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The Response of Corporate Financing and Investment to Changes in the Supply of Credit

Michael Lemmon and Michael R. Roberts*

Abstract

We examine how shocks to the supply of credit impact corporate financing and investment using the collapse of Drexel Burnham Lambert, Inc.; the passage of the Financial Institutions Reform, Recovery, and Enforcement Act of 1989; and regulatory changes in the insurance industry as an exogenous contraction in the supply of below-investment-grade credit after 1989. A difference-in-differences empirical strategy reveals that substitution to bank debt and alternative sources of capital (e.g., equity, cash balances, and trade credit) was limited, leading to an almost one-for-one decline in net investment with the decline in net debt issuances. Despite this sharp change in behavior, corporate leverage ratios remained relatively stable, a result of the contemporaneous decline in debt issuances and investment. Overall, our findings highlight how even large firms with access to public credit markets are susceptible to fluctuations in the supply of capital.

I. Introduction

Fluctuations in the supply of financial capital flowing to different sectors of the market can be extreme.[1] Coupled with the presence of financing frictions,

*Lemmon, finmll@business.utah.edu, Eccles School of Business, University of Utah, 1645 E. Campus Center Dr., Rm. 109, Salt Lake City, UT 84112; Roberts, mrrobert@wharton.upenn.edu, Wharton School, University of Pennsylvania, 3620 Locust Walk, Ste. 2300, Philadelphia, PA 19104. We are especially grateful for helpful comments from an anonymous referee, Paul Malatesta (the editor), and Mitchell Petersen. We also thank Andy Abel, Marshall Blume, David Chapman, Darrell Duffie, Itay Goldstein, Joao Gomes, Wei Jiang, Arvind Krishnamurthy, Augustin Landier, David Matsa, Andrew Metrick, Toby Moskowitz, Stewart Myers, Vinay Nair, Josh Rauh, Andreea Roman, Nick Souleles, Phil Strahan, Amir Sufi, Petra Todd, Greg Udell, Toni Whited, Julie Xu, and Rebecca Zarutskie; seminar participants at Boston College, Massachusetts Institute of Technology, Northwestern University, Norwegian School of Management (BI), Stanford University, University of Arizona, University of Chicago, University of Indiana, University of Pennsylvania, and University of Wisconsin-Madison; and conference participants at the 2006 University of British Columbia Summer Finance Conference and 2007 Princeton/New York Federal Reserve Conference on Liquidity. Roberts gratefully acknowledges financial support from a Rodney L. White Grant and an NYSE Research Fellowship.

[1] As recently noted in *BusinessWeek* (January 29, 2007): "Foreign investors are shipping gobs of cash into the U.S. At the same time, there has been an explosion of hedge funds, distressed debt traders, and others eager to buy junk-rated debt for the higher yields it offers. . . . Together, these factors have combined to create unheard-of pools of liquidity [that have] made funding readily available [to] companies."

such as adverse selection (e.g., Stiglitz and Weiss (1981)) or moral hazard (e.g., Holmstrom and Tirole (1997)), these fluctuations can impact financing and investment. In this paper we study how changes in the supply of capital affect firm financing and investment by focusing on the sharp decline of capital flows to the speculative-grade debt market that occurred in 1989.

Understanding whether the supply of capital corresponds to a separate channel, independent of demand, through which market imperfections influence corporate behavior, is important for several reasons. First, the supply of capital may play an important role in the transmission of monetary policy (Bernanke and Gertler (1989), Kashyap, Lamont, and Stein (1994)). Second, fluctuations in the supply of capital may play an important role, more generally, in determining the financial and investment policies of firms, outside of monetary policy regime changes (Faulkender and Petersen (2006), Leary (2007), and Sufi (2009)). Finally, surveys of corporate managers and financial intermediaries suggest a dichotomy in how academics and practitioners tend to view financing decisions: The former perceive decisions as governed by the demands of the users of capital; the latter perceive decisions as governed by the preferences of the suppliers of capital (Titman (2001), Graham and Harvey (2001)).

However, identifying a linkage between the supply of capital and corporate behavior is difficult because of the fundamental simultaneity occurring between supply and demand. This task is further complicated by an inability to precisely measure investment opportunities or productivity shocks. The goal of this paper is to address these issues and to identify the extent to which variations in the supply of capital influence corporate financial and investment policies. To do so, we use three near-concurrent events as an exogenous shock to the supply of credit to below-investment-grade firms after 1989: i) the collapse of Drexel Burnham Lambert, Inc. (Drexel); ii) the passage of the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA); and iii) a change in the National Association of Insurance Companies (NAIC) credit rating guidelines.

The disappearance of Drexel led to a significant reduction in capital available to non-investment-grade firms by investors whose participation relied on Drexel's presence as both an originator and intermediary (Benveniste, Singh, and Wilhelm (1993)). Likewise, the passage of FIRREA led to an immediate cessation of the $12 billion annual flow of capital to speculative-grade firms from savings and loans (S&Ls), while simultaneously forcing a sell-off of all junk bond holdings by S&Ls. Finally, commitments by life insurance companies to purchase below-investment-grade debt fell by 60% in 1990 and continued to fall over the next 2 years, after the NAIC changed its ratings of corporate debt to mimic those used by nationally recognized statistical rating organizations (NRSROs) (e.g., Moody's, Standard & Poor's (S&P)). Importantly, we show that the primary impetus for each of the three events is largely removed from nonfinancial firms' demands for financing and investment; that is, the shocks are exogenous with respect to firm demand. In concert, these three events led to the near disappearance of the market for below-investment-grade debt—both public and private placements—after 1989.

The specificity of these events to the speculative-grade debt market enables us to employ a difference-in-differences empirical approach that helps to identify

both the direction and magnitude of the supply shock's impact on firm behavior. Our findings reveal that the supply shock had significant implications for the financing and investment behavior of below-investment-grade firms after 1989. As a whole, below-investment-grade firms decreased their total net security issuances (debt plus equity) by approximately 5% of assets relative to a propensity-score-matched control group of unrated firms. Economically, this decline corresponds to a near halving of net security issuances relative to pre-1990 levels and is driven entirely by a decline in net debt issuing activity, which fell by approximately 66% relative to pre-1990 levels. Additionally, we observe almost no substitution by below-investment-grade firms to alternative sources of financing such as equity, trade credit, or internal funds, and no change in dividend policy. The ultimate consequence of this reduction in debt issuing activity and lack of substitution is a one-for-one decline in net investment of 5% of assets, a 33% decline relative to pre-1990 levels.

We also investigate cross-sectional variation in the impact of the supply shock by identifying variation in the costs of switching to alternative sources of funds. For example, bank lending contracted relatively more sharply in the Northeast part of the U.S. during 1990 and 1991—a consequence of eroding bank capital driven by declining real estate prices (Bernanke and Lown (1991), Peek and Rosengren (1995)). This geographic heterogeneity in the availability of bank credit and the fact that firms tend to borrow from local banks (Bharath, Dahiya, Saunders, and Srinivasan (2007)) enables us to use the location of firms' headquarters as an instrument to identify the impact of the contraction in intermediary capital on firm behavior.

We show that below-investment-grade firms with headquarters located in the Northeast experienced a decline in net security issuing activity equal to 6% of assets relative to the change experienced by below-investment-grade firms with headquarters in other parts of the country. Again, this decline is concentrated almost entirely in net debt issuing activity, with little or no substitution to alternative sources of finance. Consequently, net investment declined one-for-one (6%) with decreased financing activity. Importantly, we show that these effects are found only among below-investment-grade firms; neither investment-grade nor unrated firms reveal any significant changes in financing or investment behavior as a function of geography, thereby ensuring that our findings are not a consequence of geographic heterogeneity in aggregate productivity shocks or the severity of the 1990–1991 recession. Thus, for firms facing higher borrowing costs because of less intermediary capital, we see a more pronounced response to the credit contraction in the speculative debt market.

In addition to geographic heterogeneity, we also find that riskier below-investment-grade firms (those rated B+ or lower) had a different response to the credit contraction relative to less risky below-investment-grade firms (those rated BB– to BB+). Specifically, riskier firms experienced a sharper decline in net security issuances and net investment relative to their less risky counterparts. Riskier firms also experienced a more protracted decline in net security issuances and net investment, lasting for 4 years after the shock. The more highly rated firms, on the other hand, experienced a meaningful change in financing and investment behavior for only the first 2 years following the shock. Thus, for riskier firms requiring

more monitoring or facing greater incentive problems, we also see a more pronounced response to the credit contraction.

Overall, our findings support the view that shifts in the supply of capital can have significant consequences for the financial and investment policies of firms, while our study makes three contributions. First, our examination of the speculative-grade market is particularly revealing in that even firms with access to public debt markets can be significantly affected by fluctuations in the supply of credit.[2] This result is somewhat surprising for several reasons. First, previous studies that investigate how the supply of credit affects firm behavior have often used firms with access to public debt markets as a comparison or control group, implicitly assuming that these firms are relatively immune to credit supply fluctuations (e.g., Kashyap et al. (1994), Faulkender and Petersen (2006)).

A second reason is that speculative-grade firms are 4 times larger and 4 times more profitable than unrated, bank-dependent firms, on average. This characteristic also contrasts with results from previous work relying on large firms as a comparison group that is relatively immune to credit supply fluctuations (e.g., Gertler and Gilchrist (1994), Leary (2007)). Finally, despite using relatively more debt, speculative-grade firms are significantly financially healthier than unrated firms, as indicated by higher Altman Z-scores. That is, counter to their colloquial name, "junk firms" are anything but marginal, excessively risky firms, on average, when compared to the bank-dependent firms studied throughout much of the previous literature. Thus, our results complement previous studies by showing that the real effects of shocks to the supply of capital are not limited to small, bank-dependent firms.

Finally, our study also reveals that shocks to capital market sectors other than the banking sector can impact corporate behavior. Most previous studies focus exclusively on shocks to bank capital or on the role of bank lending in influencing corporate behavior. For example, Gertler and Gilchrist (1994), Kashyap, Stein, and Wilcox (1993), and Kashyap et al. (1994) examine the impact of tighter monetary policy on corporate behavior. Sufi (2009) examines the introduction of syndicated loan ratings in 1995, while Leary (2007) examines the introduction of the certificate of deposit and binding interest rate ceilings that occurred during the 1960s.[3]

The second contribution is that some of our results provide a contrast with recent evidence suggesting an important role for the supply of credit in determining leverage ratios. Interestingly, though net debt issuing activity contracted quite sharply in our sample, we find that the combined effect of reduced debt issuances and investment results in relatively stable leverage ratios for below-investment-grade firms during this period. This finding differs from those of Faulkender and

[2]New junk bond issuances have averaged $127 billion per year since 2002, when new issuances were $62 billion, according to Moody's. Leveraged loan (i.e., high-yield credit agreements) issuances have tripled since 2002, increasing to $480 billion last year, according to S&P's Leveraged Commentary and Data (LCD) unit.

[3]Other studies examining the effect of shocks to the banking sector on firm behavior include Chava and Purnanandam (2006), who examine the short-run impact of the Russian crisis on bank-dependent borrowers' equity returns, and Zarutskie (2006), who examines the impact of the Riegle-Neal Act on newly formed firms.

Petersen (2006), Sufi (2009), and Leary (2007), all of whom suggest that supply shifts significantly impact corporate leverage. Thus, the role played by supply-side factors in determining variation in leverage ratios is, perhaps, limited to particular instances.

While our study falls short of a controlled experiment, we believe that it takes an important step forward relative to previous studies in terms of addressing the basic identification problem of disentangling supply-side and demand-side forces. Indeed, Oliner and Rudebusch ((1996), p. 308) emphasize this identification problem by arguing that it is the "shortcoming of most previous empirical work on the bank lending channel." Our study investigates a *local* supply shock affecting a well-defined segment of the corporate population, which provides for a more natural treatment-control delineation relative to previous studies that investigate broader shocks affecting all firms (or all public firms). We also explicitly examine the identifying assumption (i.e., the "parallel trends" assumption) behind the difference-in-differences framework. Finally, by investigating cross-sectional variation in the corporate response to the supply shock, we are able to point to a specific source of exogenous variation (i.e., the geographic location of firms' headquarters) that we use to identify the impact of the credit contraction.

The remainder of the paper proceeds as follows. Section II describes the events generating the supply shock and the economic environment surrounding the shock. Section III discusses various theories of why fluctuations in the supply of capital might affect corporate behavior. Section IV introduces the data and the basic empirical strategy. Section V presents the results of our analysis. Section VI concludes.

II. Background and Macroeconomic Environment

The goal of this section is threefold. First, we establish a link between the three events and the supply of capital to below-investment-grade firms. Second, we argue that these three events are largely exogenous with respect to nonfinancial corporate demand for debt financing and investment. Finally, we discuss the macroeconomic environment surrounding our time period of interest, paying close attention to the recession occurring in 1990 and 1991. References to the literature surrounding these issues are provided for further details.

A. The Rise and Fall of Speculative-Grade Credit

Prior to 1977, junk bonds consisted primarily of bonds originally issued as investment-grade securities that were subsequently downgraded to speculative grade, so-called "fallen angels" (Simonson (2000)). Shortly after 1977, firms began issuing a nonnegligible amount of speculative-grade securities (Asquith, Mullins, and Wolff (1989)). Figure 1 presents the rate of issuance for speculative-grade bonds, expressed as a percentage of total stock market capitalization.[4]

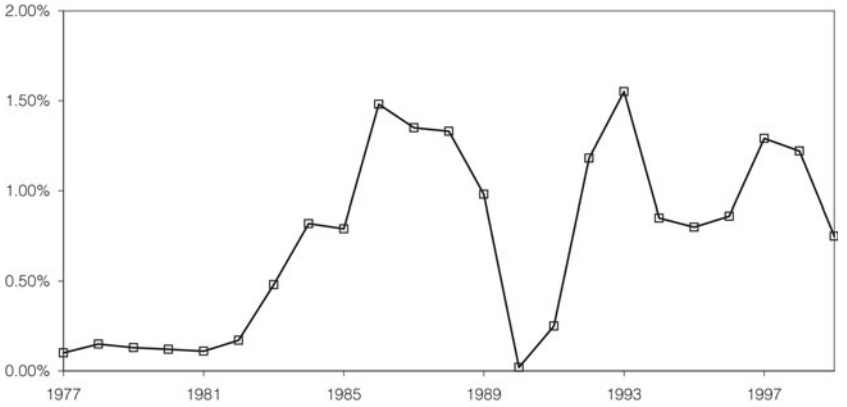
[4]We are grateful to Bengt Holmstrom and Steve Kaplan for allowing us to reproduce this figure from Holmstrom and Kaplan ((2001), Fig. 5).

Evident from the figure is the rapid increase in the rate of issuance beginning in 1983 and the subsequent plateau in 1986, a time when much of the issuing activity was directed at acquisitions (Holmstrom and Kaplan (2001)). After a slight decline in 1989, net issuances all but disappear in 1990 and 1991 before rebounding in 1992.

FIGURE 1

Below-Investment-Grade Issuance Volume

Figure 1 presents the rate of below-investment-grade bond issuances as a percent of total stock market capitalization from 1977 to 1999. The data are kindly provided by Bengt Holmstrom and Steven Kaplan, who present a similar figure in Holmstrom and Kaplan ((2001), Fig. 5).



The first event contributing to the decline in junk bond issuances after 1989 was the collapse of Drexel. Following the indictment of its chief financier, Michael Milken, in March of 1989, Drexel pleaded guilty in September of 1989 to 6 felony counts of insider trading activity, securities market manipulation, and tax evasion. This plea preceded Drexel's bankruptcy filing in February of 1990. Prior to this plea, Drexel and Milken were responsible for 46% of the total number and 57% of the dollar value of junk bond issuances from 1978 to 1989 (Benveniste et al. (1993), Simonson (2000)). Even during its last full year of operation, 1989, Drexel maintained a 38.6% market share of new issue dollars—approximately 4 times the market shares of its closest competitors, Shearson Lehman and Morgan Stanley (Benveniste et al.). Thus, the departure of Drexel after 1989 created a significant gap in the origination of speculative-grade debt.

Equally important, the departure of Drexel created an important gap in the secondary market for junk debt. Drexel was the primary source of junk bond prices (*The Wall Street Journal*, March 16, 1990), and, as Benveniste et al. ((1993), p. 109) note, "their willingness to commit capital to carrying inventory made them an important source of liquidity in the market." This willingness to provide liquidity using the firms' own funds maintained investor confidence in the junk bond market—a confidence that was irreversibly shattered upon Milken's departure (*The Wall Street Journal*, June 6, 1990). Thus, the departure of Drexel led to a significant reduction in the flow of capital to junk bond issuers via two channels,

in addition to origination services: a direct and an indirect channel. The direct channel was the removal of Drexel funds from the market. The indirect channel was the removal of funds from investors whose participation relied on Drexel's presence.

The second event contributing to the decline in junk bond issuances was the passage of FIRREA in 1989.[5] A response to the S&L crisis that emerged in the 1980s, FIRREA required financial thrifts regulated by the Federal Deposit Insurance Corporation (FDIC) to liquidate their holdings of below-investment-grade debt by 1994 and prevented future investments in similar securities after 1989.[6] This regulation had a large impact on the supply of capital to below-investment-grade firms because S&Ls were responsible for purchasing a significant fraction of junk bond issuances.

Panel A of Table 1 presents the total junk bond holdings by S&Ls from 1985 to 1989 and is taken from the data in Table 1 of Brewer and Mondschean (1994). Also presented in Panel A is the aggregate principal amount of new issues over the same time period obtained from the Securities Data Company (SDC) new issues database. All values are deflated by the gross domestic product (GDP) deflator to year-end 1989 dollars. A casual comparison of the holdings by S&Ls and the flow of new funds suggests that S&Ls held a significant fraction of the outstanding speculative-grade debt, though we caution against a literal interpretation of the ratio of total holdings (a stock) to principal amount of new issues (a flow).[7] Nonetheless, the exclusion of S&Ls from this market by FIRREA coincided with a meaningful decrease in the supply of capital to speculative-grade borrowers. Thus, as Brewer and Mondschean simply note, "The FIRREA restrictions have adversely affected the low-grade-bond market by eliminating a potential source of demand [by investors] for these securities" (p. 146).

Contemporaneous with the decline in speculative-grade *public* debt was a similar decline in funds channeled to speculative-grade *private* debt. Prior to 1990, life insurance companies were "the major investors in private placements … purchasing substantial quantities of below-investment-grade private bonds" (Carey, Prowse, Rea, and Udell (1993), p. 81). Additionally, the size of the private placement debt market during the late 1980s and early 1990s was substantial—approximately 75% that of the public debt market. Thus, privately placed debt funded by life insurance companies represented a significant source of financing for below-investment-grade firms.

By 1990, this source of funding would dry up as well because of a combination of regulatory action and weakening insurer balance sheets. The NAIC changed its ratings of corporate debt, including private placements, to more closely mimic the ratings used by NRSROs (e.g., Moody's, S&P, etc.). This change resulted in the reclassification of many securities on insurers' balance sheets from

[5]For more details on FIRREA, see FIRREA (1989), Pulles, Whitlock, and Hogg (1991), and Brewer and Mondschean (1994).

[6]For a more detailed treatment of the S&L crisis see, for example, White (1991) and Brewer and Mondschean (1994).

[7]The estimates of new issuances from SDC exclude mortgage- and asset-backed issues from the computation.

TABLE 1

Thrift and Insurance Below-Investment-Grade Debt Participation

The data in Panel A of Table 1 are based on the Quarterly Reports of Condition filed with the Office of Thrift Supervision and are obtained from Brewer and Mondschean (1994) and the SDC. The panel presents the total holdings of junk bonds by savings and loans and the total principal amount of new issuances in millions of dollars from 1985 to 1989. All values are deflated by the GDP deflator to year-end 1989 dollars. The data in Panel B are from the American Council of Life Insurance and are obtained from Carey et al. (1993).

Panel A. Thrift Junk Bond Holdings and Total New Issuances

Year	Total Holdings ($mil)	Total Principal Amount ($mil)
1985	6,356	17,843
1986	8,394	36,881
1987	12,853	32,891
1988	15,164	32,215
1989	10,457	28,753

Panel B. Life Insurance Company Below-Investment-Grade Commitments

Year	Fraction of Total Commitments to Purchase Below-Investment-Grade Private Placements
1990 (1st half)	15.0%
1990 (2nd half)	6.0%
1991 (1st half)	5.5%
1991 (2nd half)	2.5%
1992 (1st half)	3.0%
1992 (2nd half)	2.0%

investment-grade to below-investment-grade status; and, as a result, the holdings of life insurance companies that were classified as below-investment-grade increased by almost 40% from 1989 to 1990. At the same time, poorly performing commercial mortgages and increased public scrutiny of the quality of insurance companies' assets led most insurance companies to restrict further purchases of below-investment-grade private placements for fear of losing customers. Panel B of Table 1 reproduces the data from Figure 5 of Carey et al. (1993) and illustrates the sharp decline in new commitments to purchase below-investment-grade private placements after June of 1990. Thus, as Carey et al. ultimately note, "Although the demand for funds surely declined with the falloff in general economic activity during the period, the increase in spreads in this market segment indicates that a much greater reduction occurred in the supply of funds" (p. 85).

Ultimately, the net effect of these three events is, perhaps, best summarized by Jensen ((1991), p. 16): "However genuine and justified their concern … the reactions of Congress, the courts, and regulators to losses (which, again, are predominantly the results of real estate, not highly leveraged loans) have … sharply restricted the availability of capital to non-investment grade companies."

B. Were These Events Exogenous with Respect to Demand?

An important question to address at this stage concerns the exogeneity of these three events with respect to demand-side forces. The potential concern is that these three events were a response to an anticipated decline in investment opportunities and the demand for debt by nonfinancial firms. If so, then these events

are a manifestation of the expected change in demand, as opposed to catalysts for a contraction in the supply of capital. We discuss each event in turn, identifying the primary forces behind each.

Why did Drexel collapse? Concerns over Drexel's behavior began in November 1986 with a formal SEC investigation of Ivan Boesky's ties to Drexel's junk bond operations. The investigation culminated in an SEC recommendation issued on January 25, 1988 that civil charges be filed against both Drexel and Michael Milken for major securities-law violations. This was followed by the eventual indictment of Milken for, among other things, stock parking schemes, and the bankruptcy of Drexel. There is little question that the primary reason for Drexel's failure was the illicit activities of its employees and, in particular, Michael Milken. Further, these activities appear to have begun (and ended) well before any downturn in the economy. Thus, we believe that it is unlikely that Drexel's demise or the impetus for its illegal activities was in anticipation of a faltering economy and a contraction in the demand for its product.

What inspired the passage of FIRREA? The events leading to the passage of FIRREA in 1989 can be categorized as two distinct but closely related crises (Benston and Kaufman (1997)). The first crisis occurred after an unexpected large and abrupt increase in interest rates in the late 1970s. Because Regulation Q capped the interest rates available to S&L depositors, deposits flowed out of S&Ls and into financial institutions offering higher rates of return, while, simultaneously, the higher interest rates shrank the value of fixed-rate mortgages, the principal assets of S&Ls. Despite the removal of interest rate restrictions in the early 1980s, "most S&Ls were close to or actually economically insolvent by 1982" (Benston and Kaufman, p. 140).

The second crisis was a result of the moral hazard problem created by the Federal Savings and Loan Insurance Corporation's (FSLIC's) deposit insurance and the Federal Home Loan Bank Board's (FHLBB's) policy of regulatory forbearance that permitted financially weak institutions to continue in business. Coupled with a softening of real estate prices, many S&Ls faced an asset substitution problem, which led managers to gamble for resurrection. The disarray in the S&L industry eventually led to a sharp increase in fraud. Indeed, Pontell and Calavita ((1993), p. 203) note that "crime and fraud were the central factors in the savings and loan crisis … [brought on by] thrift deregulation in the early 1980s, in conjunction with federal insurance on thrift deposits."

The ultimate response to these crises was the enactment of FIRREA, which replaced the existing regulatory structure (FHLBB and FSLIC) with the Office of Thrift Supervision, while giving insurance functions to the FDIC. Thus, the primary forces behind the passage of FIRREA were a declining real estate market and a fundamentally flawed regulatory system that provided perverse incentives to S&Ls. In fact, Jensen ((1991), p. 28) argues that rather than FIRREA being a response to an expected decline in economic activity, the direction of causality runs the other way: "Unfortunately, however, the flurry of legislative and regulatory initiatives provoked by real estate losses overrode such normal market correctives and created a 'downward spiral' in prices (and business activity generally)."

Finally, what caused the regulatory change and ultimate retreat of life insurance companies from the below-investment-grade debt market? The primary

impetus for the ratings classification change stemmed from a desire for consistency with NRSROs. As Carey et al. ((1993), p. 86) note:

> The sudden appearance of a much increased percentage of below-investment-grade securities on the balance sheets of life insurance companies focused the attention of policyholders and other holders of insurance company liabilities on the composition of insurers' bond holdings. . . . The public's greater sensitivity to the quality of life insurance companies' assets discouraged many insurers from purchasing lower-quality private placements out of fear that they might lose insurance business to competitors with lower proportions of below-investment-grade bonds in their portfolios.

Thus, the public pressure subsequent to the ratings change appears to be driven primarily by competitive concerns, as opposed to anticipated declines in economic activity.

In sum, while the three events contributing to the supply shock were not random, the existing evidence suggests that these events were largely exogenous with respect to the investment and financing demands of nonfinancial firms. In fact, Jensen ((1991), p. 16) argues that it was these events, and in particular the collapse of Drexel and reregulation of the S&Ls, that have "contributed to the current weakness of the economy."

C. The Macroeconomic Environment

While the events discussed above were largely independent of the demand for capital, demand was not constant during this period. In July of 1990, the economy moved into a recession that lasted through March of 1991. As with most recessions, it is normal for the demand for credit to fall, reflecting declines in demand for producers' goods. Additionally, many borrowers significantly increased their leverage during the early and mid-1980s (Bernanke, Campbell, and Whited (1990)), suggesting that firms may have been "overlevered" entering 1990. Coupled with the downward pressure placed on cash flows by the recession and declining asset values, credit and investment demand would naturally be expected to fall after 1989.

In addition to weakening balance sheets, the 1990–1991 recession was marked by a significant decline in bank lending (Bernanke and Lown (1991), Peek and Rosengren (1995), and Hancock and Wilcox (1998)). According to data from the Flow of Funds Accounts of the United States, total loan growth declined by 3.6% per annum during this period. This is in contrast to previous recessions, in which loan growth merely slowed to an average of 6.6% per annum.[8] Despite this distinction in credit supply, credit terms for bank loans during the 1990–1991 recession behaved similarly to those in previous recessions. Nominal loan rates fell only slightly during the first 2 quarters of the recession before dropping more sharply in the first quarter of 1991.

[8]The previous recessions, defined by the year of cyclical peak (and loan growth), are 1960 (7.5%), 1969 (4.4%), 1973 (12.2%), 1980 (3.5%), and 1981 (5.4%).

The implication of the recession and the pre-recessionary behavior of firms is that the demand for credit and investment after 1989 was likely slowing. Therefore, particular care must be taken in the empirical analysis to ensure that the impact of the supply contraction is disentangled from any contemporaneous changes in demand (i.e., the impact of the supply contraction is identified). While complicating the identification strategy, addressing changes in the business cycle in the context of studying supply shocks is by no means unique to our setting. Recessionary (expansionary) periods often go hand in hand with supply contractions (expansions) (Kashyap et al. (1994)), and, therefore, our experimental design must grapple with issues similar to those confronting previous studies mentioned at the outset of the paper. Before turning to this task, we first discuss why the credit supply contraction might impact corporate behavior.

III. Theoretical Framework

In the absence of market imperfections, the supply of capital is perfectly elastic and has no effect on firms' investment policy (Modigliani and Miller (1958)). This section presents the theoretical motivation for our study by discussing how imperfections in the capital markets coupled with changes in the supply of capital can impact corporate behavior.

One way in which the supply of capital may influence the behavior of firms is via capital rationing. Jaffee and Russell (1976) and Stiglitz and Weiss (1981) provide early examples of how information asymmetry between borrowers and lenders creates an adverse selection problem that leads lenders to withdraw from the market. Consequently, low-risk (in terms of second-order stochastic dominance) firms that are unable to separate from high-risk firms may be unable to borrow at any price. Likewise, the presence of information asymmetry may give rise to institutions that address this problem (e.g., Diamond (1984), (1991), Fama (1985)). Financial intermediaries are viewed as having an advantage over arm's length lenders, such as bond holders, in relaxing ex ante financing constraints (e.g., Berger and Udell (1995), Petersen and Rajan (1995)) via more efficient monitoring and restructuring capacities (e.g., Rajan (1992), Bolton and Scharfstein (1996)).

Holmstrom and Tirole (1997) also construct a model of credit rationing based on a moral hazard problem. Specifically, firms face a moral hazard problem in that managers can extract private benefits through an appropriate choice of projects. Intermediaries alleviate the moral hazard problem through costly monitoring, which in turn creates a moral hazard problem for the intermediaries. The moral hazard problem faced by the intermediaries requires them to inject their own capital into the firms they monitor. Limitations on the amount of *intermediary* capital, therefore, act as a potential constraint on the financing and investment of firms.[9]

More recently, Bolton and Freixas (2000) propose a model of financial markets in which firm financing is segmented across equity, bank debt, and bonds. Specifically, the riskiest firms are either unable to obtain financing or are forced

[9]He and Krishnamurthy (2006) examine the implications of credit rationing on asset prices in a framework similar to that of Holmstrom and Tirole (1997).

to turn to the equity markets because of information asymmetry between firms and investors. As a result, these firms bear an informational dilution cost, similar to that in Myers and Majluf (1984). Safer firms are able to obtain bank loans, which avoid the informational dilution cost but carry the intermediation costs associated with debt that is relatively easy to renegotiate (Diamond (1994), Hart and Moore (1995)). Finally, the safest firms tap the public debt markets in order to avoid internalizing the intermediation costs, which are less relevant because of the relatively low likelihood of experiencing financial distress.

Finally, regulation is another potential source of market segmentation. A host of government and institutional regulations explicitly or implicitly limit capital mobility. For example, capital requirements limit the amount and type of investments made by banks. Similarly, money market mutual funds are often required to limit their exposure to subprime commercial paper. Indeed, one of the events under study here, FIRREA, explicitly prohibited S&Ls from participating in the below-investment-grade market.

While the mechanisms vary, the theories suggest the following two empirical implications of the supply shock for below-investment-grade firms:

Hypothesis 1. Switching to alternative sources of funds will be limited, and the extent of this limited substitution is a reflection of the relative costs of capital. Further, the inability to costlessly substitute across sources of capital will translate into a reduction in investment.

Hypothesis 2. The impact of the supply shock will vary cross-sectionally with variations in the cost of switching to alternative sources of funds.

The goal of the empirical analysis is to test these hypotheses in a manner that isolates the impact of the supply shock. Before doing so, we first discuss the data and our empirical strategy aimed at identifying these supply effects.

IV. Data and Empirical Strategy

A. Data

The starting point for our sample begins with all nonfinancial firm-year observations in the annual Compustat database between 1986 and 1993. We choose this particular sample horizon in order to have a balanced time frame around the event date and avoid artificially skewing the degrees of freedom in the pre-supply-shock (1986–1989) and post-supply-shock (1990–1993) eras. We also require that all firm-year observations have nonmissing data for book assets, net debt issuances, net equity issuances, investment, and the market-to-book ratio. Finally, we trim all ratios at the upper and lower 1 percentiles to mitigate the effect of outliers and eradicate errors in the data. The definition and construction of each variable used in this study is detailed in the Appendix.

For presentation purposes, we focus on results obtained from using financing and investment measures from the statement of cash flows. This enables us to follow the impact of the supply shock through the accounting sources and uses identity. It also enables greater resolution in terms of which financing and investment channels are affected by the supply shock. However, in unreported results

we find that alternative measures based on balance sheet information produce qualitatively similar results.

We use S&P's long-term domestic issuer credit rating to categorize firms. This rating represents the "current opinion on an issuer's overall capacity to pay its financial obligations" (S&P (2001)). While other issue-specific ratings are available (e.g., subordinated debt), Kisgen (2006) notes that most other ratings have a strict correspondence with the issuer rating, and, therefore, little information is lost by focusing attention on this particular rating. As defined by S&P, firms rated BBB– or higher are "investment-grade"; firms rated BB+ or lower are "below-investment-grade" (or "speculative-grade" or "junk"); and firms without an S&P rating are referred to as "unrated."

Table 2 presents summary statistics for several groups of firms differentiated by their rating status during the period 1986–1993. In addition to revealing the general characteristics of our sample of firms, Table 2 is also helpful in identifying along which dimensions these groups of firms differ and by how much, albeit at a coarse, aggregate level. Several useful facts emerge. Below-investment-grade (Junk) firms issue relatively more debt (5% of assets) and have a higher leverage ratio (50%) than both investment-grade (2% and 30%) and unrated (1% and 26%) firms. Compared to unrated firms, junk firms are 4 times as large and more than twice as profitable.[10] Thus, the greater usage of debt by junk firms is not terribly surprising given their greater debt capacity, but, more importantly, the use of this extra debt does not appear to have hampered the financial soundness of junk firms relative to their unrated counterparts. A comparison of Altman's Z-scores shows that the average junk firm's Z-score is significantly larger than the average unrated firm's Z-score, suggesting that junk firms are, on average, more financially healthy than unrated firms.[11]

B. Empirical Strategy

As noted above, because the supply shock to the junk bond market was followed by a recession and changes in the demand for capital, particular care must be taken to disentangle the supply and demand effects on corporate behavior. For example, a change in the behavior of firms accessing speculative-grade debt after 1989 may simply reflect unobserved shifts in these firms' demand for capital commensurate with the change in economic environment. Similarly, a comparison of junk bond issuers and, for example, investment-grade bond issuers after 1989 may merely reflect unmeasured differences between the two groups' demand for capital. To control for these factors, we employ a difference-in-differences empirical approach.

[10] We focus on market leverage in the presentation of our results. However, in unreported analysis, replacing market leverage with book leverage results in qualitatively similar findings (see the Appendix for the definitions of these variables).

[11] Altman's Z-score is a linear combination of sales, income, retained earnings, working capital, and leverage that proxies for the likelihood of financial distress (Altman (1968)). In unreported analysis, we also compare the cash flow volatilities of the three groups, which reveal that junk firms have relatively lower volatility than unrated firms.

TABLE 2

Summary Statistics

Table 2 presents variable averages for 5 subsamples of the annual Compustat database during the period 1986–1993 and subject to the data requirements discussed in Section II. The samples are defined as follows: Investment Grade consists of all investment-grade-rated firm-year observations (i.e., BBB– and above), Junk consists of all below-investment-grade-rated firm-year observations (i.e., BB+ and below), and Unrated consists of all firm-year observations without a credit rating. The last two columns condition on firms maintaining either investment-grade or below-investment-grade status between 1986 and 1993 and firms having at least one observation in both the pre- and post-1989 era. BBB consists of all firm-year observations with a BBB rating, and BB consists of all firm-year observations with a BB rating. NE HQ consists of all below-investment-grade firm-year observations with firm headquarters located in the Northeast region of the country, which includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania. Not NE HQ consists of all below-investment-grade firm-year observations with firm headquarters located elsewhere in the United States. All variables are defined in the Appendix.

	Sample						
Variable	Investment Grade	Junk	Unrated	BBB	BB	Not NE HQ	NE HQ
Panel A. Sources of Funds							
Net LT debt issuances	0.02	0.05	0.01	0.02	0.05	0.05	0.05
Net equity issuances	0.00	0.03	0.05	0.01	0.02	0.03	0.03
Cash flow	0.12	0.08	0.05	0.11	0.10	0.09	0.07
Panel B. Uses of Funds							
Net investment	0.10	0.11	0.09	0.10	0.11	0.11	0.10
Capital expenditures	0.08	0.08	0.08	0.09	0.09	0.09	0.06
Acquisitions	0.02	0.03	0.02	0.02	0.03	0.02	0.03
Sale PPE	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Change in inventory	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01	–0.01
Dividends	0.02	0.00	0.01	0.02	0.01	0.00	0.00
Panel C. Firm Characteristics							
Market leverage	0.33	0.51	0.26	0.40	0.45	0.51	0.50
log(Sales)	7.82	6.04	3.70	7.50	6.51	6.11	5.82
Market-to-book	1.12	1.06	1.60	0.97	1.06	1.06	1.06
Profitability	0.15	0.10	0.04	0.13	0.12	0.10	0.09
Tangibility	0.48	0.37	0.32	0.50	0.40	0.40	0.27
Altman's Z-score	1.85	1.32	0.95	1.70	1.68	1.28	1.43
Firms	738	744	6,321	356	395	555	189

As Angrist and Krueger (1999) note, the difference-in-differences strategy is well suited for estimating the effect of sharp changes in the economic environment or changes in government policy, as we have with our setting. The key identifying assumption behind this strategy is that, in the absence of treatment, the observed difference-in-differences estimator is 0, an assumption that is often referred to as the "parallel trend" assumption. Intuitively, this assumption requires similar trends in the outcome variable during the pre-shock era for both treatment and control groups. In the current context, this assumption translates into similar growth rates in investment, for example, for the treatment and control groups prior to 1990. To be clear, the identifying assumption does *not* require that the level of investment be identical across the two groups or the two eras, as these distinctions are differenced out in the estimation. Thus, in our analysis below, we pay particularly close attention to ensuring that the parallel trends assumption is satisfied.

Nevertheless, an unavoidable trade-off associated with the difference-in-differences empirical strategy is that between identification and extrapolation. Although our strategy helps mitigate concerns over endogeneity, it also limits our ability to extrapolate inferences outside of our sample. Thus, the usual caveat applies to our results—a limitation that is at least partially offset by increased confidence in our inferences.

While our primary interest lies in identifying the effect of the supply shock on net financing and net investment, we also decompose the financing and investment variables into their components. For example, we break out net security issuances into long-term debt, short-term debt, and equity. Similarly, net investment is broken out into capital expenditures, acquisitions, and the sale of property, plant, and equipment (PPE).[12] Examining each component individually serves three purposes. First, it enables us to better understand the precise channels through which the supply shock travels. Second, it enables us to quantify the extent of substitution across financing sources. Finally, in conjunction with the aggregate measures, it enables us to examine cross-sectional heterogeneity in financing and investment behavior.

V. Results

A. The Impact of the Shock on Below-Investment-Grade Firms

Previous studies examining the supply-side effects on firms' behaviors have used a variety of implicit treatment-control comparisons, including: large versus small firms (Gertler and Gilchrist (1994), Leary (2007)), the presence of a credit rating (Kashyap et al. (1994), Faulkender and Petersen (2006)), and investment-grade versus speculative-grade firms (Sufi (2009)). In this paper, we take a somewhat different approach by comparing the behavior of below-investment-grade firms (the treatment group) with that of a propensity-score-matched sample of unrated firms (the control group).[13]

The first 3 columns (Pre-Match) in Panel A of Table 3 illustrate why we undertake a matching approach when comparing these two groups. The columns present means, standard errors (in brackets), and *t*-statistics of the differences across the treatment and control groups. As expected, the firms without bond ratings are substantially different from firms accessing the speculative-grade debt market along a number of dimensions. On average, the firms without bond ratings are significantly smaller, have higher market-to-book ratios, are less profitable, and are less financially healthy when compared to firms with speculative-grade debt. In addition, the parallel trends assumption is violated for all of the financing and investment measures with the exception of the growth rates of short-term debt issues and capital expenditures. Thus, a comparison of below-investment-grade firms to unrated firms as a whole is unlikely to provide an accurate estimate of the impact of the supply shock on corporate behavior.

[12] We also examine changes in cash and trade credit; however, unreported results reveal statistically and economically negligible effects of the supply shock on these funding sources in all of our analyses. That is, firms are not substituting toward these funds. Similarly, we also examine alternative definitions of net investment incorporating inventory investment, advertising expenditures, and research and development (R&D), as well as investment in unconsolidated subsidiaries. The results are qualitatively similar to those presented and, therefore, are not reported.

[13] For an appropriate interpretation of the difference-in-differences estimator, we restrict attention to firms not transitioning in and out of the treatment and control groups. Thus, we exclude from the potential control group any firms that were ever rated between 1986 and 1993. Similarly, we exclude from the treatment group any firms that transition between investment-grade and below-investment-grade between 1986 and 1993. We also require that each firm have at least one observation in the pre-1990 and post-1989 eras in order to compute the within-firm difference.

Our matching procedure relies on a nearest neighbor matching of propensity scores, originally developed by Rosenbaum and Rubin (1983) (see also Smith and Todd (2005) for a discussion of matching procedures, as well as recommendations and cautionary notes that we follow in our analysis). The matching begins with a probit regression at the firm level of a binary variable indicating whether or not a particular firm is below-investment-grade or unrated on a host of firm characteristics. Specifically, we include averages over the pre-shock era (i.e., pre-1990) of variables identified by previous studies examining the distinction between these

TABLE 3

Propensity Score Matching Diagnostics

The sample begins with below-investment-grade (BB+ or lower) and unrated firms in the annual Compustat database (excluding financial firms) during the period 1986–1993 and satisfying three additional criteria: i) unrated firms are always unrated throughout the entire 1986–1993 period, ii) below-investment-grade firms do not change status to or from investment grade during the period, and iii) each firm contains at least one observation both before and after 1989. The treatment group is defined as below-investment-grade-rated firms, and the control group is defined as unrated firms. Panel A of Table 3 presents pairwise comparisons of the variables on which the matching is performed (except for Industry indicators) both before and after the matching. Panel B presents parameter estimates from the probit model used in estimating the propensity scores for the treatment and control groups. The dependent variable equals 1 if the firm is rated below-investment-grade (treatment firm) and 0 if it is unrated (control firm). The probit is run at the firm level, and all covariates included in the regression are averages over the pre-shock era (1986–1989). The Pre-Match column contains the parameter estimates of the probit estimated on the entire sample, prior to matching. This model is used to generate the propensity scores for matching. The Post-Match column contains the parameter estimates of the probit estimated on the subsample of matched treatment and control observations, after matching. The matching procedure is a one-to-one nearest-neighbor match of treatment and control firms falling in the common support of estimated propensity scores. Panel C presents the distribution of estimated propensity scores for the treatment firms, control firms, and the difference in estimated propensity scores. All variable definitions appear in the Appendix. * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Panel A. Pairwise Comparisons

	Pre-Match			Post-Match		
Variable	Control	Treatment	*T*-Diff.	Control	Treatment	*T*-Diff.
Net LT debt issues growth	0.00	–0.04	—	–0.01	–0.03	—
	[0.00]	[0.01]	–5.20**	[0.00]	[0.01]	–1.54
Net ST debt issues growth	0.01	0.00	—	–0.00	–0.00	—
	[0.00]	[0.00]	–1.42	[0.00]	[0.00]	0.18
Net equity issues growth	–0.11	–0.03	—	–0.02	–0.03	—
	[0.01]	[0.03]	2.58**	[0.00]	[0.01]	–1.08
Leverage growth	0.02	0.03	—	0.03	0.03	—
	[0.00]	[0.00]	2.53*	[0.00]	[0.01]	0.27
Capital expenditures growth	–0.02	–0.02	—	–0.02	–0.02	—
	[0.00]	[0.01]	0.90	[0.00]	[0.00]	0.13
Acquisitions growth	–0.00	–0.02	—	–0.01	–0.02	—
	[0.00]	[0.00]	–5.13**	[0.00]	[0.01]	–1.44
Cash flow	–0.05	0.01	—	0.02	0.01	—
	[0.00]	[0.02]	3.84**	[0.00]	[0.01]	–1.73
Market-to-book	1.54	1.06	—	1.09	1.06	—
	[0.03]	[0.10]	–4.90**	[0.02]	[0.04]	–0.72
Altman's Z-score	1.16	1.67	—	1.79	1.68	—
	[0.06]	[0.22]	2.22*	[0.08]	[0.16]	–0.61
log(Sales)	3.40	6.03	—	6.12	6.02	—
	[0.03]	[0.13]	19.80**	[0.06]	[0.11]	–0.79
S&P 500	0.02	0.08	—	0.08	0.07	—
	[0.00]	[0.01]	4.53**	[0.01]	[0.02]	–0.62
NYSE	0.16	0.49	—	0.53	0.48	—
	[0.01]	[0.03]	11.23**	[0.02]	[0.04]	–1.27
Firm age	13.47	18.55	—	18.66	18.47	—
	[0.18]	[0.67]	7.34**	[0.42]	[0.84]	–0.21
No. of obs.	2,427	173	—	684	171	—
Unique obs.	2,427	173		311	171	

(continued on next page)

TABLE 3 (continued)
Propensity Score Matching Diagnostics

Panel B. Probit Regression Results

Variable	Pre-Match	Post-Match
Intercept	–8.85**	–0.78*
	(33.07)	(2.40)
Net LT debt issues growth	–0.66	–0.21
	(1.40)	(0.45)
Net ST debt issues growth	–1.98	0.93
	(1.30)	(0.51)
Net equity issues growth	0.18	–0.20
	(0.43)	(0.31)
Leverage growth	3.60**	–0.22
	(4.54)	(0.26)
Capital expenditures growth	0.68	0.42
	(0.66)	(0.39)
Acquisitions growth	–1.64*	–0.92
	(2.21)	(1.23)
Cash flow	1.06	–1.68
	(1.51)	(1.66)
Market-to-book	–0.23**	0.00
	(2.60)	(0.01)
Altman's Z-score	–0.17**	0.02
	(4.86)	(0.49)
log(Sales)	0.51**	–0.00
	(13.08)	(0.05)
S&P 500	–0.00	–0.04
	(0.01)	(0.21)
NYSE	0.32**	–0.08
	(2.72)	(0.66)
Firm age	–0.00	–0.00
	(0.71)	(0.05)
Industry fixed effects	Yes	Yes
Control	2,427	684
Control (unique obs.)	2,427	311
Treatment	173	171
No. of obs.	2,600	855
Pseudo R^2	0.37	0.02
χ^2 *p*-value	0.00	0.37

Panel C. Estimated Propensity Score Distributions

	No. of Obs.	Unique Obs.	Mean	SD	Sum	Min	P5	Median	P95	Max
Match Number 1										
Difference	171	—	0.00	0.00	0.28	0.00	0.00	0.00	0.01	0.02
Treatment	171	171	0.30	0.20	51.95	0.00	0.05	0.25	0.72	0.88
Control	171	120	0.30	0.20	51.88	0.00	0.05	0.25	0.71	0.87
Match Number 2										
Difference	171	—	0.00	0.01	0.63	0.00	0.00	0.00	0.02	0.03
Treatment	171	171	0.30	0.20	51.95	0.00	0.05	0.25	0.72	0.88
Control	171	121	0.30	0.21	51.96	0.00	0.05	0.26	0.74	0.90
Match Number 3										
Difference	171	—	0.01	0.01	0.93	0.00	0.00	0.00	0.02	0.03
Treatment	171	171	0.30	0.20	51.95	0.00	0.05	0.25	0.72	0.88
Control	171	128	0.30	0.21	52.05	0.00	0.05	0.26	0.74	0.91
Match Number 4										
Difference	171	—	0.01	0.01	1.25	0.00	0.00	0.00	0.03	0.05
Treatment	171	171	0.30	0.20	51.95	0.00	0.05	0.25	0.72	0.88
Control	171	125	0.30	0.20	51.89	0.00	0.05	0.25	0.71	0.84

two groups, such as Faulkender and Petersen (2006), as well as other studies investigating the determinants of financing and investment choices (e.g., Titman and Wessels (1988), Rajan and Zingales (1995), and Eberly, Rebelo, and Vincent (2007)). We incorporate industry indicator variables in an effort to absorb any time-invariant differences not captured by the firm characteristics.[14]

We also include several additional controls into the specification to address two concerns. First, we want to ensure that the parallel trends assumption is satisfied and, therefore, incorporate growth measures of financing and investment variables during the pre-shock era. Second, to address selection concerns over firms' decisions to obtain a credit rating, we incorporate the instruments identified by Faulkender and Petersen (2006), who argue that index and exchange listings, as well as firm age, are valid instruments for identifying financing differences between rated and unrated firms (see Faulkender and Petersen for a detailed discussion of this issue).

The probit model is estimated on a cross section of 173 below-investment-grade (treatment) firms and 2,427 unrated (control) firms containing nonmissing data for all of the variables included in the specification. The estimation results are presented in the first column of Panel B in Table 3, labeled "Pre-Match," and reveal differences that are largely in line with those found in the pairwise comparison in Panel A. The results also reveal that the specification captures a significant amount of variation in the choice variable, as indicated by a pseudo-R^2 of 37% with a corresponding p-value well below 1%.

We then use the predicted probabilities, or propensity scores, from this probit estimation and perform a nearest-neighbor match with replacement. That is, each firm in the treatment group is paired with the firm in the control group whose propensity score is closest, in an L^1-norm sense.[15] Because the number of unrated firms is so large relative to the number of speculative-grade firms (approximately 14 times as large), we choose to find 4 control firm matches for each treatment firm. We choose 4 matches because it seems to offer the benefit of not relying on too little information without incorporating observations that are not sufficiently similar. However, we note that changing the number of matches to any number between 1 and 5 has little effect on our results.

Panel C of Table 3 illustrates the accuracy of the matching process by revealing that the majority of differences in the estimated propensity scores between the firms in the treatment group and their corresponding matches from the control group are inconsequential. For the first-best matches (Match Number 1), the maximal difference between the matched propensity scores is 2%, while the 95th percentile is 1%. Even for the last, or worst, set of matches (Match Number 4), the maximal difference between the treatment and control groups reveals only a 5% difference in propensity scores. The result of the matching process is a treatment

[14]In estimating the probit, we restrict attention to variables known prior to the supply shock to avoid introducing any forward-looking bias into the matching process. This ensures that firms are matched on characteristics that are known prior to the occurrence of the supply shock.

[15]Following Smith and Todd (2005), we match with replacement to improve the accuracy of the match, at the cost of lower power. We also require that successful matches fall in the common support of estimated propensity scores. This requirement results in two below-investment-grade firms for which we are unable to find a corresponding match.

group consisting of 171 below-investment-grade firms and a control group consisting of the 684 control firms, 311 of which are unique.

The accuracy of the matching process is also shown in the columns denoted "Post-Match" in Panels A and B of Table 3. Specifically, Panel A reveals no statistically significant differences across any of the firm characteristics after the matching process. Similarly, Panel B reveals that none of the determinants are statistically significant in a probit regression restricted to the matched sample. Further, we note that the magnitudes of the coefficient estimates decline significantly from the Pre-Match estimation to the Post-Match estimation, ensuring that our findings are not simply an artifact of a decline in degrees of freedom. (None of the industry indicators are statistically significant in the Post-Match probit, though we withhold these findings to ease the presentation of results.) Finally, the pseudo-R^2 has fallen from 37% prior to the matching to a statistically insignificant 2% (p-value = 37%) after the matching. In sum, the matching process has removed any meaningful differences along observables from the two groups of firms and, in the process, ensured that the parallel trends assumption is satisfied.

Table 4 presents the results of the difference-in-differences estimation using the matched sample. Financial policy variables are presented in Panel A and investment policy variables in Panel B. Each panel presents several summary measures beginning with the average difference between the post-1989 period and the pre-1990 period for the treatment (i.e., Junk) and control (i.e., Matched Unrated) groups. For example, Panel A shows that the average change in net long-term debt issues for below-investment-grade firms is –10% of total assets. This estimate is computed by first calculating the average net long-term debt issues from 1990 to 1993 and then subtracting the average net long-term debt issues from 1986 to 1989 for each firm. This difference is then averaged over below-investment-grade firms. A similar procedure is performed for the matched unrated firms.

We also present the standard error for each average, suitably adjusted for the multiple control observations (in parentheses). At the bottom of each panel are the difference-in-differences estimate (Dif-in-Dif) and the corresponding t-statistic of the null hypothesis that this estimate is 0 (t-stat). Note that there is no need for additional control variables since the treatment and control firms are already matched, nonparametrically, on all of the relevant observable characteristics. We also note that, in unreported analysis, we examine the corresponding median values for the treatment and control groups. The results are qualitatively similar.

Focusing first on Panel A of Table 4, we see that total net security issuances (net debt plus net equity) by below-investment-grade firms decreased by 5% of assets relative to the change experienced by similar unrated firms. The average total net security issuances by below-investment-grade firms in our matched sample from 1986 to 1989 is 11%, implying a decline of 45% relative to pre-shock levels. Thus, aggregate external financing activity contracted sharply for below-investment-grade firms in response to the supply shock.

Columns 2–5 of Panel A in Table 4 reveal that the contraction is concentrated almost entirely in net long-term debt issuances, indicating that substitution toward other forms of debt capital is limited, since this measure encompasses all forms of credit in excess of 1 year in maturity (e.g., public debt, bank debt, and

TABLE 4

The Response of Financing and Investment to the Supply Shock

The sample is a propensity score matched sample of below-investment-grade (BB+ or lower) and unrated firms in the annual Compustat database (excluding financial firms) during the period 1986–1993 and satisfying three additional criteria: i) unrated firms are always unrated throughout the entire 1986–1993 period, ii) below-investment-grade firms do not change status to or from investment grade during the period, and iii) each firm contains at least one observation both before and after 1989. (See the previous tables for propensity score matching diagnostics.) Table 4 presents the following summary statistics for the two sets of matched firms: Avg is the average difference between the post-1989 era and the pre-1990 era for all below-investment-grade firms; SE is the standard error of the average; Dif-in-Dif is the difference between the average differences (Avg) for the two groups of firms; and *t*-stat is the ratio of Dif-in-Dif to the standard error of the difference between the two averages. Panels A and B present results where the within-firm (i.e., Junk or Unrated) time-series difference is computed as the average during 1993 and 1990 less the average from 1986 to 1989. For example, to obtain the average junk difference for net long-term (LT) debt issues of –0.10, we begin by computing the average annual net LT debt issues for each firm from 1986 to 1989 and 1990 to 1993. We then subtract the former average from the latter average to obtain the difference for each firm. These differences are then averaged cross-sectionally to obtain the figures in the table. To account for the multiplicity of control observations, all standard errors are clustered at the firm level. * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Panel A. Financial Policy

Variable	Net Debt and Equity Issues	Net LT Debt Issues	Net ST Debt Issues	Net Equity Issues	Market Leverage
Avg: Junk difference	–0.10	–0.10	0.00	–0.00	0.03
SE: Junk difference	(0.02)	(0.02)	(0.00)	(0.00)	(0.01)
Avg: Unrated difference	–0.05	–0.04	0.00	–0.01	0.02
SE: Unrated difference	(0.01)	(0.01)	(0.00)	(0.00)	(0.01)
Dif-in-Dif	–0.05	–0.06	0.00	0.00	0.01
t-Stat: Dif-in-Dif	–2.74**	–3.49**	0.58	0.88	0.87

Panel B. Investment Policy

Variable	Net Investment	Capital Expenditures	Acquisitions	Sale PPE
Avg: Junk difference	–0.10	–0.03	–0.05	–0.00
SE: Junk difference	(0.02)	(0.01)	(0.01)	(0.00)
Avg: Unrated difference	–0.05	–0.03	–0.02	–0.00
SE: Unrated difference	(0.01)	(0.00)	(0.01)	(0.00)
Dif-in-Dif	–0.05	–0.00	–0.03	–0.00
t-Stat: Dif-in-Dif	–2.43*	–0.23	–2.17*	–1.28

private placements). Likewise, there is relatively little substitution toward alternative sources of financing, including short-term debt and external equity, neither of which reveals a significant estimated effect. Unreported analysis also reveals that changes in internal reserves, trade credit, and dividend policy show little response to the supply shock, suggesting that below-investment-grade firms are not dipping into cash balances or scaling back shareholder distributions to maintain financial slack. In short, net debt issues fell precipitously after 1989 for below-investment-grade firms relative to similar unrated firms, with little accompanying substitution to alternative sources of capital.

The final column of Panel A in Table 4 shows that, in spite of the precipitous decline in net debt issuing activity, the change in leverage of the below-investment-grade firms is not different from that of the control firms.[16] This finding contrasts with the results in a number of recent papers (e.g., Faulkender and Petersen (2006), Leary (2007), and Sufi (2009)) that find evidence that differences in the supply of capital play an important role in determining firms' leverage ratios and is driven primarily by two forces. First, both book and market equity

[16]Results obtained with a measure of book leverage, defined in the Appendix, are similar.

values declined after 1989. Indeed, the decline in equity values was so severe that market leverage actually exhibits a slight increase for both below-investment-grade and unrated firms, separately. Second, as discussed next, investment experienced a contemporaneous contraction limiting asset growth.

Turning to Panel B of Table 4, we see that net investment declined almost one for one with the decline in net debt issuing activity. Net investment by below-investment-grade firms decreased by 5% of assets relative to the change experienced by unrated firms and by approximately 40% relative to the rate of net investment prior to the shock. The remaining columns identify the composition of the investment decline, which is concentrated in slowing acquisition activity (rounding error is the cause of any discrepancy between the aggregate measures, net issuances and net investment, and the sum of their components).[17]

In sum, our results suggest that the supply contraction in the below-investment-grade debt market had a significant effect on the financing and investment behavior of corresponding firms, though the impact on corporate leverage ratios was negligible. These findings illustrate the susceptibility to variations in the supply of capital of even relatively large firms with access to public debt markets. The following section attempts to buttress this conclusion with additional evidence from tests of Hypothesis 2, predicting cross-sectional variation in the financing and investment response to the supply shock.

B. Cross-Sectional Variation in the Response to the Supply Shock

1. Geographic Heterogeneity in the Cost of Bank Debt

As discussed earlier, the 1990–1991 recession was accompanied by a sharp contraction in bank lending that was concentrated in the Northeast region of the country (Bernanke and Lown (1991), Peek and Rosengren (1995), and Hancock and Wilcox (1998)).[18] This localized contraction is primarily attributed to an erosion of bank capital driven by declining real estate prices, and therefore this event is sometimes referred to as a "capital crunch" (Wojnilower (1980), Bernanke and Lown, and Peek and Rosengren).

We hypothesize that bank debt is the natural substitute for speculative-grade bonds and assume that the geographic heterogeneity associated with the capital crunch is associated with localized differences in the costs of accessing bank credit. Below-investment-grade borrowers during this period were effectively required to reintermediate their debt in the absence of below-investment-grade public debt and private placement investors. Insofar as the geographic location of corporate headquarters within the United States is exogenous to the financing demand and investment opportunities of firms, we can use location as an instrument to identify the impact of the loan-supply shock on firm behavior. The assumption implicit in this strategy is that firms, on average, tend to borrow from local banks.

[17] In unreported analysis, we also show that our results are largely immune to concerns of measurement error in our proxy for q (Erickson and Whited (2000)), using the reverse regression bounds approach of Erickson and Whited (2005) to show a sufficiently low correlation between the treatment effect variable and our proxy.

[18] The Northeast region of the United States is comprised of Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania.

Bharath et al. (2007) confirm this assumption by showing a strong propensity of public firms to borrow from local lenders; however, any deviation from this tendency, or noise in this delineation, will tend to attenuate our results.

We define the treatment group as consisting of all below-investment-grade firms with headquarters located in the Northeast, and the control group as all below-investment-grade firms with headquarters located elsewhere in the country. We refer to this sample as the Geography sample. If the availability of substitute financing in the form of bank credit was more constrained in the Northeast, then we should observe that below-investment-grade firms located in this region responded more severely to the collapse of the junk bond market than did below-investment-grade firms located in other parts of the country.

Table 5 presents results from tests of the parallel trends assumption between the treatment and control groups in the pre-shock period (1986–1989). As seen in the table, the growth in security issuance, both for debt and equity, is statistically identical across the treatment and control groups. Similarly, net investment growth and the growth in market leverage are statistically identical across the two groups.[19] We also note that the magnitudes of the differences, all approximately 1% or less, are economically small. Thus, across all of the outcome variables, the treatment and control groups appear to satisfy the parallel trends assumption.

Estimation of the effects of the supply shock on firm behavior is carried out with the traditional difference-in-differences regression:

$$(1)\quad Y_{it} = \beta_0 I_{it}\,(\text{Post-1989}) + \beta_1 I_{it}\,(\text{NE}) + \beta_2 I_{it}(\text{Post-1989}) I_{it}\,(\text{NE}) + \gamma' X_{it-1} + \varepsilon_{it},$$

where i indexes firms, t indexes years, Y is the response variable (e.g., net security issuances and net investment), I(Post-1989) is an indicator variable equal to 1 if the observation occurs after 1989, I(NE) is an indicator variable equal to 1 if the firm's headquarters are located in the Northeast region of the country, X is a vector of control variables, and ε is the firm-year-specific effect assumed to be correlated within firms and possibly heteroskedastic (Bertrand, Duflo, and Mullainathan (2004), Petersen (2009)). The coefficient of interest is β_2, which corresponds to, approximately, the average change in Y from pre-1989 to post-1989 for the treatment group minus the change in Y from pre-1989 to post-1989 for the control group.[20]

The results from estimating equation (1) are presented in Table 6. While we examine several variations of the specification in unreported results, we present only those results found in the "kitchen-sink" specification incorporating all of

[19]The growth rate in asset sales reveals a statistically significant difference across the two groups; however, the economic magnitudes are tiny when compared to the other components of net investment. To ensure that our results are not driven by this difference, we examined gross investment, net of the effect of asset sales. The results are virtually identical to those presented and, consequently, are not reported.

[20]The relation is only approximate because of possible correlation between the interaction term and X. We also note that the difference-in-differences empirical framework requires us to impose two additional data requirements, similar to those found in the propensity score analysis above. First, each firm must contain at least one observation in both the pre- and post-1989 periods. Second, we exclude the few firms that change their rating status from below-investment-grade to investment-grade, or vice versa.

TABLE 5

Tests of Parallel Trends (geography sample)

The sample consists of all firms in the annual Compustat database (excluding financial firms) with a below-investment-grade debt rating (BB+ or lower) during the period 1986–1993 and satisfying three additional criteria: i) each observations satisfies the data requirements discussed in Section II, ii) the firm does not change status to or from investment grade during the period, and iii) the firm contains at least one observation both before and after 1989. Table 5 presents results from tests of the identifying assumption (i.e., parallel trends) behind the difference-in-differences framework by comparing mean (and median) annual growth rates (relative to total assets) for each outcome variable during the pre-shock era (1986–1989). The treatment group consists of all below-investment-grade-rated firms whose headquarters are located in the Northeast region of the country, which includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania. The control groups consists of all below-investment-grade-rated firms whose headquarters are located elsewhere in the United States. The Wilcoxon *p*-value is the probability value of the two-sample Wilcoxon test of the hypothesis that the two samples are taken from populations with the same median. The *t*-statistics of the difference in means is presented in parentheses. * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Variable	Mean Growth Not NE HQ (Control)	Mean Growth NE HQ (Treatment)	Difference	Wilcoxon *p*-Value
Net debt and equity issues growth	–0.05	–0.05	–0.00 (–0.11)	0.87
Net LT debt issues growth	–0.04	–0.04	0.00 (0.06)	0.97
Net ST debt issues growth	0.00	0.00	–0.00 (–0.80)	0.40
Net equity issues growth	–0.01	–0.01	–0.00 (–0.29)	0.65
Net investment growth	–0.04	–0.05	0.01 (0.46)	0.70
Capital expenditure growth	–0.02	–0.01	–0.01 (–1.68)	0.66
Acquisition growth	–0.02	–0.04	0.01 (1.07)	0.12
Sales of assets growth	–0.00	0.00	–0.00* (–2.04)	0.36
Market leverage growth	0.04	0.05	–0.01 (–0.52)	0.54

the relevant control variables. These estimates are the most conservative in terms of magnitude and statistical significance. Panel A reveals that the net security issuance activity of below-investment-grade firms in the Northeast part of the country experienced a significant decline relative to the change experienced by below-investment-grade firms in other parts of the country. Specifically, net security issuances of firms in the Northeast region fell by 6% of assets relative to firms located in other regions. The reduction in security issues is concentrated in long-term debt, and there is no evidence that speculative-grade firms in the Northeast fill the decline in debt issuances with other forms of financing (e.g., short-term debt, equity, or, in unreported results, changes in cash and trade credit). Interestingly, we again find no evidence that the precipitous decline in net debt issuing activity was accompanied by a significant change in corporate leverage ratios, as revealed by the last column.

Turning to Panel B of Table 6, we see that net investment fell by 6%, a decline concentrated primarily in acquisition activity (4%), as opposed to capital expenditures, which fell only modestly (1%). Closer inspection of the coefficients also suggests that the *level* of debt usage and investment among Northeast firms in the pre-shock era was slightly higher than among firms elsewhere in the country. This suggests that one possible interpretation is that the credit contraction accelerated a return of Northeast firm behavior to that of the rest of the

country.[21] Overall, the evidence is consistent with the view that the slowdown in bank lending driven by the contraction in intermediary capital among Northeast banks effectively eliminated bank loans as a substitute source of finance for below-investment-grade firms in that area of the country.

One potential concern with our identification strategy here is that accompanying the larger decline in real estate values in the Northeast was a relatively more severe recession that simply reduced aggregate demand in that part of the country relative to the rest of the country. However, if this was indeed the case, then we should find similar results if we examine investment-grade or unrated firms stratified by the geographic location of their headquarters. To test this hypothesis, we reestimate all of the financing and investment regressions presented in Table 6 on

TABLE 6

Geographic Variation in the Response of Financing and Investment to the Supply Shock

The sample consists of all firms in the annual Compustat database (excluding financial firms) with a below-investment-grade debt rating (BB+ or lower) during the period 1986–1993 and satisfying the criteria detailed in Section II. Table 6 presents coefficient estimates from a difference-in-differences regression of financing and investment variables, where the dependent variable is indicated by the column heading and each variable is normalized by the contemporaneous end-of-year assets. The indicator variables $I(\text{Year} > 1989)$ is equal to 1 if the year is greater than 1989 and 0 otherwise. Similarly, $I(\text{NE})$ is equal to 1 if the firm's headquarters are located in the Northeast region of the country, which includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania. The interaction of these indicators, identifying the treatment effect, is denoted by $I(\text{Year} > 1989) \times I(\text{NE})$. All other variables are lagged 1 period relative to the dependent variable and are formally defined in the Appendix. All *t*-statistics are computed with standard errors that are robust to both heteroskedasticity and within-firm correlation. * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Panel A. Financial Policy

Variable	Net Debt and Equity Issues	Net LT Debt Issues	Net ST Debt Issues	Net Equity Issues	Market Leverage
Intercept	0.09	0.09*	0.01	0.02	0.56**
	(1.73)	(1.96)	(1.71)	(1.38)	(5.77)
$I(\text{Year} > 1989)$	–0.04*	–0.04**	0.00	–0.00	0.02
	(–2.49)	(–2.99)	(0.63)	(–0.49)	(1.17)
$I(\text{NE})$	0.04	0.05	–0.01	0.01	0.03
	(1.60)	(2.11)	(–1.65)	(1.32)	(1.01)
$I(\text{Year} > 1989) \times I(\text{NE})$	–0.06*	–0.06**	0.01	–0.02*	0.00
	(–2.16)	(–2.75)	(1.75)	(–1.96)	(0.09)
Cash flow	–0.12	0.05	0.04	–0.02	0.12
	(–0.96)	(0.50)	(1.92)	(–0.31)	(0.43)
Market-to-book	0.03	0.00	–0.00*	0.01	–0.16**
	(1.43)	(0.32)	(–2.50)	(1.26)	(–6.53)
log(Sales)	–0.02	–0.02	0.00	–0.00	0.01
	(–4.48)	(–4.83)	(0.25)	(–0.85)	(1.04)
Altman's *Z*-score	0.02**	0.03**	0.00	–0.01**	–0.04
	(2.96)	(3.61)	(0.40)	(–3.20)	(–2.34)
$I(\text{Distress})$	–0.02	0.00	–0.00	–0.01	0.05
	(–0.98)	(0.16)	(–1.28)	(–2.71)	(1.42)
Term spread	0.76	0.53	–0.09	0.54**	–1.29
	(1.17)	(0.94)	(–0.94)	(2.77)	(–1.74)
Credit spread	2.92	3.34	–0.59	–0.39	7.78*
	(1.19)	(1.60)	(–1.53)	(–0.48)	(2.09)
Equity market return	0.06	0.05	–0.01	0.01	–0.13**
	(1.50)	(1.61)	(–1.72)	(1.01)	(–3.15)
R^2	0.12	0.15	0.04	0.05	0.17
No. of obs.	766	759	732	737	745

(continued on next page)

[21] We thank an anonymous referee for highlighting this interpretation.

TABLE 6 (continued)

Geographic Variation in the Response of Financing and Investment to the Supply Shock

Panel B. Investment Policy

Variable	Net Investment	Capital Expenditures	Acquisitions	Sale PPE
Intercept	0.13**	0.05*	0.06*	0.01
	(2.91)	(2.10)	(2.21)	(1.38)
I(Year > 1989)	–0.01	0.00	–0.01*	–0.00
	(–1.12)	(0.61)	(–2.21)	(–1.94)
I(NE)	0.03	–0.02*	0.04*	–0.00**
	(1.45)	(–2.35)	(2.12)	(–3.12)
I(Year > 1989) × I(NE)	–0.06**	–0.01	–0.04	0.00
	(–2.70)	(–1.39)	(–1.89)	(0.68)
Cash flow	0.07	–0.05	0.12*	–0.01
	(0.68)	(–0.86)	(2.25)	(–1.00)
Market-to-book	0.04**	0.04**	–0.00	–0.00
	(4.37)	(5.44)	(–0.60)	(–1.43)
log(Sales)	–0.01**	–0.01*	–0.00	–0.00
	(–3.23)	(–2.18)	(–1.80)	(–1.94)
Altman's Z-score	0.01	0.01	–0.00	–0.00
	(1.48)	(1.33)	(–0.22)	(–0.64)
I(Distress)	–0.01	–0.01*	–0.00	–0.00*
	(–1.53)	(–2.07)	(–0.61)	(–2.40)
Term spread	–0.11	–0.25	0.01	0.03
	(–0.22)	(–1.00)	(0.04)	(0.56)
Credit spread	1.02	1.82	–0.07	0.73**
	(0.54)	(1.59)	(–0.05)	(3.10)
Equity market return	–0.00	0.03*	–0.01	0.01
	(–0.07)	(2.27)	(–0.85)	(1.69)
R^2	0.13	0.15	0.07	0.07
No. of obs.	766	748	762	758

the sample of investment-grade (and unrated) firms. The results, not reported, reveal no significant treatment effects (i.e., β_2 is statistically indistinguishable from 0) in financing or investment behavior for either of these two samples. That is, investment-grade and unrated firms in the Northeast experienced no decline in net security issuances or net investment relative to other regions, suggesting that geographic heterogeneity in the severity of the recession is not behind our findings in Table 4.

The findings here support our previous results by illustrating how variations in the cost of an alternative source of capital, bank loans in this case, differentially impacted below-investment-grade firms forced to turn to alternative sources of capital. The next subsection presents an alternative test to identify cross-sectional variation in the impact of the supply shock.

2. Heterogeneity across Risk Classes

A key implication of the credit rationing models discussed earlier concerns the type of firm most likely to be rationed. Specifically, riskier or less financially healthy (i.e., marginal) firms are more likely to be rationed than relatively healthier firms. This differential behavior could be due to greater information opacity or greater moral hazard problems, which tend to be exacerbated in riskier settings (Jensen and Meckling (1976)). Thus, we might expect a differential impact of the supply shock across credit rating levels *within* the below-investment-grade

category. In particular, riskier firms should be hit harder by the supply shock than less risky firms. Further, we might expect that the supply shock also has a more protracted effect on riskier firms.

To test these hypotheses, we stratify our sample of below-investment-grade firms into less risky, Upper Tier (rated BB–, BB, or BB+) and more risky, Lower Tier (rated B+ and lower) firms. We also decompose the estimated treatment effects into a short-run (1990 and 1991) and a long-run (1992 and 1993) component. The implementation of our test in the regression setting used for the geographic sample is to estimate the following regression:

$$
\begin{aligned}
(2) \qquad Y_{it} \quad = \quad & \beta_0 I_{it}\,(\text{Post-1989}) + \beta_1 I_{it}\,(\text{NE}) \\
& + \beta_2 I_{it}(\text{Year} \in \{1990, 1991\}) I_{it}\,(\text{NE}) \\
& + \beta_3 I_{it}(\text{Year} \in \{1992, 1993\}) I_{it}\,(\text{NE}) + \gamma' X_{it-1} + \varepsilon_{it},
\end{aligned}
$$

separately on the Upper Tier and the Lower Tier firms. We can then compare the estimated treatment effects (β_2, β_3) across the Upper and Lower Tier samples.

Panels A and B of Table 7 present the financing and investment results, respectively, from estimating equation (2) on the sample of Upper Tier firms. Panels C and D of Table 7 present the analogous results for the sample of Lower Tier firms. To ease the presentation, we suppress the estimates of the γ-vector but note that we use the same set of controls as employed in Table 6. For the Upper Tier firms, the impact of the supply shock is concentrated in the years immediately following the supply shock, 1990 and 1991. In particular, net long-term debt issuances fall by 5%, with little substitution to alternative sources of finance. Consequently, we see a similar decline in both total net security issuances (6%) and net investment (6%), both of which are concentrated entirely in 1990 and 1991. While the statistical significance of the estimated financing effects is weak, the estimated magnitudes are comparable to those found in the broader sample. Thus, this statistical weakness is more likely a consequence of low power due to the 56% reduction in the number of observations, as opposed to a disappearance of the effect.

After 1991, the effects of the supply shock on the financing and investment behavior of relatively less risky and healthier firms appear to have completely dissipated. None of the estimated treatment effects in the years 1992 and 1993 are statistically or economically significant.

Turning to Panels C and D of Table 7, we see rather different results for Lower Tier firms. Net long-term debt issuances decline significantly in both the short run (8%) and the long run (6%). With little substitution to alternative sources of finance throughout the post-shock era, total net security issuances fall significantly in both the short run (9%) and the long run (5%). While the long-run treatment effect for total net security issuances is statistically insignificant, the magnitude suggests that this too is more a result of low power. Turning to Panel D, we see that the lack of substitution leads to corresponding declines in net investment in both the short run (8%) and the long run (5%). Thus, the riskier and less financially healthy Lower Tier firms experienced a larger and more protracted contraction in net debt issuances and net investment when compared to their Upper Tier counterparts.

We also perform an analysis using the propensity-score-matching method of Section V.A. Specifically, we split the sample of below-investment-grade firms

into Upper and Lower Tiers, as defined above, and match each subsample separately to unrated firms following the procedure discussed earlier. We then compute two difference-in-differences estimators corresponding to a short-run (1990–1991) and long-run (1992–1993) effect, as was done with the Geography sample. Because of similar results and space considerations, we merely summarize our findings with this analysis, all of which are available from the authors. Specifically,

TABLE 7

Variation in the Response of Financing and Investment to the Supply Shock across Risk Classes

The sample consists of all firms in the annual Compustat database (excluding financial firms) with a below-investment-grade debt rating (BB+ or lower) during the period 1986–1993 and satisfying the criteria detailed in Section II. Table 7 presents coefficient estimates from a difference-in-differences regression of financing and investment variables, where the dependent variable is indicated by the column heading and each variable is normalized by the contemporaneous end-of-year assets. The indicator variable $I(\text{Year} \in \{1990, 1991\})$ is equal to 1 if the year is equal to 1990 or 1991 and 0 otherwise (likewise for $I(\text{Year} \in \{1992, 1993\})$. Similarly, $I(\text{NE})$ is equal to 1 if the firm's headquarters are located in the Northeast region of the country, which includes Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, and Pennsylvania. The interaction of these indicators, identifying the treatment effect, is identified by the multiplicative term. Other variables included in the regression, but not reported, are: cash flow, market-to-book ratio, log(sales), Altman's Z-score, a financial distress indicator, a measure of the term spread, a measure of the credit spread, and the firms' annual equity return. All of these variables are lagged 1 period relative to the dependent variable and are formally defined in the Appendix. Panels A and B present the financing and investment results for Upper Tier firms, rated BB–, BB, or BB+, respectively. Panels C and D present the financing and investment results for Lower Tier firms, rated B+ or lower, respectively. All *t*-statistics are computed with standard errors that are robust to both heteroskedasticity and within-firm correlation. * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Panel A. Financial Policy—Upper Tier Firms (rated BB–, BB, or BB+)

Variable	Net Debt and Equity Issues	Net LT Debt Issues	Net ST Debt Issues	Net Equity Issues	Market Leverage
Intercept	0.06	–0.00	0.02	0.03	0.25*
	(0.55)	(–0.04)	(1.83)	(0.92)	(2.19)
$I(\text{Year} > 1989)$	–0.05*	–0.06**	0.00	–0.00	–0.01
	(–2.52)	(–2.85)	(0.56)	(–0.18)	(–0.27)
$I(\text{NE})$	0.02	0.01	–0.00	0.02	0.03
	(0.65)	(0.42)	(–0.25)	(1.73)	(–0.70)
$I(\text{Year} \in \{1990, 1991\}) \times I(\text{NE})$	–0.06	–0.05	0.00	–0.02	–0.00
	(–1.61)	(–1.40)	(0.44)	(–0.95)	(–0.04)
$I(\text{Year} \in \{1992, 1993\}) \times I(\text{NE})$	0.01	–0.00	0.01	–0.00	0.00
	(0.26)	(–0.11)	(1.10)	(–0.06)	(0.04)
Additional control variables	Yes	Yes	Yes	Yes	Yes
R^2	0.14	0.18	0.05	0.11	0.23
No. of obs.	334	332	321	321	333

Panel B. Investment Policy—Upper Tier Firms (rated BB–, BB, or BB+)

Variable	Net Investment	Capital Expenditures	Acquisitions	Sale PPE
Intercept	0.05	0.03	0.03	–0.00
	(0.89)	(0.93)	(0.75)	(–0.61)
$I(\text{Year} > 1989)$	–0.01	–0.00	–0.01	–0.00
	(–0.70)	(–0.22)	(–0.73)	(–0.95)
$I(\text{NE})$	0.01	–0.02*	0.03	–0.00*
	(0.49)	(–2.31)	(1.37)	(–1.99)
$I(\text{Year} \in \{1990, 1991\}) \times I(\text{NE})$	–0.06**	–0.01	–0.05*	0.00
	(–2.73)	(–0.95)	(–2.17)	(0.42)
$I(\text{Year} \in \{1992, 1993\}) \times I(\text{NE})$	0.01	–0.02	0.02	0.00
	(0.13)	(–1.21)	(0.48)	(0.58)
Additional control variables	Yes	Yes	Yes	Yes
R^2	0.17	0.18	0.10	0.04
No. of obs.	334	326	332	329

(continued on next page)

TABLE 7 (continued)

Variation in the Response of Financing and Investment to the Supply Shock across Risk Classes

Panel C. Financial Policy—Lower Tier Firms (rated B+ or lower)

Variable	Net Debt and Equity Issues	Net LT Debt Issues	Net ST Debt Issues	Net Equity Issues	Market Leverage
Intercept	0.05	0.05	0.01	0.00	0.55**
	(0.65)	(0.88)	(1.05)	(0.16)	(4.21)
I(Year > 1989)	–0.03	–0.03*	0.00	–0.00	0.05
	(–1.52)	(–2.10)	(0.08)	(–0.72)	(1.68)
I(NE)	0.05	0.06*	–0.00	–0.00	0.10**
	(1.41)	(2.08)	(–0.86)	(–0.06)	(2.61)
I(Year ∈ {1990, 1991}) × I(NE)	–0.09*	–0.08**	0.00	–0.01	0.03
	(–2.34)	(–2.61)	(0.54)	(–1.75)	(0.67)
I(Year ∈ {1992, 1993}) × I(NE)	–0.05	–0.06*	0.01	–0.00	–0.05
	(–1.29)	(–2.05)	(0.85)	(–0.08)	(–1.12)
Additional control variables	Yes	Yes	Yes	Yes	
R^2	0.18	0.18	0.02	0.06	0.20
No. of obs.	441	436	416	421	422

Panel D. Investment Policy—Lower Tier Firms (rated B+ or lower)

Variable	Net Investment	Capital Expenditures	Acquisitions	Sale PPE
Intercept	0.15*	0.08*	0.10*	0.02*
	(2.36)	(2.03)	(2.23)	(2.23)
I(Year > 1989)	–0.01	0.00	–0.01	–0.00*
	(–0.65)	(0.33)	(–0.97)	(–2.00)
I(NE)	0.04	–0.01	0.04	–0.01*
	(1.34)	(–0.68)	(1.95)	(–2.53)
I(Year ∈ {1990, 1991}) × I(NE)	–0.08*	–0.03*	–0.05*	–0.00
	(–2.77)	(–2.24)	(–2.34)	(–0.00)
I(Year ∈ {1992, 1993}) × I(NE)	–0.05	–0.02	–0.03	0.00
	(–1.59)	(–1.54)	(–1.44)	(1.18)
Additional control variables	Yes	Yes	Yes	Yes
R^2	0.17	0.15	0.09	0.09
No. of obs.	441	425	440	436

we find that Lower Tier firms experienced a sharper decline in net debt issuances, which, when coupled with no substitution to alternative sources of finance, led to a significant decline in net investment. Additionally, the net security issuance and net investment declines were more protracted for Lower Tier firms relative to Upper Tier firms. Thus, as in the Geography sample, variations in financial health led to different responses to the supply shock.

In sum, the analysis here reveals another dimension on which the impact of the supply shock varied, namely, risk. In addition to supporting theoretical predictions, our analysis here, like that in examining geographic heterogeneity, helps to reinforce our identification strategy and interpretation of our results as evidence of supply-side forces shaping corporate behavior.

C. Implications for Firm Performance and Equity Values

Our final analysis examines the impact of the supply shock on measures of firm performance and value. Specifically, we investigate the response of equity

returns, operating income, asset turnover, and return on equity to the credit contraction using the matching framework discussed above. The results are presented in Table 8 and show that firm performance of junk bond issuers generally improved following the credit contraction. In fact all four measures show improvement, though only operating income and return on equity reveal statistically significant results.

TABLE 8

The Response of Firm Performance to the Supply Shock

The sample is a propensity score matched sample of below-investment-grade (BB+ or lower) and unrated firms in the annual Compustat database (excluding financial firms) during the period 1986–1993 and satisfying three additional criteria: i) unrated firms are always unrated throughout the entire 1986–1993 period, ii) below-investment-grade firms do not change status to or from investment grade during the period, and iii) each firm contains at least one observation both before and after 1989 (see the previous tables for propensity score matching diagnostics). Table 8 presents the following summary statistics for the two sets of matched firms: Avg is the average difference between the post-1989 era and the pre-1990 era for all below-investment-grade firms; SE is the standard error of the average; Dif-in-Dif is the difference between the average differences (Avg) for the two groups of firms; and *t*-stat is the ratio of Dif-in-Dif to the standard error of the difference between the two averages. The table presents results where the within-firm (i.e., Junk or Unrated) time-series difference is computed as the average during 1993 and 1990 less the average from 1986 to 1989. For example, to obtain the average junk difference for net long-term (LT) debt issues of –0.10, we begin by computing the average annual net LT debt issues for each firm from 1986 to 1989 and 1990 to 1993. We then subtract the former average from the latter average to obtain the difference for each firm. These differences are then averaged cross-sectionally to obtain the figures in the table. To account for the multiplicity of control observations, all standard errors are clustered at the firm level. * and ** indicate statistical significance at the 5% and 1% levels, respectively.

Variable	Equity Return	Operating Income	Asset Turnover	Return on Equity
Avg: Junk difference	0.02	0.00	0.10	0.04
SE: Junk difference	(0.04)	(0.00)	(0.02)	(0.03)
Avg: Unrated difference	–0.01	–0.02	0.08	–0.04
SE: Unrated difference	(0.03)	(0.00)	(0.02)	(0.01)
Dif-in-Dif	0.03	0.02	0.02	0.08
t-stat: Dif-in-Dif	0.59	2.97**	0.68	2.65**

These results are interesting because they suggest that at the end of the junk bond boom in the late 1980s, the availability of credit may have encouraged firms to invest in negative net present value (NPV) projects. This inference is consistent with agency-based theories highlighting overinvestment, as opposed to those highlighting the discipline imposing benefits of debt. At first glance, this conclusion may appear odd, since most below-investment-grade firms were highly levered. However, insofar as junk bonds were "cheap," firms could use this source of financing for negative NPV projects. Further, this interpretation coincides nicely with the evidence in Kaplan and Stein (1993) suggesting an "overheating phenomenon in the buyout market," which relied primarily on junk bonds for fuel.

Before concluding, we note two limitations of these results. First, our results do *not* imply that junk bonds were bad. The net effect may very well have been positive on economic surplus, a position argued strongly by Jensen (1991). Our results speak only to the welfare of firms around the time of the collapse. Likewise, our results do *not* imply that the credit contraction was "good." As discussed earlier, our inferences are limited only to the firms under study. However, the prevalence of credit booms and busts (Jensen) suggests that the phenomenon that we observe here is not unique.

VI. Conclusion

We use the shock to the supply of below-investment-grade debt precipitated by the fall of Drexel, the enactment of FIRREA, and changes in the insurance industry in late 1989 to early 1990 to examine the impact of fluctuations in the supply of capital on the distribution of financing and investment. The specificity and exogenous nature of these events enable us to employ a difference-in-differences research design aimed at disentangling supply-side from demand-side forces.

Our results show that the contraction in the supply of credit to below-investment-grade firms significantly altered their financing and investment behavior. Net debt issuances were nearly halved relative to what they were prior to the supply shock. This contraction was accompanied by almost no substitution to alternative sources of finance, such as bank debt, equity, retained earnings, or trade credit. Consequently, net investment declined almost one for one with the decline in net debt issuances. The contemporaneous decline in debt and investment had offsetting effects on corporate leverage ratios, which were largely unaffected by the supply shock.

While the events contributing to the contraction in credit supply after 1989 were unique—enabling identification of the supply effect—one cannot help but draw parallels between the influx of money into the high-yield market in the 1980s and the influx of money into venture capital in the late 1990s and, especially, the high-yield market today. Whether today's speculative-grade firms will experience outcomes similar to those of their predecessors remains to be seen. As such, we look forward to future research that examines the impact of this and other supply effects on corporate behavior, as well as research aimed at uncovering the underlying mechanisms linking supply-side forces to corporate behavior.

Appendix. Variable Definitions

All numbers in parentheses refer to annual Compustat item numbers.

Credit Rating = senior long-term debt rating (280).

Net Investment = (capital expenditures (128) + acquisitions (129) – sale PPE (107) + increase in investments (219) – sale of investments (109)) ÷ start-of-period assets (6).

Net LT Debt Issues = long-term debt issues (111) – long-term debt reduction (114) ÷ start-of-period assets.

Net ST Debt Issues = change in current debt (301) ÷ start-of-period assets.

Net Equity Issues = sale of common and preferred stock (108) – purchase of common and preferred stock (115) ÷ start-of-period assets.

Net Issues of Secured Debt and Mortgages = change in secured debt and mortgages (241) ÷ start-of-period assets.

Change in Trade Credit = change in accounts payable (304) + change in accounts receivable (302) ÷ start-of-period assets.

Change in Cash = change in cash equivalents (274) ÷ start-of-period assets.

Total Debt = long-term debt (9) + short-term debt (34).

Book Leverage = total debt ÷ book assets (6).

Market Value of Assets = stock Price (199) × shares outstanding (25) + short-term debt + long-term debt + preferred stock liquidation value (10) – deferred taxes and investment tax credits (35).

Market Leverage = total debt ÷ market value of assets.

Firm Size = log(sales), where sales (12) are deflated by the GDP deflator.

Market-to-Book = (market equity + total debt + preferred stock liquidating value – deferred taxes and investment tax credits) ÷ book assets.

Z-Score = 3.3 × pre-tax income (170) + sales (12) + 1.4 × retained earnings (36) + 1.2 × (current assets (4) – current liabilities (5)) ÷ book assets.

Cash Flow = income before extraordinary items (123) ÷ lagged book assets.

Net Equity Issues (Alternative) = the split-adjusted change in shares outstanding $(\text{data25}_t - \text{data25}_{t-1} \times (\text{data27}_{t-1} \div \text{data27}_t)$ × the split-adjusted average stock price $(\text{data199}_t + \text{data199}_{t-1} \times (\text{data27}_t \div \text{data27}_{t-1}) \div$ the end-of-year $t-1$ total assets.

Financially Distressed = indicator variable equal to 1 if either i) the firm's earnings before interest, taxes, depreciation, and amortization (EBITDA) is less than its reported interest expense for the previous 2 years or, ii) EBITDA is less than 80% of its interest expense in the previous year.

Term Spread = the yield spread between the 1- and 10-year Treasury bonds.

Credit Spread = the yield spread between BB– and BBB-rated corporate bonds.

Equity Market Return = CRSP annual value-weighted return.

S&P 500 = indicator equal to 1 if the firm is in the S&P 500 index.

NYSE = indicator equal to 1 if the firm is listed on the NYSE.

Firm Age = the age of the firm computed as the number of years in which the firm has been listed on Compustat and has a nonmissing value for total assets.

Operating Income = operating income (data13) before depreciation ÷ total assets.

Asset Turnover = total sales (data12) ÷ total assets.

Return on Equity = operating income before depreciation ÷ book equity (data60).

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