ABSTRACT

The U.S. experienced a sharp decline in commercial bank lending from 1990 to 1992. This particular event has caught the attention of many scholars because it is often blamed as one of the factors that led to a failure of a speedy recovery from the ongoing recession. This issue remains controversial because debate exists on whether the credit decline was due to a reduction in supply or to a reduction in demand. Both categories are investigated in this paper by dealing with potential causes ranging from recessionary effects to capital-asset constraints. The analytical component focuses on involves single and multiple regressions employing data sets from aggregate state-by-state totals and individual banks in California. The results from the analysis suggest that low capital-asset levels and strict regulatory standards during 1990 resulted in a supply-induced credit decline.
Dedicated to my parents and Elise
I. INTRODUCTION

The sluggish recovery of the 1990 U.S. recession led many economists to blame banks in failing to fulfill its transmission role as a monetary policy stimulus to the economy. Businesses and consumers discovered credit was difficult to obtain, which possibly discouraged them from investment endeavors. As evident in Figure A, net loans experienced an unprecedented decline from 1990 to 1992.

Specifically, loans experienced a significant decline with a -2.8% growth rate from 1990 to 1991 after decades of continuous growth. Loans continued to decrease by 1.0% from 1991 to 1992. It was only until the beginning of 1993 that loans steadily increased again. If lending had followed usual trends however, it is estimated that the

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1 I wish to thank my advisor Felix Kubler for his advice, comments, and the time he has devoted in helping me with this study. I also wish to thank Geoffrey Rothwell for Honors College and his advice as well.

2 Data was taken from Federal Deposit Insurance Corporation.
level of commercial bank loans in 1993 would have had $358 billion more than its actual level\(^3\). Since businesses on the average obtain 61.9\% of their money from loans\(^4\), this obviously was an enormous opportunity loss for capital-starved corporations. The sheer magnitude of the decrease in loans during the two-year period gives reason to believe that the expansionary monetary policy in 1991 failed to stimulate business investment, thus possibly prolonging the recession.

The unprecedented nature and negative effects of the 1990-1992 credit decline on the economy makes it a prerogative that it be examined carefully in order to shed light on its causes. Therefore, the purpose of this paper is to determine the true reasons behind the credit decline. To begin, it is worth analyzing possible reasons from a high-level perspective. The reasons can be placed into one of three categories: (1) reduction in business and consumer loan demand, (2) reduction in loan supply, or (3) both. Assuming ceteris paribus, Figure B below visually demonstrates the effects of each of these three categories through the supply and demand model:

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\(^3\) Estimation assumes an average annual loan growth rate of 8.3\% from 1975 to 1989. Loans continued to have an annual average growth rate of 8.3\% after 1992.

\(^4\) Source: Mishkin (2001)
In Figure B, all three possibilities result in the reduction of the quantity of loans. However, the effects on interest rates are different in each situation: rates decrease in response to a downward demand shift while rates increase in response to an upward supply shift. If the demand and supply curves shift simultaneously and assuming both shifts are of equal distance, then interest rates would remain the same. The effect on interest rates makes intuitive sense: banks lower interest rates in order to stimulate borrowing while banks raise interest rates to decrease incentives for borrowing. Both methods alter the cost of borrowing by respectively making loans cheaper or more expensive relative to an earlier fixed interest rate.
The dilemma whether the 1990-1992 credit decline was due to a reduction in loan demand or loan supply is a controversial subject among economists. Moreover, the additional possible in which loan supply and loan demand simultaneously reduce adds to the complexity of this debate. Nevertheless, a preliminary analysis to determine which one of the three possibilities was responsible can be conducted by comparing the cost of borrowing from a commercial bank or raising funds through corporate bonds. Figure B predicts that a supply-side reduction would raise the cost of commercial bank borrowing relative to corporate bond issuing while a demand-side reduction would reveal otherwise. Table A displays the average prime loan rate and corporate bond rate biannually from 1986 to 1994.

<table>
<thead>
<tr>
<th>Year</th>
<th>Prime Loan Rate (%)</th>
<th>Corporate Bond Rate (%)</th>
<th>Spread</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986—1</td>
<td>8.99</td>
<td>9.29</td>
<td>-0.3</td>
</tr>
<tr>
<td>1986—2</td>
<td>7.68</td>
<td>8.75</td>
<td>-1.07</td>
</tr>
<tr>
<td>1987—1</td>
<td>7.77</td>
<td>8.77</td>
<td>-1</td>
</tr>
<tr>
<td>1987—2</td>
<td>8.63</td>
<td>9.99</td>
<td>-1.36</td>
</tr>
<tr>
<td>1988—1</td>
<td>8.68</td>
<td>9.68</td>
<td>-1</td>
</tr>
<tr>
<td>1988—2</td>
<td>9.95</td>
<td>9.74</td>
<td>0.21</td>
</tr>
<tr>
<td>1989—1</td>
<td>11.12</td>
<td>9.59</td>
<td>1.53</td>
</tr>
<tr>
<td>1989—2</td>
<td>10.58</td>
<td>8.93</td>
<td>1.65</td>
</tr>
<tr>
<td>1990—1</td>
<td>10.02</td>
<td>9.3</td>
<td>0.72</td>
</tr>
<tr>
<td>1990—2</td>
<td>10</td>
<td>9.35</td>
<td>0.65</td>
</tr>
<tr>
<td>1991—1</td>
<td>8.93</td>
<td>8.92</td>
<td>0.01</td>
</tr>
<tr>
<td>1991—2</td>
<td>8</td>
<td>8.62</td>
<td>-0.62</td>
</tr>
<tr>
<td>1992—1</td>
<td>6.5</td>
<td>8.28</td>
<td>-1.78</td>
</tr>
<tr>
<td>1992—2</td>
<td>6</td>
<td>8</td>
<td>-2</td>
</tr>
<tr>
<td>1993—1</td>
<td>6</td>
<td>7.57</td>
<td>-1.57</td>
</tr>
<tr>
<td>1993—2</td>
<td>6</td>
<td>6.87</td>
<td>-0.87</td>
</tr>
<tr>
<td>1994—1</td>
<td>6.46</td>
<td>7.55</td>
<td>-1.09</td>
</tr>
<tr>
<td>1994—2</td>
<td>7.82</td>
<td>8.37</td>
<td>-0.55</td>
</tr>
</tbody>
</table>

5 Data taken from [http://www.stls.frb.org/fred/data/irates.html](http://www.stls.frb.org/fred/data/irates.html). Spread is calculated by subtracting the corporate bond rate from the prime loan rate. The corporate bond rate is the Moody’s seasoned Aaa corporate bond yield.
Assuming the prime lending rate and corporate bond rate are representative of the average costs of borrowing through their respective channels, Table A reveals clues about whether the 1990-1992 credit decline was a demand or supply-side phenomenon. The spread was negative from 1986 to 1988, suggesting that raising capital was more expensive with corporate bonds. The situation changed suddenly in 1988, however, as the prime loan rate increased while corporate bond rates remained static, and the spread became positive. Specifically, the spread reached a peak of 1.65 during the last few months of 1989, a time right before the amount of commercial bank loans begun to decline. Businesses at this time discovered that commercial bank loans on the average were more expensive than corporate bonds. Upon first glance, this trend would seem to be more consistent with the outcome of Figure B’s supply curve shift rather than its demand curve shift, suggesting that the credit decline was the result of supply factors. However, the spread significantly dropped at the beginning of the credit decline in 1990 and continued to do so as the spread finally returned to a negative value at the end of 1992. Despite the spread being positive during most of the time from 1990 to 1991, it was declining considerably as credit was itself declining, which is contradictory according to Figure B’s framework. Therefore, the results from Table A are inconclusive.

The above inconclusive results suggest that the credit decline is a complicated topic that requires in-depth analysis of a variety of factors. What makes this study so difficult is that so many factors may have been involved; it is presumptuous to single out a sole determining factor. Furthermore, it is perfectly possible the credit decline was the result of a combination of factors, stemming from both the supply-side and demand-side.
A primary problem in this study is trying to control demand from supply factors and vice versa. Finally, even if the credit decline was indeed the result of supply factors, the above analysis does not specify exactly what supply factor was the cause.

Therefore, this examination requires a close analysis of each supply-side and demand-side mechanism that may have caused the 1990-1992 credit decline. Possible causes range from increased risk aversion of bank examiners to the trend toward alternative forms of borrowing. Although these topics will be covered in this paper, I will primarily focus on the capital shortage of commercial banks, as there exist particularly strong evidence that such shortages had played a significant role in initiating the credit decline.

The document is divided as follows: Section II gives an overview of the possible causes of the credit decline. The rest of the thesis is devoted to focusing on a single hypothesis from Section II: the capital crunch hypothesis. Section III contains my empirical analysis of the capital crunch using data from both statewide and individual banks. Finally, Section IV is my conclusion.

II. OVERVIEW OF POTENTIAL CAUSES

This section examines possible demand-side causes of the 1990-1992 credit decline: (1) weak credit demand and borrowers’ financial status and (2) trend toward alternative forms of borrowing. The rest of this section then involves examining supply-side causes: (3) increased risk aversion of bank examiners, (4) trend toward loan securitization, (5) tight monetary policy, and (6) capital constraints.
**Possible demand side factors**

_A. Weak Credit Demand and Borrowers’ Financial Status_

A significant factor that must be taken into account was the influences of the 1990 recession, which coincided with the decrease in lending from 1990 to 1992. During this recession, U.S. GDP experienced negative growth at the end of the second quarter for 1990 and did not resume positive growth until the end of 1991. It is possible that the recession decreased consumer confidence, thereby inducing the group to save more rather than to borrow less due to their precarious financial status at the time. For example, the soaring unemployment rate that accompanied the recession from 1990 to 1991 may have induced the consumer to save more out of the fear of massive layoffs. Moreover, businesses would naturally borrow less during a recession since predicted returns on investment opportunities are at its lowest\(^6\).

Although the above assertions make intuitive sense, it cannot explain why credit experienced an unprecedented decline during the recession from 1990 to 1991 in comparison to past recessions. Table B displays the amount of loans broken down for each recession since 1960:

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total loans</td>
<td>4.1</td>
<td>14.6</td>
<td>3.1</td>
<td>9.3</td>
<td>1.7</td>
</tr>
<tr>
<td>Commercial loans</td>
<td>10.1</td>
<td>19.2</td>
<td>4.8</td>
<td>16.8</td>
<td>-1.1</td>
</tr>
<tr>
<td>Consumer and other loans</td>
<td>-1.3</td>
<td>9.7</td>
<td>-1</td>
<td>2.6</td>
<td>-1.7</td>
</tr>
<tr>
<td>Real Estate loans</td>
<td>2.9</td>
<td>15.4</td>
<td>5.8</td>
<td>7.7</td>
<td>5.9</td>
</tr>
</tbody>
</table>

\(^6\) These assertions are consistent with the theory of asset demand, which states the quantity demanded of an asset is positively related to its expected return. Loans, of course, are not assets but are used by businesses to acquire more assets.

\(^7\) Nominal loan data taken from Flow of Funds released by Federal Reserve. Growth rates are averaged and taken from the month preceding the cyclical peak to three quarters later.
According to Table B, lending growth by commercial banks in 1990 was dramatically weaker than other recessions. The 1990 recession experienced 1.7% loan growth compared with an average of 7.1% loan growth from past recessions. Loans to businesses particularly took a hard hit in 1990, as it was the only recession since 1960 to experience negative growth. If typical demand reduction effects from a recessionary period were the sole cause of the decline in lending during 1990, then it is expected that data in this year would show values similar to past recessions. Certainly Table B shows that this is not the case: therefore, a demand-side explanation for the credit decline cannot rely on typical recessionary effects on businesses and consumers alone.

It is possible credit demand declined greater than normal during this recession because of the extreme weak state of borrowers’ finances during this time. The real estate bubble of the 1980’s crashed just during the turn of the decade, which significantly lowered asset prices. As a result, many corporate borrowers’ balance sheets were considerably harmed and experienced a drop in net worth. This increased the amount of leverage and reduced the amount of leverage borrowers’ had to offer. Assuming banks during this time maintained constant risk aversion and identical loan application standards, such borrowers would be considered less creditworthy and have a harder time being accepted for a loan\(^8\). Indeed, data seems to support the fact that borrowers’ balance sheets were weaker than normal: according to the Department of Commerce, the ratio of interest payments to before-tax cash flow for non-financial corporations was nearly 23% at the end of 1990 while the ratio was less than 18% in 1980. Clearly, this suggests that

\(^8\) This assertion seems like it should belong more to the supply-side category rather than demand-side but it is assumed that banks held identical standards it did compared with previous years. Therefore, it was not the suppliers of loans (banks) but the borrowers’ of such loans (businesses and consumers) who had their characteristics changed. Thus, according to such line of thought, the credit decline originated from the demand-side.
borrowers have been leveraged at such high levels that their loan applications may not have passed banks’ requirements.9

B. Trend toward Alternative Forms of Borrowing

Another possibility that could have caused the 1990-1992 credit decline from the demand-side was that borrowers’ may have increasingly resorted to other ways of raising money without resorting to traditional commercial bank lending. During the past two decades, the banking industry has had to compete with financial innovations ranging from commercial paper to junk bonds.10 These innovations were made possible by the advancement of information technology, which has significantly decreased transaction costs. In turn, businesses can raise money without going through the traditional lending process. The decline of traditional lending by commercial banks is made evident by the fact that in 1974, commercial banks provided approximately 40% of funds to non-financial borrowers; by 1999, this market share was reduced to below 30%. Clearly as time has progressed, traditional bank lending has become not as important as a source of funds for businesses as it had been before.

These observations allow the possibility that the 1990-1992 credit decline may not have been an economic concern at all since it was only limited to the commercial bank industry. In fact, the phenomenon can actually be seen as beneficial to the economy since businesses and consumers have found more efficient ways to raise capital.

Though this hypothesis seems attractive due to its positive news and simplicity, it raises some doubts. For example, if commercial bank loans were indeed substituted

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9 A better test for this assertion would be to compare the percentage of failed loan applications in 1990-1992 with the percentage of other years. Unfortunately, such data is proprietary for most banks and cannot be obtained.
10 See the May 18, 1993 Wall Street Journal article “Wall Street is Using Junk Bonds to Take Another Slice of Banks’ Lending Pie.”
away, then the decline in commercial bank lending would not have been solely isolated from 1990 to 1992. The period from 1990 to 1992 contained nothing particularly revolutionary regarding financial innovations as junk bonds and commercial paper had existed since the 1980’s. Furthermore, if loans from commercial banks finally did start to decrease in 1990, then this trend would have continued beyond 1992. Information technology would continue to lower transaction costs, thereby continuing to lower the amount of bank loans as financial innovations became more and more popular. Clearly, this was not the case: Figure A shows commercial bank loans had resumed positive growth after 1992.

Another observation that discredits the loan substitute hypothesis involves examining the concurrent growth rates of alternative forms of borrowing. If the hypothesis were indeed valid, then alternative credit would grow while commercial bank credit would decline. Table C displays the initial level of credit and growth rate for both categories in 1980 and 1990:

<table>
<thead>
<tr>
<th>Source of Credit</th>
<th>1980 Initial Level</th>
<th>1980 Growth (%)</th>
<th>1990 Initial Level</th>
<th>1990 Growth (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial banks</td>
<td>276.4</td>
<td>4.8</td>
<td>677.3</td>
<td>-1.1</td>
</tr>
<tr>
<td>Non-financial commercial paper</td>
<td>26.3</td>
<td>24.7</td>
<td>125.3</td>
<td>-6.0</td>
</tr>
<tr>
<td>Trade credit</td>
<td>135.2</td>
<td>2.1</td>
<td>246.8</td>
<td>-7.4</td>
</tr>
</tbody>
</table>

It is clear from Table C that alternative forms of borrowing experienced astronomical growth in the 1980 recession as commercial paper grew almost six times more than commercial bank credit. However, its popularity did not carry over to the 1990 recession as it experienced negative growth rate, coinciding with the decline in

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11 Source: Bernanke and Lown (1991)
commercial bank lending. In fact, commercial paper as a source of credit decreased even more so than commercial bank loans. These facts discredit the assertion that alternative forms of borrowing were acting as substitutes: since alternative forms of lending decreased along with commercial bank lending during 1990, then it was certainly not stealing customers from commercial banks. It does give credence to the view, however, that the decline in commercial bank lending was not the result of supply but instead the result of a widespread demand shift that influenced all forms of credit.

As of now, the paper has given a brief overview of potential demand-side reasons for the credit decline. Given the preliminary analysis, both the trend toward alternative forms of borrowing and the weak state of borrowers’ finances as explanations for the credit decline have substantial weaknesses. The paper now turns to potential supply-side reasons.

**Possible supply side factors**

*A. Risk aversion of bank examiners*

A possibility that may have contributed to 1990-1992 credit decline was that bank managers became so risk averse that they reduced the number of loans out of their heightened fear of loan defaults. Though the loan business is the primary contribution of profits for many commercial banks, the bank managers have to be continuously careful with whom they give loans to. This is primarily due to the existence of asymmetric information. Loan officers have less information about the investment opportunities and budget activities than the borrowers’ themselves, therefore making monitoring of the borrower’s activities difficult. Moreover, adverse selection is also a problem in the loan business as those who are more likely a credit hazard would seek out loans in the first
place. These factors combine to make the loan business a risky venture: those loan managers who are more risk averse than others would be less willing to give out loans.

In order for risk aversion to be a credible cause for the 1990-1992 credit decline, an explanation is needed why bank managers particularly became more risk averse during this two-year period than other periods. Indeed, managers have incentives to become more risk averse after the 1980’s: the savings and loan debacle created almost $20 billion in losses in 1989 and the collapse of real estate prices greatly exacerbated the crisis. Both commercial banks and savings and loan institutions averaged failures ten times more than previous decades\(^{12}\). Indeed lawmakers, if not bank managers, became so alarmed by the frequency of bank failures due to aggressive asset management that they created new regulatory laws: Financial Institutions Reform, Recovery, and Enforcement Act (FIRREA) and the Federal Deposit Insurance Corporation (FDIC). Both these laws required the earlier intervention of government agencies when a bank is in danger of failing, which in turn makes bank managers more risk averse. In addition, the Basle Accord was also formed to reduce the bank’s risk toward insolvency. The paper later analyzes in detail the Basle Accord’s influence toward capital standards. The overall effect of these new laws is that the banking industry has more of an incentive to clamp down on their loans in order to not repeat the disastrous mistakes that had been made in the 1980s.

A good way to verify this risk aversion hypothesis is to examine if the amount that banks had set aside for loan losses reflect any significant jump from 1990 to 1992. If bank managers indeed had increased their risk aversion, then most likely they would have

\(^{12}\) See Mishkin (2001) for a good overview of the 1980’s banking crisis and the regulatory laws that were formed as a result.
accordingly expected more defaults for that year and thus adjust the bank’s allowance for loan losses higher. Figure C graphs the loan loss allowance for all FDIC-insured commercial banks during the past two decades. The amount of actual loans lost is also graphed alongside for the purposes of comparison.

![Figure C: Loan Allowances and Net Loan Losses for All FDIC-Insured Commercial Banks (1980-2000)](image)

Indeed it can be seen from Figure C that banks experienced a significant increase in loan loss during the second half of the 1980’s. Loan loss actually peaked in 1991 with a $32.9 billion charge-off but dramatically declined during later years. The dramatic

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13 Data compiled from the Federal Deposit Insurance Corporation’s *Historical Statistics on Banking*
drop can be attributed to the 1990-1992 credit decline and the implementation of new banking regulations.

However, the loan loss allowance portion of Figure C actually goes contrary to the risk aversion hypothesis. As mentioned earlier, the loan loss allowance should increase significantly during the 1990-1992 period if bank managers indeed increased their risk aversion. Yet the allowance steadily maintained its level during this period with $53.7, $55.5, $55.1 billion levels respectively in 1989, 1990, and 1991. Meanwhile, loan loss allowance levels were skyrocketing during the mid 1980’s yet the amount of loans continued to grow. Though these trends can be perceived as that bank managers were increasing their allowances because they were anticipating future losses, it does not make sense why managers would later maintain allowance levels if they did increase their risk aversion. Taken as a whole, Figure C does not seem to suggest that increased risk aversion by bank managers played a significant role in the 1990-1992 credit decline. If anything, Figure C shows how large the magnitude in loan losses commercial banks were facing during this period and bank managers may not have taken up the task of solving this crisis themselves. The thesis later shows how the increase in government regulations and capital constraints is related to these issues.

B. Trend toward Loan Securitization

Another supply-side hypothesis that could explain the 1990-1992 credit decline involves the increasingly popular method of loan securitization. Securitization is the process of transforming assets that are otherwise illiquid into transferable capital market securities. Since bank loans that are securitized do not appear on balance sheets and are
not counted toward the standard measure of loans, then it is possible that credit never really declined in the first place.

To begin analyzing this hypothesis in relation to the credit decline, it must be explained why banks would prefer to securitize their loans rather than to manage them traditionally. At first, it seems confusing why banks would securitize: investors would prefer to hold their own assets rather than purchasing from others in a securitized form, since the latter will create a moral hazard. The sellers of the securitized asset would be less inclined to enforce and monitor the actual loan since they do not directly own the asset anymore. Therefore, securitization, according to this theory, would be a doomed financial innovation.

In contrast, however, the process of securitization gives both the buyer and the seller of the loan many advantages. If the moral hazard can be minimized through covenants, securitization offers the buyer attractive interest payments on loans that he originally cannot have enforced by himself\(^\text{14}\). Furthermore, the bundling aspect of loan securities allows the buyer to enjoy the financial advantages of diversification. Meanwhile, the seller no longer needs to hold loans until maturity and can also avoid reserve and regulatory capital requirements since securitized loans are shown off-balance sheet. The latter reason is most likely why securitization would be a popular financial innovation for capital constrained banks, a category of banks that the thesis focuses on later. Indeed, these advantages for both parties along with improvements in information technology have made securitization a mainstream activity: two-thirds of residential

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\(^{14}\) With common denominations of less than $100,000, loan securities are affordable by non-bank entities while capturing the monitoring advantages of banks. Banks, of course, can afford this through economics of scale.
mortgages are now securitized and $100 billion are currently outstanding from
securitized consumer credit cards\textsuperscript{15}.

Certainly the thesis has made it evident that buyers and sellers have incentive to
convert to securitization but now the question is whether this financial innovation has
particularly influenced commercial lending from 1990 to 1992. If the suggestion is true
that credit never really declined but through securitization was hidden away from
statisticians, then it must be shown that enough securitization activity increased from
1990 to 1992 to compensate for the ‘missing’ bank credit. Securitized consumer credit is
one area that has gotten much attention because of its significant increase during this time
period. According to the Federal Reserve, securitized consumer credit increased from 65
billion dollars in the second quarter of 1990 to 80 billion dollars in the first quarter of
1991. Assuming all securitized credit is attributed to banks, the \textdash1.7\% consumer loan
growth shown in Figure A would actually be \textit{positive}\textsuperscript{16}.

However, this analysis has many weaknesses. First, the assumption that all
securitized credit can be attributed to banks is a gross overstatement. Much of securitized
consumer credit is sold by non-bank entities so therefore not all of the data can be
included in the calculations. Second, securitized consumer credit forms a small
percentage of commercial bank credit as a whole. A mere 19\% of net loans were given to
consumers in 1991. Therefore, even if the overstated assumption holds true in the first
place, this analysis still does not bode well in explaining the overall credit decline.

A better way to analyze the relation of commercial bank lending with
securitization would be to examine data involving the buying and selling of commercial

\textsuperscript{15} Source: Mishkin (2002)
\textsuperscript{16} This analysis was conducted by Bernanke and Lown (205). Taking securitized consumer credit into account, they
predict that consumer loan growth would actually be 1.3\% rather than \textdash1.7\%. 
and industrial loan securities. As opposed to consumer credit that is standardized across financial markets, commercial and industrial loans deal more with commercial banks’ specialty of monitoring and assessing the credibility of borrowers; this data would therefore be a better indicator of trends specifically in the realm of commercial banks. Table D displays the amount of commercial and industrial loans securitized and sold from 1983 to 1991:

<table>
<thead>
<tr>
<th>Quarter</th>
<th>C+I Loans Sold (billions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1983-4</td>
<td>29.1</td>
</tr>
<tr>
<td>1984-4</td>
<td>50.2</td>
</tr>
<tr>
<td>1985-4</td>
<td>75.7</td>
</tr>
<tr>
<td>1986-4</td>
<td>111.8</td>
</tr>
<tr>
<td>1987-1</td>
<td>162.9</td>
</tr>
<tr>
<td>1987-4</td>
<td>198.0</td>
</tr>
<tr>
<td>1988-1</td>
<td>236.3</td>
</tr>
<tr>
<td>1988-2</td>
<td>248.4</td>
</tr>
<tr>
<td>1988-3</td>
<td>263.0</td>
</tr>
<tr>
<td>1988-4</td>
<td>286.8</td>
</tr>
<tr>
<td>1989-1</td>
<td>272.7</td>
</tr>
<tr>
<td>1989-2</td>
<td>276.5</td>
</tr>
<tr>
<td>1989-3</td>
<td>290.9</td>
</tr>
<tr>
<td>1989-4</td>
<td>258.7</td>
</tr>
<tr>
<td>1990-1</td>
<td>228.3</td>
</tr>
<tr>
<td>1990-2</td>
<td>190.2</td>
</tr>
<tr>
<td>1990-3</td>
<td>216.6</td>
</tr>
<tr>
<td>1990-4</td>
<td>165.0</td>
</tr>
<tr>
<td>1991-1</td>
<td>132.9</td>
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</tbody>
</table>

Table D confirms the assertion that securitization is an increasingly popular financial innovation with immense growth of commercial and industrial loans being sold throughout the 1980’s. However, the amount of commercial and industrial loans being

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17 Data is from Gorton and Pennacchi (1991) and Bernanke and Lown (1991). The amount of C+I loans sold is not annualized. Data later than 1991 is not available.
sold significantly dropped as early as the fourth quarter of 1989. This is two quarters earlier when the overall credit decline occurred. The drop continued until 1991 and by then, it had reached 1986 levels. Therefore, securitization from 1990 to 1991 did not significantly increase to compensate for the credit decline, as the above hypothesis would have predicted but in fact dramatically dropped. If securitized commercial and industrial loans were taken into account in banks’ balance sheets, then aggregate credit decline would have been even lower.

The above analysis discredits the hypothesis that the dramatic jump in popularity of securitization from 1990 to 1992 contributed to the credit decline. Although securitized consumer credit did in fact dramatically increase, the more relevant commercial and industrial loans actually declined in sales. If anything, the surprising drop suggests that the credit decline was worse than originally thought.

C. *Tight monetary policy*

A third supply-side hypothesis for explaining the 1990-1992 credit decline asserts that banks reduced their lending because of the tight monetary policy at the time. Since banks need actual funds ranging from checking deposits to capital in order in order to loan in the first place, the Federal Reserve can control the amount of funds commercial banks hold through the use of reserve requirements and open market operations\(^\text{18}\). If the Federal Reserve from 1990 to 1992 had conducted a monetary policy with high reserve requirements and open market sales, then it is possible that banks simply ran out of funds to lend.

\(^{18}\) Reserve requirements force a bank to hold a percentage amount of their total deposits with the Fed in which the Fed pays no interest. Open market operations that reduce the money supply involve selling bonds to individuals and banks. See Mishkin (2001) for more information on the Federal Reserve System and monetary policy.
Since both a higher reserve requirement and an open market sale would raise the federal funds rate, then observing whether this particular rate was overly high or low would indicate how tight or loose the monetary policy the Federal Reserve intended to pursue. Table E displays the average federal funds rate every quarter from 1986 to 1994:

<table>
<thead>
<tr>
<th>Year</th>
<th>I Quart. (%)</th>
<th>II Quart. (%)</th>
<th>III Quart. (%)</th>
<th>IV Quart. (%)</th>
<th>Ann. Average (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1986</td>
<td>7.83</td>
<td>6.92</td>
<td>6.21</td>
<td>6.27</td>
<td>6.81</td>
</tr>
<tr>
<td>1987</td>
<td>6.33</td>
<td>6.65</td>
<td>6.84</td>
<td>6.92</td>
<td>6.69</td>
</tr>
<tr>
<td>1988</td>
<td>6.66</td>
<td>7.16</td>
<td>7.98</td>
<td>8.47</td>
<td>7.57</td>
</tr>
<tr>
<td>1989</td>
<td>9.44</td>
<td>9.73</td>
<td>9.08</td>
<td>8.61</td>
<td>9.22</td>
</tr>
<tr>
<td>1990</td>
<td>8.25</td>
<td>8.24</td>
<td>8.16</td>
<td>7.74</td>
<td>8.10</td>
</tr>
<tr>
<td>1991</td>
<td>6.43</td>
<td>5.89</td>
<td>5.64</td>
<td>4.82</td>
<td>5.70</td>
</tr>
<tr>
<td>1992</td>
<td>4.02</td>
<td>3.77</td>
<td>3.26</td>
<td>3.04</td>
<td>3.52</td>
</tr>
<tr>
<td>1993</td>
<td>3.04</td>
<td>3.00</td>
<td>3.06</td>
<td>2.99</td>
<td>3.02</td>
</tr>
<tr>
<td>1994</td>
<td>3.21</td>
<td>3.94</td>
<td>4.49</td>
<td>5.17</td>
<td>4.20</td>
</tr>
</tbody>
</table>

Much evidence from Table A exists that suggests the Fed was enacting an extremely tight monetary policy near the turn of the decade. Indeed, the rate was at its peak in 1989 and 1990 with values of 9.22 and 8.10, respectively. By comparison, the federal fund rate is a mere 1.75 at the time of this writing! However, the rate significantly dropped by more than 30% the following year. This suggests that perhaps the Federal Reserve reversed its tight monetary policy into an expansionary one, most likely in response to the ongoing recession. However, commercial bank loans in 1991 continued to decline despite the rate drop. Since the tight monetary policy hypothesis not only implies that an increase in the federal fund rate would deter borrowing but also that

---

19 Data taken from www.stls.frb.org/fred/data/irates/fedfunds. The interest rate for each quarter is calculated by taking the average rate out of the three months.

20 It may be interesting to note that President George Bush Senior later blamed Fed Chairman Alan Greenspan for his failure in getting reelected to office in 1992 due to Greenspan’s refusal to lower interest rates earlier on during the 1990 recession.
a decrease in the rate would stimulate borrowing, then the hypothesis is contradicted by
the 1991 data. Nevertheless, lag times may exist between the time the Federal Rate
altered the federal fund rate to when banks are actually influenced so whether the
hypothesis is valid or not is still uncertain.

Further data besides the federal funds rate should be examined to see how
influential the Federal Reserve’s monetary policy really was. If banks were indeed
impacted by fund shortage, then these institutions would more actively seek out funds to
replenish their supply. Since banks can actively obtain funds by raising depository rates
and thus attracting more depositing customers, the proportion of time deposits to total
bank deposits is a good measure of the banks’ initiative in combating the tight monetary
policy. Figure D graphs the ratio of time deposits to total deposits from 1960 to 2000:

Figure D: Ratio of Time Deposits to Total Deposits of U.S. Commercial Banks

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21 Data taken from Federal Deposit Insurance Corporation Statistics on Banking.
Figure D shows that the ratio of time deposits to total deposits was at a relatively high value of .46 in 1990. However, the ratio significantly decreased in the beginning of 1991 and continued throughout 1992. This suggests that the high level of the ratio may have been more the end product of the banks’ desire for funds to feed the 1980’s lending craze rather than a reaction to the extraordinary high funds rate. Therefore, Figure D does not support the tight monetary policy hypothesis.

Another contradictory piece of evidence against the hypothesis is the fact that the dramatic drop in loans occurred in this time period and not other time periods when tight monetary policy was also being conducted. For example, the Fed set a stratospheric federal funds rate of 17.61% in 1980 but commercial bank lending during that year still had a strong growth rate of 8.12%. Surely, commercial banks did not experience a shortage of funds in 1980 despite having a federal funds rate twice as large as the 1990 average rate. This, along with other observations above, implies that a tight monetary policy most likely did not necessarily result in a credit decline. I will now turn to the paper’s final supply-side hypothesis involving capital constraints.

D. Capital constraints

The capital constraint hypothesis asserts that loans declined because commercial banks were not able to meet regulatory capital requirements. Capital is used as the bank’s backup reserves in case the bank runs out of primary reserves. Reserves are needed just in case the bank is suddenly compelled to pay back its depositors due to loan defaults or withdrawal runs. Therefore, capital is the bank’s protection against insolvency. To minimize the amount of bank insolvencies, government agencies such as
the FDIC enforce rules that make banks hold a certain minimum level of capital relative to their total assets. If banks have trouble meeting this requirement, severe penalties will be ensued. Therefore, severely under-capitalized banks would be inclined to raise their capital-asset ratio utilizing three choices: (1) obtain more capital, (2) reduce their assets, or (3) both. Here I finally come to crux of my argument: if conditions existed in which the first choice would be not profitable to carry out, then banks would be forced to pursue the second option. Note that in reality, banks would pursue both to a certain degree. However, in this specific scenario, the reduction of assets would outweigh the benefits of obtaining more capital. Since loans are by definition a form of assets, then the decrease in assets would logically lead to a decrease in loans.

Following this logic, there are two conditions that would make obtaining more capital less profitable as opposed to reducing assets: (1) government agencies significantly raise capital-asset requirements to make banks severely under-capitalized and (2) banks were already severely undercapitalized to begin with. I will later show in the next section using a mathematical model why these two conditions would indeed induce banks to reduce assets instead of increasing capital. But for now, I examine how the two conditions occurred in a historical context around 1990.

As the result of the banking industry crisis during the 1980’s, many banks entered the next decade with capital shortages. First, it may be helpful to show from a basic level why under-capitalized banks would exist in the first place. In other words, strong incentives must be revealed on why bank managers would risk penalties from the government and expose the bank’s capital to risk. To show this, I analyze how reducing
capital levels can increase the profitability of the bank. First, let the variable \( \text{Return}_{\text{assets}} \) be a measure of the bank’s profitability:

\[
(1) \quad \text{Return}_{\text{assets}} = \frac{\text{net profit}}{\text{total assets}}
\]

\( \text{Return}_{\text{assets}} \) is a good measure of the bank’s profitability because it shows how efficiently the bank is using its assets to create returns. However, the owners of the bank care more about the amount of returns from capital since it is capital that the owners have equity in\(^{22} \). Therefore, let \( \text{Return}_{\text{equity}} \) be another measure of the bank’s profitability that owners have more of an interest in:

\[
(2) \quad \text{Return}_{\text{equity}} = \frac{\text{net profit}}{\text{capital}}
\]

Equation 1 and 2 are related by equation 3 below. Equation 4 simplifies equation 3.

\[
(3) \quad \frac{\text{net profit}}{\text{capital}} = \frac{\text{net profit}}{\text{total assets}} \times \frac{\text{total assets}}{\text{capital}}
\]

\[
(4) \quad \text{Return}_{\text{equity}} = \text{Return}_{\text{assets}} \times \frac{\text{total assets}}{\text{capital}}
\]

Equation 4 shows the relationship between the return from capital and capital levels: if the bank reduces capital levels, then the return from capital increases. The return from capital decreases, however, when the bank increases capital levels. To summarize, capital levels are inversely proportional to the profitability of the bank from the owner’s perspective. Thus, it is understandable why bank managers would be so

\(^{22} \) There exists more than one type of capital but for the purpose of simplicity, I will be primarily be referring to equity capital
aggressive in decreasing the bank’s capital at the risk of going below capital requirements. Bank managers are ultimately the employees of owners, who hire such people to maximize profits in the owner’s best interest.

Though it is theoretically shown why there would exist under-capitalized banks, it still needs to be empirically exposed that a significant increase in the quantity of under-capitalized banks did in fact occur around 1990-1992. A good indicator of how many banks were under-capitalized during this period would be to see how many banks actually became insolvent. Figure E below graphs the number of insolvent banks from 1975 to 2000.

Figure E: Number of U.S. Commercial Bank failures from 1975 to 2000

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23 Data compiled from Federal Deposit Insurance Corporation, *Historical Statistics on Banking*
Figure E makes clear that the second half of the 1980’s was a disastrous period for the commercial banking industry. The industry reached an average of over 400 failed banks from 1988 to 1991. The number of failed banks reached a peak in 1989, with an extraordinary level of 535. By comparison, banks were averaging 15 a year from 1934 to 1980. In just the past few years, bank failures have been averaging less than 10 a year. Clearly, more banks than normal were severely under-capitalized right before the 1990-1992 credit decline.

Not only were capital shortages occurring around 1990 but increased regulatory standards took place at the same time as well. No regulatory standards requiring minimum capital-asset ratios existed before the 1980’s. However, during the early 1980’s as bank failures became more and more commonplace, federal regulations began to notice the moral hazard by bank owners in relation to returns on capital, and thus formed committees to determine an appropriate minimum level. The lobbying of bank owners successfully eliminated minimum capital requirements until 1984 in which the FDIC mandated all financial institutions to have capital-asset ratios at least 5.5%. The Basle Accord, introduced in 1988, increased regulatory standards by raising the minimum ratio to 8%. Moreover, the accord also exposed the true risk of a given bank’s capital by weighing different types of capital with different percentages. Overall, the addition of new regulations during the latter half of the 1980’s significantly raised the bar on what is considered well-capitalized and what is not. As a result, many banks had their capital

---

24 The Basle Accord divided capital into four risk categories. The first category had zero weight and included reserves and government securities while the second category had 20% weight and included claims on banks in OECD countries. The third category had 50% weight and included residential mortgages and municipal bonds. The fourth category was considered the most risky, with a weight of 100% and included loans to consumers and businesses.
ratings lowered right before 1990, adding more banks in the already crowded ‘troubled banks’ category.

Thus, the combination of (1) stricter capital regulatory standards and (2) an influx of under-capitalized banks may have led to a credit decline from 1990 to 1992. Stronger standards such as the Basle Accord not only exacerbated the problems of low capital banks but influenced mid to high capital banks to increase their standards as well. Moreover, banks were already experiencing capital shortages so therefore the capital crunch was even more pronounced in this period. As will be mathematically shown in the next section, these two conditions induced banks to drastically decrease their assets, resulting in a credit decline.

III. ANALYSIS OF CAPITAL CRUNCH HYPOTHESIS

The last section examined how the commercial banking industry has come to face a crisis in capital levels during the 1990-1992 period. Using empirical data from both states and individual banks, this section goes deeper with the investigation by analyzing the relationship between capital levels and lending.

State-wide analysis

My more in-depth analysis of the capital crunch begins with a state-wide analysis. The design is loosely based on a study completed by Bernanke and Lown in 1991. However, the design of the analysis shown here uses different explanatory variables in
some of the models and also applies the model using historical bank statistics from 1991 to 1992, which was clearly not available at the time for Bernanke and Lown\textsuperscript{25}.  

Compiled from FDIC’s Historical Statistics on Banking, the data set for my econometric regressions includes aggregate commercial bank statistics from every state\textsuperscript{26}. Bank statistics were gathered by the FDIC from year-end call reports\textsuperscript{27}. Overall, the data set has 51 series of observations.

Since my preliminary analysis of the capital crunch predicts that the change in loans given by commercial banks is influenced by capital-asset levels, my first regression is a simple one. The annual rate of change in loans is regressed against the year-end capital-asset ratio from the previous year. Note that the capital-asset level is from the previous year and not from the year of interest. This was due to the fact that I assume a sufficient time lag exists between the time the bank manager calculates her bank’s capital-asset ratio and the time she uses the ratio to determine loan growth.

I let $L$ be the variable representing the aggregate net loans of all FDIC-insured commercial banks within a state. $K$ represents total equity capital and $A$ represents total assets. The results from the regression for the two time periods, 1990-1991 and 1991-1992, are shown below\textsuperscript{28}.

\textsuperscript{25} Bernanke and Lown’s study was conducted during 1991, so their data does not incorporate 1991’s fourth quarter banking statistics as well.

\textsuperscript{26} My compiled data sets are organized into Microsoft Excel format and can be downloaded from the website: http://www.stanford.edu/~randyho.

\textsuperscript{27} In the goal to keep a close eye on banks, every FDIC-insured commercial bank is required to submit one quarterly. Call reports contain an income statement, balance sheet, and detailed statistics on lending and other asset sales activities.

\textsuperscript{28} Regressions in this paper were done using Microsoft Excel with the Data Analysis toolkit.
Both K/A coefficient values from R.1 and R.2 were found to be significant at the 5% level\(^{29}\). This implies that in the periods 1990-1991 and 1991-1992, states with aggregate K/A levels from the previous year were more likely to have higher loan growth than states with low K/A levels. This in turn supports the previously made assertion that, within this time period, capital-asset levels were particularly influential toward loan growth.

Nevertheless, R.1 and R.2 regressions are not strong enough to convincingly substantiate such an assertion. At best, the above single variable model shows a correlation between negative loan growth and low capital-asset levels but not that the latter was the cause of the former. If the capital crunch hypothesis is to be indeed convincingly substantiated, a stronger regression would eliminate other possibilities other than capital-asset levels that may have caused credit to decline.

An alternative possibility that was examined earlier in Section II is that declining economic conditions from 1990 to 1991 may have instead reduced loans by inducing consumers and businesses to save rather than to apply for loans. A stronger test for the capital crunch than R.1 and R.2 would be to include this factor within the econometric model along with capital-asset levels. Bernanke and Lown also acknowledged this

\[^{29}\text{To determine significance for my regressions, I used a two-tailed t-test at the 5\% significance level. T-statistics for each coefficient was determined by dividing the values by the respect standard errors. Since each regression had 51 observations, the degree of freedom was 50 and the critical value was 2.01. See Wooldridge (2000) for an excellent review of econometrics.}\]
included state-by-state economic conditions within their regressions by using the change in capital-asset ratios from the past five years. Since capital-asset levels are influenced by many factors other than economic conditions, I disagree with Bernanke and Lown in believing that changes in capital-asset ratios are good indicators of changing economic conditions. For example, an increase in government standards can raise capital-asset levels independent of an economic boom. Therefore, I deviate from Bernanke and Lown by instead using changes in Gross State Product (GSP) as the indicator for changing economic conditions.\(^30\) Since GSP measures the value of the total output produced for a particular year, then a state with higher increases in GSP than other states would logically have a stronger economy. I add this variable to the regression and the results for both 1990-1991 and 1991-1992 are below:

\[
\begin{align*}
\text{(R.3)} \quad \Delta L/L\text{1990-1991} &= 2.372*\frac{K}{A\text{1989}} + .472*\frac{\Delta \text{GSP}}{\text{GSP}\text{1990-1991}} + -.179 \\
& (\text{.943}) \quad (\text{.356}) \quad (\text{.066}) \quad R^2 = .166
\end{align*}
\]

\[
\begin{align*}
\text{(R.4)} \quad \Delta L/L\text{1991-1992} &= 2.010*\frac{K}{A\text{1990}} + .472*\frac{\Delta \text{GSP}}{\text{GSP}\text{1991-1992}} + -.166 \\
& (\text{.903}) \quad (\text{.481}) \quad (\text{.064}) \quad R^2 = .166
\end{align*}
\]

Using the same t-test before, it is discovered that coefficients for \(K/A\) in both periods continue to be significant in determining loan growth. This is despite the regression model taking into account the economic conditions of states. Therefore, R.3 and R.4 predict that a state with similar GSP growth rate but lower capital-asset levels compared to another state would have lower loan growth. This is a stronger test than R.1 and R.2 and indeed convincingly substantiates the capital crunch hypothesis.

\(^{30}\) Data on GSP for all 50 states were gathered from Economagic. Link is http://www.economagic.com.
What is more surprising from the results in R.3 and R.4 is that the coefficients for δGSP/GSP are not significant. Economic conditions were not relevant in relation to changes to the amount of loans in 1990-1992. This hints at the surprising hypothetical situation in which even if an economic boom occurred instead of a recession and assuming ceteris paribus, loans would still decline. Therefore, the regression results contradict the previously made assertion that the 1990-1991 recession reduced borrowers’ demand. All together, the results from R.3 and R.4 insightfully reveal that the 1990-1992 decrease in lending was primarily a supply-side phenomenon due to a capital crunch and not shaped by demand factors.

**Analysis of individual banks**

A weakness of the state-wide analysis is that although it provides strong evidence that low capital-asset levels caused the negative loan growth from 1990 to 1992, it is more difficult to ascertain what sparked most banks in choosing to decrease loans in the face of low capital-asset levels. Since capital-asset levels can be raised by either raising capital or reducing assets/loans, then it is still not established why in 1990, more banks than usual chose the latter. Preliminary evidence from section II suggests a correlation between low capital-asset levels and small lending behavior but the question how this relationship precisely works still remains.

My final in-depth analysis of the capital crunch attempts to go beyond preliminary evidence by combining mathematical theory with empirical data regarding the behavior of individual commercial banks. To begin, I will present a mathematical model largely based on one formed by Peek and Rosengren. Specifically, the model predicts the
responses of two types of banks, one constrained by binding capital-asset regulations and one who is not, when both are subjected to a capital crunch.

The model begins with an initial equation relating the relationship between loans (L), assets (A), capital (K), and deposits (D) within an individual bank. I assume that in this idealistic bank, all of its assets are loans.

\[ (M.1) \quad A = L = K + D \]

The next equation states that deposits and loans can be individually determined by setting interest rates above and below the mean market rate, respectively. For example, a bank with a higher deposit rate than the average bank would naturally attract more depositors\(^3\). Of course, this assumes an imperfectly competitive market. Let \(d_0\) equals the amount of deposits at time 0, \(d_1\) equals the amount of deposits at time 1, \(r_{dm}\) equals the average market interest rates for deposits, and \(r_d\) equals the interest rate for deposits set by this bank.

\[ (M.2) \quad D = d_0 + d_1(r_{dm} + r_d) \]
\[ (M.3) \quad L = l_0 + l_1 (r_{lm} + r_l) \]

In this ideal world, a bank may be constrained by binding capital requirements. Let \(\theta\) equals the minimum required capital-asset ratio set by the government.

\[ (M.4) \quad \theta = \frac{K}{A} = \frac{K}{L} \]

---

\(^3\) This is opposite to what happens when loan interest rates increase, of course.
The profit function ($\prod$) of the ideal bank is calculated by taking the difference from the revenue earned from interest on loans to the cost from interest on deposits. This profit function takes into account the amount of loans that defaulted, letting $\partial$ equals the percentage of loans that default.

\[(M.5) \quad \prod = r_L - \partial L - r_d D\]

Equations M.1, M.2, and M.3 can be used to eliminate $L$, $r_L$ and $r_d$ and obtain a profit maximization function. Lagrangian multiplier $\lambda$ is associated with the binding capital-asset requirement. When the ideal bank is not constrained, $\lambda$ equals zero.

\[(M.6) \quad \text{Max } \prod = \left[ (l_0 + l_1 (r_m - \partial) - K - D) [K + D] - [D - d_0 + d_1 r_d m] D + \lambda [K - \Theta (K + D)] \right]
\]

I choose $D$ to maximize profit results, which produces two first-order conditions.

\[(M.7) \quad \frac{d}{dD} \prod = \frac{l_0 + l_1 (r_m - \partial) - 2D - 2K}{l_1} - \frac{2D - d_0 + d_1 r_d m - \lambda \Theta}{d_1} = 0
\]

\[(M.8) \quad \frac{d}{d\lambda} \prod = K - \Theta K - \Theta D = 0
\]

If the ideal bank is constrained by capital-asset regulations, then $\lambda$ does not equal zero and the deposit function can be solved from M.8 and will appear as:

\[(M.9) \quad D = \frac{(1 - \Theta) K}{\Theta}
\]
If the ideal bank, however, is not constrained by binding capital-asset regulations, then \( \lambda \) equals zero and the deposit function can be solved from M.9, instead appearing as:

\[
\text{(M.10)} \quad D = d_1 (l_0 + l_1 (r_{lm} - r_{dm}) - d_1 \hat{c}) + d_0 l_1 - 2d_1 K \frac{2}{(d_1 + l_1)}
\]

Using M.9 and M.1, predicting how an unconstrained ideal bank alters its deposits and loans in reaction to a capital shock can be observed:

\[
\text{(M.11)} \quad \frac{dD}{dK} = \frac{-d_1}{(d_1 + l_1)}
\]

\[
\text{(M.12)} \quad \frac{dL}{dK} = \frac{l_1}{(d_1 + l_1)}
\]

Using M.10 and M.1, predicting how a constrained ideal bank alters its deposits and loans in reaction to a capital shock can also be observed:

\[
\text{(M.13)} \quad \frac{dD}{dK} = \frac{1 - \theta}{\theta}
\]

\[
\text{(M.14)} \quad \frac{dL}{dK} = \frac{1}{\theta}
\]

M.11, M.12, M.13, and M.14 predict that the behaviors of a constrained bank and an unconstrained bank would react differently in response to identical capital shock. Though both types of banks would pursue profit maximization, the distinguishing element of whether the bank is bound by capital-asset ratios or not would lead to different ways to maximize profits. Table F summarizes the mathematical model’s predictions on the two banks’ behavior:
Table F: Predicted Behavior of Unconstrained banks vs. Constrained banks in response to $\Delta K = -1$

| Bank $^{\text{unconstrained}}$ | $0 \leq \Delta D \leq 1$ | $-1 \leq \Delta L \leq 0$ |
| Bank $^{\text{constrained}}$    | $\Delta D \leq 0$          | $\Delta L \leq -1$ |

Table F reveals interesting predictions: if the amount of capital decreases for an bank not constrained by capital-asset regulations, M.11 and M.12 predict that the bank would respond by increasing deposits$^{33}$. On the other hand, a constrained bank would decrease deposits. Further, the two types of banks differ in the adjustment of their loans. While both banks would decrease their loans in response to a capital shock, the constrained bank would more likely reduce their loans significantly more than the unconstrained bank. Specifically, the constrained bank’s best route toward profit maximization would be to decrease more than one unit of loans for every unit decrease in capital. A bank unconstrained by capital would adjust its lending by less than one unit for every unit decrease in capital.

With its predictions, the mathematical model of an ideal bank is consistent with the capital crunch hypothesis in explaining the 1990-1992 credit decline. Since the hypothesis asserts that an unprecedented number of banks were capital constrained in 1990, then a significant drop in loans would imply, according to the model, that this was certainly the case.

One weakness in using the drop in loans, however, is that it does not convincingly establish whether most banks during 1990 were severely affected by capital requirements.

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$^{32}$ Values based on the presented mathematical model of an ideal bank and the assumption that $\Theta < 1$.

$^{33}$ As previously mentioned the model assumes banks exist in a non-perfectly competitive market and can adjust deposits and loans by setting their own rates away from the average market rate.
or not. Although constrained banks ideally decrease their loans significantly more than unconstrained banks, it would be hard to distinguish whether the 1990-1992 credit decline was the result of either type, since both produce the same negative effect on loans.

A better way to determine whether capital-asset requirements hindered lending would be to instead look to banks’ deposits. The prediction that a constrained bank and an unconstrained bank would respectively adjust deposits in negative and positive directions would produce results easy to pinpoint. If the reduction in lending were indeed the result of banks’ capital-asset levels being overly constrained by capital-asset requirements, then the mathematical model would predict that under-capitalized banks would decrease their deposits more so than well-capitalized banks.

To verify this, my analysis examines the differences in deposit growth rates among individual banks. Compiled from the Statistical Depository Institution (SDI), my data set consists of examining the financial statistics from each bank out of 513 FDIC-insured commercial banks in California from 1992 to 1993. To avoid the skewing of data by banks involved in special cases, I eliminated those who have either become insolvent or have undergone mergers during the one year period.

My analysis is limited by the lack of availability of individual bank data before 1992. The Statistical Depository Institution publicly releases data from 1992 onward but any data before must be specially requested along as well as paying a large fee. Luckily, many individual banks in California from 1992 to 1993 can act as decent proxies for individual banks from 1990 to 1991 and from 1991 to 1992. While the national aggregate sum of net loans finally increased from 1992 to 1993 after two years of
continuous negative growth, the California state aggregate continued to have negative loan growth for one more year. Specifically, California net loans experienced -3.7% negative growth from 1992 to 1993 while the U.S. as whole experienced 6.0% positive growth. This leads me to believe that California has not yet recovered from the effects of 1990 and that its individual banks from 1992 to 1993 would display similar characteristics as its 1990-1992 counterparts.

Using 1992-1993 California banks as proxies then, I sorted them according to their average capital-asset levels calculated from their year-end 1992 and 1993 levels. The sorted banks were then equally divided among three categories: those institutions with low, mid, and high capital-asset levels. Table G displays these three divisions along with the average deposit growth rates from banks within each division.

<table>
<thead>
<tr>
<th>Capital/Assets</th>
<th>Deposit Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>-0.291</td>
</tr>
<tr>
<td>Medium</td>
<td>-0.049</td>
</tr>
<tr>
<td>High</td>
<td>0.276</td>
</tr>
</tbody>
</table>

Table G gives preliminary evidence that California banks were severely constrained by capital-asset requirements. Only banks with relatively high capital assets increased the amount of their deposits while both low and medium capitalized banks decreased their deposits. Since a drop in deposits was observed for the low to mid

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34 Why California continued to experience a credit decline in 1992 when the rest of the nation recovered is arguable but many blame the above average drop in real estate prices compared with the rest of the nation as one of the possible reasons. Furthermore, Southern California’s highly represented defense industry was particularly hard hit by the massive decline in military spending. The particular phenomenon is beyond the scope of the paper’s investigation but would be an interesting topic to pursue further research on. See FDIC’s *Banking Problems in California* for further information about this topic.
category, this suggests banks within these categories, according to the mathematical model, were indeed constrained.

I conduct a stronger test of the assertion that capital constraints induced a decline in lending by running regressions using the 513 California observations. A stronger test would be to see whether well-capitalized banks would reduce deposits less than less-capitalized banks. To do this, I run three regressions, each using bank data from the low, medium, high capital-asset category separately. My econometric model contains the 1992-1993 change in deposits (\( \Delta D/A_{1992-1993} \)) as the dependent variable and the 1992-1993 change in capital (\( \Delta K/A_{1992-1993} \)) as the independent variable. Both variables are normalized by the bank’s assets since the size of the bank is proportional to the magnitude of the changes within its balance sheet. Furthermore, I also include the initial capital-asset level (\( K/A_{1992} \)) as an additional independent variable. This is because banks with lower capital-asset levels may feel more pressure to adjust their balance sheets more quickly than banks with higher capital-asset levels. Results from the three regressions are below:\(^{35}\):

\[
\begin{align*}
\text{Banks with low K/A levels} \\
\text{(R.5)} \\
\Delta D/A_{1992-1993} &= 3.06*\Delta K/A_{1992-1993} + 3.38*K/A_{1992} + .245 \\
(.512) &+ (.831) + (.049) R^2 = .227 \\
\text{Banks with medium K/A levels} \\
\text{(R.6)} \\
\Delta D/A_{1992-1993} &= 5.81*\Delta K/A_{1992-1993} + 1.85*K/A_{1992} + .128 \\
(.561) &+ (.179) + (.141) R^2 = .396 \\
\text{Banks with high K/A levels} \\
\text{(R.7)} \\
(.541) &+ (.269) + (.038) R^2 = .083
\end{align*}
\]

\(^{35}\) Each regression has 171 observations. Significance tests are done at the 5% level using the t-test.
As expected, all $\Delta K/A_{1992-1993}$ coefficients are positive and significant at the 5% level. This implies that a bank subjected to a higher capital shock than a bank with a similar capital-asset ratio would decrease deposits more. More interesting, however, are the magnitudes of the coefficients among the three regressions. R.7 has a low $\Delta K/A_{1992-1993}$ coefficient of 1.13 while R.5 and R.6 have much higher $\Delta K/A_{1992-1993}$ coefficients of 3.06 and 5.81, respectively. The differences suggest that banks in the better-capitalized category would experience significantly less drop in deposits than a bank in the poorer-capitalized categories. This is consistent with the capital crunch hypothesis since raised capital standards from 1990-1992 would have subjected more banks to poorer capitalized levels, resulting in a more drastic shrinkage of their balance sheets.

IV. CONCLUSION

The results from the analysis in Section III strongly suggest that regulatory capital constraints created a capital crunch in 1990, resulting in a drastic decline in commercial bank lending. Higher regulations created problems for many banks as they had trouble meeting the minimum capital-asset requirements. These banks, under-capitalized and constrained, pursued to drastically shrink their liabilities and assets in an effort to salvage its balance sheets.

These findings have significant implications regarding to what extent the government should intervene in its effort to stabilize the economy. Clearly, high capital-

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36 One surprising finding, however, is that medium-capitalized banks have higher $\Delta K/A_{1992-1993}$ coefficients than low-capitalized banks. This is evidence against the capital crunch hypothesis but the extremely low $\Delta K/A_{1992-1993}$ coefficient of well-capitalized banks makes a much stronger case in support for the hypothesis.
asset regulations set by government agencies most likely may have contributed to the length of the 1990-1991 recession as it resulted in an environment in which the Federal Reserve had trouble stimulating the economy with low interest rates. The recent amendment to the Basle Accord\textsuperscript{37} to loosen capital-asset requirements may be signs that agencies have acknowledged the negative effects their policies can inadvertently cause. Ironically, however, the high capital-asset standards may have achieved its ultimate goal of smarter bank management as the number of bank insolvencies in recent years is at a historical low. Whatever the case, the lesson ultimately learned in this paper is that economic policy has unforeseen and powerful consequences.

\textsuperscript{37} The Basle Committee on Banking Supervision announced in December of 2001 that the committee intends to modify the Basle Accord. One of its stated goals is to make capital-asset standards less stringent in the finalized amendment.
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