, similar patterns are obtained when we consider the second most important supplier as well, separately or in conjunction with the first.

Finally, Model 8 tests the effects of suppliers' scope on exit rates of buyers (hypothesis 9). A wider scope of the main supplier, measured by the number of film genres in which the producer engaged, increases exit rates of buyers (controlling for buyers' size that now significantly reduces exit). The scope measure is a ratio net of number of films produced by the supplier, describing the strategy adopted by feature film producers. The positive effect on exit rates seems interesting also because scope actually reduces exit of producers themselves. A wider scope protects against market risks in an uncertain environment; however, this advantageous strategy reduces performance of organizations they interact with. The reason for this asymmetry likely goes back to strategic issues of leveraging bargaining power. Overall, Model 8 increases explanatory power over Model 3 ($\chi^2 = 2[L2 - L1] = 53.51$ with p-value <

.001 for 1 d.f.); also, information measures strongly support the selection of this specification against any other model in the set.[7]

[7] AIC for Models 3-8 are, respectively: 1974.327, 1972.023, 1973.977, 1946.059, 1975.059, and 1922.815; BIC values are: 2133.66, 2153.084, 2140.552, 2112.635, 2141.635, and 2089.39.

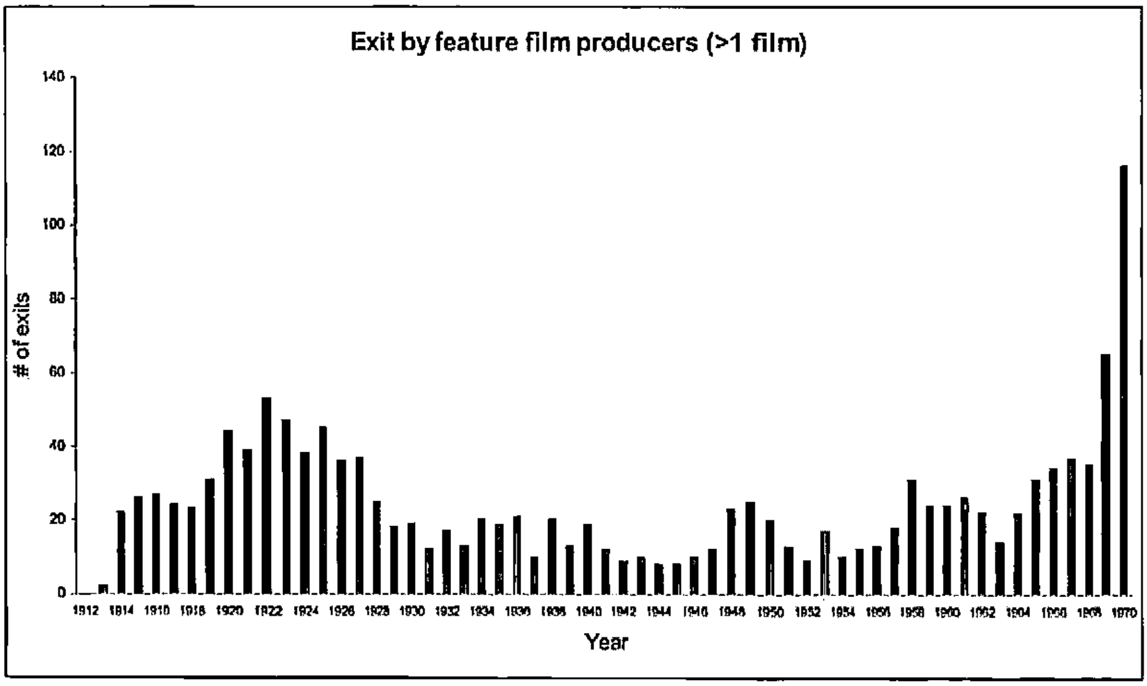

Figure 4.1 Annual exits of producers (of more than one feature film)

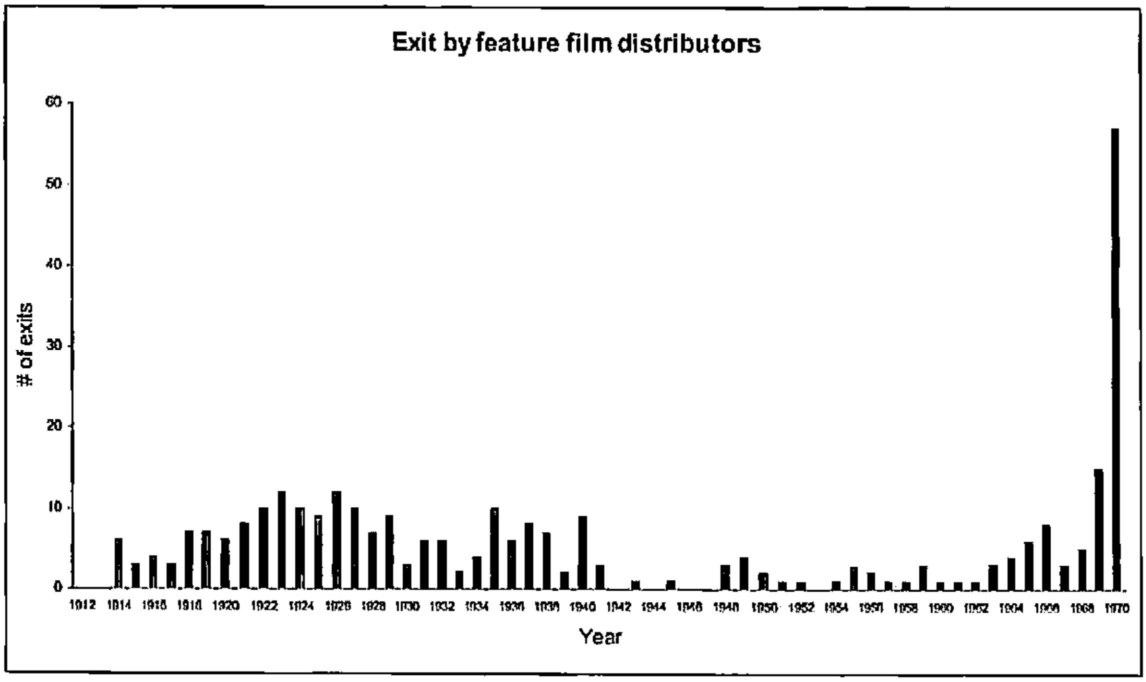

Figure 4.2 Annual exits of distributors (of more than one feature film)

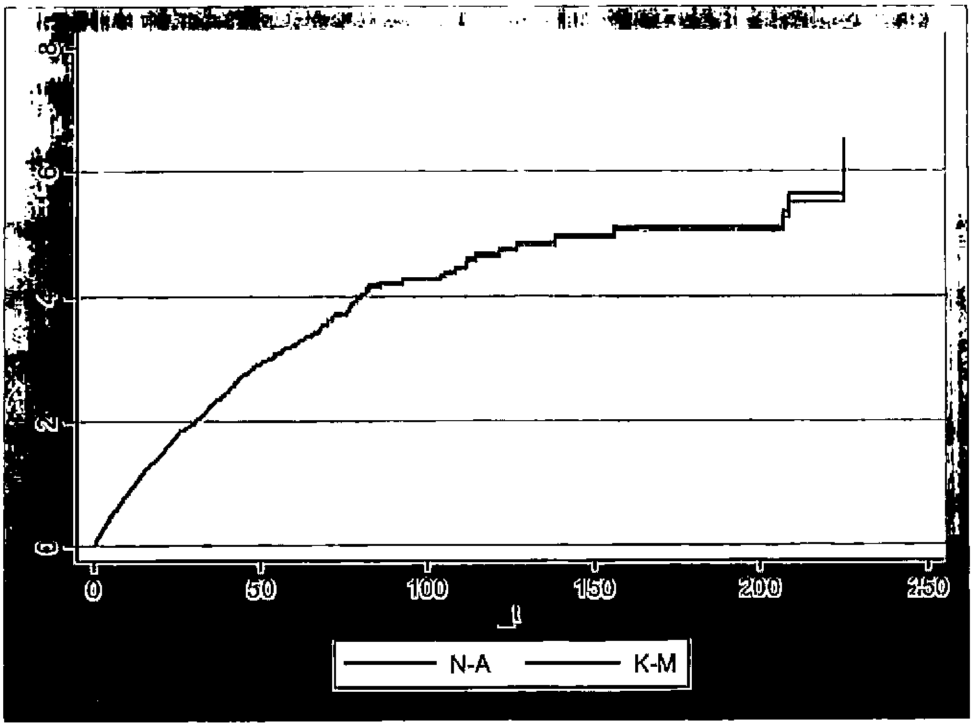

Figure 4.3 Nonparametric estimates of the cumulative hazard function for distributors (Kaplan and Meier, Nelson-Aalen estimators)

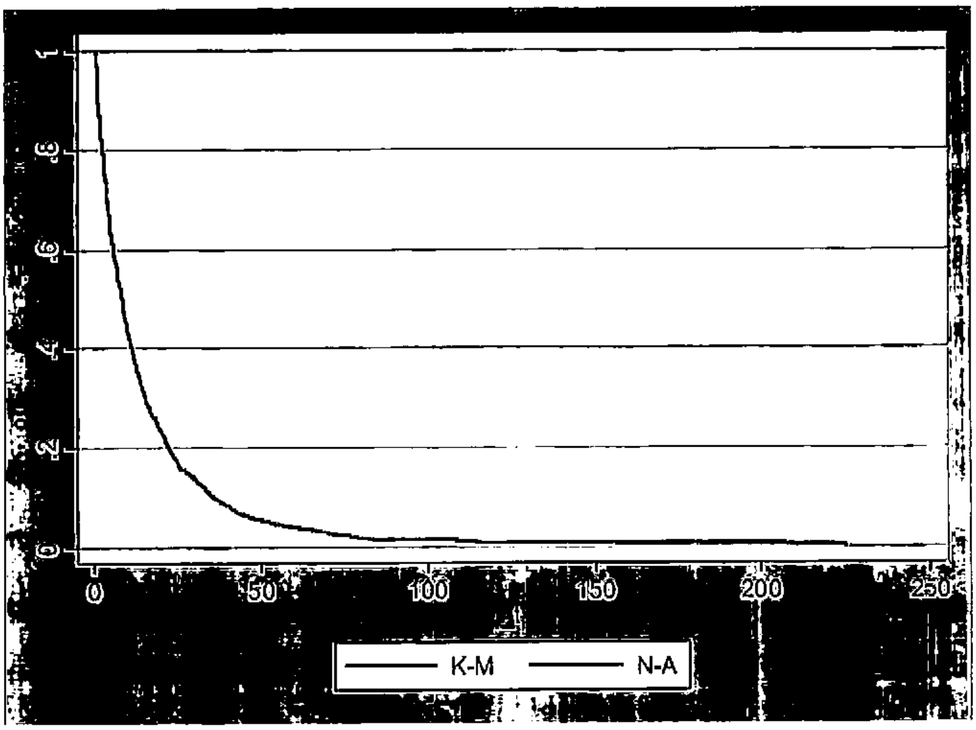

Figure 4.4 Nonparametric estimates of the survivor function for distributors (Kaplan and Meier, Nelson-Aalen estimators)

Variable |	Obs	Mean	Std. Dev.	Min	Max
War	21762	0.115431	0.319548	0	1
Paramount case I	21762	0.034602	0.182773	0	1
Paramount case II	21762	0.455151	0.497996	0	1
Sound	21762	0.735686	0.440977	0	1
Screens	21762	17.39878	2.362261	11.875	22.998
Attendance	21762	48.37042	22.71837	17.89925	87.25
Price	21762	3.340926	1.237043	1.67983	7.119297
TV Households	21762	30.00678	38.96715	0	94.45
HH Index	21762	3.978292	2.325461	0.507515	58.5
Density at founding	21762	168.0879	57.48753	8	351
Density prod	21762	145.7628	52.95166	13.75	288.75
Density prod^2	21762	24.05067	17.47349	.189063	833.7656
Size	21762	118.6367	386.7943	2	1962
Density dis	21762	72.22406	30.64834	7	138.75
Density dis^2	21762	6.155545	4.977039	0.49	192.5156
Mass	21762	4.507428	1.823026	0.04	8.7625
Sum Age x size dis	21762	6.431672	2.31077	0.002	10.26875
Sum age dis	21762	0.457168	0.225387	0.00725	0.93375
Density x size	21762	516.4474	162.5741	14	917.5848

Table 4.1.a Descriptive statistics for exit models, producers

Variable |	Obs	Mean	Std. Dev.	Min	Max
War	10326	0.115431	0.319548	0	1
Paramount case I	10326	0.034602	0.182773	0	1
Paramount case II	10326	0.455151	0.497996	0	1
Sound	10326	0.735686	0.440977	0	1
Screens	10326	17.39878	2.362261	11.875	22.998
Attendance	10326	48.37042	22.71837	17.89925	87.25
Price	10326	3.340926	1.237043	1.67983	7.119297
TV Households	10326	30.00678	38.96715	0	94.45
HH Index	10326	6.330416	4.515671	2.0738	78.125
Density at founding	10326	67.21102	27.56821	2	147
Density	10326	72.22406	30.64834	7	138.75
Density^2	10326	6.155545	4.977039	0.49	192.5156
Size	10326	323.0947	673.1018	2	2733
Mass	10326	4.556967	1.832201	0.04	8.7625
Sum Age x size prod	10326	3.837715	2.048867	0.002	7.73
Sum age prod	10326	0.785873	0.288287	0.0165	1.28525
Density x size prod	10326	499.1847	185.0165	3.875	890.9368
Number of suppliers	10326	39.89037	79.33593	0	435
Films first supplier	10326	11.36684	23.29879	0	135
Genres first supplier	10326	.1271676	.166812	0	1

Table 4.1.b Descriptive statistics for exit models, distributors

	War	Par I	Par II	Sound	Screens	Attend	Price	TV	HH x	Den delay	Den prod	Den prod2	Size	Den dis	Den dis2	Den x size dis	Mass	Sum age x size dis	Sum age
War	1.00																		
Paramount I	0.13	1.00																	
Paramount II	-0.33	-0.17	1.00																
Sound	-0.16	0.11	0.55	1.00															
Screens	0.00	0.08	-0.10	0.46	1.00														
Attendance	0.22	0.30	-0.60	0.16	0.63	1.00													
Price	-0.16	-0.04	0.72	0.65	-0.13	-0.42	1.00												
TV Houses	-0.28	-0.15	0.84	0.46	-0.26	-0.77	0.78	1.00											
HH Index	0.19	0.21	-0.52	0.08	0.53	0.80	-0.44	-0.70	1.00										
Density delay	-0.29	-0.10	0.21	-0.04	-0.27	-0.44	0.35	0.41	-0.52	1.00									
Den prod	-0.36	-0.20	0.44	-0.10	-0.56	-0.78	0.53	0.66	-0.82	0.68	1.00								
Den prod^2	-0.31	-0.17	0.43	-0.04	-0.55	-0.75	0.61	0.67	-0.77	0.67	0.98	1.00							
Size	0.03	0.04	-0.03	0.04	0.06	0.09	-0.02	-0.05	0.07	-0.10	-0.08	-0.07	1.00						
Den dis	-0.24	-0.09	0.11	-0.13	-0.57	-0.54	0.46	0.42	-0.63	0.64	0.86	0.88	-0.06	1.00					
Den dis^2	-0.22	-0.10	0.23	-0.03	-0.57	-0.57	0.59	0.51	-0.63	0.64	0.88	0.92	-0.05	0.98	1.00				
Den x size dis	0.18	0.07	-0.75	-0.68	-0.11	0.29	-0.59	-0.68	0.18	0.04	-0.04	-0.08	0.01	0.20	0.07	1.00			
Mass	0.22	0.08	-0.79	-0.67	-0.03	0.38	-0.68	-0.76	0.28	-0.07	-0.19	-0.23	0.02	0.04	-0.09	0.98	1.00		
Sum Age x size	-0.31	0.00	0.72	0.67	-0.11	-0.41	0.93	0.82	-0.51	0.44	0.62	0.68	-0.02	0.53	0.64	-0.56	-0.67	1.00	
Sum age	-0.17	0.17	0.62	0.86	0.41	0.15	0.62	0.43	0.04	-0.03	-0.04	0.00	0.03	-0.21	-0.08	-0.60	-0.59	0.66	1.00

Table 4.2.a Bivariate correlations for models estimating exit rates, producers

	War	Par I	Par II	Sound	Screens	Attend	Price	TV	HH x	Den delay	Den dis	Den dis2	Size	Den prod	Den prod2	Mass	Sum age x size	Sum age	Num sup	Film first sup	Grn first sup	Den x size dis
War	1.00																					
Paramount I	0.12	1.00																				
Paramount II	-0.29	-0.17	1.00																			
Sound	-0.21	0.12	0.53	1.00																		
Screens	-0.03	0.10	-0.22	0.38	1.00																	
Attendance	0.16	0.31	-0.68	0.12	0.65	1.00																
Price	-0.18	-0.06	0.77	0.62	-0.24	-0.52	1.00															
TV Houses	-0.26	-0.15	0.90	0.47	-0.33	-0.79	0.84	1.00														
HH Index	0.12	0.07	-0.22	-0.08	0.12	0.26	-0.34	-0.32	1.00													
Density delay	-0.17	-0.04	0.16	0.03	-0.27	-0.29	0.38	0.30	-0.39	1.00												
Den dis	-0.27	-0.13	0.36	0.04	-0.57	-0.62	0.63	0.59	-0.59	0.60	1.00											
Den dis^2	-0.24	-0.13	0.45	0.12	-0.57	-0.65	0.74	0.66	-0.53	0.60	0.98	1.00										
Size	0.07	0.05	-0.03	0.05	0.13	0.15	-0.07	-0.10	0.09	-0.21	-0.20	-0.18	1.00									
Den prod	-0.33	-0.21	0.59	0.01	-0.56	-0.81	0.66	0.75	-0.57	0.53	0.90	0.91	-0.17	1.00								
Den $prod^2$	-0.29	-0.19	0.59	0.07	-0.55	-0.78	0.73	0.76	-0.51	0.55	0.91	0.94	-0.16	0.98	1.00							
Mass	0.24	0.08	-0.80	-0.64	0.07	0.44	-0.67	-0.77	-0.07	-0.03	-0.15	-0.26	0.01	-0.30	-0.34	1.00						
Sum Agexsize	-0.22	0.19	0.61	0.85	0.29	0.07	0.64	0.48	-0.16	0.07	0.03	0.14	0.09	0.13	0.18	-0.56	1.00					
Sum age	-0.33	-0.03	0.78	0.65	-0.21	-0.49	0.95	0.86	-0.43	0.42	0.68	0.77	-0.08	0.72	0.77	-0.67	0.70	1.00				
Num of sup	-0.11	-0.06	0.42	0.21	-0.17	-0.37	0.37	0.45	-0.11	0.06	0.25	0.28	-0.34	0.33	0.33	-0.36	0.22	0.38	1.00			
Film first sup	-0.05	-0.06	0.10	-0.02	-0.13	-0.17	0.12	0.14	-0.06	0.20	0.17	0.17	-0.34	0.18	0.18	-0.06	-0.02	0.12	0.41	1.00		
Gnr first sup	-0.08	-0.06	0.18	0.06	-0.15	-0.22	0.20	0.22	-0.07	0.24	0.22	0.22	-0.34	0.22	0.23	-0.14	0.04	0.20	0.52	0.87		
Denxsizedis	0.19	0.16	-0.7	-0.4	0.15	0.53	-0.6	-0.7	-0.1	-0	-0.2	-0.3	0.03	-0.3	-0.4	0.94	-0.3	-0.5	-0.3	-0.1	-0.1	1.00

Table 4.2.b Bivariate correlations for models estimating exit rates, distributors

Table 4.3

Piecewise constant exponential regression estimates of exit rates for feature film producers, 1912-1970[8]

	Baseline	*DD delay*	*Double DD*	*Simple mass*	*Barnett*	*Barron*
Tenure u≤1	-1.951***	.700	.823	1.597***	1.097	1.742***
	(.36)	(.53)	(.55)	(.58)	(.79)	(.59)
Tenure 1<u<4	-2.025***	.625	.747	1.519***	1.021	1.665***
	(.36)	(.53)	(.55)	(.58)	(.79)	(.59)
Tenure 4<u≤8	-2.148***	.491	.612	1.373**	.877	1.519**
	(.36)	(.54)	(.55)	(.58)	(.79)	(.59)
Tenure 8<u≤20	-2.286***	.341	.465	1.225**	.731	1.370**
	(.36)	(.54)	(.55)	(.58)	(.79)	(.59)
Tenure 20<u≤40	-2.450***	.116	.245	1.018*	.526	1.161*
	(.37)	(.54)	(.56)	(.59)	(.80)	(.60)
Tenure 40<u≤100	-2.549***	.057	.183	.948	.455	1.094*
	(.37)	(.55)	(.56)	(.59)	(.80)	(.60)
Tenure>100	-2.426***	.145	.256	1.019	.529	1.162*
	(.46)	(.61)	(.62)	(.65)	(.84)	(.66)
War year	-.348***	-.394***	-.410***	-.576***	-.590***	-.581***
	(.09)	(.11)	(.11)	(.12)	(.12)	(.12)
Paramount I	.356**	.316*	.320*	.222	.328	.213
	(.18)	(.18)	(.18)	(.18)	(.20)	(.18)
Paramount II	-.292**	-.048	-.220	-.098	.063	.116
	(.13)	(.15)	(.21)	(.21)	(.20)	(.21)
Sound	-.394*	.124	-.015	.144	.221	.173
	(.23)	(.23)	(.25)	(.25)	(.26)	(.25)
Screens	-.012	.026	.014	-.010	-.022	-.015
	(.02)	(.02)	(.02)	(.02)	(.02)	(.02)
Attendance	-.007	-.004	-.006	-.005	.006	-.005
	(.01)	(.01)	(.01)	(.00)	(.01)	(.01)
Ticket price	.398***	.045	.088	.045	.097	.049
	(.04)	(.07)	(.08)	(.08)	(.11)	(.08)
TV Households	-.013***	-.013***	-.014***	-.008**	-.004	-.009**
	(.00)	(.00)	(.00)	(.00)	(.01)	(.00)
HHI	-.083**	-.184***	-.190***	-.219***	-.203***	-.221***
	(.03)	(.04)	(.04)	(.04)	(.04)	(.04)
Size	-.006***	-.007***	-.007***	-.007	-.006***	-.007***
	(.00)	(.00)	(.00)	(.11)	(.00)	(.00)

[8] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Baseline	*DD Delay*	*Double DD*	*Simple mass*	*Barnett*	*Barron*
Density prod		-.027***	-.025***	-.039***	-.032***	-.039***
		(.00)	(.01)	(.00)	(.01)	(.01)
Density prod²		.096***	.096***	.136***	.123***	.135***
		(.01)	(.02)	(.03)	(.03)	(.03)
Density delay		-.003***	-.003***	-.003***	-.003***	-.003***
		(.00)	(.00)	(.00)	(.00)	(.00)
Density dis			-.003	-.001	-.011	-.001
			(.01)	(.00)	(.02)	(.01)
Density dis²			-.015	-.067	-.019	-.069
			(.10)	(.11)	(.03)	(.10)
Density dis x size dis						.002***
						(.00)
Sum of age dis					-.073	
					(1.70)	
Sum of size dis				.157***	.186***	
				(.03)	(.05)	
Sum of age x size dis					-.094	
					(.07)	
Log-likelihood	-2290.9754	-2259.4909	-2258.6328	-2248.3849	-2247.2273	-2249.0544

Table 4.4

Piecewise constant exponential regression estimates of exit rates for feature film distributors, 1912-1970[9]

	Baseline	*Comm DD delay*	*Comm DD*	*Comm Barnett*	*Comm Barron*	*Comm # of sup*	*Comm. # film 1st*	*Comm Genre 1st*
Tenure u≤1	-1.540***	2.040**	4.140***	6.209***	4.803***	4.187***	4.295***	3.206***
	(.55)	(.96)	(1.16)	(1.72)	(1.25)	(1.16)	(1.18)	(1.19)
Tenure 1<u<4	-1.401**	2.193***	4.312***	6.382***	4.976***	4.364***	4.492***	3.427***
	(.54)	(.96)	(1.16)	(1.72)	(1.25)	(1.16)	(1.18)	(1.19)
Tenure 4<u≤8	-1.764***	1.843*	3.981***	6.053***	4.642***	4.046***	4.186***	3.129***
	(.54)	(.96)	(1.16)	(1.72)	(1.26)	(1.17)	(1.18)	(1.19)
Tenure 8<u≤20	-1.764***	1.834*	4.010***	6.074***	4.670***	4.076***	4.255***	3.204***
	(.54)	(.96)	(1.17)	(1.72)	(1.26)	(1.17)	(1.19)	(1.20)
Tenure 20<u≤40	-1.803***	1.763*	3.971***	6.019***	4.628***	4.030***	4.292***	3.201***
	(.57)	(.93)	(1.17)	(1.72)	(1.27)	(1.17)	(1.19)	(1.20)
Tenure 40<u≤100	-2.618***	.971	3.145***	5.222***	3.811***	3.233***	3.563***	3.504**
	(.59)	(.99)	(1.19)	(1.73)	(1.28)	(1.19)	(1.21)	(1.21)
Tenure>100	-1.653**	1.780*	4.132***	6.265***	4.790***	4.230***	4.617***	3.429***
	(.69)	(1.03)	(1.23)	(1.77)	(1.32)	(1.23)	(1.26)	(1.25)
War year	-.173	-.068	-.013	-.040	-.142	-.010	-.061	-.005
	(.15)	(.17)	(.18)	(.20)	(.20)	(.18)	(.18)	(.18)
Paramount I	.540**	.548**	.204	.216	.151	.217	.205	.267
	(.24)	(.24)	(.25)	(.28)	(.25)	(.25)	(.25)	(.25)
Paramount II	-.262	-.389	.738*	.885**	.802*	.792*	.703*	.684
	(.27)	(.32)	(.42)	(.41)	(.43)	(.42)	(.42)	(.42)
Sound	-.463	.195	.009	.344	.093	.019	.012	-.211
	(.29)	(.32)	(.37)	(.39)	(.37)	(.37)	(.37)	(.37)
Screens	-.063**	-.062**	-.078**	-.141***	-.095***	-.079**	-.079**	-.070**
	(.03)	(.03)	(.34)	(.04)	(.04)	(.03)	(.02)	(.03)
Attendance	-.003	-.006	-.001	-.007	-.001	.002	-.002	-.004
	(.01)	(.01)	(.01)	(.01)	(.01)	(.08)	(.01)	(.01)
Ticket price	-.372***	-.167	-.303**	-.344**	-.352**	-.306**	-.330**	-.316**
	(.07)	(.13)	(.14)	(.17)	(.15)	(.14)	(.14)	(.14)
TV Households	-.013**	-.011**	-.011*	-.020**	-.006	-.010*	-.010*	-.008
	(.00)	(.01)	(.01)	(.01)	(.01)	(.01)	(.01)	(.00)
HHI	-.004	-.004**	-.072**	-.081**	-.078**	-.065**	-.080***	-.074***
	(.01)	(.02)	(.02)	(.03)	(.03)	(.03)	(.02)	(.03)
Size	-.005***	-.005***	-.005***	-.005***	-.005***	.007	.001	-.003***
	(.00)	(.00)	(.00)	(.00)	(.00)	(.03)	(.00)	(.00)

[9] * p<.10, ** p<.05, *** p<001. Standard errors in parentheses.

	Baseline	*DD delay*	*Comm DD*	*Comm Barnett*	*Comm Barron*	*Comm # of sup*	*Comm. # film 1st*	*Comm Genre 1st*
Density dis		-.067***	.049**	.055*	.046**	.044*	.052**	.044**
		(.01)	(.03)	(.03)	(.02)	(.02)	(.02)	(.02)
Density dis^2		.484***	-.409**	-.552**	-.421**	-.384**	-.434**	-.379**
		(.09)	(.17)	(.22)	(.17)	(.17)	(.17)	(.17)
Density delay		.001	.002	.002	.002	.001	.002	.001
		(.02)	(.02)	(.02)	(.02)	(.02)	(.00)	(.00)
Density prod			-.077***	-.107***	-.084***	-.075***	-.081***	-.076***
			(.01)	(.03)	(.01)	(.01)	(.01)	(.01)
Density prod^2			.258***	.338***	.278***	.253***	.269***	.259***
			(.04)	(.07)	(.00)	(.04)	(.04)	(.04)
Density prod x size prod					.001*			
					(.00)			
Sum of age prod				2.482*				
				(1.43)				
Sum of size prod				.240***				
				(.08)				
Sum of age x size prod				-.213*				
				(.12)				
Number of sup						-3.867***		
						(.97)		
Num film first sup							1.075***	
							(.04)	
Num genres first sup								1.203***
								(.15)
Log-likelihood	-999.29712	-983.60945	-965.16349	-961.01172	-963.63147	-954.34345	-947.46258	-934.38956

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5.1 CONCLUSIONS

In the introduction we argued that the main research question of this study is very simple. We believe that the question of if and how interaction between vertically interdependent populations affects their vital rates is also relevant. On the one hand is relevant for organizational ecology because it suggest an extension of existing theory and models based on single population processes toward multi-level perspectives. On the other hand, it may help understand the evolution of industries across articulate trajectories that are addressed with difficulty by intra-population mechanisms, namely prolonged decline and resurgence. This issue has relevance not only for organizational ecology where vital rates are the main dependent variables analyzed (Hannan and Freeman 1989, Carroll 1997, Carroll and Hannan 2000), but also for strategic management and industrial organization that are directly concerned with industry evolution (McGahan 2000, Geroski and Mazzuccato 2001).

In investigating the research question, we relied on the general model of density dependence and its extensions – density delay, temporal variation, mass dependence (Carroll and Hannan 1989a, 1989b, Barnett 1997, Hannan 1997, Barron 1999, Sorenson 2000). The theory of density-dependence argues that forces of social legitimation and competition drive changes in vital rates of populations over time. A proxy measure for legitimation and competition is the number of organizations operating in a population, or density. Density shows curvilinear relationships with vital rates, an inverted U-shape with founding rates and a U-shape with mortality rates.

After Chapter 1 has introduced the research questions and has detailed the empirical setting and research design, Chapter 2 applies organizational ecology's theory of density dependence evolution by evaluating the original formulation of the theory and its main extensions in the context of two new populations, feature film producers and distributors in the United States. We test hypotheses on two sub-sets of issues, mass dependence and temporal variation. The idea included in both specifications is that the relationship between legitimation, competition and vital rates is not an immutable function of density. It may vary with at least two factors of heterogeneity, aggregate/firm-level size of organizations and time. In turn, time may have an external, chronological clock or an internal time scale that is based on evolutionary processes of variation, retention and selection. For entry rates, the empirical analysis of Chapter 2 finds that density dependence processes receive mixed support in the simplest model specifications. For producers, legitimation and competition have positive-negative association with entry rates only when mass or is included, a sign that we probably need to add more complexity to explain more complex evolution. For distributors, the basic density dependence is supported, and the incorporation of mass specifications increases the explanatory power of the theory. An interesting result, indeed, is the asymmetry with which the two populations that are interdependent on each other react to evolutionary processes. When we move specifically to analyzing temporal heterogeneity, we find that the evolutionary time scale has better explanatory power than the chronological time scale. Internal processes of variation, however, do not seem to be associated with population-level learning as in the case of automobile producers described by Sorenson (2000). Learning, associated with higher density retention relative to entry in the population, may reside at different ecological levels than the population, be they the organizations or the community. Or it may be absent due to structural uncertainty that affects the motion picture industry.

For exit rates, Chapter 2 finds that density dependence processes are supported in both populations, while the inclusion of conditions at founding, or mass have limited explanatory power. Contrary to expectations, we also find that concentration reduces exit, an effect that is compatible with partitioning mechanisms of populations among generalists and specialists (Carroll 1985). The historical pattern of concentration, however, does not increase over the observation period as partitioning theory would suggest. Some exploratory analyses investigate the possible integration of density-dependent with niche-width processes, and find for instance that wider scope of both producers and distributors reduce their exit rates. Chapter 2 contributes to prior research by extending the reach of the theory into a new industrial context: the feature film industry. It also provides a direct comparison of alternative specifications of density dependence extensions.

Chapter 3 makes an attempt to extend existing theory to community-level interactions by examining whether interdependence between populations affects their entry rates, and eventually helps explain the complex trajectories of industry evolution. The approach based on community ecology (Hannan and Freeman 1977, Ruef 2000, 2004) posits that the system of relationships involving suppliers, buyers, consumers, intermediaries, and institutions affects directly the evolution of organizational populations. A community perspective extends the key insight of ecology according to which other organizations in a population form the critical element of the environment faced by organizations. Organizations interact regularly with their environment outside the boundaries of the population, and in most cases that same environment is made up of other organizational populations. Although community ecology represented a foundational element within the formulation of the ecological theory to explain organizational diversity and evolution (Hannan and Freeman 1977: 942-44), researchers have less frequently addressed this issue in analyzing vital rates of populations (Rao 2002). We theorize that not only populations may be influenced by the legitimating and competitive processes shaping the evolution of other populations they interact with, but they also develop different types of responses to community interactions. We combine organization theory addressing social structure and organizational ecology with strategic management theory to develop some general hypotheses on how density may affect both interacting populations. We incorporate ecological theory on predatory-prey interactions to generate additional hypotheses how different responses may affect entry rates. Theories on predatory-prey systems posit explicitly that the interaction between the two populations is compatible with the complex evolutionary trajectories including cycles and oscillations.

In the empirical analysis we find that for distributors, density of producers does not generate cross-legitimating but competitive effects, reducing entry rates. The idea that complementarity of functions within a community may produce mutualistic association is not supported. This result somehow disconfirms previous attempt to develop a theory of community entrepreneurship (Mezias and Kuperman 2001). Rather, distributors develop a functional response to their interaction with producers that affects entry rates through behavioral adaptations. The interactions between linear, quadratic and cubic producers' density have significant effect on entry rates of distributors. Here, buyers are first in ad adversarial relationship with suppliers, but as the number of the encounters between the two population increases, effective matching may reduce the need for new ties between existing buyers and suppliers. New buyers therefore find it easier to enter the industry. Finally, when encounters increase further, selection of suppliers on the part of buyers reduce the availability of actual partners. This result in particular may point to the existence of learning at the community-level, maybe substituting for the absence of population-level processes described above. At the same time, we may find a conflict with early theories of community ecology, which posited relevance for community relationships mainly in the developmental phases of industry evolution while in later stages intra-population processes take over (Astley 1985). This study argues that when populations structurally interact with each other, the influence that they can produce on each other may not necessarily weaken – a view consistent with the logic of structuration of community relationships over time.

For producers, the inclusion of density dependence for both populations makes significant intra-population processes as well. The only other study that analyzed the effects of vertical interdependence on suppliers' evolution (Martin et al. 1998) finds opposite results. In their study of international expansion of Japanese automobile suppliers, Martin et al. find evidence of classic density dependence processes (positive first order and negative second order effects) from the buyers' population that influenced suppliers' likelihood and timing of international expansion. They argue that suppliers follow buyers when the latter move in low numbers. Problems associated with control over information and resource scarcity turn the mutualism between the two populations into a competitive relationship. Here, similar to what we obtained for the population of distributors, linear density of buyers reduce entry of suppliers, while quadratic density increases entry. The articulate density dependence dynamics may be explained by the power relationships existing between the two populations. Low numbers imply very likely direct interaction, and power relations determine what eventually buyers or suppliers can obtain from the transactions. When we include mass dependence, entry rates of producers are depressed by larger dimensions of the population of distributors as well as their mean size, supporting a theory of countervailing powers. Chapter 3 contributes to prior research in organization theory and strategy by examining the effects of vertical interdependence on vital rates of organizational populations. We find an explanation based on external processes of inter-population evolution that is compatible with declining and resurgent trajectories of population density.

Chapter 4 continues the attempt to extend existing theory to community-level interactions by examining whether interdependence between populations affects their exit rates. In this study, we aim at verifying the existence of structured mutualism between populations (Land 1994), as previously found in prior research on single populations. When firms perform complementary activities, the interdependence between their functions can be recognized by social actors as well and superimpose additional density-dependent processes on them. The empirical analysis show interesting asymmetries in the populations: producers do not seem to be affected by cross-density processes, but mass of distributors and the interaction between distributors' size and density actually increase exit rates. Again, bargaining power dynamic may be effective in explaining vital rates of interdependent populations. However, comparative methods used to select statistical models suggest that single population mechanisms are more efficient to explain the evolution of producers than specification including interdependence. For distributors, instead, we find that interaction between the two populations significantly affects exit rates. Interestingly, when we include "double" density dependence hypotheses, the within-population processes reverse (by flipping sign). While the presence of suppliers may help legitimize the population of buyers, the presence of other distributors may generate competitive processes – when suppliers are few, other buyers can "steal" them away. When density of suppliers increases, their proliferation may require search costs and time that actually reduces performance of buyers. An increase in the number of buyers themselves, however, may mitigate this expensive selection process by increasing actual matching between the two populations and contributing to the structuration of the community. The inclusion of mass dependence does not modify this pattern. Then, we decided to explore further the relationships that might link vertical interdependence to exit rates of distributors and analyzed relational density, scale and scope effects. Increasing the number of actual suppliers with which distributors have engaged transactions reduce exit rates of the latter. Scale of suppliers does not affect exit rates, while scope has a strong, significant positive effect on exit rates. This implies that wider scope protects against market risks in an uncertain environment (scope reduces exit within the population, as obtained in the analysis of Chapter 2); however, this advantageous strategy reduces performance of organizations they interact with. The reason for this asymmetry very likely goes back to strategic issues of leveraging bargaining power. For exit rates, producers and distributors respond to both population- and firm-level processes. Finally, distributors are influenced by how large and specific is the association with firms in the supplier population in addition to multilevel density dependence mechanisms.

This study has several important limitations. A first limitation is that we have modeled vital rates of populations separately, however consistent with most existing literature on organizational ecology. If we obtain results compatible with evolutionary trajectories of industrial decline or resurgence, we only obtain indirect evidence for it. Future research should address explicitly models of population growth where entry/founding and exit/mortality rates are included in the same specification and tested together. This could be done by building systems of simultaneous equations where population growth of producers is a function of density and vital rates of both distributors and producers, and vice versa. A first variation on this strategy would be to adopt the system selection theory developed by Lomi et al. (2003), where vital rates of a population depend on density and carrying capacity, but: environmental resource constraints are not exogenous and depend on density and resource consumption/regeneration rates; and populations adjust with delay to resource constraints. A second variation on this strategy would be to adopt ratio dependence models, where densities and/or mass measures are expressed as ratio between the two populations. Figures 5.1 and 5.2 plot the evolution of density ratio between producers and distributors and mean size ratio between distributors and producers. The vital rates of interdependent populations may in fact be determined by relative rather than absolute processes. For example, the density ratio graph shows that the period where the ratio is higher more or less corresponds to the phase where we observe the resurgence in density – maybe when the ratio first increases relative the population growing more subtracts legitimation as the dominant form in an industry.

Surely, we need a finer representation of the resource space for the different populations to develop theory and analysis that address community ecology more effectively. At this stage, we are only speculating on what might represent interesting avenues of future research for inter-population interactions.

A second limitation concerns the alternative explanations for the processes we have observed. Focusing on density dependence, we controlled for a major alternative mechanism that affects organizational evolution, resource partitioning. In reality, for exit rates the measure employed as a control, the HH Index, indicates that segregating processes can be operating in the two populations. Resource partitioning may be integrated with density dependence and community interactions to induce effects on vital rates of populations. However, we are not able to either identify other sources of unobserved heterogeneity or causal processes linking these mechanisms. Particular caution is therefore recommended in the interpretation of the results.

A third limitation is related to the structural under-determination of community studies (Ruef 2004: 82-83). Explanations based on community interactions "tend to be *underdetermined*, in the sense that many different configurations of the community matrix may give rise to the same pattern of decline and resurgence for any given organizational population. A clear *a priori* theory of organizational forms (and corresponding identities) is required to predict how cross-population interactions are likely to be initiated and how they tend to evolve with the maturation of the industries involved. Otherwise, disconfirmation of explanations that take community ecology into account can become exceedingly difficult." We think that the effort we have made in this dissertation toward an extension to structural interdependence between populations represents only a very preliminary step in the possible formulation of a theory on community ecology.

Finally, additional caution in the interpretation of results stems from at least another reason: models that fail to improve statistical significance, for instance specifications including mass dependence, may produce inconsistent results due to collinearity problems (e.g., density dependence is not significant anymore for distributors when we specify temporal variation in Chapter 2). The addition of highly correlated covariates to the models affects also the community-level specifications, and although this is not a condition specific to this study, it remains a problem. Model specifications are indeed sensitive to sampling variability (making it more difficult to generalize results) as well as the inclusion of covariates. In addition, several models include many covariates with a limited number of observations: for instance, the analysis on entry rates records entries every calendar month, but most covariates are updated annually generating only 59 observations. Econometric textbooks, however, suggests that if high correlation among covariates may create problems of estimation, estimates with collinear data do not violate the standard assumptions of regression and offer unbiased and efficient estimates (Maddala 2001; Greene 2003). Multicollinearity is not necessarily a problem when statistically significant support is found with collinear data (Maddala 2001). Since the effects of many of our key explanatory variables show statistical significance (at the level of $p < .05$), we are fairly confident that with our specifications, issues of multicollinearity do not affect the findings. But because estimates with collinear data can be sensitive to changes in the number of observations in a sample (Maddala 2001, Greene 2003), we re-ran our entry models, which would be most susceptible to multicollinearity, without the first three and last two years of observation and found little change in our original estimates. In any case, a more careful sensitivity analysis is required before claiming our results really robust.

Overall, this dissertation finds that: interaction between population matters in influencing their vital rates; history of interaction matters as well, because the analysis on entry rates reveal that the interaction between density and cumulative variation introduced with previous entry affects entry rates; interaction matters asymmetrically, because the two populations are influenced by interdependence in different ways for entry or exit rates; the structural association of interdependent populations may induce specialized relationships that may contribute to explain why we observe diversity in organizations – the same specialization can be contingent and not replicated in other contexts; the development of organizational identities seems to incorporate more conflict than complementarities – at the same time, oppositional identities are somewhat complementary; learning across populations may exist and substitute for learning at the population level is some actors are better able or positioned than others to cope with environmental phenomena like uncertainty or variability.

This study addresses explicitly organizational ecology's theory of density dependence, but its examination speaks to organization theory and strategic management as well. The effects of the interaction between vertically interdependent populations addresses strategic relationships between buyers and suppliers in strategy, and the analysis of exit rates informs us on how it may matter for firm performance. The exploration of community-level effects of scale and scope follow the same logic. Interdependence has mostly been analyzed at the organization level and for the consequences that it produces on individual firms. Here we argue that there may be effects emerging at the population level due to community interactions. The incorporation of mechanisms related to partitioning, or the link between macro and micro evolution that incorporates the dynamic between creative talent and producers and the effects they generate on organizational evolution would address other relevant research topics in strategy and organization theory. Eventually, the integration of current and future efforts along these directions will make a little contribution to the complex task of explaining industry and organizational evolution, and the processes by which they are governed.

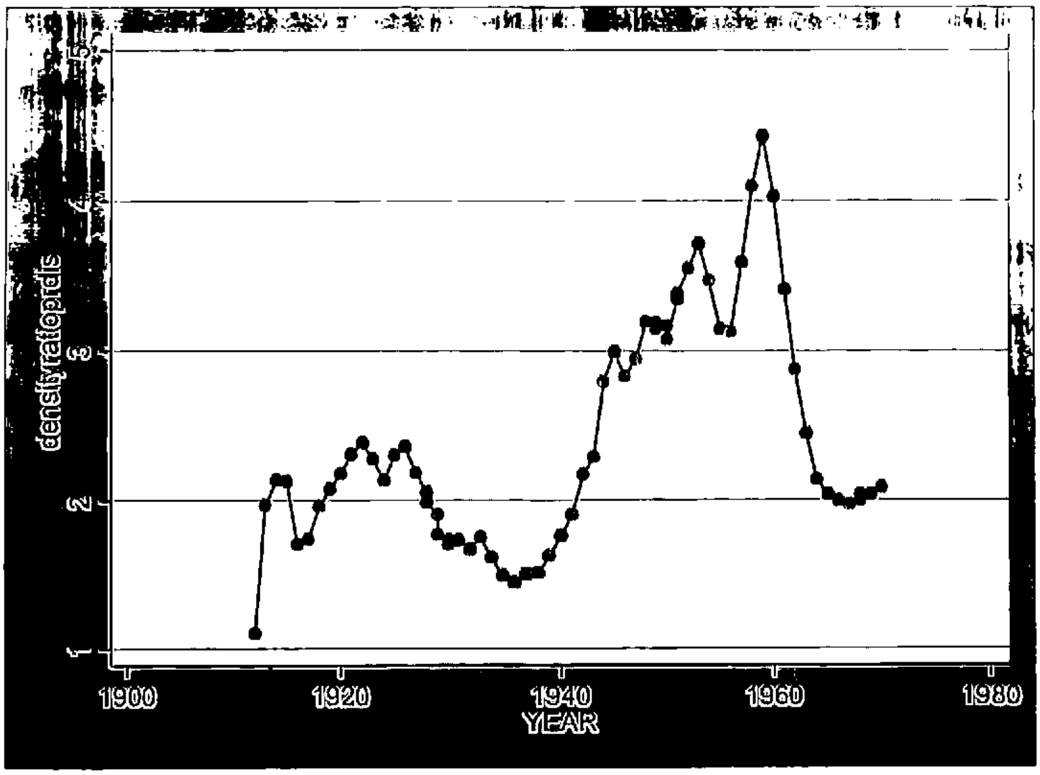

Figure 5.1 The evolution of density ratio between the population of feature film producers and distributors, 1912-1970

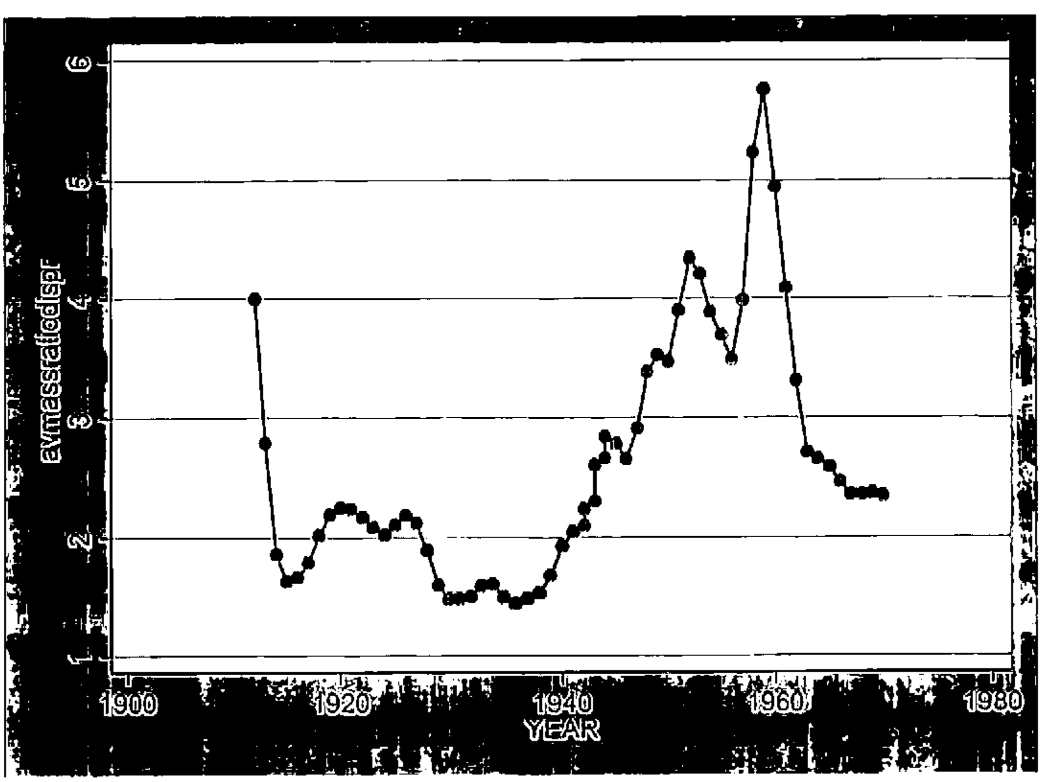

Figure 5.2 The evolution of mass ratio between the population of feature film distributors and producers, 1912-1970

References:

Abel R. 1999. *The Red Rooster Scare. Making Cinema American 1900-1910.* Berkeley, CA: University of California Press.

Akaike H. 1974. A new look at the statistical model identification. *IEEE Transaction and Automatic Control* AC-19: 716-723.

Aldrich H. E. 1999. *Organizations Evolving.* Thousand Oaks, CA: Sage Publications.

Aldrich H. E. and E. R. Auster 1986. Even dwarfs started small: Liabilities of age and size and their strategic implications. In Staw B. M. and L. L. Cummings. *Research in Organizational Behavior* 8 (edited by). Greenwich CT: JAI. Pp. 165-198

Aldrich H. E., Zimmer C. R., Staber U. H. and J. J. Beggs. 1994. Minimalism, mutualism, and maturity: The evolution of the American trade association population in the 20^{th} century. In Baum J. A. C. and J. Singh. *Evolutionary Dynamics of Organizations* (eds). New York: Oxford University Press: 223-239.

Allison P. D. 1984. *Event History Analysis.* Beverly Hills CA. Sage Publications.

American Film Institute. 1989. Hanson P. K. and A. Gevinson (ed). *The American Film Institute Catalog of Motion Pictures Produced In the United States: Feature Films, 1911-1920.* Berkeley CA. University of California Press.

American Film Institute. 1997. Hanson P. K. and A. Gevinson (ed). *The American Film Institute Catalog of Motion Pictures Produced In the United States: Feature Films, 1921-1930.* New York: R. R. Bowker.

American Film Institute.1993. Hanson P. K. and A. Gevinson (ed). *The American Film Institute Catalog of Motion Pictures Produced In the United States: Feature Films, 1931-1940.* Berkeley CA. University of California Press.

American Film Institute.1997. (ed). Hanson P. K. and A. Gevinson (ed). *The American Film Institute Catalog of Motion Pictures Produced In the United States: Feature Films, 1961-1970.* Berkeley CA. University of California Press.

American Film Institute.1999. Hanson P. K. and A. Gevinson (ed). *The American Film Institute Catalog of Motion Pictures Produced In the United States: Feature Films, 1941-1950.* Berkeley CA. University of California Press.

Astley W. G. 1985. The two ecologies: Population and community perspectives on organizational evolution. *Administrative Science Quarterly* 30: 224-41.

Astley W. G. and C. J. Fombrun. 1983a. Collective strategy: The social ecology of organizational environments. *Academy of Management Review* 8: 576-587.

Astley W. G. and C. J. Fombrun. 1983b. Technological innovation and industrial structure: The case of telecommunications. In Lamb R. *Advances in Strategic Management* (ed). San Francisco: JAI Press.

Baker W. and R. Faulkner. 1991 Role as resource in the Hollywood film industry. *American Journal of Sociology* 97 (2): 279-309.

Balio T. 1985. *The American Film Industry* (edited by). Madison, WI: University of Wisconsin Press.

Balio T. 1993. *Grand Design: Hollywood as a Modern Business Enterprise 1930-1939.* Berkeley, CA. University of California Press.

Barnett W. P. 1994. The Liability of Collective Action: Growth and Change among Early Telephone Companies. In Baum J. A. C. and J. Singh. *Evolutionary Dynamics of Organizations* (eds). New York: Oxford University Press. Pp. 337-354.

Barnett W. P. 1997. The Dynamics of Competitive Intensity. *Administrative Science Quarterly* 42: 128-160.

Barnett, W. P. and T. L. Amburgey. 1990. Do larger organizations generate stronger competition? In Singh, J.V. (ed.), *Organizational Evolution: New Directions.* Newbury Park CA. Sage. Pp. 78-102.

Barnett W. P. and G. R. Carroll. 1987. Competition and Mutualism among Early Telephone Companies. *Administrative Science Quarterly* 30: 400-421.

Barron D. N. 1999. The structuring of organizational populations. *American Sociological Review* 64: 421-445.

Barron, D.N., E. West, and M.T. Hannan. 1994. A time to grow and a time to die: Growth and mortality of credit unions in New York, 1914-1990. *American Journal of Sociology* 100: 381-421.

Baum J. A. C. 1996. Organizational Ecology. In Clegg S. R., Hardy C. and W. R. Nord. *Handbook of Organization Studies* (edited by). London: Sage. Pp. 77-114.

Baum J. A. C. and J. V. Singh. 1994. Organizational niche overlap and the dynamics of organizational founding. *Organization Science* 5: 483-502.

Baum J. A. C. and T. L. Amburgey. 2002. Organizational Ecology. In Baum J. A. C. *Companion to Organizations* (edited by). London. Basil Blackwell. Pp. 304-326.

Baum J. A. C. and W. W. Powell. 1995. Cultivating an institutional ecology of organizations: Comment on Hannan, Carroll, Dundon, and Torres. *American Sociological Review* 60: 529-538.

Blossfeld H.-P.and G. Rohwer. 2002. *Techniques of Event History Modeling. New Approaches to Causal Analysis. Second Edition.* Mahwah NJ. Lawrence Erlbaum Associates.

Bonaccorsi A. and P. Giuri. 2001. The long-term evolution of vertically-related industries. *International Journal of Industrial Organization* 19: 1053-1083.

Bordwell D., Staiger J. and K. Thompson. 1985. *The Classical Hollywood Cinema. Film Style & Mode of Production to 1960.* London: Routledge.

Bowser E. 1990. *The Transformation of Cinema. 1907-1915.* Berkeley, CA: University of California Press.

Briggs A. 1960. *Mass Entertainment: The Origins of a Modern Industry.* Adelaide. The Griffin Press.

Brittain J. and D. R. Wholey. 1988. Competition and coexistence in organizational communities: Population dynamics in electronic components manufacturing. In Carroll G. R. *Ecological Models of Organization* (ed). Cambridge, MA: Ballinger. Pp. 195-222.

Brittain J. W. 1994. Density-independent selection and community evolution. In Baum J. A. C. and J. V. Singh. *Evolutionary Dynamics of Organizations* (eds). New York: Oxford University Press.

Burt R. S. 1980. Autonomy in a social topology. *American Journal of Sociology* 89: 892-925.

Burt R. S. 1988. The stability of American markets. *American Journal of Sociology* 94(3): 592-626.

Burt R. S. and D. S. Carlton. 1989. Another look at the network boundaries of American markets, *American Journal of Sociology* 95: 723-53.

Carroll G. R. 1981. Dynamics of organizational expansion in national systems of education. *American Sociological Review* 46: 585-599.

Carroll G. R. 1984. Organizational ecology. *Annual Review of Sociology* 10: 71-93.

Carroll G. R. 1985. Concentration and Specialization: Dynamics of Niche Width in Populations of Organizations. *American Journal of Sociology* 90: 1262-1283.

Carroll G. R. 1997. Long-term evolutionary change in organizational populations: theory, models and findings in industrial demography, *Industrial and Corporate Change* 6(1): 119-143.

Carroll G. R. and A. Swaminathan. 1992. The organizational ecology of strategic groups in the American brewing industry from 1975 to 1990. *Industrial and Corporate Change* 1 (1): 65-91.

Carroll G. R. and A. Swaminathan. 2000. .Why the microbrewery movement? Organizational dynamics of resource partitioning in the American brewing industry after prohibition. *American Journal of Sociology* 106: 715-762.

Carroll G. R. and M. T. Hannan. 1989a. Density dependence in the evolution of populations of newspaper organizations. *American Sociological Review* 54: 524-541.

Carroll G. R. and M. T. Hannan. 1989b. Density delay in the evolution of organizational populations: A model and five empirical tests. *Administrative Science Quarterly* 27: 169-198.

Carroll G. R. and M. T. Hannan. 2000. *The Demography of Corporations and Industries.* Princeton: Princeton University Press.

Caves R. E. 2000. *Creative Industries. Contracts between Art and Commerce.* Cambridge, MA: Harvard University Press.

Christopherson S. and M. Storper. 1989. The effects of flexible specialization on industrial politics and the labor market: the motion picture industry. *Industrial and Labor Relations Review* 42 (3): 333-347.

Cleves M. A., Gould W. W. and R. G. Gutierrez. 2004. *Introduction to survival analysis using STATA. Revised Edition.* College Station TX. Stata Press.

Conant M. 1960. *Antitrust in the Motion Picture Industry. Economic and Legal Analysis.* Berkeley, CA: University of California Press.

Cook D. A. 2000. *Lost Illusions: American Cinema in the Shadow of Watergate and Vietnam, 1970-1979.* New York. Scribner's and Sons.

Copyright Office. 1951. *Catalog of Copyright Entries: Motion Pictures 1912-1939.* Washington. Library of Congres

Copyright Office. 1953. *Catalog of Copyright Entries: Motion Pictures 1940-1949.* Washington. Library of Congres

Copyright Office. 1960. *Catalog of Copyright Entries: Motion Pictures 1950-1959.* Washington. Library of Congres

Copyright Office. 1971. *Catalog of Copyright Entries: Motion Pictures 1960-1969.* Washington. Library of Congres

Crafton D. 1999. *The Talkies: American Cinema's Transition to Sound 1926-1931.* Berkeley, CA. University of California Press.

De Vany A. 2004. *Hollywood Economics*. New York. Routledge.

Delacroix J., Swaminathan A. and M. E. Solt. 1989. Density dependence versus population dynamics: An ecological study of failings in the California wine industry. *American Sociological Review* 54: 245-262.

DiMaggio P. J. 1994. Community Evolution. In Baum J. A. C. and J. Singh. *Evolutionary Dynamics of Organizations* (eds). New York: Oxford University Press. Pp. 444-450.

Dimmick J. and E. W. Rothenbuhler. 1984. Competitive displacement in the communication industries: New media in old environments. In Rice R. *The New Media* (ed). Beverly Hills: Sage Publications. Pp. 287-304.

Dobbs M. E. and J. R. Harrison. 2001. Losing the game: The failure of professional sports leagues. *Working Paper*. University of Texas, Dallas.

Dobrev S. D. 2001 Revisiting organizational legitimation: cognitive diffusion and sociopolitical factors in the evolution of Bulgarian newspaper enterprises, 1846-1992 *Organization Studies*, 22: 419-444.

Donahue S. M. 1987. *American Film Distribution. The Changing Marketplace.* Ann Arbor, MI. UMI Research Press.

Emerson R. M. 1962. Power-dependence relations. *American Sociological Review* 27: 31-41.

Fetrow A. G. 1999. *Feature Films 1950-1959: A United States Filmography.* Jefferson NC. McFarland & Company, Inc.

Fichman, M. and D.A. Levinthal. 1991. Honeymoons and the liability of adolescence: A new perspective on duration dependence in social and organizational relationships. *Academy of Management Review* 16: 442-68.

Fombrun C. J. 1986. Structural dynamics within and between organizations. *Administrative Science Quarterly* 31: 403-421.

Freeman J. and M. T. Hannan. 1983. Niche width and the dynamics of organizational populations. *American Journal of Sociology* 83: 1116-1145.

Geroski P. A. and M. Mazzucato. 2001. .Modeling The Dynamics of Industry Populations. *International Journal of Industrial Organization* 19(7): 1003-1022.

Gomery D. 1986. *The Hollywood Studio System*. New York: St. Martin's Press.

Greene W. H. 2003. *Econometric Analysis. Fifth Edition*. New York. MacMillan.

Hannan M. T. 1986. Competitive and institutional processes in organizational ecology. *Technical Report 86-13*. Department of Sociology, Cornell University.

Hannan M. T. 1997. Inertia, density, and the structure of organizational populations: Entries in European automobile industries, 1886-1981. *Organization Studies* 18: 193-228.

Hannan M. T. and G. R. Carroll. 1992. *Dynamics of Organizational Populations*. New York: Oxford University Press.

Hannan M. T. and J. H. Freeman. 1977. The population ecology of organizations. *American Journal of Sociology* 82: 929-964.

Hannan M. T. and J. H. Freeman. 1984. Structural inertia and organizational change. *American Sociological Review* 49: 149-164.

Hannan M. T. and J. H. Freeman. 1989. *Organizational Ecology*. Cambridge, MA: Harvard University Press.

Hannan M. T., Carroll G.R., Dundon E.A. and J. C. Torres. 1995. Organizational evolution in multilevel context: Entries of automobile manufacturers in Belgium, Britain, France, Germany, and Italy. *American Sociological Review* 60: 509-528.

Hawley A. H. 1950. *Human Ecology: A Theory of Community Structure*. New York: Ronald Press.

Hilmes M. 1990. *Hollywood and Broadcasting. From Movie to Cable*. Urbana, IL: University of Illinois Press.

Holling C. S. 1959a. The components of predation as revealed by a study of small mammal predation of the European pine sawfly. *Canadian Entomologist* 91: 293-320.

Holling C. S. 1959b. Some characteristics of simple types of predation and parasitisms. *Canadian Entomologist* 91: 385-398.

Huettig M. D. 1944. *Economic Control of the Motion Picture Industry. A Study in Industrial Organization*. Philadelphia: University of Pennsylvania Press.

Izod J. 1988. *Hollywood and the Box Office 1895-1986*. New York: Columbia University Press.

Jones C. 2001. Coevolution of entrepreneurial careers, institutional rules and competitive dynamics in American film, 1895-1920. *Organization Studies* 22: 911-944.

Jovanovic B and G. Macdonald G. 1994. The Life Cycle of a Competitive Industry. *Journal of Political Economy* 102: 322–347.

Kamps J. A. A. M. and L. Pólos L. 1999. Reducing uncertainty: A formal theory of organizations in action. *American Journal of Sociology* 104: 1776-1812.

Klepper S. 1996. Entry, Exit, Growth, and Innovation Over the Product Life Cycle. *American Economic Review* 86: 562–583.

Koppes C. R. and G. D. Black. 1990. *Hollywood Goes to War: How Politics, Profits and Propaganda Shaped World War II Movies.* Berkeley CA. University of California Press.

Korn H. J. and J. A. C. Baum. 1994. Community ecology and employment dynamics: A study of large Canadian organizations, 1985-1992. *Social Forces* 73(1): 1-31.

Koszarski R. 1990. *An Evening's Entertainment. The Age of the Silent Feature Picture 1915-1928.* Berkeley, CA: University of California Press.

Land K. C., Davis W. R. and J. R. Blau. 1994. Organizing the boys of summer: The evolution of U.S. minor-league baseball, 1883-1990. *American Journal of Sociology* 100: 781-813.

Leontief W. 1966. *Input-Output Economics.* New York. Oxford University Press.

Lewis H.T. 1939. *The Motion Picture Industry.* New York: D. Van Nostrand Company.

Lomi A. 1995 The population ecology of organizational founding: location dependence and unobserved heterogeneity. *Administrative Science Quarterly*, 40: 111-145.

Lomi A. 2000. Density dependence and spatial duality in organizational founding rates: Danish commercial banks, 1846-1999. *Organization Studies* 21: 433-461.

Lomi A., Larsen E. R., and J. H. Freeman. 2003 Things change: Dynamic resource constraints and system-dependent selection in the evolution of populations of organizations. *Working Paper*, University of Bologna.

Long J. S. 1997. *Regression Models for Categorical and Limited Dependent Variables.* Thousand Oaks CA. Sage Publications.

Maddala G. S. 2001. *Introduction to Econometrics.* New York. John Wiley & Sons.

Malerba F. and L. Orsenigo. 1996. The Dynamics and Evolution of Industries. *Industrial and Corporate Change* 5(1): 51-87.

Marsden P. V. 1983. Restricted access in networks and models of power. *American Journal of Sociology* 88: 686-717.

Martin X., Swaminathan A. and W. Mitchell. 1998. Organizational evolution in the interorganizational environment: Incentive and constraints on international expansion strategy. *Administrative Science Quarterly* 43: 566-601.

Martinez N. D., and J. .H. Lawton. 1995. Scale and food-web structure-from local to global. *Oikos* 73: 148-154

McGahan A. M. 2000. How Industries Evolve. *Business Strategy Review* 3: 1-16.

McKendrick D. G., Jaffe J., Carroll G. R. and Olga M. Khessina. 2003. In the bud? Analysis of disk array producers as a (possibly) emergent organizational form. *Administrative Science Quarterly* 48: 60-93.

Meyer, J. W. and B. Rowan. 1977. Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology* 83: 340-63.

Mezias J. M. and M. E. Boyle. 2002. Getting what you wish for: Market control and the failure to innovate in the early American film industry, 1893-1920. *Working Paper.* New York University.

Mezias J. M. and S. J. Mezias. 2000. Resource partitioning, the founding of specialist firms, and innovation: The American film industry, 1912-1929. *Organization Science* 11(3): 306-322.

Mezias S. J. and J. C. Kuperman. 2001. The community dynamics of entrepreneurship: The birth of the American film industry, 1895-1929. *Journal of Business Venturing* 16: 209-233.

Monaco P. 2000. *The Sixties 1960-1969.* New York. New York. Scribner's and Sons.

Musser C. 1990. *The Emergence of Cinema. The American Screen to 1907.* Berkeley, CA: University of California Press.

Musser C. 1991. *Before the Nickelodeon Edwin S. Porter and the Edison Manufacturing Company.* Berkeley, CA: University of California Press.

Nardone J. M. 1982. Is the Movie Industry Countercyclical? *Cycles* 33(3) April.

Nash J. R. and S. R. Ross *The Motion Picture Guide 1927-1982.* 1983. New York. Cinebooks.

Nielsen F. and M. T. Hannan. 1977. The expansion of national education systems: Tests of a population ecology model. *American Sociological Review* 42: 479-490.

Paine R. T. 1980. Food webs: linkage, interaction strength and community infrastructure. *Journal of Animal Ecology* 49: 667-685.

Pathé C. 1970. *De Pathé Frères à Pathé Cinema.* Lyon. Serdoc.

Paul A. and A. Kleingartner. 1994. Flexible production and the transformation of industrial relations in the motion picture and television industry. *Industrial and Labor Relations Review* 47 (4): 663-678.

Pellmyr O., Thompson J. N., Brown J. M. and R. G. Harrison. 1996. Evolution of pollination and mutualism in the Yucca Moth Lineage. *American Naturalist* 148(5): 827-847.

Pfeffer J. and G. R. Salancik. 1978. *The External Control of Organizations.* New York. Harper and Row.

Pimm S. L., Lawton J. H. and J. E. Cohen. 1991. Food web patterns and their consequences. *Nature* 350: 669-674.

Podolny J.M., Stuart T.E. and M.T. Hannan. 1996. Networks, knowledge, and niches: Competition in the worldwide semiconductor industry, 1984-1991. *American Journal of Sociology* 102:659-89.

Porac J. F., Thomas H., Wilson F., Paton D. and A. Kanfer. 1995. Rivalry and the industry model of Scottish knitwear producers. *Administrative Science Quarterly* 40: 203-227.

Porter M. E. 1980. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. New York: The Free Press.

Raftery A. E. 1996. Bayesian model selection in social research. In Mardsen P. V. *Sociological Methodology* 25 (edited by). Oxford. Basil Blackwell. Pp. 111-163-

Ranger-Moore J. 1997. If bigger is better, is older wiser? Organizational age and size in the New York life insurance industry. *American Sociological Review* 59: 501-520.

Ranger-Moore J., Banaszak-Holl J. and M. T. Hannan. 1991. Density-dependent Dynamics in Regulated Industries: Founding Rates of Banks and Life Insurance Companies. *Administrative Science Quarterly* 36: 36-65.

Rao H. 2002. Interorganizational ecology. In Baum J. A. C. *Companion to Organizations* (edited by). London. Basil Blackwell. Pp. 541-556.

Rao H. and J. V. Singh. 1999. Types of variation in organizational populations: The speciation of new organizational forms. In Baum J. A. C. and B. McKelvey. *Variations in Organization Science In Honor of Donald T. Campbell* (eds). Thousand Oaks, CA: Sage Publications. Pp. 63-78.

Ricklefs R. E. and G. L. Miller. 1999. *Ecology*. Fourth Edition. New York: W. H. Freeman and Co.

Romanelli E. 1989. Organization birth and population variety: A community perspective on origins. In Cummings L. L. and B.M. Staw. *Research in Organizational Behavior* Vol. 11 (eds). Greenwich, CN. JAI Press. Pp. 211-246

Rosten L. C. 1941. *Hollywood: the Movie Colony the Movie Makers*. New York. Harcourt, Brace, & Co.

Ruef M. 2000. The emergence of organizational forms: A community ecology approach. *American Journal of Sociology* 106: 658-714.

Ruef M. 2004. For whom the bell tolls: Ecological perspectives on industrial decline and resurgence. *Industrial and Corporate Change* 13(1): 61-89.

Saxenian, A. L. 1994. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Cambridge, MA: Harvard University Press.

Schatz T. 1999. *Boom and Bust: American Cinema in the 1940s*. Berkeley, CA. University of California Press.

Schwarz G. 1978. Estimating the dimension of a model. *Annals of Statistics* 6: 461-464.

Scott W. R. and J. W. Meyer. 1991. The organization of societal sectors: Propositions and early evidence. In Powell W. W. and P. J. DiMaggio. *The New Institutionalism in Organizational Analysis* (eds). Chicago: The University of Chicago Press. Pp. 108-140.

Shy O. 1995. *Industrial Organization. Theory and Applications*. Cambridge, MA. The MIT Press.

Silverman B. S., Nickerson J. A. and J. Freeman. 1997. Profitability, transactional alignment, and organizational mortality in the U.S. trucking industry. *Strategic Management Journal* 18 (Special Issue): 31-52.

Singh J. V., Robert J. and D. J. Tucker. 1986. Organizational change and organizational mortality. *Administrative Science Quarterly* 31: 587-611.

Slide A. 1998. *The New Historical Dictionary of the American Film Industry*. Lanham MD. Scarecrow Press.

Sørensen J. B. 1999. Stpiece: A program for the estimation of piecewise-constant rate hazard models in STATA 6.0. *Unpublished ado-file*. University of Chicago: Graduate School of Business.

Sørensen J. B. 2003. Recruitment-based competition between industries: A community ecology. *Industrial and Corporate Change 12(1)*: 149-170.

Sørensen J. B. and O. Sorenson. 2003. From conception to birth: Opportunity perception and resource mobilization in entrepreneurship. In Baum J. A. C. and O. Sorenson. Advances in Strategic Management 20 (edited by). Greenwich CT: JAI. Pp. 71-99.

Sorenson O. 2000. The effect of population-level learning on market entry: The American automobile industry, *Social Science Research* 29: 307-326.

Sorenson O. 2003. Interdependence and adaptability: Organizational learning and the long-term effect of integration. *Management Science* 49: 446-463.

Sorenson O. and P. G. Audia. 2000. The social structure of entrepreneurial activity: Geographic concentration of footwear production in the U.S., 1940- 1989, *American Journal of Sociology*, 106: 424-62.

Sorenson O., McEvily S. and R. Roy. 2003. Niche width revisited: Organizational scope, behavior and performance. *Working paper*. Anderson Graduate School of Management UCLA.

Sorenson O. and D. Waguespack. 2003. Social networks and exchange: Self-confirming dynamics *Working paper*. Anderson Graduate School of Management UCLA.

Spehr P. C. and G. Lundquist. 1996. *American Film Personnel and Company Credits, 1908-1920* (edited by). Jefferson NC. McFarland & Company, Inc.

Squire J. E. 1992. *The Movie Business Book. Second Edition*. New York. Fireside Books.

Staber U. 1989. Organizational foundings in the cooperative sector in Atlantic Canada: An ecological perspective. *Organization Studies* 10: 383-405.

Staiger J. 1983. Combination and litigation: Structures of U.S. film distribution, 1896-1917. *Cinema Journal* 23 (1): 41-72.

Stigler G. J. 1968. A Note on Block Booking. In Stigler G. *The Organization of Industry*. Homewood, IL. Irwin.

Stinchcombe A. L. 1965. Social structures and organizations. In March J. G. *Handbook of Organizations* (edited by.). Chicago. Rand Mcnally: 142-193.

Storper M. 1989. The transition to flexible specialisation in the US film industry: External economies, the division of labour, and the crossing of industrial divides. *Cambridge Journal of Economics* 13: 273-305.

Stuart T. and O. Sorenson. 2003. The geography of opportunity: Spatial heterogeneity in founding rates and the performance of biotechnology firms. *Research Policy* 32: 229-252.

Stuart T. E. 2000. Interorganizational alliances and the performance of firms: A study of growth and innovation rates in a high-technology industry. *Strategic Management Journal* 21: 791-811.

Stuart T. E., Hoang H., and R. Hybels R. 1999. Interorganizational endorsements and the performance of entrepreneurial ventures. *Administrative Science Quarterly* 44: 315-349.

Stuart T. E., Ozdemir S. and W. Ding. 2004. Brokerage in a vertical alliance network. *Working Paper.* Presented at the Organizational Ecology and Strategy Conference. Ohlin School of Business Washington University at Saint Louis.

Swaminathan A. 1996. Environmental conditions at founding and organizational mortality: A trial-by-fire model. *Academy of Management Journal* 39: 1350-1377.

Thompson J. D. 1967. *Organizations in Action. Social Science Bases of Administrative Theory.* New York: McGraw-Hill Co.

Varian H. R. 1992. *Microeconomic Analysis.* Third Edition. New York. W. W. Norton and Co.

Vogel H. L. 1998. *Entertainment Industry Economics: A Guide for Financial Analysis. Fourth Edition.* New York. Cambridge University Press.

Wade J. B. 1995. Dynamics of organizational communities and technological bandwagons: An empirical investigation of community evolution in the microprocessor market. *Strategic Management Journal* 16 (S1): 111-133.

Wade J. B. 1996. A community-level analysis of sources and rates of technological variation in the microprocessor market. *Academy of Management Journal* 39 (5): 1218-1244.

Walker J. R. and D. A. Ferguson. 1998.*The Broadcast Television Industry.* Boston. Allyn and Bacon.

White H. C. 1992. *Identity and Control: A Structural Theory of Social Action.* Princeton NJ: Princeton University Press.

Wholey D. R. and J. W. Brittain. 1986. Organizational ecology: Findings and implications. Academy of *Management Review* 11: 513-533.

Yamaguchi K. 1991. *Event History Analysis.* Newbury Park CA. Sage Publications.

Zuckerman E. W., Kim T.-Y., Unkanwa K. and J. von Ritman. 2003. Robust identities or non-entities? Typecasting in the feature film labor market. *American Journal of Sociology* 108: 1018-1074.