ESSAYS ON THE PANIC OF 1893 - LESSONS FROM HELENA, MONTANA

by

Wayne P. Zandbergen

A Dissertation
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Date: _____ Fall 2013
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Dedication

To Karen, for supporting me in my many intellectual and professional wanderings.

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Abstract

ESSAYS ON THE PANIC OF 1893 - LESSONS FROM HELENA, MONTANA

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The understanding of emergent financial phenomena such as bank panics, though of interest for many years, has received increased attention since the crisis of 2007-8. Previous crises are often examined, seeking to gain insight into ways in which the frequency or economic damage of such events can be reduced. The Great Depression has garnered a great deal of attention, the Panic of 1893 less so. However, the Panic of 1893 and the Great Depression share several common features: They originated in the interior of the country and spread eastwards, they were double-dip depressions, and they were the two greatest peacetime economic crises in U. S. history [Wicker, 2006]. In contrast to the several banking panics of the Great Depression, the Panic of 1893 has been called "The Perfect Panic" due to the limited institutional intervention between agents engaged in banking [Ramirez, 2009].

Two dominant theories are used to explain bank panics: random factors [Diamond and Dybvig, 1983] and asymmetric information [Greenwald and Stiglitz, 1986], [Akerlof, 1970]. Both theories assume depositors act in an individually rational manner, seeking to optimize outcomes. The difference between the two approaches is less in the cognitive models used for depositors than in the ability of depositors to understand the meaning of events external to the depositor. In this sense, the random factors approach is simply a limit point of

asymmetric information, with the limit point opposite random factors representing perfect economic rationality. Empirical analysis has provided at best mixed results in terms of establishing which of the two theories best explains panics [Iyer and Puri, 2008], [Kelly and O'Grada, 2000], and [O'Grada and White, 2003], with recent evidence from the Panic of 1893 suggesting that, depending on the level of analysis, both theories hold [Carlson, 2005]. When empirical studies have focused on individual depositor behavior, they are performed using records of only one bank.

The Montana Historical Society Library in Helena, Montana, maintains daily records for four banks that operated independently during the Panic of 1893. The detailed ledgers and letters document a combined 61 years of operation. This resource provides a unique opportunity to understand features of banking and bank panics not available in any other archival record. Information garnered from this archive provides a common thread of the essays presented.

Historiographically 1893 has been featured in narratives regarding the social and political climate of the Gilded Age, but detailed critical economic analysis is lacking. The Panic in Montana was severe, and its impact long lasting. The impact on Helena was even more damaging. Bank records show the impact of events in 1893, as well as how each of the four banks was able to respond, or not respond, to changing conditions. Helena banks were exposed to a generalized economic downturn associated with the collapse of silver prices as well as mismanagement and criminality on the part of bank managers. Daily rates of change in overall bank deposit balances and the distribution of bank deposit balances by customer are shown to be fat-tailed. The data also suggests no single common theme or event as the cause of the banking problems that occurred in Helena.

Bank panics have been observed to be localized events, spreading through means of contagion to other regions [Wicker, 1996]. It remains an open question as to whether and to what degree bank-to-bank contagion exists, and whether weaker banks are punished and healthy banks rewarded as a result of such contagion. Data on the four Helena banks provides evidence for such contagion, with depositors in Helena reacting to news of bank

panics and failures in other U. S. cities. The evidence also demonstrates that those who withdrew money from one bank did not redeposit into banks deemed more solvent, which is evidence of significant information asymmetries. These findings support policies such as lender-of-last-resort.

Models of panic based upon the two dominant theories can generate panic-like behaviors, but have shown limited success at capturing more detailed empirically observed phenomena [Bryant, 1980], [Romero, 2007], [Gu, 2011]. Such models lack psychosocial characteristics, presenting a limit to their utility [Smith and Shubik, 2012]. The Bank Depositor Model (BDM) considers depositors as embedded in a social complex, with actions driven by their emotional state. Agent emotional state is a function of individual attributes and the positions of neighbors. Derived from models of group dynamics [Bosse et al., 2009], BDM is a reactive agent model that reproduces panic behaviors found in earlier models through social contagion networks, without a model of cognition or of economic rationality. Unlike economically-driven agent models based in random factors or asymmetric information reasoning, it is able to generate distributions observed in the Montana banks.

Taken together, the presented essays use the extensive data available from Helena banking records during the Panic of 1893 to demonstrate that the complexity of banking crises exists on several levels. Investigating empirical sources results in findings that are best viewed as psychosocial phenomena. Such an approach can provide unique insights into theories of financial panic, modeling such events, and policy and regulatory systems focused on limiting the occurrence and mitigating the impact of such events.

Chapter 1: Introduction

Bank panics of the Gilded Age, the Great Depression, stagflation in the 70's, the crash of 1987, the "dot com" bubble, the sub-prime crisis of 2008 and the ensuing Great Recession - financial crises have occurred with a frequency and a persistence that would suggest they are permanent features of the American economic landscape. Banking panics or crises are central features in many of these events. The word panic, when applied to banking, brings to mind crowds of people clamoring at the doors of a bank, perhaps the image of Jimmy Stewart trying to calm those who have been led to believe Bailey Savings and Loan will soon be insolvent. Although the advent of deposit insurance has made such events rare, at least at retail banks, panics and runs on financial institutions still occur, though customers may join a digital queue versus one at the doors of the bank.

Historical and economic scholarship, be they applied or theoretical, have often yielded mono-causal explanations for such events. In the case of the Panic of 1893, the dominant narrative involves the issue of bimetallism as a threat to the maintenance of a gold-only standard resulting in diminished confidence by investors, especially those in Britain. Economic historians have identified that as a result of the significant economic growth in the United States during the last third of the 19^{th} century, the success of gold standard advocates resulted in insufficient circulating currency, thus the depression of the 1890s. With regards to bank panics, economic theorists have converged on two explanations, random factors and information asymmetries. Both argue that depositors compare their perceived risk of losing deposits as compared with the potential gains of keeping deposits intact. They differ only with regards to the amount and accuracy of information available to make such decisions. Such descriptions, either historical or economic, do not do justice to the multi-faceted causes and mechanisms of such events. Investigation of detailed 19^{th} century bank

records from Helena, Montana, demonstrates this and gives rise to the thesis of this research program.

Thesis: Examination of 1890s bank records in Helena, Montana demonstrates that viewing banking through a psychosocial lens provides unique insights into the explanation of banking crises and panics.

Panic is a social phenomena. Depositors who rush to withdraw can be participating in an act of self-fulfillment, the act of withdrawing on the fear of a run on a bank resulting in an actual run on the bank. Use of such psychosocial terms is not restricted to discussions of panics, but is also used in the description of everyday economic affairs. The creation and destruction of confidence, like panic, is a psychosocial phenomena, requiring an investigation of the means by which groups develop shared understandings of the meanings of past or potential events.

The work presented proposes that examining the full context of panic as a psychosocial process can contribute to a better understanding of financial crises. To do this requires looking through multiple lenses, lenses derived from historical, econometric, and complexity disciplines. The order of the three is important. The discipline and method of history, particularly the focus on primary sources that is a given in most historical research, lies at the foundation of this effort. Examining financial panics through an historical lens provides the necessary detail, empirical evidence, and context necessary to develop or test economic theories. It also provides the foundation for the development of models as theory. The premise, then, is that applying the historical approach to understanding economic phenomena, whether in econometrics or in agent-based modeling, allows insights not availble through other mechanisms and allows the development of models that have distinct advantages compared with previous models of bank panics.

Fortunately the historical record is not silent on matters concerning depositor behavior during periods identified as bank panics. There is a small but growing literature using actual depositor and bank records.[1] Unfortunately, in each case the historical record is of

[1]See [O'Grada and White, 2003], [Kelly and O'Grada, 2000], [Iyer and Puri, 2008].

one bank, or of banks without publicly available records that would allow researchers to test hypotheses. The research presented seeks to remedy this problem by offering an analysis based on four Helena, Montana banks which coexisted during a time of great financial turmoil.

History of the Panic of 1893 Though existing in a context of national and international finance, events in Helena, Montana, during the Panic of 1893 had their own specific character. The debate over whether silver should be used in addition to gold as a basis for national currency, referred to as bimetallism, was a central feature of political debate in the late 19^{th} century. While the bimetallism debate played an important role in the silver-dominated economy of Helena, other factors were involved in what would become the collapse of a regional banking center. Corruption and mismanagement combined with the onset of economic challenges associated with the collapse of the silver movement to wreak havoc on Helena and its banks.[2]

Quantitative Findings The four Helena banks for which detailed records exist were of varying age, size and institutional quality. With the records available in the Montana State Historical Society archives it is possible to get a detailed picture of what happened during the Panic of 1893 at both the bank and the depositor level. Details for each of the four banks are presented, and specific structural findings are examined and tested. To simply extract numbers from the bank records without first understanding the origin, meaning, and limitations of those numbers can lead to unreasonable conclusions. The data presented is essential to arguments in other findings from this research, yet on its own is used to illuminate two interesting facts. First, the amount of financial resources invested by individuals can be shown to fit specific statistical distributions normally referred to as fat-tailed. The implication of this finding is that the impact of the wealthy few dominated issues of bank solvency in Helena. Second, the underlying character of banking challenges

[2]See [Noyes, 1898] for the contemporary anti–silver narrative of the Panic of 1893, [Sprague, 1910] for a more nuanced discussion. See [Friedman and Schwartz, 1963] for the monetarist explanation of the Panic.

in Helena is refined and the issue as to whether a panic occurred in Helena in 1893 is addressed.

Bank-to-Bank Contagion The existence or lack of bank-to-bank contagion provides evidence for the accuracy of existing theories regarding the causes and mechanisms bank panics. The two primary theories, random factors and information asymmetries, both imply the existence of such contagion.[3] Greater information asymmetries should cause greater contagion. Such theories also argue that contagion allows panic to spread from region to region. Results of an econometric analysis of bank-to-bank contagion during the early 1890s in Helena are presented, and it is shown that there is significant evidence in support of such contagion. Demonstrating such contagion suggests that depositors withdraw funds from banks without regard for the perceived health of the banks. This means that during a financial crisis banks that are essentially healthy will suffer in ways similar to those that are more fragile. Such findings can be used to justify policies regarding the financial system, such as providing deposit insurance or a lender of last resort, normally assumed to be a central or centrally coordinated bank.

An Agent-Based Model of Bank Depositors Existing models of bank panics rely upon a model of economic action, that depositors seek to maximize their outcomes based upon their economic knowledge and cognition. Theories and models differ on what information may be available to a depositor, but all posit a cognitive model that requires agents to act in their own self-interest.[4] The implications of such theories have been tested empirically, with mixed results.[5] As a counterpoint to the economically rational agent models of economics, the Bank Depositor Model (BDM) uses a reactive versus cognitive model of depositor behavior. Like the random factors, exogenous events that carry no economically meaningful information occur. In contrast with random factors, simple reactive depositor

[3]For random factors see [Diamond and Dybvig, 1983]. Information asymetries are examined in [Akerlof, 1970].

[4]See [Romero, 2007], [Bryant, 1980], [Allen and Gale, 2000], amongst others, for such models.

[5]See [Calomiris and Gorton, 1991], [O'Grada and White, 2003], [Carlson, 2005], amongst others.

agents are embedded in a social network which propogates agent outlooks through the network with resulting impacts on deposit levels. The model is shown to generate empirically derived facts not generated by models based on pure economic rationality. The model thus demonstrates that the process of contagion can play a dominant role in explaining depositor actions during a crisis.

There is little agreement as to what constitutes a panic or bank run. Carmen M. Reinhart & Kenneth S. Rogoff define panics as "bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions" [Reinhart and Rogoff, 2009, p. 10]. A run is identified symptomatically as occurring when "depositors lose confidence in the bank and withdraw en masse" [Reinhart and Rogoff, 2009, p. 144]. Thus it is distinguished from withdrawals based on other reasons, such as economic needs. Charles P. Kindleberger defines a panic as one of the stages in a bubble; first mania creates the bubble, then panic bursts the bubble [Kindleberger et al., 2005, p. 12]. When discussing the Great Depression, Elmus Wicker [Wicker, 1996, p. 17] defines a panic as "an exogenous shock whose origins can be found in any sudden and unanticipated revision of expectations of deposit loss accompanied by an attempt to substitute currency for checkable deposits, a situation usually described as a run on the bank." In his later book on panics of the National Bank Era, Wicker [Wicker, 2006] describes runs and suspensions as indicators of bank panics, but falls short of mentioning exogenous shocks, perhaps because he determined that the panic that gripped Denver in July of 1893 seemed to be without any distinguishable cause.

There is much disagreement over the definition of bank panic as well as whether a set of events qualifies as a panic. Interestingly enough, the Panic of 1893, with more than 500 bank suspensions and closings, did not make the list of such events in Reinhart & Rogoff's analysis. They included 1890 as a panic in the United States, although there were very few suspensions, and little economic impact.[6]

[6]Bruce Champ [Champ, 2007, p. 7] lists 4 panics of the National Bank era, 1873, 1884, 1893, and 1907. Wicker [Wicker, 2006, p. 34] argues that since so few banks suspended in 1884 (63 over three months, although only 7 were national banks) it should not be considered a panic, referring to it instead as an "incipient panic". Unlike Reinhart & Rogoff, neither consider 1890 a panic, at least not in the United

Perhaps the confusion is caused by the fact that the word panic is used in several different ways. The national and even international financial events of 1893 are referred to as the Panic of 1893. Within the Panic of 1893 are a series of other panics, such as the panic that gripped Denver in mid–July. The word panic is also loaded with meaning. The word panic derives from the Greek god Pan, who was thought to cause the strange and apparently random outbursts of activity and flight in flocks of sheep. Those who experienced the events of 1893, although not referring to those who panicked as sheep, did wonder as to the causes and mechanisms of the behaviors of investors and depositors.

> We have had another week illustrative of the utter lack of confidence which exists. Rumors at the moment are as good if not better than facts to start a semi-panic, for facts appeal to the judgment, but rumors take hold of the imagination which is now in control of the public mind. No new event has happened to justify the conditions which prevailed on Tuesday, and which also prevailed in large measure on Wednesday and to some extent still continue. To be sure bank failures formed a conspicuous feature on the days mentioned, especially at Denver; but even the bank failures had almost no connection with insolvency, being occasioned rather by an insane effort of wildly-excited depositors to turn the entire assets of a few financial institutions into cash on a single day ...
>
> *Commercial and Financial Chronicle*, July 22, 1893, p. 122

Words used to describe the events of July, 1893 not only hinted at irrationality but, as in the *Chronicle*, went well beyond, asserting insanity on the part of those participating in the panic. Two of the better known contemporary chroniclers of the period, O. M. W. Sprague and A. D. Noyes, observed the Panic from different perspectives. Noyes was a journalist working for a series of New York papers covering financial events and Wall Street. Sprague was a student at Harvard in 1893 who would go on to become a professor of economics, compiling a history of the National Banking era for the Aldrich Commission. Although from different backgrounds, they shared a common view regarding panics. Noyes [Noyes, 1898,

States.

p. 190] described panic as "in its nature unreasoning", while Sprague [Sprague, 1910, p. 170] declared that "the spread of distrust and the contagion of panic are essentially products of unreasoning fear."

The term run is perhaps more tractable, as it speaks to actions versus motivation. Unfortunately it is difficult to identify when a run begins and whether the action of the depositor is a result of economic rationality, i.e., the economic situation of the depositor is deteriorating, or of psychosocial contagion, as would commonly be associated with the term panic. Given the lack of consensus regarding the meaning of the term panic, questions such as "Was there a bank panic in Helena in 1893?" are not easily understood. An answer to the question seems unimportant if the goal is to simply apply a label to a set of events.

Given the etymological challenges inherent in such terms, and the fact that such terms are used throughout this study as well as existing literature, it is necessary to offer definitions of the terms and how they will be used going forward. For the purposes of this effort, the term panic will be used as a general label of the events of the first eight to nine months of 1893. It will also be used to references events for which there is little controversy that they apply, such as the Panic of 1893, or the panic the occurred in Denver in July of that year. Whether the events formally constituted what others would proclaim as panic does not in any way change the nature of the events that occurred. It would not be surprising if, when examining the motivations of bank customers, some depositors behaved according to economic need, others according to mimicking behavior without any specific economic rationale, and some could have indeed been considered clinically insane. It becomes the task of the researcher to examine the records and determine the fine–grained structure of the events that transpired. A run will be used to identify a period of abnormal withdrawals at a bank, without any regard for the motivation of the customers.

Borrowing a phrase from Robert Shiller, this work seeks to define the "contours of causation" and demonstrate, through a variety of means, that these countours provide a nuanced and potentially fruitful way to understand the complex social events that are financial crises [Shiller, 2005, p. 31].

Chapter 2: The "Perfect" Panic of 1893

In May of 1893 a wave of bank suspensions and closures began in the interior of the United States. By the end of August, more than 500 banks had shuttered. Of the 500, at least 158 were national banks [Kane, 1922, p. 190]. Although many of the suspended banks would quickly reopen, the crisis year of 1893 would begin the greatest period of depression the country had yet seen. This ignominious title would not be lost until the Great Depresison [Wicker, 2006, p. 52]. The Panic of 1893 brought about or perhaps was brought about by the political defeat of the bimetallist movement and a confirmation of the primacy of gold as the basis of American finance. Although opposition to the gold standard would not melt away, the failed "Cross of Gold" candidacy of Bryant in 1896 would perhaps be the highwater mark for such efforts; the repeal of the Sherman Silver Purchase Act in October of 1893 was certainly the beginning of the end for the Free Silver movement.

The demise of the National Bank era in 1913 ended a period that was "a laboratory for systems of volunteer collective action" [Bruner and Carr, 2007, p. 169]. During this time few institutional structures intervened in the relationship between depositors and banks. The Comptroller of the Currency had but one disciplinary measure available, revocation of charter. Such draconian measures were rarely used. Deposit insurance was not available, and there was no central bank to provide support when conditions became challenging. As the most severe economic crisis of the era, the Panic of 1893 provides an excellent case study within the laboratory, one relatively free of complicating institutional structures. Unlike preceeding panics, 1893 was better documented by not only the Comptroller of the Currency, but also by burgeoning financial information services businesses such as *Bradstreet's*, R. G. Dun & Co., and *The Commercial and Financial Chronicle* [Carlson, 2005].[1] It has thus

[1]When the context is clear the *The Commercial and Financial Chronicle* will be referred to simply as the *Chronicle*.

earned the nickname "the perfect panic" [Ramirez, 2009, p. 8].

2.1 Prelude to Panic

The similarities between the Panic of 1893 and the banking problems of the Great Depression are striking. As with the Great Depression, problems emanating from the interior of the country were mostly ignored or deemed insignificant by those residing at the financial heart of the country in New York [Wicker, 2006, p. 52]. Only when things had gotten entirely out of hand did those with the means to alter the financial situation intervene. As with the Great Depression, such intervention was a day late and more than a dollar short. For those who lived in the interior, the events of 1893 proved cataclysmic. When the problems that arose in the interior during 1893 found their way to New York, years of depression were the net result.

The 1890s began with the near collapse of Barings Bank, the oldest merchant banking house in London. Barings had taken huge risks in South America, particularly Argentina, and when the Argentine bubble burst, Barings did as well, and helped bring on a recession in England as well as Brazil and other South American countries. The bank survived through the intervention of the Bank of England, but not before helping plunge England, and much of Europe, into recession.[2]

In the United States, 1890 was marked by the first full year of the presidency of Republican Benjamin Harrison. Several landmark pieces of legislation were passed in 1890, including the Sherman Anti-Trust Act, the McKinley Tariff Act, and the Sherman Silver-Purchase Act. The three bills were considered to be compromise legislation on all fronts; the Anti-Trust Act was passed but rarely enforced by the Harrison administration; the Tariff Act, which many thought would protect domestic producers, but instead resulted in an overall reduction in Federal revenues as well as increases in prices for any product using sugar; and the Silver Purchase Act, which required the purchase of an increased amount of

[2]Barings collapsed for good in 1995 after a derivatives trader was allowed to expose the company to massive risk in the Asian markets. The risk materialized as losses of more than $1.3 billion by late February, 1995.

silver to be used in expanding the supply of currency; yet reserved gold as the basis of the currency.

The Baring Panic and its accompanying recession reduced U. S. exports significantly in 1890 and early 1891. The potential impact of the Baring cirsis and the major legislation of 1890 was muted when crop failures in Europe and Russia combined with a bumper crop for U. S. farmers in 1891. This favorable export situation continued through most of 1892.

2.1.1 Business in Late 19th Century Montana

The last decades of the 19th century were a period of great expansion in the Western United States. Although the gold rush in California had subsided, other discoveries of precious metals created similar rushes to riches as had the discovery at Sutters Mill. Montana was no exception, growing in population from 20,595 in 1870 to 142,924 in 1890.[3] Gold finds in Bannack (1862), nearby Virginia City (1863), Last Chance Gulch (1864), and Marysville (1876) helped generate not only increases in population but even greater increases in levels of wealth.

In late 1864 the town of Helena was established at the site of the gold strike in Last Chance Gulch. The Territory of Idaho had only months before been divided into three parts, including the new Territory of Montana. The first national bank charter in what was to become the state of Montana was granted in 1866, with the 1st National Bank of Helena opening for business during 1867, reporting $217,000 in resources in October of that year [Comptrollers Report 1867]. Gold is what brought the initial wave of immigrants to the territory, and gold brought the federal government as well. In 1874, with the strong support of W. H. Claggett, the United States Mint established an Assay Office in Helena [Bancroft, 1890, Vol. XXXI, p. 677]. Assay offices served as central locations for the purchase and processing of precious metals for the government.

Initially prospectors would look for the easy strike, following stream beds and valleys,

[3]In the 19th century the United States Census did not include Native Americans, who were specifically excluded from the process. Given the state of Federal / Native American affairs at the time in Montana, even if desired, it would have been extremely difficult to conduct a census of Native Americans.

looking in the deposits of streams and runoff where heavier metals, such as gold, would sometimes accumulate. Mining such deposits is referred to as placer mining. Placer mining is a relatively simple and inexpensive process. Deposits in stream beds or gullies are processed through a sluice box, a device that uses water to drive deposits over a series of barriers to capture the much heavier gold. The early strikes in Montana were all placer mines. Unfortunately such resources can be quickly exhuasted. Though the territorial capital was originally located in Bannock, by 1875 the Bannock and Virginia City gold fields had run out. The territorial capital was then moved to the more centrally located Helena, where the influence and value of mining would remain strong for twenty more years. Last Chance Gulch, a placer mining area, would last but a few more years. However, the Drumlummon Mine in nearby Marysville, a lode versus a placer mine, would soon become a strong gold producer. Along with the territorial capital, the arrival of the main line of the Northern Pacific Rail Road in Helena in 1883 made Helena's future look bright. With statehood in 1889, Helena was chosen as the capital.

Mining was the core of Montana's early economy. Table 2.1 shows the change in value of mining for each of the three primary metals produced in the state [Toole, 1959, p. 159]. Silver, second only to copper in terms of importance to the Montana economy, would be at the center of national politics through much of the later part of the 19^{th} century. Montana copper mines, particularly the huge Anaconda works, would be at the center of a business conflict that played a central role in the Panic of 1907.

Table 2.1: Value of Montana Mine Production (in $ million)

Year	Gold	Silver	Copper	Total
1879	2.5	2.3	—	4.8
1885	3.3	10.1	7.3	20.7
1890	3.3	16.5	17.6	37.4

Though mining was certainly the largest, it wasn't the only business in Montana. Cattle were originally raised using the massive open range land available. The unpredictability of the weather demonstrated the limits of this sort of enterprise. During the winter of 1886-7 large numbers of cattle perished. Some large herds were almost completely wiped out. Cattle would make a recovery in the 1890s, but the operations moved to more capital–intensive captive systems. Sheep also became common, as did the seemingly requisite battles between the sheep and cattle factions.

The Northern Pacific Railroad also provided economic opportunities, and not simply as a way for miners and livestock producers to get their products to market. The scale of construction and maintenance in a territory as large as Montana provided a significant economic engine for many businesses. Supplying the railways and the mines with timber and coal became small but important businesses in those parts of the state with access to such resources [Toole, 1959, p 144-7].

Capital and Banking The major industries of Montana were capital intensive enterprises, but also potentially quite lucrative. With little home-grown capital available, investors from the Eastern United States and Europe were recruited to support the expansion of mines, building of railroads, and even to stock a rancher's initial herd of cattle. Located twenty miles northwest of Helena, the Drumlummon Mine was originally discovered and developed by an illiterate Irish miner named Thomas "Tommy" Cruse. In 1883 Cruse sold five-sixths of his interest in the mine to a London-based conglomerate for $1.63 million. The new organization, originally named The Montana Company, Limited, quickly demonstrated the impact of increased capital resources by expanding the 5-stamp mill to a 50-stamp mill within one year [Meyer, 1998].

The Anaconda Mine, which eventually would dwarf mines such as the Drumlummon both in size and value of minerals extracted, was originally developed as a silver mine but was soon found to sit atop a massive deposit of copper. Needing funds to execute a purchase option on the yet underdeveloped mine, part-owner Marcus Daly went to San Francisco,

partnering with James Haggin, George H. Hearst[4], and Lloyd Tevis. In 1899 the Anaconda would form the core of the Amalgamated Copper Company, a holding company formed by John D. Rockefeller's Standard Oil Company [Arguimbau, 2006].

Along with the development of mining interests came the development of banking (See Figure 2.1). 1st National of Helena had the sprawling territory of Montana to itself for five years. In 1872 and 1873 four new national banks would be chartered, Montana National in Helena, 1st National in Bozeman, 1st National in Deer Lodge, and 1st National in Missoula. Of the new entrants, Montana National would last but a year, and by 1879 only 1st National of Missoula would remain. Thirteen years after Helena's 1st National was chartered, and well after the creation of the Montana Territory, there were but two national banks in the entire territory. This meant most Montanans relied upon private bankers, those who combined small loans and banking with other services, such as purchasing and selling small amounts of gold and silver and financing merchant enterprises. Beginning in 1879 the resources of Montana's national banks would begin to grow at a much greater pace than had occurred in the previous decade. Between 1881 and 1884 ten new national banks would be chartered in Montana. From 1881 to 1892 Helena banks grew from 1 to 6, with resources growing from $1.5 million to $11 million. Banks outside Helena were growing even faster. 1882 would show 3 non-Helena banks with total resources of $1.7 million. Ten years later the number of banks had grown to 26, with total resources of almost $18 million.

Figure 2.1 shows the growth, and decline, of banking in Montana and particularly in Helena. By Sept. 30, 1892, Montana had 34 national banks with total resources of $25,678,998 [Comptrollers Report 1892]. The magnitude of the wealth being created in Montana meant that when considering all bank types (national, state, private, trust, and savings banks), only six states, four in New England plus New York and California, had greater per capita bank resources than the $157.41 per person in Montana. No other state averaged more than $100 per person. When considering only national banks, Montanas $142.70 per person was

[4]Senator from California and father of William Randolph Hearst.

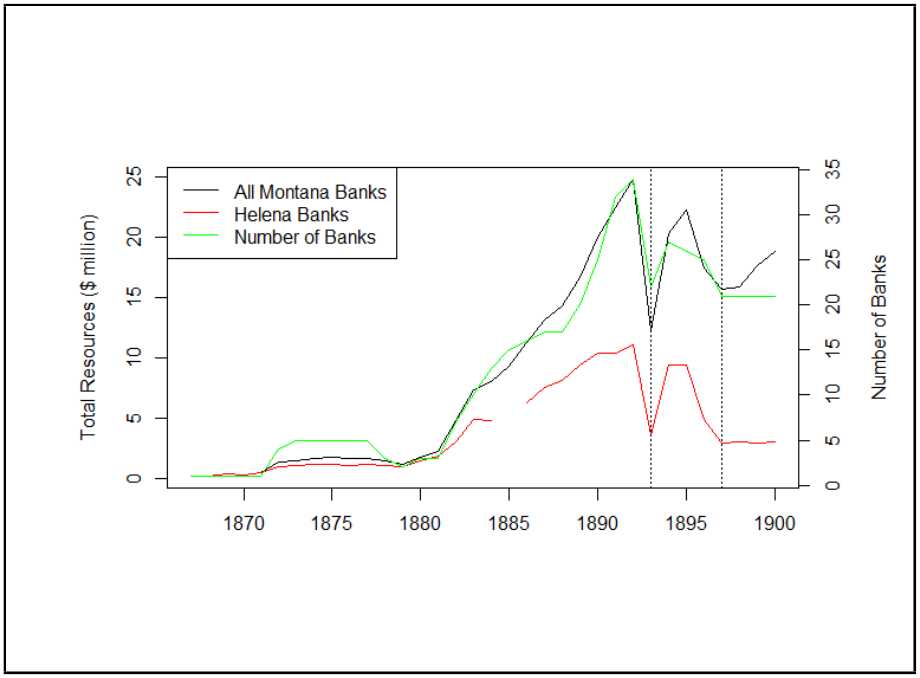


Figure 2.1: Number and Total Resources of Montana Banks[5]

the highest in the nation, only five states exceeding even half that level.[6] Compared to much of the rest of the United States, Montana was awash in money. National banks dominated banking in Montana, and the banks in Helena were dominant amongst Montana banks.

As shown in Table 2.2, the cumulative resources of Helena banks were large in comparison to the state of Montana, and the individual banks were also significant in size nationally. In October 1892, Denver was the only city west of Omaha that had a greater concentration of national banks than Helena. Only three national banks west of Omaha were larger than 1st National Bank of Helena, which was in the top 4% of national banks ranked by size (#125 of 3,772 national banks included in the Comptrollers Annual Report to Congress in 1892). Almost half (55) of the larger banks were located in the three Central Reserve cities, and only 7 country banks in the United States had greater total resources. Merchants' National was ranked #247 in size, Montana National #304. American National and Helena

[6]Massachusetts at $138.53, Rhode Island at $128.62, New York at $89.65, Connecticut at $87.54, and Colorado, like Montana a state with significant mining interests at the time, having $83.73 per capita resources in national banks. [Comptrollers Report 1892]

[6]Individual bank data was not published in the 1885 Annual Report of the Comptroller of the Currency.

National were both in the top 20%. Even the smallest of the six Helena banks, 2nd National, was larger than more than 40% of all national banks [Comptrollers Report 1892]. While the 1890 census put the number of people living in the United States at almost 63 million, only 13,834 were determined to be living in Helena.

Table 2.2: Helena National Banks

Bank	Year of Charter	Year of Closure / Merger	Resources ($) (Oct. 1892)
1st National	1866	1896	4,388,232
Merchants National	1882	1897	2,531,277
2nd National	1882	1893	327,780
Helena National	1890	1894	978,982
Montana National	1882	na	2,168,269
American National	1890	na	677,231
All Helena Nat'l Banks			11,071,771
All Montana Nat'l Banks			25,678,998

2.1.2 Four Helena Banks

Helena began 1893 with six national banks. Montana National, the third largest bank in Helena, suspended on July 27 July, but would reopen a few weeks later. The oldest and by far largest national bank in Montana, 1st National, also suspended on July 27th. 1st National was able to reopen in February 1894, only after renegotiating more than $1.3 million in time certificate deposits to fix redemption times spread over five payment periods from July 1, 1894 to November 1, 1895. Merchants', People's, 2nd National, and Helena National all survived the Panic. 2nd National and Helena National merged in September of 1893. Feeling that the founder and president of 1st National, Samuel T. Hauser, had grown complacent and ineffective managing the bank, examiners encouraged a merger with Helena National (See Table 2.3). By the end of 1894 the six had become four. With

the new organization of 1st National came new leadership, leadership that was expected to run the bank in a more professional and financially sound manner. Such was not to be the case. The combined bank, retaining the name 1st National and by far the largest bank in the region, suspended for good in early September of 1896. Five months later, the second largest bank in Helena, Merchants' National, suspended as well. These suspensions, and the ensuing investigation into their operations, resulted in the concentration into one location of the hundreds of ledgers and thousands of documents that comprise the Montana State Historical Society collection. This collection provides an unprecedented resource to investigate bank operations during the last half of the 19th century, and a particularly critical resource in understanding the Panic of 1893. These four banks form the core of an on-going research intiative. By March of 1897, only Montana National and American National, the smallest of the remaining banks in Helena, would remain.

Table 2.3: Helena National Banks and Senior Managers - Oct. 1892

Bank	Year of Charter	President	Cashier
1st National	1866	Samuel T. Hauser	E. W. Knight
Merchants' National	1882	Lawrence H. Hirshfield	Aaron Hirshfield
2nd National	1882	Eratus D. Edgerton	George B. Child
Montana National	1882	Charles A. Broadwater	Robert L. McCulloh
American National	1890	Thomas C. Power	A. C. Johnson
Helena National	1890	Shirley C. Ashby	Frank Baird

1st National Bank of Helena 1st National was headed by Samuel T. Hauser from 1866 until 1894. On March 17, 1866, Hauser, along with 17 other investors, pledged $100,000 start-up capital for the bank and applied for a national bank charter. Other owners contributed between $1,000 and $10,000 to the venture. When Merchants' National Bank

received a charter in 1882 with $150,000 in paid in capital, Hauser quickly moved to increase 1st to $300,000. By that time Hauser, who owned more than 51% of the stock, was essentially partners with S. J. Davis, who controlled more than 42%. Of the remaining $20,500 in stock, $3,000 was owned by the bank's cashier, E. W. Knight, and Hauser's wife Ellen, who owned $5,000 of stock [1st NB Records, Vol. 315]. Hauser was a staunch Democrat and supporter of the Free Silver movement. In 1885 he was appointed territorial governor of Montana by fellow Democrat Grover Cleveland, a position he held for 19 months. The bank was under constant criticism from examiners for poor recordkeeping, maintaining inadequate reserves, and a variety of other problems [Petrik, 2009]. 1st National enjoyed early success, growing from just over $200,000 total resources in its first year to a bank with more than $5,000,000 in 1889. To understand how large this was for the late 19th century, consider all U. S. territory to the west of the Missouri River as well as the entire former Confederacy. In this entire region in 1889, only two National banks were larger than 1st National of Helena: 1st National of Denver with $5,390,000 in resources and Omaha National, with $6,439,000 [Comptrollers Report 1889].[7]

Merchants' National Bank of Helena Merchants' National Bank of Helena was founded by brothers Lewis and Aaron Hershfield. Lewis began his Montana business career in Virginia City in July 1864, where he traded 26 wagons of trade goods purchased in Denver for gold dust. The gold dust received served as a foundation for his private banking business. Lewis moved to Helena in 1865. His younger brother Aaron joined him there in 1867. In 1882 the private bank of L. H. Hershfield & Bro. received a national bank charter and was renamed Merchants' National Bank of Helena. Aaron Hershfield was involved in several other banking efforts in Montana, including 1st National of Kalispell, where he served as President from its founding in 1891 until 1896, 1st National of White Sulphur Springs, and

[7]Only 76 National banks were larger than 1st National of Helena in 1889. They were distributed as follows: Central Reserve Cities (40) - New York, 30; Chicago, 8; St. Louis, 2. Reserve Cities (30) - Boston, 15, Philadelphia, 7, Cincinnati, 3; Kansas City, 2; Albany, Pittsburgh, and Omaha, 1 each. Country banks (6) - St. Paul, 2; Brooklyn, Jersey City, Minneapolis, and Denver, 1 each. Several reserve cities did not have any single bank larger than 1st National, including Detroit, Cleveland, Baltimore, Washington, New Orleans, Louisville, Milwaukee, St. Joseph (Missouri), and San Francisco.

State National of Miles City. Beginning with a strong presence in the gold trading business, Merchants' was able to grow from just over $500,000 in total resources in 1882 to more than $2,500,000 in 1892. Personal connections with the Kountze Brothers banking house of Denver and New York was established before the Hershfield brothers received their national bank charter. Merchants' served as the exclusive agent for the Kountze's in Helena from as early as 1876 [MNB Records, Box 4-25].

Banking relationships were often a two–way street. As a national bank Merchants' was eligible to receive Federal deposits. With the help of the Kountze Brothers in New York City, the designation as a depository was received by Merchants' in late 1882 [MNB Records, Box 7-3]. The Treasury's Assay Office generated a great deal of business for Merchants'. It is perhaps not coincidental that the only possible competitor for the Assay Office business, 1st National Bank, was owned and controlled by a Democrat, Samuel T. Hauser, whereas Lewis Hirschfield was a Republican and donated heavily to party activities, claiming in 1892 to be spending "three to five hundred dollars" a week supporting the party [MNB Records, Box 16-1].

2nd National Bank of Helena 2nd National was founded in 1882 by Erastus D. Edgerton. Of the $75,000 in capital pledged when the national charter was granted, Edgerton provided $56,000. The bank never grew to great size, but was also never considered a great risk. Like 1st National, 2nd reached its resource peak of slightly more than $375,000 in 1890, quickly dropping back to previous levels in 1891. A short resurgence of deposits occurred in 1892, but the bank never consistently achieved resources greater than $300,000. Due to its small size, as well as the lack of state and savings banks in Helena, 2nd National found a small but important deposit market providing savings accounts to its customers.

Helena National Bank Helena National was founded in 1890, the same year as the Silver Purchase Act and Montana's first senate and congressional representation. The first president of the bank was railroad owner and rancher Charles A. Broadwater. After

Broadwater's death in 1892, John T. Murphy became president, followed in 1893 by Shirley Ashby. The $500,000 in initial capital was matched in Helena only by 1st National and Montana National. The bank grew quickly during its first two years, with resources briefly exceeding $1,000,000 in October of 1892, but the bank found little room for growth as the panic year of 1893 approached.

2.2 The Panic Year

As 1893 began, the January 7 *Commercial and Financial Chronicle* reviewed the previous business year and described expectations for the year to come. From a business perspective 1892 was deemed "far more prosperous than either 1891 or 1890", although it was noted that even though business volume had increased, profit margins had been low. Mostly positive in outlook, the business forecast for 1893 declared "a hard struggle and a poor chance for the small capitalist." The Wall Street–based weekly reported growing confidence in the financial sector and that business trends were "decidedly encouraging" with "rapid growth" expected in the new year. With the only concern being the on-going silver situation, a positive mood was proclaimed.

2.2.1 The Panic from 50,000'

First Ripples (January - April) The first significant crack in the positive outlook appeared on February 20, when the Philadelphia and Reading Railroad, a highly leveraged player in the new business of mergers, entered receivership. The collapse of Reading was proclaimed to be a surprise to those on Wall Street. Two days before the collapse, in the February 18 issue of the *Chronicle*, editors stated that, even though prices for Reading were dropping, the "Reading situation does not appear to be a bad one." The Reading had recently moved into New England, encroaching on the territory of J. P. Morgan. The *Chronicle* reported on January 28 that Morgan had made aggressive moves to protect his New England interests by increasing his holdings in a line being contested with Reading. The Reading crisis, though perhaps inevitable, was certainly also helped along by Morgan's

machinations and efforts to deny Reading additional credit [Steeples and Whitten, 1998, p. 39]. In its first issue after Reading filed for receivership, the *Chronicle* displayed traits similar to more modern financial pundits. Though admitting complete surprise at the developments, *Chronicle* writers, in hindsight, proclaimed the collapse of Reading a "natural and inevitable consequence." The collapse resulted in the two largest days of trading the exchange had ever experienced.

Though it would not be apparent for several months, February marked the beginning of a national recession [Mishkin, 1991]. The collapse of Reading did not immediately lead to bank failures, but the event was followed by a general decline in the stock market that lasted throughout March and April, with mercantile failures during the January to May period at the highest level ever reported [Sprague, 1910].

The Storm Builds (May & June) The evening of May 3, a receiver was appointed for National Cordage Company, a combination focused on dominating the market in the manufacture and sale of rope. The spectacular failure of National Cordage marked the beginning of a generalized collapse of the stock market, and the beginning of the second phase of the panic. After "one of the worst" weeks in New York Stock Exchange history, the May 6 *Chronicle* proclaimed this occurred "without any unsoundness in our financial institutions, without any rottenness in the business of the country at large."

New York banks did not appear to deteriorate during the weeks following the market crash of early May. At the end of the month Sprague reports that banks were in a somewhat better condition than when the month began. The May 20 *Chronicle* reported that the "sprinkling of small bank failures" that had occurred was but to be expected and declared the failures as having "no great significance", not constituting in any way the beginning of a more general panic. Bank failures that did occur in May appear to be uncorrelated and scattered. The situation would quickly change and by the third week of June withdrawals by interior banks had grown significantly, reducing New York bank reserves by $24,000,000, an almost 18% decline [Sprague, 1910, p. 172] [Wicker, 2006, p. 62]. Although no banking

problems had arisen in New York, on June 15 the constant demand for currency in the interior convinced New York bankers to begin using clearing house certificates as a means of handling interbank balance transfers. On June 27 a significant blow was dealt to the price of silver and the bimetallist position in general when Parliament in London revoked the Indian Paper Currency Act of 1882, moving one of the major markets for silver to a gold–only standard. Three days later President Grover Cleveland declared the Sherman Silver Purchase Act the culprit in the growing economic distress, ordering Congress to a special session in August, the sole purpose of which would be to rectify "... the present perilous condition [that] is largely the result of a financial policy which the executive branch of the Government finds embodied in unwise laws."[8] Though not explicitly stated in the proclamation, the "unwise laws" were but one, the Sherman Silver Purchase Act.

The Storm Strikes (July) July saw a wave of bank failures throughout the interior, expanding from scattered country banks to larger centers of finance such as Denver, Milwaukee, Louisville, and even Chicago. From early May to mid-July banks, in particular country banks, had increased their on-hand cash reserves as a percentage of deposits from 11.2% to 13.3% [Sprague, 1910]. This was accomplished to a great extent by withdrawing corresponding balances and by increasing to a significant degree the amount of bills rediscounted at central reserve city banks. Most banks were pulling back reserves, building up their own cash on hand. Since this was being done at every level banks that had relied on other banks deposits found themselves weakened significantly. New York and Chicago banks, at the top of the bank food chain, did the only thing they could do to remain liquid: they cut back on loans.

With bank failures and the tightening of credit at the major banking centers came further business failures, including the Erie Railroad, which entered receivership on July 25.[9] The failure of Erie set off the largest collapse in stock market values of the year.

[8]Presidential Proclamation 357 - Convening an Extra Session of the Congress, 30 June 1893. Available on–line at `http://www.presidency.ucsb.edu/ws/index.php?pid=70913`

[9]The Erie had been considered at risk of failure for some time. February 27, as the Philadelphia and Reading was plummeting, the *Wall Street Journal* reported that rumors were circulating that the Erie was going to enter receivership. On the 28th the paper reported that the fall in Reading's price was making

The Storm Subsides (August - December) The beginning of August saw the suspension of payments by many banks, including those in New York. By the end of August the panic appeared to have run its course, but the damage had been done. Three years of depression would follow.

2.2.2 The Panic in Helena

For the Helena banks the first two months of 1893 showed little out of the ordinary. Merchants' received its normal influx of demand deposit money from state and local governments. Time certificate deposits also continued to grow. 1st National saw perhaps more volitility in its corresponding bank balances, but with steadily increasing individual deposits all seemed to be moving satisfactorily. The deposit base at Helena National had been on the decline for several months. In February Helena National took the somewhat unusual step, at least for them, of rediscounting $42,750 in bills, a measure that was normally used to keep cash or reserve levels above the legislated minimum. 2nd National rediscounted bills as a normal matter of business. Its balance of rediscounts remained stable for January and February.

March and April in Helena were not as sanguine as the first two months of the year had been. Although Helena and the railroads running through Montana had no clear connection with the Philadelphia and Reading debacle, Helena bank balance data started to show an increase in overall instability.

For 1st National trends were beginning to emerge. Though corresponding bank balances often varied by large amounts, the normal pattern was for 1st National to have a much larger amount owed to other banks (deposited at 1st National) than owed by other banks. For one short period in March and another in April, this was not the case. Banks that normally deposited money at 1st National had been pulling back. The last two weeks of April also saw a decline in individual deposits. The net impact on the all–important cash on hand was a reduction of more than $100,000 from the $425,000 on-hand at the beginning

brokers "question whether Reading is worth any more than Erie."

of the year.

1st National had a history of flirting with the minimum reserve requirement [Petrik, 2009]. On March 27 the General Ledger Balance Sheet had new computed entries at the bottom; the required and the on-hand amounts for reserves. On March 31 the first violation of the mandated reserve requirement occurred. The problem became more significant through the month of March. By the middle of April the bank consistently ran well below the mandated reserve requirement.

For Merchants' it was normal for a large amount to be deposited in government demand deposit accounts at the beginning of each year. These amounts were spent down as the year went on, so it was not uncommon to see a reduction as the months went by. But 1893 was different. What looked like normal reductions in January and February became much greater and more unusual in March and April. In early January demand deposit accounts showed a net balance of almost $400,000. By the end of April the amount was close to $100,000. Time certificate deposits, the backbone of banks in Montana, stayed strong, and continued a slow climb that had been in progress for more than two years.

On April 6 1st National Bank of Butte redeemed two $10,000 time certificates at Helena National Bank. The bank, which had been building its time certificate deposit balance since it opened in 1890, lost almost 10% of the total balance in one transaction. Such was the potential impact of any one depositor, given it was the right depositor. This was a significant blow, but as April continued no further significant withdrawals occurred and demand deposits remained stable. For 2nd National deposit levels did not change significantly during this period and cash on hand was stable.

As April turned to May, banking challenges grew greater. By May 6, the reserve requirement calculation for 1st was no longer being computed, though the amount of reserves on hand was calculated each day. This was true until June 2, when even the on hand reserve value was no longer recorded. On that day the final entry regarding reserves was made in the general ledger. 1st National was down to half the cash on hand they had started the year with, and the bank had already pulled back much of the deposits kept in reserve and central

reserve city banks. With most of the funds previously deposited with corresponding banks already withdrawn, cash became the only outlet for withdrawals. Beginning in mid-April, time certificate deposits at 1st National began a steady decline. By late July more than $350,000 of time certificate deposits had been lost.

The other three banks saw varying degrees of problems. Merchants' and Helena National saw serious deterioration in both time certificate and demand deposits. Both banks sought to shore up their cash reserves by rediscounting bills to Eastern banks. 2nd National, the smallest, was apparently suffering the least.

By the end of June the pattern of deposit withdrawals for the three largest banks was set. The trend for each would remain the same through late July. The bleeding at Helena National was the worst, losing more than a third of their total non-bank deposits in less than four months. The rate of decline at Merchants' was the smallest of the three, but had started earlier in the year. 1st National did not see a decline until April, but the decline that began that month was steady and unchanging. Only 2nd National appeared to be weathering the building storm. This was true until mid-June, when the beginning of a short, steep decline in deposits began to occur there as well.

In Helena the four banks all struggled to remain afloat. Merchants' convinced some who were running negative demand deposit balances to pay back their interest-free loans and aggressively rediscounted bills in Chicago and New York. Helena National was in some ways fortunate to have only been in business for a few years. The ratio of capital to deposits was high, with capital accounting for about half of the bank's liabilities, so a significant loss of deposits did not require more drastic measures than were taken. 2nd National, whose deposits dropped at the fastest rate of any of the banks, was able to maintain a reasonable amount of cash on hand. This was accomplished by rediscounting bills aggressively, an exercise that generated more than $16,000 in much–needed cash in the month of July.

In July the full fury of the financial storm hit Helena and the state of Montana. A series of bank suspensions occurred, beginning with 1st National of Phillipsburg (See Table 2.4). The Phillipsburg bank normally maintained a large reserve deposit in 1st National

Table 2.4: Montana Banks Suspending, Summer of 1893

Bank	City	Date Suspended	Resources ($) (Oct. 1892)
1st National	Philipsburg	July 1	253,536
Livingston National	Livingston	July 7	504,833
Bozeman National	Bozeman	July 19	311,951
Merchants' National	Great Falls	July 24	344,403
Gallatin Valley National	Bozeman	July 24	714,690
1st National	Helena	July 27	4,388,232
Montana National	Helena	July 27	2,168,269
1st National	Big Timber	July 27	173,761
1st National	Great Falls	July 28	1,190,112
Stockgrowers National	Miles City	July 29	382,438
1st National	White Sulphur Springs	August 5	623,211
Dillon National	Dillon	August 24	806,052
Total Banks Suspended			11,861,488
All Montana Nat'l Banks			25,678,998

of Helena, exceeding $50,000 on April 1. When Phillipsburg suspended, the situation had been reversed: 1st of Helena had a balance of $1,068 in Phillipsburg. Bozeman lost both its national banks within five days, Great Falls lost two of the four in that city. The largest suspending bank outside of Helena, 1st National of Great Falls, maintained its primary relationship in Helena with Helena National, having reduced their deposits from $13,804 on Apri 1l to $1,606 the day the bank suspended. In proportion to its size Merchants' carried a larger burden of failed bank withdrawals, but not until August. 1st National of White Sulphur Springs had $14,070 in Merchants' on April 1 and $31 when it suspended August 5. Dillon National had $41,883 deposited in Merchants' on April 1. The bank suspended August 24, having depleted deposits to $3,580.

By late July the system of Montana national banks was in tatters. The local press did its best to attempt to quell rumors of further bank problems. *The Helena Daily Herald* reported on July 27 that Merchants' had gained in total deposits the day after the suspensions in Helena. The records show this to have not been the case, with deposits dropping by more than $2,000. The paper also stated, "In addition to the present large reserve in the vaults of the Merchants' National Bank there will arrive tomorrow by express over three hundred

thousand dollars in currency, which left New York on Tuesday." Bank records indicate no significant increase in currency until August.[10]

Merchants', the largest bank remaining in the state, opened for business July 28, the day after 1st and Montana National had suspended, with $28,947 in cash. Despite local newspaper reports to the contrary, Merchants' position deteriorated for the next several days. Three days after the suspensions, the amount of cash on hand at Merchants' had dwindled to $9,631. On August 1, the much reported shipment of currency from the East arrived, $10,000 from 4th National of New York and another $10,000 from Continental National Bank of Chicago, a far cry short of $300,000.

Emergency measures taken by New York banks had negative impacts on the country banks in Helena. Since all treasury balances for Merchants' were settled through Western National Bank in New York, the use of clearing house certificates in New York resulted in a ten– to twelve–day delay in the use of Treasury funds in Helena.[11] In late August Aaron Hirshfield wrote to Secretary of the Treasury Daniel Morgan and asked for help dealing with the Assistant Secretary in New York, who was proving difficult.[12] Currency was hard to come by and on September 1, Merchants' informed one customer that since Merchants' was having a difficult time getting currency, the customer would receive payment for a redeemed time certificate as a draft drawn on Merchants' New York bank; which required the customer to figure out how to get currency out of the vaults in New York.[13]

From the low point on July 31 Merchants' was able to rebuild its cash position. But the decline in deposits did not stop. Deposit levels equal to mid-July levels were once again achieved in late November, but only after increasing the deposits from the federal government, reducing outstanding overdrafts, and, most significantly, accepting more than $100,000 in demand certificate deposits, other than rediscounting the most expensive money

[10]The publication of reasonably biased reports regarding bank solvency and deposits was commonplace. On January 23, 1894, the *Anaconda Standard* reported that the 1st National Bank of Helena had more than $236,000 in deposits and only $16,000 in withdrawals during their first day open in six months. The ledgers show that deposits exceeded withdrawals by approximately $100,000, less than half the amount reported, and within 2 days that increase had disappeared.

[11]MNB Records, LH Hirshfield, 13 Jul 1893, Box 14-21

[12]MNB Records, AS Hirshfield, Aug 24, 1893, Box 14-21

[13]MNB Records, AS Hirshfield, 1 Sep 1893, Box 14-21

available to the bank.

Helena National and 2nd National merged in September, with Erastus Edgerton becoming the new president of Helena National Bank. Five of the ten suspended banks not based in Helena would not reopen. Many of those that survived and those that reopened were fatally wounded. Helena National would merge with 1st National in late 1895. The combined bank survived barely one year before suspending for good. A few months after the final collapse of 1st National, Merchants' closed for good. 1st National Bank of Butte had weathered the Panic of 1893 relatively unscathed. By the late 1890s the economic power of Montana came from copper, not silver. And though the state capital remained in Helena, the financial center of Montana moved 60 miles down the road to The Richest Hill on Earth.

2.3 The Panic of 1893 - Taking Credit and Placing Blame

However chaotic the events of 1893 seemed to be, simple *post hoc* explanations of the financial disaster quickly emerged.

2.3.1 What Caused the Panic of 1893?

The Silver Issue Having successfully defeated the silver movement, interpretors of the collapse and eventual recovery of the U. S. economy focused on the political events of the time. A simple narrative evolved whereby the threat of bimetallism was seen as the primary culprit [Noyes, 1898] [Dewey, 1918]. Attempts to make silver part of the basis for American dollars not only threatened inflation, it also assaulted the moral foundation on which advanced nations were built - the absolute value represented by gold [O'Malley, 2012]. The additional deficits that resulted from the silver purchases under the act exacerbated the problem. It was argued that if the U. S. were to go off the gold standard, massive inflation would occur, and dollar denominated bonds and other investments would suffer huge loses. It only made sense for investors, particularly those from Europe, to question the value of U. S. investments and begin withdrawing much needed capital. Some authors went so far as to declare the silver movement the one and only cause of the panic and ensuing depression

[Lauck, 1907, p. 118]. Thus the argument of a firm foundation for the national currency and national debt became combined into a still common critique of economic folly - too much spending by the federal government and significant national debt were recipes for disaster.

Sprague specifically addressed the impact of bimetallism, in particular the universal causal narrative features. He felt that the second phase of the panic, including the massive move of New York-based funds into the interior, "was certainly not in any definite way connected to the silver situation." Most bank failures occurred in pro-silver areas of the country, where, if anything, bimetallism would be viewed as a benefit rather than a challenge. The threat of silver could not be the explanation for bank insolvency in pro-silver parts of the country. The fear of bank insolvency was the cause of withdrawals of bank deposits in the interior rather than the potential for monetizing silver [Sprague, 1910, p. 168]. Milton Friedman and Anna Schwartz argued that uncertainty regarding silver presented problems, more so than the actual economic threat of failure to maintain a pure gold standard [Friedman and Schwartz, 1963].

Insufficient Money in Circulation, Business Cycles Free Silver advocates had argued that the lack of currency kept prices artificially low. Friedman & Schwartz argue that as the post-Civil War economy of the United States grew, the amount of currency in circulation did not keep pace, even with the purchases mandated by the Sherman Act. The period from 1879 to 1914 was one of constant economic growth, with the only anomaly being the depression years of the 1890s. Money supplies simply did not keep up with economic growth. Inflation or deflation had little impact on overall economic growth, and monetary uncertainty was a problem, but neither of these issues were the primary culprits of the panic and ensuing depression. The increase in currency resulting from the Sherman Act had little impact on the total currency increases seen before 1893, and, were it not for the perceived threat to the gold standard, silver purchases under the Sherman Act could have continued without a significant impact on the economy. When the Sherman Act was repealed, and the increase in the amount of currency constrained, the three-year depression was necessary to

achieve a necessary downward adjustment of prices. The damage it did was a natural and unavoidable consequence of restrictions on the growth of currency [Friedman and Schwartz, 1963].

Lack of Leadership Sprague pointed out that the economic problems of 1893 were complex, and that banking was at most only partially responsible for the panic and depression that followed. The portion of the economic crisis of 1893 that could be attributable to banking was exacerbated by "the absence of the intelligent and bold action" of New York bankers that had served to limit the impact and duration of the Panic of 1873 [Sprague, 1910].[14]

Other Arguments - Structure, Speculation, Criminality, and Incompetance A variety of other circumstances were sometimes presented as factors in the crisis, though rarely as more than an aside. Some viewed the pyramid structure of the National Bank system as a benefit, arguing that Eastern banks had far more and better opportunities to invest the savings of those in the hinterlands. Thus a system that helped make funds available for such investment made perfectly good sense [Noyes, 1898, p. 189]. Seasonal patterns, which caused shifts to and from interior banks, was an expected phenomena. In 1893 the movement was greater than could be explained by such seasonality. When interior banks pulled back their money, economic stringency in Eastern credit markets was the result. The failure of many interior banks was seen as the cause of the shift in funds, failures that the Comptroller of the Currency attributed to gross mismanagement and malfeasance on the part of the banks [Comptrollers Report 1893]. Hence the mismanagement of interior banks, combined with the reserve structure of the system, created credit problems and currency shortages throughout the country.

Speculation and an inflated stock market were often mentioned, yet seldom suggested as a primary culprit. Noyes felt that the connection between the "rampant speculation"

[14] A similar argument would be echoed by Friedman & Schwartz when they agreed with Carl Snyder that had Benjamin Strong, the president of the New York Federal Reserve Bank and protege of J. P. Morgan, survived another year, "we might have ended the depression in 1930" [Friedman and Schwartz, 1963, p. 692].

that occured beginning in 1890 and the Sherman Act was at most "slight". He also points to renewed speculation resulting from a large increase in 1891 crop exports [Noyes, 1898, p. 155]. When National Cordage entered receivership, "the bubble of inflated credit" had been burst. These events were seen by Noyes as being symptomatic of the larger issue of excess currency in the economy, a result of several converging policies, including increased spending by the federal government and, most importantly, the increase in currency made available by silver purchases.

The bankruptcies of Reading and National Cordage and the corresponding fall in stock prices are always mentioned in the chronology of the panic. Sprague thought the drop in the market reasonable given what he felt were the inflated values in the market, especially in the industrials, as well as a contraction in New York bank loans, that were again seen as appropriate given the overextended nature of many of the companies being financed. The failure of some banks was inevitable given the great number of business failures during the first half of the year [Sprague, 1910, p. 168].

Given all these possible complications, the simple story of too much money, primarily from silver but partly from too much federal spending, was an easy and convenient argument for many to make. It was simple and has been shown to have staying power. As recently as 2012 Scott Reynolds Nelson repeated the more than century-old narrative, a story of federal deficits, fear of devaluation, and going off the gold standard. What Nelson adds to the argument is a tale of corruption at the highest levels, of the Sugar Trust bribing legislators to pass a tariff bill that provided a means to corner the sugar market. The net impact of the new tariff legislation was a significant reduction in federal revenues, an ensuing deficit, and all the woes of the Panic of 1893. Nelson speaks little of banks outside New York, and aside from the occasional reference to how 1893 was somehow different from all the other panics referenced in the book, the overall story he tells is one of the growth of New York financial hegemony. Noting that every crisis is unique, in the end Nelson absolutely rejects the analysis of Friedman & Schwartz - "There are not and never have been 'cycles' dictated by an inexorable ebb and flow of investments" [Nelson, 2012, p. 242].

2.3.2 What Ended the Panic?

Repeal of the Sherman Act For goldbugs, when President Cleveland called for a special session of Congress, whose only purpose was to revoke the hated Sherman Silver Purchase Act of 1890, confidence was restored and the panic ended [Noyes, 1898] [Dewey, 1918] [Lauck, 1907]. Others felt that the impact of calling the Special Session was small [Sprague, 1910, p. 171]. It is difficult to view the argument as sound given that Cleveland issued the call in June and asked that Congress convene on August 7. Several weeks after the call panic swept through the South and West, closing hundreds of banks. As Sprague pointed out, the wave of bank suspensions occurred in areas where Free Silver had its greatest support. The causality could reasonably be seen to run the other way: the call for repeal caused panic in the interior, which then spread east.

Suspension of Specie Payments Friedman and Schwartz argue that the suspension of cash payments ended the panic, although, as pointed out before, what started or ended the Panic 1893 was, at least in the case of 1893, not important to them. Friedman and Schwartz agreed that suspension probably contributed to the extensive economic damage done by the crisis, but with a necessary adjustment of prices downward a depression was a given [Friedman and Schwartz, 1963, p. 110].

Sprague argues that although few banks failed once suspension of payments was widely adopted, suspension of cash payments was unnecessary. The need for suspension was not due to a lack of total cash reserves in New York banks, but the degree to which the cash was distributed. With no means to equalize cash reserves, banks who had accepted clearing house certificates as the primary means of interbank adjustment were often left with little cash to satisfy their own depositors. Thus, Sprague concludes that a process that would allow the equalization of reserves at the New York banks would have probably made suspension of payments, and the resulting stringency of cash in the overall economy, unnecessary. Sprague critizes those who convolved the issuing of clearing house certificates and the suspension of payments to depositors, arguing that the two events were quite separate,

as they occurred more than a month apart [Sprague, 1910, p. 171].

Wicker points out the error in the arguments of Friedman & Schwartz as well as Sprague by noting that the panic did not end with the suspension of payments. After the imposition of currency restrictions in New York and other central reserve cities in August, more than 100 banks, including 34 national banks, suspended [Wicker, 2006, p. 78-9].

It is difficult to disregard the suspension of payments as a mechanism that helped slow down the spread of panic. Bank runs were not possible if banks were not allowing depositors to access their cash. What gives this argument less traction is that payments were not suspended throughout the country, only in specific locations. Even at that, only partial suspension occurred; not all transactions in specie were stopped. A premium on cash occurred as a result, but as the month of August ended the premium ended as well [Sprague, 1910, p. 187].

Foreign Investment Sprague agreed that calling the Special Session had perhaps calmed some jitters, but also pointed out that the collapse of the stock market offered foreign investors bargains, resulting in a significant growth in foreign capital flowing into New York banks, ending the panic. With New York banks having additional hard currency available, the pressure resulting from flows to the interior was at least partially relieved [Sprague, 1910, p. 171].

2.4 Helena, The Aftermath

In Helena, two of the three largest banks closed, banks whose resources totaled close to the resources of the 12 national, private, and state banks that suspended in Denver from July 17 to July 19, 1893. The declining price of silver must have played a role. What is perhaps more perplexing is that the panic ended. Banks in Montana were in desperate condition. The special session of Congress was about to meet to revoke the Sherman Silver Purchase Act and ensure that the price of silver, the basis of much of the wealth of Helena and of Montana, would not recover. Merchants' National could not have survived even a small run

after 1st National and Montana National suspended, but the vast majority of depositors decided to ride it out with the remaining banks.

The amount of capital and savings deposited in Helena banks would take years to recover from the losses of 1893. In Helena, and Montana more generally, the Panic of 1893 marked the beginning of a long period of economic stagnation. The economy of the United States began an impressive period of growth in 1897, quickly making up for lost productivity and wealth during the depression. Montana was not as fortunate. By 1900 Montana banks had yet to recover to the point where total resources were even 75% of the 1892 peak. It would take five more years of expansion, until August of 1905, before Montana national banks would return to the levels of 1892. During that time the total national bank system more than doubled in value. Into the 1920s, the total assets of Helena national bank's had yet to reach the heights achieved at the beginning of 1893.[15]

The deterioration of Helena banking was swift and long-lasting. Butte, with the great Anaconda works, and Great Falls, where the Missouri River provided hyroelectric power that fueled factories, would pass Helena both in terms of population and banking wealth. At the macro level the boom and bust of Helena can be seen as coinciding with the rise and fall of silver mining in the region. However, the extent and persistence of the demise can also be seen as being exasperated by the mismanagement of the local banks.

[15] *Source*: Annual Reports of the Comtroller of the Currency for the period 1893 - 1920.

Chapter 3: Anatomy of a Crisis - Helena, Montana, 1893

As with many archival research efforts, the challenge is often not related to finding information to examine, but coming to terms with too much information to examine. This is certainly the case with the banking record archives in Helena. For each of the four national banks, 1st National of Helena, Merchants' National of Helena, Helena National, and 2nd National of Helena, the records contain daily transactions for depositors of all types, as well as balance sheets and ledger entries for the times each existed as independent banks. The collection includes more than 300 ledgers with the estimated number of entries exceeding 30,000,000. The archive is in many ways like a mountain whose mineral wealth lies hidden from the outside. To explore the mountain of data, we cut a series of holes, some deep, some wide. From this we hope to construct a better image than we had before of the contents and structure of the mountain. This section aims to expose some of the potentially rich veins in the mountain by presenting the results of several of these cuts, some connected, some less so, always limited by the resources of the prospector. In general the data presented focuses on enhancing the quantitative understanding of the months leading up to and culminating in the suspension of operations of the 1st National Bank of Helena on 27 July 1893.

The data was collected by taking high resolution photographs of the ledger pages. More than 6,300 images were captured during more than 25 days in the archives.[1] This represents a significant portion of the data available for the four banks during the period of 1891 through 1893. Data was manually coded into spreadsheets from these images. Only a small fraction of the data was coded. The effort focused on developing a cross-section of data that could describe the different types of accounts as well as capturing daily bank level balances

[1]The level of effort by bank was driven by the desire to capture specific information and the reasonability of coding the data using a single person (the Author). By bank the number of images varies greatly: 1st National – 1480 images; 2nd National – 1661 images; Helena National – 325 images; Merchants' National – 2802 images.

for the major accounts. When available, coded data was compared with other ledger entries or sums included in the ledgers to insure accuracy.

3.1 The National Bank System

The National Bank era (1863 – 1913) was preceded by what historians refer to as the Free Banking era. At the national level the Free Banking period was dominated by the contentious First and Second Banks of the United States. For the average customer smaller, state-licensed banks were the primary means of banking during the period.[2] State charters for banks were granted through specific legislation, with each bank requiring its own legislative authorization. From state to state rules varied widely and banks, as well as almost any other organization or person, were often allowed to issue their own paper currency. Such currency was redeemable for gold only at the issuing institution, assuming that such gold were available and the issuing institution still in existence. Currencies were often discounted with the discount amount being, in part, a function of the distance from the place of the discounted transaction to the originator of the note in question.

Ad hoc systems arose to manage the proliferation of currencies in use at the time. The term "carpetbagger", originally a pejorative term for anyone carrying the ubiquitous and inexpensive carpetbag, arose during this period as a description of someone engaged in the trade of either distributing newly printed notes, or traveling to distant locations to collect a large amount of notes purchased at discounts in order to return the notes to their originator to redeem them at face value [O'Malley, 2012, p. 85]. Guides, such as *Hodges' New Bank Note Safeguard* [Hodges, 1859] and the *Universal Counterfeit and Altered Bank Note Detector* [Foote, 1852], were published and distributed widely to offer advice as to how to distinguish legitimate notes from those supposedly less so. There was no central currency and few restrictions on who could issue currencies. At the beginning of the Civil War more

[2]The charter of the Second Bank of the United States expired in 1834. As of that time there were 506 state banks, with the number increasing to 1,601 by the time the National Bank Act was passed and National Bank charters began to be granted [Federal Reserve Report, 1932, Report on the Size and Number of Banks].

than 7,000 different types of note issued by more than 1,600 banks and other institutions were in circulation. The market was also rife with counterfeit notes, with an estimated 5,000 different types of counterfeit notes in circulation. John Kenneth Galbraith summarizes the situation succinctly - "By the time of the Civil War, the American monetary system was, without rival, the most confusing in the long history of commerce and associated cupidity" [Galbraith, 1975, p. 88-89]. The Civil War provided the justification and the reasonably unified federal government necessary to alter the financial system of the United States. A national banking system was brought into being, resulting in a compromise between a central bank, which was consistently excoriated in national political discourse, and the existing totally uninvolved federal government.

The National Banking Era began with the passage of the National Bank Acts of 1863 and 1864. The National Bank system sought to kill two birds with one stone by creating a way to both sell federal bonds to help finance the Civil War as well as create a national currency, all while avoiding the feared evils of a central bank. Banks were allowed to issue and distribute currency, although in a manner greatly contrasted with previous bank-issued notes. The currency was technically issued by the bank, with the bank's name on the notes, but it was printed and given to the bank by the federal government. The issuing bank would purchase U. S. Treasury bonds, paying the bank approximately 2% annual interest. When the bonds were deposited with the Comptroller of the Currency, notes equal to 90% of the value of the bonds were given to the bank for distribution. This leveraging, and surety, provided significant motivation for banks to issue such currency, and also gave consumers great confidence that were they to be holding notes issued by a defaulting national bank, the bonds deposited with the Comptroller would be available to guarantee redemption. It also proved an excellent way for the federal government to sell bonds. In this way the amount of federal government debt was tied to the amount of currency in circulation. Congress recognized the potential for an ever-increasing federal debt inherent in this arrangement and therefore limited the total amount of currency available for circulation to $300,000,000.

The law also stipulated that all national banks would accept all other national bank notes

at par. Hence national bank notes circulated as a fiat national currency, with little regard for the financial health of the issuing bank and no discounting from bank to bank. The National Bank Act was amended in 1865 to tax state and private issue currency, essentially eliminating the variety of other currencies then in use. National banks were not allowed to operate branch banks except in the case of state banks with branches that converted to national bank charters.

By 1870 the initial goals of the National Bank Act had been met. A national currency had been established and national banks dominated the financial markets, with more than 6 times the total resources compared with state banks.[3] The legal limit of $300,000,000 in national bank notes were in circulation, and state and private notes were a thing of the past.

By 1893, state and local banking had recovered. There were an equal number of national versus state banks, though national banks were normally larger, holding on average 60% more resources than state banks. Loan and trust companies as well as savings banks also existed, many to provide mechanisms for savings and real estate purchases for smaller customers. The distribution of national versus state and local banking resources varied by region, with the states at the extremes located in the West. In 1893, national banks in California accounted for slightly greater than 7.5% of all banking resources, whereas in Montana more than 90% of bank resources were held by national banks [Comptrollers Report 1893, p. 41].

National banks were categorized by a tiered or pyramid system. At the top of the pyramid were banks in the three central reserve cities, New York, Chicago, and St. Louis.[4] Large cities, such as Boston and Philadelphia, were designated as reserve cities along with smaller cities such as Omaha and Minneapolis. If a bank was neither a reserve or central reserve bank, i.e., not located in either a reserve or central reserve city, it was referred to as a "country" bank.

[3] In the late 19th century the balance sheet of a bank was divided into resources and liabilities. The term resources was eventually replaced by the term assets, though, to be consistent with the records of the time, the term resources will be used.

[4] The law was modified in 1888 to add Chicago and St. Louis to New York as central reserve cities.

All banks were required to hold reserves proportional to the amount of deposits at the bank plus the amount of national bank notes in circulation issued by the bank. Deposits of one bank held by another counted in the same way as deposits from individuals or businesses. Specie and cash, as well as balances at clearing houses for banks who belonged to such, were considered part of a bank's reserve. Certain deposits made in banks "further up the pyramid" were also counted as reserves. Reserve requirements, and the percentage of bank-to-bank deposits that could be counted towards the reserve requirement, were different for each of the three types of bank. Country banks had a 15% reserve requirement. Deposits at banks in reserve and central reserve cities could be used for as much as three fifths of that amount. Such deposits earned interest, which was clearly superior to having the reserve consist entirely of cash. Up to half of the 15% reserve requirement for reserve city banks could be comprised of deposits in central reserve banks. Central reserve banks, having no level above them on the pyramid, held their reserves in cash. Central reserve banks were also required to hold a 25% reserve. So of the deposits made at a given bank, 15% (or 25% in the case central reserve banks) had to be held in reserve, and the remainder could be loaned out. If a bank violated their reserve requirement, the bank was technically restricted from making new loans and executing similar business. If the requirement was violated for a period of more than 30 days, the Comptroller had the option of closing the bank.

Since a certain portion of deposits at each level could be loaned out, the actual total reserve, as compared with total amounts deposited, was not as high as the raw percentages would suggest. Consider a $1,000 deposit made at a country bank. The country bank could lend $850 of the $1,000, keeping $150 (15%) to meet their reserve requirement. Of the $150, $90 could be deposited at a reserve city bank, leaving $60 in cash at the country bank. The reserve city bank could then loan out 85% of the $90, holding $13.50 as reserve, of which half could be sent up the pyramid to a central reserve bank, leaving $6.25 at the reserve city bank. The central reserve city bank held 25%, or $1.69 of the deposited amount in cash reserve. Of the original $1,000 deposited at a country bank, as little as $68.44 could be held as cash reserve somewhere in the pyramid. What appears to be a minimum 15%

reserve requirement could actually be only 6.84%.

Demand deposit drafts, which comprised a significant portion of all financial transactions, were redeemable with any bank that held deposits of the bank that held the demand deposit account. This created a network of relationships beyond those required to hold reserves. For example, banks in Butte, Montana, would have funds deposited in Helena banks so as to expedite using their drafts in Helena. The amounts deposited in reserve and central reserve banks not only served the purpose of acting as reserve, but also allowed customers in Butte to conduct business in larger cities such as New York. When a bank held another bank's deposits, they were said to be corresponding banks. This network of banks was essential to the settlement of bank drafts and contributed to the relative ease with which funds from one state could be usable in a distant city.

In order to implement and enforce the law, the Comptroller of the Currency was created. The Comptroller required banks to submit financial reports up to five times each year. Banks were also required to publicly publish a summary of their financial condition in a local newspaper, though the veracity of those reports was sometimes questionable [Petrik, 2009]. The Comptroller also employed bank examiners who provided on-site review of banking documents and procedures. The examiner's findings were submitted in writing to the Comptroller, and though often scathing, they were not made available to the public. With only one enforcement mechanism available, revocation of a bank's charter, such reports, as well as threats regarding the violation of other policies, were mostly toothless.

Other than California, the states and territories in the American West were at best thinly settled. Few financial institutions beyond the merchant banker existed. The strict, and reasonably steep, capital required to form a National Bank often meant that most small towns and villages were left without national banks [Doti and Schweikart, 1991, p. 25]. Gold and silver mines made capital far less scarce in Montana than other parts of the frontier. With the advantages to be gained by circulating currency and being very much isolated from what little federal regulatory scrutiny existed, Montanans found National Bank charters attractive.

3.1.1 Chartering a National Bank

Under the National Bank Act, five or more persons could come together and apply for a national bank charter. After receiving a charter the bank raised the promised capital. In many ways this was a traditional investment, with investors expecting to receive dividends based upon the banks profitability and vote their shares to select a Board of Directors that was responsible for selecting bank management. For example, in return for the $350,000 used to capitalize Merchants' National in 1882, a 4% dividend, $14,000 in total, was paid twice yearly, resulting in a return of about 8% annually. In comparison a six-month certificate of deposit paid an annual rate of 5%, a twelve-month paid 6%. The additional potential return of bank stock ownership did not come without additional risks. National banking laws required that those investing capital in a bank not only risked the invested capital, but also an additional amount equal to their invested capital. This served as a means to recover depositor losses if the bank were deemed insolvent [MNB Records, Vol. 93] [Comptrollers Report 1892, p. 16].

Such penalties did not disuade people from investing. Investors throughout the country were recruited to provide capital for Montana banks. Helena National Bank engaged American National Bank of Kansas City to help with their initial capitalization. American National earned a 2% commission on the amount of capital raised and proved to be quite effective at this task. Of the $500,000 of Helena National capital raised in 1890, almost 40% was generated through American National efforts. In 1893, stockholders in the combined Helena National and 2nd National banks came from far and wide. Of the 182 stockholders 156 were not residents of Montana, accounting for almost 60% of stock ownership. Of these, only 14 resided west of Missouri. Investors could reap the benefits of the vast resources of the West without having to endure the hardships of emigration [HNB Records, Box 10 – 10].

3.1.2 Bank Deposits

As a bank began operations it would use a number of offerings to attract new depositors. Time certificates, equivalent to current day certificates of deposit, were the dominant form of deposit during the late 19th century. Each Helena bank offered the same terms for such deposits, 5% annual interest for six-month deposits, 6% for a twelve-month deposit. At the start of the fateful month of July 1893 more than 75% of all individual deposits at the four Helena banks were in the form of time certificates.

Demand certificates were interest-bearing instruments that could be redeemed at any time without interest penalties. Such instruments were uncommon in the Helena banks and were generally used only during times of stress when banks were aggressively seeking to attract deposits by offering generous terms. Only 1st National consistently maintained such deposits, averaging approximately 5% of total deposits and never exceeding 7%.

The second most prevalent form of deposit instrument was the demand deposit, equivalent to a modern checking account. Such accounts did not accrue interest, and were used mostly as a cash-free way to conduct business. By the late 19th century the demand deposit draft system had become dominant in American business. In 1892 the Comptroller estimated that more than 90% of all financial transactions performed in the United States were done by non-cash means. The use of silver and gold currency amounted to slightly more than 1% of all transactions in the national banking system [Comptrollers Report 1892, Vol. 1, p. 36]. In Helena, demand deposits comprised between 20 and 25% of total deposits at the four banks.

Traditional savings deposits, where interest is paid if funds are held over a specific interval, were only offered by 2nd National. As the smallest of the Helena national banks, 2nd National offered services more traditionally associated with a trust or savings bank, even maintaining Sunday Name accounts, small savings accounts never amounting to more than $1,000 total deposits.

Time certificates, demand deposits, and savings accounts were used by individuals and businesses depending on their needs. One other type of customer was much sought after

by the Helena banks - government institutions. City and county treasuries used demand deposit accounts as most modern government agencies would use them, to collect and manage receipts and expenses for their respective government organizations. Some of the largest depositors in the two largest banks, 1st National and Merchants, were government accounts. Federal Assay Officers needed ready access to funds to execute their purchases of gold and silver. These funds were deposited by the federal government into local banks. In the 1890s this bank was Merchants' National. At any given time up to $200,000 could be deposited in Merchants' accounts for use by the assay agents. Although government entitites provided a source of significant deposits, they could also present specific diffculties to bank operations. As the panic began intensifying in June 1893, Merchants' challenges were exacerbated by the federal treasury's inability to replenish the treasury account to a positive level.[5]

A final source of deposits resulted from bank-to-bank deposits. Banks in nearby towns would often deposit funds in the Helena banks as a way to handle drafts that were spent in Helena. Interest was paid on bank-to-bank deposits, so it was better than having cash on hand, yet often close enough that a return transfer was easy to execute. Finally, due to the reserve requirements for national banks, all banks except those in central reserve cities, maintained deposits in reserve and central reserve cities. Since bank-to-bank, or correspondent bank, deposits were both made and accepted by banks, banks could either show a net liability, i.e., have more deposited in them than they had deposited elsewhere, or a net on the resource side of the ledger, if the situation were reversed.

3.1.3 Customers and Managers Stretching the Rules

Overdrawn Accounts Like current day checking accounts, demand deposit accounts could be overdrawn. Unlike today, there were no specific financial penalties associated

[5]U. S. Treasury and Assay Officer account balances would vary over a wide range. In January 1891, total balances averaged more than $100,000. It was not uncommon to have the balance drop to less than $60,000, though this situation was normally rectifiedquickly. On July 18, 1893, the total deposit level was allowed to drop to less than $43,000. On July 27 the balance was greater than $70,000, and by July 31, the federal government had more than $90,000 deposited at Merchants'.

with such actions. This often resulted in habitually overdrawn accounts, especially for bank managers, cashiers, and others with significant involvement with the banks. Though the practice was declared unsound by bank examiners from the Comptroller, other than including the abuse in their report, little could be done to stop such practices. Montana banks were habitual offenders of this policy.

E. D. Edgerton, President of 2nd National, was perhaps the least abusive of his position in his bank. During January 1893 his demand deposit account became overdrawn by as much as $5,770. However, by Febraury 17, a positive balance was reestablished and maintained, with few exceptions throughout the year. Such discipline was generally maintained at 2nd National, with demand deposit overdrafts amounting to 5-6% of demand deposit balances, and from 2-3% of total deposits. Merchants' National consistently abused demand deposit accounts. During March 1893, total overdrafts ranged from a low of $161,000 to a high of $266,000, with a total deposit base of approximately $1,500,000. This means between 10% and almost 18% of deposits were "loaned" out at 0% interest.

Such habits were not restricted to Helena banks. In October of 1892 the 1st National Bank of Phillipsburg reported to the Comptroller overdrafts of $59,679.53. With total outstanding loans and discounts of $49,692.78, the bank had a greater amount of resources applied to non-interest-bearing overdrafts than it did to interest-bearing loans. Not surprisingly the bank, which was organized in December of 1891, suspended in early 1893. It was deemed insolvent and had a receiver appointed by the Comptroller on July 8, 1893 [Comptrollers Report 1893, Vol. 1, p. 202]. The Comptroller classified the failure of the Phillipsburg bank as resulting from "General stringency of the market, shrinkage in value, and imprudent methods of banking." It took only 32 months for the bank to go from being chartered to failing outright [Comptrollers Report 1897, Vol. 1, p. 512].

Perhaps the most complicated, or egregious depending on one's point of view, case was that involving Merchants' and the Montana Mining Co. Ltd., the British firm that had purchased the Drumlummon Mine located north of Helena near Marysville. Montana Mining Co. Ltd. had a demand deposit account to handle daily transactions relating to

purchases and payroll. Correspondent bank relationships existed between Merchants' and the Anglo-California Bank Ltd. offices in San Francisco and London, banks designated by Montana Mining to handle their interests. Funds would be deposited in the Anglo-American bank accounts, primarily in San Francisco, that were credited to Merchants'. On June 30, 1893, Montana Mining was overdrawn in the amount of $48,000, and had less than $4,000 on deposit at Anglo-California, a deficit of more than $44,000. Recognizing the liquidity stress that Merchants' was under, Montana Mining worked to rectify the imbalance. On July 27, 1st National and Montana National suspended. That day Montana Mining was overdrawn by more than $28,000 and had just over $6,000 deposited in Anglo-California. On July 28, the numbers were very different. More than $28,000 of the overdrafts had been retired and more than $25,000 was credited at Anglo-California.

Loans to Principals As in any other joint stock corporation, being one of the owners of the bank gave one a say in governance. Those owners who sat in important positions operating the bank also had access to other bank resources. It was commonplace, especially with Montana banks, for bank officers to not only own stock in the bank, but to have large loans from the bank. Banks were limited by statute to loan no more than 10% of invested capital to any one entity. It was often the case that this was violated, ignored, or avoided through a series of related parties. This problem was recognized by bank examiners, but with little enforcement power there was little that could be done. In the 1892 annual report to Congress, the Comptroller argued that this rule was burdensome under many reasonable legitimate banking circumstances and that they could not determine a clear manner to formulate a similar rule that could determine when exceeding the 10% limit was reasonable or when it was chicanery. Since the total deposits at many banks far exceeded the amount of invested capital, the limit seemed arbitrary compared to the size of the bank. In the case of Montana banks, the rule was generally flaunted, even when examiners aggressively attacked the practice [Petrik, 2009].

Soon after Helena National Bank opened for business on September 1, 1890, founder

and bank president Shirley Ashby began taking loans from the bank. Ashby's initial capital payment of $12,500 was made on August 18, 1890. On September 9, he took a loan for $31,000. On October 29, he borrowed $15,000, using $10,000 to pay off 60 day notes that were coming due. This added $5,000 to his total indebtedness to the bank. Ashby consistently maintained a loan level at or near $50,000; his total invested capital was $25,000, which was fully paid on December 8. Capitalized at $500,000, by regulation Ashby was allowed to borrow at most $50,000, a number he quickly achieved not long after the bank had its capital in place [HNB Records, vol. 38] [MC1, 1890 – 1896, Box 10 –12].

Paula Petrik describes one example of how the 10% of paid in capital limit was easily circumvented. After 1st National entered receivership, it was discovered that $170,000 had been loaned to a local business, The Independent Publishing Company. The receiver felt the company was worth at most $35,000. It was believed that the funds had been diverted by then 1st National president Samuel Hauser for use in other activities. As the affairs of 1st National were wound down by the receiver, it was estimated that approximately $2,000,000 could be traced directly to Hauser and his family. Although these practices were either illegal or close to illegal, no indictments could ever be brought against the former governor of the territory. Washington-based treasury officials did not stand a chance convincing a grand jury of solid, upright Helena citizens that one of the state's Founding Fathers was so corrupt. Besides, many of the locals could be easily bribed [Petrik, 2009].

3.2 Distribution of Individual Depositor Balances

3.2.1 Savings Accounts[6]

For people in the late 19th century, the first encounter with a bank would frequently be through a savings account. Such accounts have not changed much in the intervening years, with small amounts being deposited and, if held over a certain period of time, an interest payment credited to the account. State banks and local savings & loans were the primary

[6] *Source:* Savings account data is derived from 2nd NB Records, Vol. 38 & 39.

locations for establishing such accounts. Of the four Helena banks, only 2nd National offered such accounts, paying 3% per 6 months interest on January 1, and July 1, for funds on deposit during the preceeding 6 months. When compounded, the earnings were actually greater than that paid for time certificates at any of the four national banks. The spectrum of the population that used savings accounts was different than those who used the other services of the national banks. For 2nd National, only two persons had both savings accounts and demand deposit accounts, with the two types of accounts overlapping for only a short period of time.

Savings accounts were not considered necessary for the business models of the three larger national banks but played an important role at 2nd National. May 1, 1893 showed $36,540.52 deposited in savings accounts at 2nd National. Although small in comparison with the total individual deposits at the other Helena banks, for 2nd National savings deposits could contribute up to 30% of total individual deposits.

From January of 1889 to the end of 1893, 331 persons, and four civic organizations, had savings accounts, with no more than 175 accounts being active at any one time. The amount deposited in any given account ranged from a few cents to more than $2,000. As shown in Figure 3.1, on July 1, 1893, the distribution of amounts deposited approximated an exponential distribution, with the five largest depositors accounting for more than 25% of the total deposited.

Savings depositors reflected a cross section of sexes, and also of uses. Of the 331 account holders that were persons, 167 can be identified as male, 163 as female. Figure 3.2 shows the distribution of the maximum value of an account over the 5 years of data, organized by account size and by sex of the account holder. For smaller account sizes the distribution is similar. However, the seven accounts that had the largest amounts deposited were owned by men. A nearly equal number of account holders were female. Female deposit size follows an exponential distribution very closely. For males, larger deposit amounts show some sign of being power law distributed, although an exponential distribution describes the sizes of most accounts. Although account holdings were smaller for women, the distinction between

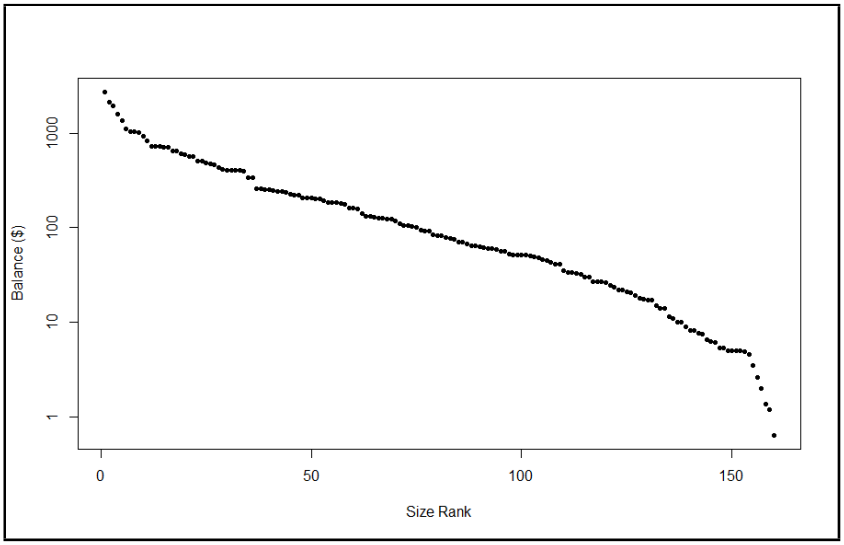


Figure 3.1: Distribution of Savings Account Sizes, 2nd National Bank (July 1, 1893)

male and female financial resource distribution was small.

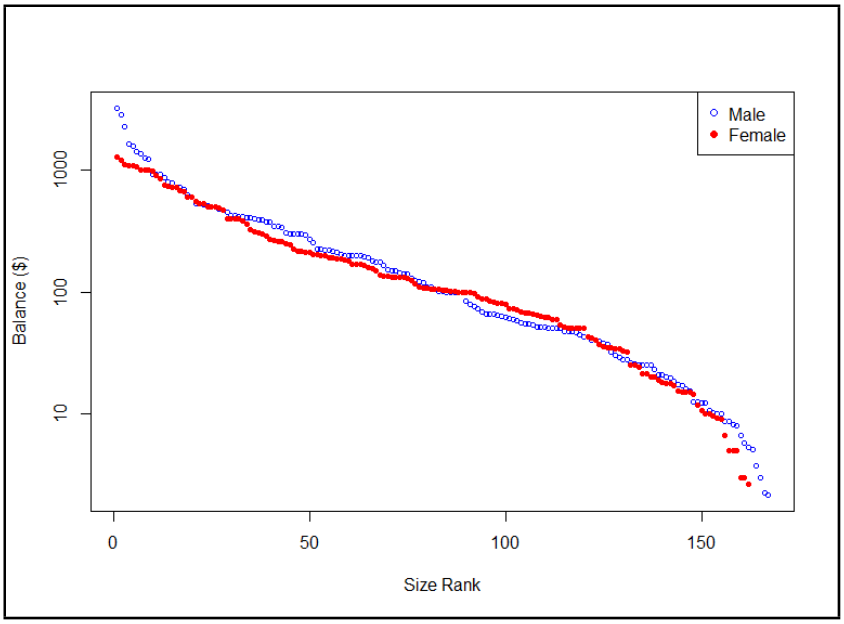


Figure 3.2: Maximum Savings Amount by Sex, 2nd National Bank (Jan 1, 1889 - Dec 31, 1893)

To expand on the understanding of how savings accounts were used, account holder behaviors were coded according to the categories shown in Table 3.1. Given these categories, the breakout, by type and by sex, of account holders is shown in Table 3.2.[7] In general there appears to be little difference in behavior between male and female depositors.

Table 3.1: Category Definitions for Savings Depositor Behavior

Category Name	Category Definition
Saver	Open 1 year without withdrawals, 3 years with only minor withdrawals
Semi-Saver	Open at least 1 year with no more than 1 significant withdrawal per year
Short Term	Account open for less than one year
Other	Normally those who actively deposited and or withdrew with some frequency

Table 3.2: Savings Depositor Behavior by Category and Sex

Category	Total	Male	Female
Saver	109	55	54
Semi-Saver	22	13	9
Short Term	104	56	48
Other	70	32	38
Total	305	156	149

[7]Excludes civic organizations and accounts opened in 1893.

3.2.2 Demand Deposit Accounts[8]

Of 565 demand deposit accounts held at Merchants' National Bank on July 1, 1893, 89 were overdrawn, with 30 accounts overdrawn by more than $1,000. The accounts of several businesses and bank directors were consistently overdrawn by large amounts. Stockmen Silas Huntley and P. B. Clark were overdrawn by $18,314.93, and the Hirschfield brothers (who served as the bank president and the chief cashier at Merchants') were each overdrawn by more than $6,000. Greenhood & Bohm, a wholesale liquor company, had been in receivership for more than a year, and was in arrears to Merchants' for almost $11,000. A. J. Davidson, who ran a wagon and saddlery business in Helena and Butte, was overdrawn by more than $25,000 between his business and personal account. Davidson would have his business sold at auction in August 1897, six months after Merchants' Bank had itself entered receivership.

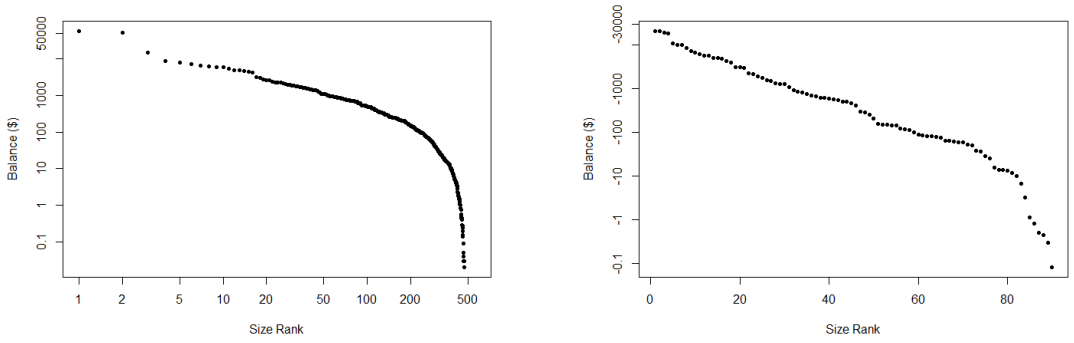
Government accounts were much desired, though there was some risk that came with such accounts. On July 1, 1893, the U. S. Treasury had the largest single overdrawn account at $21,387, although this would be remedied within one week. The largest positive balances were those held by men working in the U. S. Assay Office in Helena, whose account balances totaled more than $100,000, outweighing by far the amount the U. S. Treasury account was in arrears.

When examined in order of size, demand deposit balances at Merchants' display significant regularity. For those accounts with a positive balance, the largest accounts approximate a power law distribution (See Figure 3.3(a)). For those who had negative balances the distribution more closely resembles an exponential (See Figure 3.3(b)).

3.2.3 Time Certificates[9]

A wide range of customers purchased time certificates, with a wide range of values. At the close of business on July 1, 1893, Merchants' had at least 1164 time certificates outstanding,

[8] *Source:* Individual account level data is derived from MNB Records, Vol. 78, 79, 80 & 81.
[9] *Source:* Individual account level data is derived from MNB Records, Vol. 206 & 207



(a) Log-Log Distribution of Positive Balances (b) Log Distribution of Negative Balances

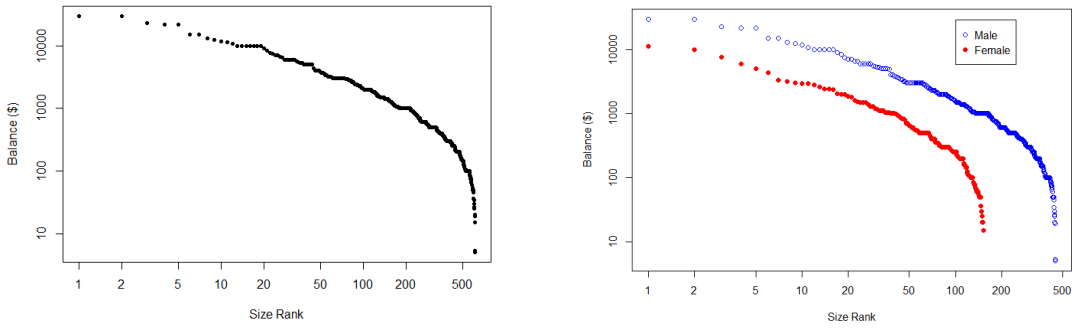
Figure 3.3: Distribution of Demand Deposit Balances, Merchants' (July 1, 1893)

belonging to more than 600 unique owners.[10] Henry Elling, a banker and investor from Virginia City, Montana, had $30,000 in certificates, as did attorney William Muth, whose certificates indicated they were being held in a receivership. At the other extreme, 97 different persons owned certificates totalling $100 dollars or less, with the smallest certificate being $5. Figure 3.4(a) shows that the distribution by owner was fat-tailed, with the top 2% of owners (13) holding 25% of the total value of time certifcates. The 308 persons below the median in holdings size accounted for less than 8% of the outstanding value of time certificates, a total of $68,473.75. It would require a loss of confidence in more than the small account holders to cause significant issues for Merchants' Bank.

Unlike savings accounts at 2nd National, women owned a minority of Merchants' time certificates. Approximately 25% (153) of those who owned certificates were female, with a total value of $139,073, slightly less than 17% of the total time certificates. Figure 3.4(b) shows the distribution of time certificate deposits by sex. Although the number and size of deposits by females was significantly less than that of their male counterparts, the distribution shape is very similar, both expressing a power law for the largest depositors, with similar slopes or exponents.

Depositors at Helena's national banks ranged from small-time savers to corporations

[10] Although the time certificate records are reasonably complete, there are differences between the total amount of time certificate deposits as shown on the general balance sheet and those computed directly from the time certificate registers, whose data is described here. Further investigation is certainly warranted.



(a) All Time Certificates

(b) Time Certificates by Sex

Figure 3.4: Log-Log Distribution of Time Certificate Balances, Merchants' (July 1, 1893)

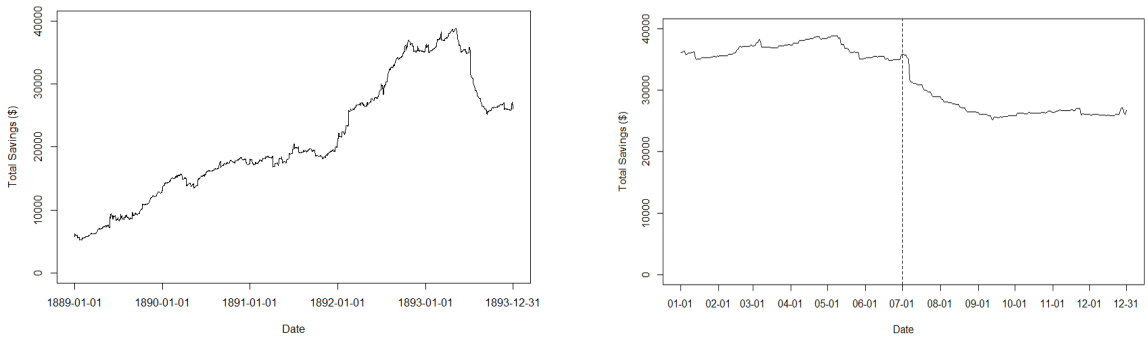
and governments. The role played by the banks was just as varied. Small savers would use banks to build a small nest egg, whereas those involved in interstate and international business found support from banks on the same block. Though men held most of the accounts, and owned most of the wealth, women had similar wealth and behavior patterns. Mathematically the wealth was unequally distributed, approximating a power law. A few account holders controlled the majority of deposits. This structure of deposits meant that a great number of depositors, those with small holdings, could have panicked in the summer of 1893, and not had a significant impact on the solvency of the banks in Helena. That the banks did suffer, and some suspended, means that the wealthy few were amongst those who, for whatever reason, felt compelled to join the crowd.

3.3 Bank Level Data

Bank-level data shows the impact of depositor and banker decisions on the overall condition of the banks. Total depositor balances, bills discounted and rediscounted, and corresponding bank balances worked together to generate the cash necessary for daily operations. When cash flowed out of a bank's vault, measures would be taken. When there was not enough cash left in the bank to satisfy customer demands, a bank would suspend.

3.3.1 Individual Deposits

Savings Accounts[11] Figure 3.5(a) shows that as 1892 and the early months of 1893 progressed, savings deposits at 2nd National increased, reaching a peak of $38,701.20 on May 4. Examination of Figure 3.5(b) reveals that deposit levels begin declining in early May, but by the end of the month a one month period of stability began. July 6 marks the beginning of a serious decline that did not end until early September. This short recovery in June can be explained by the fact that on July 1 interest was payable on all deposits held from the beginning of the year to June 30. Once interest was earned, the decline in deposits began again at about the same pace as had occurred in May. The total decline amounted to more than 35% of the total savings deposits. After 2nd National merged with the larger but much newer Helena National in late September, existing savings customers were allowed to maintain their accounts, but new savings accounts were discouraged.



(a) Jan 1, 1889 - Dec 31, 1893

(b) Jan 1 - Dec 31, 1893

Figure 3.5: Savings Account Total Balances, 2nd National

Table 3.5(a) shows a steady increase over three years of the number of savings depositors at 2nd National. However, 1893 was different. The number of depositors shrank significantly,

[11] *Source:* Bank level data is derived from 2nd NB Records, Vol. 14, 15 & 16

returning to 1890 levels.

Table 3.3: Number of Savings Accounts, 2nd National Bank

Year	Accounts Opened	Accounts Closed	Total at End of Year
1890	61	42	121
1891	44	37	128
1892	76	39	165
1893	24	65	125

1893 saw an increase in closed accounts focused not surprisingly during the summer months. During June, July, and August of 1893, 30 persons and 1 civic organization (The Trustees of Myrtle Lodge #3, affiliated with the Freemasons) closed savings accounts, almost as many as had closed accounts during the entire year of 1891. Table 3.4 shows the distribution by number and value for the three months. July had the greatest number and value, with Anton Johnson, one of the largest single savings depositors with $2,269.55, closing his account on July 7. Decomposing the 30 persons by sex and behavior type (see Table 3.1 for category definitions), we find more females closed accounts than males, and that this difference was made up of females in the "saver" category (Table 3.5).

Table 3.4: Closed Savings Accounts, 2nd National Bank, 1893

Month	Accounts Closed	Value of Accounts
June	5	$820.25
July	17	$5,460.44
August	9	$1,714.39
Total	31	$7,995.08

Table 3.5: Account Closings by Type, 2nd National Bank, Summer 1893

	Saver	Semi-Saver	Short Term	Other	Total
Male	3	3	1	5	12
Female	9	3	3	3	18
Total	12	6	4	8	30

Demand Deposit Accounts[12] Demand deposit accounts were often used by business operators who benefited from the utility resulting from drafts, i.e., checks, drawn on their accounts. As corresponding bank relationships grew and clearing houses became a feature of most larger cities, drafts became easily redeemable throughout the country, even from more remote locations such as Helena. However, as described in Section 3.1.3, this system of drafts admitted certain "flexibility" to the banking relationship. Figure 3.6 shows the level of demand deposit accounts from January 1 to July 26, 1893, for the four Helena banks. Table 3.6 shows the date and amount of the 1893 peak in demand deposits and the total demand deposit amounts at the time of 1st National's suspension of operations. For Merchants' Bank the total deposit amounts for demand deposit accounts went from a high of nearly $400,000 in early January to a negative total balance in early June.

Figure 3.6 shows that Helena National saw a loss of demand deposits beginning in early May, and 1st National found its demand deposits having only one noticable period of decline during the last two weeks of June. Though short in duration, the decline amounted to almost $200,000. Merchants', in a constant struggle with negative demand deposit balances, bottomed out in early June. Merchants' was able to recover somewhat from the early June lows, though the total demand deposit amount struggled to stay on the positive side. 2nd National saw its lowest point in early May, with a recovery to normal levels by the end of May, then another period of decline beginning the second week of June. As shown in Table 3.6, all banks suffered significant losses.

[12] *Source:* Bank level demand deposit data is derived from HNB Records, Vol. 22, MNB Records, Vol. 93 & 94, 2nd NB Records, Vol. 8 & 9 and 1st NB Records, Vol. 45, 46, 48 & 50.

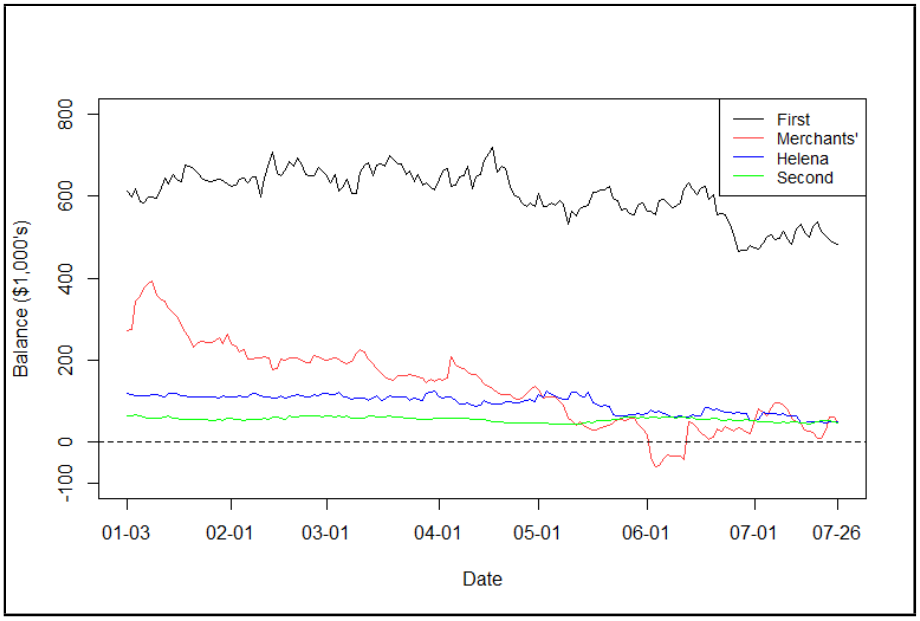


Figure 3.6: Demand Deposit Total Balance, All Banks (Jan 1 - Jul 26 1893)

Table 3.6: Demand Deposits Decline From 1893 Peak

Bank	Date of Max Deposits	Deposits ($) Maximum	Deposits ($) July 26, 1893	Decline
1st National	17 Apr 1893	719,081	481,497	33.0%
Merchants National	10 Jan 1893	392,295	47,892	87.8%
Helena National	3 May 1893	126,201	50,035	60.4%
2nd National	5 Jan 1893	66,470	46,421	30.2%

Time Certificates[13] Time certificates comprised the primary means of deposit for the four national banks in Helena. While demand deposits were a mechanism to provide a secure way to transact business, time certificates were an investment in the bank. In return for a six- or twelve-month commitment, depositors were to be paid annualized interest of 5% or 6% respectively. Time certificates could be redeemed before the end of the contract, but all interest earned would be forfeited. As a result, time certificate deposits were much more stable compared with demand deposits. For Merchants', time certificates normally represented 80% to 90% of non-bank deposits. For 1st National, the value was in the range

[13] *Source:* Bank level time certificate data is derived from HNB Records, Vol. 22, MNB Records, Vol. 93 & 94, 2nd NB Records, Vol. 8 & 9 and 1st NB Records, Vol. 45, 46, 48 & 50.

of 75%. Helena National, as the newest bank, had a growing proportion of time certificates, beginning in 1893 with approximately 65% of savings in time certificates, the ratio increasing to about 75% by the end of July.

Figure 3.7 shows the daily total value of time certificate deposits for the four banks during the period from January 26, 1891, to July 26, 1893. Table 3.7 shows the peak date and amount of time certificate deposits as well as the amount on July 26, 1893, for each bank. The peak for 1st National occured in mid-April, but the decline in time certificates did not really begin in earnest until late April or the beginning of May. In fact, on April 26 the value of time certificate deposits had dropped less than 1% from the peak. As with demand deposits, 1st National suffered a smaller percentage loss than either of the non-suspending banks. Merchants' descent began May 12, and Helena National on March 24, with a precipitous decline beginning mid-May. For the two oldest and largest banks, the slow but steady growth of two and a half years was wiped out in about two months.

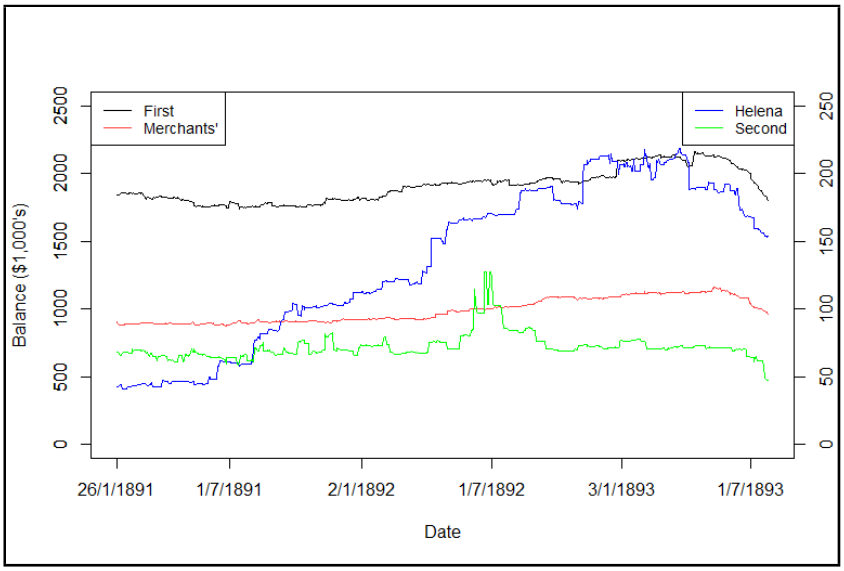


Figure 3.7: Time Certificate Deposits (Jan 26, 1891 - Jul 26, 1893)

Table 3.7: Time Certificate Deposits Decline From Peak[14]

Bank	Date of Max Deposits	Deposits ($) Maximum	Deposits ($) July 26, 1893	Decline
1st National	13 Apr 1893	2,159,707	1,801,416	16.6%
Merchants National	12 May 1893	1,158,569	963,009	16.9%
Helena National	24 March 1893	218,666	153,984	29.6%
2nd National	27 Jan 1893	77,588	47,586	38.7%

Time certificate investment levels sometimes exhibited seasonal patterns. Figure 3.8 shows the monthly value of purchases and redemptions for time certificates at Merchants' National Bank. The mining economy of the Helena region tended to be seasonal, with many mines shutting down during the harsh winters, opening when better weather arrrived in the spring. This perhaps explains the cyclical pattern seen in the two years prior to the crisis, with the amounts of both purchase and redemption climbing as the year progresses.

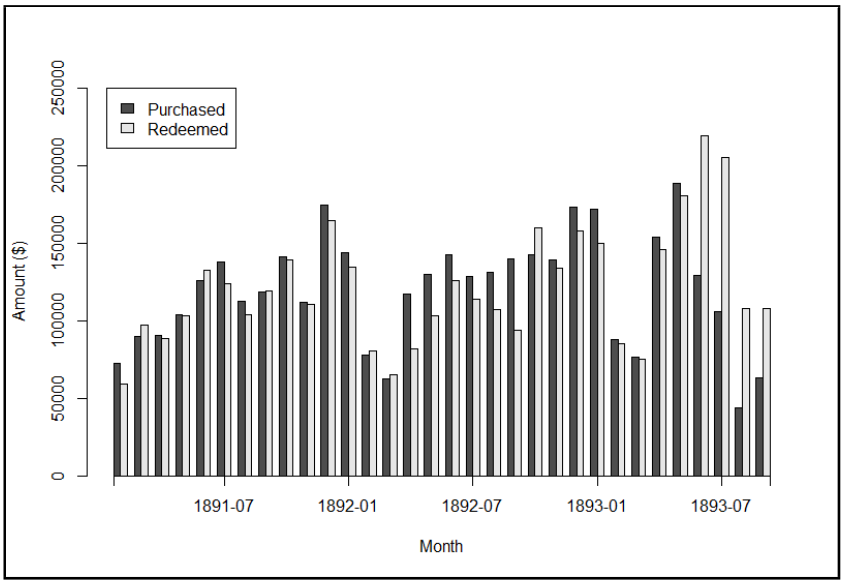


Figure 3.8: Monthly Time Certificates Purchased & Redeemed, Merchants' Bank

[14] 2nd National maximum is for 1893 only.

The pattern set in 1891 and 1892 remained the same for the first five months of 1893. Beginning in June, however, redemptions far exceeded time certificate purchases for several months. Just as certificates of deposit work now, depositors who redeemed their certificates before they were mature forfeited any interest earned. By measuring the total amount of forsaken interest due to prematurely redeemed certificates, some insight can be gathered regarding the level and degree of pessimism in the population of depositors. Table 3.8 shows that total purchases for the months of June and July were $36,496 less than in 1892, less than a 15% change. However, redemptions were far higher, increasing more than $90,000 for each month. Figure 3.9 shows the monthly amount of forsaken interest by owners of Merchants' Bank time certificates over the period of July 1892 to December 1893. The difference between redemptions in 1893 versus 1892 amounted to more than $90,000 each month. This resulted in an increase of forsaken interest during June and July in June of approximately $1,000 per month, equal to 1.1% of the redemption amounts. To earn this amount of interest would require slightly more than 2 months, assuming the certificates that were redeemed early were exclusively used to purchase six-month certificates. This suggests that the bulk of early redemptions were certificates that had only recently been purchased.

Table 3.8: Time Certificate Purchases and Redemptions, June & July, 1891-1893

	June		July	
Year	Purchased	Redeemed	Purchased	Redeemed
1891	$126,105	$132,285	$138,124	$124,214
1892	$142,566	$125,984	$128,857	$113,672
1893	$129,338	$219,128	$105,589	$205,172

Total time certificate deposits were far less volatile than total demand deposits. The cost of early redemption, and the size of time certificate account balances as a percentage of total bank deposits, make time certificate account behavior a key factor in determining the cumulative impact of depositor behavior on bank operations. Depositors who had significant

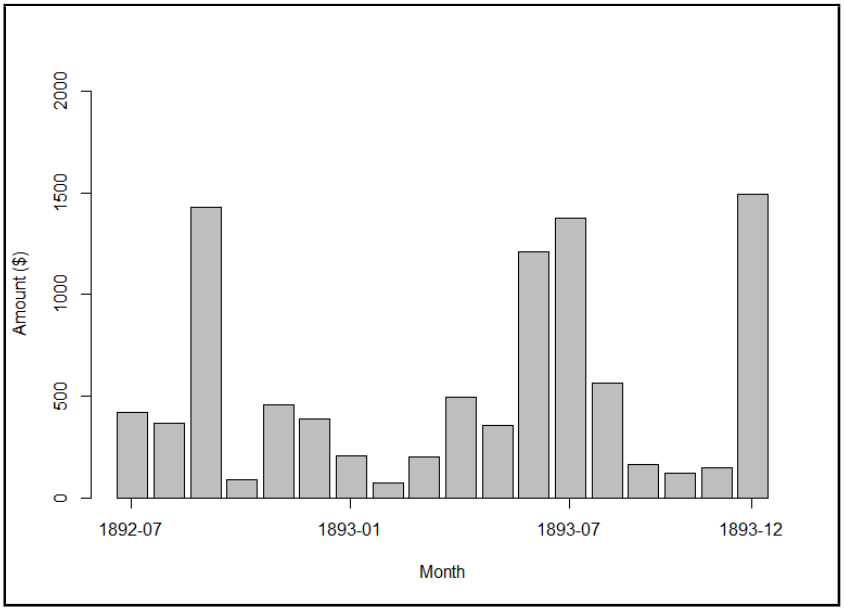


Figure 3.9: Monthly Time Certificate Forsaken Interest, Merchants' Bank

interest at risk, those with 12 month time certificates purchased several months before the panic, were inclined to hold their certificates to maturity. Those who had recently purchased certificates had less to lose, so were more likely to redeem them.

Total Individual Deposits[15] Summing the three forms of individual deposits provides a combined picture of the amount of money being moved in and out of the banks by individuals. Figure 3.10 shows the daily sum of time certificate, demand, and savings deposit balances for each bank for the period from January 26, 1891 to July 26, 1893.[16] Examining the patterns over time, we can see that from the beginning of the data presented, 1st National and Merchants' enjoyed an extended period of steady growth in deposits, lasting about two years for Merchants' and a few months longer than that for 1st National. In comparison, Helena National had a more erratic growth pattern. This is attributable to

[15] *Source:* Total individual deposits account data is derived from 2nd NB Records, Vol. 15 & 16, HNB Records, Vol. 22, MNB Records, Vol. 93 & 94 and 1st NB Records, Vol. 45, 46, 48 & 50.

[16] The end points of the data series were selected for a combination of reasons. On July 27, 1893, 1st National suspended for several months. Helena National began business in late 1890, so data is very irregular before the selected dates. Finally, the series is 30 months in total, a duration that balanced the need for extended observation with a reasonable limit on resources to be expended coding the data.

having only recently begun business. 2nd National remained relatively steady except for a growth spurt of about six months in mid-1981 that was at least partially eliminated by withdrawals in early 1892. All four banks saw a steep decline from their peaks, although when those peaks occurred, and the nature and extent of the decline, are quite different.

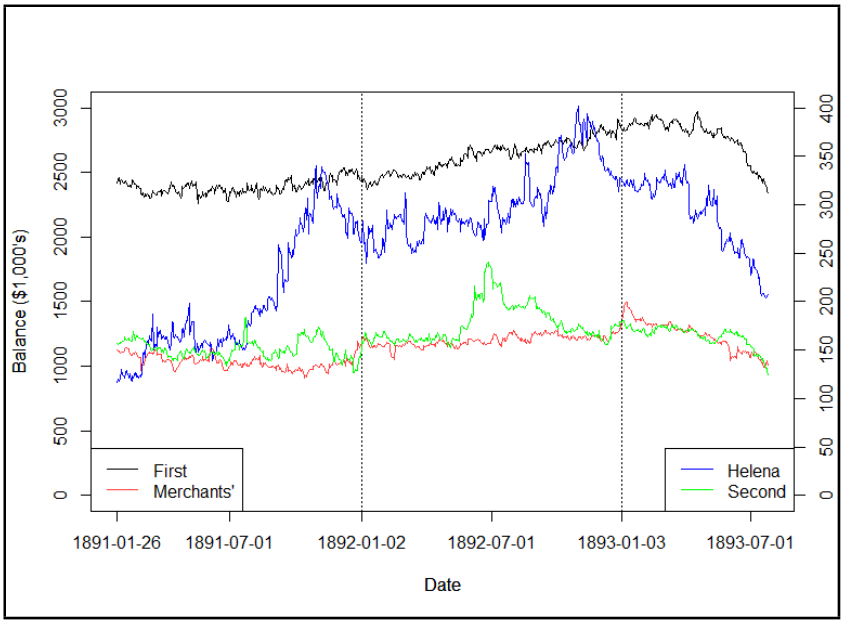


Figure 3.10: Total Non-bank Deposits, (26 Jan 1893 - 26 July 1893)

Table 3.9 lists peak dates and the percentage declines in deposits from the individual bank peaks to July 26, 1893. Two findings are readily apparent: the percentage loss was inversely proportional to bank size, and the bank that suspended in July 1893, 1st National, suffered proportionally much smaller losses than the three smaller banks. Judged from the starting point of January 26, 1891, the net change in deposits for 1st National is very small, less than a 3.5% decline over the 30-month period, as compared with a 10% decline for Merchants' and 20% for 2nd National. 1st National saw stable or growing deposits until mid-April of 1893. At that time deposit levels fell at a rate not significantly different than

the two smaller banks. Merchants' saw its peak right after the new year, but the descent, longer in duration than 1st National but at a lower rate of decline, resulted in a significantly greater percentage loss of deposits. Helena National opened for business only a few months before the data series begins, which explains the volatility of the first year of data, as the bank began acquiring new depositors. Helena National had a much more systemic, and precipitous, decline beginning on October 31, 1892, and accelerating slightly in early May of 1893. After the brief growth spurt in mid-1892, 2nd National returned to deposit levels found in 1891. In late May and early June of 1893, 2nd National began suffering a sharp decline. Both Helena National and 2nd National suffered a loss of deposits nearing 50% from peak.

Table 3.9: Deposit Decline From Peak

Bank	Date of Max Deposits	Maximum Deposits ($)	Deposits July 26, 1893	Decline
1st National	17 Apr 1893	2,973,421	2,337,789	21.4%
Merchants National	10 Jan 1893	1,497,780	1,010,900	32.5%
2nd National	27 Jun 1892	240,256	124,385	48.2%
Helena National	31 Oct 1892	402,004	206,598	48.6%

Figure 3.11 shows the net change in total individual deposits for the four banks during the period of May 1 to July 26, 1893. Each bank shows a serious decline in deposit levels, although the amount suffered by 1st National is the smallest, closely followed by Merchants'. The two smallest banks drop the most, with Helena National suffering more than a 30% loss in deposits.

3.3.2 Rates of Change in Total Deposits

During the period of January 26, 1891, to July 26, 1893, there were 761 business days for banks in Helena. Figure 3.12 presents log-frequency vs. log-daily growth rate data

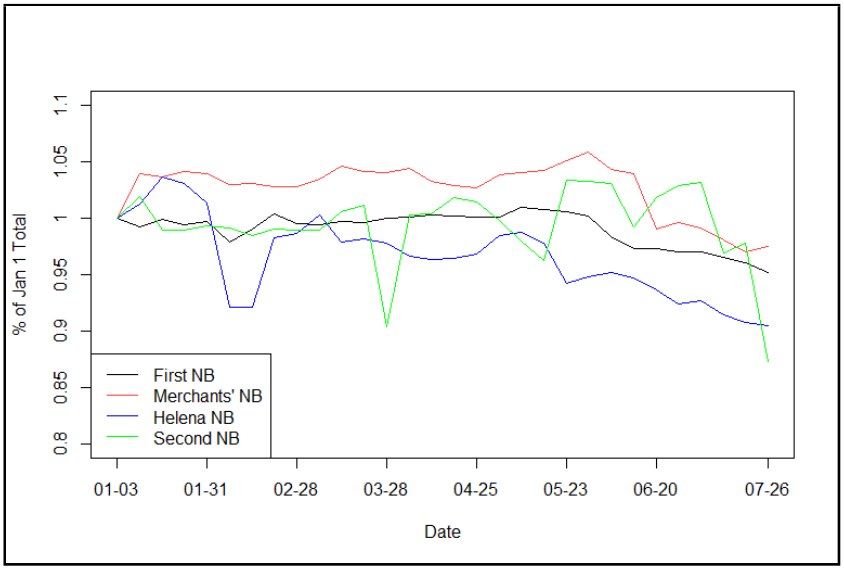


Figure 3.11: Percent of May 1 Deposits, January 1 - July 26, 1893

for the three older banks. Daily growth rates for all three banks fit the form prescribed by a Laplace distribution. Such distributions have been found to occur in other growth rate data, including monthly and quarterly GDP and IP growth rates in OECD countries [Fagiolo et al., 2006] and annual firm growth rates in the United States [Perline et al., 2006]. 2nd National displays asymmetry and convexity on each side of the mean, which suggests a Laplace distribution with Subbotin tails.

Such patterns indicate that statistical tests specifically designed for such distributions should be used to examine such data. The data also provides a very distinctive pattern, or stylized fact, that models of depositor behavior or bank deposit levels should generate.

3.3.3 Corresponding Bank Relationships[17]

Individuals and businesses were not the only customers for banks. Banks had relationships amongst themselves that constituted a form of customer relationship. This was quite true of late 19th century banking, where networks of correspondent bank relationships sometimes stretched around the globe, such as Merchants' relationship with the Anglo-American Bank,

[17] *Source:* Corresponding bank balances is derived from MNB Records, Vol. 93 and 1st NB Records, Vol. 48 & 50.

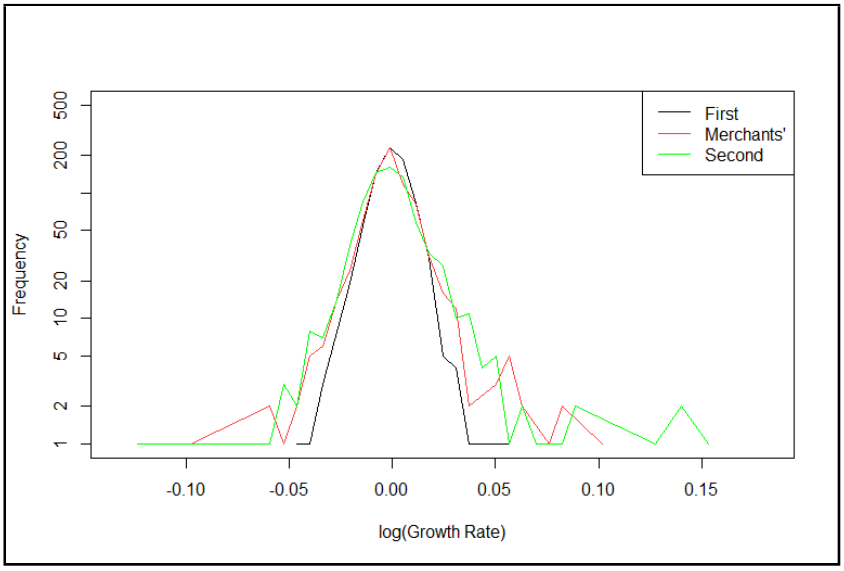


Figure 3.12: Rate of Change Total Deposits for Merchants', 1st National and 2nd National Banks (1 Jan 1891 - 26 Jul 1893)

which had offices in San Francisco and London.

The flow of money within the national as well as regional economy created reasons for banks to have deposits held in other banks. The pyramid of central reserve - reserve - country banks extended from Helena to include private, state, and smaller national banks. Though not a reserve city, Helena served as a financial center for towns throughout Montana and into neighboring states.

Larger national banks, such as 1st National and Merchants', had extensive correspondent bank relationships. Table 3.10 shows the number and type of banks and other financial institutions that maintained corresponding relationships with 1st National and Merchants' as of January 3, 1893. Private and state banks often had relationships with both banks. Banker Henry Elling, holder of large time certificate investments at Merchants' (see Section 3.3.1), had more than $11,000 deposited in 1st National at the beginning of 1893. Dillon National Bank of Montana, which had almost $16,000 deposited at Merchants', also had $1,681 deposited at 1st . This overlap sometimes extended to banks in the smaller reserve cities such as the 1st National Bank of Omaha, where both Helena banks maintained small

deposits. However, the critical central reserve city banks were mutually exclusive, with no overlap between each of the five corresponding bank relationships maintained by the two Helena banks.

Table 3.10: Number and Type of Corresponding Financial Institutions, Merchants' and 1st National Banks, Jan 3, 1893

Type	Merchants'	1st National
Central Reserve City	5	5
Reserve City	5	14
Country	17	36
Private State	9	26
Total	36	81

Correspondent bank balances could constitute either a major liability or a major resource for banks in Helena. In the case of 1st National, the amount deposited by other banks normally exceeded the amount they deposited in others. This is illustrated in Figure 3.13. It is a rare situation when 1st National's balance goes negative, where more is due from banks than is due to 1st National.

Coding similar data for Merchants' is far more difficult than for 1st National. Unlike 1st National, no single entry in any ledger represented either the amount due from, to, or the total balance for corresponding bank relationships. To complicate matters further, in June 1893, Merchants' changed the organization of their daily balance sheet ledger from having corresponding banks being listed alphabetically with all other balance sheet entries, to keeping them on a separate page in the balance sheet ledger.

Table 3.11 shows correspondent bank balances of 1st National and Merchants' for selected dates in 1893. Due to and due from balances for both banks descend quite significantly. Merchants' maintained a surplus of deposits in other banks, whereas 1st National

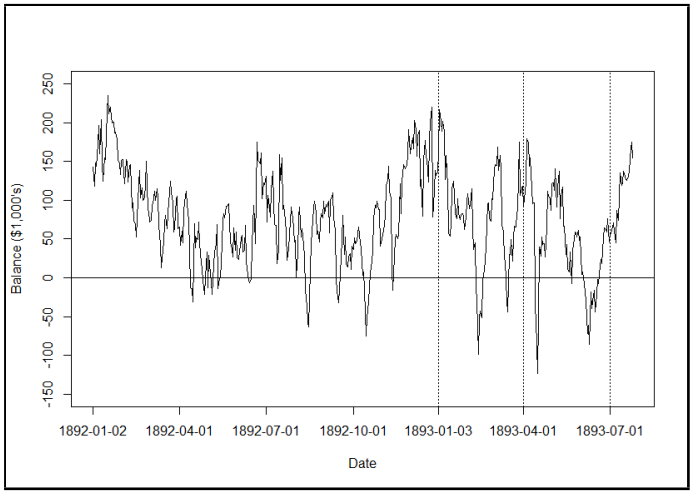


Figure 3.13: Corresponding Bank Net Balance, 1st National (Jan 1, 1892 - Jul 26, 1893)

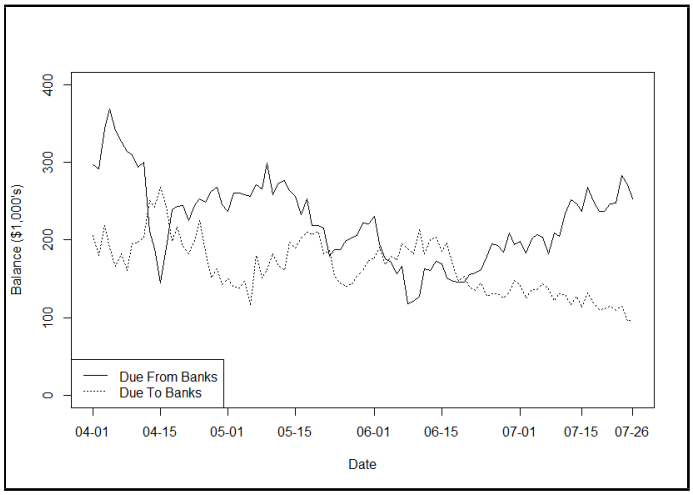


Figure 3.14: "Due to" and "Due from" Balances, 1st National (Apr 1 - Jul 26, 1893)

had more money deposited by other banks than they had deposited elsewhere. For 1st National the total balance was approximately the same the day the bank suspended as it was at the beginning of the year. Merchants' had far more deposited in other banks than they held as deposits. This gave Merchants' more flexibility to overcome the significant withdrawals ofrom demand deposit and time certificate accounts. On July 1, Merchants' had an amount due from other banks greater than 10% of its total liabilities. For 1st National the amount was less than 4%.

Table 3.11: Correspondent Bank Balances, Merchants' and 1st National Banks

	Merchants'		1st National	
Date	Due from Banks	Due to Banks	Due from Banks	Due to Banks
January 3, 1893	$402,202	$124,780	$255,353	$417,754
July 1, 1893	$222,466	$94,410	$141,177	$198,166
July 15, 1893	$177,100	$113,088	$113,890	$236,753
July 26, 1893	$139,084	$66,768	$97,808	$252,823
July 31, 1893	$151,701	$38,073	Suspended	Suspended

Over the course of 1893, Merchants' was able to move a net $160,000 from corresponding banks to cash, making it able to accomodate the large demand for cash from depositors. As a result of having far more deposited in Helena compared to deposits of its own, 1st National was able to shift a net amount of only $7,000. The amount of money deposited in and by the two banks was greatly reduced. At the beginning of the year there was more than $1.3 million in corresponding bank balances at the two banks. On July 26, the amount was reduced to less than $600,000, providing detailed evidence of the contraction of banking resources that occurred as the early stages of the panic played out [Noyes, 1898], [Sprague, 1910].

3.3.4 Bills Discounted and Rediscounted[18]

Bills Discounted The business of banks is to collect short term liabilities in the form of deposits, and convert them to longer term loans. In the late 19th century, such loans were referred to as discounted bills. Borrowers would pay periodic interest but would also pay a small percentage of the loan when it was made, the loan value being "discounted", not dissimilar to current day origination fees paid on loans and mortgages. Figure 3.15 shows the total bills discounted for each bank as a fraction of the total bills discounted at the beginning of 1893. The value of total bills discounted was not subject to significant variation for a variety of reasons. Perhaps in the case of 1st National, it was a result of the corruption described earlier, where most bank debts, sooner or later, led back to the

[18] *Source:* Bills discounted and rediscounted data is derived from 2nd NB Records, Vol. 15 & 16, HNB Records, Vol. 22, MNB Records, Vol. 93 & 94 and 1st NB Records, Vol. 48 & 50.

president of the bank, Samuel T. Hauser.

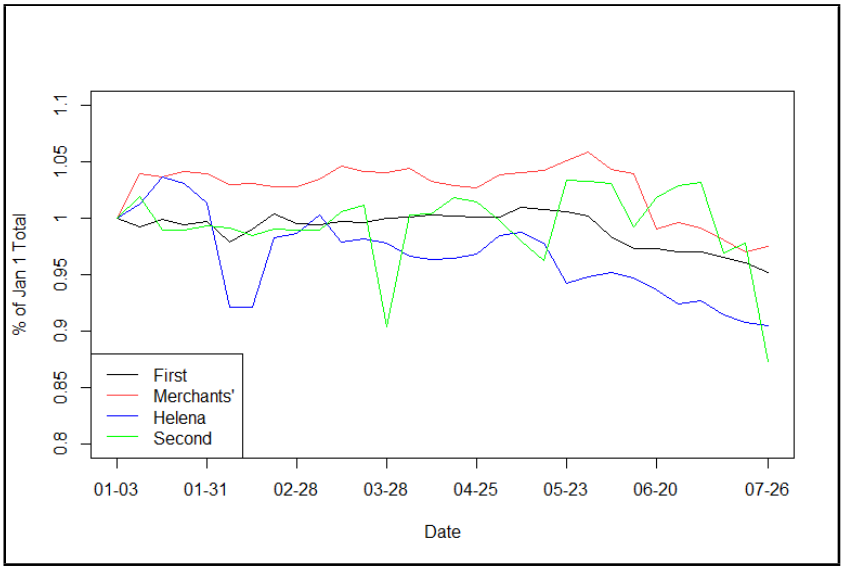


Figure 3.15: Bills Discounted as Percent of January 1, 1893 Amount

Table 3.12 compares the maximum amount of bills discounted during 1893 with the amount discounted on July 26. For all banks the effort to reduce discounted bills meant that July 26 had the lowest amount outstanding for the year to date. As with the loss of depositors, the larger banks had a much smaller decrease in outstanding bills discounted than the two smaller banks.

Table 3.12: Bills Discounted Decline From Peak, Measured Weekly

Bank	Date of Maximum	Maximum Bills Discounted	Bills Discounted July 26, 1893	Decline
1st National	9 May 1893	3,023,953	2,852,099	5.6%
Merchants National	29 May 1893	1,424,038	1,392,560	2.2%
2nd National	23 May 1893	261,553	240,953	7.9%
Helena National	7 Mar 1893	808,869	736,601	8.9%

The ability to reduce oustanding bills discounted appears to have been quite challenging, especially for the two larger banks. Only when the crisis was well underway did any of the banks begin to reduce the amount of discounted bills outstanding.

Bills Rediscounted Rediscounting bills was the process of temporarily assigning discounted bills to another financial institution. For Merchants' and Helena National it appears to have been used only in times of dire need for cash. This suggests that the cost of rediscounting was significant. For Merchants' National the need arose in mid-June. On June 16, $28,130 in bills were rediscounted to Continental National Bank in Chicago. The next day $52,013 in bills were rediscounted to Fourth National Bank in New York. Although Merchants' rediscounted less than 2.5% of their outstanding bills, the funds were essential to the bank's survival during the peak of the panic in late July.

2nd National Bank rediscounted bills as a normal part of business. During the first months of 1893 between $25,000 and $30,000 in bills were rediscounted, climbing to more than $40,000 as the crisis worsened in mid-July. On July 26, 2nd National had more than 17% of their bills rediscounted, the highest percentage of any of the four Helena banks. By the end of August the value of rediscounted bills had returned to the $30,000 level.

On February 6, 1893, Helena National Bank rediscounted bills in the amount of $42,750. This amount climbed above $56,000 by late April and remained near that amount for the duration of the summer. At the peak of the crisis Helena National rediscounted about 7.5% of the total bills discounted, approximately the same percentage amount as Merchants'.

1st National Bank, even as they approached suspending, did not rediscount.

3.4 What does it all mean?

At 10 pm on July 26, 1893, two of the three largest banks in Helena posted notices that they would not reopen in the morning. Banks suspended for one simple reason - they were no longer able to meet the demands of depositors for cash. More than half the accumulated resources of the six Helena national banks were frozen. With only $12,936 in cash available

and no end to the run in sight, 1st National closed its doors. Management at the Montana National had drawn the same conclusion and suspended as well. To the average resident of Helena, it was not clear what the condition of the remaining four national banks was. So it was a point of great interest when, the next morning, Aaron Hirshfield opened the doors of Merchants' National Bank, and turned the sign to "open" [Petrik, 2009, p. 743].

The four banks in Helena, though starting the year with very different amounts of cash on hand, converged to similar net positions in late July (See Figure 3.16). As smaller banks, Helena and 2nd National's cash needs were far less than the two larger banks. As Table 3.13 shows, 2nd National had a better ratio of cash to deposits at the peak of the panic than they had at the beginning of the year. The other three banks were not as fortunate.

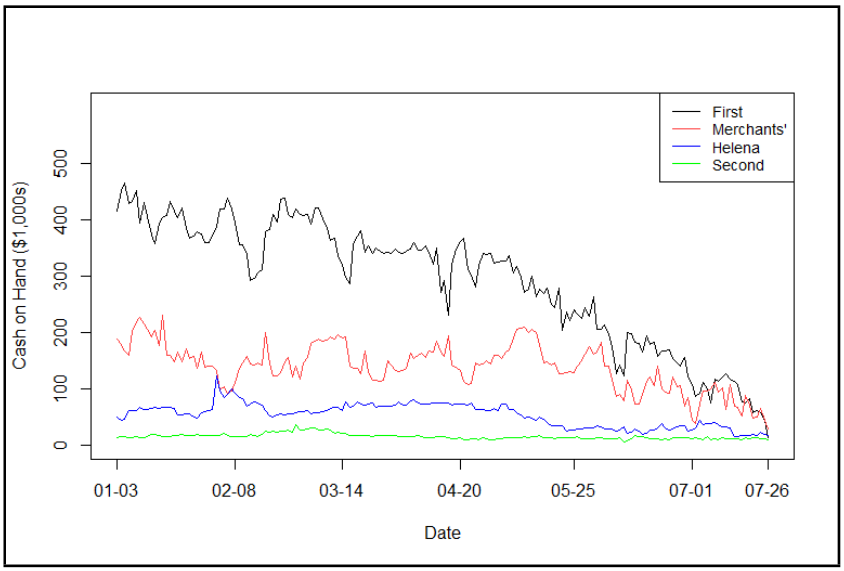


Figure 3.16: Cash on Hand, All Banks (Jan 2, 1893 - July 26, 1893)

All four banks suffered significant withdrawals, but the flexibility of each bank to react to the withdrawals was different. Table 3.14 shows the changes in major account levels for 1st National and Merchants' from May 1 to July 26. The amount of deposits lost at Merchants'

Table 3.13: Cash on Hand and as % of Deposits, All Banks, Jan 1, 1893 & July 26, 1893

	January 3, 1893		July 26, 1893	
Bank	Cash on Hand	% of Deposits	Cash on Hand	% of Deposits
1st National	$415,692	14.6%	$12,936	0.6%
Merchants' National	$187,692	13.7%	$28,947	2.9%
2nd National	$13,425	7.5%	$9,987	8.0%
Helena National	$50,047	15.3%	$18,095	8.8%

was slightly higher percentagewise than at 1st National, but the striking difference is the way the two banks attempted to manage the crisis. 1st relied on reducing outstanding discounted bills and increasing the amounts deposited by other banks. No bills were rediscounted, even with a portfolio of almost $3,000,000 in discounted bills. Merchants', who unlike 1st always had far greater deposits in banks than was deposited by banks, was able to withdraw money from banks and also rediscount notes in New York and Chicago. By the thinnest of margins, Merchants' was able to use relationships in New York and Chicago to survive the crisis.

Table 3.14: Changes in Major Account Values, 1st and Merchants', May 1 & July 26, 1893

	1st National			Merchants' National		
	1 May	26 July	Change	1 May	26 July	Change
Individual Deposits	2,836	2,338	-498	1,344	1,085	-259
Corresponding Banks	87	155	68	-120	-72	48
Bills Discounted	-2,997	-2,852	145	-1,399	-1,392	7
Bills Rediscounted	-	-	-	-	80	80
Total	-77	-359	-282	-175	-299	-124
Cash on Hand	323	13	-310	159	29	-130

Table 3.15 shows the same information for 2nd National and Helena National. Although suffering far larger withdrawal levels as a percentage of total deposits, both banks were able to keep reaonably safe amounts of cash on hand by reducing outstanding bills and rediscounting. The amount deposited in other banks, and deposited by other banks, was

small and played a minor role in keeping cash on hand at a satisfactory level. Outstanding notes were either rediscounted or reduced in total value. With 2nd National having far less capital than the other Helena banks, examiners encouraged Helena National and 2nd to merge. Shirley Ashby, who was suspected of financial improprieties involving a loan to his close associate D. A. G. Floweree, was replaced as president of Helena National by Erastus Edgerton from the much smaller 2nd National [Jackson, 1980].

Table 3.15: Changes in Major Account Values, 2nd and Helena, May 1 & July 26, 1893

	2nd National			Helena National		
	1 May	26 July	Change	1 May	26 July	Change
Individual Deposits	159	124	-35	307	207	-100
Corresponding Banks	-11	-6	5	7	-10	-17
Bills Discounted	-258	-241	17	-798	-737	61
Bills Rediscounted	27	42	15	56	58	2
Total	-83	-81	2	-428	-482	-54
Cash on Hand	10	10	0	65	18	-47

3.4.1 Conclusion

The detailed bank data presented shows that certain regularities appear within the four banks examined. The distribution of deposit amounts can be approximated by fat-tailed distributions such as power laws. Fat-tailed distributions also describe the day to day changes in each banks total deposits. These findings establish that methods that are appropriate for such distributions must be used when analyzing such data. It also demonstrates that some depositors were far more important than others. When theorizing regarding bank panics, approaches that use uniform endowment distributions should be revisited to determine the impact of empirical findings. As is apparent from the evidence, in 1890s Helena, the actions of the few could have far more impact than the actions of the many.

In 1893 1st National suffered far less loss of deposits than other banks, yet failed to survive without suspending and reorganizing. Within 2 years of the Panic of 1893, the four banks described in this chapter would be reduced by mergers to two. Paula Petrik quotes John Edgerton as saying "It seem[ed] to him like a damned rotten institution [First National Bank] getting a sound one [Helena National Bank] to pull it through [Petrik, 2009]. Although the goal may have been to use Helena National to pull 1st through, the plan failed miserably. The combined banks failed rather quickly, and by early 1897 all four banks would be in the hands of agents of the Comptroller.

What isn't demonstrated by examination of quarterly data [Dupont, 2007], or looking for regularities amongst suspended banks [Gorton, 1988], is that there was a great variety of impacts seen by banks during the crisis. A broad-based loss of deposits clearly occurred; a healthy bank, Montana National, suspended as did a clearly marginal bank, 1st National. Healthier banks, like Helena National and 2nd National, suffered far greater losses in deposits and were able to navigate the crisis without serious liquidity issues. Without examination of the details, conclusions based simply on whether or not a bank suspended or survived may be misleading.

Figure 3.11 (Page 62) shows the rate of deposit decline for each of the four banks. The highest sustained rate of decline begins in early July at 2nd National. Over a one-month period, deposits dropped almost 20%. Without understanding the psychology of depositors, it is not possible to determine whether a panic was occurring. Merchants' had the second greatest rate of decline, starting in early June and equaling about 7% of deposits. Helena National appeared to suffering a continuous decrease in deposit levels, with no significant change in rate from the beginning of the year. Beginning in early May, 1st National saw a slow but steady decrease in deposits. Decreases occurred, but they were in all cases spread out over a large number of days, even months.

Did Helena banks suffer a panic in the summer of 1893? Was there a run on the banks? A bank run is often defined as an unusual drop in deposits over a relatively short period of time. What constitutes unusual or short is open to debate. Again, the definition of

run is problematic. There is no single point in time where all banks began to change in some correlated fashion. There was a general reduction of deposits that was sustained, at different rates for different banks, over a long period of time but no generalized panic or run.

Chapter 4: Demonstrating Bank-to-Bank Contagion During the Panic of 1893[1]

4.1 Motivation

Contagion is a central feature in many theories of widespread financial crises. It has been argued that panics start locally, then spread via contagion [Dasgupta, 2004]. Contagion has been examined in several forms, including correspondent banking relationships [Iyer and Puri, 2008] as well as through social connections [Chari and Jaganathan, 1988]. Social psychologists have developed theories of emotional contagion which, when combined with research demonstrating the impact of emotion on behavior, could provide the framework for demonstrating the psychosocial foundation of contagion [Frederickson and Joiner, 2002] [Friedkin, 2010].

Little is settled regarding contagion in actual panics. Friedman and Schwartz argue that, beginning in October 1930, "a contagion of fear spread among depositors" causing bank failures that began in agricultural areas and moved to the cities, culminating in the failure of the Bank of the United States in December [Friedman and Schwartz, 1963, p. 308]. Wicker argues that it was not a wave of contagion causing independent banks in the interior to collapse. Failures were associated with the collapse of one major financial institution, Nashville-based Caldwell and Co. It was not a generalized loss of confidence but the failure of networked interdependent components of Caldwell and Co. enterprises [Wicker, 1996, p. 32-35].

Studies using more detailed empirical information have shown that contagion played a role in some of the bank panics of the Great Depression [Saunders and Wilson, 1996],

[1]Note: The vast majority of the work presented in this section is the product of a joint effort between Carlos Ramirez and the Author [Ramirez and Zandbergen, 2013]. Any mistakes, incorrect statements, or other possible misteps are the full responsibility of the Author.

but not in panics in Chicago in 1932 [Calomiris and Gorton, 1991]. In 1893 in Kansas, contagion was a factor for state and local banks but not for national banks [Dupont, 2007]. Panics of the National Bank era have been shown to be based on economic weakness and not pure panic [Gorton, 1988]. In all studies the analysis was based on annual data or, at best, quarterly data. Unfortunately, bank panics occur in much shorter time frames than annually or quarterly. Liquidity based suspensions can be resolved within days. All of this leaves the central question unanswered - does contagion occur in the realm of finance, in particular during financial crises?

The Helena bank records provide a unique opportunity to investigate this question. The archives contain daily balances for all accounts from organization to demise for all four banks. As shown in Table 4.1, the four national banks for which detailed records exist comprise almost 75% of the total market in Helena.[2] State and local banks in Helena, as in Montana in general, were infrequent and small. In the early 1890s the only non-national bank in Helena was the Thomas Cruse Savings Bank, with capital of $100,000. All six national banks were located on the same block in downtown Helena. There were few customers who had significant accounts at more than one of the four banks, and the largest correspondent banks for each of the four were unique to each bank.

4.2 Research Questions and Approach

The availability of such a rich data repository allows the general question of contagion to be addressed in three specific ways.

1. Does news of a bank run in one part of the country impact depositor actions in another?

2. Do changes at one bank that correlate with such news also correlate with changes at other Helena banks?

[2]See Section 2.1.1 for a discussion on the size of Helena banks relative to other national banks of the time as well as the comparative significance of Helena banks in the western United States.

Table 4.1: Helena National Banks

Bank	Total Individual Deposits	Resources ($) (Oct. 1892)
1st National	2,810,113	4,388,232
Merchants National	1,547,664	2,531,277
2nd National	193,643	327,780
Helena National	349,669	978,982
Montana National	1,085,808	2,168,269
American National	208,328	677,231
All Helena Nat'l Banks	6,285,224	11,071,692
All Sample Banks	4,543,918	8,212,634
Sample / Total	0.72	0.74

3. How do significant withdrawals at one bank relate to changes at the other banks?

These questions are addressed sequentially using distinct econometric methods.

4.2.1 Examining the impact of news of bank runs on Helena Banks

Contagion can be defined as news of the failure of one bank causing an adverse reaction by depositors at another. To test whether this is the case in Helena, a dynamic linear transfer function model was used. First, define the following variables.

1. i, an index of deposit type - demand deposits or time certificates.
2. j, an index of banks, 1st National, Merchants', Helena, and 2nd National.
3. t, an index of dates when banks were open during the period 26 January 1891 to 26 July 1893.
4. L, the lag operator.
5. A, B, and C, polynomials of L.
6. $\Delta d_{i,j,t}$, the change in the log of deposits of type i at bank j on day t.

The dynamic transfer function is then defined as:

$$A(L)\Delta d_{i,j,t} = \alpha + B(L)R_t + C(L)X_t + \epsilon_t \tag{4.1}$$

The variable R_t is an indicator function whose value is 1 for date t if a story of a bank run appeared in one of several prominent newspapers, 0 otherwise. To establish the values for R, a Proquest search on the terms ""bank run" or ("bank" and "heavy withdrawals")" was conducted over the date range of t. To provide approriate geographic coverage as well as capture most of the primary newspapaers of the time, *The Atlanta Constitution*, *Baltimore Sun*, *Boston Globe*, *Chicago Tribune*, *Los Angeles Times*, *New York Times*, *Wall Street Journal* and the *Washington Post* were searched. All articles returned as a result of the search were about bank runs or closures.

The control variables included in the function X_t are the daily stock market return [Schwert, 1990] and the daily change in the log of the price of silver derived from the London Times and New York Times. These two variables were selected to represent fundamentals regarding local banking conditions that are of the same frequency as the bank deposit data. Stock prices were chosen as a forward looking measure of aggregate macroeconomic conditions, and silver prices as silver mining was the primary industry in Helena during the early 1890s.

Section 3.3.2 demonstrates that the distribution of dependant variable Δ displays significant heteroskedasticity. There is also the possibility that the volatility of deposits becomes more asymmetric during times of high withdrawals as compared with other times; therefore the method used to estimate Equation 4.1 must be selected with this as a consideration. The ARCH/GARCH/TARCH process (sometimes referred to as GJR-GARCH) was chosen as a process which is specifically designed to address such data features [Glosten et al., 1993].

The selection of the lag order L is based upon standard information criteria, including the Akaike InformationCriterion (AIC), Bayesian Information Criterion (BIC), and the

Hannan-Quinn Informaiton Criterion (HQIC). Based on these approaches the chosen lag order ranged varied between 2 and 4 lags, with 2 being recommended in most cases by the information criteria.

4.2.2 Measuring bank-to-bank correlated responses to news of bank runs

The objective of this test is to determine if, during a seven day window around a bank story event ($R_t = 1$), movements in deposit levels at one bank are correlated with movements at others. A positive response to this question would not, in and of itself, demonstrate the existance of contagion amongst the Helena banks, but would provide additional evidence to the existance of contagion.

4.2.3 Examining the impact of significant withdrawals from one bank on the other banks

Given perfect information, withdrawals from a bank viewed as vulnerable or of dimished fundamentals would be redeposited in another institution deemed healthier. Theories based on asymmetric information would suggest that this may not be the case, that withdrawals from one institution may create spillover effects at others, without consideration of bank fundamentals. Given the close proximity of the Helena banks it would not be surprising to demonstrate such contagion, based upon bank depositors being physically able to observe the behavior of customers at each of the banks.

To test for this condition, a structural vector autoregression model (SVAR) was used. The model expresses deposit changes in a given bank as a linear function of the banks own deposit lags and lags of deposit changes of the other banks, controlling for the impact of the same fundamentals used in the dynamic linear transfer function model above. In order to examine the potential for correlated contemporaneous (same day) withdrawals, a structural VAR with long-run restrictions was utilized [Blanchard and Quah, 1989].

Formally the model is expressed as:

$$\mathbf{x_t} = \sum_{\mathbf{k=1}}^{\mathbf{n}} \mathbf{A_k x_{t-k}} + \sum_{\mathbf{j=0}}^{\mathbf{n}} \mathbf{B_j z_{t-j}} + \mathbf{D}\epsilon_\mathbf{t}, \tag{4.2}$$

The endogenous variables in the SVAR are the daily changes in time certificate deposits at each of the three banks for which the data is currently available and is defined formally as $\mathbf{x_t} = (\Delta d_{F-TC,t}, \Delta d_{M-TC,t}, \Delta d_{H-TC,t})^T$, with F-TC indicating 1st National, M-TC indicating Merchants', and H-TC being Helena National. The exogenous variables are defined by $\mathbf{z_t} = (\Delta p_{stocks,t}, \Delta p_{silver,t}, R_t)^T$ where R_t is as in Equation 4.1 as well as the previously identified stock and silver price changes. The value of n, the number of lags, is set to 2. The assumption is also made that the smallest bank, in this case Helena National, does not have long-term effects on the next largest, Merchants'. Similarly, Merchants' does not have long-term effects on the largest, 1st National.

4.3 Results

4.3.1 Question 1: Does news of a bank run in one part of the country impact depositor actions in another?

Figure 4.1 shows the implied cumulative impulse responses for the four banks for time certificates. In this case the impact of a reported bank run is negative (deposits decline) and statistically significant at the 10% level in most cases. A story regarding bank runs or failures in one of the major newspapers listed previously is correlated with a 0.5% drop in time certificate deposits at 1st National, a similar drop at Merchants', and a 3% drop at 2nd National. A decline of about 1.5% at Helena National was found, although in the last case the significance is at the 15% level, below the normally accepted 10% found in the other three banks. The impact is felt within 3 to 5 days of publication. Two factors would suggest this is a reasonable time for the impact to be felt. First, many of the customers of the Helena banks did not reside in the city of Helena, thus making a visit to the bank

costly in terms of time. Additionally, the propogation of news stories during this period, especially from national papers to local papers, was often erratic.

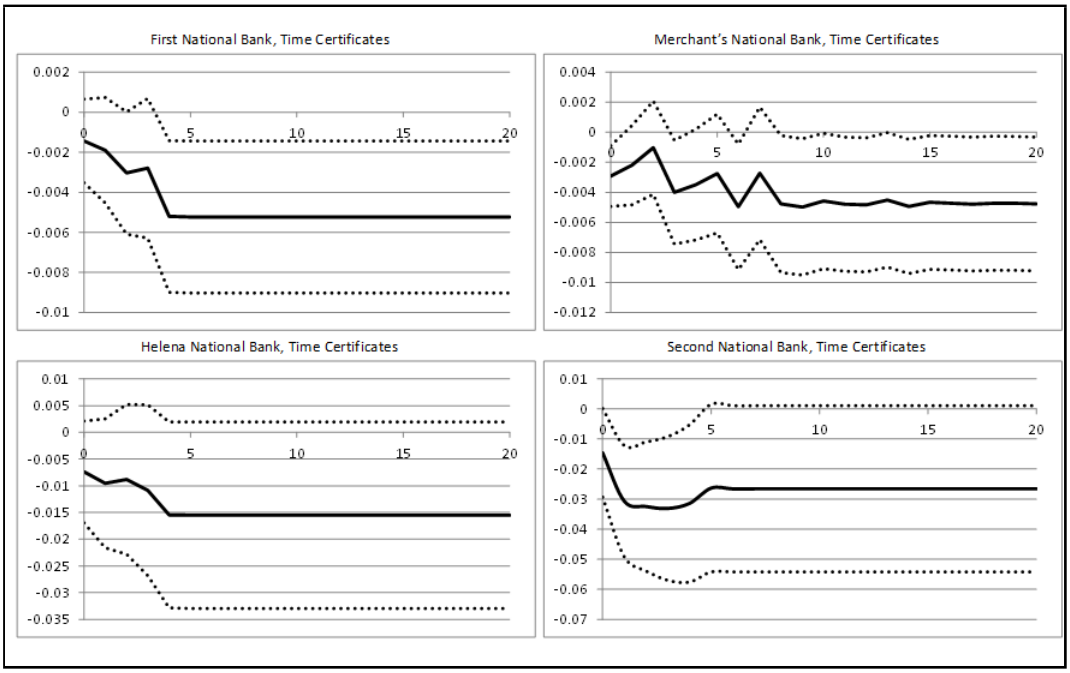


Figure 4.1: Cumulative dynamic effect of a "bank run" on time certificate deposits
Horizontal Axis: Days, Vertical Axis: Percent

Figure 4.2 shows the implied cumulative impulse responses for demand deposit accounts at all four banks. In this case the results are not statistically significant and vary from negative correlation to positive correlation within the 3- to 5-day window.

4.3.2 Question 2: Do changes at one bank that correlate with such news also correlate with changes at other Helena banks?

Correlation calculations were performed for each of the nine pairs of banks and deposit types. For each combination coefficients were calculated for each of the nine days in the window, starting four days before the publication of a bank run story and ending four days

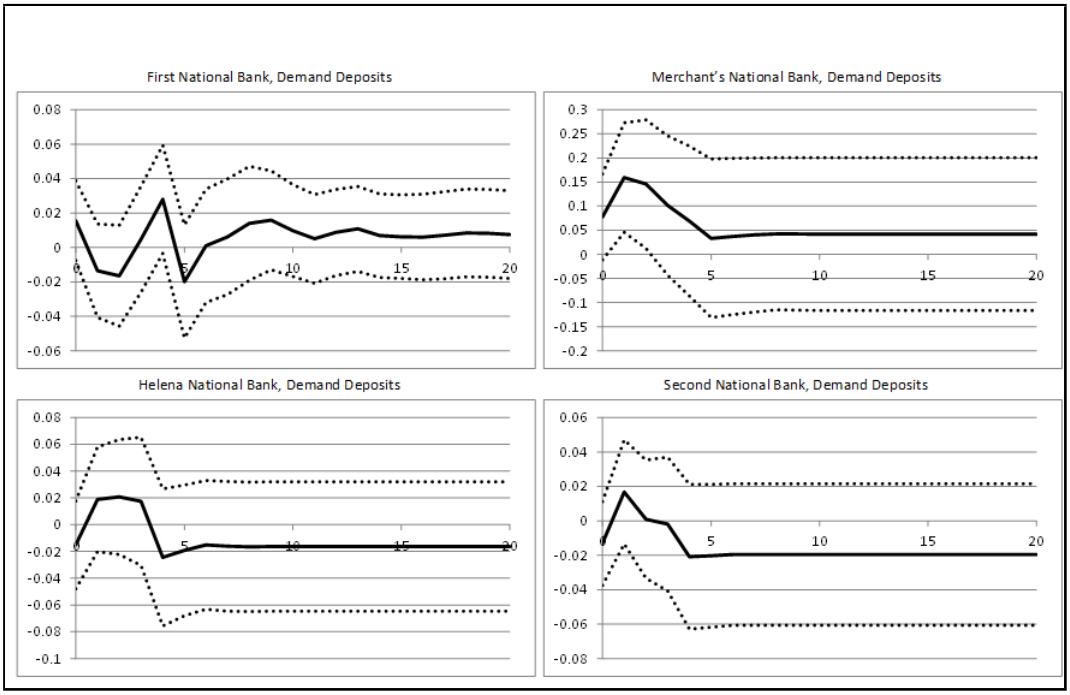


Figure 4.2: Cumulative dynamic effect of a "bank run" on demand deposits
Horizontal Axis: Days, Vertical Axis: Percent

after. Values were also computed for the overall nine-day period.

Table 4.2 shows the results of these calculations for time certificate deposits. Overall there appears to be little significant correlation. The correlation coefficient trend from the four days before publication slowly grows, although unevenly. The relationship between 1st National and Merchants' meets significance thresholds, especially for the day of publication and the following two days. Merchants' has some significant correlative impact on Helena National, as well.

Table 4.3 shows the correlation coeficient values for demand deposits. Unlike time certificates there is little discernible pattern, and none of the values reach statistical significance.

The dynamic linear transfer function results and the additional correlation tests of this section show that time certificates appear to be more responsive to negative news, and to be more correlated from bank to bank than are demand deposits. Dependence on time deposits that yielded high interest was a practice frowned upon in many banking circles.

Table 4.2: Time Certificate Correlation Coefficients During the 9-Day Window of a "Bank Run" Report

$\rho_{A,B}$	All	t - 4	t - 3	t - 2	t - 1	t	t + 1	t + 2	t + 3	t + 4
$\rho_{F,M}$	0.096[1]	0.0830	0.147	0.622[1]	0.764[1]	0.432[1]	0.438[1]	0.609[1]	0.139	0.713[1]
$\rho_{F,H}$	0.120[1]	-0.177	0.139	0.150	-0.085	-0.078	-0.105	0.137	0.093	-0.230
$\rho_{F,S}$	-0.008	0.143	-0.097	-0.133	-0.224	0.044	0.042	0.307	0.123	0.082
$\rho_{M,H}$	0.068[2]	-0.756	-0.021	-0.136	-0.120	0.197	0.356[2]	0.480[1]	0.029	0.106
$\rho_{M,S}$	0.003	-0.143	-0.148	-0.100	-0.193	-0.059	0.181	0.304	0.044	0.322
$\rho_{H,S}$	0.042	-0.047	0.385	0.079	-0.148	0.155	0.163	0.190	0.360[2]	0.415[1]

Note: Cell values are the computed correlation coefficient. Columns indicate time before or after publication of the "bank run" article. The "All" column indicates correlation over the entire 9-day window.
$\rho_{A,B}$ denotes the correlation between changes in bank A and bank B, where F = 1st National, M = merchants', and H = Helena National.
[1] denotes statistical significance at the 5% level.
[2] denotes statistical significance at the 10% level.

Table 4.3: Demand Deposit Correlation Coefficients During the 9-Day Window of a "Bank Run" Report

$\rho_{A,B}$	All	t - 4	t - 3	t - 2	t - 1	t	t + 1	t + 2	t + 3	t + 4
$\rho_{F,M}$	-0.002	-0.333	-0.157	0.349	-0.010	-0.171	-0.134	-0.156	-0.012	-0.108
$\rho_{F,H}$	-0.070	-0.290	-0.081	-0.047	-0.095	-0.186	-0.050	-0.171	-0.064	-0.164
$\rho_{F,S}$	-0.033	-0.240	-0.186	-0.246	-0.180	0.102	-0.101	0.089	-0.218	0.020
$\rho_{M,H}$	-0.028	0.096	-0.096	-0.163	-0.204	-0.194	-0.151	-0.006	-0.168	-0.276
$\rho_{M,S}$	-0.023	0.180	0.072	0.084	0.061	-0.036	-0.006	-0.020	-0.222	-0.070
$\rho_{H,S}$	0.041	0.216	-0.291	-0.176	-0.001	0.009	0.290	0.133	0.364	0.177

Note: Cell values are the computed correlation coefficient. Columns indicate time before or after publication of the "bank run" article. The "All" column undicates correlation over the entire 9 day window.
$\rho_{A,B}$ denotes the correlation between changes in bank A and bank B, where F = 1st National, M = merchants', H = Helena National and S = 2nd National.

Banker's Magazine warned of the practice in September of 1891, noting that reserve city national banks rarely offered such terms. Banks that relied upon time certificate deposits yielding 5 or 6% interest required higher returns on thier loans, i.e., higher risk loans.[3] Section 3.3.1 shows that for Helena banks this practice was not only utilized, but it was the primary means of deposit, especially in the case of 1st National and Merchants'.

[3] *Source: Banker's Magazine*, September 1892, Vol. 46, p. 220.

On the other hand, demand deposits were not an investment but were normally used as a means to conduct business. The seasonal ebb and flow of business had a significant impact on the overall demand deposit holdings at any given bank. Demand deposits were also frequently used by government entities, particularly at Merchants'. It would be of little surprise that government funds were not subject to the same stimuli as funds that amounted to sometimes significant portions of an individual's net worth.

4.3.3 Results: How do significant withdrawals at one bank relate to changes at the other banks?

Figure 4.3 displays the implied impulse response functions derived from the structural VAR model. The rows correspond to the banks initiating the impulse, i.e., the bank which had a change in time certificate values, and the columns correspond to the responding banks. Each graph shows the magnitude of the response over time. For example, a one standard deviation drop at 1st National would be followed, within one or two days, by a 0.03% drop at Merchants'.

The impulse response function is always positive. The findings are not considered statistically significant at generally acceptable levels of significance since the 90% confidence levels include the zero line. However, it is clear that in no cases are the trends consistently negative. There is no indication that a deposit decrease at any of the banks led to an increase at one of the other banks, as would be expected under full information.

4.4 Conclusions

The collapse of Helena banking in 1896 and 1897 led to the collection of documents and ledgers used in this study. The investigation into the collapse by the Comptroller of the Currency-appointed receiver has been described in detail by Paula Petrik in "Parading as Millionaires" [Petrik, 2009]. Petrik tells of Helena banks, and bankers, who suffered from many faults. Seemingly the larger the bank, the more likely it was at odds with what was deemed reasonable and prudent banking methods of the time. 1st National had long been

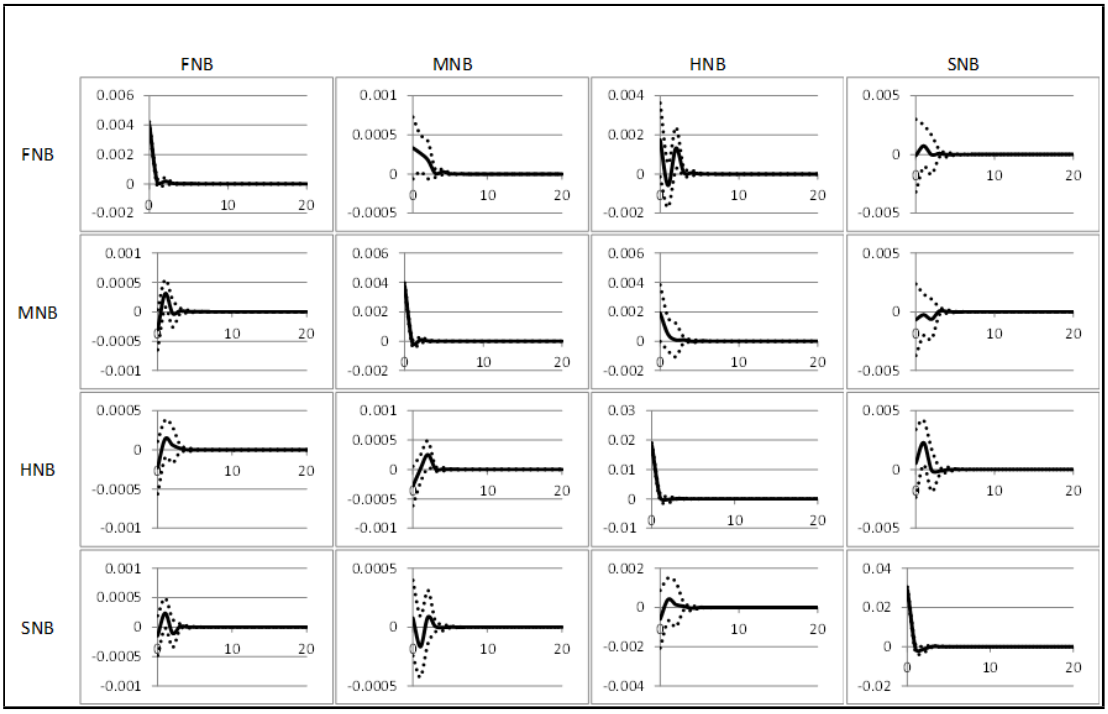


Figure 4.3: Impulse Response Functions implied by the structural VAR model. Horizontal axis: days. Vertical axis: percent. Row = impulse, Column = response.

criticized for failure to maintain proper reserves, excessive loans to a single person, in this case the president of the bank Samuel T. Hauser, and long-standing "free" loans in the form of consistently overdrawn demand deposit accounts held by bank officers, employees, and friends. Such practices also plagued the second largest bank in Helena, Merchants' National. Although brought to ruin by being merged with 1st National, as independent banks Helena National and 2nd National were run far better than the two larger banks.

The first test demonstrates that news of bank runs published in national newspapers had a significant negative impact on time certificates, by far the largest component of bank deposits, for the three banks for which data is currently available. The additional correlation tests performed in the second section lend detail to this finding by showing that negative changes at the larger banks had a knock-on effect at the smaller banks. Under full information scenarios, it would be expected that money moved out of 1st National and Merchants' would at least partially find its way back to safer havens such as 2nd National and

Helena National. The structural VAR analysis suggests this was not the case. Withdrawals, once made, did not reappear in the local banking system in any significant way. These findings provide evidence consistent with that expected by asymmetric information theories of bank panics.

Chapter 5: Bank Depositor Model

The Bank Depositor Model (BDM) is based on viewing depositors as immersed in a social complex where the choice of depositing or withdrawing funds is a function of the emotional state of the depositor. This state is determined by heterogeneous attributes of the depositor, external events, and the impact of the social network a depositor is embedded within. This approach allows input data that is based in empirical findings and generates system performance values that fit empirical findings that previous models, based on economic theories of bank panics, do not.

5.1 Motivation

In the years following the financial crisis of 2007-8, several organizations have placed increased emphasis on modeling the complexities of the financial system. The goal of such model development is to improve the overall understanding of the way institutions respond to risk and the impact of such responses on the larger financial system. The Bank of Japan has chosen to extend a macro-level model developed before the crisis. The Financial Macroeconometric Model (FMM) is a vector auto-regression model built as an extension of the Quarterly Japanse Economic Model (Q-JEM). The limitations of the model are made clear in the final paragraph of the summary report for FMM. "The FMM ... fails to predict the development of a bubble economy. This is partly because the role of expectations is not fully incorporated into the model. Therefore, one should extend the current model by incorporating real world expectations, be they rational or irrational" [Ishikawa et al., 2012, p. 25–26].

The European Commission's Complexity Research Initiative for Systemic Instabilities (CRISIS) is perhaps the most grandiose attempt to capture the variety of interactions

that comprise the European economic and financial system. Launched in late 2011, the project is expected to be complete by the end of 2014. A multi-organization program, CRISIS is currently developing modules that will be confederated into a "next generation macroeconomic and financial system policymaking model ... that fully accounts for the heterogeneity of households, firms, and government actors."[1] Currently under development, the CRISIS model will be a suite of tools, including an interactive game. It is projected to include multiple markets, goods, and agents by late 2013 [Farmer, 2013].

Both FMM and CRISIS seek to understand the financial system of entire countries or even groups of countries. Banking is but a part of these models. Models of banking, and specifically of bank panics, are usually based upon one of two rival theories, random factors and asymmetric information. Both theories are based upon depositors acting according to a utility function that compares the potential benefit of keeping deposits intact with the risk of losing deposits.

The random factors approach, or sunspots as it is sometimes called, argues that bank runs or panics occur for completely random reasons. This theory posits that random exogenous events cause depositors to determine that the event or events that have occurred somehow cast doubt on the viability of certain banking institutions. This results in depositors withdrawing funds from institutions without regard for the unknowable financial health of the institution because they fear that banks will have insufficient liquidity to meet demands.

Asymmetric information approaches reflect the idea that the knowledge of bank investment quality is asymmetric between the depositor and the bank. When an external shock that may reflect on the quality of a bank's investment holdings occurs - such as a drop in key asset prices like commodities, real estate, or stocks - it is not known to what extent a given bank's portfolio of investments is impacted. This can lead to a questioning of the solvency of banks perceived to be heavily invested in such assets, precipitating a generalized run on banks that may or may not have increased risk as a result of the external shock.

[1] Information regarding the CRISIS project is available at `http://www.crisis-economics.eu`.

Both approaches seek to provide explanations of how and in what way rational depositors participate in a panic. In each case depositors compare the expected return of a deposit with the expected risk of losing the deposit as a result of bank illiquidity. If the risk of loss is too high, the depositor withdraws all funds. Asymmetric information assumes some underlying truth regarding the condition of a bank and the impact of certain economic news on that bank as compared with a depositor's imperfect view of that truth. Decision making, though rational, is confused by differences between the real and the depositor's perceived risk at a given institution. In this respect the random factors theory is the same as asymmetric information approaches where the asymmetry is complete; no information is contained in the signals that depositors respond to. The specific events that cause a shift in expectations are random, yet depositors act rationally to limit potential loss of investments.

Attempts to empirically validate these theories of panic have met with limited success. Although some have claimed to have found evidence that is supportive of one theory more than another [Calomiris and Gorton, 1991] [Gorton, 1988] [Iyer and Puri, 2008], others have determined that the better explanation of the two depends on the panic being analyzed [O'Grada and White, 2003]. Some panics display attributes of both [Wicker, 2006]. Carlson's analysis of the Panic of 1893 provides a nuanced explanation of which theory appears to be operative. He argues that at the national or regional scale there appears to be some economic rationale behind the occurrence of crises and where panics in general occur. This finding supports information-based theories. However, close examination of where actual panics occur and the mechanics of such events yields significant support for the random factors explanation [Carlson, 2005].

The best known model of bank panics is that of Diamond & Dybvig [Diamond and Dybvig, 1983]. In describing the nature of the events that may change depositor confidence, Diamond & Dybvig describe the event as being of any nature, economic or not, even "sunspots", thus giving the theory its nickname. Attempts to model information asymmetries frequently begin with Diamond & Dybvig, adding features that seek to represent

rational responses to exogenous events that contain economic information that is not completely understandable to depositors. The original Diamond & Dybvig model has been extended to introduce several different features, including some information asymmetries [Bryant, 1980], asset shocks [Gu, 2011], and cross-market contagion [Allen and Gale, 2000]. In each case panics occur, i.e., agents withdraw significant amounts from the modeled banks, with some additional nuances based upon the particular addition to the basic model.

The analytic model of Diamond & Dybvig has also been used as the foundation for agent-based models. Pedro Romero [Romero, 2007] developed a model of a single bank with depositors having uniform wealth, divided between patient and impatient, as per Diamond & Dybvig. Impatient agents have a probability of withdrawing a fraction of funds at each time step. Patient agents, who can earn a greater return by leaving their deposits in the bank, then make a decision as to whether it is advantageous to withdraw now, i.e., they fear insolvency, or maintain their deposit in hopes of a greater return. Romero allows the breakpoints for patient agents to be distributed versus uniform, as is the case in the basic Diamond & Dybvig model. He also introduces social networks based on adjacency, where the decision of patient depositors to withdraw early or not is based upon observation of adjacent depositor actions. The model generates bank runs, and demonstrates that by restricting depositor knowledge to a social network the frequency of runs can be reduced, though in conclusion Romero determines that the model "does not provide anything that can be considered as a definite answer" to the cause of localized bank runs [Romero, 2007, p. 21].

The simplicity of the Diamond-Dybvig model is appealing. For specific abstract questions, the model has provided interesting insights. Stylized facts, such as "panics occur" and "panics are contagious", are reproduced in some form, with little attempt to determine if bank or depositor level results of the model are recognizable in the historical record. The model, originally developed thirty years ago, has perhaps been extended to its feasible limits. This is the conclusion of Eric Smith and Martin Shubik [Smith and Shubik, 2012], who extended Diamond-Dybvig by implementing the noise model of Stephen Morris and Hyun

Song Shin and utilizing evolutionary game theory approaches to do sensitivity analysis of both the basic and extended Diamond-Dybvig models. Smith & Shubik suggest the limits of the *homo ludens*[2] approach central to Diamond & Dybvig may have been reached. Their summary is telling, "... when confronted with items such as incomplete knowledge of the rules of the game and a multiplicity of socio-psychological phenomena to account for we are still far from understanding context and dynamics."

The common feature of many models of bank panics is the foundation in Diamond & Dybvig, with extensions seeking to integrate factors not considered in the original model, while maintaining the fundamental viewpoint that agents are calculating engines, seeking to optimize outcomes. Significant effort has been exerted to make such models meaningful in terms of understanding real banking panics, with limited success.

Sawyer [Sawyer, 2005] defines two approaches used in the agent-based modeling community, the *cognitive* and *reactive* approaches. Diamond & Dybvig is a cognitive model, positing a specific agent decision-making process focused on optimizing an individual's outcomes. What is proposed here is a reactive approach, where changes in deposit levels, customer behaviors, are driven by external events and the shared views of those in an agent's neighborhood. There is no attempt at individual optimization or calculation of a best course of action.

It has been well established that social networks impact depositors' decisions to run or not [Iyer and Puri, 2008] [Kelly and O'Grada, 2000]. It has also been demonstrated that some individuals exercise more influence than others [Iyer and Peydro, 2011]. For these reasons a network-focused approach of social behavior is indicated. Bosse et al. [Bosse et al., 2009] proposed an agent model of the emotional contagion process described in more general terms by Barsade [Barsade, 2002]. The model provides mechanisms for contagion as well as spiraling emotional levels, which have been observed in group settings [Barsade, 2002] [Frederickson and Joiner, 2002]. The BDM uses the Bosse model as an analog for

[2]Technically "Man as Player" from the sociological role of games and play in human development and social functions as first described by Huizinga [Huizinga, 1949]. In the case of Smith and Shubik [Smith and Shubik, 2012], it refers to game theoretic approaches as a means of understanding bank runs.

bank depositor actions. Consistent with social influence network theory, the emotional level of an agent is linked to the agent's actions as a depositor [Friedkin, 2010]. As agent emotion becomes more positive, a greater share of the agent's endowment is deposited. As it decreases, less is deposited. In the case of the BDM, emotional spirals and behavioral spirals are one and the same.

Objective The objective of the Bank Depositor Model is to demonstrate that bank panic-like behaviors can be achieved via a purely reactive model of heterogeneous agents connected via social network using empirically grounded data for certain data inputs.

5.2 Model Specification

The BDM follows directly from the model proposed by Bosse et al., differing in minor details, and with a model of exogenous shocks rather than the ambient agent model implented by Bosse.[3] BDM includes stochastic events that can be used to alter certain attributes of agents within the model.

5.2.1 The Bosse Model of Social Contagion

As previously mentioned, the ambient agent model of behavioral spirals [Bosse et al., 2009] consists of a collection of agents, defined with specific attributes, with a series of social connections that also have attributes. The model also defines the mechanism of emotional change. The following is a formal specification of agents, attributes and the connecting social network.

1. Define A, a set of agents. Each agent $a \in A$ has attributes:

   (a) $q \in [0, 1]$, the agent's emotion or outlook.

   (b) $\epsilon \in [0, 1]$, the extent to which the agent expresses their emotion to social contacts.

[3]The expression "ambient agent model" derives from the use of "ambient intelligence", meaning an agent-based model that is used in conjunction with a human in order to assist in an activity. In the case of Bosse et al. [Bosse et al., 2009], the model is intended to be used to achieve certain group goals in conjunction with a group interaction exercise.

(c) $\delta \in [0, 1]$, the agent's openness or sensitivity to received emotions.

(d) $\beta \in [0, 1]$, the agent's tendency to adopt positive or negative emotions.

2. Define $L = \{l_{i,j}\}$, a set of directed links, where $l_{i,j}$ denotes a link connecting agent i to agent j.

3. Each link $l_{j,i} \in L$ has strength $s_{j,i} \in [0, 1]$ which expresses the degree to which agent j's current outlook is communicated to agent i.

4. For agent a_i define $N_i = \{a_j \in A \mid \exists \text{ link } l_{j,i} \in E \text{ for } i \text{ and } j\}$ as the neighborhood of agent i, i.e., the set of agents who have links to agent i.

The attribute q, or outlook, is dependent upon the agent's other attributes and the social network within which agents are embedded. It is the fraction of agent wealth, or endowment, as defined in Section 5.2.2, that is considered deposited in the bank at a given point in time.

The attribute ϵ, or expressiveness, describes the level or degree to which an agent expresses their emotion or position. A value of 1.0 indicates an agent that expresses their opinion or outlook constantly and to everyone they connect to, a true extrovert. A value close to 0.0 indicates someone who rarely if ever communicates their views to the outside world.

The attribute δ indicates the openness of an agent to the opinions of others, as measured by the rate at which agents adopt the views of others as their own. A value of 0 indicates an agent who will not change their mind under any circumstances. A value of 1.0 indicates an agent who will quickly take a position consistent with the combined opinions of their neighbors.

The attribute β indicates the overall inclination of an agent to process and accept positive or negative emotions as expressed by neighbors. A value of 0.5 indicates an agent who interprets negative and positive positions equally. A value of 1.0 means only positive views are considered; a value of 0.0 indicates the opposite, only negative views are considered.

At each time step the model computes the change in the emotion level of an agent, q_i, based upon interaction with agents in its neighborhood, N_i. The change in q_i for a given time period t for agent i is computed as follows:

$$\frac{\Delta q_i}{\Delta t} = \gamma_i[\beta_i(1-(1-q_i^*)(1-q_i)) + (1-\beta_i)q_i^* q_i - q_i], \tag{5.1}$$

where

$$\gamma_i = \frac{\sum\limits_{j \in N_i} e_j s_{j,i} \delta_i}{\mid N_i \mid} \tag{5.2}$$

is the normalized sum of the magnitude at which a given emotional level would be received by agent i. The variable q_i^* is defined as:

$$q_i^* = \frac{\sum\limits_{j \in N_i} \epsilon_j s_{j,i} q_j}{\sum\limits_{j \in N_i} \epsilon_j s_{j,i}}, \tag{5.3}$$

and is the sum of the emotion values being transmitted to agent i, normalized by the sum of the level at which those emotions are being communicated.

Equation 5.2 differs slightly from Bosse et al. Normalizing the value by dividing by $\mid N_i \mid$ is necessary to avoid a value of $\frac{\Delta q_i}{\Delta t}$ greater than β_i.

5.2.2 Extending Bosse to the BDM

To utilize the Bosse model for the purposes of understanding bank panics requires several additions. First, the concept of endowment or wealth must be attached to agents. Second, exogenous events and their impact must be represented.

Agent Wealth

The definition of agent attributes is expanded to represent initial agent endowments. By this mechanism endowments can be heterogeneously distributed.

1. For each agent $a_i \in A$ define $w_i \in R^+$ as the endowment or wealth of the agent.
2. Define $W = \sum_i w_i$ as total wealth.
3. For each agent $a_i \in A$ and time t define $m_i(t) = w_i(t) * q_i(t)$, as the total amount deposited by agent i at time t.
4. Define $M(t) = \sum_i m_i(t)$ as the total invested by all agents at time t.

Exogenous Events

Exogenous events represent those things that may change the general outlook of an agent but lie outside of the social interactions explicitly modeled. Such events may change whether a given agent is more or less receptive to views expressed by those in their neighborhood. This is achieved by altering the value of β_i. Events take one of two forms, global or individual. Events can be either scripted, i.e., assigned a specific time and set of parameters, or generated stochastically. Individual events alter the value of β by a predetermined amount for the indicated agent. Global events are governed by the following list of parameters and are the only stochastic element of the BDM. Stochastic events have a defined start time, and remain in effect for the duration of a simulation run.

1. $E \in [0, 1]$, the probability an exogenous event will occur for any given time step. In the case of a scripted global event, $E = 1.0$ and the event has a defined time t when it will occur.
2. $min \in [-1, 1]$, the lower bound on the impact of an exogenous event
3. $max \in [min, 1]$, the upper bound on the impact of an exogenous event

4. $P_{max} \in [0, 1]$, the maximum probability that a given event will impact a given agent

BDM Pseudo Code Algorithm 1 presents a description of the implementation of the BDM, as implemented in the Python programming language. At a basic level, the model involves looping over a prescribed number of time steps. For each step, three functions are executed. First, the model assesses whether an exogenous event has occurred and, if so, evaluates the impact of the event as detailed in Algorithm 2. Second, each agent uses Equation 5.1 to compute and store their expected change in q, the agent's current emotion or outlook. Finally, all agents update their values of q. By computing all agent changes before adjusting agent outlook, simulation artifacts associated with the order of agent execution are eliminated.

5.3 Model Behavior Without Exogenous Events

The BDM model is computationally simple. The possible input parameter space is not. To develop a better understanding of the impact of a range of possible model inputs, a controlled examination of the different components within the BDM was performed. The analysis of model behavior is divided into two sections, with and without exogenous events. Unless otherwise specified the number of agents, agent endowments, and the neighborhood of each agent is the same and based on one instantiation of a small-world network generated using the following values.[4]

1. Agent radius = 5.

2. Probability a link is randomly rewired = 0.1.

3. Link strength ϵ set according to Equation 5.4, with $S_{fac} = 0.5$.

4. Agents are ordered by endowment.[5]

[4]Small-world networks are stylized representations of social networks [Watts and Strogatz, 1998].

[5]As with standard small world networks, agents are arranged in a circle. The agent with the largest endowment at the top. Successive agents, ranked by highest remaining endowment, are distributed to the left and right of the highest endowed agent until all agents are placed. The results in the agent with the smallest endowment being placed at the bottom of the circle.

Algorithm 1 Bank Deposit Model Basic Functional Description

```
1: while t < End of Simulation do
2:     #Determine the impact of scripted events#
3:     if A scripted event occurs at this time then
4:         if The event is global then
5:             p ← Scripted value
6:             C ← Scripted value
7:             Compute Global Event Impact(p, C)
8:         else
9:             C ← Scripted value
10:            for all Agents listed in the event do
11:                if C < 0 then
12:                    β_i ← β_i * (1 + C)
13:                else
14:                    β_i ← β_i + (1.0 − β_i) * C
15:                end if
16:            end for
17:        end if
18:    end if
19:    #Determine the impact of random events#
20:    if Random events are on then
21:        if U[0, 1] < E then
22:            p ← U[0, P_max]
23:            C ← U[min, max]
24:            Compute Global Event Impact(p, C)
25:        end if
26:    end if
27:    #For each agent compute the network impact as Δ_i#
28:    for all Agents a_i do
29:        Compute Δ_i using Equation 5.1
30:    end for
31:    #For each agent adjust β_i by the computed Δ_i#
32:    for all Agents a_i do
33:        β_i ← β_i + Δ_i
34:    end for
35: end while
```

Algorithm 2 Bank Deposit Model Global Impact Event Adjudication

```
1: procedure Compute Global Event Impact(p, C)
2:     for all Agents a_i do
3:         if U[0, 1] < p then
4:             if C < 0 then
5:                 β_i ← β_i * (1 + C)
6:             else
7:                 β_i ← β_i + (1.0 − β_i) * C
8:             end if
9:         end if
10:    end for
11: end procedure
```

Given the empirical findings in Section 3.2, endowments were distributed according to a Zipf distribution with exponent 1. The total endowment W was set to 200,000.

Bank customers with higher social capital have been shown to exert greater influence over agents with less such capital [Iyer and Puri, 2008]. For purposes of BDM, endowment, i.e., wealth, is used as a surroigate for social capital. Therefore, the strength of a link from agent i to agent j is computed as:

$$e_{i,j} = \frac{1}{2}\left(sgn\left(w_i - w_j\right) \left| \frac{w_i - w_j}{W_{max}} \right|^{S_{fac}} + 1.0 \right), \tag{5.4}$$

where the scaling factor S_{fac} determines the degree to which the difference between endowment values is emphasized and W_{max} is the maximum agent wealth of all agents for the scenario.[6]

5.3.1 Steady States - Equilibria

Without exogenous events, the model converges to a steady state after a limited nmber of time steps. In limited cases this can be demonstrated directly from the model's definition. Equation 5.1 shows that for an agent with $\beta = 1$, $\frac{\Delta q_i}{\Delta t} \geq 0$, and is equal to zero only when all agents in the neighborhood have $q \equiv 0$. System-level steady states can be shown to occur when $\beta_i \equiv \beta$ for some β, and $q_i \equiv q$ for some value q. Under these assumptions the following can be shown to be true:

1. If $\beta = 0.5$, the system is in a steady state, $M(t) \equiv k \ \forall$ time t.

2. If $q = 0.0$ or 1.0, the system is in a steady state, $M(t) \equiv 0.0$ or $W \ \forall$ time t.

3. If $\beta < 0.5$, then $\forall i, q_i \Rightarrow 0.0$ over time, $M(t) \Rightarrow 0.0$ over t.

4. If $\beta > 0.5$, then $\forall i, q_i \Rightarrow 1.0$ over time, $M(t) \Rightarrow 1.0$ over t.

[6] If $S_{fac} = 0$, all link strengths $= 1/2$. At a value of 1.0, link strength is a linear function of the differences, where links of equal strength are of strength $1/2$, and links connecting the largest endowment with the smallest are approximately 0.0 and 1.0, depending on the direction of the link.

Although a formal proof is not provided, anecdotal evidence suggests that with any set of initial parameters, the model converges to a steady state after some number of time steps.[7] For the input data sets used in this analysis, this occurs between $t = 250$ and $t = 2{,}000$.

5.3.2 Nonmonotonic Convergence

An additional observation regarding the overall behavior of the system is that convergence is not always monotonic. As shown in Figure 5.1, Case 5 converges monotonically, whereas Case 4a reaches a value of approximately 122,000, then returns to stabilize at 121,788.[8]

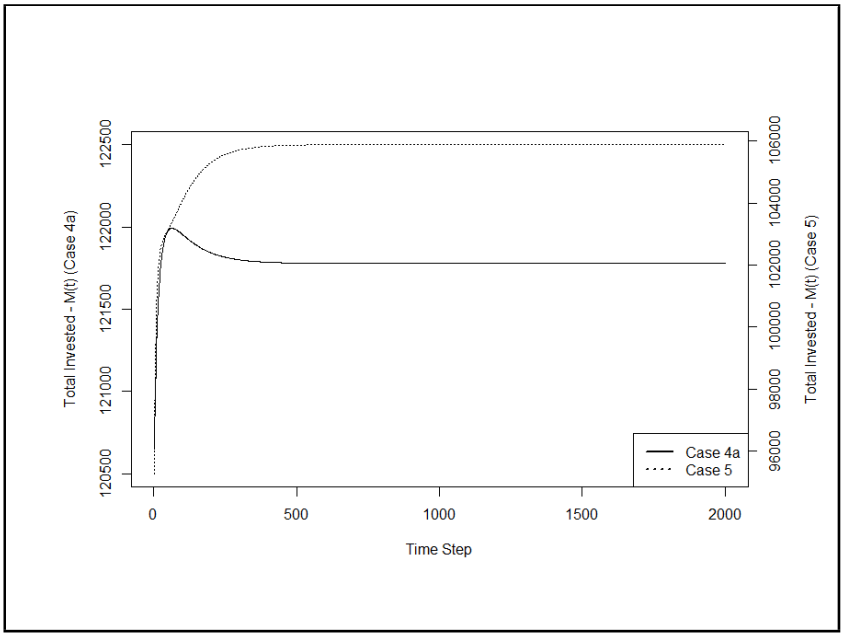


Figure 5.1: Convergence Without Exogenous Events

[7] If $\delta = 0$ for all agents, no contagion can exist, so the model does not change. Other such pathological examples exist but are not examined here.

[8] The cases presented are simple examples used as model test cases. Case 4a used $\beta \equiv 0.5$, Case 5 used $\epsilon \equiv 0.5$. Both used $\delta \equiv 1.0$. Other agent attributes were uniformly distributed over the interval [0.25, 0.75].

5.3.3 Convergence Value Is Invariant With Respect To Initial q Values

The first agent attribute examined was q, the initial outlook or emotional value for an agent. A series of model runs were executed based upon the following attribute settings:

1. Values for the attributes β, ϵ, δ, and q were generated from a uniform distribution $U[0.2, 0.8]$.

2. Two such samples were generated for the attributes β, ϵ, and δ.

3. Three samples were generated for q.

This defines 24 possible combinations of parameter settings. For each combination, 5 iterations were executed for 5,000 time steps, a total of 120 iterations of the model. Cumulative bank balances M were reported every 20 time steps.

For a given combination of β, ϵ, and δ, the value to which the model converges was identical for each of the three initial settings for q and for each of the 5 iterations. Hence the equilibria for the model without exogenous events is invariant with respect to the initial values of q.[9] This finding reduces the search space by an order of magnitude.

5.3.4 Conclusion

Without exogenous events, the model converges to some value, normally within less than 1,000 time steps. This is consistent with the concept that without new information to alter an agent's views, a constant emotional level, and therefore behavior, should exist.

5.4 Model Behavior With Exogenous Events

Three different mechanisms will be used to describe the results of model tests: graphs of the value of $M(t)$ for a model run, graphs of the log(growth rate of $M(t)$) vs. log(frequency)

[9] As previously noted, certain pathological initial values for q can make this finding false, such as $q_i \equiv 0$ or $1 \; \forall \; i$.

distribution for a given run, and a summary of the values of σ and μ of the distribution [Perline et al., 2006].[10]

5.4.1 Agent Attributes

Further investigation of the impact of initial agent parameter settings on model outcomes were performed using a limited parameter sweep. Values for the agent parameter q were selected from one of the randomized settings used in the previous section. For the remainder of the agent parameters, six settings were defined, using three different uniform distributions and two samples from each distribution. Section 5.3.1 demonstrates that having values of β strongly biased below or above 0.5 can lead to an equilibria state of 0 or W_{max}. Therefore all tested values for β are assumed to have a mean of 0.5. They are specified as follows:

1. $\beta \in U[0.4, 0.6], U[0.3, 0.7], U[0.2, 0.8]$, with corresponding indices $i = 1, 2$ and 3.

2. ϵ & $\delta \in U[0.4, 0.6], U[0.2, 0.8], U[0, 1]$, with corresponding indices $i = 1, 2$ and 3.

This defines 6 initial settings for each of the three attributes to be examined, thus resulting in 216 possible permutations. For brevity, a given set of input parameters is specified using a double subscript. For example, $\beta_{1,2}$ refers to the second sample of the first parameter setting for β, i.e. $U[0.4, 0.6]$.

A stochastic process is used to represent the near continuous flow of information to depositors. To examine the impact of agent parameter settings on model outcomes, exogenous events were generated using the following values.

1. $E = 0.1$, the probability an event will occur during a given time step.

2. min = -0.1, $max = 0.1$. If an event occurs, the impact on affected agents C = U[-0.10, 0.10].

3. $P_{max} = 0.1$, the probability an agent will be impacted by the event.

[10] For convenience the log(Growth Rate) v. log(frequency) histogram will be referred to as the growth rate histogram or growth rate plot.

The model was run for 2,000 time steps before events occurred, thus allowing the model to stabilize at its equilibria. Exogenous events were allowed to occur over a period of 25,000 time steps, with results *M(t)* reported every 20 steps. Three iterations per scenario were executed to determine the impact of changes in the random number stream. Results were analyzed by plotting the log(Growth Rate) v. log(frequency) histogram, examining how this plot compares with the findings detailed in Section 3.3.2.

Example of Model Outputs Figure 5.2 shows the output of four model runs selected from two different initial agent parameter cases, for two different random number seeds. Both cases are initialized using $\beta_{3,1}$ and $\epsilon_{2,1}$. Case 1 uses $\delta_{1,2}$ and Case 2 uses $\delta_{3,2}$. For each case the random streams are identical.

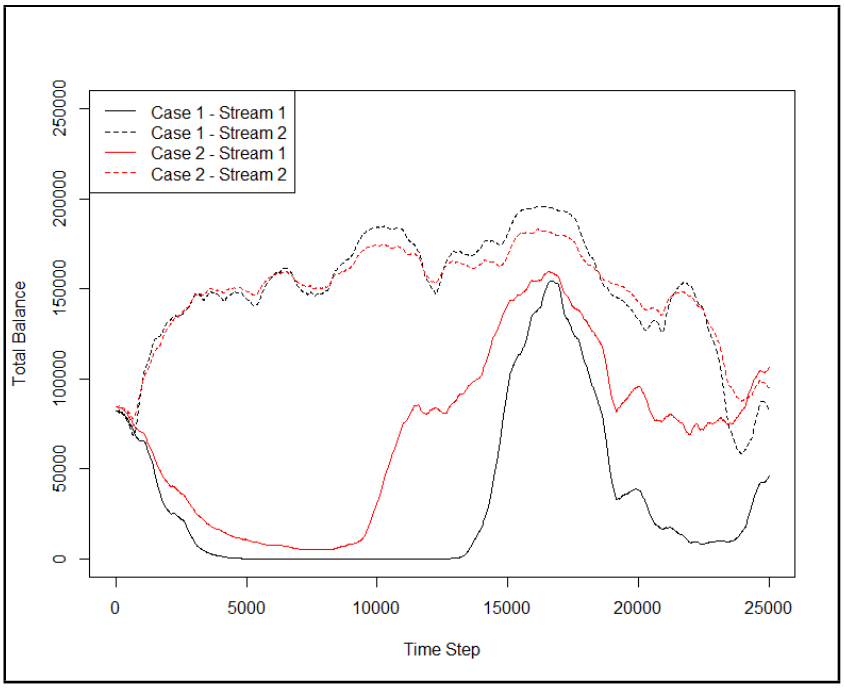


Figure 5.2: Model Output, Two Cases, Two Random Streams

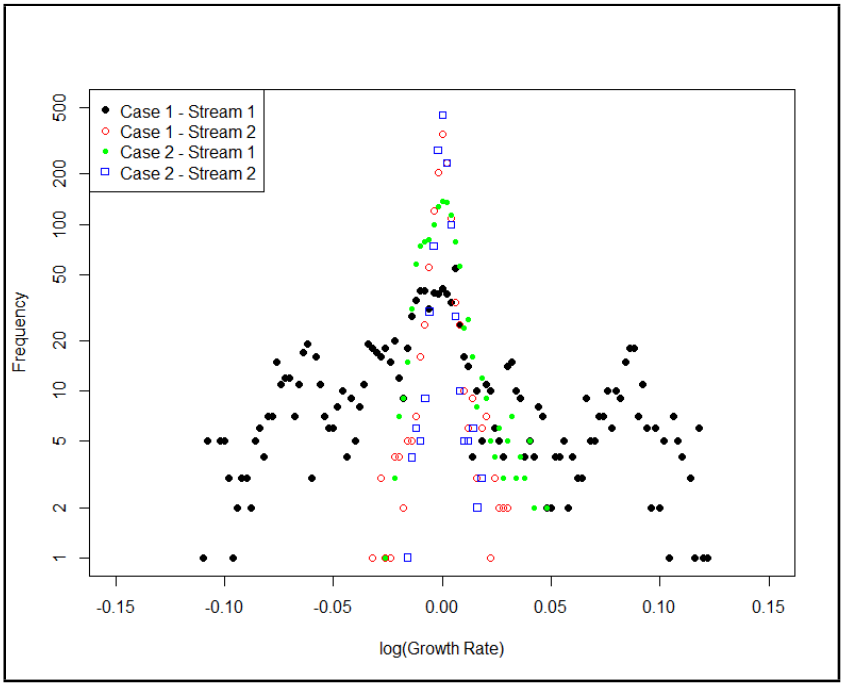


Figure 5.3: Growth Rate Frequencies, Two Cases, Two Random Streams

The similarity of outcomes for the different cases using the same random number stream is apparent. This reflects the fact that all agents are impacted in the same way by the same events from case to case. For the second random stream, the agent parameter cases have more significant impacts. It should also be noted that in Case 1, Stream 1, the value $M(t) \approx 0.0$ from $t \approx 5000$ to $t \approx 13{,}000$.

Figure 5.3 shows the growth rate plot for the four runs. Note that for Case 1, Stream 1, the variance is quite large. This is a result of the small values of $M(t)$ when the model converges to 0.0 between time 5000 and 13,000. The value $M(t) < 1.0$ between $t = 6280$ and $t = 11{,}500$, where most of the significant growth rates occur. This suggests that when $M(t) \to 0.0$ the growth rate frequency histogram will have very large variances.

Finally, we can examine the mean and variance of the logarithm of model growth rates [Perline et al., 2006]. Table 5.1 shows the computed values of μ and σ for the four runs. Again, the visual evidence for Case 1, Stream 1, in Figure 5.3 is confirmed by the much larger value of σ as compared with the other values of σ.

Table 5.1: μ and σ for Different Model Runs

	Case	Stream 1	Stream 2
μ	1	-0.000458	-0.000019
	2	0.000195	0.000075
σ	1	0.049443	0.005768
	2	0.009928	0.003395

Table 5.2: Impact of δ on Model Outcomes

		Distribution of δ		
	Sample	U[0.4, 0.6]	U[0.2, 0.8]	U[0, 1]
μ	1	-0.000807	-0.002392	-0.000038
	2	-0.001803	-0.001417	0.000187
σ	1	0.052442	0.043795	0.008966
	2	0.021036	0.017560	0.008414

Examining the impact of the different agent attributes will be performed by examining the comparative changes in μ and σ similar to Table 5.1 as well as a visual examination of the model growth rate plots, as illustrated in Figure 5.3. The random number stream used for the stochastic events is identical for all runs presented.

Impact of Agent Attribute δ Values of δ were analyzed for a fixed instance of β and ϵ settings, in this example $\beta_{2,1}$ and $\epsilon_{3,1}$.[11] Summary results of the 6 runs are presented in Table 5.2. The values for σ are inversely proportional to the range of δ. Such results are consistent with the role of δ in governing the rate of contagion between agents. Smaller values of δ make agents more immune to contagion as compared with those agents with larger values. If values are allowed to get close to 0.0, the immunity is complete; agents never change their outlook no matter what events transpire or what views are expressed by their neighbors.

Figures 5.4 and 5.5 show the growth rate plots for the instances summarized above. In Figure 5.4 the plot shows the impact of the convergence of the model to zero in two of the three distributions of δ. This was previously reflected in the computed values of σ for

[11] $\beta_{2,1}$ corresponds to the second set of β parameter settings (U[0.3, 0.7]), instance 1, and the third value of ϵ settings (U[0, 1]), instance 1.

these runs. The third run conforms to the Symmetric Subbotin distribution with shape parameter $\alpha = 2.0$, indicating a Gaussian distribution.

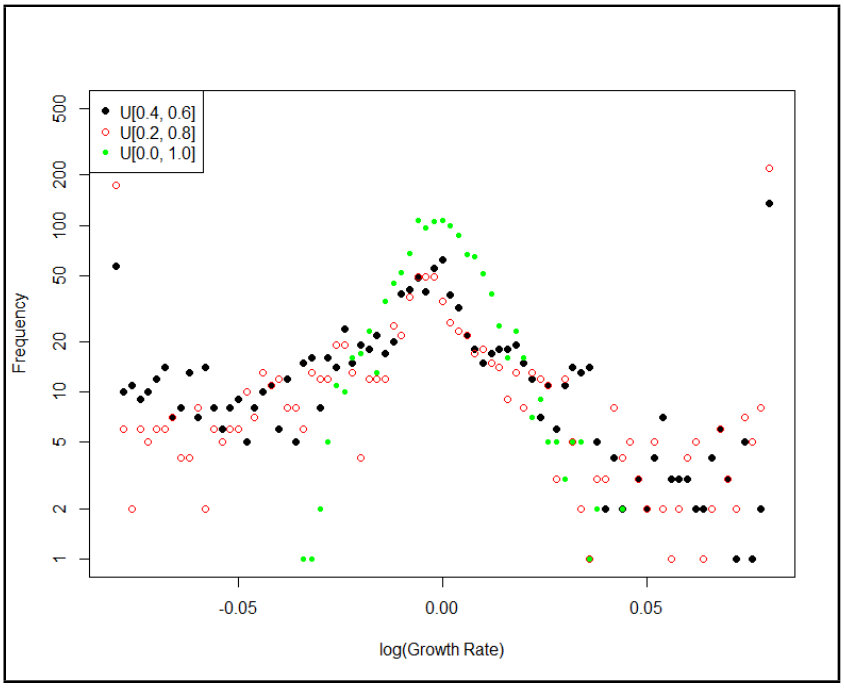


Figure 5.4: Impact of Values of δ, Sample Set 1

Figure 5.5 the shows less variance in all three choices for distribution of δ, and indicates that at no time did $M(t) \to 0.0$. The third distribution, where δ values are allowed to be close to 0.0, again shows the Symmetric Subbotin distribution with $\alpha = 2.0$. In the other cases can be seen is a much sharper crest to the distribution, with the points to either side being symmetric and linear. This implies an α value near 1.0, indicating a Laplace Distribution.

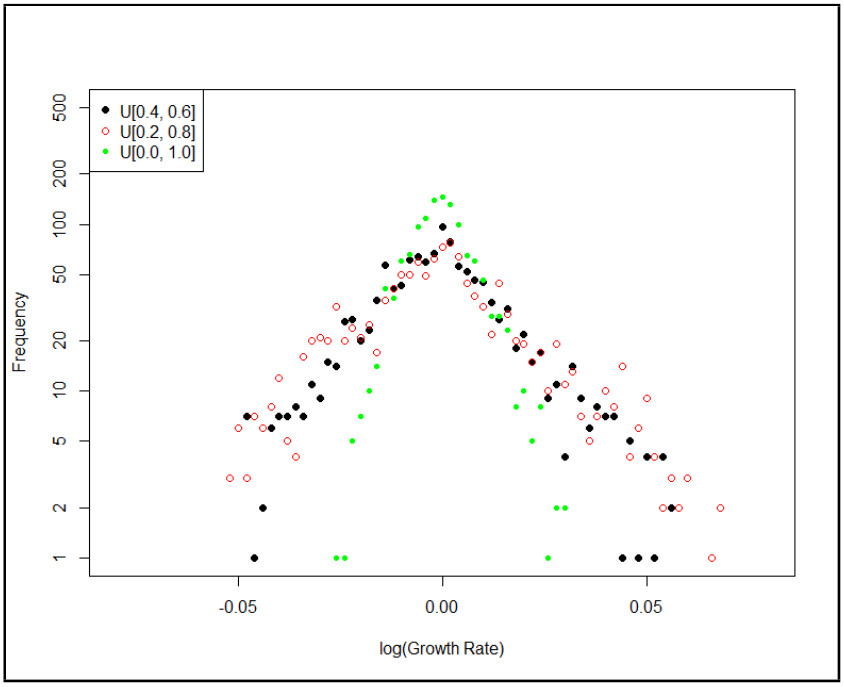


Figure 5.5: Impact of Values of δ, Sample Set 2

Table 5.3: Impact of ϵ on Model Outcomes

		Distribution of ϵ		
	Sample	U[0.4, 0.6]	U[0.2, 0.8]	U[0, 1]
μ	1	0.000195	-0.000037	-0.000050
	2	-0.000162	-0.000035	0.000034
σ	1	0.009928	0.009264	0.010425
	2	0.010163	0.011163	0.010894

Impact of Agent Attribute ϵ Values of ϵ were analyzed for a fixed instance of β and δ settings, in this example $\beta_{2,1}$ and $\delta_{3,2}$.[12] Summary results of the 6 runs are presented in Table 5.3. There is little correlation between the variance of the values of ϵ and the values of μ and σ. This suggests that the impact of this parameter is less important than the impact of the setting for δ.

Figures 5.6 and 5.7 show the growth rate plots for the instances summarized above. In both figures the model does not converge to either boundary point. Results for all 6

[12]The second set of β parameter settings (U[0.3, 0.7]), instance 1, and the third value of δ settings (U[0, 1]), instance 2.

runs show a clear asymmetry, with the left, or negative growth, regime showing behavior comparable with the generalized Subbotin distribution with $\alpha \approx 2.0$. The right side, or positive growth regime, displays characteristics of Subbotin distributions with $\alpha < 1.0$.

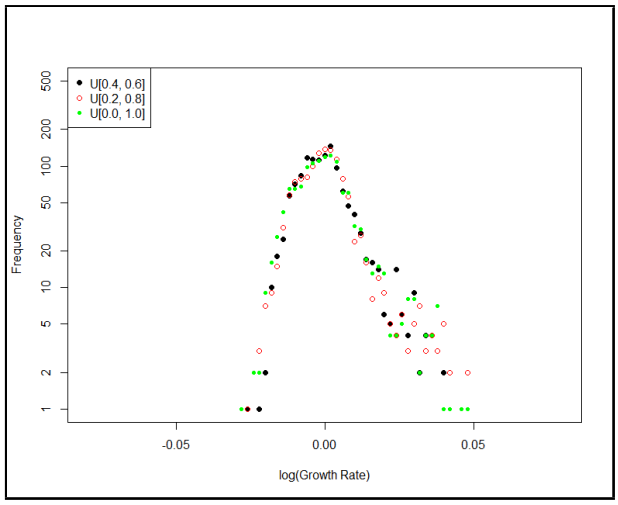


Figure 5.6: Impact of Values of ϵ, Sample Set 1

Impact of Agent Attribute β Values of β were analyzed for a fixed instance of δ and ϵ settings, in this example $\delta_{3,2}$ and $\epsilon_{3,1}$.[13] Summary results of the 6 runs are presented in Table 5.4. The values for μ and σ are in general inversely proportional to the range of β, though the differences are minor, especially in comparison to the role of δ previously described.

Figures 5.8 and 5.9 show the growth rate plots for the instances summarized above. The results are similar to those found by varying ϵ.

[13] $\delta_{3,2}$ corresponds to the third set of δ parameter settings (U[0.0, 1.0]), instance 2, and the third value of ϵ settings (U[0, 1]), instance 1.

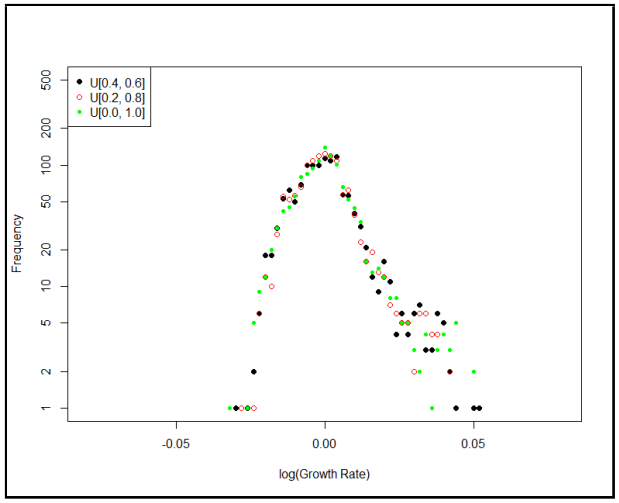


Figure 5.7: Impact of Values of ϵ, Sample Set 2

Table 5.4: Impact of β on Model Outcomes

		Distribution of β		
	Sample	U[0.2, 0.8]	U[0.3, 0.7]	U[0.4, 0.6]
μ	1	0.000187	-0.000285	-0.000263
	2	0.000195	-0.000338	-0.000424
σ	1	0.007029	0.012549	0.011870
	2	0.009928	0.007927	0.012935

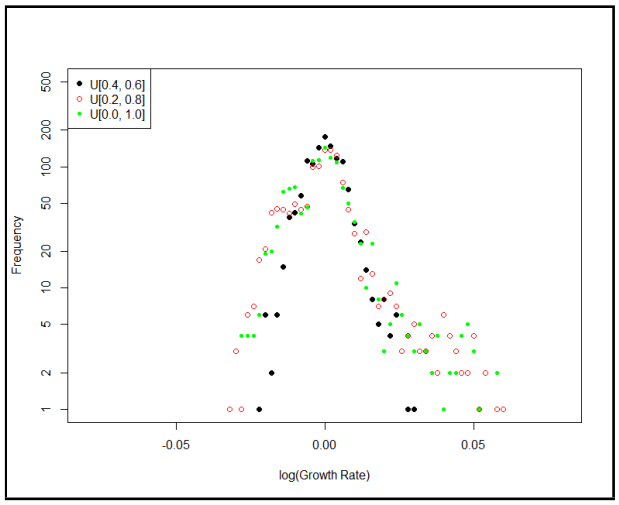


Figure 5.8: Impact of Values of β, Sample Set 1

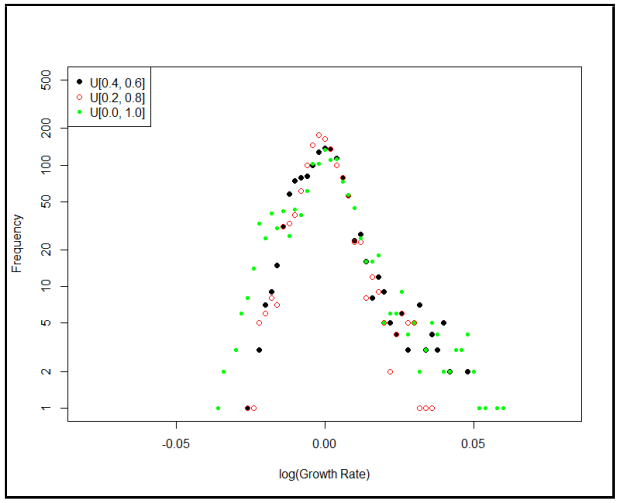


Figure 5.9: Impact of Values of β, Sample Set 2

5.4.2 Conclusions

Agent attributes provide a wide range of outcomes, with great sensitivity to the exogenous event stream. The impact of each attribute is as would be expected given the attribute definitions. This flexibility, and intuitive behavior, suggests that, with some significant empirical data development, sample scenarios could be developed to allow a mapping between empirical results and attribute settings.

5.5 Impact of Social Network on Model Behavior

5.5.1 Impact of Link Strength

Link strength models an agent's ability to communicate their position to those they are connected to. In all scenarios examined to this point, the strength of the links between nodes was computed using Equation 5.4, with $S_{fac} = 0.5$. The symmetry of Equation 5.4 means that if agents i and j are in each other's neighborhood, then $e_{i,j} + e_{j,i} \equiv 1.0$. Figure 5.10 illustrates the impact of changing the way in which link strength is defined. Illustrated are results of three methods: using Equation 5.4, setting all link strengths to 1.0, and randomly distributing link strengths over the unit interval. Although the general shape of

the outputs track well, there are points where the network makes a significant difference. For the first random stream, at $t = 10{,}860$ the value of M is more than 80% greater in the proportional case versus the constant case (121,979 versus 66,847). Link strength appears to play a less significant role in terms of general shape, but can make a difference in the extremities for given overall system movements.

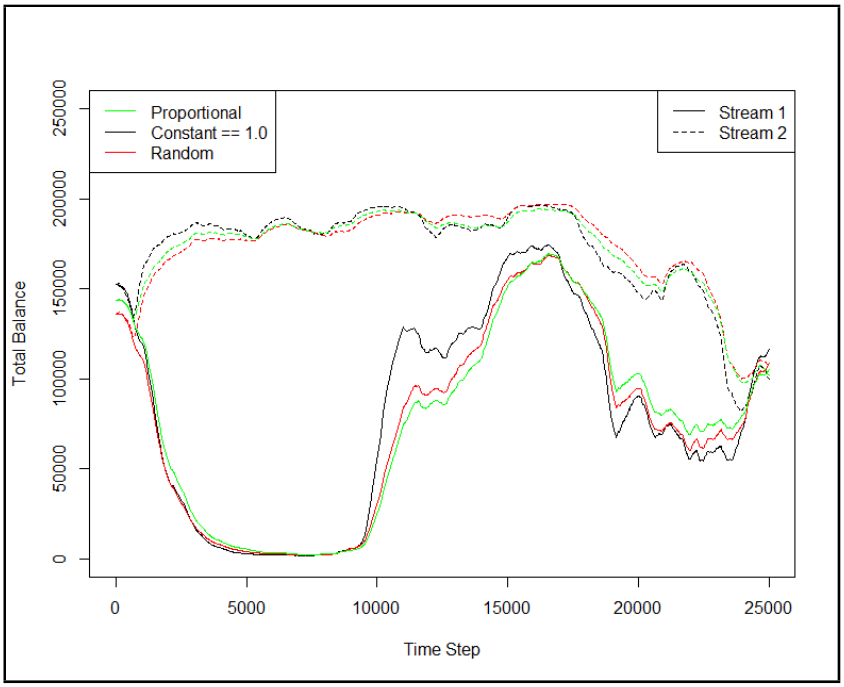


Figure 5.10: Impact of Link Strength (Solid v. Dashed for Different Streams)

5.5.2 Impact of Network Structure

To compare the impact of network structure, the base scenario from Section 5.5.1 was used as a starting point. The connections between nodes were altered in two different ways. In Variant 1 the order of the nodes in the small world was random (versus ordered by endowment as in the base scenario). Other small world parameters remained the same,

Table 5.5: Impact of Network Topology on Outcomes

Statistic	Scenario	Iteration Number 1	2	3	4	5
μ	Baseline	-0.000285	-0.000279	-0.000432	-0.000940	-0.000013
	Random Order	-0.003457	-0.000115	-0.001467	-0.027251	0.000584
	Random Links	-0.000397	-0.000026	-0.000892	-0.001608	0.000123
σ	Baseline	0.012549	0.002450	0.006102	0.011799	0.003817
	Random Order	0.035245	0.006558	0.017649	0.028585	0.010231
	Random Links	0.012244	0.002040	0.007247	0.010518	0.004047

with connection radius = 5 and the probability of rewiring a link set to 0.1. Variant 2 uses a network where the 10 links for each agent are randomly assigned. In both variants agent attributes were identical to the base scenario and link strength e was computed in the same way as the baseline, using $S_{fac} = 0.5$.

Results of five iterations of each scenario are presented in Table 5.5. Of the three network topologies, the Baseline and Random Links are most similar. Randomly ordered agents in a small-world topology results in significant increases in the values of σ as compared with the other topologies, on the order of two to three times greater. This suggests a higher sensitivity to the random exogenous events. In all but one case the value of μ is further from 0.0 in the Random Order iterations than for the others.

Examination of detailed outputs for a fixed iteration confirms these findings. The log growth plot shows the structural difference in outputs indicated by the summary statistics. Figure 5.11 shows that in the baseline and random links cases, the distribution is slightly asymmetric, approximating a Laplace distribution ($\alpha = 1.0$). With randomly ordered agents in a small world setting, the same agents with the same events generate an asymmetric growth rate distribution with fatter tails and concave shape, approximating a Subbottin distribution ($\alpha < 1.0$). The output of Iteration 2 is presented in Figure 5.12. The three cases move in similar ways, with the Random Order case beginning from a stable point about half the value of the other two scenarios and showing far greater sensitivity to the same exogenous events.

Results of these limited tests suggest network topology has a significant impact on

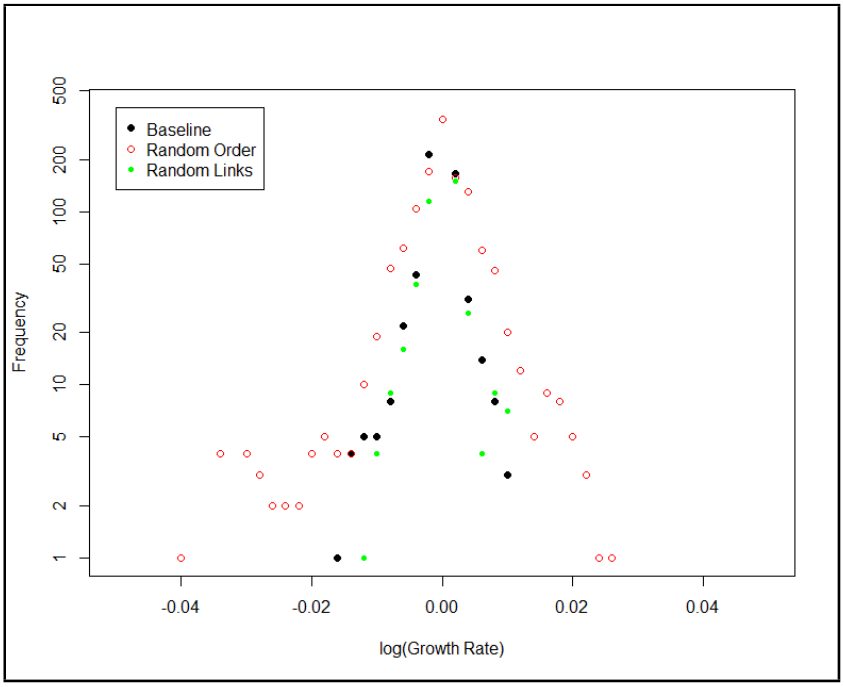


Figure 5.11: Impact of Network Topology on Growth Rates (Iteration 2)

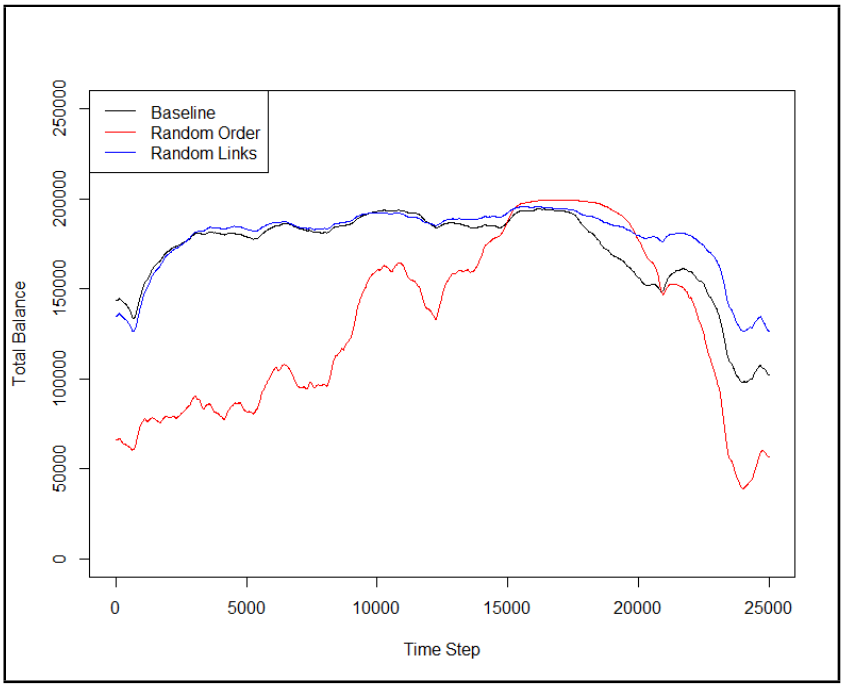


Figure 5.12: Impact of Network Topology on Total Invested (Iteration 2)

outcomes and is relevant to the fragility of the system. It also has a significant impact on the initial stable values of the system.

5.6 Impact of Exogenous Events

In previous sections a fixed stream of exogenous events was used to stimulate changes in the BDM. In this section the impact of changes in the exogenous event stream will be analyzed.

5.6.1 Impact of a Single Event

More complex exogenous events are composed of single exogenous events, generated either stochastically or scripted over time. The impact of a single event is shown in Figure 5.13. The impact of contagion over the network can be seen in the change in the amount invested from the stable value. Only 10% of agents had their β value changed by 20%, yet the total amount invested changes by more than 20% of the amount invested at the time of the exogenous event. This demonstrates that the impact of contagion, as well as the impact of the random process on agents, can be far greater than the simple changes made to an agent as a result of the event.

5.6.2 Impact of Stochastic Events

Previous sections examined the impact of each of the different types of inputs to BDM using the same stream of exogenous events. To examine how changes in the event stream impact agents, and their cumulative behavior, a series of excursions were performed using the baseline data set from the previous section. Table 5.6 describes the cases examined. Case 1 describes an exogenous event stream where events occur every time step, with only 1% of agents expected to be affected. Each case reduces the probability of an exogenous event by a factor of 2, while doubling the probability the event will impact a given agent. The expected number of agents altered due to events remains constant for all 5 cases. It is important to remember that for any given event, all agents that are affected by the event will be changed using the same value, drawn from between $[min, max]$. For this reason it

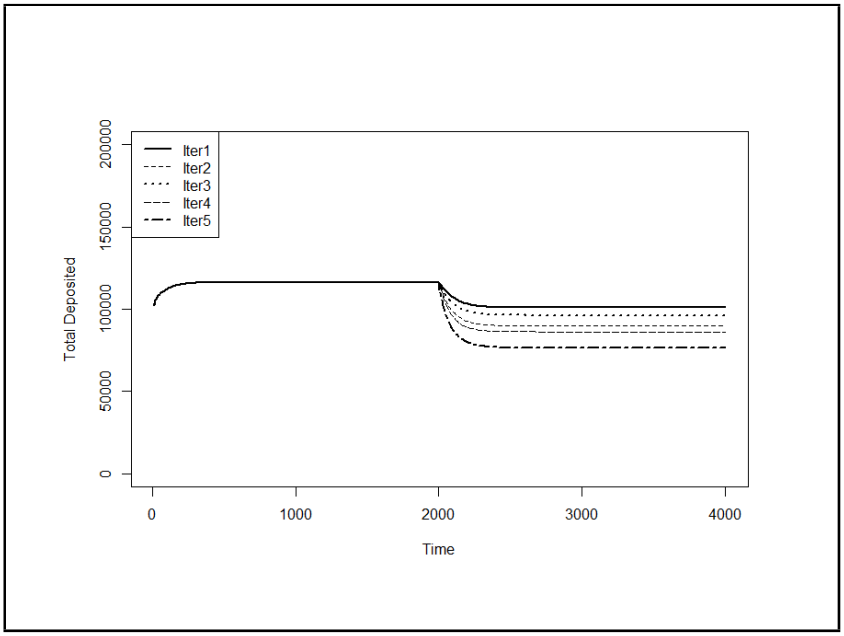


Figure 5.13: Impact of a Single Exogenous Event

is expected that the cases with lower values of E and greater values of P_{max} will have less frequent but larger changes in depositor behavior.

Table 5.6: Exogenous Event Cases

Case	E	P_{max}	min	max
1	1.0	0.01	-0.1	0.1
2	0.5	0.02	-0.1	0.1
3	0.25	0.04	-0.1	0.1
4	0.125	0.08	-0.1	0.1
5	0.0625	0.16	-0.1	0.1

Results for Iteration 1 are presented in Figures 5.14 and 5.15.[14] Visual comparison of Case 1 (black solid line) and Case 5 (purple dashed line) demonstrates the two extremal

[14]To avoid already cluttered graphics only Cases 1, 3, and 5 are presented in the growth rate plots. The general findings are not altered by excluding Case 2 and Case 4.

behavior points. In Case 1 there is little significant variation, with a total range of system change of approximately $70,000. In Case 5 the range goes from near maximum, $200,000, to near $0. Events are far less frequent in Case 5 (this can be seen by observing the smoothness of the Case 5 plot as compared with Case 1) but have much more significant impact. Examining the growth rate plot in Figure 5.11 shows the increased variance in growth rates from Case 1 to Case 3 to Case 5. Comparing the results with the standard form for such distributions shows an inverse relationship between the case number and the value of α [Perline et al., 2006, p. 12].

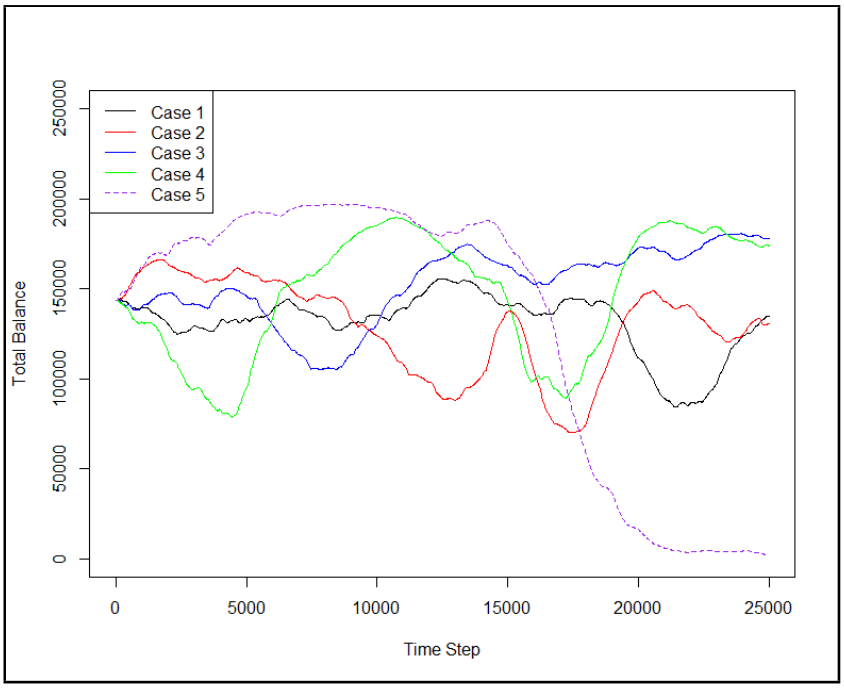


Figure 5.14: Impact of Exogenous Event Streams on Model Outcomes - Iteration 1

Iteration 2 model outcomes, shown in Figure 5.16, show a similar correlation of case number with extreme values, though not as significant as in Iteration 1. For this iteration Case 1 has a relatively small range of values, in this example less than $25,000. Case 4 and

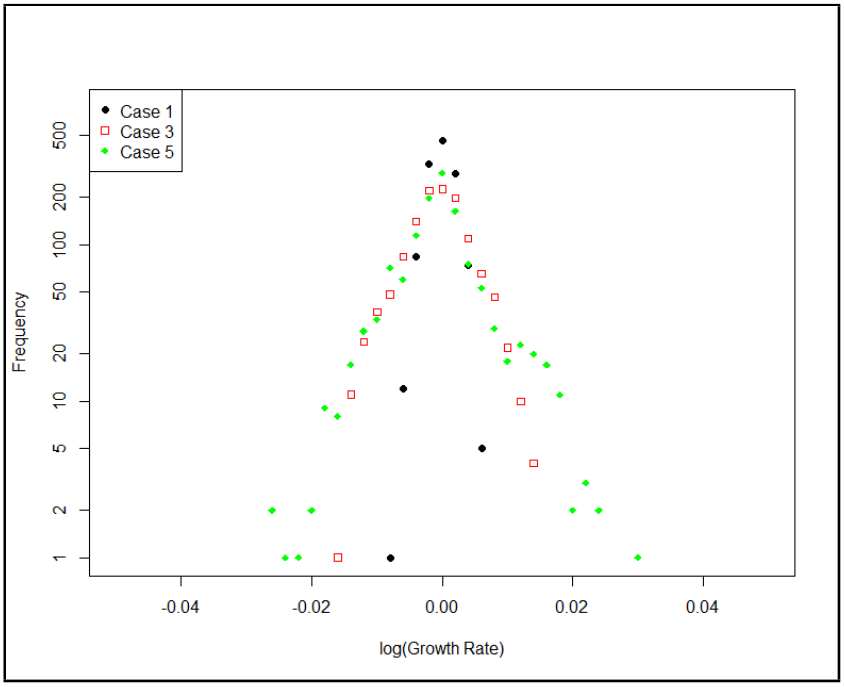


Figure 5.15: Impact of Exogenous Event Streams on Growth Rates - Iteration 1

Case 5 also have a similar range of values. Figure 5.17 shows growth rate plots for Case 1, 3, and 5. Again, the variance is proportional to the case number, with Case 5 showing even greater asymmetric behavior than in Iteration 1.

The exogenous event stream is a critical component of the BDM. As was demonstrated, events can result in greater or lesser variance in outcomes and growth rates. Utilizing the stochastic event stream as well as the ability to script individual events provides the ability to model empirical events, such as those developed as part of the econometric analysis of Chapter 4. Overlaying such events on a stream of stochastically generated events, perhaps as a substitute for the day-to-day changes in depositor cash needs, would provide a realistic, empirically grounded event stream for use with agent networks.

5.7 Conclusions

Attempts to build a rational, cognitive model of human behavior that yields systemic results associated with bank panics have been of limited success. Cognitive models of bank panics,

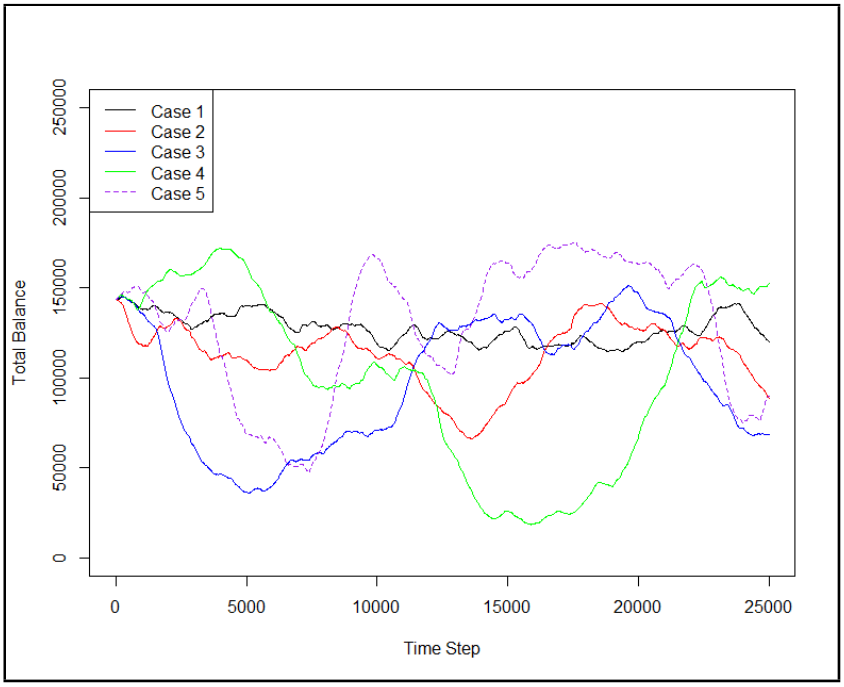


Figure 5.16: Impact of Exogenous Event Streams on Model Outcomes - Iteration 2

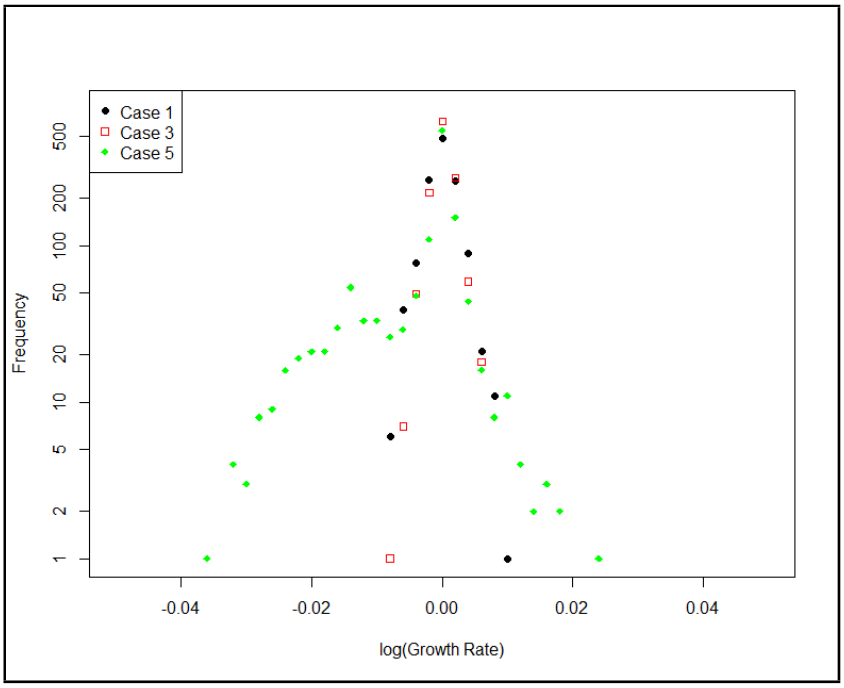


Figure 5.17: Impact of Exogenous Event Streams on Growth Rates - Iteration 2

primarily developed as excursions from Diamond & Dyvig, have been shown to have limitations [Smith and Shubik, 2012]. What appears to be lacking is consideration of financial systems that arise, are structured by, and are part and parcel of, social systems.

The objectives set forth for the BDM were quite limited: Demonstrate that a reactive model based on psychosocial research and with empirically justified endowment distributions can exhibit panic-like behavior similar to that of existing cognitive models and can additionally demonstrate behavior not seen in cognitive models derived from Diamond & Dybvig, i.e., growth rate distributions fitting the empirically demonstrated fat-tailed distributions of Section 3.3.2. This approach was intentionally chosen as a strategy in some ways opposite that of the prevalent cognitive approach. It is not suggested that it is more realistic, simply that it exhibits behaviors that have not been documented to be found in cognitive models. The current model does not reflect any actual economic activitiy that may require depositors to use the endowments they have invested. Such shortcomings are obvious, and require moving from the purely reactive approach into the middle ground, a combination of cognitive and reactive.

Chapter 6: Conclusions

6.1 Summary of Findings

The essays presented provide perspectives on the Panic of 1893 from an empirical point of view. It is a transdisciplinary view of banking and panics, ranging from historical analysis to econometrics to agent-based modeling. The vast data archives of the Montana Historical Society Research Library provide the foundation to achieve this goal.

The Panic of 1893 was a seminal event in U. S. history, centrally situated during the shift from the narrative of a country with limitless frontier and possibilities, to one of expanded urbanization and industrializtion. Montana was one of the final frontiers, where mining boom towns combined with ranching and open spaces. Banking in Montana reflected this last frontier mentality. Bankers played fast and loose with the rules, with little regard for toothless regulators in far-off Washington. However, the Panic of 1893 made the connections between Helena and Washington clear. The silver movement, a prominent feature on both the local and national scene, was shown to be at the heart of political discourse. It was also at the heart of Montana's economic engine. As the economic crisis progressed, the wealth of the banks in Helena was demonstrably fragile. Years of mismanagement by the largest banks in Helena resulted in a lack of flexibility and a lack of resources to fall back upon. The Painc of 1893 would serve as a prelude to an even more devastating period, where more than two-thirds of Helena national banks, and bank resources, dissolved permanenetly.

From the wreckage of the banks in Helena came a vast archive of detailed banking information. The capture of some of this information forms the core of the quantitative arguments made. The results can be divided into two broad categories, those involving customers of the banks and those that describe each bank as a whole. Customers of the banks in Helena were diverse, ranging from small savers to wealthy financiers. The amounts

they invested in savings at the banks were also extremely varied. The impact of a handful of large depositors far outweighed the impact of the far greater number of small depositors, the distribution being fat-tailed. Although women controlled far less wealth than men, their wealth was distributed in a similarly unequal fashion. It also shows that the economic pressure on Helena banks was not uniform and was not from a single cause. Deposit levels dropped, sometimes significantly, but in a progressively worsening manner versus a precipitous manner.

The high-resolution data is also useful in doing formal statistical analysis. Perfect rationality suggests that depositors have perfect knowledge of the condition of banks. If a bank's assets were impaired, depositors would move deposits to an institution that is deemed more safe. At the opposite end of the spectrum lie random factors, where depositors still fear bank insolvency, but the ability to determine the status of bank assets is nonexistent. Between these two points lie asymmetric information theories, which suggest imperfect, but rational, understanding of bank asset values. Under perfect information, structural intervention is unnecessary, and in fact harmful. Under less than perfect rationality, intervention may be necessary in order to minimize damage to sound institutions. Evidence of bank-to-bank contagion, controlling for economic signals such as asset price declines, is evidence of less than perfect information. It is shown that in the case of Helena in the early 1890s, depositors withdrew funds based on news of bank problems in other parts of the country. It is also shown that withdrawals from one Helena bank were not associated with deposits in another. Therefore depositors did not simply switch deposits from a bank deemed risky to one considered more safe. These findings provide evidence of significant information asymmetries.

Under assumptions of economic rationality, models of bank depositors can generate panic-like symptoms, but do not in general reflect the findings of empirical analyses. Eliminating the assumption of economic behavior, and substituting psychosocial mechanisms as the primary means of depositor action, is the central argument of the Bank Dpeositor Model (BDM). The BDM can be shown to not only generate panics, but also reflect more

detailed structural findings, such as fat-tailed total deposit level growth rates. The design of the BDM also allows for more complex representations of depositor endowments and behaviors than is admitted in models based upon Diamond & Dybvig's random factors model of panic.

6.2 Further Research Questions

The results of these detailed investigations have been shown to be useful in a range of academic disciplines including historical, eocnometric, and agent-based modeling analyses. Several interesting areas of research can be addressed by further exploration of the data and models developed in the essays presented.

Were the banks of Helena zombie banks or was the outcome for Helena preordained by economic events? By 1897 Helena banking had been reduced by orders of magnitude. This result was accompanied by a significant decline in mining activities in and around Helena. Meanwhile mining in nearby Butte increased greatly. Given the challenges of the local economy, and the fact that Helena bankers had long operated in a way deemed imprudent, or even illegal, by the standards of the time, was the collapse of Helena banking the result of economic factors, simple boom and bust, or was it the result of malfeasance and mismanagement on the part of Helena bankers? Such findings would support the role of regulatory and enforcement measures for banking authorities.

Addition of other banks for which detailed records exist – It has recently been discovered that detailed records for 1st National Bank of Butte have been preserved. Such records can be used to extend the findings contained in these essays, examining the role of contagion, and determining whether the structural features established via quantitative analysis hold for banks outside of Helena.

What can be learned from a detailed analysis of the actions of depositors during the Panic of 1893? Through a laborious process, the actions of time certificate deposits has been coded for Merchants' National Bank. It is known that time certificate deposit levels declined over a period of months, and that the declines often correlated with news of bank failures in

other parts of the country. These 4,000+ records can also be analyzed to determine who responded in what way during this period. Such data also exists, but has not been coded, for the much larger 1st National Bank of Helena. Detailed analysis of such records would provide significant insight into the actions of depositors during the crisis, and whether these actions are correlated with specific features, such as social network, profession or gender.

Examination of the structure and impact of corresponding bank relationships – Inter-bank deposits, corresponding bank balances, were shown to have played a critical role in the fragility or resilience of Helena banks during 1893. It has also been argued that the network of deposits between country and reserve banks provided a mechanism for economic challenges to spread from one region to another [Sprague, 1910]. Detailed analysis of the records in Helena, not to mention Butte, would provide evidence for the role of such deposits not only in the suspension of 12 Montana national banks during 1893, but also the impact of country banking on reserve and central reserve banks. It is also known that during the days preceeding the final suspension of 1st National Bank of Helena, corresponding deposits in the amount of nearly $150,000 from 1st National of Butte were withdrawn [1st NB Records, Vol. 16, p. 26]. Clearly the bankers in Butte were informed of the fragility of the Helena bank. Other corresponding banks had significant deposits frozen when 1st of Helena suspended 2 days after 1st of Butte pulled their funds.

Expansion of the BDM – As presented, the BDM has only one bank. Current model code allows the inclusion of more than one bank, but does not model bank actions. Extending the model to allow a larger network of banks, and to allow banks to actively participate in measures such as loans and corresponding balances, would allow the investigation of regional and national systems of banks. An additional area of expansion would be to admit limited depositor rationality, so that economic news has some impact on depositor behavior. Additionally, it will be possible to instantiate an empirically derived bank scenario, where depositors are identified with specific locations and with specific deposit amounts as well as social networks derived from individual data such as location of home and workplace, membership in organizations such as churches, and associations derived from business

relationships.

6.3 In Closing

National and international financial crises have been, and likely will remain, frequent events. Enhancing our understanding of such events will be a critical component in designing and justifying measures that will attempt to either reduce the frequency or minimize the impact of such events. The many dimensions of the policy design debate require addressing the problem from several perspectives. The essays presented show several different paths to approach this goal of improved understanding. They build upon what Deirdre McCloskey refers to as a "rhetoric of economics", where the detailed mathematical arguments are a tool in the process of developing convincing arguments for change [McCloskey, 1998].

The archives in Helena are an amazing resource. The possibilities are essentially unbounded, at least for those currently involved in utilizing these resources. The challenge will be to focus what resources are available.

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