RIDING THE WAVE: DISTRIBUTIONAL PROPERTIES AND PROCESS EXPLANATIONS OF MERGER AND ACQUISITION WAVES

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ABSTRACT

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Although Mergers and Acquisitions (M&A) are potential value-creation opportunities, why they tend to occur in waves is a mystery to scholars and managers alike. Most models of M&A waves are unilevel, reductionist, and Gaussian, whereas wave patterns are arguably multi-level, emergent, and non-normally distributed. Using complexity theory, I interpret waves as *emergent* expressions of a *self-organized critical* ecology of firms conceptualized as a *complex adaptive system*. My observation that aggregate U.S. M&A waves from 1895 to 2008 are power-law-distributed lends support. The view that waves are self-organized critical phenomena, similar to earthquakes and avalanches, facilitates integration of prior wave theories. I then employ *process-tracing* to generate a historical narrative of the Great Merger Wave of 1898-1903, from which I obtain a *robust process* for waves consistent with a CAS interpretation of these phenomena: (1) a privatizing, market-expanding and financially innovating transportation network generates (2a) *laissez-faire* regulation, (2b) economic competition, and (2c) financial arbitrage, leading to (3) a burst of consolidation. My process explanation explains the power law's emergence, and may help to understand better the process dynamics of M&A waves.

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Pittsburgh, PA

1.0 INTRODUCTION

This dissertation focuses on a venerable management phenomenon: merger and acquisition (M&A) waves. M&A activity occurs constantly yet unevenly in cyclical non-periodic bursts, or waves (Barkoulas, Baum, & Chakraborty, 2001; Town, 1992). Their origin is a mystery, despite their having inspired a vast, hundred-year-old literature. M&A waves are also relevant to practice, since M&A at a wave's beginning can create value (McNamara, Haleblain, & Dykes, 2008; Moeller, Schlingemann, & Stulz, 2005). Thus, it is important for managers to "see them coming." Given the theoretical and practical import of understanding these phenomena better, an integrated description and explanation of M&A waves is needed.

The two essays of this dissertation are undergirded by a set of interlocking ontological, epistemological and methodological commitments. Ontologically speaking, I adopt an objectivist stance: the social world exists "out there," independent of human perception. In other words, M&A waves are real things that have an existence apart from various scholars' sensory observations of them. Epistemologically speaking, however, I adopt a subjectivist stance: that objective reality may be perceived differently, depending on one's unique cognitive framework. In other words, researchers may have different interpretations of M&A waves, depending on the theoretical paradigms they subscribe to. Therefore, methodologically speaking, I am a pluralist. In other words, to generate knowledge of social phenomena, neither quantitative nor qualitative

methodologies are unconditionally better than the other, but both complement each other in verifying the truth-claims scholars make about M&A waves. This set of philosophical commitments encapsulates the "critical realist" perspective (Johnson & Duberley, 2000).

Thus, both essays use the same integrative theory to make sense of the same objective reality. However, Essay One employs a traditional deductive, quantitative approach to *describe* M&A waves in terms of an empirical regularity observed in their overall distribution's statistical properties. Subsequently, Essay Two utilizes a less conventional inductive, qualitative method to *explain* the first essay's empirical regularity in terms of a narrative outlining a set of social processes inferred from a single M&A wave's historical context.

1.1 OVERVIEW OF ESSAYS

Current M&A wave research can be summarized as follows: M&A waves happen during stock market booms (Nelson, 1959), are prompted by technology shocks (Gort, 1969; Mitchell & Mulherin, 1996), involve the arbitraging of firm securities (Rhodes-Kropf, Robinson, & Viswanathan, 2005; Rhodes-Kropf & Viswanathan, 2004; Shleifer & Vishny, 2003), are motivated by managerial search processes (Iyer & Miller, 2008), and involve a social contagion process (Haunschild, 1993; Stearns & Allan, 1996). These findings originate from macroeconomics, neoclassical economics, behavioral economics, the Carnegie behavioral school, and sociology, respectively. Yet these paradigms begin with competing theoretical assumptions regarding the level and unit of analysis, (in)efficient markets, (boundedly) rational

managers, and primacy of M&A wave driver. Furthermore, each explanation works well for a few waves or just one wave, but often applies poorly to the others. Thus, a more integrated account of M&A waves can extend prior theories and perhaps explain some of the theoretical anomalies.

Complexity theory, or the study of complex adaptive systems (CAS), can provide such integration. In a CAS model, M&A waves are macro-level patterns generated from an ecology of firms competing for resources at the micro-level. Resource-competition gradually builds up pressure in the ecology until it is barely stable with respect to further perturbations, i.e. *self-organized critical* (SOC) (Bak, Tang, & Wiesenfeld, 1987). Then a SOC M&A wave dissipates the pent-up tension in a nonlinear return of the system to dynamic equilibrium. Further ongoing resource-competition again leads to recurrent, alternating states of tension and dissipation, and hence more SOC waves. By analogizing from other SOC phenomena such as avalanches and earthquakes, I try to integrate prior theories by (1) addressing macroeconomists' concern with stock and M&A markets' boom-bust patterns; (2) considering neoclassical economists' exogenous shocks as important; (3) embracing behavioral finance scholars' inefficient markets; (4) complementing Carnegie behavioralists' views of firms as goal-directed systems that use decision heuristics to adapt to performance feedback (Iyer & Miller, 2008); and (5) utilizing sociological diffusion processes.

Now the spatial and temporal "fingerprint" of CAS at the SOC state is the power law distribution of Paretian statistics (Bak, Tang, & Wiesenfeld, 1988). Thus, one tests whether a phenomenon hews to the CAS model by observing this empirical signature for the system, analogous to how a hunter infers the existence of a game animal by tracking its characteristic

prints in snow or mud. Essentially a straight line of negative slope on log-log paper, the power law means that a quantity N is expressed as a power of another quantity s: $N(s) \sim s^{-a}$. Some real-world power laws are shown in Figure 1. In the first essay, I observe a power law size-distribution of aggregate U.S. M&A waves from 1895 to 2008 (as shown in Figure 1), thus supporting a CAS model of them. In other words, most M&A waves are small, some are medium, and a few are very large, confirming a non-normal distribution for an essentially non-linear phenomenon.

The mysterious emergence of the power law distribution begs an explanation. Yet the small sample size of six M&A waves precludes regression analysis, and the indeterminacy of CAS makes feasible only a narrative account of events *post mortem* (Bak, 1996). Thus, the method of detailed predictions followed by reproducible experiments is untenable.

But in its stead, qualitative methods emphasizing small-n samples, narrative analysis and historical events are ideally suited for this situation. In the second essay, I use *process-tracing*, a within-case analytical technique, that combines certain elements of the case study and history. Like a case study, process-tracing tracks the development of a phenomenon of interest over time. And like a history, process tracing examines past events. Unlike a case study, however, process-tracing does not make use of contemporary sources, such as interviews. And unlike a history, process tracing does not simply tell what happened, but *argues* about what happened (Goldstone, 1991).

Process tracing identifies *robust processes* (Goldstone, 1991), which show that across different historical contexts, (1) similar initial conditions confront (2) actors, who react in similar ways, to produce (3) similar outcomes. Goldstone describes how Darwin's theory of evolution

through natural selection is a process: (1) reproductive competition among species with variation among individuals leads (2) reproductively successful individuals to diffuse their traits throughout the population, giving rise to (3) new species.

Through the process-tracing of books, government publications, and journal articles, I generate an initial atheoretical historical narrative. 19th century America grew from an agrarian society to a leading 20th-century industrial power. During the Civil War, the Federal government consolidated power by helping build railroads initially for military transport (Roy, 1997). Investment bankers financed railroad mergers while politicians regulated the privatized railroad industry as it took civilian passengers and commercial cargo. In the 1880s, modern managerial systems developed for railroads were applied to corporations, as functional departments were organized under single industrialists. Firms reached unprecedented size and scope to achieve cost efficiencies and scale economies, until a national market connected urban populations via a transcontinental railroad network (Chandler, 1959). In the 1890s, the Sherman Antitrust Act was only weakly enforced as exhibited in the E.C. Knight decision of 1895, while the McKinley Tariff protected domestic manufacturing for Eastern commerce, and the Sherman Silver Purchase Act aided Western farmers and miners honoring debts with inflated silver dollars. The Panic of 1893 derailed decades of progress, and the ensuing depression led to Robert McKinley's election as President on a pro-business platform. The Gold Standard Act of 1900 *de jure* ended bimetallism, while tariffs created attractive industries inviting domestic entry and generating price competition. Consolidation ensued (Commission, 1900; Commission & House, 1901) as industrialists utilized investment bankers to underwrite securities and promote M&A deals. As industrial stocks became popular (Navin & Sears, 1955), bankers profitably arbitraged securities

issues of the new consolidations. A robust market for corporate control emerged as M&A activity necessitated financing and profits from the latter enabled growth of the former. McKinley's assassination one year after re-election in 1900 allowed President Roosevelt to address "the trust problem," while monopolistic industry structures reduced competition, stabilized prices and halted further consolidation. Corporations inevitably were unable to pay dividends on overcapitalized stock, resulting in failure and reorganization.

With this narrative, I outline a robust process for the Great Merger Wave. As shown in Figure 2, (1) the development of a revolutionary transportation network which privatized, expanded markets, and financially matured, leads (2a) politicians to adopt *laissez-faire* regulation; (2b) industrialists to engage in economic competition, and (2c) financiers to participate in innovative arbitrage; all interacting in a (3) burst of consolidation. I also explain how the wave ends: (1) as the wave generates public outcry, monopolistic industry structures and firm overcapitalization, (2a) politicians enforce antitrust laws; (2b) industrialists engage in anticompetitive, inefficient strategies; (2c) financiers lose confidence in securities markets; all of which interacted to (3) quickly decelerate M&A activity.

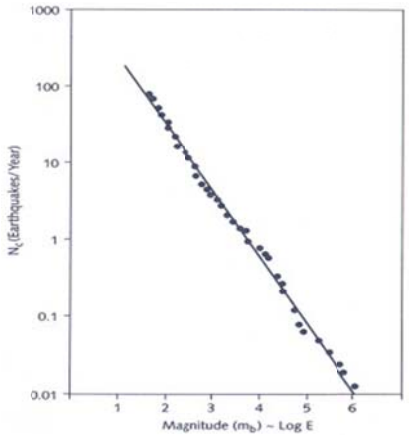
1.2 CONTRIBUTIONS AND IMPLICATIONS

Critical realism undergirds my dissertation. The first essay deductively proposes a theoretical descriptive model that is supported by quantitative data. The second essay then inductively analyzes qualitative data to create a theoretical process explanation of M&A waves.

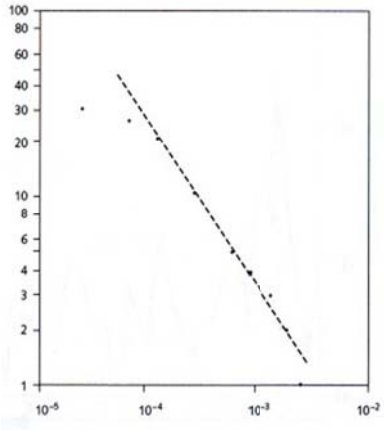
Thus, my dissertation provides an integrated *description* and *explanation* of M&A waves which could lead to future *prediction* of these phenomena. A potential third study would necessitate an extension of prior philosophical commitment to one of *pragmatic* critical realism, which would argue that the truth-claims of my CAS model and robust process are confirmed only when they solve "real-world" problems. Thus, a third essay might attempt to validate the second essay's process model with existing quantitative data. A valid model predicting M&A waves would allow for their anticipation and possible shaping in order to realize their value-creation potential. With this set of manuscripts covering description, explanation and, in the future, prediction of M&A waves, I hope to advance understanding of these mysterious and relevant phenomena.

Figure 1. Some Power Law Distributions Exhibiting Self-organized Criticality

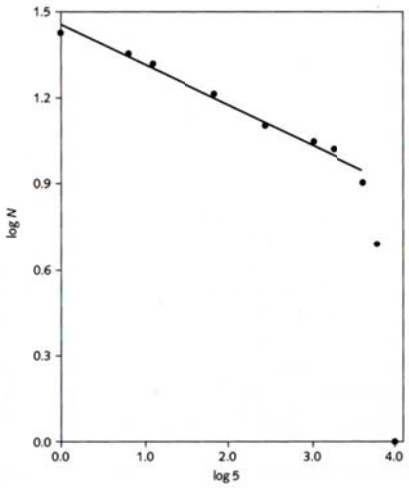
Earthquakes (Johnston & Nava, 1985)



Variations in Cotton Prices (Mandelbrot, 1963)



Pulsar Glitches (Garcia-Pelaya & Morley, 1993)



M&A Waves (based on current analysis)

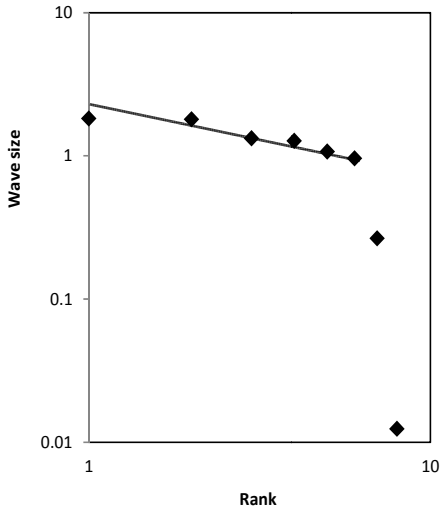
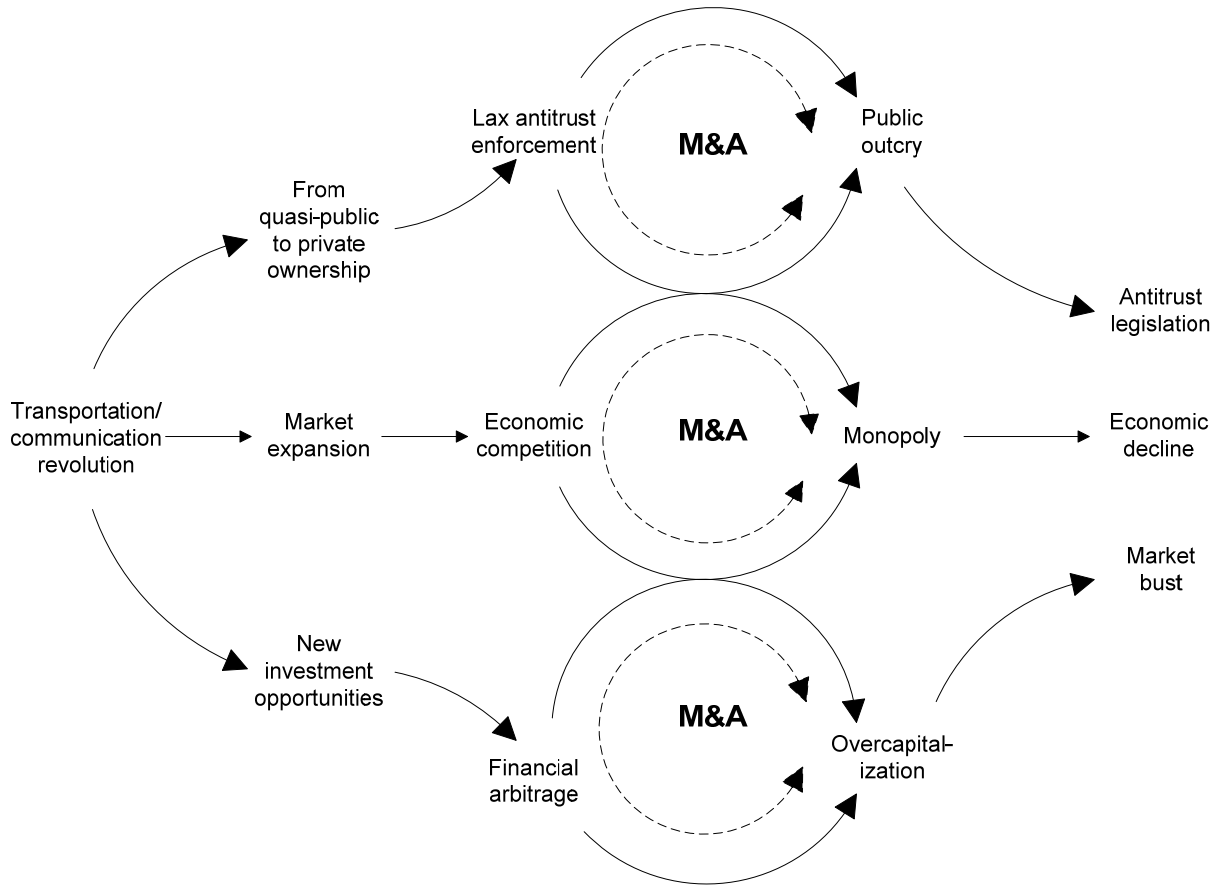


Figure 2. A Process Model of M&A Waves



2.0 ESSAY ONE: BIG SURF: SELF-ORGANIZED CRITICALITY IN MERGER AND ACQUISITION WAVES

Even after a century of debate, Merger and Acquisition (M&A) waves remain a mystery to economists, sociologists, finance scholars and strategists alike. Brealey and Myers regard M&A waves as one of the ten most important unsolved questions in financial economics. Various explanations for their occurrence have been suggested, such as capital markets drivers (Nelson, 1959), technological innovations (Gort, 1969; Mitchell & Mulherin, 1996), firm securities misvaluations (Shleifer & Vishny, 2003), corporate board interlocks (Haunschild, 1993) and managerial responses to performance feedback (Iyer & Miller, 2008). While each of these accounts has merit, they emerge from competing theoretical paradigms, and provide only partial explanation, as they do not explain why waves keep coming back. In this paper, I offer an alternative interpretation in which M&A waves are part of the evolutionary dynamic of an ecology of firms, and I provide preliminary empirical support.

Existing M&A wave models tend to be unilevel, reductionist and Gaussian; yet they attempt to describe a phenomenon that is arguably multilevel, emergent (Lovejoy, 1927) and non-normally distributed. Thus, we suggest that a *complex adaptive systems* (CAS) model is a likely candidate for better explanation of M&A waves. In a CAS model, M&A waves are *emergent* macro-level patterns resulting from the collective behavior of many firms competing

with each other for resources at the micro-level. M&A waves are evidence that the system of firms builds a *self-organized critical system* (SOC) (Bak, 1996), i.e., M&A waves occur when the ecology of firms develops some instability as part of its evolutionary dynamic, and are a mechanism of return to a form of dynamic equilibrium, a state that characterizes the system's life between waves. Over time, long periods of near-dormant equilibrium (low M&A activity) alternate with short, spasmodic bursts of dissipative change (the M&A waves), a longitudinal dynamic known as *punctuated equilibrium* (Eldredge & Gould, 1972). Self-organized Criticality is ubiquitous in nature, from earthquakes to mass extinctions and meanders in rivers.

The empirical signature of SOC phenomena is the power law distribution (Bak et al., 1987, 1988) which follows a negatively sloping straight line on log-log paper. I looked to see if M&A waves' size distribution expressed a high frequency of small waves in one tail and a low frequency of large-size observations in the other tail. I find that from 1895 to 2008, most aggregate U.S. M&A waves are small, some are medium, and a few are very large, which supports a CAS model of M&A waves, and suggests that they are indeed multilevel, emergent and non-Gaussian. The CAS model is multi-level because it features a large number of adaptive organizations which interact using simple rules to generate complex aggregate M&A wave patterns. The CAS model expresses emergence because the power law distribution "mysteriously" originates from SOC M&A waves and cannot be easily explained by modeling the interactions of the individual firms (Morel & Ramanujam, 1999). Finally, CAS models are non-Gaussian because they rely on Paretian power laws instead of normal bell-curves.

Because SOC M&A waves share the dynamical processes of SOC earthquakes and avalanches, I analogize from them in order to integrate prior M&A wave theories. In this first

essay, I review prior literature, and then posit a CAS model. The empirical analysis and results follow, and I conclude with a discussion of implications to research and practice.

2.1 LITERATURE REVIEW

I first cover the three economic theories of M&A waves, followed by behavioral and sociological accounts. Subsequently, I introduce complexity theory.

2.1.1 Economic Theories of M&A Waves

The three economic M&A wave theories focus on different levels and units of analysis, and differ in their assumptions of market efficiency and manager rationality. Macroeconomists subscribe to the "capital markets" thesis at the aggregate level. Neoclassical economists argue the "industry shocks" thesis at the industry level. Behavioral economists advocate the "firm misvaluation" thesis at the deal level. All three theories assume manager rationality. However, the first two assume efficient markets, while the third assumes inefficient markets.

2.1.1.1 Capital markets

This hypothesis suggests that macroeconomic variables drive M&A activity. Specifically, a market for corporate capital was necessary to absorb the large securities issues of

the consolidations of the turn of the 20th century M&A wave, as well as allow financiers and promoters to induce independent business owners to submit their family legacies to the large corporations of the era (Nelson, 1959; Roy, 1997). The empirical support is the robust positive correlation of stock prices (as an indicator of capital market conditions) with aggregate M&A activity. However, this thesis does not adequately explain stock or M&A boom-bust patterns.

2.1.1.2 Industry shocks

Neoclassical economists focus on external industry-level shocks, whether technological, regulatory or economic, triggering industry-wide reallocation of asset ownership via the least-cost method: M&A. Shocks create discrepancies in investors' valuations of firms, which fosters economically rational M&A activity when the firm's assets are valued more highly by non-owners than owners (Gort, 1969). Aggregate waves are combinations of multiple industry waves occurring simultaneously (Harford, 2005).

The shock thesis is persuasive as well as compatible with the capital markets thesis, and it also explains industry wave clustering. However, both hypotheses are based on two somewhat problematic assumptions: (1) efficient markets and (2) manager rationality. The first is difficult to defend against evidence of market manias (e. g., the Internet M&A bubble of 1995-2000) and recent discoveries in behavioral finance (Shleifer, 2000). Moeller, Schlingemann & Stulz (2005) also observed that M&A returns in the 1990s wave were non-normally distributed,

violating the random walk hypothesis that securities price changes reflect random information.[1] Regarding the second assumption, behavioral economists (Kahneman & Tversky, 1979) have observed cognitive biases in human economic decision-making. Also, humans arguably rely on rules of thumb and experience—induction—just as much as rational utility-maximizing calculus—deduction (Mauboussin, 1997). The shock thesis thus rests on assumptions which behaviorally oriented researchers may find problematic.

2.1.1.3 Firm misvaluation

Behavioral economists focus on the M&A deal and assume inefficient markets. During buoyant stock markets, managers of highly overvalued acquirers rationally arbitrage their stock to purchase less overvalued targets (Shleifer & Vishny, 2003). Acquirers know that their stock's long-term value is lower than reflected in the current price, so by buying targets for stock, acquirers make these returns less negative. In turn, targets achieve short-term gains from being acquired. Rhodes-Kropf & Viswanathan (2004) further explain that each new M&A in an inefficient market increases the general expectation that the synergies of all firms are high, motivating managers to engage in more M&A. Yet, with each additional deal the increase in expectations decreases, until the true value of the synergies is recognized and the M&A market crashes when individuals begin to question the value of the deals (Bruner, 2004).

[1] Random walk theory implies a normal probability distribution of returns, which in turn implies efficient markets.

In sum, the misvaluation thesis explains the form of financing (stock during booms, cash during busts) used during M&A waves. However, unlike the industry shock thesis, it does not address wave clustering by industry.

2.1.2 **Behavioral Explanations of M&A Waves**

For behavioral scholars (Iyer & Miller, 2008), rational-actor models of strategic action cannot account for the variations among firms over time in the intensity of search for M&A targets. Assuming that all firms are identical, if all managers reacted rationally, they would act identically toward targets.

Instead, managers are "boundedly" rational due to psychological limits on their cognitive information-processing capacities when operating in complex, uncertain environments. They therefore "satisfice," or attain realistic goals instead of economically maximize. The resulting inefficiencies either generate organizational slack (i.e., extra unused human and financial capital) which motivates experimentation in the pursuit of new M&A, or induce performance below managerial expectations, leading to problemistic search for solutions in external targets.

Although this unique framework helps us understand the drivers of M&A timing patterns, industry and aggregate waves are left unexplained. Also, bounded rationality and satisficing are not compatible with economic assumptions of pure rationality and utility-maximizing.

2.1.3 **Sociological Explanations of M&A Waves**

A research stream examining diffusion processes in social movements and organizational fields exists in the M&A literature. These contagion models involve an originating source disseminating and communicating the M&A strategy to adopters exposed to the practice or its beneficial consequences, and who engage in mimicry or social learning (Strang & Soule, 1998).

Haunschild (1993) observed that for the 1980s wave, board interlocks allowed knowledge about M&As to disseminate, diffusing the practice among firms. Stearns and Allan (1996) noted similarly that then-fringe players and institutions like Michael Milken and Kohlberg, Kravis & Roberts adopted financial innovations like the leveraged buy-out or junk bond financing to execute M&A deals, the initial success of which facilitated widespread imitation throughout the business community. Stearns et al. (1996) thus concluded that all waves are preceded by: (1) a permissive politico-legal climate; (2) "challenger" fringe actors in the organizational field; (3) challengers' greater access to capital markets; (3) an innovation playing a key role in raising M&A activity; and (4) the introduction of the innovation by the challenger.

Yet although we know board interlocks enable imitation, the drivers of imitation are less understood. It is also unclear why fringe actors would abruptly emerge to challenge the business establishment, or why innovations would suddenly arise to facilitate M&A activity.

2.2 COMPLEXITY THEORY AND M&A WAVES

In sum, we know that waves can be preceded by technological shocks, and can occur in a positive economic and regulatory environment, amidst rapid credit expansion, and during stock market booms (Martynova & Renneboog, 2008). But these observations are assembled from competing theories, and provide partial explanation at best. A more integrated account of wave patterns that extends prior theory and explains some of the anomalies would be helpful.

I turn to complexity theory, or the study of complex adaptive systems (CAS), in search of such an integrated model. The central intuition is best illustrated by the metaphor of a sand pile cellular automata (Bak et al., 1987). Suppose I add grains of sand one-by-one onto a flat surface to generate a pile of sand. *Ceteris paribus,* the rate at which grains are dropped will correlate to the size of the sand pile generated. Over time, the pile becomes gradually but increasingly steeper until, at a critical point, an avalanche suddenly occurs, quickly collapsing the pile, which then rebuilds upon further addition of sand. An external, localized perturbation such as a small gust of wind can cause a local avalanche. The grains themselves obey the law of gravity on their unique trajectories when dislodged. The degree of friction between grains determines the size and likelihood of an avalanche (Bak et al., 1988). The pile consistently approaches the same critical steepness before each avalanche, while the avalanches themselves cannot be easily inferred from the individual movements of the sand grains, but rather are empirically verifiable phenomena that emerge (Lovejoy, 1927) at an aggregate level of analysis.

Analogizing from the sand pile to M&A activity shows the theoretical value of a CAS model. The capital market thesis notes that, *ceteris paribus,* the rate of M&A activity (the rate of

dropped grains) correlates to higher stock prices (the size of the sand pile representing the macroeconomy), yet the pattern over time is one of M&A booms (gradually increasing buildup of the pile) alternating with M&A busts (the dramatic drop-off of an avalanche in the pile, which then requires rebuild). The shock thesis argues that perturbations to multiple industries (i.e., multiple wind gusts) can set off an aggregate M&A wave (a large avalanche). The firm misvaluation thesis argues that each new misvalued M&A (each new dropped sand grain) increases the inefficiency in the M&A market (the sand pile gets steeper and steeper) until their true value is revealed (the SOC state), at which point the M&A market crashes (an avalanche). Behavioral scholars suggest that organizations (the grains) are uniquely goal-directed systems (obey the law of gravity) that respond characteristically (fall down) to performance feedback (when dislodged). Sociologists believe that the interlock among company boards (the friction between grains) determines the M&A strategy's diffusion (an avalanche) throughout the business community (the sand pile). The consistent return of challenger "fringe" actors in a business community (the consistent approach to the SOC state in the sand pile) occurs right before an M&A wave (an avalanche). While each model offers a plausible account of how sand grains behave, M&A waves (like avalanches) cannot be reduced to the movements of the individual firms in the economy (the individual grains in the pile), but are empirically verifiable phenomena that emerge at an aggregate level of analysis.

In contrast, a CAS model can integrate prior theories by: (1) addressing the capital markets thesis's concern for the boom-bust patterns in M&A activity; (2) attending to the shock thesis by considering exogenous shocks as important; (3) embracing the misvaluation thesis's assumption of inefficient markets; (4) complementing the behavioral theory's understanding of

firms as goal-directed systems that use decision heuristics to adapt to performance feedback (Iyer & Miller, 2008); and (5) utilizing sociological diffusion processes.

In the following sections, I describe the CAS model, the SOC mechanism, punctuated equilibrium, and the power law distribution.

2.2.1 **Complex Adaptive Systems**

A CAS is a system of interconnected and interacting components that, when subjected to a stressor or force, displays interesting aggregate patterns or behaviors essential to the system's survival. These global, collective behaviors or patterns are *emergent* (Lovejoy, 1927), or irreducible to the actions of the individual agents. CAS are typically characterized by (1) aggregation, (2) adaptive schema, (3) nonlinearity, and (4) feedback loops (Holland, 1995).

Consider a single ant, but one component of the ant colony. Each of these component agents has a set of narrowly defined tasks, or just one task (Mauboussin, 1997). However, engage a sufficiently large and interdependent *aggregation* of agents and what emerges is a functional ant colony. Ant colonies serve to fend off insect enemies and provide strength in numbers. The ants take in information from the environment and combine it with their own interaction with the environment to form *adaptive schema* or decision rules (Gell-Mann, 1995) which compete according to their utility, creating adaptive behavior. CAS are also *nonlinear*: the aggregate behavior is more complicated than would be predicted by summing the parts (Mauboussin, 1997). For example, a basic predator/prey model with "feast and famine" patterns

is generated from the *product* of variables, not the sum, such that cause and effect relationships are no longer simply linear (Mauboussin, 1997). *Positive feedback loops* occur when the output of one iteration becomes the input of another iteration, thus amplifying the effect, similar to how an electric guitar amplifies the noise generated by the speaker it is plugged into, generating audio feedback. Positive feedback generates explosive, self-reinforcing behaviors, while negative feedback dampens a system's response to a stimulus.

Now analogize to firms. Individual firms have two basic tasks: (1) consume inputs (2) produce outputs. But engage a sufficient *aggregation* of interconnected and interdependent firms, with one firm's output being another firm's input, and the outcome is a thriving economy replete with competitive, cooperative, and predatory firm behaviors (such as M&A). Firms engage in these adaptive behaviors via the *decision-rules* obtained from the performance feedback managers receive from the surrounding economic environment. One firm's M&A changes the stances of its competitors, and subsequent defensive acquisitions may result in *feedback loops* among firms, triggering surges of M&A. This predator-prey dynamic between acquirers and targets generates the *non-linear* "feast and famine" pattern of emergent M&A waves alternating with long stretches of little M&A activity.

2.2.2 **Self-organized Criticality**

CAS naturally evolve to the *self-organized critical* (SOC) state, when they transition from mere collections of individual agents into vibrant emergent phenomena (Bak, 1996) poised

far out of equilibrium (Bak & Sneppen, 1993). Consistently adding sand grains onto a flat surface generates a pile of sand grains held together in a delicate interplay of forces (gravity and friction) which leads to avalanches every time a critically steep slope is reached, so that the pile "self-organizes" to this state. Avalanches are the mechanisms for the SOC system to dissipate built-up tension and energy in a non-linear return to unstable equilibrium, much like earthquakes that violently dissipate the accumulated tension of continental plates when the earth's crust cracks. Analogously, as the business cycle progresses, firms become increasingly interdependent via M&A (like dropping sand grains that form a whole interconnected pile) occurring at a nominal, "linear" rate. This process subjects the firms participating in the M&A market to increasing tension as a result of their interconnectivity. Once the economy achieves the SOC state, even a single additional M&A (like one dropped grain) can unleash an outbreak of deals via the interdependence among firms in the M&A market. These M&A waves are SOC phenomena expressing a non-linear return to dynamic equilibrium.

2.2.3 **Punctuated Equilibrium**

CAS are "alive," and their activity over time is one of relative equilibrium interrupted by catastrophic instabilities, similar to mass extinctions in the fossil record. Kauffman (1993) argued that life itself, in its nonlinear evolution over time and its admixture of inert order and random chaos, is complex. Do M&A patterns express an evolutionary dynamic similar to that of biological evolution?

If so, perhaps their overall development and change embody *punctuated equilibrium* (Eldredge & Gould, 1972), a theory which positions itself in distinction from the Darwinist argument for gradual and smooth evolutionary change. The basic settings of a biological ecosystem—(1) tension from a struggle for survival and (2) interconnectivity of interdependent species—produce long periods of incremental evolutionary change that are "punctuated" by mass extinctions which precede periods when the ecology undergoes a fast rebuild, hence the appearance of so many new species seemingly instantaneously.

For example, consider an ecosystem comprising interconnected organisms, species and the surrounding habitat. The interconnectivity of organisms produces an evolutionary dynamic, as embodied in ongoing natural selection from the struggle for survival. This dynamic aggregates random changes over many successive generations of species as the less fit are naturally "discarded," so the interaction of interdependent organisms is relatively stable most of the time. But at some point in time, a significant advantageous variation cumulates to a species' organisms, leading quickly to frustrated and intensified predation of predator and prey species, respectively. These species, in turn, become ravaged, and their sad fate in turn harms other related predators but benefits other related prey. Thus, one adaptation in a single organism or species can trigger mass extinctions throughout the entire ecosystem.[2]

Analogously, consider organisms as firms, species as industries, and the economy as their habitat. The adaptation processes of evolution in an aggregation of vitally interconnected firms proceed in natural selection as the aggregated effect of random M&A activity as less "fit," i.e.

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[2] Bak & Sneppen (1993) modeled punctuated equilibrium of species in an ecosystem by simulating both their adaptive mutations and their interdependencies, an exercise that produced intermittent bursts of evolutionary activity alternating with long periods of calm.

economically viable, firms naturally become "extinct," i.e., acquired. For long periods, this competitive dynamic among firms is relatively stable. But over time, some firms accrue slack resources in interacting with competitors, and these firms build on their adaptive success by engaging in M&As (Iyer & Miller, 2008) which represent the subsuming of a firm by a "fitter" one in an ecological niche (Bak & Sneppen, 1993). Soon thereafter, intraindustry competitors become horizontal M&A targets as the adapted firms sow the seeds for future generations of firms in the industry (i.e., species). Along the value chain, "prey" firms providing inputs to the adapted firms or "predator" firms consuming adapted firms' outputs become preemptive targets of vertical integration. The adapted firms also diversify vis-à-vis M&A as they interact in selection processes and establish symbiotic relationships with other species' organisms, i.e., with related and unrelated industries' firms. Eventually, whole industries-species compete with other industry-species, resulting in mass firm extinctions: an aggregate M&A wave. Thus, a single M&A deal can trigger off an aggregate M&A wave throughout the entire economy.

2.2.4 **The Power Law Signature**

In punctuated equilibrium, a CAS builds up evolutionary pressures over long periods of seeming stasis until the SOC state is reached, destabilizing the system and generating sudden bursts of systemic, revolutionary change. This pattern violates Gaussian assumptions that extreme events happen but rarely, that the future can be predicted from the past, and that linear proportional cause-effect relationships hold. In contrast, Paretian statistics seem to fit a

punctuated equilibrium account of waves better. In a Paretian world, the past is not a good predictor of the future, small causes can have big effects (or large influences can lead to insignificant outcomes), and large earthquakes, stock market crashes, torrential floods and mass epidemics occur often.[3] Likewise, M&A waves are hard to predict, their purported causes are disproportionately small to the wave effect, and they are non-trivial and extreme events.

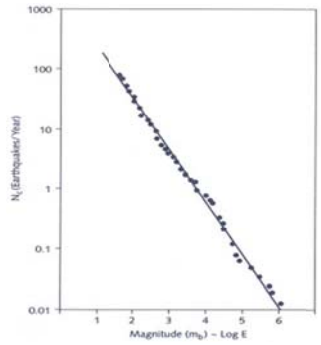
But how can we show that M&A waves hew to a CAS model? By observing a Paretian power law distribution for the wave system. Like a hunter inferring the existence of a game animal by observing its characteristic footprints in mud or snow, Bak, Tang and Wiesenfeld (1987, 1988) originally described the spatial and temporal "fingerprint" of the SOC state as "1/f noise," or the power law distribution (also known as Zipf's law or the Pareto distribution). Some real-world power laws are shown in Figure 3. In geophysics, for every 1000 earthquakes of magnitude 4 on the Richter scale, there are 100 magnitude-5 earthquakes, 10 of magnitude 6, and so on (Johnston & Nava, 1985). A similar mathematical relationship holds for pulsar glitches (Morley & García-Pelayo, 1993). Pulsars are spinning neutron stars, and glitches happen when the pulsar's rotation changes suddenly. The relationship of a glitch's size to its frequency of occurrence follows a power law. Benoit Mandelbrot recorded the number of months in which cotton prices changed from the prior month by 10% – 20%, 5% - 10%, and so on. The relationship of the number of months to percent variation follows a power law (Mandelbrot, 1963). Raup (1986) plotted the extinction intensity during the Phanerozoic Period to the number of extinctions during that time, an exercise which generated a power law distribution. Brunk (2002) hypothesized that societies regularly collapse through wars in a nonlinear, self-organized

[3] In other words, traditional statistical analysis *is* Gaussian; a power law distribution reflects a Paretian *dynamic*.

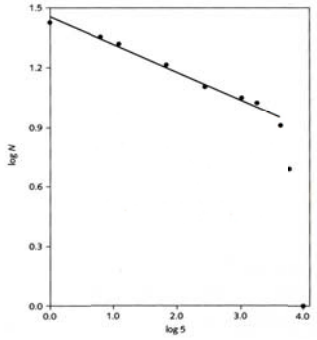
critical process, as shown in log-plotting war deaths to their frequency. Electricity blackouts are often attributed as evidence of SOC. Carreras, Newman, Dobson and Poole (2004) observed that the number n of North American customers from 1984 to 1998 subject to blackouts plotted against the number of blackouts with more than n customers followed a power law.

Figure 3. Various Power Law Distributions Exhibiting Self-Organized Criticality

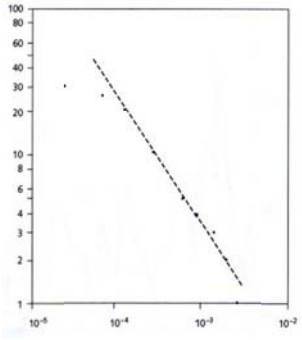
Earthquakes (Johnston & Nava, 1985)



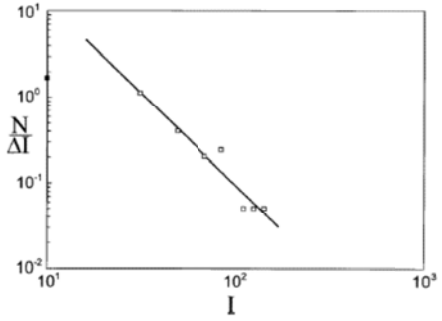
Pulsar Glitches (Garcia-Pelaya & Morley, 1993)



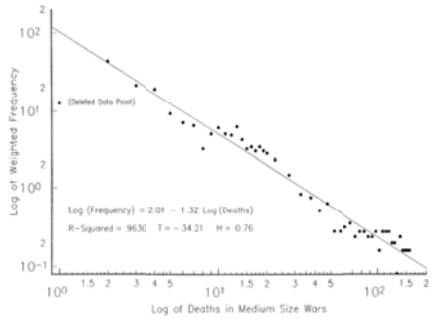
Variations in Cotton Prices (Mandelbrot, 1963)



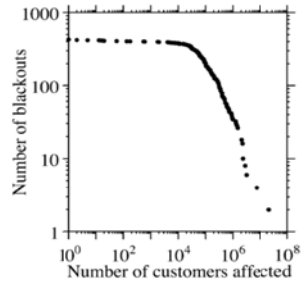
Biological Extinctions (Raup, 1986)



Wars (Brunk, 2002)



Electricity Blackouts (Carreras et al., 2004)



The power law, Zipf's law and Pareto distribution are mathematically equivalent. Zipf (1949) initially examined the "size" or frequency of words in an English text. Zipf's Law states that the size of the *r*th largest occurrence of the event is inversely proportional to its rank:

$$y \sim r^{-b},$$

where *b* is usually unity (i.e., one). Economist Vilfredo Pareto examined the distribution of wealth in an economy, and Pareto's law is given in terms of the cumulative distribution function, i.e. the number of events larger than *x* is an inverse power of *x*:

$$P[X > x] \sim x^{-k}.$$

Zipf and Pareto laws involve inverted axes. For Zipf, rank and size are on x- and y-axes, respectively, whereas for Pareto the two are reversed. So if the rank exponent is *b*, i.e. $y \sim r^{-b}$ in Zipf, then the Pareto exponent is *1/b* such that $r \sim y^{-1/b}$.

In turn, a power law is the probability distribution function associated with the cumulative distribution function of Pareto's Law, or

$$P[X = x] \sim x^{-(k+1)} = x^{-a}.$$

Since the power law is a derivation of Pareto's Law, the power law exponent is $1+1/b$ (Adamic, 2000).

The power law exponent can be informative, but because it may be generated from different mechanisms its value fluctuates. Zipf posited "the principle of least effort," or the idea of individuals trying to minimize their efforts, as the stochastic mechanism reflecting the author's idiosyncrasies that generate the word frequencies to produce a rank exponent of one. Yet Simon (1955) claimed that the Zipf exponent is directly related to the probability that a new word which had never appeared before is added to the text. Thus, the rank exponent may not be

one. In distinction, Pareto's law emerges from the many interactions among a society of economic actors, and deserves a less statistical mechanism than Zipf's. Finally, SOC expresses dynamical processes, like competition for resources in an ecology, and thus no optimal mathematical derivation of the power law exists, only evidence via "cellular automata" like Bak et al.'s (1987) sand piles. Therefore, the interpretation of the value of the exponent is ultimately context dependent.[4]

Power law-distributed M&A waves would imply that they are SOC and that a CAS model is a good fit for them. Because power laws imply systemic instability vis-à-vis SOC (a known mechanism for generating complexity) (Bak, 1996), SOC waves would therefore be mechanisms for dissipating the accumulated tension of long-range forces in the M&A system, returning it to dynamic equilibrium in a non-linear fashion. Additionally, waves would share the same underlying mechanism generating complex behavior as in avalanches for sand piles, earthquakes for tectonic plates, glitches for pulsars and price variations for commodities markets.

2.3 METHODOLOGY

I first obtained an M&A time-series, and then identified M&A waves for a Zipf plot.

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[4] In some cases, as in the size distribution of nuclear accidents, the rank slope should be one because human planners keep the expected cost of an accident constant when investing resources into safety measures,. In contrast, the power law distributions for connectivities in social networks emerge from the finding that the probability of being influenced by or imitating others depends on the number of neighbors doing something (Watts, 1999), and so the exponent differs for each specific network.

2.3.1 **Obtaining U.S. M&A data**

Town's (1992) z-scores covering 1895:1-1989:1 is one of the few complete historical M&A time-series covering aggregate U.S. industrial M&A.[5] I added z-scores from 1989:2–2008:2, and in doing so I sought consistency with the four series comprising Town's (1992): Nelson (1959) 1895:1–1919:4; Thorp , 1920:1–1954:4; the Federal Trade Commission's (FTC) Large Merger Series 1955:1–1979:4; and Mergers and Acquisitions Magazine 1980:1–1989:1. Each source, except for the non-appraised Thorp series, differed on the following categories: (1) public vs. private transactions; (2) whole or partial deals; (3) U.S. or non-U.S. buyers; (4) announcement vs. completed/effective date; (5) degree of industry inclusion.

1) Public transactions only. All series except for M&A magazine included only publicly listed firms, so I excluded private transactions.

2) 100% whole M&A deals. Nelson utilized whole firm disappearances; FTC did not distinguish between full and majority deals; and M&A magazine included deals of 5% ownership or more changing hands. I chose 100% whole ownership deals, since M&As should represent a significant shift in the market for corporate control.

3) U.S. and non-U.S. buyers of U. S. targets. Nelson mentioned no cross-border deals, but FTC and M&A magazine included non-U.S. buyers. Furthermore, U.S. M&A by non-U.S. buyers represented an increasingly significant portion of the M&A market from 1989-2008.

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[5] The data is available at Research Papers in Economics (RePEc): http://ideas.repec.org/p/boc/bocins/merger.html

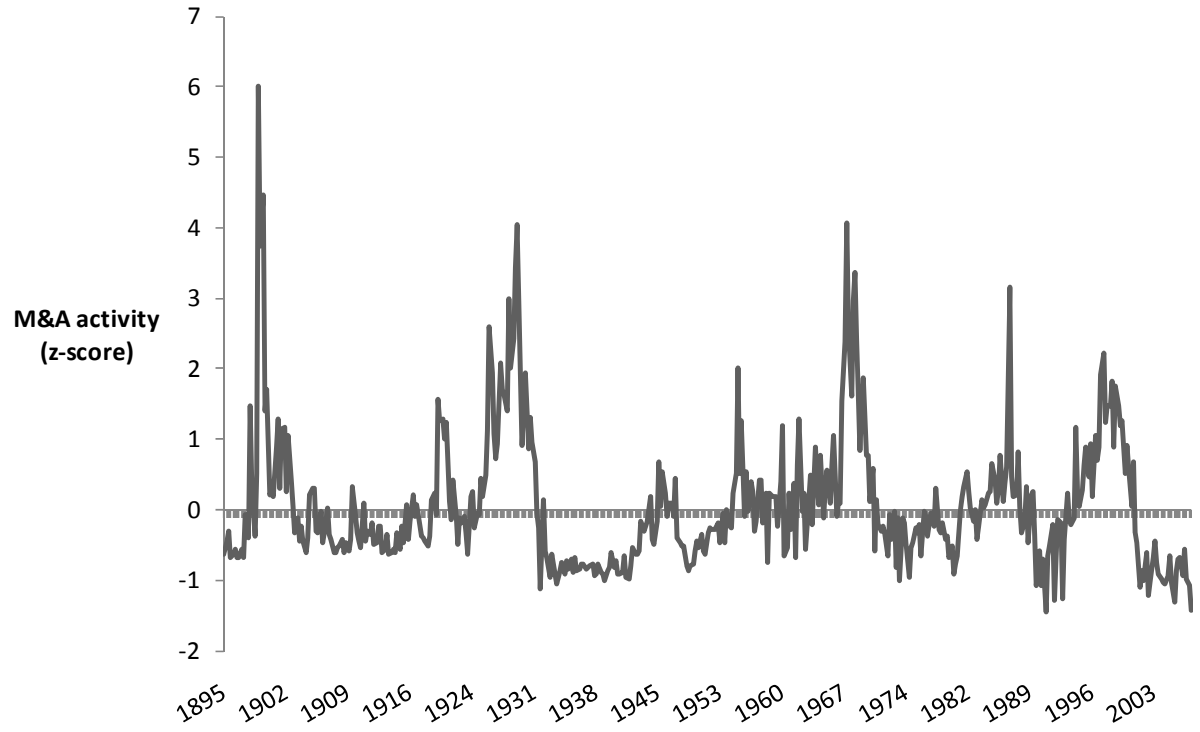
4) Announcement date (of completed deals). Nelson, FTC and M&A magazine were based on announcements in the financial press, and SDC provided announcement dates. I included completed announced deals since Nelson considered long-standing firm disappearances, FTC took into account consummated deals, and M&A Magazine removed cancelled deals.

5) All industries. Manufacturing and mining for Nelson and FTC comprised most of the U.S. economy then (although this is debatable toward the end of FTC). M&A magazine included all industries in its universe of firms. Thus, I included all industries for 1989-2008 to capture the overall economy.

I then normalized and standardized the raw data. SDC records corporate transactions of $1 million and over from 1979–1992, and all deals from 1993-present. Coverage in SDC from 1979-1982 is spotty, and not all items were available. Therefore, for 1983:1-1992:4 I divided the number of M&As by the yearly number of active U.S. corporations with assets above US $1 million, and for 1993:1-2008:1, by the yearly number of all active U.S. corporations.[6] I standardized the two series (1983:1-1992:4 and 1993:1-2008:2) per the equation $n_{y\tau} = \frac{(y_\tau - \mu_y)}{\sigma_y}$ where y_t is the series and μ_y and σ_y are the sample mean and standard deviation of y_t, respectively. Figure 4 shows the resulting time-series of aggregate U.S. M&A activity from 1895 to 2008.

[6] I obtained data on corporations 1994–2007 from the Internal Revenue Service Statistics of Income at http://www.irs.gov/taxstats/article/0,,id=170544,00.html.

Figure 4. Time Series of Aggregate U.S. M&A activity, 1895-2008



Sources: 1895:1–1989:1: Town, RJ. 1992. Merger waves and the structure of merger and acquisition time-series. *Journal of Applied Econometrics* 7: S83-S100. 1989:2 – 2008:2: Securities & Data Company (SDC) database published by Thomson Financial.

2.3.2 **Defining a Wave**

Defining a wave proved to be an arbitrary process. Carow et al. (2004) identified M&A waves from inception to peak and back down in six-year windows. Harford (2005) compared the highest frequency of industry M&A activity in 2-year windows against simulations. McNamara et al. (2008) recorded M&A waves as increases over 100% from a base year to decrease by over

50% from peak year, in six-year windows. In my search, I avoided time windows and simulations in favor of a more rigorous approach.

I employed **strucchange** in R (Bai & Perron, 2003; Zeileis, Kleiber, Kramer, & Hornik, 2003; Zeileis, Leisch, Hornik, & Kleiber, 2002) which tests for structural change in linear regression models. For Figure 4, it records significant shifts in the mean of the series but ignores random noise. I defined an M&A wave as a significant upward structural change from a baseline $z = 0$ M&A activity to a peak, with a subsequent significant decrease below $z = 0$. The minimum wave length was set at three quarters (beginning, middle and end). **Strucchange** produced 27 "breakpoint" quarters where mean shifts occurred, creating 28 segments. I identified changes in the series mean from negative to positive and back to negative. A wave began with the quarter after the breakpoint separating a negative from a positive segment. The wave ended with the breakpoint quarter (inclusive) preceding the next negative-mean segment. At one point a negative trough preceded a positive peak, descended to a *positive trough*, and then increased to a positive peak before descending to a negative-mean trough. Therefore, the first wave ended at the breakpoint quarter (inclusive) separating the first positive-mean peak and the positive-mean trough. The second wave began with the quarter after the breakpoint separating the positive-mean trough from the second peak. Consequently, no overlap existed between the waves, and they were not adjacent to each other.

For wave size, I considered amplitude (highest z-score), duration (length in quarters), a combination of amplitude and duration, and intensity (average z-score). For Zipf's Law, I ranked the waves by intensity from largest to smallest, placing "1" first, and plotted rank to size.

2.4 RESULTS

Table 1 presents the descriptive statistics, a chronological ordering of M&A waves ranked by size.

Table 1. Chronological Ordering of U.S. M&A Waves with Various Rankings

Wave period	*Amplitude (z)*	*Duration (qtr)*	***Combined Rank***	*Intensity ($\bar{z}$)*
1898:1-1902:4	6.012 (1)	20 (4)	***1***	1.326
1920:1– 1921:1	1.572 (7)	5 (7)	***7***	1.274
1925:4– 1931:2	4.045 (2)	23 (3)	***2***	1.793
1943:4– 1947:4	.681 (8)	17 (5)	***5***	0.012
1954:4– 1955:3	2.001 (6)	4 (8)	***6***	1.070
1967:2 – 1970:4	4.062 (3)	15 (6)	***4***	1.819
1981:1– 1989:3	3.146 (4)	35 (1)	***1***	0.265
1994:3– 2001:2	2.215 (5)	28 (2)	***3***	0.960

Note: Ranks in parentheses.

Strucchange dates the historical M&A waves more accurately than anecdotal evidence: 1898:1–1902:4, 1925:4–1931:2, 1967:2–1970:4, 1981:1–1989:3 and 1994:3–2001:2. For amplitude, the 1900s wave is the largest, with the 1920s wave placing second, the 1960s in third, and the 1980s and 1990s finishing fourth and fifth, respectively. For duration, the 1980s wave is

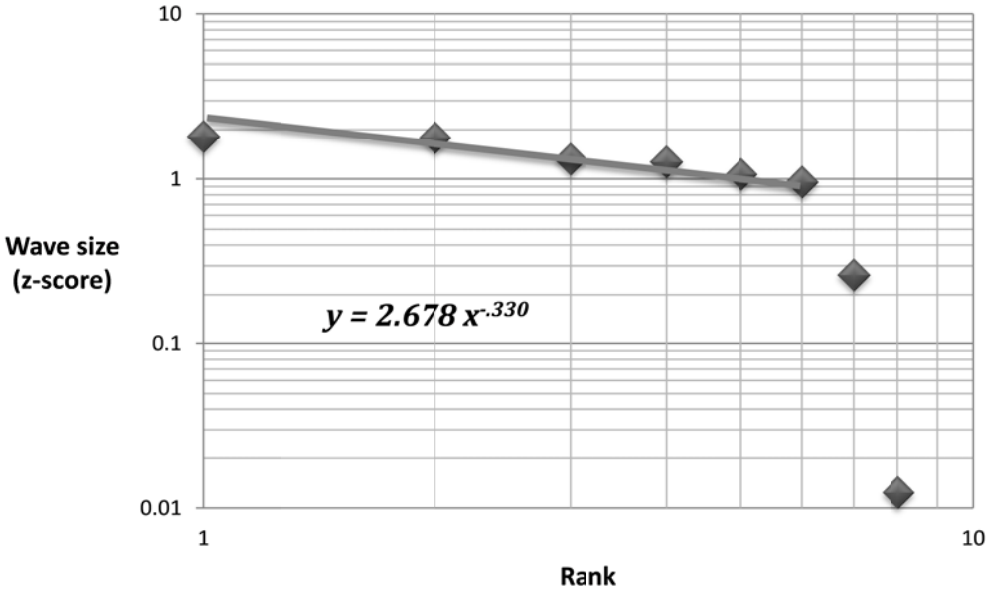
the longest, the 1990s wave second longest, the 1920s wave in third and the 1900s comes in fourth. The 1960s comes in sixth, with a post-WWII wave in fifth place. Missing from the accounts of Bruner (2004), Ravenscraft (1987) and Scherer & Ross (1990)—M&A scholars who list the same five large M&A waves—are spikes in 1920-1921 and 1954-1955 that admittedly rank lowest.

Thus, the amplitude and duration rankings are at odds with each other and with historical accounts. But when I rank amplitude and duration together equally for a "combined ranking," a more congruent historical picture emerges, as shown in Table 1: tied for first, (1) 1900s and 1980s, (3) 1990s, (4) 1960s and (5) 1920s.[7] The last three smallest waves—1920:1–1921:1, 1943:4–1947:4 and 1954:4–1955:3—are mentioned in Nelson (1959), and corroborated by Town (1992), who further adds 1960:1–1960:2 and 1962:1–1962:2. These last two, not listed by the other scholars, were not detected by **strucchange** because the minimum wave length was three quarters.

To combine the amplitude and duration metrics into a general intensity ranking I averaged the z-scores of the quarters comprising each wave. The results, shown in the right column of Table 1, reveal that the largest wave is $\bar{z}$ = 1.819 and the smallest is $\bar{z}$ =.012. Figure 5 shows Zipf's law for M&A waves by intensity on log-log paper, revealing the power law signature, a straight line of negative slope.

[7] To combine the two rankings, I first compared both for each wave, and chose the higher of the two to represent the wave rank. In the case of a tie between two waves, I gave precedence to the wave for which the second-category rank was higher. For example, the 1920s wave ranked second in amplitude and third in duration, while the 1990s wave ranked fifth in amplitude and second in duration. By ranking with the higher number, these two waves were tied for second. But because the 1920's wave was ranked third and the 1990's wave was ranked fifth in the secondary category, the former was ranked second, and the 1990's wave placed third.

Figure 5. Zipf's Law for M&A Waves, 1895-2008



Two small waves fall off of the line, requiring explanation. Like the roiling boil in a teapot that dissipates the stove's heat quickly, truly SOC waves are new-order creations (Prigogine, 1989) that dissipate environmentally imposed tensions. However, M&A activity is continuous and routine in the life of some firms, as when entrepreneurial biotech start-ups are acquired by established pharmaceutical firms to exploit a new drug discovery, or when computer software firms take over search engine sites to outsource that activity. These M&A do not generate dissipative effects, although M&A activity's stochastic nature generates uneven distributions in time which look like small waves. These small waves are spurious and are not expressions of order-creating dissipative feedback reacting to disequilibrium in the system.

In order to determine the equation for the line in Figure 5, I follow the procedure in the Appendix. I start with the sixth largest wave as x_{min}= .960. With Equations (1) and (2), I obtain a = 4.032. Working backwards, I find Zipf's rank exponent b = .330. With Equations (3) and (4) I calculate C = 2.678. Thus the equation for the power law is

$$\boldsymbol{y = 2.678x^{-.330}}.$$

To interpret this equation, I use the cumulative distribution function of Equation (1) in the Appendix. Thus, the probability of a wave greater than the largest wave in U.S. history (i.e., the area under the log-normal curve to the right of $\bar{z}$ = 1.819) is $\frac{\mathbf{2.678}}{\mathbf{4.032-1}}\mathbf{(1.819)^{-(4.032\ -\ 1)} = .144,}$ or 14.4%. In turn, the probability of a wave greater than the smallest wave in U.S. history (i.e., the area under the log-normal curve to the right of $\bar{z}$ = .960) is $\frac{\mathbf{2.678}}{\mathbf{4.032-1}}\mathbf{(.960)^{-(4.032-1)} = 1.00,}$ or 100%. Therefore, the probability of a wave with a size within the range of recorded U.S. history is **1 – .144 = .856**, or 85.6%.

In post-hoc analysis, I instituted a different wave definition to increase the sample size for the recently developed curve-fitting procedure of Clauset, Shalizi & Newman (2009) which determines the best-fitting distribution to a data set. I defined a wave as any undulation of the time-series from a negative z-score to a positive z-score and then back to a negative z-score, which increased the sample size to N = 44. Using **MATLAB**, I obtained x-min = .2135 for an equation of the new power law: $\mathbf{y = 1.8523\ x^{-2.2745}}$. The goodness-of-fit test between the data and the power law produced a Kolmogorov-Smirnov statistic = .104, p = .254, suggesting that the power law distribution is indeed a good fit to my data.

2.5 DISCUSSION

I described the population of U.S. firms as a *complex adaptive system*. I then suggested Bak et al.'s (1987) *self-organized criticality* construct as a generative mechanism for M&A waves. I also compared the M&A system to a biological ecosystem displaying the evolutionary dynamic of *punctuated equilibrium.* Afterwards, I introduced the "fingerprint" of SOC phenomena, the *power law* distribution, and observed such a distribution for M&A waves. Finally, I calculated that the probability of a wave larger than the most intense M&A wave in recorded history was close to 15%.

2.5.1 **Limitations**

Here I consider my study's limitations. Currently, Paretian dynamics do not admit of the same range of formal tests as that available for Gaussian statistics (such as tests of linearity and normality). Indeed, finding proper tests for a distribution's fit to a power law distribution, like Clauset et al.'s (2009) is an active area of research. Furthermore, many rank/frequency plots often follow power laws primarily in the *tail* of the distribution. The only alternative in such cases is to collect a sample size of waves large enough to analyze and test their distribution. However, over a 113-year period **strucchange** only produced eight waves, of which two were appropriately discarded. And, given that the six remaining M&A waves clearly matched other scholarly and anecdotal accounts, my method properly generated the correct data structure. Even

the post-hoc analysis with a larger sample size failed to offer an absolute, definitive conclusion. Furthermore, Clauset et al.'s (2009) procedure is only a curve-fitting exercise, and says little about the underlying mechanism generating the distribution of the data. Notwithstanding the exploratory nature of my investigation, I feel that the CAS model has much to offer. Some of those insights I share below.

2.5.2 **Embracing Existing Theory**

A CAS interpretation of M&A waves can serve to further inform previous theories. For example, for the capital markets thesis, perhaps the stock market is also a CAS whose aggregate patterns include emergent bubbles and crashes (Sornette, 2003). If the M&A and stock markets are intricately connected, as the sand pile metaphor suggests, perhaps both oscillate nonlinearly from frozen inactive states to hot disordered states in a predator/prey type dynamic.

For the industry shock thesis, shocks do happen, but perhaps they are not the primary cause, just as the cracking of the earth's crust is the more visible external trigger for earthquakes while the underlying friction of tectonic plates is the less obvious but more fundamental reason.[8] Analogously, an industry shock may *hasten* a wave as the more visible, but ultimately less important, precursor. Instead, evolutionary pressures in the firm ecology that have built up over time are the less visible, but more fundamental, triggers.

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[8] Similarly, some evolutionary biologists have suggested that an exogenous meteorite impact caused the dinosaurs' extinction, but arguably the dinosaurs were by then already becoming extinct (Bak, 1996). Rather than being the prime mover, a meteorite impact *hastened* extinction.

Regarding efficiency and rationality of the shock and misvaluation theses, complexity theory suggests that for M&A waves, firm behavior is irrationally herd-like, as in an avalanche when the grains in a sand pile naturally slide and fall together. But for non-wave periods, neoclassical efficiency and competition hold, as in the stillness of the pile as grains are added one-by-one (which is explainable by classical physics). At the SOC state, when the ecology of firms (like the sand pile) is just barely stable with respect to further perturbations, firms cooperate *and* compete in adapting to the environment.

A CAS model can also generate industry waves lacking in the misvaluation thesis. The biological metaphor shows how mass extinctions (aggregate M&A waves) begin with some organisms (firms) achieving evolutionary fitness to become their species' (industry's) progenitors. Soon after, predator and prey species (industries along the value chain) become endangered (via vertical integration). Meanwhile, fitter organisms establish relationships with other, formerly uninvolved prey species (i.e., (un)related industries suitable for diversification). Thus, industry waves occur with aggregate waves.

Additionally, a CAS model agrees with the behavioral theory's conception of firms as open, goal-directed systems that utilize M&As as adaptive responses to organizational slack and falling performance, like the adaptive schema CAS use to direct and modify behavior to shifting environments. Such heuristics are not consciously derived per se, but are not purely instinctual either. Instead, they represent the vibrancy of SOC.

Finally, for sociological theories, Watts (1999) observed that in "small-world" networks, the distribution of connections between actors follows a power law. Such a structure allows small local changes to generate large global cataclysms, so that a single M&A may cascade

throughout an interlocked business community. A CAS model may also suggest that fringe actors and financial innovations (Stearns & Allan, 1996) appear when the business network is SOC, as when the slope of a sand pile is SOC right before an avalanche.

2.5.3 **Connecting the CAS Model to Historical Waves**

To bolster my case for a CAS model, I correlate each M&A wave theory's driver or mechanism with an event from the five historical U.S. M&A waves, as shown in Table 2.

Macroeconomists points to the positive correlation between stock and M&A markets. In Table 2, the time period of each M&A wave corresponds to a period of elevated stock prices.

For neoclassical economists, shocks generate periods of asset reallocation via M&A. Table 2 reveals some distinctive shocks preceding each M&A wave.

Behavioral finance scholars mention firm securities' arbitrage causing an inefficient market to rise astronomically. Table 2 reveals such an occurrence for each historical wave.

The behavioral theory of the firm describes (1) organizational adaptation to performance feedback leading to (2) distinctive target search. Table 2 correlates each wave to one of each.

Finally, sociological explanations posit (1) fringe actors and (2) financial innovations prior to M&A waves spreading via (3) a change in corporate governance. I provide examples of each in the table.

Table 2. Table of M&A Wave Drivers Correlated with People and Events of the Five Historical U.S. M&A Waves

Theory	Theoretical Variable	Wave 1 1898-1903	Wave 2 1925-1931	Wave 3 1967-1970	Wave 4 1983-1989	Wave 5 1994-2000
Capital markets	Period of rising stock prices	Between Panic of 1893 & Panic of 1907	Roaring Twenties until Great Depression	The Go Go Years	1970s stagflation to market crash, October 1987	Between Recession of 1991 to 9/11
Industry shocks	Economic, regulatory or technological shocks	Electricity; Sherman Antitrust Act of 1890; McKinley Tariff of 1890	Automobile; Clayton Act of 1914; assembly line production	Jet service; Celler-Kefauver Act of 1950; Baby Boomer consumer demand	Microprocessor; Reagan Tax Act of 1986; Hart-Scott-Rodino Act of 1976	Internet; Deregulation of key industries; Lax antitrust enforcement
Firm misvaluation	Plausible mechanism	Overcapitalization; watered stock	Oversubscription of public securities	Consolidation of corporate income tax statements without penalty	Firms' low PE ratios & borrowed money	Difficulty of valuing "Dot com" ventures
Behavioral	Theory-in-use	Vertical integration; Search for monopoly	Vertical integration; Search for oligopolistic advantage	Corporate diversification	Value-based strategy; "Market for corporate control" theories	Pursuit of global scale
Sociological	Board-level factors	Elite networks (e.g., the Simmons dinner of 1900 & creation of U.S. Steel)	Board interlocks (e.g., General Motors & DuPont)	Firms tied to banks in friendly, NOT predatory M&A (Palmer, Xueguang, Barber, & Soysal, 1995)	Focal firms connected to acquiring sister firms engage in more M&A (Haunschild, 1993)	Diversity initiatives: adding women & people of color
	Key actors	John R. Dos Passos: J. P. Morgan; Andrew Carnegie	Alfred P. Sloan; John Raskob; Donaldson Brown	Harold Geneen, Jimmy Ling	Boone Pickens; Michael Milken	Sandy Weil; Steve Case
	Financial & legal innovations	Issuance of common & preferred stock	Financial ratios (e.g., ROI, ROE) & flexible budgeting	Price-to-earnings ratio arbitrage	Leveraged buyout; Junk bond financing; Hostile takeover	Expansion of Venture Capital and Private Equity

2.5.4 **Managerial Implications and Future Research**

Other than as academic curiosities, M&A waves also contain value-creation potential. Moeller, Schlingemann and Stulz (2005) observed that acquiring-firm shareholders gained $24 billion from 1991 through 1997—the start of the 1990s M&A wave—before losing $240 billion at the end of the wave, from 1998 through 2001. Given this and the sizable probability of yet another large M&A wave, it is important to know when the next one will happen. Yet at first glance the managerial relevance of complexity theory seems limited. The indeterminacy of CAS makes prediction difficult, and their variability makes feasible only a narrative account of distinguishable events *post mortem* (Bak, 1996).

But as Goldstone (1991) noted, geologists may not be able to predict the precise number and location of fossils in a particular sort of rock, but *can* predict the types of fossils and their rough proportions if they know that the rock was formed at a time when certain species lived. Likewise, waves are unique in terms of timing, amplitude, duration and strategic motivation, thus precluding exact prediction, but they do share certain recognizable, generic patterns that managers *can* identify as the patterns emerge before an oncoming M&A wave. Scholars can learn to identify such robust processes (Goldstone, 1991), which signify that across different historical contexts, (1) similar initial conditions confront (2) actors, who react in similar ways, leading to (3) similar outcomes. Robust processes, singly or in concert, may generate small, medium and very large M&A waves, and timely adaptation to them may involve identifying such processes.

Such robust processes may not necessarily be predictable or controllable, but they may be anticipated and shaped. Thus, from a managerial viewpoint, it may be more important to strive for situational awareness combined with fast response rather than for (an unattainable) predictive capacity. This suggests that, like the investor who does not predict when the market has bottomed out to make an investment, but rather ascertains that the market has in fact bottomed out before then investing, managers could try to be less like early movers, and more like fast followers. Although value-creation may be less intense, value-capture may be more feasible.

Other compelling managerial implications come from the analogies to the sand pile. Bak et al. (1988) noted that the angle of repose is higher for a pile of wet sand so that as the water evaporates, small and large avalanches occur at random places on the pile. If "sticky," wet sand grains are more resistant to avalanches, perhaps firms with many inter-organizational linkages—"sticky linkages"—are more capable of withstanding takeovers during M&A waves. Sticky linkages, like equity strategic alliances, are a set of cross-shareholdings between a focal firm and its broad constellation of *stakeholders*, like Japanese keiretsu firms with vertical relationships connecting all factors of production, and horizontal relationships with owner banks and trading companies. In contrast, U.S. firms may be embedded in an atomistic social, economic, legal, political and institutional "fabric" loosely comprised of antagonistic constituencies. This implies that fostering sticky linkages among U.S. entities may ameliorate the likelihood of disruptive acquisition during M&A waves by weaving a strong, localized "safety net" comprised of law firms, investment banks, shareholders, the government, suppliers, and customers. By aligning their interests, stakeholders may generate in-group *keiretsu*-like biases that keep opportunistic "outsider" acquirers at bay and foster "thick" internal cross-ownership structures. Of course,

existing financial market and anti-trust regulations have the express purpose of acting as a counterweight to such embedding tendencies – leading both to robust markets for corporate control and to M&A waves.

2.6 CONCLUSION

Prior research on M&A waves, drawn from often conflicting scholarly disciplines, has produced reductionist models that throw little light on the emergent properties of such waves. Our CAS model provides a more integrated account, and generates a useful metaphor to facilitate managerial understanding and preparation for M&A waves. While but an initial step, we hope our work enriches future studies on this fascinating and important phenomenon.

3.0 ESSAY TWO: SURF'S UP: ROBUST PROCESSES IN MERGER AND ACQUISITION WAVES

After a century of debate, merger and acquisition (M&A) waves remain a mystery to scholars and practitioners alike. Moeller, Schlingemann and Stulz (2005) and McNamara, Haleblian and Dykes (2008) noted that the beginnings of M&A waves create value, making it important to "see them coming." In the first essay, I observed that the size-distribution of aggregate U.S. M&A waves follows a power law, yet it is unclear why most waves sputter out while a handful has explosive potential. Given the theoretical interest in explaining this empirical signature, along with the practical import of understanding how M&A waves form, a process explanation of them would serve academics and managers well.

My statistical power-law description supported a complex adaptive systems (CAS) model of M&A waves, which attempted to integrate prior economic, behavioral and sociological M&A wave theories. Thus, an explanation of M&A wave formation consistent with a CAS model holds great promise. But because of small sample size and the indeterminacy of CAS, the mainstream method of management science—detailed predictions followed by reproducible experiments (Bak, 1996)—was infeasible for my research aim. I therefore embraced *process tracing*, a qualitative, within-case analytical technique that uniquely combines elements of the case-study and history. By analyzing how a past event occurred, process tracing seeks to make

causal inferences based on one historical case. My analysis focused on the Great Merger Wave of 1898-1903 because this first and largest wave in recorded U.S. history was not adulterated by "spill over" effects from a previous M&A wave, and the dynamics of wave formation were more visible in this extreme case than in a less dramatic context (Eisenhardt, 1989; Eisenhardt & Graebner, 2007).

Process tracing evidence is encapsulated in *robust processes*, as distinct from law-like generalizations that hold independent of historical context (Goldstone, 1991). By identifying and explaining connections among many details of the historical record that were previously unrecognized or not understood, a robust process tries to show that, across historical contexts: (1) similar initial conditions confront (2) actors, who react in similar ways, to produce (3) similar outcomes. With the process tracing of journal articles, government publications, and books spanning a number of theoretical disciplines, my single-case research design for the Great Merger Wave suggested that: (1) the gradual maturation of a privatized, market-expanding and well-financed transportation network motivates (2a) politicians to adopt *laissez faire* regulation; (2b) industrialists to engage in cutthroat competition, and (2c) financiers to undertake firm securities arbitrage, generating (3) a sudden burst of consolidation.

The following sections provide a literature review, summarize the methodology, explain the sampling procedure, describe the historical data, outline the results and discuss implications.

3.1 LITERATURE REVIEW

3.1.1 Previous M&A Wave Theories

Current explanations of M&A waves include three economic theories, and behavioral and sociological accounts. Macroeconomists posit that capital markets, indicated by stock market prices, drive M&A activity (Nelson, 1959). Neoclassical economists suggest that technological shocks to industries generate M&A waves as periods of asset reallocation (Gort, 1969; Mitchell and Mulherin, 1996). Behavioral economists theorize that the arbitraging of acquirer and target securities drives an inefficient M&A market to rise and then collapse (Shleifer and Vishny, 2003; Rhodes-Kopf and Viswanathan, 2004). Behavioral theorists of the firm explain M&A activity through the satisficing of boundedly rational managers, who react to performance feedback with search for acquisition targets (Iyer and Miller, 2008). Sociologists argue that a permissive regulatory environment enables the M&A strategy to spread from fringe actors to the business community via board interlocks (Haunschild, 1993; Stearns and Allan, 1996).

Yet these observations come from competing theoretical paradigms, and anomalies exist. For macroeconomists, M&A boom-bust patterns are left unexplained. Neoclassical economic theories assume market efficiency and manager rationality, which are problematic to behavioral researchers. Behavioral finance scholars' assumption of inefficient markets conflicts with macroeconomic and neoclassical assumptions of efficiency. For Carnegie school behavioralists,

it is unclear how bounded rationality and satisficing are reconcilable with economic rationality and utility maximizing. Finally, sociologists do not identify the drivers of social diffusion mechanisms, nor why fringe actors consistently appear. Thus, a more integrated account of M&A wave patterns would be an important contribution.

3.1.2 **Complexity theory and M&A waves**

In the first essay, I turned to complexity theory, or the study of CAS, in search of an integrated model. A CAS model suggests that M&A waves are macro-level patterns emerging from micro-level resource-competition in an ecology of firms. This competition endogenously generates pressure and tension in the ecology until at a critical point an M&A wave occurs, dissipating the pent-up instability in a non-linear return to dynamic equilibrium. The critical point is dubbed the self-organized critical (SOC) (Bak, 1996) state. In complex systems such as sand pile cellular automata, the steepening of the pile upon addition of grains leads to SOC avalanches.

My first essay attempted to integrate prior M&A wave theories by analogizing from sand avalanches to M&A waves. For macroeconomists, M&A booms (gradual buildup of the pile) alternate with M&A busts (an avalanche's drop-off). For neoclassical economists, industry shocks (multiple wind gusts) set off an M&A wave (a large avalanche). For behavioral finance scholars, each new M&A (dropped grain) makes the market more inefficient (steepens the pile) until the deals' true values are revealed (the SOC state), crashing the market (an avalanche). For

Carnegie behavioralists, firms (grains) are uniquely goal-directed systems (obey the law of gravity) that respond characteristically (slide downward) to performance feedback (after being dislodged). For sociologists, board interlocks (friction between grains) determines the M&A strategy's diffusion (avalanche size) through the business community (sand pile), while fringe actors consistently return (the SOC state) preceding an M&A wave (avalanche). While each model offers a plausible account of how sand grains behave, M&A waves (avalanches) cannot be inferred from the movements of the individual firms (sand grains), but are empirically verifiable phenomena that emerge at an aggregate level of analysis.

The spatial and temporal fingerprint of CAS at the SOC state is the power law distribution (Bak et al., 1988). In other words, one infers the existence of CAS by observing this empirical signature for a system of events, similar to how a hunter infers the existence of a game animal by observing its characteristic tracks in mud or snow. Essentially a straight line of negative slope on double-log paper, the power law suggests that a quantity N can be expressed as a power of another quantity s: $N(s) \sim s^{-a}$. In natural science, the sizes of SOC avalanches are power law-distributed. Similarly, in the first essay I observed that the size distribution of aggregate U.S. M&A waves from 1895-2008 follows a power law, thus supporting the notion that M&A waves are SOC phenomena in an ecology of firms conceptualized as a CAS. Yet the descriptive CAS model does not explain how waves form to generate a power law size-distribution. For that, I introduce a method that can produce process explanations.

3.2 METHOD

3.2.1 **Process Tracing**

Process tracing is a within-case analytical technique that combines elements of the history with those of the case-study (Yin, 1994). Like the latter, process tracing tries to answer the *how* question for a given phenomenon, while like the former, process tracing focuses on past events. However, it does not make use of contemporary sources such as surveys or interviews, as a true case-study would, nor does it merely tell what happened, as a history might. Rather, a process tracing account *argues* about what happened (Goldstone, 1991), i.e., it tries to explain how a past event came to be. As such, it is ideally suited to my research question and phenomenon of interest: *how* the Great Merger Wave happened.[9]

While statistical methods treat causation as a constant correlation between two variables (Mahoney, 2001), process tracing views causation as a hypothesized mechanism or process connecting variables (Bennett & Elman, 2007). In establishing this latter form, process tracing attempts to validate *robust processes* (Goldstone, 1991), which break down into three parts: (1) a

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[9] Process tracing is undergirded by a set of ontological, epistemological and methodological commitments that can be labeled *critical realism* (Johnson & Duberley, 2000). Ontologically, the critical realist assumes an objectivist position, i.e. reality exists "out there," independent of and apart from the researcher's sensory perceptions of it. Epistemologically, however, the critical realist is subjectivist, i.e., the same reality can be perceived in different ways, depending on the researcher's theoretical lens. Therefore, the critical realist advocates methodological pluralism, i.e. quantitative and qualitative methods have complementary strengths that, when used together, can produce a powerful description or explanation of a phenomenon.

Thus, the fact that macroeconomists, neoclassical economists, behavioral economists, Carnegie behavioralists and sociologists all have distinct theories of M&A waves must presuppose that there is something that they all see, yet in different ways. In the first essay, I built on this philosophical foundation by negotiating the conflicting truth claims of these theoretical paradigms with an integrated CAS model. My contribution here is to complement the first essay's deductively obtained and quantitative CAS description of the population of M&A waves with an inductively generated, qualitative process explanation of just one wave.

set of *somewhat similar* initial conditions confront (2) actors who react in *somewhat similar* ways, to produce (3) *somewhat similar* outcomes.[10] Robust processes are useful in that they can test a theory by invoking evidence in the historical record that is consistent with the process or refutes alternative explanations. But in generating theory, robust processes relate a large number of details of the historical record to each other in a way that had not previously been recognized or understood. By connecting historical data with prior theory, process tracing can produce a scholarly work of great value.

For example, Goldstone (1991) describes Darwin's theory of evolution by natural selection as a robust process: (1) reproductive competition among species with variation among individuals leads (2) the reproductively successful individuals to diffuse their traits throughout the population, giving rise to (3) new species.[11] Now it is true that Darwin's theory was consistent with the known fossil record, while Lamarck's alternative evolutionary hypothesis, that characteristics acquired during an individual's lifetime are inherited, was later refuted. But Darwin's theory also served to integrate a broad range of evidence from animal husbandry,

[10] The qualification "somewhat similar" distinguishes robust processes from laws, which are the end-result of quantitative methods. Laws typically "decontextualize," i.e. hold regardless of initial conditions, *always* generate the same behaviors in actors, and *always* end with an exactly identical, precisely predictable result. In contrast, robust processes are more like *limited generalizations* stating essential and necessary initial conditions that produce characteristic (but not precisely identical) behaviors, which result in a similar (but not exactly identical or precisely predictable) outcome.

[11] What makes this robust process so is that the initial condition (reproductive competition) is an *essential and necessary* contextual element of the process without which it could not proceed. And while reproductively successful individuals typically diffuse their traits, sometimes this is not the case. After all, laboratory mice do not experience natural selection, as their reproductive success is purposefully minimized by their owners; however, this exception does not invalidate the theory of evolution. Finally, precise prediction is not at issue, since the theory does not claim to predict any particular new species, nor the precise time of their emergence (Goldstone, 1991). Contrast this process to the law of gravity, which is *independent* of initial conditions, i.e., the initial conditions, such as the masses of and distance between two gravitationally bound bodies, are simply parameters that can vary without affecting the operation of the law. In other words, gravity *per se* operates regardless of the initial conditions. Furthermore, the law of gravity requires the two gravitationally bound bodies to *always* be attracted to each other, without exception. Third, the law's outcome, the actual movement of the bodies toward each other, *can* be precisely predicted or plotted from the initial conditions.

biogeography, embryology, geology and morphology. Indeed, from Goldstone's perspective, before Darwin, people knew of the fossil record and the principle of inheritance, but did not know how to combine them until Darwin elucidated the process of natural selection.

3.2.2 **Sample**

Our small-N sample consisted of the Great Merger Wave of 1898-1903, which I chose for a number of reasons. Research design-wise, the sizeable amount of available historical data on the first M&A wave made the process-tracing analysis more productive. Practically speaking, the Great Merger Wave was the largest in history in amplitude, and the largest in relation to the size and maturity of the contemporary economy (Town, 1992), implying the event's great value-creation potential and consequential importance to practitioners. Regarding theoretical considerations, the Great Merger Wave, as the first wave in recorded U.S. industrial history, was least likely to have been adulterated by "spillover effects" from a prior wave.[12] And because the power law distribution for M&A waves reflects Paretian dynamics which stress the importance of extreme or rare events, my choice of M&A wave followed the same logic. Finally, I chose this outlying case because the dynamics of the M&A wave process would be more evident in this case than in a less extreme context (Eisenhardt, 1989).

[12] This was an important consideration to us since the existence of spillover effects would have complicated our analysis even more for an already complex, multifaceted phenomenon. For example, Shleifer and Vishny (1990) observed that the 1980s hostile takeover wave involved efficiency-motivated bust-ups of large diversified firms that had initially been assembled during the 1960s conglomerate wave.

3.2.3 **Data Sources**

I collected data from three archival sources: (1) books (2) journal articles (3) government publications. Books involved various aspects of the Great Merger Wave (i.e., biographies of prominent industrialists, legal briefs of important antitrust cases, descriptions of 19th century technological advances, history of the modern corporation, a history of the steel industry). The empirical journal articles represented a wide variety of theoretical and professional disciplines, including business history, law, economics, politics, sociology, finance, the Carnegie behavioral school and general management/strategy. The government publications included the 1900 Preliminary Report on Trusts and Industrial Combinations and the 1901 Report on Trusts and Industrial Combinations, both authored by the United States Industrial Commission. These 1000-plus page volumes contained narrative reviews of evidence, price lists for important industries, graphs of stock market prices, and Congressional testimony of prominent witnesses.

3.2.4 **Data Collection**

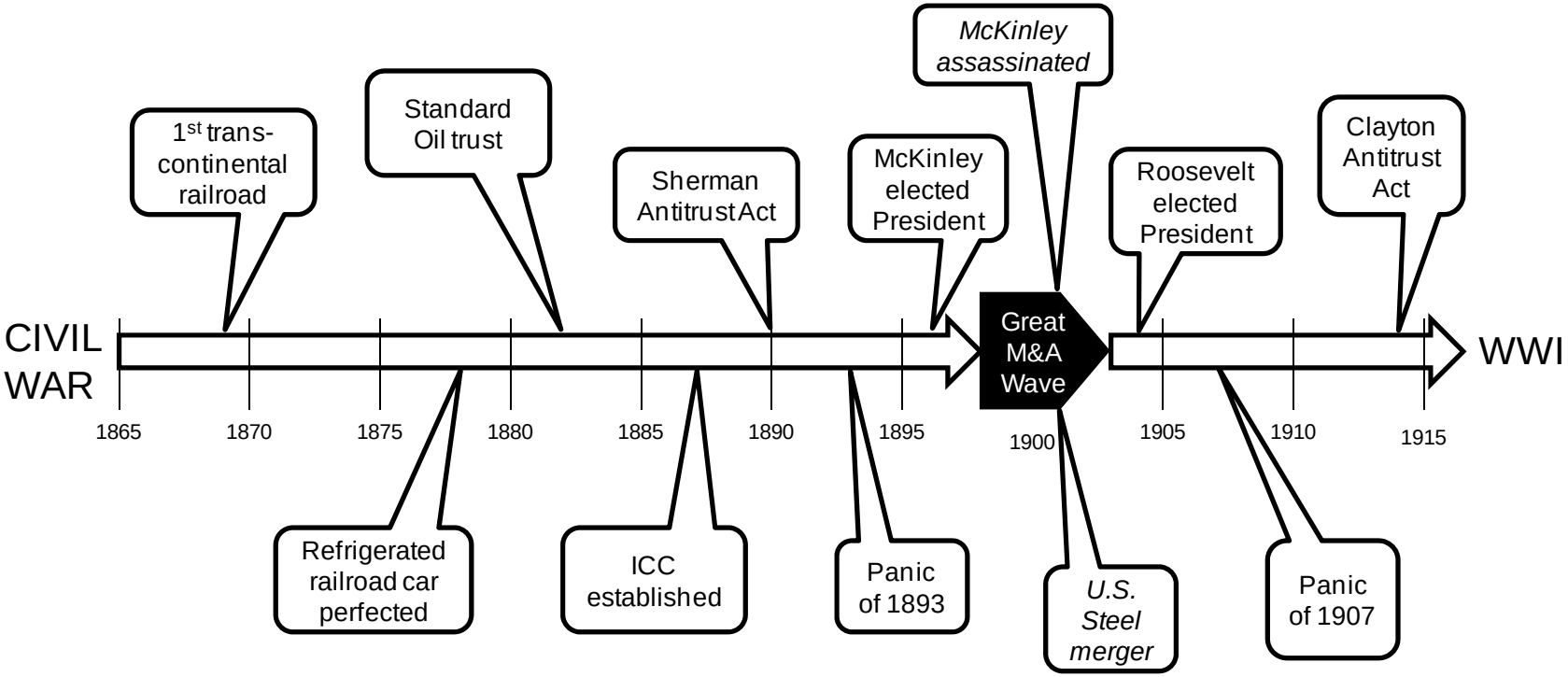
Data collection proceeded qualitatively.[13] My task was to reduce the data into manageable form, so that I could then select data to answer my research question (Gersick, 1989). While reading each document, I coded any page for which a notable event, person, organization, or other important milestone was mentioned, by jotting the event and its date on a

[13] Compared to the ensuing data analysis, this particular phase was more time-intensive.

Post-it and affixing it on the page. I judged the relevance of an event in two ways: (1) if the surrounding text described the event in terms of its extraordinary impact on business, society or the Great Merger Wave; or (2) if the same event was mentioned multiple times either within the same document or across multiple documents. Once all the material had been coded, I then temporarily grouped the Post-it's with similar information into emerging themes: technological developments, financial panics, stock market trends, predominant firms, famous industrialists, political elections, major wars, important legal decisions, contemporary social issues, and of course, milestone merger transactions. Finally, I placed the Post-it's on a rectangular poster in separate rows, one theme per row, from left to right in chronological order. Figure 6 shows a timeline of important historical events between the American Civil War and World War One.[14] In the data section, I provide a historical narrative based on this timeline.

[14] The choice to span an interval of time between wars was not coincidental. Tilly (1975) writes that war has historically stimulated profound economic change as much as any other kind of political event. Roy (1997) calls the American Civil War the country's most traumatic war and the precipitating event for the creation of the corporate infrastructure as it is known today. Correspondingly, the United States' entry into World War One signaled the country's progress from a fractious band of agrarian states to an internally unified industrial power.

Figure 6. Timeline of Major Events for the Great Merger Wave



3.2.5 **Data Analysis**

Data analysis (process tracing) proceeded qualitatively.[15] Although I knew that the Great Merger Wave was the clear outcome of our robust process, I still lacked the initial conditions, the main actors, and their reactions. Therefore, the process tracing analysis attempted to identify these missing components. Working iteratively with (1) the historical narrative, (2) prior M&A wave theories, and (3) the sand pile CAS metaphor, I sought to generate an empirically grounded, theoretically informed and metaphorically accurate robust process (Ashcraft, 2001; Denis, Lamothe, & Langley, 2001; Dutton & Dukerich, 1991; Eisenhardt & Graebner, 2007; Pratt, Rockmann, & Kaufmann, 2006; Pratt & Rosa, 2003).

To identify the initial condition, I first treated each theme of Post-it's as an analogue of a prior M&A wave theory's driver.[16] For example, technological developments (the Bessemer process, open-hearth furnace, refrigerated railroad car) were considered technological shocks in the neoclassical economic framework. I then matched each analogue to a logical aspect of the sand pile metaphor (e.g., multiple wind gusts through the sand pile). But the sand pile metaphor did not rank the theoretical drivers in order of importance (i.e., wind gusts are equally influential in generating an avalanche as falling sand grains, the increasing steepness of the pile, the friction between sand grains, or the physical properties of the grains). Furthermore, the initial condition needed to be consistent with the fundamental process underlying CAS (i.e., a long period of

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[15] Compared to data collection, this data analysis phase was the more labor-intensive.

[16] A sixth driver, Bittlingmayer's (1985) antitrust policy, was placed under the sociological M&A wave theory as part of a permissive regulatory framework.

gradual build-up prior to the quickly dissipative avalanche). Additionally, my first essay discussed the connectivity of sand grains as a fundamental factor permitting the avalanche to form. I subsequently reverted back to the data, which obliged me to look for an event that slowly developed, physically connected firms together, and logically preceded the Great Merger Wave. These conditions pointed to the maturation of a transcontinental railroad network, which in fact Chandler (1959) already attributed the creation of a national market to.

Identifying the relevant actors also involved informed choices. The task was to select the relevant data that would answer my research question (Gersick, 1989). I knew that prior M&A wave theories provide different units of analysis, at different levels of analysis: capital markets (aggregate), exogenous shocks (industry), acquirer and target management (deal), focal managers (firm), and politico-legal environment (sociological field). But all of these levels and units merited consideration since the CAS model was integrative and CAS are multi-level phenomena. So in the interests of abstracting from the complex reality, I first collapsed the Post-it themes, which were already matched to their theoretical analogues, into broader disciplinary rubrics sympathetic to CAS models: economics (Carnegie behavioral), finance (macroeconomic and behavioral financial) and politics/law (sociology). I then collapsed the levels of analysis of these three major disciplines into their micro- (individual), meso- (group) and macro- (institutional) level counterparts.[17] However, I focused on the macro-level institutions, since aggregate M&A waves are macro-level phenomena.

[17] The micro- (individual) level actors included the following: (1) industrialists, (2) investment bankers, and (3) politicians and municipal governments. At a meso- (group) level, I observed the following analogues: (1) firms, (2) investment banks, and (3) governors and state governments. At the macro or institutional level, the U.S. economy

The final part was to record the actors' reactions to the initial condition.[18] I first sought to know what aspects of the railroads affected our actors singularly. With information in the historical record on various aspects of the railroads' gradual development, as well as the relationships of prominent individuals in economics, finance and politics/law (and their group- and institution-level counterparts) to the railroads, I concluded that market-connecting, financial innovation, and privatization were important aspects. From this, knowledge of these actors' typical behaviors (economic actors compete and merge, financial actors organize and promote deals, politico-legal actors regulate M&A activity), generated a complete picture. Figure 7 illustrates my robust process, which I discuss in the results section.

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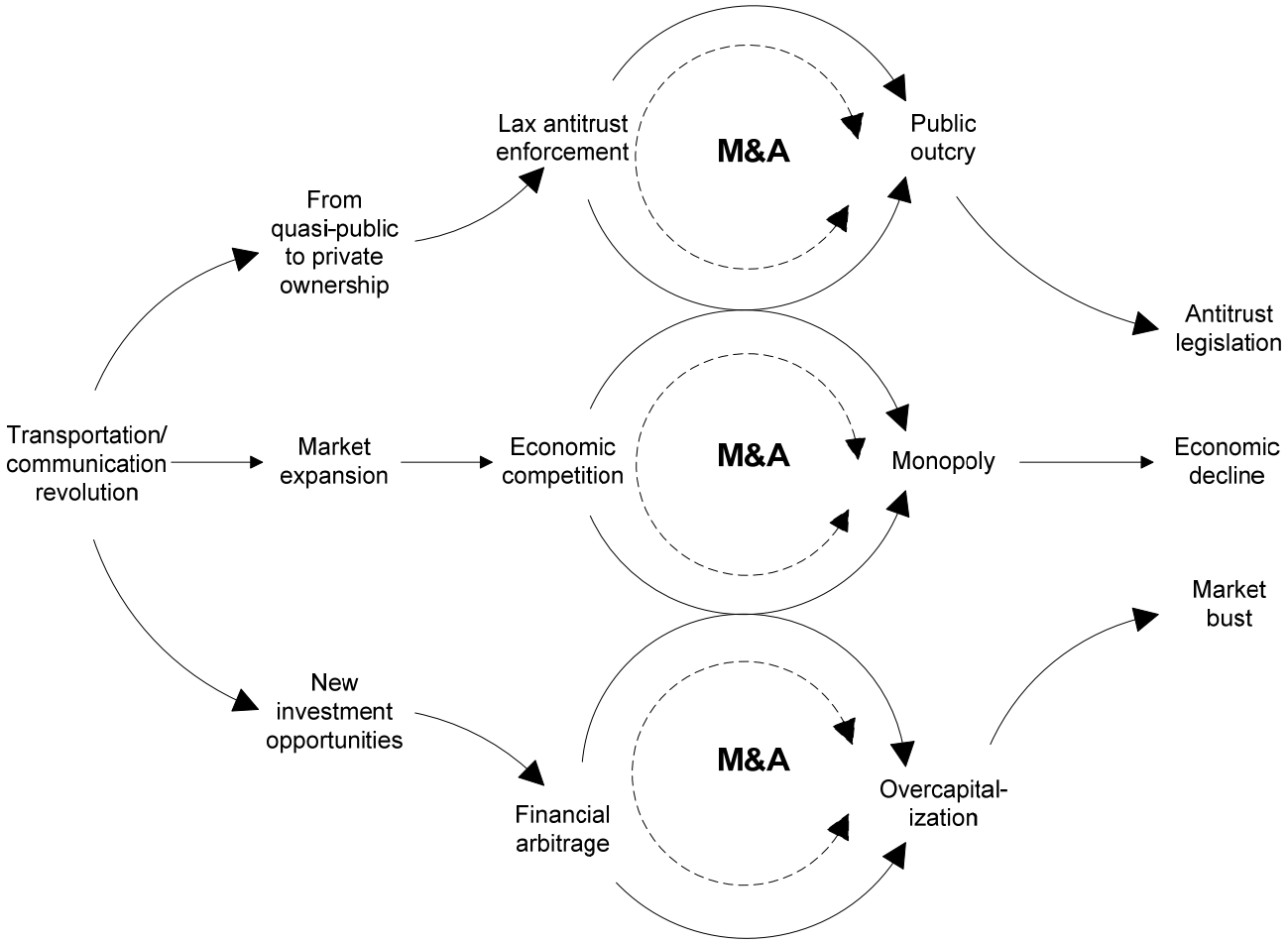
was the economic actor, Wall Street the financial actor, and the Federal government and Supreme Court the politico-legal (or "regulatory") actor.

[18] Industrialist Andrew Carnegie began his career speculating on the railroads and then selling steel to them in order to acquire weaker competitors (Roy, 1997). Investment banker JP Morgan started out underwriting railroad securities and organizing railroad mergers, then turned to promoting industrial mergers. The Federal government initially subsidized railroad development, until the bungling of these public works projects popularized *laissez faire* ideology and the subsequent privatization of the railroads.

Figure 7. A Process Model for the Great Merger Wave



3.3 DATA

3.3.1 **The American Civil War: 1860s**

19th century America witnessed the gradual disappearance of the Western frontier as the Manifest Destiny principle, that American expansion to the Pacific Ocean across the continent was self-evident ("Manifest") and inexorable ("Destiny"), captured the public's imagination. However, Manifest Destiny was only truly realized with the Civil War when, in its open conflict with the Southern states, the Federal government consolidated power by helping build the railroads for military transport across the Union states of the industrialized North and agrarian West (Roy, 1997). As part of the war effort, the Lincoln administration's National Banking Act of 1863 established a national currency and a corresponding system of nationally chartered banks that fostered the institutionalization of Wall Street as the center of American moneyed interests (Roy, 1997).

3.3.2 **Reconstruction: 1870s**

After the war, reconstruction established basic railroad transport between the industrial North, post-bellum South and the expanding West. Indeed, the world's first transcontinental railroad concluded at Promontory, Utah, in 1869. Railroad construction required financing, and

over time investment bankers began to issue increasingly sophisticated railroad securities, including preferred stock and income, convertible and mortgage bonds (Chandler, 1965). Indeed, 19th-century American financial markets were exclusively comprised of railroad stocks and bonds, and only occasionally did less reputable industrial securities circulate (Navin & Sears, 1955). The world's largest company at the time was the Pennsylvania Railroad, initially run by Philadelphia merchants to secure the city's commercial success by tapping the resources of the expanding west (Roy, 1997). Meanwhile, politicians regulated the privatized railroad industry as the transportation networks took more civilian passengers and commercial cargo.

3.3.3 **The Gilded Age: 1880s**

In the 1880s, modern managerial systems developed for railroads were applied to limited liability stockholder corporations (Roy, 1997), as the U-form structure organized functional departments under single industrialists (Chandler, 1959). Standard Oil in 1882 under John Rockefeller was the first organized trust issuing Standard Oil certificates in exchange for those of the constituent companies (Commission, 1900). Other industrialists soon took the lead, such as Carnegie Steel's Andrew Carnegie who, like Rockefeller, was often accused of receiving preferential treatment from railroad management via rebates and kickbacks to deliver large volumes of oil and steel necessary for the industrializing U.S. economy. In 1887, the Interstate Commerce Commission (ICC) was founded to regulate the railroads. However, the ICC initially lacked the enforcement power to set rates or disallow discriminatory practices. Resultantly,

constituencies beholden to the railroads—miners, farmers and small municipal governments—pressed for reform throughout the 1890s.

As railroads expanded and demand for steel rails skyrocketed, technological innovations such as the Bessemer process and the open-hearth furnace led to mass-production of steel (Lamoreaux, 1985). Previously, making steel required smelting iron ore with coke, a byproduct of coal, to form pig iron, an intermediate product that contained too many impurities and was too brittle to be of much use. The Bessemer process, developed in the 1850s but not fully utilized until decades later, required a steel container (a Bessemer converter) to blow air over molten pig iron, thus increasing temperatures and removing further impurities from the molten metal (Hogan, 1971). The open-hearth furnace, also invented decades before commercialization, transferred heat from exhaust gases to bricks to burn impurities from pig iron; the bricks then heated new gases upon reverse flow of the furnace. This process produced large quantities of high-grade steel and more efficiently utilized the coking fuel.

As the country steadily grew from an agrarian society to an industrialized nation, runaway late 19th-century consumer demand coincided with the ascendance of a national market that connected urbanizing populations via the transcontinental railroads (Chandler, 1959). Regional markets were connected through a chain of regional branch offices with a central office coordinating operations from a large metropolis such as Chicago, New York or Pittsburgh. Firms around this time began to reach unprecedented size and scope, as cost-reduction efficiencies and scale economies could only be achieved through large-scale operations (Chandler, 1959).

3.3.4 **The Close of the 19th Century: 1890s**

A number of pivotal events in the 1890s set the stage for the Great Merger Wave. The Sherman Antitrust Act of 1890 established the letter (but not the spirit) of the law for dealing with trusts. The concurrent McKinley Tariff of 1890 and Sherman Silver Purchase Act of 1890 predated the Panic of 1893 and the ensuing shift of public opinion in favor of big business.

Although the Sherman Act initially banned railroad abuses, the Supreme Court consistently interpreted the Act as a restriction only against "tight" industrial combinations rather than "loose" ones. Loose combinations were uncomplicated prosecutions as they consisted of independent producers conspiring to fix prices, acts which could easily be shown as a restraint on competitors' actions. In contrast, tight combinations were much more difficult to challenge as they were comprised of single corporations whose mere size and market share did not necessarily imply restraints on the actions of other firms (Lamoreaux, 1985). Furthermore, the E.C. Knight decision of 1895 implicitly absolved the Federal government of responsibility over antitrust matters, giving due course back to the individual states. However, the states' corporate charters, which permitted business within state lines, were ineffective against the trusts' interstate commerce; and in reality, states were often beholden to the economic prowess of big business (Commission, 1900; Lamoreaux, 1985; Roy, 1997). Corporations took advantage of the lax Federal antitrust interpretation and state-level legal loopholes, which did not receive critical review until the "Trust Problem" had already assumed large proportions.

Along with the trust question, the tariff and silver questions were of prime importance to late-19th century contemporaries (Bullock, 1901). Before fiat currency, the Federal

government's bimetallist policy allowed paper currency to be exchanged for gold or silver. Farmers and miners (who flooded precious metals markets with silver from newly-discovered Western mines) sought to honor debts more easily with inflated silver dollars, while Eastern bankers sought maximum return on loans via gold-backed currency. Additionally, Northeastern commercial interests desired protection from European manufacturing, while Western agrarian constituencies sought to abolish protectionist policies which raised the prices of domestic goods. The McKinley Tariff and Sherman Silver Act were a political compromise between Republicans representing Eastern banking and commercial interests and Democrats representing Western farmers and miners. The tariff raised *ad valorem* tariffs to 48.4% on manufacturing imports and received Democratic votes while the Sherman Silver Purchase Act received Republican support and raised the Federal government's minimum purchase of silver.

Yet the Panic of 1893 decisively derailed the U.S. economy and only intensified debates over bimetallism and protectionism. With unemployment approximating 20% at its height, and the 800+ bank failures from 1893-1897 exceeded only by those during the Great Depression, the Panic of 1893 was one of the most severe depressions in U.S. history (Hoffmann, 1956). Hoffman mentions a large contraction in railroad investment as a primary contributing factor to the ensuing depression. Manufacturing and agricultural sectors also slowed considerably throughout the mid-1890s. However, investment in street railways increased throughout the 1890s, and investment in building construction enjoyed an early, continuous rebound in 1894, implying that despite the worst of times, urbanization and industrialization continued unabated.

With memories of the Panic fresh in the public's mind, Democrats and Republicans took forceful stands on economic issues in the Presidential election of 1896. Professionals, skilled

factory workers, well-to-do farmers and businessmen supported Robert McKinley's Republican campaign by contributing a large war chest which was used to outspend the poorer Democratic contender William Jennings Bryan, the voice of populist agrarian sentiment and the "silverites." McKinley's Republican administration was placed in the White House, and in 1897 the Dingley Tariff raised tariffs further to as high as 57%. In 1900, the Gold Standard Act *de jure* officially removed the U.S. economy fully off silver and squarely on gold-backed paper.

3.3.5 **The Great Merger Wave: 1898-1903**

By the dawn of the Great Merger Wave, the U.S. had emerged as one of the world's leading industrialized nations. A national market had coalesced around the railroads, as independent business owners were confronted by ballooning consumer demand for mass produced items (Lamoreaux, 1985). Railroad financiers, firmly ensconced but no longer as profitable as a result of the Panic of 1893, were on the hunt for other investment opportunities. Staunchly pro-business Republican politicians, fresh from victory, sought opportunities to stimulate an economic recovery. Starting in 1898, a spike in merger activity occurred, with society's moneyed interests enjoying several years of popularity, prosperity and power.

As manufacturing began to overtake transportation as the key engine of U.S. economic growth, the politico-legal apparatus transferred to industrial corporations the same *laissez faire* policies that it had learned to apply to the railroads (Roy, 1997). The E.C. Knight Supreme Court decision of 1895 had given "tight" combinations *carte blanche* to further consolidate.

Given this newfound permissiveness, privately owned business corporations increasingly challenged the Federal government's fragile regulatory safety net. State governments were economically powerless to enforce their authority of corporate charters over the trusts' interstate commerce, and the lack of a Federal incorporation law allowed the new corporations to flout the common-law provisions of the Sherman Antitrust Act of 1890 (Bittlingmayer, 1985; Lamoreaux, 1985). The McKinley and Dingley Tariffs had ostensibly protected the U.S. domestic manufacturing base, but by closing off foreign competition, they generated attractive industry structures that invited domestic entry, leading to price warfare between incumbents and entrants. As these parties fought for market share, horizontal consolidation ensued (Commission, 1900; Commission & House, 1901).

The tolerance of big business by McKinley also paralleled an important legal milestone, the right of a corporation to own another corporation (Roy, 1997). Opportunistic entrepreneurs soon saw this ruling as tacit permission to form shell companies that owned a controlling 51% interest in holding companies, which in turn owned majority shares in yet other companies. With this pyramidal structure, it became relatively simple for a small minority of business owners to possess controlling shares in a vast number of enterprises, thus facilitating the corporate board interlocks and "communities of interest" among competitors found in late-19th century big business (Chandler, 1959; Commission, 1900; Commission & House, 1901; Haunschild, 1993; Roy, 1997). For example, the famed "Simmons dinner" in New York City in December 1900 (Hogan, 1971) was a closed meeting of a small network of well-heeled industrialists and financiers which led to the incorporation in April 1901 of U.S. Steel, negotiated

by Charles Schwab (president of Carnegie Steel), sold by Andrew Carnegie to J.P. Morgan, and organized by Judge Elbert Gary.

As industrialists consolidated their business empires, they utilized the financial services of Wall Street bankers, who underwrote the securities of the large consolidations and promoted the deals themselves. By the mid-1890s, railroad securities, which had been the main trade on financial markets in Boston, Philadelphia and New York, were being taken over by new and riskier industrial stocks and bonds (Navin & Sears, 1955). For example, of the six M&A in the fall of 1897 running through the summer of 1898 that were valued at a net worth of $10 million or more, four were put together by independent promoters operating on Wall Street (Navin & Sears, 1955). They included John R. Dos Passos for American Thread Company, the Moore brothers for National Biscuit, and Elverton Chapman for American Malting and for Standard Distilling. Promoters had discovered that arbitraging M&A deals through stock swaps between the constituent companies and the newly formed corporations was a quick way to generate paper profits. A robust market for corporate control began to coalesce around the geographical location of Wall Street in lower Manhattan of New York City (Roy, 1997).

Consolidation was an involved dealing. Independent business owners who wished to sell out to a large combine approached a Wall Street promoter, who paid for the plant, property and equipment (or the stock) of the constituent companies with the new corporation's securities supplied by financiers' cash (Commission & House, 1901). Beginning in 1897, independent promoters began issuing common alongside preferred stock to the investing public, with the common representing risk capital (intangible assets, or the earnings capacity of the future corporation) and the preferred representing investment value (tangible assets, or plant, property

and equipment) (Navin & Sears). The issuance to business owners of common stock at less than par alongside preferred stock at par (with the remaining common up to par set aside for the promoter) typically meant that the preferred was worth something less than par and that the speculative value of the common was more than enough to make up the differential (Navin & Sears, 1955). Therefore, an investor who paid $100 for a preferred-common package did so in the belief that he would be able to turn around and market his shares separately for a combined value of perhaps $110 or $115. Promoters were thus placed in a position of risk: they were paid in the new corporation's common stock left over from their negotiations with the business owners, and then sold their shares to the investing public for cash (Commission, 1900; Commission & House, 1901; Navin & Sears, 1955; Stearns & Allan, 1996).

News spread fast, and in a few years, conservative investment bankers like J.P. Morgan, who had traditionally worked with reliable railroad securities, began to engage in industrial mergers starting with Federal Steel, which was later involved in the U.S. Steel merger (Navin & Sears, 1955). In exchange for investment and risk capital, promoters initially asserted themselves over industrialists by requiring payment for their financial services through a portion of the new corporation's stock (Commission & House, 1901), but starting with Morgan, the additional practice of demanding board seats in the new corporations took hold (Roy, 1997).

In the 1900 Presidential election, again between McKinley and Bryan, the Republican slogan of "Four More Years of the Full Dinner Pail" reflected the economic prosperity of the past four years, signaling McKinley as the winning incumbent. In return, the McKinley administration's passage of the Gold Standard Act of 1900 further aided and abetted Eastern banking and financial concerns, and sided against Western agrarian and mining interests. The

stock and M&A markets boomed into the 1900s as a consistent stream of merger activity necessitated further stock financing, while the profit-making potential of the latter in turn enabled the growth opportunities of the former. On August 7, 1896, a year before the Great Merger Wave, the Dow Jones Industrial Average closed at 28.66. At the height of the merger boom, the index peaked at 78.26 on June 17, 1901.

However, this virtuous cycle began to unravel when corporations were left unable to pay dividends to investors on overcapitalized stock, "watered" by the same financiers who had at first promoted them (Commission & House, 1901). On November 19, 1903, the Dow fell to a low of 42.15. And Republican jubilation at the 1900 election outcome, however, was short-lived. McKinley was assassinated in August 1901 by self-proclaimed anarchist Leon Czolgosz. His last words were "I killed the President because he was the enemy of the good people – the good working people. I am not sorry for my crime" (Seibert, 2002). One of the few anarchists to defend Czolgosz, Emma Goldman attacked McKinley as the "president of the money kings and trust magnates."

3.3.6 **Into the 20th Century: 1900s & 1910s**

Although anarchism never achieved mainstream popularity, Progressivism did. Begun in the 1890s and dedicated to regulation of business, commitment to public service, and expansion of government's scope, Progressivism grew alongside big business and focused on union organization, repeal of child labor, and "trust-busting." Following McKinley's assassination,

President Theodore Roosevelt began reversing many of the initiatives fostered under McKinley. Attorney General Philander Knox famously filed suit in 1902 against the Northern Securities railroad holding company. The Supreme Court's decision in 1904 sided with the U.S. government, that "tight" combinations could be prosecuted under the Sherman Antitrust Act as being in illegal restraint of trade (Lamoreaux, 1985). With this legal precedent, trust-busting would continue under the 1908 Taft administration and culminate in the Clayton Antitrust Act of 1912, prohibiting the horizontal mergers that had been popular years before.

Parallel developments soon followed. Under the Elkins Act of 1903 and the Hepburn Act of 1906, the ICC was given the enforcement power to set maximum railroad rates and the ability to view any railroad's financial records despite legal resistance. With the Payne-Aldrich Tariff of 1909, the first change in tariff laws since the Dingley Act, *ad valorem* tariffs on some goods were reduced. Finally, the Panic of 1907 induced a sea change in public attitudes toward financiers. The near-bankruptcy of major U.S. banks required the personal intervention of J.P. Morgan himself to organize emergency European funding, redirect money between banks, and buy falling stocks of notable corporations. The Panic ended quickly, but banking and political leaders, bending to charges of crony capitalism, passed the Federal Reserve Act of 1912 (with Morgan's blessing) to establish a system of twelve Federal banks in order to provide greater liquidity and opportunities for the money supply to expand and contract seasonally with the economy. The high-flying days of finance capitalism were over.

3.4 RESULTS

The preceding narrative provided a rich description of the Great Merger Wave. In this section, I describe the robust process obtained from my process-tracing analysis. I specify the initial condition and the three subprocesses leading to the Great Merger Wave.

3.4.1 **A Robust Process for the Great Merger Wave**

Figure 7 establishes the initial conditions on the left: (1) the development of a rapidly privatizing, economically integrating and financially maturing network for transporting goods long distances (the railroads). This motivates a set of three actors to behave in characteristic, somewhat predictable (but not precisely identical across episodes) ways, as shown in the left-center of Figure 7: (2a) politicians assume for private corporations *laissez-faire* regulation; (2b) industrialists compete in the newly formed huge national market; and (2c) financiers begin to arbitrage lucrative industrial securities. All three interact to produce a (3) burst of consolidation, as shown in the center of Figure 7.[19]

[19] Note that this robust process is *not* a law-like generalization, because the privatization, market convergence and financial maturation of the railroads are initial conditions that are *essential* to motivating the rest of the process. In other words, the process does not operate independent of those initial conditions, but is rather *precisely* a statement about the initial conditions (Goldstone, 1991). Furthermore, note that politicians *may not* necessarily have transferred privatization to the joint stockholder corporation despite the pro-business clamor of their constituents, if as a group those politicians felt strongly enough that privatization would ultimately lead to abuses of the public trust by big business. Similarly, the connecting of local regional markets to a huge national one *may not* have necessarily induced industrialists to engage in internecine price warfare despite the pregnant possibility of enormous profits, had these men felt it was not in their collective economic interest to do so. And financiers *may not* necessarily have begun trading in riskier and less well-known industrial stocks and bonds despite lucrative prospects for arbitrage,

3.4.2 **Support for the Robust Process**

3.4.2.1 The initial condition

Chandler (1965) already noted the importance of the railroads as the precursor of today's big business. Indeed, the modern corporation arose in large part from the advances in administrative and financing techniques that the 19th century railroads pioneered. Yet although a precise connection from the railroads to the Great Merger Wave has not, to my knowledge, been established by previous business historians, it would seem logical that the *rise* of American big business would share the same origin as its *birth*. As such, I observed in the data three ways in which the railroads developed: (1) politico-legally, (2) economically, and (3) financially. I discuss these three characteristics in turn.

In the mid-19th century, the railroads were quasi-public entities supported by land grants and economic subsidies from the Federal government (Chandler, 1965; Roy, 1997). And during the American Civil War, the railroads were nationalized to move men and munitions to strategic locations on the warfront. However, the North's eventual victory ended the railroads' expressly military *raison d'être,* as these transportation networks began privatizing during post-war Reconstruction to accept the burgeoning commercial trade and civilian cargo. With the onset of privatization came the advent of *laissez faire*, still novel in the 19th century. Government works before the 20th century had typically been a matter of civic pride and duty. However, the idea of

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had these men agreed to be sufficiently risk-averse to avoid an ensuing market bust. But given human nature, it would have been highly unlikely had these actors expressed collective restraint in the face of extreme temptation. Therefore, the process is robust because actors respond to a set of necessary initial conditions in characteristic fashion, to produce a predictable outcome. Indeed, Goldstone (1991) insightfully remarks that it is the belief that human beings do act in a consistent or discernibly rational (though perhaps not precisely predictable) fashion which makes social science possible.

removing government "interference" from private industry began to take hold until, by the 1890s, it had become a *cause célèbre* of Republican politicians (Roy, 1997).

Additionally, in the mid-19th century working for the railroads was the conventional way of entering the ranks of management. Indeed, the "line and staff" distinction, the multi-divisional structure, and the huge, vertically integrated organization with central offices in a large cosmopolitan city coordinating branch office activities in smaller regional markets, all originated with the railroads (Chandler, 1965). But as the century progressed, manufacturing first equaled and then overtook transportation as the main engine of economic growth. The national market created by the railroads lifted the population from a primarily agrarian rural base to an increasingly urbanized industrial core (Chandler, 1959). Thus, the railroads were involved in their own demise by gradually transferring the nexus of power from railroad men to industrialists as the delivery of goods became the handmaiden to the production of goods.[20]

As railroad construction required more sophisticated financing, investment bankers were increasingly employed to underwrite railroad securities and promote railroad mergers. For 19th century financial markets, railroad stocks and bonds formed the lion's share of securities issues, and financial innovations such as preferred stock and mortgage, income and convertible bonds were first worked out with railroad securities (Chandler, 1965). However, the Panic of 1893 significantly derailed railroad expansion and the ensuing depression made swift work of railroad stocks (Navin & Sears, 1955). However, industrial securities fared better as a whole, some even

[20] Chandler (1959) writes of the meat-packing industry's Swift brothers, who saw demand for fresh meat in Eastern cities like New York, Philadelphia and Boston rise with the increasing supply of livestock massing in the American Plains. The Swift brothers struggled throughout the 1880's to perfect deliveries of fresh butchered meat preserved in refrigerated railroad cars to urban dwellers on the East Coast. The railroads had become a means to an end rather than an end in itself.

earning positive returns throughout the 1890s; thus, independent promoters like John R. Dos Passos, issuing common alongside preferred stock in order to achieve speculative profits, began attracting the investing public in industrials instead.[21] By century's end, the investment community was squarely focused on industrial stocks.

Interestingly, Gort (1969), Mitchell and Mulherin (1996) and other neoclassical economists have argued that exogenous regulatory, technological or economic shocks generate periods of asset reallocation within and across industries to form aggregate M&A waves. In that regard, the Panic of 1893 could be seen as one such shock that generated the Great Merger Wave. And indeed the Panic does represent a point in time when the attention of regulators, industrialists and financiers began to focus on American big business. Yet I believe the Panic of 1893 *hastened* the wave; it did not cause it. For example, in the historical record, Andrew Carnegie started his steel company from personal profits amassed speculating in railroads, and built it by selling steel to railroad and locomotive companies (Roy, 1997). Analogously, for SOC earthquakes, the gradual rubbing of crustal plates deep below the Earth's surface is the fundamental trigger, not the externally visible top-level cracking of the Earth's crust immediately before. Thus, the Panic was the more visible but more peripheral driver, while the railroads were the less visible but more fundamental cause of the Great Merger Wave.

[21] Stearns and Allan (1996) mention that one necessary condition for M&A waves is a financial innovation which enables the business community to perform M&A deals.

3.4.2.2 The regulatory subprocess

Bittlingmayer (1985) argued that 19th century antitrust policy, by legalizing merger and making cartels illegal, favored consolidation and thereby "caused" the Great Merger Wave. Furthermore, Stearns and Allan (1996) concluded that M&A waves require a lax politico-legal regulatory framework to allow for diffusion of the corporate M&A strategy through the rest of the business community. These research findings are corroborated by the process-tracing data which show that *laissez faire* regulation and industry privatization were *en vogue* by the close of the 19th century. For example, as the historical record suggested, the Republican McKinley administration assented to pro-business constituencies which cooperated to produce merger activity. My regulatory sub-process gives political and legal actors a facilitating role in the Great Merger Wave.

3.4.2.3 The economic subprocess

Iyer and Miller (2008) suggested that M&A activity is driven by managerial search processes in adaptive response to performance feedback from engagement with the external environment. As the historical data seems to corroborate, falling performance levels triggered problemistic search for acquisition targets in order to adapt to interfirm competition. In the late 1890s, with mass-production techniques perfected and commercialized, industrialists like Andrew Carnegie told their managers to operate factories at full capacity despite falling market prices: "To keep running, not to make profit is the point we should steer to" (Lamoreaux, 1985). This policy was a response to high demand for a homogeneous product which generated heavy

competition among rival producers. The development of a huge national market (Chandler, 1959) merely amplified the competitive trend, with the resulting price warfare on a massive scale motivating vertically integrated forms of business organization, as in the case of the U.S. Steel merger integrating basic steel producers with makers of finished steel (Hogan, 1971). Thus, my economic sub-process supports the Carnegie behavioralist interpretation of M&A activity.

3.4.2.4 The financial subprocess

For the investment community, the Great Merger Wave was demarcated by the Panics of 1893 and 1907. Before the Panic of 1893, financing was reserved for the underwriting and organizing of railroad consolidations, an activity heavily partial to the interests of single, powerful bankers like JP Morgan. As independent promoters took a position of risk in peddling industrial securities, overcapitalization of corporations became a concern for regulators (Commission, 1900). Thus, the spread of speculative securities trading generated the stock market boom characterizing the period of the Great Merger Wave between the two panics, supporting macroeconomists' thesis that strong capital market conditions drive the M&A market (Nelson, 1959). Although macroeconomists cannot explain the boom-bust patterns of both markets, behavioral economists would suggest that managers rationally arbitrage acquirer and target securities, inflating the stock market until the true value of the deal synergies is realized, crashing the market. Certainly, a case can be made for this behavior happening, what with the interactions of bankers, lawyers, promoters and business owners as recorded by the Industrial Commission's report (Commission & House, 1901), and the widespread existence of "watered

stock" during the Great Merger Wave. Thus, my financial subprocess embraces the macroeconomic and financial behavioral economic explanations of M&A waves.

3.4.2.5 The M&A wave

The Great Merger Wave was extreme in many respects. In the first essay I delimited the wave as between 1898:1 and 1902:4. In 1897, Nelson (1959) counted 63 firm disappearances by merger. In 189:1 alone, there were 132. 1899, the peak year for consolidations, witnessed 1,125 firm disappearances, and 1901 registered another 390. In the first essay, I compared the five historical U.S. M&A waves, and observed that the Great Merger Wave ranked first in amplitude, fourth in duration, and first in a combined or "intensity' ranking. The Great Merger Wave was also unique in that most M&A then took the form of the multi-firm consolidation as opposed to the modern two-party acquisition between acquirer and target.

3.4.2.6 The M&A wave's end

If I proceed to the Great Merger Wave's end, I observe new initial conditions that result in new actor reactions: (3) public criticism of big business, monopolistic industry structures and the overcapitalization of corporations induced by the Great Merger Wave (4a) coerces politicians to placate Progressivist constituents with trust-busting tactics; (4b) causes industrialists to engage

in inefficient management practices; (4c) leads financiers into a market bust. These three reactions then generate a (5) halt to further consolidation.[22]

3.5 DISCUSSION

In this section I discuss my second essay's potential limitations, possible implications and hopes for future research.

3.5.1 **Limitations**

One concern with process tracing is the provisional nature of its explanations. In other words, my robust process could be segmented further into a yet more fine-grained chain of causal events. Indeed, this is an important objection against process tracing, for it implies that causal inferences using one or a few cases are difficult to sustain. But a valid rebuttal to this concern is that there are practical reasons, such as lack of time and research resources, for not further splicing the causal chain of events into smaller segments. And admittedly, many scientific explanations are ultimately provisional.

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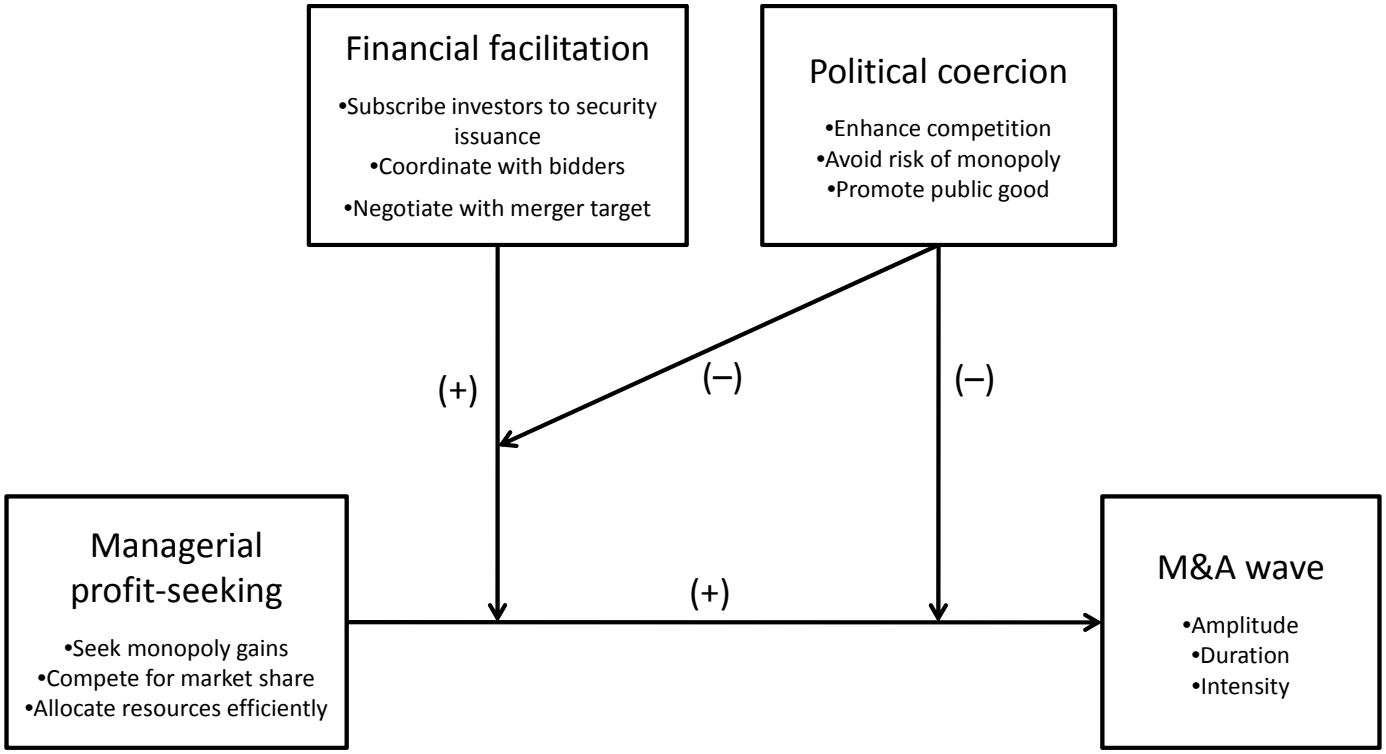
[22] Again, for this robust process of the end of the Great Merger Wave, a set of *essential* initial conditions exists without which the rest of the process could not operate: abuse of the public trust, "winner-take-all" industry consolidation, and watered corporate stock, respectively. Again, politicians, industrialists and financiers are the three actors who react to the initial conditions in consistently rational, although not precisely predictable, ways: forceful regulation, unprofitable management, and financial ruin, respectively. And the end result is a generally characteristic, although not completely identical, outcome: the end of an M&A wave.

3.5.2 **Implications**

3.5.2.1 The power law

The emergence of the power law for the size-distribution of M&A waves may be accounted for by my robust process. Recall the power law implies that most M&A waves are small, some are medium, and a few are very large, expressive of a right-skewed, non-normal distribution for a non-linear phenomenon. In normally distributed phenomena, independent-additive effects are the norm (Andriani & McKelvey, 2007), but when the units of a phenomenon are interdependent-multiplicative, power law distributions naturally emerge. Thus, I believe the regulatory, economic and financial sub-processes comprising our robust process may interact multiplicatively. Figure 8 presents my model.

Figure 8. A Model for the Power Law Size-Distribution of M&A Waves



Competition was considered the key driver of the Great Merger Wave (Commission, 1900; Commission & House, 1901; Cotter, 1916). Thus, in Figure 8 the independent variable predicting M&A wave size is managerial profiteering. And since promoters and bankers provided the fiscal capabilities enabling M&A activity, financial facilitation is a positive moderator of that direct relationship. But because politicians and the courts generated a contextual or situational constraint on the actions of managers *and* financiers, political coercion is a negative moderator of the managerial independent variable *and* the financial moderator. My model thereby generates three-way interactions with nonlinearities befitting a power law.

3.5.3 **Future Research**

3.5.3.1 A robust process for all M&A waves

My study lends hope to the potential generalizability of findings from the Great Merger Wave to other waves. If a *robust process* implies that despite striking differences in historical situations, observers note a *similar* sequence of events unfolding (Goldstone, 1991), then a cross-case comparison of process-tracing accounts of the five M&A waves in U.S. history would be a value-added exercise.

For example, compare the Great Merger Wave with the 1990s wave.[23] For the former, recall that (1) the railroads transitioned to privatization, created a huge national market, and

[23] I choose this particular comparison because it highlights the efficacy of a "polar opposites" approach to selecting on the dependent variable when using qualitative methods (Eisenhardt & Graebner, 2007). The 1900s wave

engendered novel investment techniques; (2a) politicians instituted *laissez-faire* regulation, (2b) industrialists engaged in economic competition and (2c) financiers performed risk arbitrage, producing an (3) burst of consolidation. Now consider the 1990s M&A wave: (1) the Internet began as a Department of Defense communications network, authorized for commercial use in 1995 under the Clinton administration. With the click of a mouse, the Internet could connect national economies to an emerging *global* market. As the Internet commercialized, trading in new e-business securities began in earnest. Thus, as the rapidly privatizing, economically integrating and financially innovating Internet quickly developed, (2a) a Republican Congress and acquiescent Clinton administration relaxed antitrust enforcement, (2b) multinationals competed for domestic and foreign market share, and (2c) investment bankers traded e-business stocks in a "dot.com" bubble. The end result was (3) the first international M&A wave.

The practical import of this comparison is that strategies could be developed to *anticipate* and *shape* future M&A waves. CAS are highly indeterminate due to their *sensitivity to initial conditions* (Holland, 1995); hence, prediction is difficult. However, a process tracing account replicated across cases may identify the fundamental elements of M&A wave formation invariant across all waves. Future strategists can "plan and prepare" as a technologically advanced transportation/communication network (1) removes itself from the jurisdiction of the public trust, (2) brings into contact previously unconnected product-markets, and (3) spawns creative financing methods. Anticipation begins as pro-business political administrations, attractive

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registered a barely mature market for capital, crude technological innovations, untried securities arbitrage tactics, recently developed modern managerial structures, and a sparsely populated business community. These markets, strategies, structures and networks grew and developed for over a hundred years until the 1990s wave. Thus, identifying a common robust process in two highly contrasting contexts would make the resulting explanation more robust and well-defined.

industry structures, and buoyant securities markets take hold. Feasible action is then taken as politicians, competing firms and bankers respond to the burgeoning M&A market.

3.5.3.2 "Deep" mechanisms of CAS

I discuss the possibility of better understanding M&A wave dynamics, consistent with my first essay's CAS model. For example, I initially identify three "deep" mechanisms of CAS: (1) *recursion* (2) *loop reversal* (3) *reticulation*.

Recursion characterizes processes that self-referentially repeat at multiple, nested levels of analysis. Recursive dynamics are an essential feature of multi-level CAS such as M&A waves, in which simple micro-level firm interactions produce complex macro-level M&A wave patterns.[24] In the political realm, co-located cities (e.g., Pittsburgh and Philadelphia) fought for consolidations within-state (e.g., Pennsylvania), while states (e.g., Pennsylvania and New Jersey) competed for the most incorporations within the U.S., which in turn fought for merger activity against western European countries (e.g., Britain, France and Germany). In economics, industrialists of firms consolidated within industries (e.g., Andrew Carnegie of Carnegie Steel, Judge Elbert Gary of Federal Steel, and the Moore brothers of National Steel, all in heavy steel production), while industries (e.g., heavy steel production and finished steel products) vertically integrated within the U.S. economy, until America established an export trade (via U.S. Steel Corporation) alongside Britain, France and Germany. In finance, investment bankers (e.g., Elverton Chapman and J.P. Morgan) struggled to promote M&A for their banks (e.g., Moore and

[24] Thus, recursive dynamics account for the "Complex" in "Complex Adaptive System."

Schley or JP Morgan and Company), which competed to be the dominant dealmaker on Wall Street, which in turn competed against the Rothschild family and Barings Bank for world predominance in M&A finance.

The second mechanism, loop reversal, refers to alternating periods of self-reinforcement and self-regulation. Essentially a string of short-term positive feedback loops closed by a long-term negative feedback loop, loop reversals are necessary for CAS that must continuously maintain themselves in order to survive and grow (Bechtel & Abrahamsen, 2010).[25] For the Great Merger Wave (as the self-reinforcing period), fiscally conservative financiers contributed heavily to the 1896 and 1900 Republican Presidential election campaigns, while the McKinley administration returned the favor with pro-business policies promoting Eastern commercial and financial interests. Meanwhile, Republicans' lax oversight of consolidations resulted from industrialists' endorsement of McKinley's pro-business platform. Concurrently, industrialists made heavy use of financiers' underwriting and promoting capabilities, while the latter extracted board seats and stock ownership from the new consolidations. Toward the wave's end (as the self-regulating period), the Roosevelt administration prosecuted the industrialists' trusts and financiers' "crony capitalism." In turn, financiers attempted to remove from power politicians hostile to Wall Street, while industrialists resorted to legal resource in response to antitrust litigation. Finally, financiers and industrialists halted their mutually beneficial relationship as markets collapsed and corporations failed to pay dividends on watered stock.

My third CAS mechanism, reticulation, refers to the connectivity of actors that permits social contagion processes to diffuse in a network. Such dynamics allow local adaptations in

[25] Thus, loop reversals account for the "Adaptive" in "Complex Adaptive System."

CAS to generate widespread changes through the entire system, thus delimiting the system and distinguishing it from its environment.[26] The connectivity of industrialists was exhibited in how the holding company created pyramidal management structures (Roy, 1997) that engendered communities of interest and board interlocks as the M&A strategy diffused rapidly throughout the business community (Haunschild, 1993) and connected key "hub" industrialists to peripheral ones in the business network.[27] For bankers, strategies for promoting deals began at the periphery but soon became all the rage on Wall Street (Stearns & Allan, 1996). For example, independent promoters with less concern for their reputation and more appetite for risk initially championed industrial securities (Navin & Sears, 1955), but staid, conservative bankers like JP Morgan made such a practice respectable (and a cliché). Among politicians, a *lack* of reticulative dynamics can be discerned. Federal, state and city governments were unwilling or unable to rally a coordinated response against the industrial combinations. In the E.C. Knight case of 1895, the Supreme Court removed antitrust litigation from Federal jurisdiction. States were powerless to enforce the authority of corporate charters against the economic wealth and interstate activities of the trusts (Roy, 1997). And municipal governments were beholden to the corporations, since big business brought much-needed jobs and wealth within city limits.

[26] Thus, reticulation dynamics account for the "System" in "Complex Adaptive System."

[27] Indeed, scientists have observed that many real-world networks (e.g., number of Internet website hits, range of movie actor collaborations, and the size of business firms) contain long-tailed power law size-distributions of events (Watts, 2004).

3.6 CONCLUSION

My process-tracing study contributes a historical narrative of the Great Merger Wave, from which a process explanation accounts for the first essay's CAS model's power law signature. With my robust process, strategists can identify weak signals of impending M&A waves while managers can realize the value-creation potential of future waves. In turn, policymakers may identify the lever points (Holland, 1995) of waves to shape such patterns. My aspiration in this study is to take a small step toward such a set of theoretical and practical advances.

4.0 EPILOGUE

M&A waves are both theoretical conundrums and value-creation opportunities. A critical realist approach lent itself to two studies: one, a traditional hypothetical-deductive description of all M&A waves, and the other, an unorthodox inductive-qualitative explanation of a single M&A wave. Prior economic, behavioral and sociological wave theories have produced incompatible and reductionist explanations of M&A waves. A CAS model can integrate these various accounts and throws light on the emergent properties of these phenomena. The power law distribution provided empirical support for my CAS model, and its mysterious appearance engendered thoughtful speculation. Although detailed predictions followed by reproducible experiments were infeasible for explaining M&A waves, process-tracing was a fruitful alternative. Applying this within-case analytical technique to the Great Merger Wave of 1898-1903 produced a detailed historical narrative from which a process explanation of M&A waves, containing economic, political-legal and financial elements, was generated. The process-tracing account illustrates the process dynamics of M&A waves, and can explain the power law's emergence. As M&A waves are currently an active area of ongoing research, a future study might entertain pragmatically solving "real-world" managerial problems through prediction of these phenomena.

APPENDIX: THE EQUATION FOR THE POWER LAW

To determine the equation for the power law distribution, we first use the cumulative distribution function and integrate the area under the log-normal curve to the right of *x*:

$$\boldsymbol{P}[\boldsymbol{X} > x] = \int_{\boldsymbol{x}}^{\infty} \boldsymbol{x'^{-\infty}}\, \boldsymbol{dx'} = \frac{\boldsymbol{C}}{\boldsymbol{a-1}} \boldsymbol{x^{-(a-1)}}$$ (Newman, 2005). (1)

I then utilize the maximum likelihood estimate for the exponent:

$$\boldsymbol{a} = \mathbf{1} + \boldsymbol{n}\left[\sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \ln \frac{\boldsymbol{x_i}}{\boldsymbol{x_{min}}}\right]^{-\mathbf{1}},$$ (2)

where x_{min} corresponds to the smallest value of *x* for which the power-law holds, *not* the smallest value of *x* measured. This is because $\boldsymbol{P[X=x] \sim x^{-a}}$ diverges as $\boldsymbol{x}$ approaches 0, i.e., the distribution deviates from the power-law form below $\boldsymbol{x_{min}}$. Indeed, few real-world power law distributions have a straight slope over their entire range, especially for smaller values of the measured variable (e.g., some points in the graphs in Figure 2) (Newman, 2005).

Returning to the derivation, we multiply the probability distribution function by a constant $\boldsymbol{C}$ to remove the tilde:

$$\boldsymbol{P[X = x] = Cx^{-a}}.$$ (3)

The normalized expression of the constant is

$$\boldsymbol{C} = (\boldsymbol{a} - \mathbf{1})\boldsymbol{x_{min}^{a-1}}\,.$$ (4)

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