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Working Paper 15848
http://www.nber.org/papers/w15848

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2010

We are grateful for valuable comments and suggestions received from Navneet Arora, Vineer Bhansali, Richard Cantor, Josh Davis, Marvin Lieberman, Hanno Lustig, Scott Richardson, and Derek Schaeffer, and seminar participants at Blackrock, Brunel University, Copenhagen Business School, Exeter University, the Georgia Institute of Technology, New York University, PIMCO, The University of Alaska at Fairbanks, UCLA, and the Vienna School of Business and Finance. We are particularly grateful for extensive research assistance provided by Priyank Gandhi, Xiaolong Cheng, Scott Cowin, Matthias Fleckenstein, Baeho Kim, Brent Longstaff, and Scott Longstaff. Strebulaev is grateful to the London Business School's Center for Corporate Governance (under ESRC contract number R060230004). All errors are our responsibility. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 15848
March 2010
JEL No. G12,G33

ABSTRACT

We study corporate bond default rates using an extensive new data set spanning the 1866–2008 period. We find that the corporate bond market has repeatedly suffered clustered default events much worse than those experienced during the Great Depression. For example, during the railroad crisis of 1873–1875, total defaults amounted to 36 percent of the par value of the entire corporate bond market. We examine whether corporate default rates are best forecast by structural, reduced-form, or macroeconomic credit models and find that variables suggested by structural models outperform the others. Default events are only weakly correlated with business downturns. We find that over the long term, credit spreads are roughly twice as large as default losses, resulting in an average credit risk premium of about 80 basis points. We also find that credit spreads do not adjust in response to realized default rates.

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The longer you can look back, the farther you can look forward.

Winston S. Churchill

1. INTRODUCTION

This paper studies the properties of corporate bond default rates using an extensive new data set covering the 1866−2008 period. This data set is comprised of both hand-collected data extracted from historical financial records such as the *Commercial and Financial Chronicle* as well as tabulated data from a variety of sources including the National Bureau of Economic Research (NBER), the Federal Reserve Board, Standard and Poor's, and Moody's Investors Services. In this study, we focus on the value-weighted default rates for U.S. nonfinancial bond issues. The reason for studying nonfinancials is that while they have historically represented the majority of the bond market, they have generally received far less attention in the literature, particularly during the earlier part of the study period.[1] Thus, the focus of this study is on "Main Street" rather than on "Wall Street."

In setting out on this study, a question that immediately raises itself is: How is historical corporate default experience dating back as far as the Civil War relevant to current financial research? After all, the corporate bond market of the 1860s was composed primarily of railroad, canal, and mining issues, which is a far cry from the current composition of the market. We believe that there are at least four compelling reasons for studying the long-term default experience of the corporate bond market. First, while the names of the bond issuers and the industries they represent may change and evolve over the centuries, the applicability of financial theory to the determinants of default risk and the pricing of corporate bonds should not change. In other words, if a credit model such as Merton (1974) applies to bonds in the 21st Century, it should be equally applicable in the 19th Century (albeit to a very different set of bonds). Second, the NBER dates business cycles back as far as the 1850s, and the study of these

[1]For example, there is an extensive literature documenting the failures of banks, securities firms, real estate trusts, and other financials during the Great Depression. These include Goldschmidt (1933), Galbraith (1955), Friedman and Schwartz (1963), Bernanke (1981, 1983), Kindleberger and Aliber (2005), Easley and O'Hara (1979), and many others. In contrast, there are relatively few sources describing failures of nonfinancial firms during this period. We observe, however, that most recent corporate and credit risk empirical studies exclude financial and utility industries (for example, see Eom, Helwege, and Huang (2004).

cycles has provided valuable insights into fundamental economic mechanisms. Indeed, business cycle data has been used extensively in macroeconomic research for parameter calibration. We believe that similar insights can be obtained by studying historical default cycles. In addition, by identifying historical default cycles over the same time period as NBER business cycles, we hope to shed light on the interaction between adverse credit market events and economic downturns. Third, in coming to grips with the current financial market situation which has been termed a "historic crisis" or "the worst financial crisis since the Great Depression," nothing is so valuable as actually having a long-term historical perspective. Fourth, there are many parallels between the early part of the study period and recent credit market events. In particular, the latter part of the 19th Century was a period in which massive investment in a number of exciting new technologies (railroads, electricity, etc.) was financed heavily by debt. These technology booms were then followed by waves of financial crises and bond defaults, closely resembling patterns in the telecommunications and structured-credit-products cycles of the past decade.

To provide overall perspective on corporate default rates, we begin with a simple descriptive analysis of the data. The U.S. experienced many severe clustered default events during the study period. The worst event occurred in the 1870s when the railroad boom of the 1860s was followed by a disastrous decade of defaults. During the three-year period from 1873−1875, the annual default rates total to 35.90 percent of the total par value of the corporate bond market. Several other three-year periods in the study period experience comparable default rates. Surprisingly, the worst three-year period during the Great Depression with default rates totaling to 12.88 percent barely makes it into the top five credit events for nonfinancials.[2] On average, the annual corporate default rate during the sample period is about 1.50 percent. Corporate defaults, however, cluster significantly in time and the default rate is very persistent. Curiously, the correlation between credit events and NBER business downturns is only about 26 percent.

Our primary focus is on understanding the determinants of corporate default rates. Theoretical work on the valuation of corporate bonds and default prediction falls into three broad categories: structural models, reduced-form models, and macroeconomic and/or accounting-based models. We explore the implications of each of these frameworks and identify the economic factors that each suggests should drive corporate default risk. Using available historical data, we apply a regression approach to

[2]This is consistent with the evidence given in Friedman and Schwartz (1963) that the actual financial losses incurred by debtholders during the 1930−1933 period were relatively modest as a percentage of total market capitalization. Friedman and Schwartz also observe that "The impairment in the market values of assets held by banks . . . was the most important source of impairment in capital leading to bank suspensions, rather than the default of specific loans or of specific bond issues." See Friedman and Schwartz, pp. 351-355.

examine which factors best forecast corporate default rates. We find that variables implied by the structural credit modeling framework have significant forecasting power for corporate default rates. In contrast, lagged corporate credit spreads have no predictive power for default rates. These results complement and extend Collin-Dufresne, Goldstein, and Martin (2001), Elton, Gruber, Agrawal, and Mann (2001), Schaefer and Strebulaev (2008), and others who also find that credit spreads are significantly influenced by factors that are difficult to link to credit fundamentals. Finally, we find that the state of the economy as measured by a recession indicator variable has little incremental predictive ability for corporate default rates.

Motivated by these results, we then explore the issue of how the market prices default risk. Applying a 50-percent loss rate to the average default rate of about 1.50 percent gives a back-of-the-envelope estimate of average annual credit losses of roughly 75 basis points. Using the available data, however, we find that credit spreads average about 153 basis points during the sample period. Thus, credit spreads have been approximately twice as large as expected default losses on average, implying an average premium of about 80 basis points for bearing default risk during the study period. We again use a regression approach to examine whether increases in default rates map into higher credit spreads. We find little or no evidence that credit spreads respond to current or lagged default rates. Taken together, these counterintuitive results support the view that corporate credit spreads are driven largely by factors such as illiquidity, consistent with Collin-Dufresne, Goldstein, and Martin (2001), Elton, Gruber, Agrawal, and Mann (2001), Longstaff, Mithal, and Neis (2005), and others.

In summary, this study provides four important results. First, we show that the historical default experience in the United States includes periods much worse that those during the Great Depression. Second, the historical correlation of default cycles and economic downturns is surprisingly weak. Third, we find that variables suggested by structural models of credit risk have significant forecasting power for corporate defaults, while credit spreads and business cycle indicators do not. Fourth, we show that over the long-run, credit spreads appear to provide investors with a modest premium for bearing credit risk, but do not adjust to current or lagged realized default rates. These results have many important implications for credit markets.

This paper contributes to the extensive literature on corporate credit risk and bond valuation. Key theoretical work in this area includes Black and Scholes (1973), Merton (1973, 1974), Black and Cox (1976), Leland (1994), Longstaff and Schwartz (1995), Jarrow and Turnbull (1995), Jarrow, Lando, and Turnbull (1997), Duffie and Singleton (1997, 1999), Collin-Dufresne and Goldstein (2001), Goldstein, Ju, and Leland (2001), Duffie and Lando (2001), and others. Important studies focusing on default risk in corporate bonds include Altman (1968, 1989), Shumway (2001), Chava, and Jarrow (2004), Duffie, Saita, and Wang (2007), Almeida and Philippon (2007), and Campbell, Hilscher, and Szilagyi (2008). Research addressing the default premium

and the properties of corporate credit spreads includes Fons (1987), Sarig and Warga (1989), Kim, Ramaswamy, and Sundaresan (1993), Pedrosa and Roll (1998), Duffee (1999), Collin-Dufresne, Goldstein, and Martin (2001), Elton, Gruber, Agrawal, and Mann (2001), Huang and Huang (2003), Eom, Helwege, and Huang (2004), Longstaff, Mithal, and Neis (2005), Driessen (2005), Berndt, Douglas, Duffie, Ferguson, and Schranz (2005), Jarrow, Lando, and Yu (2005), Davydenko and Strebulaev (2007), Schaefer and Strebulaev (2008), Bharath and Shumway (2008), and many others. This paper contributes to the literature by examining default risk and its relation to credit spreads over a time period significantly longer than in any previous study.

The remainder of this paper is organized as follows. Section 2 describes the data set used in the paper and explains how it is constructed. Section 3 describes some of the historical background for the study period. Section 4 explores the properties of the historical corporate default rates. Section 5 studies the determinants of corporate default risk. Section 6 examines how the market prices corporate bond default risk. Section 7 makes concluding remarks. The Appendix provides a detailed description of the data collection process.

2. THE DATA

Our objective in this paper is to study the default rates that investors in the U.S. corporate bond markets have experienced historically. Specifically, our focus is on the bonds issued by U.S. firms in the nonfinancial sector. We limit our attention to U.S. corporate bonds since this allows us to study the relation between default rates and a number of key financial and macroeconomic variables that are only available for the U.S. markets. As discussed above, we focus on the nonfinancial sector since it has received much less attention in the literature than the financial sector. Furthermore, the nonfinancial sector has historically represented a much larger fraction of the market for long-term corporate debt than the financial sector. For example, financial issuers represented zero percent of all corporate bond issuers listed in the *Commercial and Financial Chronicle* in 1870, 1.2 percent of all issuers listed in 1900, 6.9 percent of all issuers listed in 1930, and 1.8 percent of all issuers listed in 1969. Thus, the tendency of financial firms to raise capital through the bond markets is a relatively recent one from a historical perspective.[3]

In measuring default rates, we focus on the fraction of the total par value of the corporate bond market (the default rate) that enters into financial distress during each year in the sample period. Thus, our approach differs somewhat from that of

[3]Financial firms, of course, raise capital from other sources such as deposits, commercial paper, or the money markets. For a description of growth in the financial sector, see Philippon (2008) and Gandhi and Lustig (2009).

other surveys such as Moody's *Corporate Defaults and Recovery Rates, 1920−2008* publication that are based on the fraction of issuers that enter into financial distress each year.[4] By studying the proportion of the total par value of bonds entering into financial distress, our results more closely reflect default rates from the perspective of a representative investor holding the value-weighted portfolio of all corporate bonds. For brevity, we will refer to the domestic nonfinancial value-weighted default rate simply as the default rate throughout the remainder of this paper.[5]

The collection of data for the study represented an extensive multi-year undertaking involving thousands of hours of research assistance. For example, obtaining corporate bond market data for the 19th Century required obtaining original copies of the *Commercial and Financial Chronicle*, tabulating the number of corporate issuers and the number and par value of all corporate issues, and then painstakingly reading though the pages of this source to identify news items providing information about issuers entering (or exiting) financial distress. The *Commercial and Financial Chronicle* was founded in 1865 and was the first national business newspaper in the United States. The *Commercial and Financial Chronicle* published extensive lists of the corporate bonds that were available in the financial markets, including bonds traded on the NYSE, the NYSE Curb Exchange, the AMEX, all of the regional exchanges, as well as leading unlisted and inactive bonds.[6]

Our sample period begins with 1866 since this is the first full year that the *Commercial and Financial Chronicle* was published. The year 1866, however, is a logical starting point for a number of other reasons as well. First, 1866 is the first full year following the conclusion of the Civil War, thereby representing something of a regime shift in U.S. history. Second, the 1866−2008 sample period closely parallels the 1857−2008 period covered by the NBER business-cycle-dating committee. Third, by beginning with 1866, we are essentially matching the starting date of the classic study of monetary history in the United States by Friedman and Schwartz (1963) which begins with 1867 (but also provides some discussion of events in earlier periods).

We also collected data from an extensive list of tabulated sources including the three volumes of the Hickman (1953, 1958, 1960) NBER study of corporate bond markets. This study was sponsored by the Works Project Administration and the Federal Deposit Insurance Corporation during the 1940s and 1950s and involved at least several dozen researchers over a number of years. We also obtained data from the NBER-sponsored study by Atkinson (1967) essentially extending the scope of

[4]Moody's publishes some limited data on value-weighted default rates beginning with 1994. See Table 45 in Moody's *Corporate Default and Recovery Rates, 1920−2008*.

[5]When the data allow, we also calculate equally-weighted issue and issuer default rates and use these for a number of robustness checks.

[6]For a description of the history of the *Commercial and Financial Chronicle* and its founder, see Steeples (2002).

the Hickman project by several decades. These studies were based on original data obtained from industry sources but were cross checked with data from sources such as the Securities and Exchange Commission, the Interstate Commerce Commission, and the National Industrial Conference Board.[7] For the latter part of the study period (1970-2008), we also used data provided to us by courtesy of Moody's Default Risk Services and extracted from their extensive data set of corporate market issuers.

In addition to these sources, we also use data provided by the Federal Reserve Board Flow of Funds Accounts of the United States, Standard and Poor's Corporation, the Securities Industry and Financial Markets Association (SIFMA, formerly the Bond Market Association), Macaulay (1938), Homer and Sylla (1991), Carty (1997, 2000), and others.

It is important to emphasize that both the focus of our study and the nature of the data set used differ significantly from those in the well-known surveys of historical corporate default experience published by industry sources such as Moody's Investor Services Inc. and Standard and Poor's Corporation. In particular, we focus on value-weighted default rates. In contrast, Moody's *Corporate Default and Recovery Rates, 1920−2008* publication focuses on the percentage of issuers that default. This distinction is an important one, however, since smaller firms tend to default more frequently. Thus, issuer-weighted default rates can be numerically large while not economically large during some periods (including some years during the 1930s). Furthermore, the default rates in this Moody's publication include defaults by global issuers. In particular, as described by Carty and Lieberman (1997), Moody's default rates were elevated by global events such as the German Transfer Moratorium in 1933 in which 62 German firms were restricted from making foreign debt payments by the newly installed Nazi government. These firms represent a large fraction of the total number of defaulting firms during 1933 in the Moody's sample. Carty and Lieberman also report that similar defaults occurred through payment moratoriums in Austria, Czechoslovakia, Rhodesia, Chile, and Uruguay. In addition, default rates published by industry sources are typically based on rated bonds. In contrast, our default statistics for the 1866−1969 period are based on the broader universe of all reported bonds (rated or unrated). Also, some of the earlier years in the Moody's sample may have less comprehensive coverage, perhaps because relatively few bond issues were rated. For example, Moody's *Corporate Default and Recovery Rates, 1920−2008* publication implies that there were about 1240 issuers in their sample in 1939.[8] In contrast, there were 2486 bond issuers listed in the *Commercial and Financial Chronicle* at the beginning of 1939. Finally, the earliest data on default rates available from Moody's begins with 1920. Thus, our data set extends 54 years further into the past, covering

[7]Sadly, the original data collected by Hickman and Atkinson seems to have been lost.

[8]This follows from the number of defaults reported in Table 15 and the default percentage reported in Table 36 of the Moody's publication.

an additional 14 business cycles.

The specific data used in calculating the default rate consists of two time series. The first is the total par value of a snapshot of all nonfinancial corporate bonds included in the historical source at the beginning of each year. The second is the total par amount of the subset of bonds in the annual snapshot entering into financial distress each year. The default rate is simply the ratio of the latter to the former. Note that for a default to be included in the numerator of this ratio, the bond needs to also be included in the denominator. This ensures that the estimated default rate is economically meaningful and bounded between zero and one.

Although we use a variety of data sources, the basic definition of financial distress remains fairly uniform throughout the study. In particular, financial distress includes events such as a firm defaulting on a coupon or principal payment, an initial account of a bondholder committee meeting, entering into receivership, bankruptcy, reorganization, etc. The Appendix provides details about the data sources, data collection protocols, and definitions of financial distress used in constructing these time series.

3. HISTORICAL BACKGROUND

In this section, we provide some selected background about the major historical trends, events, and legal environment influencing the corporate bond markets during the sample period. In doing this, we focus primarily on the earlier part of our sample period since this is likely to be less familiar to the reader.[9]

3.1 The Railroad Boom and Crashes of the 19th Century

U.S. industrialization in the 19th Century was driven in large part by the transportation revolution. In 1860, the American railroad network consisted of 30,000 miles of track in operation. By 1910, the U.S. had 351,767 miles of track, of which 266,000 miles were main track (Hughes and Cain (2007)). As Hughes and Cain argue in their economic history,

> *"Constructing America's railroads was such a giant effort that the story of it has become simply overpowering in its influence upon American history. . . . There had never before been anything like it." (p. 287).*

[9]There are many excellent financial and economic histories of the United States for the period covered by this study. Examples include Macaulay (1938), Friedman and Schwartz (1963), Snowden (1990), Homer and Sylla (1991), Markham (2001, 2002), and Hughes and Cain (2007).

There were three major waves of railroad construction in the late 19th Century: 1868–1873, 1879–1883, and 1886–1892 (Fishlow (1965)). Railroads were built mainly with borrowed money and it should not come as a surprise perhaps that each of these booms correspond to subsequent major crises and high default rates.

As discussed by Friedman and Schwartz (1963), and Homer and Sylla (1991), the late 19th Century was also characterized by an enormous expansion in the size of U.S. debt markets, economic activity and productivity, the national banking system, as well as the transportation system. Quoting from Friedman and Schwartz,

> *"There are many other signs of rapid economic growth. This was a period of great railroad expansion dramatized by the linking of the coasts by rail in 1869. The number of miles of track operated more than doubled from 1867 to 1879, a rate of expansion not matched subsequently. . . . The political developments combined with the great cheapening in transportation to produce a rapid extension of the area under cultivation. The number of farms rose by over 50 percent from 1870 to 1880 for the U.S. as whole. The average value per acre apparently increased despite the sharp decline in the price of farm products—clear evidence of a rise in economic productivity."* (Chapter 2, pg. 35).

The growth in economic activity was accompanied by a rapid expansion in the corporate bond market. For example, the number of bond issuers listed in the *Commercial and Financial Chronicle* was 158 in 1866, but quickly reached 421 by 1872. The *Commercial and Financial Chronicle* from this period is often filled with enthusiastic accounts about the promise of new technology,

> *" . . . every well-built railroad if suitably located becomes a productive machine which adds to the wealth of the whole country . . . Our new railroads increase the value of farms and open new markets for their products. They lessen the time and cost of travel. They give a value to commodities otherwise almost worthless. They concentrate population, stimulate production and raise wages by making labor more efficient. Our existing railroads are computed to create more wealth every year than is absorbed for the construction of new railroads."* (January 11, 1873).

The parallels between this period and the recent internet and dot-com era of the late

1990s and early 2000s are indeed striking.

However, later in the same year there was a major panic which led to a default rate of 14.3 percent in 1873. Contrast the buoyant spirit reflected in the previous quote with that evidenced by the following quote from the *Commercial and Financial Chronicle* exactly one year later.

> *"After such a panic as has, the past year, swept over the country, it becomes a kind of melancholy pleasure to look over the field and find that there are not quite so many dead and wounded lying about as was anticipated. It was a fearful storm while it lasted, and although every one of course can say now that he knew it was coming, yet the real truth is, its breaking was terribly sudden and unexpected. . . . There are few people who allow themselves to remember long the lessons experience would teach them. If this were not so, there would be many less failures in the world. . . . Almost all felt they were carrying too much debt; they would henceforth be out of it. There are now, however, very evident signs that these resolutions have been mostly forgotten. Overtrading, as it is called, is an evil that has ever existed, and pretty much the same epitaph can be written above each business prostration—here lies the result of an attempt to do too much with too little capital. Must history necessarily repeat itself?"* (January 10, 1874).

Once again, the parallels between the leverage-related financial crisis of the 1870s and the recent subprime-mortgage securitized-credit crisis are clear. Unfortunately, the storm was far from over and history immediately repeated itself. Consider the following quote from a demoralized editorial in the *Commercial and Financial Chronicle* less than three years after the previous quote and following default rates of 16.3 percent in 1874, 5.3 percent in 1875, and 5.9 percent in 1876,

> *"This marks the depth of the present disease. It has not been simply the falling out of reckless traders—not the end of an ordinarily wild speculation in which the failure is usually the result of individual indiscretion and rashness; but it is more a result of a wrong financial system. We have been trading on a fictitious basis. The truth that it was not real, suddenly is forced upon every man. The houses, the stocks of goods, the factories we had produced and built and held at high values, we see could now be duplicated at about two-thirds or one-half their cost."* (July 15, 1876).

Although written more than 130 years ago, both the qualitative and quantitative sentiments expressed in this quote are mirrored eerily in discussions and debates about the current global financial crisis.

Financial history repeated itself several more times during the latter part of the 19th Century. The number of issuers listed in the *Commercial and Financial Chronicle* continued to increase steadily throughout this period, reflecting a large demand for debt capital by the railroads and a growing need by the emerging utility and industrial sectors (particularly the promising new technology of electricity).[10] For example, in 1880, the bonds listed in the *Commercial and Financial Chronicle* represented 339 railroads, 12 canals, and 12 miscellaneous issuers. By 1899, the *Commercial and Financial Chronicle* listed not only bonds for 404 railroads, 196 street railroads, 55 gas and electric utilities, but also 200 miscellaneous issuers (primarily industrial firms and other types of utilities). Despite the growth in the corporate bond market (or perhaps because of it), there were several other major default events during the 1880s and 1890s, although these were not as severe as those experienced during the decade of the 1870s.

3.2 Bankruptcy and Receivership

In this subsection we review the main historical developments concerning legal issues of corporate reorganizations. The main point that emerges from this discussion is that for most of the earlier period of our study, equity receivership rather than bankruptcy was the mechanism under which the consequences of default on corporate bonds were played out.

3.2.1 Bankruptcy Law

There are many in-depth reviews of the history of bankruptcy law in the United States including Warren (1935), Tabb (1995), Skeel (2001), and Franks and Sussman (2003). In this section, we summarize some of the key events described in these sources which are relevant for our study.

Tabb (1995) explains that U.S. bankruptcy law dates back to the Constitutional Convention of 1787 which empowered Congress to "pass uniform laws on the subject of bankruptcy." Quoting from Tabb,

> *"For over a century after the Constitution, however, the Bankruptcy Clause remained largely unexercised by Congress. During those periods, many states stepped into the void and passed their own bankruptcy legislation. A Federal bankruptcy law was in existence only from 1800 to 1803, from 1841 to 1843, and from 1867 to 1878. Permanent*

[10] See Benmelech (2009) for an in-depth analysis of the debt maturity of railroads and the marketability of railroad assets during this period.

Federal bankruptcy legislation did not go into effect until 1898. Thus, states were free to act in bankruptcy matters for all but 16 of the first 109 years after the Constitution was ratified. In each instance of Federal action, the Federal legislation followed a major financial disaster: the Act of 1800 followed the Panic of 1797, the Act of 1841 came after the Panic of 1837; the 1867 Act followed the Panic of 1857 and the Civil War; and finally the 1898 Act was passed in the wake of the Panic of 1893."

The passage of the Act of 1898 (the Nelson Act) represented the beginning of permanent Federal bankruptcy law. The Act was viewed as ushering in a regime characterized by liberal debtor treatment, although there were many restrictions placed on the ability of corporations to enter voluntary bankruptcy. From 1898 to the passage of the Act of 1938 (the Chandler Act), there were many amendments made to the 1898 Act, typically in an effort to mitigate its extreme pro-debtor nature. It is important to observe, however, that the early part of the 1930s saw the passage of a number of pro-debtor amendments and laws by Congress that favored rehabilitation rather the liquidation of defaulting firms. A number of these amendments were struck down by the Supreme Court, but then reworked and reenacted by Congress in a way that survived judicial review. The Chandler Act represented a major overhaul of the 1898 Act and formalized many of the corporate reorganization mechanisms that had been passed by Congress during the earlier part of the 1930s (such as the railroad reorganization laws of 1933 and 1935).

The Chandler Act effectively transferred power in bankruptcy away from managers and towards independent trustees. As a result, as Skeel (2001) suggests, the 1938 Act discouraged managers of large firms from filing for bankruptcy (under Chapter 10 designed originally for large corporations) if there was any way to avoid it. In later decades, managers used all manner of tricks to file under Chapter 11 (designed originally for small businesses) which left the management intact.

Bankruptcy law in its current form was ushered in through the Bankruptcy Reform Act of 1978. This Act introduced many major changes to the bankruptcy process, combined several of the earlier types of reorganization into a Chapter 11 process, and re-introduced debtor-in-possession procedures and trustees, etc. The most recent major revision to bankruptcy law was the Bankruptcy Abuse Prevention and Consumer Protection Act of 2005 which made sweeping changes to the ability of consumers and business to file for voluntary bankruptcy.

3.2.2 Equity Receivership

The lack of a Federal bankruptcy law during most of the latter part of the 19th Century proved to be a challenge for corporate bondholders since most of the defaults during this period were for railroads, almost all of which (especially the large ones)

were interstate. As Tabb (1995) says,

> *"Given the interstate nature of virtually all of the railroads, state remedies were entirely inadequate. The creative solution achieved was to invoke the power of the Federal courts to supervise the restructuring of the railroad. Court-supervised receiverships remained the predominant means of corporate reorganization for about a half century, until Federal reorganization laws were enacted during the Depression."*

> *"A receivership was commenced when a creditor petitioned the Federal court to exercise its equity jurisdiction to appoint a receiver to take control of the corporate debtor's assets. The receiver then would be able to continue to run the railroad, while looking for a buyer for the assets. Eventually the assets would be sold in a foreclosure sale, and the creditors would be paid out of the proceeds of the sale. Since the business could be sold as a going concern, a higher price could be realized."*

It is important to stress that various bankruptcy acts sporadically introduced in the 19th Century (including the more permanent 1898 Act) were meant mainly for small businesses rather than large corporations. For example, the 1867 Bankruptcy Act assumed that bankrupt corporations would simply be shut down and their assets liquidated. Such an approach did not make sense for railroads, since everyone agreed that it was important to keep the railroads running. By the final decades of the 19th Century the courts had developed a judicial reorganization technique known as equity receivership, which became the basis for modern corporate reorganization. As explained in detail in Skeel (2001), equity receivership was effectively cobbled together by various claimholders and courts from two powers that did have an established common-law pedigree: courts' equitable authority to appoint receivers and the right of a mortgage holder to foreclose on a mortgaged property if the debtor defaults. The oldest case, the Munroe Railroad and Banking Company, dates from 1848. The court suggested that it made more sense to preserve the troubled railroad than to dismember it. Quoting from Skeel (2001),

> *"What disastrous consequences would have resulted," the court exclaimed, "if each judgement creditor had been allowed to seize and sell separate portions of the road, at different sales in the six different Counties through which it passed and to different purchasers? Would not this valuable property have been utterly sacrificed?" (p. 57).*

In another watershed case, the 1884 Wabash railroad reorganization, the presiding judge concluded that

> *"An expenditure [must] be made for the benefit of all parties in interest . . . in order that [the railroad] shall be made a going concern. Otherwise, in the expressive language of a distinguished friend, you have nothing else but a streak of iron-rust on the prairie."* (Skeel (2001), pp. 62–63).

As Skeel further explains, by analogy to current bankruptcy law, appointing a receiver served the same purpose as the automatic stay does now. Several important cases further modified the equity receivership procedure. In one such case, the court approved a "receiver's certificate" by allowing priority to be given to investors who contributed new funds (because railroads needed financing to cover operating costs). This is similar to the current practice of debtor-in-possession financing in Chapter 11. In the 1884 Wabash receivership equityholders (lead by Jay Gould, a robber baron) filed for receivership themselves before defaulting and were appointed the receivers. Indeed, in a study of 150 receiverships between 1870 and 1898, Henry Swain (1898) found that insiders were appointed as receivers in 138 of the cases. To give yet another example, in the 1913 case of Northern Pacific v. Boyd the Supreme Court announced the "fixed principle" that outlined the rights of unsecured creditors and eventually would become bankruptcy's absolute priority rule.

Importantly, certain industries (such as railroads) were treated differently under the 1938 Chandler Act. In particular, the Act had new railroad provisions (Section 77), which provided for a binding two-thirds vote by classes of creditors and for nation-wide jurisdiction but still left the reorganization process itself entirely to the parties themselves.

3.3 Development of Financial Markets

The massive capital investments in steam and street railroads, canals, and later utilities in the 19th Century were financed mainly by private means. Existing evidence suggests that capital was raised using securities with features that are very similar to modern financial instruments: common and preferred equity, and secured (and later unsecured) coupon-bearing debt.[11] This gave rise to a liquid and active secondary market for railroad and other securities, with corporate bonds actively traded on NYSE and

[11]It is unclear at present how the cross-section of corporate leverage ratios looked in the 19th Century. Some very preliminary evidence we collected for one year (1889), suggests that book leverage ratios were higher than observed today (on the order of 40-50 percent) and that there is a substantial cross-sectional variation with some firms having only common equity and many others exhibiting very high leverage ratios. A

other exchanges.

The NYSE by the 1860s already resembled its 20th Century counterpart in many important respects and was also quick to implement technological novelties. For example, as early as September 1882 the NYSE introduced stock tickers (electric tickers based on Edison's invention). The telephone was installed in 1879 and the electric annunciator board in 1881. These innovations led to a substantial increase in trading volume and liquidity.

Investors, and particularly bond investors, had access to a wide range of reputable sources of information. The *Commercial and Financial Chronicle* has already been mentioned. In addition to a weekly newspaper, subscribers received a monthly bulletin of all the recorded prices on major exchanges and quarterly or semi-annual supplements which listed all the major companies and gave detailed information on securities issued by them. Henry Poor's annual railroad manuals (which included industrial firms as well) contained detailed information about all large companies, including balance sheets, income statements, details on collateral for most bond issues as well as carefully drawn railroad maps.

A sizable industry of financial analysts providing second-hand assessment of the development of financial markets and investment advice developed quickly and was not dissimilar to what we observe today. To give one example, in his memoirs William McAdoo, President Wilson's Secretary of the Treasury during the First World War, recalled the early days of his career when he started selling investment securities in New York in 1892 (McAdoo (1931)):

> *"I became a walking encyclopedia of railroad statistics . . . I could give the capitalization, earnings, and general characteristics of every well known railroad in the United States. . . . The drawers of my desk were crammed full of railroad maps. I studied them day and night. After a while I had a mental picture of every important railroad system; I could take a map of the United States and mark with a pencil the main line and principal branches of any railroad one might name." (pp. 56-57).*

McAdoo's picturesque memoirs stand out, but from what we can judge, his experience was a typical one. In a nutshell, all the evidence suggests that by the second half of the 19th Century, the U.S. financial markets were already highly developed.

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more detailed study of leverage is beyond this paper.

4. CORPORATE DEFAULT RATES

As a first step in the analysis, we begin by providing a long-term historical perspective on corporate default experience in the United States. Table 1 reports summary statistics for the annual default rates for the 1866−2008 period. Figure 1 plots the time series of these annual default rates.

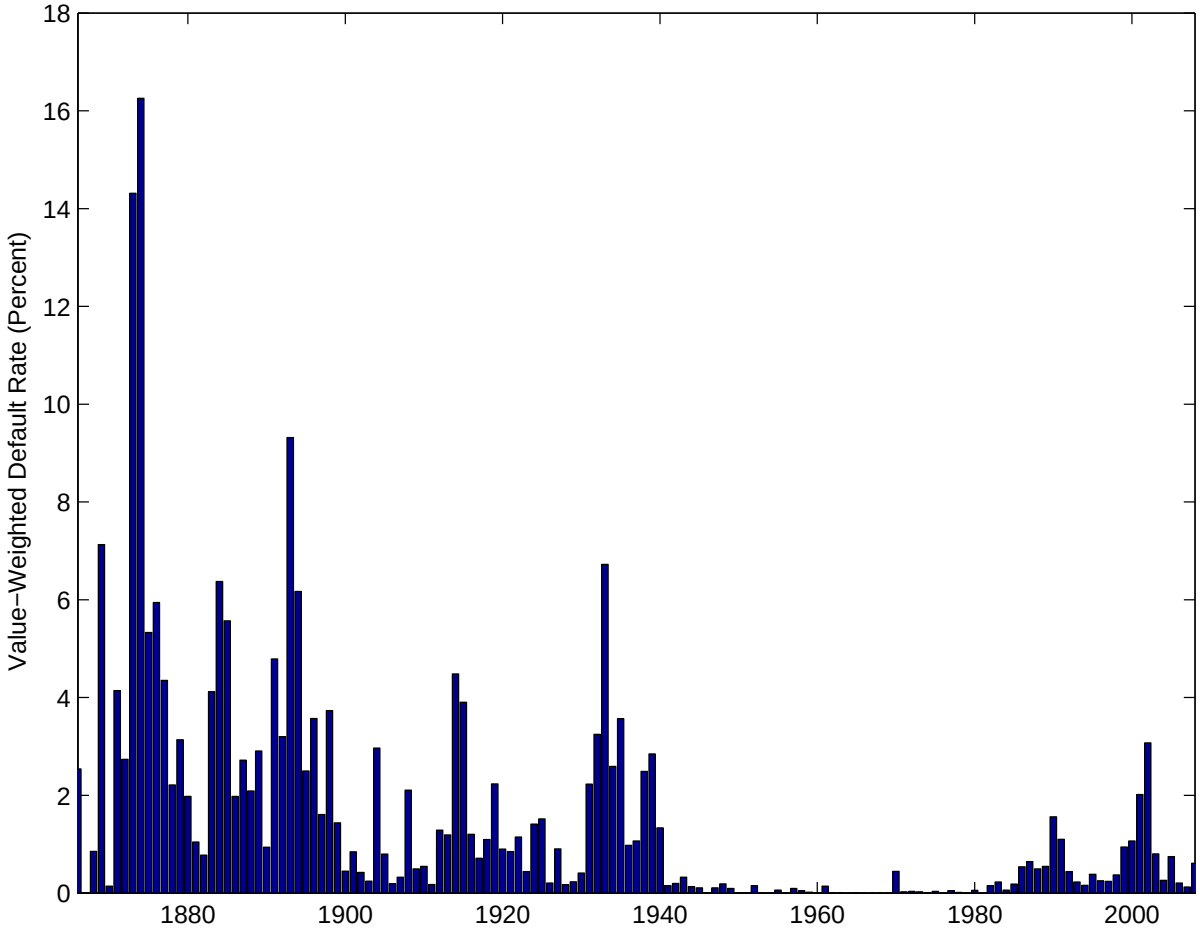

Figure 1. Historical Default Rates. This graph plots the annual value-weighted percentage default rates for bonds issued by domestic nonfinancial firms for the 1866−2008 period.

As shown, the U.S. has experienced many severe default events during the study period. The most dramatic of these was clearly the catastrophic railroad crisis of the 1870s that followed the enormous boom in railroad construction of the 1860s. This railroad crisis lasted an entire decade, and two years during this period had default

rates on the order of 15 percent. In fact, default rates during the three-year 1873−1875 period totaled 35.90 percent. In contrast, default rates for the worst three-year period during the Great Depression only totaled 12.88 percent, and this three-year period only ranks in fourth place among the worst three-year default periods during the study period.

From Table 1, the long-run average default rate is 1.517 percent. Figure 1, however, shows that the distribution of defaults is far from uniform. Rather, the historical experience is characterized by long periods with relatively few defaults following by episodes of significant clustering of defaults. This is also evident from the variation in summary statistics across the three subperiods, 1866−1899, 1900−1945, and 1946−2008. The result is a distribution of default rates that is highly skewed towards large values. As a result, the median default rate of 0.545 percent is significantly less than the mean default rate of 1.517 percent. The standard deviation of default rates is 2.414 percent. Figure 2 plots the histogram of annual default rates.

The time series of default rates shows that there is wide variation in the historical experience. The first half of the study period is characterized by a series of severe and prolonged credit episodes. In contrast, the second half of the study period experienced far fewer major credit events. This pattern parallels the well-known evidence that, from 1857 (when the NBER data begins) to today, business cycles have generally become more infrequent and less severe.

These similarities between default events and business cycles motivate examining and contrasting their properties in more depth. Table 2 reports summary statistics for the major default cycles during the study period, where a default cycle is defined as a single year or a contiguous period of more than one year during which the default rate each year exceeds the mean rate of 1.517 percent. Table 2 shows that there were 13 of these default cycles during the study period. In contrast, the NBER identifies 31 distinct recessions during the same period.[12] Thus, while there are only about 40 percent as many default cycles as recessions, the fact that the economy spends about the same amount of time in both states illustrates the more persistent nature of default cycles. The NBER data imply that the average duration of a recession during the sample period is about 1.5 years. In comparison, the default cycles identified in Table 2 have an average duration of about 3.2 years, which is more than double that for the NBER recessions.

To explore this latter point further, we define an annual dummy variable that takes a value of one if any part of the year includes a recession, and zero otherwise.

[12]While the definition of a default cycle is somewhat arbitrary, it has the consequence that the total number of years identified as belonging to a default cycle (42) is almost precisely equal to the number of recession years (42.4) identified by the NBER during the same period. For a more formal treatment of default cycles, see Giesecke, Longstaff, Schaefer, and Strebulaev (2010).

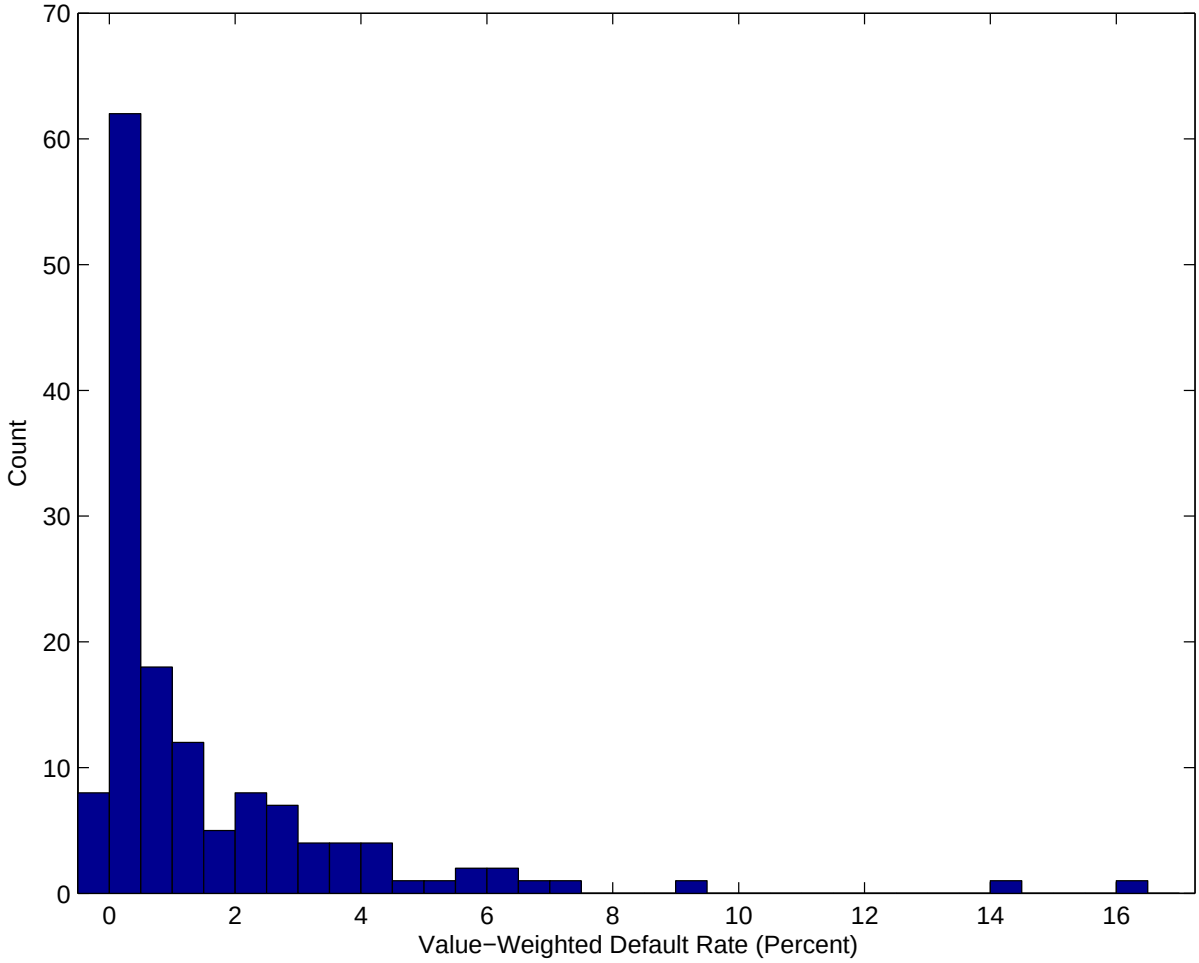

Figure 2. Histogram of Historical Default Rates. This figure shows the histogram of annual value-weighted percentage default rates for bonds issued by domestic nonfinancial firms for the 1866−2008 period.

Similarly, we define an annual dummy variable that takes a value of one if the year is included in a default cycle as identified in Table 2, and zero otherwise. The first order serial correlations for these two time series are 0.267 and 0.574, respectively. Thus, while default cycles are less common that business cycle downturns, they tend to be significantly more persistent. For a detailed analysis of the relation between default cycle and business cycles using this data set, see Giesecke, Longstaff, Schaefer, and Strebulaev (2010).

As an alternative way of looking at major default events, we tabulate total credit losses over all three-year periods throughout the sample period. Table 3 provides

summary statistics for the most significant three-year non-overlapping default events ranked by their severity.[13] As described above, the worst three-year period is the 1873−75 period in which the default rates total to 35.90 percent. The 1892−1894 and 1883−1885 periods resulted in total default rates of 18.69 and 16.06 percent, respectively. The 1933−1935 period during the Great Depression ranks a distant fourth with a total default rate of 12.88 percent. Thus, while the Great Depression may have been the worst economic period during the sample period, it is actually very far from being the worst credit event experienced in the corporate bond market. The fifth and sixth worst three-year periods have total default rates that are very similar to that of the 1933−1935 period. Observe that the 2000−2002 period is the *only* post-World-War-II period in the top twelve three-year periods listed in Table 3. We note that the year-to-date corporate nonfinancial default rate for 2009 as of the end of September is 2.46 percent (per Moody's). Thus, however large the current financial crisis may appear, the 2009 default rate is unlikely to affect any of the rankings of the three-year period shown in Table 3.

Table 3 also reports the average stock market return for each of these three-year periods. The annual stock market return time series is given by combining the monthly data for 1802−1929 provided by Schwert (1990) with CRSP value-weighted data for the subsequent period (data provided by Ken French). Of the 12 periods, 8 have average stock market returns that are below the overall average of 10.33 percent. The average return over the 12 periods is 8.66 percent. Given the volatility of stock returns, however, we cannot reject the hypothesis that the average return for the 12 periods is not significantly less than the overall average of 10.33 percent.

Table 3 also reports the average fraction for each three-year period that the economy is in a downturn based on its NBER business cycle identification. As shown, the average fractions range from 0.08 to 1.00. Averaging over all 12 periods, the overall average is 0.43. This is slightly higher than the unconditional average over the entire sample period of 0.32. These results hint at the evidence documented in Giesecke, Longstaff, Schaefer, and Strebulaev (2010) that business cycles and credit cycles are only moderately correlated. For example, the simple correlation between the annual dummy variables for business cycles and default cycles described above is only 0.263. We will return to this issue in the next section as we study the historical determinants of default risk in the corporate bond market.

5. THE DETERMINANTS OF DEFAULT RISK

In this section, we use variables suggested by a number of theoretical credit models

[13]The sum over three years can include a few issuers that default more than once. These issuers, however, represent a very small fraction of the total.

to study the determinants of corporate default rates. In doing this, we first review these models and consider their empirical implications for realized default rates. We then describe the variables we use in the empirical analysis. Finally, we report the regression results and discuss their implications.

5.1 Modeling Corporate Default Risk

There is a large theoretical literature on modeling corporate default risk, the valuation of corporate bonds, and default prediction that is far too extensive for us to review fully here. In general, however, this literature can be divided into three broad categories: structural models, reduced-form models, and macroeconomic/accounting-based models. We consider each of these three frameworks in turn below. It is important to acknowledge, however, that these three frameworks are not necessarily mutually exclusive and that specific variables may be implied by more than one framework. For example, many of the variables suggested by the structural framework can easily be incorporated into a reduced-form framework as well (for example, see Chava and Jarrow (2004), Duffie, Saita, and Wang (2007)). Thus, our analysis should be viewed as an exploratory investigation into the determinants of default risk, and not as a test of any specific credit model.

5.1.1 Structural credit models

This class of models was introduced by the important early series of papers on option pricing theory and its applications including Black and Scholes (1973) and Merton (1973, 1974). Significant extensions of the basic structural credit framework include Black and Cox (1976), Geske (1977), Leland (1994, 2004), Longstaff and Schwartz (1995), Goldstein, Ju, and Leland (2001), Collin-Dufresne and Goldstein (2001), and many others.

In this class of models, corporate bonds represent contingent claims on the underlying assets of a firm. By modeling the asset-value dynamics and the events triggering default, contingent claims valuation technology can be applied to the debt claims of a firm. An important dimension of this credit framework is that it identifies key factors that may drive corporate bond values. For example, as discussed by Collin-Dufresne, Goldstein, and Martin (2001) who investigate the determinants of credit spread changes, the structural framework implies that corporate credit spreads should be driven by variables such as firm value, leverage, interest rates, the slope of the term structure, and volatility. Factors driving credit spreads should also be relevant for determining corporate default probabilities.

In light of this, our approach will be to examine whether realized corporate default rates can be forecast on the basis of ex ante variables suggested by structural models. Rather than doing this at the individual firm level (which would clearly not be feasible given the scope of the study), we adopt a macro perspective and study default rates at the aggregate level. Specifically, we use a regression approach to test whether marketwide "structural" variables have explanatory power for subsequent realized default

rates.

Identifying structural variables that are available throughout the 1866−2008 study period is a very challenging task given the lack of data during the early years of the sample. Despite this, however, we were able to extract a number of time series from the historical record that parallel those used in Collin-Dufresne, Goldstein, and Martin (2001). Specifically, we include as explanatory variables in the regression the annual stock market return, the annual stock market return variance, the yield on riskless government bonds, and the slope of the yield curve. The annual stock returns are obtained from the sources described in Section 4. The annual stock return variance is estimated by simply computing the variance of the twelve monthly returns for each year.

The yields on government bonds are obtained from data provided by Homer and Sylla (1991) for 1866−1989, and from the Federal Reserve Board's Selected Interest Rates H.15 statistical release for the annual ten-year constant maturity Treasury rate for the 1990−2008 period. Homer and Sylla argue that because government bonds were distorted by gold premiums and liquidity issues, "market yields on governments must be disregarded altogether from 1863 until 1918 as a guide to American long-term interest rates." Accordingly, we use the yields on high-grade New England municipal bonds from 1866−1914, and the yield for the high-grade Bond Buyer municipal bond index from 1915−1918 as proxies for the riskless government yield during these periods.[14] For the 1919−1989 period, we use the average of long-term government bonds provided by Homer and Sylla (which is taken from the Federal Reserve, see the sources listed in Homer and Sylla, Table 50). The data are taken from Homer and Sylla Tables 42, 43, 45, 48, and 51.

To estimate the slope of the credit curve, we take the difference between the yield on high-quality long-term corporate bonds and a measure of the yield on short-term corporate commercial paper. The yields for commercial paper for the 1866−1989 period are taken from Homer and Sylla (1991) Tables 44, 49, and 53. The yields for commercial paper for the 1990−2008 period are taken from the Federal Reserve Board's Selected Interest Rates H.15 statistical release for the three-month maturity (nonfinancial). As a measure of the yield on high-quality corporate bonds for the 1866−1899 period, we use the annual yields on high-grade railroad bonds given in Tables 42 and 43 of Homer and Sylla. For the 1900−1989 period, we use the year-end yields for prime corporate bonds given in Tables 45, 47, and 50 of Homer and Sylla. For the 1990−2008 period, we use the annual Moody's Aaa index as reported by the Federal Reserve Board's Selected Interest Rates H.15 statistical release. An important advantage of using the high-grade railroad and prime corporate bond indexes reported by Homer and Sylla is that they allow us to measure corporate yields annually over more than a century while holding the definition of the index composition relatively

[14]Shiller (1989) adopts the same approach in identifying historical interest rates.

fixed over time.

5.1.2 Reduced-form credit models

Another important class of credit models approaches the valuation of corporate bonds from the perspective of financial distress being triggered by the realization of a jump or Poisson process. In this framework, the intensity of the Poisson process plays a central role and is directly linked to the credit spread of a corporate bond. Important papers in this area include Jarrow and Turnbull (1995), Duffie and Singleton (1997, 1999), and many others.

Because of the link between credit spreads and the intensity of the underlying process triggering default, corporate credit spreads contain information about the probability of default. Specifically, credit spreads can be expressed in terms of the actual probabilities of default (under the objective or P-measure) plus a component representing a risk premium compensating investors for bearing credit risk.[15] A direct implication of the reduced-form modeling framework is that corporate credit spreads may contain information useful in forecasting future realized default rates.

To examine this implication, we will include the spread between the yield on the high-quality corporate bonds and the yield on riskless government bonds with similar maturities. This data is described in the previous subsection.

5.1.3 Macroeconomic and Accounting-Based models

These studies focus primarily on the relation between business cycles and the financial health of bond issuers. For example, Fama and French (1993), Dichev (1998), Chava and Jarrow (2004), Vassalou and Xing (2004), Campbell, Hilscher, and Szilagyi (2008), and others consider the extent to which credit risk represents a systematic risk in the macroeconomic environment that is priced in financial markets (see, for example, Bhamra, Kuhn, and Strebulaev (2010a, 2010b)). Accounting-based examples include Beaver (1966), Altman (1968), Ohlson (1980), Beaver, McNichols, and Rhie (2005), and others that focus on earnings and accounting ratios (which reflect the sales, expenses, growth, liquidity, etc. of the firm, which in turn derive from the economic and business environment the firm faces) and their ability to forecast defaults for individual firms. The common theme throughout this literature is that corporate defaults are directly related to the broader macroeconomic environment. Specifically, the current state of the economy should impact the likelihood that a firm will enter into financial distress in the near future.

To examine the link between economic downturns and subsequent corporate default rates, we construct an annual indicator variable representing the percentage of

[15] In general, the risk premium component in a credit spread will be an increasing but nonlinear function of the objective default probability, and so the overall relation between credit spreads and default probabilities would also be nonlinear.

the year that the U.S. economy is in recession as determined by the NBER (data provided on the NBER website). For example, the NBER recession beginning in January 1980 and ending in June 1980 would result in the indicator taking a value of 0.50 for 1980.

5.2 The Results for Default Rates

Table 4 provides summary statistics for all of the variables described above. In particular, we report summary statistics for the entire 1866−2008 period as well as for the three subperiods 1866−1899, 1900−1945, and 1946−2008.

In examining the empirical implications of these credit-modeling frameworks, our approach will be to estimate a simple regression specification with three lagged values of the variables. In doing this, it is helpful to first apply a log transform to the default rate. The reason for this is simply that default rates are bounded between zero and one, inclusive. This increases the likelihood that without the log transformation, the regression residuals will not satisfy the usual normality assumption. Thus, to improve the regression specification, we use the natural logarithm of the default rate (plus one basis point since some values of the default rate are zero) as the measure of realized default rates.[16]

In estimating the regressions, we use four different specifications. In the first, we use only the structural variables. In the second, we use only the credit spread. In the third, we use only the NBER recession indicator. In the fourth, we use all of the variables. Table 5 reports the results from estimating these specifications. The first set of four columns in Table 5 reports the coefficient estimates; the second set of four columns reports the Newey-West t-statistics for the coefficients.

Focusing first on the structural specification, Table 5 shows that the first and third lagged default rate variables are highly significant in all four specifications. This is consistent with earlier results showing that default rates display significant persistence. The first lagged value of the stock return is negative and highly significant. This negative sign is consistent with the implications of the structural framework in which an increase in the value of the underlying assets leads to an increase in the value of equity and a decrease in the probability of default. Similarly, the variance of stock returns is positive and significant. Again, this is consistent with the structural framework which implies that as volatility increases, the risk of a default increases.[17] The other structural variables are not significant in this specification.

[16]We reestimate the regressions using the untransformed default rate instead and obtain results very similar to those reported.

[17]Indeed, it is the total volatility of the firm, which consists of both systematic and idiosyncratic components, that matters for default rate prediction. Therefore, it is likely that our measure of volatility which proxies for systematic stock volatility underestimates the total volatility effect.

The results for the reduced-form specification again demonstrate that the first and third lagged default rate variables are highly significant. In contrast, the lagged corporate credit spreads have no incremental forecasting power for default rates and are not significant. This result parallels and complements the findings in Collin-Dufresne, Goldstein, and Martin (2001) who show that a considerable part of the time variation in credit spreads does not appear to be closely related to economic fundamentals driving default risk. Our findings suggest that the converse proposition holds: that credit spreads have little explanatory power for default risk. One possible interpretation of these results is that time variation in credit spreads is driven primarily by changes in credit and liquidity risk premia, and only marginally by changes in the actual probability of default.

The results for the macroeconomic specification are slightly stronger than for the reduced-form specification. In particular, the same lagged default rate variables are again significant. The first lagged value of the NBER recession indicator variable is positive and significant at the ten-percent level, suggesting that experiencing a recession during the current year weakly increases the default rate for the subsequent year.

Finally, by combining all of the variables into a single specification, we can directly compare their incremental forecasting power for default rates. As shown, three of the four structural variables are significant in this combined specification. In particular, the stock return is again negative in sign, consistent with the implications of the structural framework. The variance of the stock return again has a positive and significant effect on the default rate. In contrast, neither the lagged corporate credit spreads nor the NBER recession indicators are significant in the combined specification. Taken together, these results imply that the structural variables best describe the long-run behavior of default rates in the United States.

6. HOW DOES THE MARKET VALUE DEFAULT RISK?

Given this evidence about the determinants of corporate default risk, a logical next step is to examine whether corporate bonds are priced in a way that is consistent with the properties of realized default rates. In this section, we again use a regression framework to test whether recent default experience in the market maps into higher default spreads in the future.

6.1 Default Losses and Credit Spreads

As a preliminary to the analysis, it is interesting to first contrast long-run corporate default experience with historical corporate spreads. Recall that over the entire sample period, the average default rate is about 1.50 percent. Making the broad-brush assumption that corporate defaults only result in a 50 percent loss on average, a sim-

ple back-of-the-envelope computation suggests that average historical default losses during the study period are on the order of 75 basis points per year.[18] This estimate is surprisingly similar to the average default rate of 91.3 basis points for the 1982−2008 period reported in Table 29 of Moody's *Corporate Default and Recovery Rates, 1920−2008*.[19]

Ideally, we would like to compare the average default loss with the average yield spreads for the bonds in the sample. Note that the credit spread for high-quality bonds used in the regressions in the previous section, although providing a consistent measure of the historical variation in credit spreads, may understate the average spread for all bonds in the annual snapshot (since not all bonds are high-quality). Although we do not have yield data for the individual bonds in the annual snapshot, we approximate the average yield in the following way. For the 1866−1899 period, Macaulay (1938) reports yield data for a sample of long-term high-quality railroad bonds. Since his sample is tilted towards bonds with lower yields (although there is considerable variation in the yields reported), we use the maximum yield for the set of bonds included in his sample each year as the proxy for the value-weighted average yield for all bonds. For the 1900−1918 period, we use the quadrennial information in Table 49 of Hickman (1960) to calculate the weighted-average yield for all the bonds in market.[20] For the 1919−2008 period, we use the simple average of Moody's Aaa and Baa bond indexes (implicitly assuming that the average bond has a spread midway

[18]Hickman (1960) Table 152 implies that the average recovery rate of defaulted issues during the 1900−1944 period is about 62.5 percent of par value. Table 26 of Moody's *Corporate Default and Recovery Rates, 1920−2008* implies an average recovery rate of 41.4 percent for the 1982-2008 period. Thus, an assumed 50 percent recovery rate is broadly consistent with the historical experience.

[19]It is important to acknowledge that assuming a constant loss rate of 50 percent may not fully capture the economics of credit losses. One reason for this is that loss rates may vary over time as bankruptcy laws change, as the industry composition of the cross-section of issuers evolves, and as the degree of collateralization associated with bond issues varies. In addition, Altman, Brady, Resti, and Sironi (2005) have suggested that default rates are negatively correlated with recovery rates and, therefore, calculating expected loss from the mean values of these two variables could lead to an underestimation. Nevertheless, this assumption should provide a reasonable first approximation.

[20]Because of the quadrennial nature of the data, we cannot use it for purposes of estimating the regressions as in the previous section; the high-quality corporate bond index used in the previous section is much more appropriate for estimating the regressions because of its consistent composition over time. For the purposes of estimating the average value-weighted yield in the market, however, the Hickman data should be more representative of the market.

between these two indexes). As a robustness check for methodology used in obtaining the 1866−1899 estimates, we apply the methodology to Macaulay's data for 1900 and contrast it with that given by using the Hickman data. The resulting estimates for 1900 are very similar, giving average yields of 4.19 and 4.28 percent, respectively. Similarly, as a robustness check for the use of the average of the Moody's indexes, we contrast this average with the average yield implied by the Hickman data for 1920, 1924, and 1928. The average values of the yields given by the two methodologies over this period are nearly identical. We define the yield spread as the difference between our measure of corporate yields and the risk-free rate proxy described in Section 5.1.1.

This time series results in an average corporate yield spread over the 1866−2008 period of 153.3 basis points. Thus, the average yield spread is about 78 basis points higher than our back-of-the-envelope estimate of the historical default losses. This implies that the market appears to incorporate a risk premium of roughly 80 basis points into corporate bond prices. The standard deviation of the mean yield spread is 4.18 basis points. Thus, the difference between the mean yield spread of 153.3 and an expected loss rate of 75 basis points is highly statistically significant.

Alternatively, we can estimate the ratio of the expected risk-neutral credit losses to actual credit losses (the ratio of Q- and P-measure expected losses) by dividing the average yield spread of 153.3 basis points by the estimated average credit loss of 75 basis points, giving a value of 2.04. This ratio is often used in the empirical credit literature as a measure of the size of the credit premium (including both the premium for the event of default or jump risk and the premium for changes in the probability that default occurs). For example, Driessen (2005) estimates the ratio of the risk-neutral and actual intensities for a sample of 104 U.S. firms for the 1991−2000 period. He finds that the ratio for AA-rated, A-rated, and BBB-rated firms are 1.83, 2.61, and 2.37, respectively. Similarly, Berndt, Douglas, Duffie, Ferguson, and Schranz (2005) estimate the ratio for a sample of 94 U.S. firms using CDS spreads and KMV expected default frequencies for the 2000−2004 period. The mean of their estimated ratios is 2.8; the median of their estimated ratios is 2.0. Thus, our estimated ratio of 2.04 for the 1866−2008 period closely parallels the results in the literature based on much shorter time periods.[21]

It is important to provide a number of caveats in interpreting these results. First, we cannot assert that the corporate credit spreads implied by the data described above match precisely the credit spreads for the specific snapshot of bonds on which our estimates of defaults are based. Second, as discussed previously, the historical government bond yield data in Homer and Sylla (1991) does include data for State rather than Federal bond issues for some periods during the late 19th and early 20th Centuries. To the extent that these State issues carry more credit risk than Federal

[21]These results are also consistent with those implied by Almeida and Philippon (2007).

issues, then the estimated credit spreads could slightly underestimate the actual credit spread. Despite these caveats, however, these results provide intriguing evidence that the pricing of credit risk by financial markets is remarkably consistent over time. To investigate these results further, there is an urgent need for reliable long-run data on corporate credit pricing.

6.2 The Results for Credit Spreads

Motivated by the results above, we again use a regression framework to examine the extent to which corporate credit spreads respond to realized default rates and other market and macroeconomic variables. Specifically, we test whether credit spreads can be forecast on the basis of previous default rates, stock market returns, and NBER recession indicators. In theory, credit spreads should reflect changes in expected default rates over time, plus whatever risk/liquidity premia the market demands on corporate bonds. Given the strong persistence in default rates as they cluster over time, we would anticipate that the realized default rate for the current year would be informative about expected future default rates and, therefore, reflected in current and future credit spreads. In this analysis, we use the same variable definitions and data sources as described in Section 5.

Table 6 reports the results from four different specifications. The first includes only current and lagged default rate variables. The second includes only current and lagged stock market returns. The third includes only current and lagged NBER recession indicators. The fourth includes all of these variables. As before, the first set of four columns in Table 6 reports the coefficient estimates; the second set of four columns reports the Newey-West t-statistics for the coefficients.

The first lagged value of the credit spread is highly significant in each of the four specifications in Table 6. This is consistent with the highly persistent nature of credit spreads; the first order serial correlation coefficient for the credit spread during the sample period is 0.883.

Table 6 shows, however, that the current and lagged values of the default rate variables are not significant in either the separate or combined specifications. Thus, there is no evidence that credit spreads respond to the information in realized default rates (to the extent that such information is not already impounded into lagged spreads).

In contrast, Table 6 shows that there is a significant contemporaneous relation between credit spreads and the stock market return. The negative sign implies that spreads tighten as the stock market increases in value. This is again broadly consistent with the implications of the structural credit modeling framework. Finally, although several of the lagged NBER recession indicators are significant in the recession specification, none of these lagged values are significant in the combined specification.

7. CONCLUSION

We study the nature of corporate bond default risk using an extensive new data set covering the 1866−2008 period. This data set extends by nearly a century the horizon over which corporate bond default risk can be studied (relative to previous academic research in the literature).

A number of important findings emerge from this analysis. We find that the corporate bond markets have suffered many clustered default cycles, and that some of these have been much more severe than those experienced during the Great Depression. Default cycles tend to be less frequent but more persistent that NBER economic downturns. This is perhaps one reason why the correlation between the two types of cycles appears relatively weak.

Second, we study the determinants of corporate default risk using a number of variables suggested by theoretical models of credit risk. The results indicate that the variables suggested by structural models have significant forecasting power for corporate default rates. In particular, stock market returns and stock market return volatility have significant predictive ability. Surprisingly, credit spreads and the state of the economy as measured by an NBER-recession indicator do not have incremental forecasting power.

Finally, we consider how the market values credit risk over the long-term. We find that average credit spreads are roughly twice the estimated average default losses on corporate bonds. Thus, the ratio of risk-neutral to actual default losses is roughly two, consistent with a number of recent studies based on shorter sample periods. Furthermore, we find that credit spreads tend to be largely unaffected by recent default experience in the corporate bond market. This evidence is consistent with recent work by Collin-Dufresne, Goldstein, and Martin (2001) showing that credit spreads are driven by factors difficult to explain by standard credit models.

APPENDIX

In measuring the default rate, we focus on the set of corporate bonds that satisfy the following criteria. First, we include only bonds issued by U.S. corporations in the sample. This criterion excludes bonds issued by firms domiciled in other countries. Second, we include only bonds of nonfinancial corporations in the sample. Specifically, bonds for corporations in the banking, securities, real estate, insurance, mortgage, etc. industries are not included in the sample. This criterion also excludes the mortgage bonds that were widely used during the first part of the 20th Century to finance major hotels, office buildings, etc. Third, we include only bonds issued by private for-profit corporations; bonds issued by eleemosynary entities such as religious organizations and universities are excluded as are bonds issued by public sector entities such as sovereigns, states, and municipalities. Note, however, that bonds issued by utilities and street railroads are included since these issuers are in the private sector. As described below, a few additional criteria are imposed on the set of corporate bonds included in the sample during several of the subperiods. In each of these cases, however, the same criteria are applied to both the numerator and denominator of the default rate calculation. Thus, these additional restrictions likely have little effect on the estimated default rates.

A. Primary Data Sources

The data for the 1866−1899 period are extracted from the *Commercial and Financial Chronicle*. This weekly newspaper was founded in 1865 and was the first national business newspaper in the United States. During the 1866−1899 period, the *Commercial and Financial Chronicle* published extensive lists of the corporate bonds that were available in the financial markets, including bonds traded on the NYSE, all of the regional exchanges, as well as leading unlisted and inactive bonds. Thus, the listing of bonds in the *Commercial and Financial Chronicle* is far more extensive than simply the bonds actively traded at the major exchanges. In addition to providing listings of issuers and their bonds, the *Commercial and Financial Chronicle* also reported on key news items relating to these issuers and bonds such as missed coupons, defaults, bondholder committees, receiverships, reorganizations, bankruptcies, etc. As far as we can determine, the coverage of these news items appears to have been relatively comprehensive. In particular, the *Commercial and Financial Chronicle* reported news about financial distress not only for the issuers included in the annual snapshot, but also for many much smaller firms as well. Poor's manuals were used to cross-check some of the data obtained from the *Commercial and Financial Chronicle*.

The data for the 1900−1965 period are taken directly from two NBER sources. The first is a three-volume report on an extensive NBER research project during the 1940s and 1950s sponsored by the Works Project Administration and the Federal Deposit Insurance Corporation. This massive project was headed by W. Braddock Hickman and involved the efforts of more than two dozen researchers and research

assistants. The stated objectives of the project were, first, to provide basic statistical time series data on corporate bond financing that might be useful to researchers and, second, to analyze and interpret the data. As part of this research, extensive data were collected on both the par amounts of outstanding bonds and bonds entering into default each year. The scope, methodology, and results of this research project are thoroughly documented in Hickman (1953, 1958, 1960). The second source is based on a subsequent NBER project in which Hickman's study was extended to cover the 1944−1965 period using essentially the same methodology. This research project is extensively documented in Atkinson (1967). The *Commercial and Financial Chronicle* was used to cross-check data for some years in this subperiod.

The data for the 1966−2008 period comes from three different sources. The first is data on the par amount of all domestic nonfinancial bonds and is tabulated by the Federal Reserve. This data is based on industry sources and is computed by tabulating the total amount of new corporate bond issuance and extinguishments each year. The second source for this period is again the *Commercial and Financial Chronicle* which is used in identifying firms entering into default during the 1966−1969 period. The third source is a data set provided to us by Moody's covering the 1970−2008 period and is extracted from the data underlying Moody's *Corporate Default and Recovery Rates, 1920−2008* publication. Specifically, we extract default amounts for U.S. nonfinancial firms from the larger Moody's data set of bonds for all issuers (including global and financial issuers). The data and methodology used by Moody's in determining these numbers are also described in this publication.

B. The Annual Time Series

The annual default rate is computed as the ratio of the annual default amount to the par value of all bonds in the annual snapshot. Recall that the annual snapshot consists of all bonds listed in the historical data source at the beginning of the year. The annual default amount is the total par amount of the subset of bonds that are included in the annual snapshot and whose issuers enter into financial distress during the year.

For the 1866−1877 period, the annual snapshot consists of all bonds included in the first weekly Bond List published by the *Commercial and Financial Chronicle* each year. For several years, this source is missing. In these cases, we use the prior year's snapshot as that year's snapshot. The annual default amounts are obtained by totaling the par amounts of bonds for issuers entering financial distress, where these issuers are identified by reports provided in the *Commercial and Financial Chronicle.*

For the 1878−1899 period, a comprehensive listing of corporate bonds appears in the January supplement to the *Commercial and Financial Chronicle.* The listing of corporate issuers in this supplement is titled *General Quotations of Bonds and Stocks.* The *Commercial and Financial Chronicle* describes this listing as providing quotations for "all securities listed on any Stock Exchange in the United States, and

for all leading unlisted and inactive securities for which we are able to obtain reliable prices." In general, the number of issuers in this listing is typically several times as large as the number of issuers with bonds that are actively traded on the NYSE.

Although comprehensive, this listing of bonds does not provide par amounts for the bonds for the 1878−1899 period. Thus, we use the following algorithm in estimating the default rates for this period. First, we count the number of bond issues listed in the supplement at the beginning of each year during this period. An analysis using data for 1876 indicates that there is a very high correlation between the par amount of debt of a corporate issuer and the number of bond issues for that issuer. This high correlation holds since the vast majority of bond issuers during this period are in the railroad industry. Second, for each year, we count the number of bonds included in that year's snapshot that enter into financial distress. To calculate the default rate for these years, we then divide the total number of defaulted bond issues by the total number of bond issues in the supplement. As a robustness check for this methodology, we apply it to several of the years during the 1866−1878 period. We find that this methodology results in estimates of the default rates for these years that are very close to those obtained based on par values.

For the 1900−1943 period, the total par amount of the bonds in the annual snapshot comes from the total par amounts for U.S. nonfinancial firms that appear in Table A-6 of Hickman (1953). As described in Hickman, the scope of his study does not include a 100-percent tabulation of all corporate bonds. Rather, Hickman tabulates par values for all bond issues with aggregate par amount of $5 million or more (the large issues sample), and then tabulates additional par values for a ten-percent random sample of the remainder of bonds for which data are available. The par value of the bonds included in the large issues sample, however, represents the overwhelming majority of the estimated total par value of all corporate bonds. Thus, there is little loss of generality from limiting our attention to the large issues sample of bonds that is exhaustively tabulated by Hickman (as opposed to the small issues sample that is only statistically sampled). The total par value of bonds that default each year (and are included in the total value of all bonds at the beginning of the year) is given as the all industries total in the large issues section of Table 136 of Hickman (1960).

We observe that the Hickman study focuses on straight bonds (single-maturity obligations), and excludes several other categories of bonds such as equipment trust bonds, income bonds, convertible bonds, and serial bonds. As discussed by Hickman, however, these other categories of bonds represent only a small fraction of total par value of bonds in his sample. Since both the total par value of bonds in the snapshot and the par value of defaulted bonds are based on the same categories of bonds, there should be little impact on the estimated default rate as a result of Hickman's focus on straight bonds.

For the 1944 to 1965 period, the total par value of corporate bonds at the be-

ginning of each year and the total par value of corporate bonds defaulting during the year are provided in Table 21 of Atkinson (1967). As is described in Atkinson, his study closely follows the methodology used in Hickman (1953, 1958, 1960). The key difference between the two studies is that Atkinson broadens his focus to include most categories of corporate bonds (rather than just straight bonds).

As robustness checks for both the Hickman (1953, 1960) and Atkinson (1967) data, we tabulated the total number of bond issuers at the beginning of each year during this period as well as the number of bond issuers entering into financial distress each year using the *Commercial and Financial Chronicle* and a methodology similar to that described above for the 1866−1899 period. The default rates based on issuers were very similar to those obtained using the Hickman and Atkinson data. In addition, we compared the default rates implied by the Hickman and Atkinson data with those reported in the Moody's *Corporate Default and Recovery Rates, 1920−2008* publication. Even though the Moody's results include both foreign issuers and financial issuers, there was generally close agreement between their results and those implied by the Hickman and Atkinson data sets. See Carty and Lieberman (1997) for a discussion of how differences between Hickman's results and those of Moody's can be reconciled. Appendix C of Hickman (1953) also conducts an in-depth comparison of their data with a number of other contemporary sources including the *Commercial and Financial Chronicle*, the *Journal of Commerce*, and estimates provided by the Securities and Exchange Commission, the Interstate Commerce Commission, and the National Industrial Conference Board.

For the 1966−2008 period, the total par value of corporate bonds at the beginning of each year is given from line 7 of Table L.2 Credit Market Debt Owed by Nonfinancial Sectors of the Federal Reserve Board's Flow of Funds Accounts of the United States Z.1 statistical release (see historical statistical releases for earlier data) for the end of the preceeding year. As a robustness check, we compared the Federal Reserve data with that of Atkinson for the mid-1960s and found that the two estimates of the total par value of the corporate bonds were very similar. Furthermore, we compared the Federal Reserve estimates with those reported by the Securities Industry and Financial Markets Association (SIFMA) for the 1995−2008 period and found close agreement between the two sources.

In determining the total par value of defaulted bonds for the 1966−2008 period, we used two different sources. For the 1966−1969 period, we again examined the *Commercial and Financial Chronicle* for news reports about firms entering into financial distress. For the 1970−2008 period, we used the data set described above that was provided to us by Moody's and extracted the par amounts of defaulted bonds for domestic nonfinancial issuers.

During the middle to latter part of the 19th Century, the corporate bond market consisted primarily of railroad and canal bonds. During this period, however, there were also a number of industrial and financial bond issues in the market. For exam-

ple, the 1866 *Commercial and Financial Chronicle* lists 138 railroad bond issuers, 14 canal bond issuers, and 6 industrial bond issuers. The set of industrial bond issuers includes Western Union, three coal and mining firms, and two bridges. Near the end of the 19th Century, the corporate bonds included in the sample consisted of railroad bonds, street railroad bonds, gas and other utility bonds, and numerous miscellaneous industrial bonds. After World War I, the corporate bonds were recategorized simply as railroad, utility, and industrial bonds. For detailed descriptions composition of the corporate bond market by industry, see Hickman (1953), Atkinson (1967), and Moody's classifications of corporate bonds

C. The Definition of Financial Distress

To identify the bonds included in the snapshot that enter into financial distress each year, we use the following procedure. For each year from 1866 to 1899, we examined each weekly issue of the *Commercial and Financial Chronicle*. Whenever a news item is reported relating to the financial distress of an issuer, we check whether bonds of that issuer are included in the sample for that year. As is standard in the literature on estimating default rates, a parent firm is assumed to enter financial distress when any of its subsidiaries enter financial distress. Typical reports include such events as missed coupon payments, defaults, bondholder committee meetings, entering into receivership, bankruptcy, reorganization, etc. If the issuer is represented in the sample, then we determine whether the report represents the initial indication of financial distress for that issuer. For example, imagine that an issuer is first reported in 1873 as defaulting on a bond issue. Then subsequent reports of entering into receivership in 1874, of the scheduling of a bondholders committee meeting in 1875, and a bankruptcy or reorganization in 1876 would not be included as initial events of financial distress.

To provide a uniform standard for identifying initial events of financial distress for the 1866−1899 period, we use the following algorithm. If there have been no previous reports of financial distress for the issuer, then the report is viewed as an initial event. If more than five years have elapsed since a previous report for the issuer appeared, then the new report is identified as an initial event, unless the previous report clearly indicates that the firm has exiting financial distress (bankruptcy, reorganization, or reaching an accord with the bondholders). For each year, we total the par value of bonds (or the number of bond issues) of distinct issuers entering into financial distress based on this algorithm and use this number as the numerator in determining the percentage of defaults for that year. We follow the same procedure for the 1966−1969 period.

The definition of financial distress used by Hickman is described in Chapter 5 of Hickman (1953). Atkinson (1967) uses a similar definition of financial distress in his extension of Hickman's study. Moody's definition of financial distress is documented in the Appendix to Moody's *Corporate Default and Recovery Rates, 1920−2008* publication.

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Table 1

Summary Statistics for Annual Corporate Bond Default Rates from 1866 to 2008. This table reports the indicated summary statistics for the annual percentage default rates of U.S. nonfinancial corporate bonds for the 1866-2008 period and the indicated subperiods.

Summary Statistic	1866-1899	1900-1945	1946-2008	1866-2008
Mean	3.998	1.345	0.304	1.517
Standard Deviation	3.571	1.383	0.530	2.414
Skewness	2.012	1.853	3.233	3.307
Kurtosis	4.725	4.127	12.783	14.686
Minimum	0.000	0.107	0.000	0.000
25th Percentile	1.978	0.347	0.009	0.131
Median	3.022	0.903	0.098	0.545
75th Percentile	5.195	1.957	0.380	2.096
Maximum	16.255	6.725	3.071	16.255
Serial Correlation	0.388	0.450	0.680	0.628
Number of Observations	34	46	63	143

Table 2

Default Cycles. This table lists the dates for the default cycles during the 1866-2008 sample period, where a default cycle is defined as a contiguous period during which annual default rates exceed the unconditional mean default rate of 1.517 percent. The length of the default cycle is measured in years. Default rates are expressed as percentages.

Date of Cycle	Length of Cycle	Average Default Rate	Maximum Default Rate	Historical Background
1866-1866	1	2.54	2.54	Post Civil War adjustment
1869-1869	1	7.13	7.13	Linking of coasts by railroad
1871-1880	10	6.04	16.25	Railroad boom and crash
1883-1889	7	3.68	6.37	Major bank panic of 1884
1891-1898	8	4.36	9.32	Major bank panic of 1893
1904-1904	1	2.97	2.97	Roosevelt, Panama Canal
1908-1908	1	2.10	2.10	Stock market panic
1914-1915	2	4.19	4.48	First World War
1919-1919	1	2.23	2.23	Post First World War adjustment
1931-1935	5	3.67	6.73	Great Depression
1938-1939	2	2.67	2.84	Great Depression
1990-1990	1	1.56	1.56	Junk bond defaults
2001-2002	2	2.54	3.07	Dot-com crisis

Table 3

The Most-Severe Three-Year Default Periods. This table lists the dates for the 12 top three-year default periods during the 1866-2008 sample period. Total default is the sum of the annual default rates during each three-year period. Stock return is the sum of the annual stock market returns for each three-year period. NBER Fraction is the proportion of time during each three-year period that the economy was in an NBER-designated business downturn. Default rates are expressed as percentages.

Rank	Period	Total Default	Maximum Default	Stock Return	NBER Fraction
1	1873-1875	35.90	16.25	1.50	0.72
2	1892-1894	18.69	9.32	−5.46	0.47
3	1883-1885	16.06	6.38	5.36	0.81
4	1933-1935	12.88	6.73	35.54	0.08
5	1876-1878	12.51	5.94	−1.29	1.00
6	1869-1871	11.41	4.14	10.06	0.50
7	1914-1916	9.59	4.48	15.98	0.33
8	1896-1898	8.91	3.73	18.74	0.50
9	1887-1889	7.71	2.91	5.17	0.36
10	1938-1940	6.67	2.84	7.61	0.17
11	1879-1881	6.16	3.14	26.14	0.08
12	2000-2002	6.15	3.07	−14.40	0.22

Table 4

Summary Statistics for the Explanatory Variables. This table reports the indicated summary statistics for the explanatory variables. Stock Return is the annual return on the U.S. stock market. Volatility is the annualized standard deviation of monthly stock returns for each year. Riskfree rate is the yield on government bonds. Slope is the difference between the yield on high-quality corporate bonds and the short-term commercial paper rate. Spread is the difference between the yield on high-quality corporate bonds and the yield on government bonds with the same maturity. Recession is the fraction of each year that the economy is in a NBER-designated business downturn.

Variable	Statistic	1866-1899	1900-1945	1946-2008	1866-2008
Stock Return	Mean	0.078	0.104	0.117	0.103
	Median	0.074	0.117	0.142	0.107
	Standard Deviation	0.138	0.234	0.178	0.190
	Serial Correlation	0.169	0.033	-0.049	0.019
Volatility	Mean	0.132	0.178	0.136	0.149
	Median	0.119	0.144	0.124	0.136
	Standard Deviation	0.051	0.115	0.053	0.080
	Serial Correlation	0.142	0.717	0.234	0.593
Riskfree Rate	Mean	4.190	3.532	5.802	4.688
	Median	3.700	3.525	5.620	4.060
	Standard Deviation	0.837	0.790	2.601	2.087
	Serial Correlation	0.979	0.949	0.949	0.963
Slope	Mean	-1.002	0.260	1.529	0.519
	Median	-0.890	0.010	1.310	0.470
	Standard Deviation	1.096	1.476	1.351	1.672
	Serial Correlation	0.068	0.844	0.558	0.744
Spread	Mean	0.447	0.285	0.919	0.603
	Median	0.440	0.200	0.910	0.470
	Standard Deviation	0.368	0.360	0.527	0.526
	Serial Correlation	0.924	0.775	0.830	0.883
Recession	Mean	0.512	0.384	0.153	0.313
	Median	0.500	0.250	0.000	0.000
	Standard Deviation	0.418	0.398	0.287	0.386
	Serial Correlation	0.186	0.173	0.030	0.264
Number of Observations		34	46	63	143

Table 5

Regression Results for Corporate Default Rates. This table reports the coefficient estimates and their Newey-West t-statistics from the indicated regression specifications. In each specification, the log of the annual default rate is the dependent variable, and the independent variables are as shown. Stock Return is the annual return on the U.S. stock market. Variance is the annualized variance of monthly stock returns for each year. Riskfree rate is the yield on government bonds. Slope is the difference between the yield on high-quality corporate bonds and the short-term commercial paper rate. Spread is the difference between the yield on high-quality corporate bonds and the yield on government bonds with the same maturity. Recession is the fraction of each year that the economy is in a NBER-designated business downturn.

		Coefficients				t-Statistics			
Variable	Lag	Structural	Reduced	Macro	Combined	Structural	Reduced	Macro	Combined
Default Rate	1	0.351	0.483	0.445	0.346	4.08	6.23	5.66	3.93
	2	0.153	0.144	0.143	0.163	1.50	1.57	1.45	1.65
	3	0.351	0.292	0.282	0.342	3.30	3.01	2.96	3.34
Stock Return	1	−1.551			−1.807	−3.08			−3.07
	2	0.091			0.270	0.16			0.46
	3	−0.143			0.128	−0.27			0.22
Variance	1	5.355			5.704	2.84			2.86
	2	−0.629			−0.731	−0.28			−0.32
	3	0.205			0.301	0.09			0.13
Riskfree Rate	1	−0.139			−0.238	−0.83			−1.54
	2	0.234			0.352	1.27			1.96
	3	0.033			−0.003	0.29			−0.03
Slope	1	−0.106			−0.148	−1.05			−1.43
	2	−0.181			−0.178	−1.72			−1.49
	3	0.092			0.093	1.47			1.10
Spread	1		0.215		−0.406		0.62		−1.21
	2		0.037		0.503		0.07		1.08
	3		−0.094		0.037		−0.29		0.11
Recession	1			0.538	−0.260			1.81	−0.67
	2			0.077	0.341			0.27	1.31
	3			−0.043	−0.181			−0.19	−0.53
Adj. R^2		0.752	0.699	0.708	0.747	–	–	–	–

Table 6

Regression Results for Corporate Credit Spreads. This table reports the coefficient estimates and their Newey-West t-statistics from the indicated regression specifications. In each specification, the credit spread is the dependent variable, and the independent variables are as shown. Spread is the difference between the yield on high-quality corporate bonds and the yield on government bonds with the same maturity. Default rate is the log of the annual default rate. Stock Return is the annual return on the U.S. stock market. Recession is the fraction of each year that the economy is in a NBER-designated business downturn.

		Coefficients				t-Statistics			
Variable	Lag	Default	Return	Recession	Combined	Default	Return	Recession	Combined
Credit Spread									
	1	0.786	0.781	0.787	0.753	8.04	7.77	7.78	7.05
	2	0.122	0.205	0.168	0.212	1.30	1.80	1.72	1.78
	3	−0.020	−0.073	−0.055	−0.066	−0.28	−1.03	−0.81	−0.92
Default Rate	0	0.010			0.010	0.46			0.48
	1	−0.014			−0.010	−0.73			−0.51
	2	−0.010			−0.007	−0.72			−0.45
	3	−0.007			−0.008	−0.46			−0.45
Stock Return	0		−0.333		−0.282		−2.42		−2.13
	1		0.135		0.187		1.31		1.68
	2		0.108		0.095		1.15		0.68
	3		0.201		0.154		1.93		1.18
Recession	0			0.137	0.111			1.63	1.28
	1			−0.133	−0.048			−2.37	−0.61
	2			0.010	0.039			0.21	0.66
	3			−0.130	−0.109			−1.88	−1.58
Adj. R^2		0.775	0.792	0.787	0.792	–	–	–	–