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Million Observations Have to Say

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Re-examining the Transmission of Monetary Policy: What More Do a Million Observations Have to Say

Abstract

In this paper we re-examine banks' lending behavior taking into account changes in the stance of monetary policy in conjunction with changes in financial sector uncertainty. Using a very large data set covering all banks in the US between 1979–2000, we show that financial sector uncertainty plays an important role in banks' lending decisions: for a given size classification, less liquid banks (and generally smaller banks) lend proportionally more than stronger counterparts in times of higher uncertainty. More importantly, we provide conclusive evidence that the bank lending channel is either nonexistent or at best not very important for the U.S.

JEL: E44, E52, G32.

1 Introduction

Understanding the role of banks in the transmission mechanism of monetary policy is essential in explaining the effects of a policy change on the aggregate economy. In seeking to evaluate the effects of monetary policy, research using bank- and firm-level data has unearthed considerable evidence that the impact of changes in monetary policy may go beyond the simple textbook interest rate channel. In particular, Kashyap and Stein (2000, hereafter KS) used the Federal Reserve System's Commercial Bank and Bank Holding Company database to study the impact of monetary policy on bank lending behavior for banks with differing degrees of liquidity, focusing on the period between 1976–1993. KS have shown that smaller and less liquid banks would reduce their loan supply in response to contractionary monetary policy as their ability to raise *reservable* forms of financing is compromised. As KS point out, another reason for small banks' curtailment of loans is that these banks cannot sell *non-reservable* liabilities due to a failure of the Modigliani–Miller proposition. These changes in bank lending behavior, particularly affecting bank-dependent borrowers, would have important implications for firms' financing behavior, as their impact is over and above the effects of changes in interest rates.

In this paper, we argue that banks' lending decision depends not only on the stance of monetary policy, but will generally be affected by the underlying uncertainty in the financial sector. The intuition to our reasoning is that profit-maximising banks will make decisions to extend loans to present or potential customers based on the current stance of monetary policy as well as on the level of uncertainty in the financial sector, over and above the constraints posed by regulatory authorities and borrowers' creditworthiness.¹ In that sense, current empirical models that investigate the transmission mechanism of monetary policy may be considered as misspecified since their exclusion of relevant explanatory variables will lead to biased conclusions. Hence, we re-examine the impact of changes in monetary policy on bank lending behavior by incorporating financial sector uncertainty into the KS framework.²

¹Use of the term uncertainty henceforth implies financial sector uncertainty.

²Baum, Caglayan and Ozkan (2004a) investigate the impact of macroeconomic uncertainty on the cross-sectional distribution of bank lending behavior. They find evidence that during more uncertain times, banks behave more homogeneously, as captured by a

To achieve our goal, following KS' strategy, we use the Federal Reserve System's Commercial Bank and Bank Holding Company (henceforth BHC) database which contains information on all commercial banks regulated by the Federal Reserve System, the Federal Deposit Insurance Corporation and the Comptroller of the Currency. Our extract of this data set covers essentially all banks in the U.S. on a quarterly basis from 1979–2000, with 9,000–16,000 observations per quarter.

Our analysis proceeds as follows. After carefully constructing variables as suggested in KS to eliminate potential definitional discrepancies, we estimate the KS model to see if the choice of sample period that we employ in our analysis qualitatively alters their findings. Next, we focus on the impact of uncertainty on bank lending behavior by employing a number of interest rates and interest rate spreads to generate uncertainty measures from daily data, using a method originally proposed by Merton (1980).³ Using these measures of financial sector uncertainty, we test whether uncertainty as well as the stance of monetary policy has a significant effect on the lending behavior of small, intermediate and large banks with varying degrees of balance sheet strength.

Our main findings can be summarized as follows: we find that the degree of uncertainty has significant effects on bank lending behavior not only on its own (the primary effect) but also through its interaction with the strength of banks' balance sheets (the secondary effect). We show that the primary effect is positive and increasing in bank size. We also find that the sensitivity of bank lending behavior to balance sheet strength declines as uncertainty increases. In this context, considering the primary and secondary effects simultaneously, although increased uncertainty leads to an increase in overall lending behavior, we find that weaker banks (banks with less-liquid assets) tend to lend proportionally more than stronger banks (banks with more-liquid assets) during times of higher uncertainty. These results are robust across all uncertainty proxies and bank loan types: total loans or commercial and industrial (C&I) loans. However, when we sift the evidence in search for

narrowing of the cross-sectional distribution of their loan-to-asset ratios. However, their study does not indicate how the level of bank lending activity may change as uncertainty evolves over time.

³Our measures of uncertainty captures the interaction of what the Federal Reserve does (and might do) with other sources of uncertainty emanating from the financial sector, and possibly effects from the real sector. Hence, it would not be accurate to consider it merely as representing monetary policy uncertainty.

a bank lending channel, we find weak support or none at all. Although our broader model confirms the existence of the bank lending channel when we examine total loans, its economic importance may not be as significant as KS claim: at least a quarter—and up to a half—of the small banks behave more like the intermediate banks, with a sensitivity to monetary policy quite dissimilar to their smaller counterparts. In addition, support for the lending view completely disappears when we investigate the behavior of C&I loans: C&I lending behavior of small and large banks seems to be quite similar in response to changes in the stance of monetary policy refuting the existence of the bank lending channel for the U.S.

The rest of the paper is constructed as follows. Section 2 provides a brief survey of the literature discussing the bank lending channel. Section 3 presents the modeling framework and discusses the methodology we employ in our investigation. Section 4 documents our empirical findings, while Section 5 concludes and draws implications for future research.

2 The Bank Lending Channel

There is now a substantial body of theoretical and empirical literature indicating that monetary policy affects the economy beyond the well known interest rate channel. The intuition for the primary impact of monetary policy, via the interest rate channel, is that contractionary monetary policy leads to an increase in real interest rates, causing postponement of consumption and a reduction of investment spending. However, as Bernanke and Gertler (1995) pointed out, the impact of monetary policy on the economy is larger than that implied by the estimates of the interest elasticities of consumption and investment and they suggest that there must be other mechanisms at work. One possibility is that, because contractionary monetary policy decreases the core deposit funding of bank loans through reserve requirements, some banks would reduce their lending activity, as they may be unable to raise nonreservable funds to continue lending due to a failure of the Modigliani–Miller proposition.⁴ This view is termed the narrow credit channel or the bank lending channel.

⁴It is also possible that contractionary monetary policy affects the balance sheets of the borrowers, by reducing the value of assets and increasing the interest payments, so that their ability to raise funds from *any* external source is diminished. This is called the broad credit channel.

An earlier study by Bernanke and Blinder (1992) finds that contractionary monetary policy leads to a decline in bank lending activity. Though consistent with the lending view, this study is criticized on the grounds that the use of aggregate data may confound a reduction in the supply of loans with reduced loan demand. Subsequently, Kashyap, Stein and Wilcox (1993, 1996) show that a monetary contraction increases the issuance of commercial paper. This evidence suggests that any reduction in observed lending is not due to a reduction in loan demand, but rather reflects a reduction in loan supply.⁵ Also, Calomiris, Himmelberg, and Wachtel (1995) show that during periods of monetary contraction, commercial paper-issuing firms increase trade credit extended by these firms, suggesting that larger firms take up some of the slack created as their smaller customers lose access to bank loans. Along similar lines, Nielsen (2002) concentrates on the use of trade credit by small firms (which is available to all customers, but at penalty rates) and shows that small firms use trade credit more heavily during periods of monetary contraction, supporting the evidence of a bank lending channel.

Turning now to studies on bank lending behavior, Peek and Rosengren (1995) and Stein (1998) point out that poorly capitalized banks and those that carry bad loans on their books, respectively, will suffer reduced access to markets for uninsured funding, and their lending behavior will be more sensitive to monetary shocks. A more influential study conducted by Kashyap and Stein (2000) employed the BHC database to find that the impact of monetary policy on bank lending activity is stronger, in particular, for small banks with less liquid balance sheets. Similarly, utilizing the approach developed by KS, researchers using European bank-level data have also begun to provide evidence in support of the bank lending channel. For example, Worms (2001) uses monthly balance sheet data for 1992–1998 covering all German banks to find evidence compatible with the lending view.⁶

⁵Gertler and Gilchrist (1994) show that large firms' bank borrowing actually increases, while small firms suffer from reductions in the growth rate of bank loans outstanding. Therefore, it could be that reduction in bank loans to small firms could be driven by a lower demand for credit.

⁶See references therein.

3 The Bank Lending Channel Under Uncertainty

In this study we aim to broaden our understanding of banks' lending behavior considering changes in the stance of monetary policy in conjunction with variations in financial sector uncertainty by extending the basic KS model. Surprisingly, although the existing literature contains a variety of evidence in support of the bank lending channel, it has not considered the impact of uncertainty on bank lending behavior. In the absence of uncertainty, it would be sufficient to investigate the impact of key indicators of macroeconomic performance to understand the behavior of economic agents. More realistically, one must be concerned with second moments (uncertainty about the course of the macroeconomy, the volatility of interest rates, or more generally financial sector volatility) along with the first moments. These second-moment effects may be of key relevance to economic policymakers, as they may have a sizable influence on commercial banks' decision making process. Therefore, it is crucial to evaluate the degree to which financial sector uncertainty will affect banks' willingness to utilize available loanable funds. In our study, we seek to demonstrate that uncertainty has important effects on bank lending behavior, and that a model of the transmission mechanism of monetary policy which ignores the primary and secondary effects of uncertainty could be seriously misspecified in their absence.⁷

KS follow two different approaches, labelled as the two-step model and the one-step model. Since they find that the two-step approach "probably errs on the side of being overparameterized" (2000, p. 421), we particularly focus on their one-step *bivariate* approach which takes the following form:

$$\begin{aligned} \Delta \log(L_{it}) = & \sum_{j=1}^4 \alpha_j \Delta \log(L_{it-j}) + \sum_{j=0}^4 \mu_j \Delta M_{t-j} + \sum_{j=0}^4 \pi_j \Delta GDP_{t-j} + \\ & \Theta TIME_t + \sum_{k=1}^3 \rho_k QUARTER_{kt} + \sum_{k=1}^{12} \Psi_k FRB_{ik} + \quad (1) \\ & B_{it-1} \left(\eta + \delta TIME_t + \sum_{j=0}^4 \phi_j \Delta M_{t-j} + \sum_{j=0}^4 \gamma_j \Delta GDP_{t-j} \right) + \epsilon_{it}, \end{aligned}$$

where L_{it} is a bank-level measure of lending activity, M_t is a monetary pol-

⁷The models employed in many of the bank-level empirical studies that have followed in KS' footsteps are subject to the same criticism.

icy indicator, and B_{it} is a measure of balance sheet strength. Time effects are captured by $TIME_t$ and $QUARTER_{kt}$ dummies and FRB_{ik} captures geographical effects via Federal Reserve district dummies and GDP_t controls for changes in overall economic activity.⁸

In this specification, KS are interested in the coefficient of ΔM_{t-j} interacted with B_{it-1} . Intuitively, the less liquid bank will reduce its loans if its lost insured deposits due to a contractionary monetary shock cannot be replenished by other forms of finance. Hence, one would expect to see $\partial^2 L_{it} / \partial B_{it} \partial M_t < 0$ for less liquid banks. To test this hypothesis, they focus on how small and large banks differ from each other in their ability to raise uninsured forms of financing without frictions and argue that one should concentrate on $\partial^3 L_{it} / \partial B_{it} \partial M_t \partial SIZE_{it} > 0$, the size effects. The sign of the third derivative can be interpreted as implying that the effect of contractionary monetary policy will be strongest for the smallest banks, while the largest banks will be less sensitive, since they have better access to the market for uninsured funds.

Nevertheless, this approach fails to take into account the fact that loans to private borrowers exhibit both market risk and default risk, with the latter risk correlated, in many cases, with macroeconomic conditions, as well as to financial-market outcomes such as movements in the cost of short-term funds. In that sense, we argue that the KS model omits an important variable: financial sector uncertainty. Such an omission will lead to biased and inconsistent estimates of the model's parameters, and in particular of the effects of monetary policy on banks' behavior. To overcome this problem, we develop the following modified *bivariate* model:

$$\begin{aligned} \Delta \log(L_{it}) = & \sum_{j=1}^4 \alpha_j \Delta \log(L_{it-j}) + \sum_{j=0}^4 \mu_j \Delta M_{t-j} + \sum_{j=0}^4 \pi_j \Delta GDP_{t-j} + \\ & \sum_{j=0}^4 \lambda_j \sigma(M)_{t-j} + \Theta TIME_t + \sum_{k=1}^3 \rho_k QUARTER_{kt} + \sum_{k=1}^{12} \Psi_k FRB_{ik} + \quad (2) \\ B_{it-1} \left(\eta + \delta TIME_t + \sum_{j=0}^4 \phi_j \Delta M_{t-j} + \sum_{j=0}^4 \gamma_j \Delta GDP_{t-j} + \sum_{j=0}^4 \xi_j \sigma(M)_{t-j} \right) + \epsilon_{it} \end{aligned}$$

⁸In their analysis, KS also utilize a so-called *univariate* model which excludes the effects of GDP from the bivariate model. Due to space considerations, we do not present results for the univariate model, which are qualitatively similar to those obtained from the bivariate model. They are available from the authors upon request.

In our specification, a proxy for financial sector uncertainty, $\sigma(M)_t$, is integrated into the simple KS approach. Note that $\sigma(M)_t$ appears both by itself and in conjunction with a measure of balance sheet strength, B_t . The latter interaction term allows us to evaluate whether the effect of uncertainty on bank lending behavior differs with respect to the bank’s liquidity, whereas the former term captures the direct effect of uncertainty. We also investigate the impact of size effects on this relationship. Furthermore, by employing this specification, we can determine whether KS’ results are biased; significant coefficients on the $\sigma(M)_t$ terms would imply that uncertainty has been mistakenly omitted from their specification.

3.1 Identifying Financial Sector Uncertainty

Any attempt to evaluate the effects of uncertainty $\sigma(M)_t$ on the bank lending behavior requires specification of a measure of risk. In this study, we utilize several different series derived from daily interest rates to generate measures of monetary policy volatility. This approach allows us to control for the robustness of our findings and examine whether our results are driven by the choice of a specific uncertainty proxy. The series we employ to generate a measure of uncertainty include both levels and spreads of daily interest rates from Treasury and private markets, accessed from the DRI–Global Insight Basic Economics database. The levels include the rates on Federal funds, three–month Treasury bills, one–year, five–year and ten–year Treasury constant maturity series, and three–month commercial paper. Three term spreads are considered: one–year Treasury versus Federal funds, five–year Treasury versus three–month bill, and ten–year versus one–year Treasury rates. In addition, we consider a risk spread: three–month commercial paper versus the three–month Treasury bill. Below we describe how we generated a monetary policy uncertainty measure from each of these series.

3.1.1 Generating volatility measures from daily data

A number of competing approaches for the construction of volatility measures may be found in the empirical literature. The choice of a particular specification to generate uncertainty may have a considerable impact on the empirical findings, since counterintuitive results may be merely reflecting errors of measurement in a proxy for risk. It is possible to employ a simple moving standard deviation of the policy series, at the same frequency as the

data: for instance, including the past four or eight quarters’ of changes in the context of quarterly data. However, this measure gives rise to substantial serial correlation in the summary measure. A more sophisticated approach utilises the ability of GARCH models to mimic the “volatility clustering” often found in high-frequency financial series. However, a GARCH model fitted to monthly or quarterly data may find very weak persistence of shocks. Furthermore, a proxy for uncertainty obtained from a GARCH specification will be dependent on the choice of the model and exhibit significant variation over alternatives.

In this study we use (squared) daily changes in the series to capture that quarter’s volatility, following a procedure originally proposed by Merton (1980) to better represent the uncertainty facing economic agents. In order to employ the Merton methodology to the problem at hand, we must evaluate the intra-quarterly volatility of the series from daily data. We first take the squared first difference of the daily changes (after dividing by the square root of the number of days intervening), which we then define as the daily contribution to quarterly volatility:

$$\varsigma_t^d = \left(100 \frac{\Delta x_t}{\sqrt{\Delta \phi_t}} \right)^2, \quad (3)$$

where the denominator expresses the effect of calendar time elapsing between observations on the x process. If data were available every calendar day, $\Delta \phi_t = 1, \forall t$, but given that data are not available on weekends and holidays, $\Delta \phi_t \in (1, 5)$. The estimated quarterly volatility of the monetary policy series is defined as $\Phi_t[x_t] = \sqrt{\sum_{t=1}^T \varsigma_t^d}$ where the time index for $\sigma_t[x_t]$ is at the quarterly frequency.⁹

In Table 1, we present correlations between four of the series that we present results for in the next section (the three-month Treasury bill, the five-year Treasury note, the risk spread (CP over TB) and the ten year-one year Treasury term spread) along with the Bernanke and Mihov (1998) measure of the stance of U.S. monetary policy whose derivation we discuss in the subsection below. Note that the correlation coefficients for the measures of uncertainty are consistently high indicating these series behave similarly over time. When we look at the relationship between the measures of uncertainty and the stance of the monetary series we observe that uncertainty is not

⁹See Baum, Caglayan and Ozkan (2004b) for a more detailed discussion of the procedure along with its merits.

linked to the stance of the monetary policy; uncertainty does not increase in times of contractionary monetary policy nor *vice versa*.

3.2 Identifying Monetary Policy Stance

In the context of our study, it is essential to accurately evaluate the stance of monetary policy. A simple approach is to keep track of the changes in the stock of money, but this may be misleading, as the Federal Reserve aims at smoothing short-term interest rates. The problems with this simple approach have led researchers to develop alternative methods for identifying the stance of policy. Although no clear consensus has emerged, some approaches have been highlighted in the recent literature. We have chosen to employ one of the methods used in KS' work, the method developed by Bernanke and Mihov (1998), to measure the overall stance of U.S. monetary policy via a flexible VAR. We construct the VAR system as described in Bernanke–Mihov's work and compute the stance of monetary policy over the extended span of our BHC data.¹⁰

4 Empirical findings

4.1 Data

We utilize the Federal Reserve System's Commercial Bank and Bank Holding Company database, covering essentially all banks in the U.S. on a quarterly basis from 1979–2000. We would note that the degree of concentration in the U.S. banking industry—increasing considerably over the period we study—implies that a very large fraction of the observations in the “all banks” data set are associated with quite small, local institutions.¹¹ Using this data set we construct our key variables following the recommendation provided in KS' appendix to ensure consistency and eliminate any potential definitional discrepancies.¹²

¹⁰Comparison of our computed Bernanke–Mihov measure over the longer sample and that published in their article (which ends in 1997) indicates that the two series are similar.

¹¹There were over 15,000 banks required to file condition reports in the late 1970s. By 2000Q4, the number of reporting banks fell to 9,261.

¹²We carry out our analysis on the level of the individual bank throughout this paper. We do not aggregate the balance sheets of banks into their holding companies. In their investigation, KS did not find any significant differences in the analysis of individual banks

We provide basic descriptive statistics on our variables in Table 2. The number of observations referenced is the number of bank–quarters in the panel. The first several lines, labeled as interest rates or spreads, are our constructed measures of uncertainty ($\sigma(M)_t$), while Δmbm_t represents the Bernanke–Mihov measure of the stance of monetary policy. The dependent variable in our model is the growth rate of total loans or commercial and industrial (C&I) loans, for which considerably fewer observations are available. Finally, the B_t variable measures the strength of a bank’s balance sheet. The following panels of Table 2 present the bank–specific variables for the small, intermediate, and large size categories, respectively, for both total loans and C&I loans. The thresholds for these definitions are the 95th and 99th percentile of total assets, evaluated each quarter; thus a particular bank may appear in different categories over time.

It may be noted that the small banks (in terms of average or median values) have the most liquid balance sheet, with large banks having just over half as large a value for B . Conversely, small banks have the lowest growth rate of loans. This observation holds whether we concentrate on the behavior of total loans (approximately one million observations) or that of C&I loans (approximately 500,000 observations). That is, the growth rates of both total loans and C&I loans, on average, are greater for large banks than they are for intermediate and small banks.

In the following subsections, we present our results. We first consider the bivariate KS model over our lengthier sample. We then integrate financial sector uncertainty into their original specification and investigate its impact on bank lending behavior for small, medium and large banks in conjunction with the stance of the monetary policy. We employ each of the ten volatility series described above in our analysis to check for the robustness of our results. For brevity, we present results for four of those series: the three–month Treasury bill, the five–year Treasury note, the risk spread (CP over TB) and the ten year–one year Treasury term spread.

4.2 Replicating the KS model

We start our investigation by replicating the KS analysis using our longer data set and examine whether changes in monetary policy have an effect on the sensitivity of lending activity to balance sheet strength, $\partial^2 L_{it}/\partial B_{it}\partial M_t$,

versus the analysis of bank holding company balance sheets.

for *small*, *intermediate* and *large* size classes. Hence, similar to KS, we create small, intermediate and large size classes based on banks' total asset distribution. Small banks are those whose total assets are less than the 95th percentile; intermediate banks' assets range between the 95th percentile and the 99th percentile; large banks' assets are above the 99th percentile. Then, we estimated the *bivariate* model given in equation (1).

To discuss our findings and be able to compare them with that of KS, for each model, we compute the sum of the ϕ coefficients on the monetary policy indicator (labeled $B \cdot MPI$).¹³ Table 3 gives the results for total and C&I loans using the standard KS approach. In comparison to those results presented in KS (2000, Table 5, Panel B, p. 422), results for total loans depicted in Table 3 show that the summary measure for ϕ is significantly negative for small banks.¹⁴ The same coefficient is positive and significant for the intermediate banks, and positive and insignificant for the large banks. The results for C&I loans, also depicted in Table 3, are qualitatively similar to those for total loans. The coefficient estimates for ϕ are negative and significant for small banks. In contrast to the results obtained for total loans, coefficient estimates of ϕ for the intermediate and the large banks are insignificant. Overall, both sets of results confirm and support the existence of the bank lending channel for our extended sample. Given our results, we verify that the KS model provides evidence of a bank lending channel for the U.S. over an extended sample period.

4.3 The modified KS model: Investigating the effects of uncertainty

Our next set of results utilizes equation (2) in which we incorporate the effects of uncertainty for each size class. In particular, we examine whether uncertainty has an impact on bank lending behavior and also whether this impact changes depending on banks' balance sheet strength, $\partial L_{it}/\partial \sigma(M)_t$ and $\partial^2 L_{it}/\partial B_{it}\partial \sigma(M)_t$, using the same size classifications. Addition of these new variables into the standard KS model is essential to broaden our understanding on the banks' role in the transmission of monetary policy, since economic

¹³Recall that we measure the stance of monetary policy using only the Bernanke–Mihov approach, and compare our results with those corresponding in KS.

¹⁴In the KS analysis of the behavior of total loans using the Bernanke–Mihov measure of the stance of monetary policy, the coefficient estimate of ϕ for small banks is insignificant for their bivariate model.

agents will consider the impact of uncertainty in their decision-making process. When gauging bank lending activity, omission of these second-moment effects may lead one to erroneous conclusions regarding the impact of changes in the stance of monetary policy due to misspecification of the forecasting model. In the subsections below we will initially concentrate on the behavior of total loans and then turn to that of C&I loans.

4.3.1 The extended bivariate specification for total loans

In Table 4, we present our results for the modified bivariate model, equation (2), which uses the growth of total loans as the dependent variable and employs four different measures of uncertainty: those based on the three-month Treasury bill, the five-year Treasury note, the risk spread (CP over TB) and the ten year-one year Treasury term spread, respectively. The table depicts the sum of the ϕ coefficients on the monetary policy indicator (labeled $B \cdot MPI$) in conjunction with the bank's balance sheet strength, the sum of the λ coefficients on uncertainty, $\sigma(M)_t$ (labeled σ), and the sum of the ξ coefficients on uncertainty interacted with bank balance sheet strength $B_{it}\sigma(M)_t$ (labeled $B \cdot \sigma$), for all size categories. For each uncertainty measure and size category, inspection of the estimates reveals that ϕ is negative and significant for *small* banks, positive and significant for *intermediate* banks and positive but insignificant for *large* banks, providing support for the bank lending channel.¹⁵

Next, we turn our attention to understanding the relationship between bank lending and financial sector uncertainty, and investigate the remaining sets of coefficients: the sum of λ estimates and the sum of ξ estimates. The sum of λ estimates on uncertainty is significant and positive for all size groups, irrespective of the uncertainty measure used, with its magnitude monotonically increasing as bank size increases. This result suggests that during times of greater uncertainty larger banks can lend more in comparison to smaller banks, as captured by the sum λ . However, the story does not end here. Uncertainty can also affect banks' lending behavior through its interaction with the strength of the bank balance sheet. We find that the sign of the derivative $\partial^2 L_{it} / \partial B_{it} \partial \sigma(M)_t$ is negative, which implies that the sensitivity of bank lending to balance sheet strength is negatively related to an increase in uncertainty. In other words, as uncertainty increases, banks with

¹⁵These findings stand in contrast to KS' findings of no clear effect for *small* banks but positive and significant effects for *intermediate* and *large* banks.

less liquid assets (weaker banks) tend to reduce their loans, but by a lesser amount than do banks with more liquid assets (stronger banks). This clearly implies greater risk-taking behavior by banks with weak balance sheets. The monotonic behavior of the same coefficient across size groups indicates that larger banks react more to an increase in uncertainty by reducing their loans. Obviously, the overall impact of uncertainty on bank lending will be related to the sums of λ and ξ estimates, and the long-run effect will depend on all of these coefficients as well as the bank's balance sheet strength. We will explain in detail the total long-run effect of uncertainty in the following sections.

4.3.2 Results based on a finer classification for total loans

Given our findings for total loans in Table 4, we further split small banks into subgroups to see whether or not the relationship we have so far portrayed holds for a finer classification. In other words, we aim to find out if aggregating 95% of the banks under one single category leads to an error in interpreting the results in relation to the effect of uncertainty or the stance of the monetary policy on bank lending behavior. To that end we break up *small* banks into four subgroups: the smallest group (*small*₀) contains banks with total assets below the 25th percentile, the next group (*small*₁) includes banks from the 25th to the 50th percentile, the third group (*small*₂) encompasses banks between the 50th and the 75th percentile, and the largest group (*small*₃) contains those banks above the 75th percentile. We estimate equation (2) using this new classification, for which results are depicted in Table 5.

A quick glance at Table 5 yields the basic message that the impact of uncertainty, as summarized in the sums of λ and ξ estimates, is monotonic across subgroups of small banks similar to those results in Table 4. The estimate of λ is positive and significant and that of ξ is negative and significant except for *small*₀ subgroup. The estimate of ξ is insignificant for the *small*₀ category for all measures of uncertainty. This observation indicates that as the strength of the banks within the *small*₀ subgroup changes, unlike in the case of other subcategories, their lending activity will not respond significantly to a change in financial uncertainty through its effects on the strength of the bank's balance sheet. Overall, the results presented in Table 5 suggest that financial sector uncertainty has strong and consistent effects on bank lending. The signs and magnitudes of the estimated coefficients are qualita-

tively similar to those in Table 4 and the monotonic relationship continues to exist.

Turning now to the effect of the stance of monetary policy on bank lending activity, Table 5 shows that the sign of ϕ for *small*₀ and *small*₁ categories is consistently negative. However, banks in the *small*₃ subgroup—comprising 20% of the population—although insignificant, have positive coefficient estimates for ϕ for each of our models and seem to behave quite similarly to those in the intermediate group presented in Table 4. Moreover, we cannot reject the hypothesis that the signs of ϕ coefficients in two out of four cases for the bank comprising *small*₂ category are significantly different from zero. Our disaggregation of the size distribution reveals that many of these ‘smaller’ banks are by no means homogeneous in their sensitivity to monetary policy shocks. We find that only about half of these banks in KS’ “small bank” classification are affected by the stance of monetary policy. Hence, although one can suggest for the prevalence of the bank lending channel for total loans, its economic significance may not be as nearly as large as KS have argued when we use the modified KS model.¹⁶ In particular, given results we present here, its prevalence seems to be weak.

In Table 6, we provide the total long-run effects of uncertainty on lending behavior for each size category. Note that these tables are constructed averaging over the four proxies for uncertainty to remove dependence of these sensitivity measures on a specific proxy. The first three columns of Table 6 report the 25th, 50th and 75th percentiles of banks’ balance sheet strength (liquidity) across all size categories. The next three columns lay out the total long-run sensitivity of lending behavior to bank strength with respect to changes in uncertainty. For example, we compute $Total[\sigma|B_{p25}] = \sum_{j=0}^4 \lambda_j + B_{p25} \cdot \left(\sum_{j=0}^4 \xi_j\right)$ where B_{p25} is the level of banks’ balance sheet strength measured at the 25th percentile, and the sums of λ and ξ estimates correspond to those presented in Tables 4 and 5, averaged over the four uncertainty proxies.

Given this background, we can now interpret our results. Let us first consider the information in the rows of Table 6. Reading across a row, $\sum_{j=0}^4 \lambda_j$ is constant within each size group, so that each row simply captures the effect of the interaction term, $\partial^2 L_{it}/\partial B_{it}\partial\sigma(M)_t$, evaluated at differing levels of

¹⁶KS proposed that the sensitivity of lending behavior to monetary policy is clearly affected by balance sheet strength, and that this “result is largely driven by the smaller banks, those in the bottom 95 percent of the size distribution.” (2000, p. 407).

B. When we read Table 6 from left to right, note that for each subcategory bank strength increases and that small banks reduce their lending activity by a much smaller proportion than large banks. This observation signals risk-taking behavior for smaller and weaker banks in times of financial uncertainty. Among all, large banks have the highest lending activity during episodes of uncertainty possibly due to their ability to manage risks better than their smaller counterparts.¹⁷ Our results imply that within each size group, banks with weaker balance sheets lend more during times of higher uncertainty, taking on more risk. This result is quite understandable from the theory of real options, in the presence of deposit insurance: the option to take a larger gamble becomes more valuable in the face of greater underlying uncertainty.

We can also read the table from top to bottom, noting that several factors change simultaneously as we move down a column from one class of banks to the next. Both $\sum_{j=0}^4 \lambda_j$ and $\sum_{j=0}^4 \xi_j$ are changing across classes, as are the levels of *B* (note from the first three columns that *B* declines as the bank size increases). However, even as the size of the bank increases, we still see risk-taking behavior when we look more closely as to how less liquid banks within each size group behave in comparison to their stronger counterparts. Large banks which fall into the strongest category in terms of their liquidity (last column) have almost half the activity of the banks in the weakest category: i.e. there is a sharp decline in lending activity as bank strength increases, avoiding extra risks that would be introduced by higher lending during times of turmoil. Hence, it seems that during times of uncertainty small banks continue with their lending activity more aggressively than do their larger counterparts. Finally, it is worth noting that as we move from the last entry of the intermediate banks to the first entry of the *small*₀ banks, we see that the response of lending activity of the smallest and the weakest bank is larger than that of the strongest intermediate bank, once again implying risk-taking behavior by those financially fragile institutions.

One can also interpret our results in conjunction with those of Gatev and Strahan (2003). They demonstrate that when financial markets are volatile and commercial paper spreads relative to Treasuries increase, banks typically experience an increase in deposit inflows. Since banks are viewed as safe havens by investors, an increase in uncertainty (or volatility) in the financial markets would cause investors to rebalance their asset portfolios in favor of

¹⁷See Cebenoyan and Strachan (2004) on risk management and bank lending activity.

bank deposits. Gatev and Strahan’s findings suggest that these inflows allow banks to increase their lending without running down their holdings of liquid assets.

4.3.3 The extended bivariate specification for C&I loans

In this section we present our empirical results for C&I loans obtained from the modified bivariate model. Observe that Table 7, in comparison to Table 3, portrays a very different picture of the bank lending channel. In this set of results, we find *no* evidence in support of the bank lending channel. Inspection of the sum of ϕ estimates reveals that it is no longer negative for small banks, but rather is now insignificant and positive for all size categories except for one model. Hence, the data refute the existence of a bank lending channel. This result is very surprising and important in that it signals that earlier research employing the simple model proposed by KS in search for the bank lending channel is subject to a severe degree of misspecification due to omission of these second-moment effects. Furthermore, such a prominent change in the message as we move from total loans to C&I loans, a major sub-category of total loans, suggests that an interpretation of the results based on a misspecified model using aggregated variables could be equally problematic.

Next we concentrate our attention on the relationship between banks’ C&I loan activity and financial sector uncertainty. Evidence for strong and consistent effects of financial sector uncertainty is apparent. The sum of λ on uncertainty is significant and positive for all size groups, irrespective of the uncertainty measure used. Furthermore, the sum of the coefficients of ξ , is negative and generally significant at the 5% level. For both sets of coefficients we see monotonic behavior, suggesting that our findings can be interpreted in the same way as those for total loans. Hence, the effects of uncertainty on bank lending activity are consistent across total loans and C&I loans.

4.3.4 Results based on a finer classification for C&I loans

We carry out our analysis for C&I loans using a finer classification for small banks to be consistent with our earlier approach and examine whether disaggregating small banks into subcategories would affect our conclusion on the disappearance of the bank lending channel. Overall, our findings presented in Table 8 provide no new surprises. For any subcategory of banks and any

choice of uncertainty measure, the estimated sum of ϕ coefficients, similar to those presented in Table 7, is either insignificant or positive and significant. These findings along with those results we presented in Table 7 are in contrast with earlier research and cast serious doubt on the existence of a bank lending channel for the U.S.

As we search for the effects of uncertainty on C&I lending, we find that the sum of λ estimates is positive and significant for any subcategory of banks and choice of uncertainty measure. When we concentrate on the sum of the interaction term coefficients we observe that the sum of ξ estimates is negative and significant for all size groups. The monotonic progression as we move from *small*₀ to *small*₃ exists for each of the coefficients. For any size subcategory, the coefficient estimates suggest that weaker banks tend to lend more in times of higher uncertainty. Also, the primary effect of uncertainty turns out to be more pronounced for the *small*₀ group. These finding can be interpreted as suggesting that the option to take a larger gamble is more valuable to the smallest banks in the face of greater underlying uncertainty.

As described in section 4.3.2, we compute the average effect of uncertainty on banks' C&I lending behavior over the four proxies and present this as our final set of results in Table 9. For each size classification, we once again see that banks with weaker balance sheets lend more than those with stronger balance sheets during times of higher uncertainty. We also find that uncertainty increases large banks' lending activity proportionally more than any other bank category on average. As suggested earlier, this can be interpreted as showing that large banks are better equipped to operate under risky conditions in comparison to small banks for they can more effectively diversify their portfolio than can their smaller counterparts. Alternatively, when we inspect the table from top to bottom, especially among *small*₀ and *intermediate* banks, Table 9 presents us with a remarkable observation: the total effect of uncertainty on bank lending behavior is generally declining as we move from the *small*₀ to *intermediate* classes. In particular, moving from the first entry of *small*₀ banks to the last entry for *intermediate* banks, the effect of uncertainty on lending drops from 0.0652 to 0.0322.¹⁸ Overall, the results in this table demonstrate that smaller and generally weaker banks tend to extend C&I loans more aggressively than larger banks with stronger balance sheets in times of uncertainty, taking on more risk in the process.

¹⁸Also note that the last entry for *large* banks, 0.0558, is smaller than that of the first entry of *small*₀ banks, 0.0652.

4.3.5 Summary findings

Our analysis lead to important implications regarding the prevalence of the bank lending channel in the U.S. and the effect of financial uncertainty on bank lending. We show that bank lending increases during periods of high financial–sector uncertainty and that regardless of bank size, it is those banks with weaker balance sheets that are more aggressive in expanding their lending. Among all banks, it is the largest banks with weaker balance sheets that increase their lending by the greatest amount. However, lending activity of *large* banks declines by half when we look at the strongest members of that category. Contrarily, the strength of a bank’s balance sheet does not play such a striking role for *small* banks. This is meaningful as the smaller banks generally operate under certain constraints, including geographical restrictions, which may prohibit their being too selective during times of higher uncertainty. This observation may be linked to the theory of real options in the presence of deposit insurance: the option to take a larger gamble becomes more valuable in the face of greater underlying uncertainty. It is also possible to interpret our findings in the light of Gatev and Strahan (2003) that increased uncertainty leads to a higher inflow of bank deposits, which in turn allows banks to increase their lending activity.

Second, we show that the BHC data refute the existence of the bank lending channel argument in the U.S., particularly for the case of commercial and industrial loans (and to some degree for total loans). There are a number of reasons leading to failure of the extended KS model. First, given that the effects of uncertainty are significant in our respecification, it is clear that the KS model is misspecified, and leads to biased conclusions. Second, we show that not all banks categorized as small within the context of KS’ definitions behave homogeneously. For the case of total loans, up to half of their “small” banks are not observationally different from those in the “intermediate” group in terms of lending activity. In that sense, particularly for the total loans category, the effects of changes in the stance of the monetary policy may not be as important as KS claim. This observation becomes more striking when we focus on C&I loans. It appears that all banks behave similarly in reaction to changes in the stance of the monetary policy when we concentrate on C&I loans; there is no longer any difference between small and large banks in terms of their lending response to changes in monetary policy. Hence, we find *no* evidence in support of a bank lending channel for commercial and industrial loans, casting doubts on the appropriateness of

drawing conclusions from aggregate measures of bank lending.

5 Conclusions

In this paper we re-examine the effects of changes in the stance of monetary policy on banks' lending activities by incorporating the impact of financial sector uncertainty. Similar to Kashyap and Stein (2000), we concentrate on the growth rates of total loans and commercial and industrial loans for various size categories. To carry out our investigation, we use the Federal Reserve System's Commercial Bank and Bank Holding Company database which contains information on all banks regulated by the Federal Reserve System, the Federal Deposit Insurance Corporation, and the Comptroller of the Currency. Our data set covers the period between 1979–2000 on a quarterly basis, with 9,000–16,000 observations per quarter.

Using our longer data set, we first confirm the existence of the bank lending channel for both total loans and commercial and industrial loans employing standard specifications used by Kashyap and Stein. We then extend their model by incorporating the effects of financial sector uncertainty. Using this broader model, we show that overall uncertainty has a positive impact on lending activities across all bank classifications. Furthermore, we find that weaker banks (banks with less-liquid assets) tend to lend more than stronger banks (banks with more-liquid assets) during times of higher uncertainty. These results are robust to the use of different measures of uncertainty.

Our analysis reveals surprising results when we consider the existence of a bank lending channel. We show that earlier research searching for a bank lending channel is subject to model misspecification: researchers may have arrived at erroneous conclusions due to omission of these second-moment effects, whose importance is evident in our estimates. The estimated sensitivity of bank lending to monetary policy shocks—the sum of ϕ coefficients—changes considerably when uncertainty is taken into account, suggesting that prior estimates may be biased. Although we found *some* evidence in favor of the bank lending channel when we concentrate on total loans, its economic significance may not be nearly as large as previously claimed, since at least a quarter—and up to a half—of the small banks behave more like intermediate banks, with a sensitivity to monetary policy quite dissimilar to their smaller counterparts.

However, when we turn our attention to C&I loans, we can find *no* evidence in favor of a bank lending channel: the effects of balance sheet strength and the stance of monetary policy on lending behavior no longer varies across bank size categories. This finding contradicts the basic intuition of the bank lending view that small, weak banks lacking access to the market for non-reservable funds should reduce their lending more than their stronger counterparts during episodes of monetary contraction, casting doubt on the existence of a bank lending channel for the U.S. Taken in sum, our findings call for more empirical research: for example, employing European data to determine whether financial sector uncertainty has any effect on bank lending, and consider whether the bank lending channel indeed exists.

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Table 1: Correlations of time series measures, 1979–2000

Mon Pol	1.0000				
Vol(TB3mo)	0.1126	1.0000			
Vol(TB5yr)	0.0996	0.9050	1.0000		
Vol(CP-TB)	0.1317	0.9872	0.8826	1.0000	
Vol(10yr-1yr)	0.0852	0.9704	0.9109	0.9629	1.0000
	Mon Pol	Vol(TB3mo)	Vol(TB5yr)	Vol(CP-TB)	Vol(10yr-1yr)

Table 2: Descriptive statistics

	N	μ	σ	$p25$	$p50$	$p75$
3-month TBill		70.1770	63.0378	32.3116	46.1210	72.3064
5-year Treasury		61.6596	30.7729	40.8401	49.3423	67.9509
CP-TB spread		78.0399	76.5679	34.4634	46.6486	74.5969
10 yr-1 yr Treas. spread		44.5795	29.3139	27.1155	33.4489	47.5641
Δmbm		0.0006	0.0283	-0.0105	-0.0004	0.0071

(A) Total Loans

All banks						
$\Delta \log totloans$	1,087,683	0.0239	0.0877	-0.0126	0.0175	0.0501
B		0.3317	0.1523	0.2249	0.3181	0.4272
Small banks						
$\Delta \log totloans$	1,041,487	0.0238	0.0866	-0.0127	0.0174	0.0501
B		0.3359	0.1516	0.2294	0.3224	0.4313
Intermediate banks						
$\Delta \log totloans$	36,707	0.0270	0.1107	-0.0096	0.0187	0.0496
B		0.2498	0.1412	0.1616	0.2405	0.3255
Large banks						
$\Delta \log totloans$	9,489	0.0303	0.1032	-0.0089	0.0206	0.0527
B		0.1880	0.1007	0.1170	0.1813	0.2444

(B) Commercial and Industrial Loans

All banks						
$\Delta \log C\&Iloans$	498,353	0.0261	0.1913	-0.0468	0.0176	0.0899
B		0.3228	0.1401	0.2278	0.3115	0.4079
Small banks						
$\Delta \log C\&Iloans$	476,472	0.0259	0.1934	-0.0482	0.0173	0.0910
B		0.3267	0.1398	0.2319	0.3153	0.4118
Intermediate banks						
$\Delta \log C\&Iloans$	17,231	0.0291	0.1422	-0.0258	0.0206	0.0722
B		0.2510	0.1173	0.1773	0.2480	0.3228
Large banks						
$\Delta \log C\&Iloans$	4,560	0.0326	0.1205	-0.0196	0.0241	0.0681
B		0.1846	0.0920	0.1178	0.1728	0.2374

Note: N refers to the number of bank-quarters in the category. $p25$, $p50$ and $p75$ represent the quartiles of the distribution of each variable, while μ and σ are the mean and standard deviation.

Table 3: One-step estimates for total and C&I loans: sums of coefficients on monetary policy indicator

<i>Size</i>	Total Loans		C&I Loans	
	[<i>N</i>]	<i>B</i> · <i>MPI</i>	[<i>N</i>]	<i>B</i> · <i>MPI</i>
Small (< <i>p</i> 95)	[964,669]	-0.516 (0.107)	[398,117]	-0.971 (0.401)
Intermediate (<i>p</i> 95 – <i>p</i> 99)	[33,603]	3.231 (0.980)	[14,859]	2.088 (1.924)
Large (> <i>p</i> 99)	[8,832]	0.454 (1.999)	[3,979]	1.674 (3.644)

Note: *N* refers to the number of bank-quarters in the category. Robust standard errors in parentheses.

Table 4: One-step estimates, bivariate model for total loans: sums of coefficients on monetary policy indicator and uncertainty

<i>σ calculated from</i>	<i>Size</i>	<i>$B \cdot MPI$</i>	<i>σ</i>	<i>$B \cdot \sigma$</i>
Three-month Treasury bill	Small	-0.480	0.012	-0.005
	(< <i>p</i> 95)	(0.120)	(0.001)	(0.002)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	2.679 (1.063)	0.018 (0.005)	-0.032 (0.016)
	Large (> <i>p</i> 99)	0.860 (2.238)	0.033 (0.007)	-0.086 (0.037)
Five-year Treasury note	Small	-0.271	0.032	-0.025
	(< <i>p</i> 95)	(0.111)	(0.002)	(0.004)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	3.293 (1.019)	0.061 (0.011)	-0.134 (0.038)
	Large (> <i>p</i> 99)	1.440 (2.069)	0.093 (0.016)	-0.231 (0.082)
Three month commercial paper– Tbill spread	Small	-0.608	0.009	-0.004
	(< <i>p</i> 95)	(0.118)	(0.001)	(0.002)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	2.908 (1.050)	0.013 (0.004)	-0.023 (0.013)
	Large (> <i>p</i> 99)	1.369 (2.240)	0.024 (0.006)	-0.067 (0.031)
Ten year– One year Treasury spread	Small	-0.513	0.029	-0.017
	(< <i>p</i> 95)	(0.115)	(0.002)	(0.004)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	3.281 (1.036)	0.043 (0.011)	-0.080 (0.037)
	Large (> <i>p</i> 99)	0.695 (2.171)	0.069 (0.017)	-0.166 (0.092)

Note: robust standard errors in parentheses.

Table 5: One-step estimates, bivariate model for total loans: sums of coefficients on monetary policy indicator and uncertainty

σ calculated from	Size	$B \cdot MPI$	σ	$B \cdot \sigma$
Three-month Treasury bill	Small ₀ ($< p25$)	-0.674 (0.220)	0.009 (0.001)	0.005 (0.004)
	Small ₁ ($p25 - p50$)	-0.719 (0.201)	0.014 (0.001)	-0.006 (0.003)
	Small ₂ ($p50 - p75$)	-0.436 (0.221)	0.014 (0.001)	-0.009 (0.003)
	Small ₃ ($p75 - p95$)	0.539 (0.347)	0.014 (0.002)	-0.016 (0.005)
Five-year Treasury note	Small ₀ ($< p25$)	-0.370 (0.203)	0.024 (0.003)	-0.003 (0.008)
	Small ₁ ($p25 - p50$)	-0.531 (0.187)	0.034 (0.003)	-0.027 (0.008)
	Small ₂ ($p50 - p75$)	-0.259 (0.203)	0.036 (0.003)	-0.036 (0.008)
	Small ₃ ($p75 - p95$)	0.614 (0.319)	0.039 (0.004)	-0.058 (0.121)
Three month commercial paper- Tbill spread	Small ₀ ($< p25$)	-0.739 (0.216)	0.007 (0.001)	-0.003 (0.003)
	Small ₁ ($p25 - p50$)	-0.857 (0.198)	0.010 (0.001)	-0.005 (0.013)
	Small ₂ ($p50 - p75$)	-0.594 (0.218)	0.011 (0.001)	-0.008 (0.003)
	Small ₃ ($p75 - p95$)	0.364 (0.340)	0.011 (0.001)	-0.013 (0.004)
Ten year- One year Treasury spread	Small ₀ ($< p25$)	-0.719 (0.208)	0.022 (0.003)	0.000 (0.008)
	Small ₁ ($p25 - p50$)	-0.778 (0.191)	0.032 (0.003)	-0.020 (0.008)
	Small ₂ ($p50 - p75$)	-0.470 (0.210)	0.031 (0.003)	-0.024 (0.008)
	Small ₃ ($p75 - p95$)	0.494 (0.333)	0.034 (0.004)	-0.043 (0.012)

Note: robust standard errors in parentheses.

Table 6: Bivariate model for total loans: Total effect of σ for quartiles of B

	B_{p25}	B_{p50}	B_{p75}	$Total[\sigma B_{p25}]$	$Total[\sigma B_{p50}]$	$Total[\sigma B_{p75}]$
<i>small</i>	0.2309	0.3235	0.4322	0.0175	0.0164	0.0149
<i>small</i> ₀	0.2361	0.3425	0.4607	0.0157	0.0158	0.0159
<i>small</i> ₁	0.2375	0.3308	0.4392	0.0191	0.0177	0.0161
<i>small</i> ₂	0.2366	0.3271	0.4314	0.0181	0.0164	0.0143
<i>small</i> ₃	0.2121	0.2915	0.3834	0.0177	0.0151	0.0121
<i>intermediate</i>	0.1629	0.2412	0.3255	0.0227	0.0174	0.0117
<i>large</i>	0.1181	0.1817	0.2447	0.0386	0.0298	0.0211

Note: Effects are averaged over the four uncertainty proxies.

Table 7: One-step estimates, bivariate model for C&I loans: sums of coefficients on monetary policy indicator and uncertainty

<i>σ calculated from</i>	<i>Size</i>	<i>$B \cdot MPI$</i>	<i>σ</i>	<i>$B \cdot \sigma$</i>
Three-month Treasury bill	Small	0.748	0.044	-0.037
	(< <i>p</i> 95)	(0.504)	(0.002)	(0.007)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	2.432 (3.014)	0.036 (0.010)	-0.053 (0.039)
	Large (> <i>p</i> 99)	1.284 (4.651)	0.054 (0.012)	-0.080 (0.057)
Five-year Treasury note	Small	-0.087	0.106	-0.096
	(< <i>p</i> 95)	(0.442)	(0.005)	(0.016)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	3.517 (2.459)	0.100 (0.023)	-0.152 (0.094)
	Large (> <i>p</i> 99)	1.571 (4.240)	0.142 (0.027)	-0.262 (0.132)
Three month commercial paper– Tbill spread	Small	0.534	0.033	-0.028
	(< <i>p</i> 95)	(0.491)	(0.002)	(0.006)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	3.033 (2.963)	0.026 (0.008)	-0.037 (0.030)
	Large (> <i>p</i> 99)	1.928 (4.640)	0.041 (0.009)	-0.057 (0.045)
Ten year– One year Treasury spread	Small	0.470	0.096	-0.078
	(< <i>p</i> 95)	(0.471)	(0.005)	(0.016)
	Intermediate (<i>p</i> 95 – <i>p</i> 99)	1.901 (2.799)	0.080 (0.022)	-0.109 (0.093)
	Large (> <i>p</i> 99)	0.852 (4.498)	0.127 (0.027)	-0.191 (0.134)

Note: robust standard errors in parentheses.

Table 8: One-step estimates, bivariate model for C&I loans: sums of coefficients on monetary policy indicator and uncertainty

σ calculated from	Size	$B \cdot MPI$	σ	$B \cdot \sigma$
Three-month Treasury bill	Small ₀ ($< p25$)	-1.004 (1.178)	0.054 (0.006)	-0.048 (0.016)
	Small ₁ ($p25 - p50$)	-0.566 (0.903)	0.044 (0.004)	-0.032 (0.013)
	Small ₂ ($p50 - p75$)	0.321 (0.936)	0.042 (0.004)	-0.037 (0.013)
	Small ₃ ($p75 - p95$)	4.400 (1.054)	0.046 (0.005)	-0.063 (0.015)
Five-year Treasury note	Small ₀ ($< p25$)	-1.210 (1.012)	0.119 (0.013)	-0.101 (0.036)
	Small ₁ ($p25 - p50$)	-1.293 (0.795)	0.099 (0.010)	-0.079 (0.029)
	Small ₂ ($p50 - p75$)	-0.737 (0.825)	0.104 (0.010)	-0.099 (0.031)
	Small ₃ ($p75 - p95$)	2.701 (0.913)	0.120 (0.011)	-0.168 (0.035)
Three month commercial paper- Tbill spread	Small ₀ ($< p25$)	-1.135 (1.139)	0.041 (0.004)	-0.038 (0.012)
	Small ₁ ($p25 - p50$)	-1.032 (0.881)	0.034 (0.003)	-0.026 (0.010)
	Small ₂ ($p50 - p75$)	-0.014 (0.918)	0.032 (0.003)	-0.030 (0.010)
	Small ₃ ($p75 - p95$)	4.295 (1.031)	0.033 (0.004)	-0.045 (0.012)
Ten year- One year Treasury spread	Small ₀ ($< p25$)	-1.457 (1.086)	0.118 (0.013)	-0.104 (0.035)
	Small ₁ ($p25 - p50$)	-1.030 (0.847)	0.099 (0.010)	-0.075 (0.029)
	Small ₂ ($p50 - p75$)	0.103 (0.890)	0.092 (0.010)	-0.083 (0.031)
	Small ₃ ($p75 - p95$)	4.057 (0.976)	0.100 (0.010)	-0.130 (0.035)

Note: robust standard errors in parentheses.

Table 9: Bivariate model for C&I loans: Total effect of σ for quartiles of B

	B_{p25}	B_{p50}	B_{p75}	$Total[\sigma B_{p25}]$	$Total[\sigma B_{p50}]$	$Total[\sigma B_{p75}]$
<i>small</i>	0.2328	0.3155	0.4115	0.0559	0.0510	0.0452
<i>small</i> ₀	0.2441	0.3375	0.4453	0.0652	0.0584	0.0506
<i>small</i> ₁	0.2389	0.3211	0.4196	0.0562	0.0518	0.0466
<i>small</i> ₂	0.2330	0.3132	0.4023	0.0529	0.0479	0.0424
<i>small</i> ₃	0.2124	0.2890	0.3715	0.0533	0.0456	0.0372
<i>intermediate</i>	0.1777	0.2478	0.3220	0.0449	0.0387	0.0322
<i>large</i>	0.1183	0.1731	0.2377	0.0734	0.0654	0.0558

Note: Effects are averaged over the four uncertainty proxies.