# The second moments matter: The impact of macroeconomic uncertainty on the allocation of loanable funds

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**Abstract**

This paper investigates how variations in macroeconomic uncertainty distort commercial banks' allocation of loanable funds by analyzing the dispersion of banks' total loan-to-asset ratios over a quarter-century period.

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# 1 Introduction

This study aims to investigate the potentially adverse effects of macroeconomic uncertainty on the allocation of banks' loanable funds. We argue that as banks must acquire costly information on borrowers before extending loans to new or existing customers, uncertainty about economic conditions (and the likelihood of loan default) would have clear effects on their lending strategies over and above the movements of macroeconomic aggregates or the constraints posed by monetary policymakers' actions.[1]

We conjecture that higher uncertainty will hinder managers' ability to accurately predict returns from available lending opportunities. Beaudry, Caglayan and Schiantarelli (2001) present a theoretical argument and empirical evidence that an increase in macroeconomic uncertainty reduces the cross-sectional dispersion of firms' investment rate and distorts their allocation of resources. Along the same lines, Baum, Caglayan, Ozkan and Talavera (2006) arrive at similar conclusions when analyzing firms' cash/total asset ratios and their convergence in times of uncertainty. In our context, we expect that when macroeconomic environment is tranquil, bank managers will be able to predict returns from each potential project more easily and channel funds towards projects with higher expected returns. Contrarily, when the economic environment is in turmoil, bank managers' ability to predict returns accurately will be hindered rendering more conservative lending behavior across all banks. This argument implies that during times of higher

[1] Our approach differs from that employed in earlier research on banks' behavior under uncertainty. See for instance Cebenoyan and Strahan (2004), Freixas, Parigi and Rochet (2000), Thakor and Udell (1984).

macroeconomic uncertainty banks will behave more homogeneously, causing the cross-sectional distribution of banks' loan-to-asset ratios to narrow. During times of low uncertainty banks will have more latitude to behave idiosyncratically, leading to a widening of the cross-sectional distribution of banks' loan-to-asset ratios. In this view, stability of the macroeconomic environment will favor more efficient allocation of loanable funds. Buttressing this argument, a recent article[2] states that given the current uncertainty in the economic environment, banks are curtailing loans to American businesses, depriving even healthy companies of money for expansion and hiring whereas a few years ago they were eager to extend loans to their customers.

To test this hypothesis we use quarterly U.S. bank-level data covering a quarter-century period extracted from the Federal Reserve System's Commercial Bank and Bank Holding Company database. Our results provide strong support for the hypothesis that macroeconomic uncertainty distorts the allocation of banks' loanable funds. We find a clear negative association between proxies for macroeconomic uncertainty and the cross-sectional variability of banks' loan-to-asset ratios. Banks' lending behavior becomes more homogeneous in times of increased uncertainty. Our results are robust to the introduction of several other variables controlling for changes in monetary policy and the macroeconomic environment: the Federal funds rate, the inflation rate, the index of leading indicators, and an indicator of regulatory changes. We present our empirical findings below.

[2] "Worried Banks Sharply Reduce Business Loans", *New York Times*, July 28, 2008.

## 2 Empirical Analysis

### 2.1 Bank data

We extract data for total loans and total assets from the Federal Reserve System's Commercial Bank and Bank Holding Company (BHC) database. The extract of this data set employed here covers essentially all banks in the U.S. on a quarterly basis from 1979Q1–2003Q3, providing us with a total of 1,241,206 bank-quarters. Our definitions correspond to those provided by on-line documentation of Kashyap and Stein (2000).[3]

### 2.2 The reduced form model

We consider the following reduced form relationship:

$$Disp_t(L_{it}/TA_{it}) = \beta_0 + \beta_1 \hat{h}_t + e_t, \qquad (1)$$

where $Disp_t(L_{it}/TA_{it})$ is the standard deviation of the cross-sectional dispersion of banks' loan-to-asset (LTA) ratios at time $t$, $\hat{h}_t$ represents macroeconomic uncertainty proxied by the conditional variance of industrial production or CPI inflation evaluated at time $t$, and $e_t$ is an *i.i.d.* error term. The advantage of this approach is that we can relate the behavior of bank loans directly to a measurable proxy for economic uncertainty. If our conjecture is supported by the data, $\beta_1$ should take a negative sign.[4]

[3]We obtain qualitatively similar findings when we use the Standard and Poor's Bank COMPUSTAT data set, which includes a subset of the largest U.S. commercial banks. These results are available upon request.

[4]Although $\hat{h}_t$ is a generated regressor, the coefficient estimates for equation (1) are consistent; see Pagan (1984) and Pagan (1986).

Our proxies for macroeconomic uncertainty, $\hat{h}_t$, are derived from monthly industrial production (International Financial Statistics series $66IZF$) and from consumer price inflation (IFS series $64XZF$). In each case, we fit a generalized ARCH (GARCH) model to the series, where the mean equation is an autoregression (AR(1) for industrial production, AR(2) for inflation).[5] The conditional variance derived from this GARCH model for each proxy, averaged to quarterly frequency, is then used as our measure of macroeconomic uncertainty ($\hat{h}_t$). In our estimated models, we use either the contemporaneous conditional variance or a weighted average of the current and last three quarters' conditional variances, with arithmetic weights 0.4, 0.3, 0.2, 0.1.

The behavior of average loan-to-asset ratios is displayed in Figure 1, juxtaposed with the macroeconomic uncertainty proxies over the sample period. It is evident that the volatility of industrial production has declined over the sample period, while inflation volatility first fell then rose sharply since the mid-1990s. Banks' reliance on loans has generally increased since 1990.

### 2.3 Empirical results

The relation between the dispersion of banks' LTA ratios and macroeconomic uncertainty is presented in Table 1. The dependent variable measures the standard deviation of the LTA ratio. We enter an indicator, ($d\_BA$) for 1992Q1 and beyond to capture the effect of the full implementation of Basel Accord risk-based capital standards on banks' lending behavior. We consider both contemporaneous uncertainty measures ($CV\_IP$ and $CV\_Infl$)

[5] Details of the GARCH models for CPI and IP are given in the Appendix.

and current and three quarters' lagged effects of the proxies for macroeconomic uncertainty, $CV\_IP\_03$ and $CV\_Infl\_03$. All estimated models include the Federal funds rate to capture the stance of monetary policy, $d\_BA$ for the Basel Accord and a time trend to reflect secular movements in bank lending behavior and the level of macroeconomic uncertainty. In columns 5 and 6 of Table 1, we present results of regressions including two additional control variables: the rate of CPI inflation and the detrended index of leading indicators (computed from DRI-McGraw Hill Basic Economics series $DLEAD$) to further test the robustness of our results.

The table presents instrumental variables–generalized method of moments (IV-GMM) regression results with HAC (heteroskedasticity- and autocorrelation consistent) standard errors for each of the proxy series.[6] Columns 1 and 2 provide estimates of our baseline regressions. The coefficients on both measures of uncertainty are negative and significant at the 1% level, as are the measures in columns 3 and 4 based on distributed lags of the conditional variances. In columns 5 and 6 we arrive at similar findings: the coefficients of uncertainty are significant and negative. For each model, as one would expect, the Federal funds rate is also significant along with the time trend and the Basel Accord dummy.

To gain some insight on the economic significance of these results, we compute elasticities of the dependent variable with respect to uncertainty ($\hat{\eta}$) and use them to calculate the effect of a 100 per cent increase in uncertainty

[6] Instruments used include several lagged values of both conditional variance series. The $J$ statistic in these tables is Hansen's test of overidentifying restrictions, with their $p$-values given below.

as captured by the conditional variances of IP and CPI inflation.[7] We find that at the end of one year the dispersion of the LTA ratio declines by 6%–10%: a quite substantial magnitude in economic terms, indicating that higher macroeconomic uncertainty distorts the allocation of loanable funds.

The evidence we gather from Table 1 can be summarized as follows. Macroeconomic uncertainty has an important role in the allocation of loanable funds as captured by movements in the cross-sectional dispersion of banks' loan-to-asset ratios. Importantly, this effect is significant even when we control for the stance of monetary policy and macroeconomic conditions.

# 3 Conclusions

In this paper, we argue that uncertainty about macroeconomic conditions should have clear effects on the allocation of loanable funds over and above the movements of macroeconomic aggregates or the constraints posed by monetary policymakers' actions. We provide robust evidence that macroeconomic uncertainty significantly distorts the allocation process, and that the magnitude of effects that we find in this paper is qualitatively important: a change of 6% to 10% in the dispersion of banks' loan-to-asset ratios in response to a doubling of macroeconomic uncertainty. This is a quite substantial magnitude in economic terms implying that the second moments matter and should not be ignored by economic policymakers.

[7] For the sample period under consideration, the mean conditional variance (at a quarterly frequency) for IP is 0.0400, with values ranging from 0.0207 to 0.1256. Similar figures for the conditional variance of the CPI inflation rate are 0.0859, 0.0248 and 0.2403. Hence, it should be no surprise to see a doubling of uncertainty in some periods as well as its halving in some others.

Appendix: Proxies for macroeconomic uncertainty

Table A1. GARCH models proxying macroeconomic uncertainty

| | (1)<br>$\log(IP)$ | (2)<br>$\log(\dot{P})$ |
|---|---|---|
| $\log(IP)_{t-1}$ | 0.979 | |
| | [0.012]*** | |
| $\log(\dot{P})_{t-1}$ | | 1.246 |
| | | [0.053]*** |
| $\log(\dot{P})_{t-2}$ | | -0.253 |
| | | [0.052]*** |
| Constant | 0.000 | 0.022 |
| | [0.001] | [0.020] |
| $AR(1)$ | 0.851 | -0.841 |
| | [0.056]*** | [0.036]*** |
| $AR(2)$ | | -0.790 |
| | | [0.036]*** |
| $MA(1)$ | -0.605 | 0.952 |
| | [0.079]*** | [0.007]*** |
| $MA(2)$ | | 0.980 |
| | | [0.008]*** |
| $ARCH(1)$ | 0.249 | 0.164 |
| | [0.057]*** | [0.030]*** |
| $ARCH(2)$ | -0.184 | |
| | [0.054]*** | |
| $GARCH(1)$ | 0.916 | 0.799 |
| | [0.022]*** | [0.036]*** |
| Constant | 0.000 | 0.004 |
| | [0.000]** | [0.001]*** |
| Observations | 561 | 559 |

Standard errors in brackets

Models are fit to detrended $\log(IP)$ and $\log \dot{P}$.

* significant at 10%; ** significant at 5%; *** significant at 1%

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Table 1: Results for $Disp(L/TA)$, 1980Q4–2003Q3

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| CV_IP | -0.420*** | | | | | |
| | (0.050) | | | | | |
| CV_IP_03 | | | -0.430*** | | -0.384*** | |
| | | | (0.042) | | (0.042) | |
| CV_Infl | | -0.134*** | | | | |
| | | (0.018) | | | | |
| CV_Infl_03 | | | | -0.117*** | | -0.111*** |
| | | | | (0.019) | | (0.018) |
| Inflation | | | | | 0.002** | 0.002** |
| | | | | | (0.001) | (0.001) |
| LeadIndic | | | | | 0.001* | 0.001** |
| | | | | | (0.000) | (0.000) |
| FedFunds | -0.115*** | -0.181*** | -0.124*** | -0.189*** | -0.211*** | -0.296*** |
| | (0.032) | (0.038) | (0.030) | (0.035) | (0.049) | (0.055) |
| d_BA | -0.009** | -0.021*** | -0.009** | -0.018*** | -0.007 | -0.014** |
| | (0.004) | (0.004) | (0.003) | (0.004) | (0.004) | (0.004) |
| t | 0.210* | 0.413*** | 0.172* | 0.378*** | 0.135 | 0.234* |
| | (0.091) | (0.101) | (0.087) | (0.105) | (0.091) | (0.109) |
| Constant | 0.181*** | 0.175*** | 0.184*** | 0.175*** | 0.184*** | 0.181*** |
| | (0.006) | (0.006) | (0.005) | (0.006) | (0.005) | (0.006) |
| Quarters | 92 | 92 | 92 | 92 | 92 | 92 |
| $\hat{\eta}$ | -0.100 | -0.069 | -0.103 | -0.060 | -0.092 | -0.057 |
| s.e. | 0.012 | 0.009 | 0.010 | 0.010 | 0.010 | 0.009 |
| $J$ | 6.985 | 7.804 | 5.884 | 10.364 | 7.313 | 10.649 |
| $J$ pvalue | 0.430 | 0.350 | 0.553 | 0.169 | 0.397 | 0.155 |

HAC IV-GMM estimates, based on 1,241,206 bank-quarter observations.

$*$ <10%, **<5%, ***< 1%

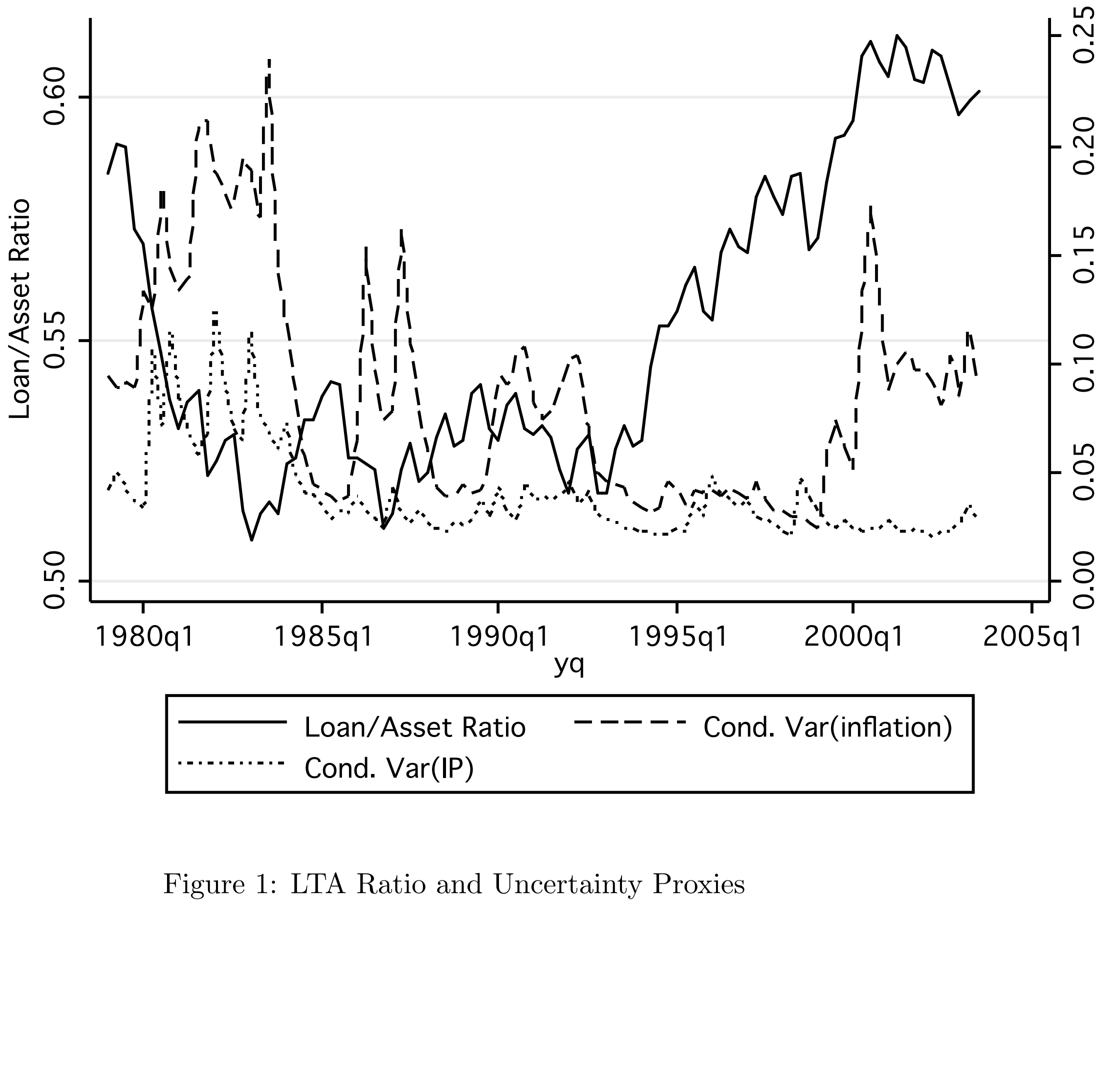


Figure 1: LTA Ratio and Uncertainty Proxies