Economic Policy Uncertainty and the Firm–Bank Nexus :
Investment, Liquidity, and Bank Risk-Taking Under Uncertainty*

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Updated version

Abstract

This research examines how economic policy uncertainty, at both the state and firm levels, influences non-financial firms' investment, debt, and cash-holding behavior, as well as financial intermediaries' deposits, loans, and liquidity holdings by evidence using U.S. Compustat and Call Report data over the period 1994–2023. I use a state-level EPU index constructed from 3,500 local newspapers and a firm-level EPU index derived from U.S. public firms' annual report, and employ an IV-GMM approach to address the endogeneity between EPU and firm- and bank-level outcomes. Results show that heightened EPU reduces firm investment and debt, while increasing cash holdings. Higher economic policy uncertainty leads banks to increase their liquidity holdings and reduce loan issuance. It also induces a shift in deposit composition, raising liquid deposits while lowering illiquid and large uninsured deposits. Heterogeneity analysis shows that these effects are stronger in manufacturing firms, high-leverage banks, and high-EPU states. Moreover, the results confirm that economic policy uncertainty influences banks' risk-taking behavior through a transmission channel that operates via firms' investment decisions and cash holding strategies, which in turn reshape the risk profile of banks' balance sheets. This paper underscores the importance of strengthening regional economic policy stability and coordination, fostering clearer policy communication to anchor firms' expectations, and enhancing firm financing support while monitoring the firm–bank nexus to safeguard financial stability.

Keywords: *Economic Policy Uncertainty; Firm Investment; Bank Risk-Taking; Liquidity Management; Financial Intermediation.*

JEL Classification: *D84; E22; E32; G21; G32.*

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1 Introduction

Economic policy uncertainty has emerged as a powerful force shaping the behavior of both firms and financial institutions. In recent years, after experiencing the disruptions caused by the COVID-19 pandemic, soaring inflation, geopolitical tensions, wars and conflicts, climate disasters, and rapid technological advancements, economic policy uncertainty has remained at a very high level. Policy shifts, including trade wars, changes in financial regulation and deregulation, and public health interventions, can disrupt expectations and introduce significant frictions into the economy. For instance, the COVID-19 pandemic increased policy uncertainty and exerted negative effects on the economy, with these impacts being more pronounced in states that implemented stricter lockdown measures. The abrupt tightening of monetary policy led to the 2023 regional banking crisis in the United States (e.g., the collapse of Silicon Valley Bank[1]), which further underscored the systemic consequences of uncertainty shocks. The aggressive use of trade tariffs to promote reshoring of manufacturing generated substantial policy uncertainty, not only at the federal level but also across states, with some governors filing lawsuits against the federal government. At the same time, perceptions of uncertainty vary widely across sectors and firms, underscoring the heterogeneous nature of its economic impact. These episodes highlight how elevated uncertainty can delay corporate investment, amplify precautionary cash holdings, trigger credit contractions, and lead to liquidity hoarding and heightened systemic risk within the banking sector. It can amplify the risk of turbulence in financial markets, delay consumption and investment decisions by households and firms, and prompt lenders to tighten credit supply. We need to understand how this heightened uncertainty may threaten financial stability.

These observations give rise to four central questions. First, how does economic policy uncertainty affect firms, banks, and overall financial stability? Second, through what transmission mechanisms does policy uncertainty influence financial stability? Third, to what extent is there heterogeneity at the regional and firm levels? Fourth, from a policy perspective, how should macroeconomic and regulatory authorities respond? To address these questions, this paper employs state-level EPU measures and develops a firm-level EPU index to empirically examine how uncertainty shocks affect firms and banks, as well as the channels through which they transmit to financial stability. Using the COVID-19 period as a case study, I conduct an event study to capture the dynamic effects of uncertainty shocks and further employ a structural dynamic general equilibrium model to analyze their broader impacts on firms, banks, and the macroeconomy, while also evaluating whether accommodative monetary policy can mitigate these effects.

While the existing literature has documented the macroeconomic effects of aggregate uncertainty, fewer studies have examined the role of more granular policy uncertainty, particularly at the state and firm levels. This dissertation emphasizes the importance of state-level economic policy uncertainty as well as firm-specific

[1] Silicon Valley Bank (SVB) failed on March 10, 2023, amid a rapid depositor run—the third-largest U.S. bank failure and the largest since 2008, and one of three U.S. bank failures that month (along with Silvergate and Signature). During the pandemic, SVB absorbed large tech/VC deposits and invested heavily in long-duration U.S. Treasuries and agency MBS (largely HTM); as interest rates rose sharply in 2022–23, the market value of these assets fell, creating sizable unrealized losses. After SVB disclosed losses and a planned capital raise on March 8, large uninsured deposits exited, precipitating FDIC receivership.

policy uncertainty extracted from financial disclosures. This study addresses these gaps by constructing fine-grained measures of policy uncertainty, applying instrumental variables generalized method of moments (IV-GMM) method to identify its impact. I construct and analyze two complementary measures of EPU. The first is a state-level index derived from the digital archives of roughly 3,500 local newspapers across U.S. states, following the approach of Baker, Davis, and Levy (2022). To quantify banks' exposure to regional policy uncertainty, the state-level index is weighted by the geographic distribution of each bank's deposit market share.The second is a novel firm-level index developed using natural language processing techniques applied to the Management Discussion and Analysis (MD&A) sections of annual reports (10-K filings) submitted by U.S. publicly listed companies, which captures the share of sentences jointly expressing uncertainty and referencing government or policy-related issues. In doing so, the dissertation moves beyond aggregate uncertainty to provide fine-grained measures at the state and firm levels, thereby deepening our understanding of how policy uncertainty is transmitted through financial intermediaries and corporate behavior.

Furthermore, the dynamic interaction between firms' responses to uncertainty and banks' balance sheet risks remains insufficiently explored. Most related studies focus solely on the effects of economic policy uncertainty on either firms or financial institutions in isolation, without considering their interactions. This dissertation integrates both firms and financial intermediaries within a unified empirical and structural modeling framework to analyze these dynamics.This dissertation advances our understanding of how economic policy uncertainty is transmitted across the real and financial sectors through the firm–bank nexus. The key idea is firms curtailed capital expenditures, built precautionary cash buffers, and reduced reliance on loans, while banks faced a compositional shift in deposits toward more liquid forms, contracted business lending, and increased their holdings of safe and liquid assets. Firms' investment and cash-holding behaviors have a mediating effect on the impact of economic policy uncertainty on banks. It focuses on the channels through which EPU shapes corporate investment and liquidity decisions, and how these firm-level adjustments feed back into banks' risk-taking and balance sheet composition. In other words, EPU exerts both a direct effect by influencing banks' credit supply, deposit structure, and liquidity risk, and an indirect effect, whereby EPU first alters firms' investment and cash-holding decisions, and these adjustments subsequently feed back into banks through changes in financing demand and deposit allocation.

To address potential endogeneity, we employ an IV-GMM framework. State-level EPU is instrumented using natural disaster damage, state-level partisan composition, and lagged EPU, while firm-level EPU is instrumented using macro-driven volatility, lagged firm-level EPU, and a sentiment index. These instruments provide plausibly exogenous variation, mitigating reverse causality concerns, such as the possibility that banking sector stress elevates measured policy uncertainty through regulatory responses. For instance, natural disasters can raise uncertainty (Baker, Bloom, & Terry, 2024) yet are orthogonal to contemporaneous bank decisions; political composition shapes policy uncertainty but is unlikely to respond to short-term bank performance; and lagged EPU is strongly correlated with current EPU but predetermined. The macro-driven volatility instruments in Alfaro, Bloom, and Lin (2024) are constructed by interacting industry-level heterogeneous sensitivities to oil, exchange rate, and policy uncertainty with the corresponding volatility shocks, while incorporating temporal lags. These instruments are driven by exogenous macroeconomic conditions rather than by individual firms' investment or financing decisions, thereby yielding plausibly external sources of variation.

To complement the baseline empirical analysis, I conduct an event study focusing on a period of exceptionally high economic policy uncertainty—the COVID-19 pandemic. This approach exploits the sharp and unexpected surge in uncertainty in early 2020 to trace the dynamic responses of both firms and banks. The results mirror the baseline findings: The event study further highlights the speed and magnitude of these adjustments over time, showing that both firms and banks responded within a matter of months, thereby underscoring the robustness of the identified transmission mechanisms. In addition, we use local projection methods to estimate the dynamic causal effects of uncertainty shocks over different horizons. We further employ the BLP demand estimation framework to quantify how local economic policy uncertainty influences local deposit demand. We also implement complementary approaches, including cloglog regression and XGBoost models, to investigate the effects of EPU on the likelihood and dynamics of bank runs.

In the quantitative modeling framework, we introduce an uncertainty shock into the GK–BGG benchmark model(Bernanke, Gertler, and Gilchrist (1999), Gertler and Karadi (2011)). In this paper, increased uncertainty is represented as a decline in average productivity accompanied by a rise in the dispersion of productivity, a pattern consistent with the dynamics observed during major U.S. recessions. The GK–BGG benchmark model is particularly suited for this analysis because it combines financial frictions in both the banking and corporate sectors, thereby capturing the amplification of financial shocks through a dual leverage-constraint mechanism. Bank lending capacity is constrained by its net worth and expected future profitability, while firms' investment decisions are shaped by their own net worth positions. Following an uncertainty shoc, characterized by lower mean productivity and higher dispersion, the model generates the following equilibrium outcomes: investment falls as external financing costs rise; aggregate output declines due to reduced capital accumulation and labor demand; loans contract as lower expected profitability restricts bank lending; and deposits increase as households shift more funds into safe assets. We further simulate the role of an accommodative monetary policy in mitigating the impact of uncertainty shocks. The results suggest that while monetary easing can temporarily boost investment, consumption, and output, the accompanying rise in inflation necessitates subsequent policy tightening. As a result, accommodative policy has no lasting effect and does not alter banks' risk-taking behavior.

The remainder of the dissertation is structured as follows. Chapter 2 reviews the related literature on economic policy uncertainty, firm investment behavior, financial intermediation, and risk modeling. Chapter 3 describes the construction of the firm-level and state-level economic policy uncertainty indices, based on textual analysis and external data sources. Chapter 4 outlines the empirical framework, including regression specifications, identification strategies, and instrumental variable design. Chapter 5 presents the descriptive analysis, highlighting key patterns in firm and bank responses to uncertainty. Chapter 6 reports the main empirical results, including baseline estimates, heterogeneity analyses, and mediation channel tests. Chapter 7 conducts event studies with a focus on COVID-19, while Chapter 8 examines the dynamic effects of uncertainty shocks using local projection methods. Chapter 9 develops a dynamic stochastic general equilibrium (DSGE) model that incorporates firm–bank interactions and time-varying uncertainty shocks. Chapter 10 concludes with policy recommendations and reflections, discussing implications, limitations, and potential avenues for future research. The Appendix provides additional details on data sources, variable definitions, the BLP demand estimation model, and supplementary results on the bank run analysis.

2 Literature Review

A rich literature has documented the macroeconomic consequences of aggregate uncertainty. Yet far less is known about how uncertainty propagates at more granular levels—across regions, and individual firms, and how these micro-level adjustments transmit between the real and financial sectors, ultimately affecting macroeconomic performance and the stability of the financial system. This paper contributes to the following strands of research.

2.1 Uncertainty and Economics Policy Uncertainty

This paper leverages state-level economic policy uncertainty and builds a novel firm-level EPU index from U.S. public companies' 10-K MD&A, contributing to the literature on how policy uncertainty at both regional and firm levels affects corporate decisions and financial intermediation, and clarifying the transmission channels from policy uncertainty to the real and financial sectors. A foundational contribution by Bloom (2009) examines the macroeconomic effects of aggregated uncertainty shocks, using stock market volatility as a proxy. He finds that increases in U.S. stock market volatility are associated with declines in employment and investment. His general equilibrium model shows that a sharp uncertainty shock leads to a drop in output, employment, and productivity growth, followed by a gradual rebound. Although some empirical work has used financial market-based proxies such as the VIX[2], it has been noted that the VIX may also reflect time-varying risk aversion or investor sentiment, rather than fundamental uncertainty (Bekaert, Hoerova, and Duca (2013)). Building on this, Aastveit, Natvik, and Sola (2017) explore how uncertainty interacts with monetary policy, employing several U.S. uncertainty measures within a structural vector autoregression framework. Jurado, Ludvigson, and Ng (2015) take a different approach by constructing a macroeconomic uncertainty index based on a large panel of variables, defining uncertainty as the unforecastable component of economic fluctuations rather than their total variance.

In parallel, a growing literature highlights the importance of information shocks as drivers of uncertainty, particularly those transmitted through media channels. One of the most widely used tools in this area is the Economic Policy Uncertainty Index developed by Baker, Bloom, and Davis (2016), which uses newspaper text analysis to quantify uncertainty related to key policy areas. The index is constructed by counting the frequency of newspaper articles that simultaneously include terms related to "uncertainty," "economic," and government-related keywords. Baker et al. (2022) extend the newspaper-based methodology to the state

[2] the implied volatility of the S&P 500 index

level by drawing on a dataset of approximately 3,500 local newspapers. The resulting state-level EPU indices allow researchers to study regional heterogeneity in uncertainty exposure and its localized economic effects. At the firm level, Hassan, Hollander, Van Lent, and Tahoun (2019) develop a measure of political risk by applying computational linguistics to earnings conference call transcripts. Their firm-level index captures the share of discussion dedicated to political risks, offering a micro-level lens on how firms perceive and respond to uncertain policy environments.

2.2 Firm Responses Under Uncertainty

This paper contributes to and advances the empirical literature by analyzing firms' responses to uncertainty. High levels of policy uncertainty often lead to substantial reallocation within the balance sheets of non-financial firms.Gulen and Ion (2016); Kermani and Ma (2023); Kim and Kung (2017) document that higher policy uncertainty depresses corporate investment, leading to retrenchment from long-horizon projects and reductions in capital expenditures. These effects are heterogeneous, being more pronounced among firms with high R&D intensity, greater leverage, or weaker access to external finance (Alfaro et al., 2024). The mechanism is consistent with the real-options framework, whereby firms delay or scale back irreversible commitments because waiting has option value (Bernanke, 1983; Dixit & Pindyck, 1994). At the aggregate level, elevated EPU is associated with weaker real activity, including slower investment and employment growth (Baker et al., 2016).

A second, complementary response is liquidity rebalancing. Firms increase precautionary cash holdings and preserve financial slack to self-insure against adverse shocks (Gao, Grinstein, & Wang, 2017; Smietanka, Bloom, & Mizen, 2018). Reliance on external finance typically falls: loan demand weakens and new debt issuance declines (Gilchrist, Sim, & Zakrajšek, 2014). Large, relatively unconstrained firms may draw on committed credit lines to build cash buffers, whereas more constrained firms often limit borrowing altogether due to a lack of attractive projects or tighter constraints (Greenwald, Krainer, & Paul, 2020).

2.3 Bank Response Under Uncertainty

Our study complements and advances existing research by analyzing the effects of economic policy uncertainty on financial institutions at a more granular level of analysis. Economic policy uncertainty induces precautionary balance-sheet adjustments by banks, with liquidity hoarding and tighter credit terms serving as key transmission channels to the real economy. Economic policy uncertainty triggers precautionary asset-side adjustments. Using U.S. evidence, Berger, Guedhami, Kim, and Li (2022) show that banks respond to elevated EPU by accumulating liquid assets, and that this hoarding translates into weaker credit supply and repricing of loans. Consistent with this mechanism, Bordo, Duca, and Koch (2016) document that banks facing high policy uncertainty raise lending rates and curtail loan origination, thereby compressing the supply of credit.

A further source of fragility arises on the liability side. When banks rely heavily on uninsured funding—especially large, uninsured time deposits—the run risk inherent in such liabilities can magnify liquidity stress. Choi, Goldsmith-Pinkham, and Yorulmazer (2023) show that markets had partially priced the risks associated with high uninsured-deposit dependence and thin cash cushions even prior to stress events. Extending this perspective, Drechsler, Savov, Schnabl, and Wang (2023) argue that a bank-run equilibrium is more likely when uninsured deposits constitute a large share of funding, particularly in rising-rate environments, underscoring how funding structure interacts with uncertainty to elevate systemic liquidity risk.

2.4 Channels of Transmission Between Firms and Banks

Economic policy uncertainty shapes the bank–firm nexus through interacting demand- and supply-side channels that form a feedback loop. On the demand side, higher uncertainty induces firms to postpone investment and hoard cash (e.g., Duchin, Ozbas, and Sensoy (2010)), compressing credit demand and weakening banks' lending opportunities. On the supply side, banks facing elevated perceived EPU tighten lending standards or widen pricing spreads, making external finance more costly for firms (Jiménez, Ongena, Peydró, and Saurina (2014)).

This two-way interaction is state dependent and intensifies during downturns. Uncertainty shocks generate sharp short-run contractions in output and investment via real rigidities and adjustment costs Bloom (2009), while incomplete markets magnify these recessionary effects Arellano, Bai, and Kehoe (2019). In parallel, banking frameworks with precautionary or capital-based constraints show how shocks are propagated and amplified through intermediaries' balance sheets, transmitting uncertainty across the financial system (Brunnermeier and Sannikov (2014)). Together, these mechanisms link firm behavior and bank intermediation in a mutually reinforcing cycle, yielding testable implications for financing costs, loan volumes, and liquidity buffers.

2.5 Banking and Financial Stability

This paper also contributes to a complementary strand of literature that focuses on the role of banks in macro-financial transmission. Key topics in this area include bank market power and competition, the deposit and credit channels, liquidity management, balance sheet adjustments, bank runs, and overall financial stability.

In particular, this study builds on work showing how banks transmit and amplify aggregate shocks. Drechsler, Savov, and Schnabl (2017) document a deposit channel whereby banks with greater deposit market power are less sensitive to interest-rate changes due to stable funding. Greenwald et al. (2020) highlight a credit-line channel through which anticipated drawdowns raise precautionary liquidity, amplifying shocks. Kundu and Vats (2021) show that firm-level idiosyncratic shocks can spill over across states via banking networks, and Kundu, Park, and Vats (2021) examine how the geography of deposits and climate-risk exposure shapes aggregate fluctuations and financial fragility. Together, these studies motivate our focus on how regional policy uncertainty—such as state-level EPU—affects banks' funding structures, lending behavior, and risk exposure.

This paper relates to and builds on the following models. Corbae and D'Erasmo (2021) develop an RBC model of the banking industry to study how regulation affects risk-taking and market structure, allowing for idiosyncratic funding shocks alongside aggregate shocks that move loan performance. Elenev, Landvoigt, and Van Nieuwerburgh (2021) propose a New Keynesian model with a financial sector that extends risky long-term loans funded by deposits. We introduce an uncertainty shock into a hybrid GK–BGG framework: in Bernanke et al. (1999), agency costs and costly state verification make the external finance premium inversely related to borrowers' net worth, amplifying shocks through the net-worth–spread–investment channel; in Gertler and Karadi (2011), limited commitment imposes a leverage constraint that ties assets to bank net worth, generating countercyclical intermediary spreads and a role for unconventional policy in compressing those spreads. Following Rannenberg (2016), we combine the firm-side financial-accelerator block of BGG (1999) with the bank-side moral-hazard/leverage-constraint block of GK (2011) in a single DSGE model.

3 Data Source and Empirical Framework

This section presents the empirical strategy for identifying the causal effects of economic policy uncertainty (EPU) on firm and bank behavior. The analysis consists of three key components: (1) IV-GMM specifications linking EPU to firm outcomes—such as capital investment, loan borrowings, and cash holdings—and to bank balance sheet measures, including deposit composition, loan supply, and liquidity holdings; (2) the use of instrumental variables for both firm-level and state-level EPU; and (3) mediation analysis to assess the role of firm behavior in transmitting EPU to the banking sector. Together, these approaches address potential endogeneity concerns and provide a comprehensive assessment of how EPU, at both the state and firm level, influences the real and financial sectors.

The state-level EPU regressions employ quarterly data over the same period (1994–2023). The primary databases used in this study include Compustat, Capital IQ, Call Reports, and the Summary of Deposits, etc.. Additional details on the data sources are provided in the Appendix. The firm-level EPU regressions are estimated using annual data from 1994 to 2023. The use of annual frequency is dictated by the construction of the firm-level EPU index, which is derived from the Management Discussion and Analysis (MD&A) sections of U.S. public companies' 10-K filings, available only on an annual basis.

3.1 State-Level EPU Empirical Model

This section investigates how state-level Economic Policy Uncertainty (EPU) influences various bank-specific outcomes. The core explanatory variable is the log of EPU at the state level, while the dependent variables include a wide range of bank balance sheet components. One key empirical challenge arises from the potential endogeneity between EPU and banking outcomes: for instance, banking distress—such as bank runs—may lead to regulatory responses that in turn raise policy uncertainty. To address this concern, I employ IV-GMM strategy.

3.1.1 Measuring State-Level Policy Uncertainty

The state-level EPU index is based on the methodology of Baker et al. (2016), who construct newspaper-based indices using digital archives from over 3,500 local newspapers across all 50 U.S. states. The index counts the frequency of articles containing terms related to the economy, policy, and uncertainty.

Three sub-indices are constructed to capture different dimensions of economic policy uncertainty: EPU-S reflects policy uncertainty arising from state and local sources; EPU-N captures uncertainty driven by national and international policy developments; and EPU-C serves as a composite index that incorporates both EPU-S and EPU-N. In this study, we primarily use EPU-C, as it effectively captures both localized and broader macro-level sources of policy uncertainty.

For non-financial firms, the state-level EPU measure is matched to each publicly listed company based on the state of its registered address. For banks, state-level uncertainty is linked to bank-level outcomes through an exposure-weighting approach that accounts for the geographic distribution of their deposit markets. Specifically, for bank b at time t, the weighted EPU exposure is calculated as:

$$EPU_{bt} = \sum_{s} w_{bs} \cdot EPU_{st}$$

where w_{bs} denotes the share of bank b's deposits held in state s, and EPU_{st} is the EPU index for state s at time t.

To address the potential endogeneity of state-level Economic Policy Uncertainty (EPU), I employ an instrumental variable strategy based on three sources of plausibly exogenous variation. First, I use lagged climate-related damage as a source of exogenous shocks. These include losses from natural disasters such as floods, droughts, storms, tornadoes, and wildfires, obtained from the National Centers for Environmental Information. Following Baker et al. (2024), such disasters can shift policy focus and increase economic uncertainty, while remaining exogenous to the decisions and balance sheets of commercial banks.

Second, I exploit state-level variation in political composition using two measures: a partisan indicator, scaled from 1 to 1, where 1 indicates full Democratic control of the state legislature, 1 indicates full Republican control, and 0 represents an even split between the two parties; and the Partisan Herfindahl-Hirschman Index, which captures the concentration of party representation. These political measures, sourced from the National Conference of State Legislatures, influence the legislative process and policy direction, thereby affecting EPU. However, they are unlikely to be directly influenced by the operations of local commercial banks and firms.

Third, I include the lagged value of the state-level EPU index itself to capture persistence in uncertainty dynamics. Although past EPU can influence current EPU, the contemporaneous behavior of banks cannot affect past policy uncertainty, making this a valid instrument under the exclusion restriction.

Together, these instruments form a strong and theoretically grounded identification strategy. They are jointly relevant and pass the Sargan test for over-identifying restrictions, providing confidence in the validity of the IV specification used to estimate the causal effects of policy uncertainty on bank outcomes.

We estimate the first stage at the state–time level using

$$\log \mathrm{EPU}_{s,t} = \pi_0 + \pi_1 Z_{s,t} + u_{s,t}, \tag{1}$$

where s indexes states and $Z_{s,t}$ denotes the set of instruments—lagged disaster damages, a partisan indicator, the Partisan HHI Index, and lagged EPU. This regression yields the fitted values $\widehat{\mathrm{EPU}}_{s,t}$.

The second stage specification is as follows:

$$\log Y_{i,j,t} = \beta_0 + \beta_1 \log \widehat{\mathrm{EPU}}_{j,t} + \beta_2 X_{i,j,t} + \alpha_i + \gamma_t + \varepsilon_{i,j,t} \tag{2}$$

For banks, $Y_{i,j,t}$ denotes the bank-specific outcome variable for bank i in county j at time t. These outcomes include deposit structures (e.g., demand, savings, and time deposits), loan portfolios (e.g., commercial, consumer, and residential loans), liquid assets (e.g., reserves, federal funds sold, mortgage-backed securities, trading assets), and other financial indicators. The vector of control variables $X_{i,j,t}$ includes both bank-level and market-level factors: the lagged logarithm of total assets, the number of branches, the number of employees, the Herfindahl–Hirschman Index (HHI) of bank concentration at the county level, the yield spread (defined as the difference between long-term rates and the federal funds rate), county population, and per capita income. Bank fixed effects α_i and time fixed effects γ_t account for unobserved heterogeneity across banks and over time, respectively.

For non-financial firms, $Y_{i,t}$ corresponds to measures such as capital expenditures, cash holdings, and debt. The control vector $X_{i,t}$ includes firm size (log of total assets), return on assets (ROA), the dividend payout ratio, the debt-to-assets ratio, Tobin's Q, and employment. These controls help isolate the effect of policy uncertainty from underlying firm characteristics. Firm fixed effects α_i and time fixed effects γ_t similarly capture unobserved heterogeneity across firms and over time.

Mediating Effects Through Firms

To explore the mechanism through which economic policy uncertainty transmits to bank outcomes, I investigate whether firm activity—such as investment or cash holdings—serves as a mediating channel. Specifically, I assess whether uncertainty-induced changes in firm behavior amplify or dampen the effects of policy uncertainty on banks. The mediation model is specified as follows:

$$\log(Y_{i,j,t}) = \beta_0 + \beta_1 \log(\widehat{EPU}_{j,t}) + \beta_2 \widehat{F}_{j,t} + \beta_3 \left[\log(\widehat{EPU}_{j,t}) \times \widehat{F}_{j,t}\right] + \beta_4 X_{j,t} + \beta_5 M_{j,t} + \alpha_i + \alpha_j + \varepsilon_{i,j,t} \tag{3}$$

In this specification, $F_{j,t}$ denotes a general measure of firm activity at the county level, which can represent either net investment or corporate cash holdings. The interaction term between $\log(\widehat{EPU}_{j,t})$ and $F_{j,t}$ captures heterogeneous treatment effects, indicating that the response of banks to uncertainty may depend on firm-side financial behavior.

I first estimate the direct effect of policy uncertainty on bank outcomes using IV-GMM without including any mediators. Then, I include firm activity and its interaction with uncertainty to assess potential indirect effects. A reduction in the coefficient on $\log(\widehat{EPU}_{j,t})$ upon inclusion of $F_{j,t}$ would suggest that part of the effect operates through firm behavior, supporting the hypothesis of an indirect transmission channel.

3.2 Firm-Level EPU Empirical Model

3.3 Firm-Level Policy Uncertainty Measurement

This study employs text mining techniques to construct a novel measure of firm-level policy-related uncertainty shocks using the *Management's Discussion and Analysis* (MD&A) sections of 10-K filings by U.S. publicly listed firms from 1994 to 2023. The MD&A section, which contains both retrospective assessments and forward-looking statements, provides insights into management's views on macroeconomic developments, policy changes, and strategic planning. It is widely recognized as a primary source of qualitative information that reflects how firms perceive and respond to external risks.

Building on the methodology of Baker et al. (2016), I compile a firm-level policy uncertainty index by extracting and quantifying sentences in the MD&A sections of 10-K annual reports that simultaneously reference policy-related and uncertainty-related content. The keyword library for identifying policy content is adapted from the Economic Policy Uncertainty (EPU) index, while uncertainty-related keywords are drawn from the Loughran–McDonald dictionary, with refinements that exclude vague terms such as "about" and "approximate." To enhance identification accuracy with minimal manual labeling, I implement a semi-supervised learning framework that leverages a small manually annotated set alongside a larger machine-labeled corpus.

The full corpus of 10-K reports is downloaded from the SEC's EDGAR system. I extract MD&A (Item 7) sections using keyword-based segmentation. The extracted text is processed using standard natural language processing (NLP) techniques. This includes lowercasing, removal of non-alphanumeric characters, sentence tokenization, and exclusion of empty or extremely short sentences. For each sentence, I compute the frequency of policy-related and uncertainty-related terms, and derive a sentence-level indicator of policy uncertainty content.

3.3.1 Quantifying Firm-Level EPU

To formalize the construction of the firm-level policy uncertainty index, each sentence s in the MD&A is evaluated to determine whether it contains uncertainty-related terms. If a sentence includes both uncertainty-related and policy-related terms, it is classified as a policy-related uncertainty sentence and added to the set P. Sentences are classified as uncertainty-related if they contain at least one keyword from the Loughran-McDonald(Loughran and McDonald (2020)) uncertainty dictionary. If such sentences also contain at least one term from a curated list of policy-related keywords (e.g., "regulation," "government," "tariff," "legislation"), they are classified as policy-related uncertainty sentences.

Let n_s denote the number of uncertainty-related phrases in sentence s, and N represent the total number of phrases in the MD&A for firm i at time t. The firm-level policy uncertainty $\mathcal{U}_{it}$ is computed as the percentage of uncertainty-related phrases in policy-related sentences to the total number of phrases in the MD&A, as defined in Equation (1):

$$\mathcal{U}_{it} = 100 * \frac{\sum_{s=1}^{S_{it}} n_s I_P(s)}{N}$$

where $I_P(s)$ is an indicator function such that $I_P(s) = 1$ if sentence $s \in P$ (i.e., it contains both uncertainty and policy terms), and $I_P(s) = 0$ otherwise.

This index captures the intensity of policy-related uncertainty discussed in corporate disclosures and serves as the primary explanatory variable in regression analysis.

To assess the impact of firm-perceived economic policy uncertainty (EPU) on firm outcomes, I employ a IV-GMM estimation strategy. The baseline regression model is specified as follows:

$$\log(y_{it}) = \alpha_t + \alpha_{\text{ind}} + \beta \log(\hat{U}_{it}) + \Theta' X_{it} + \varepsilon_{it} \tag{4}$$

In this specification, y_{it} denotes firm-level outcome variables such as capital investment, cash holdings, leverage, or debt issuance. The term $\hat{U}_{it}$ is the fitted firm-level EPU measure obtained from the first-stage regression, and X_{it} is a vector of firm-specific control variables. α_t and α_{ind} represent time and industry fixed effects, respectively, and β captures the elasticity of firm outcomes with respect to perceived policy uncertainty.

For non-financial firms, y_{it} corresponds to measures such as capital expenditures, cash holdings, and debt ratios. The control vector X_{it} includes firm size (log of total assets), return on assets (ROA), the dividend payout ratio, the debt-to-assets ratio, Tobin's Q, and employment. These controls help isolate the effect of policy uncertainty from underlying firm characteristics.

For banks, the model is adjusted to reflect balance sheet-specific outcomes. The dependent variable y_{it} represents variables such as deposits (demand, savings, and time), loans (commercial and industrial, consumer, and residential mortgages), and liquid assets (reserves, federal funds sold, mortgage-backed securities, and trading assets). Other outcomes include profitability, capital adequacy ratios, and leverage. The corresponding control variables X_{ijt-1} include the lagged log of total assets, the log number of branches, and the log number of employees. To account for local market and macro conditions, I also include the Herfindahl-Hirschman Index (HHI) of bank concentration at the county level, the local yield spread (long-term interest rate minus the federal funds rate), county population, and per capita income. Bank fixed effects α_i and time fixed effects α_t are also included.

The first-stage regression used to instrument U_{it} is specified as:

$$\log(U_{it}) = \delta_0 + \delta_1 Z_{it} + \nu_{it} \tag{5}$$

Here, Z_{it} denotes a set of instrumental variables

To address potential endogeneity in the firm-level policy uncertainty index, I construct a set of instrumental variables based on firms' exposure to macroeconomic volatility. This follows a two-step procedure.

First, I estimate the sensitivity of firm-level returns to macroeconomic risk factors by running the following regression by following Alfaro et al. (2024):

$$r_{i,t}^{adj} = \alpha_j + \sum_{c} \beta_j^c r_t^c + \varepsilon_{i,t}, \tag{6}$$

where $r_{i,t}^{adj}$ denotes the return of firm i adjusted for market-wide factors, and r_t^c represents the macroeconomic volatility in dimension c—specifically oil price fluctuations, exchange rate movements, and national policy uncertainty. The coefficient β_j^c captures the industry-level sensitivity to each of these volatility factors.

In the second step, I construct the core instrument for firm i as:

$$z_{i,t}^c = |\beta_{j,t-2}^c| \cdot \Delta\sigma_t^c, \tag{7}$$

where $\Delta\sigma_t^c$ denotes the change in volatility of macro factor c at time t, and $|\beta_{j,t-2}^c|$ is the absolute value of the lagged sensitivity, ensuring exogeneity with respect to current firm-level outcomes.

In addition to these volatility-driven instruments, I incorporate two additional lagged firm-level variables to strengthen identification: the lagged value of the firm-level policy uncertainty index, and the lagged sentiment index derived from textual analysis of the firm's MD&A section. These instruments jointly satisfy the relevance and exclusion conditions, as verified through weak instrument and over-identification tests in the empirical results section.

3.4 Hypotheses

Building on the theoretical and empirical insights from the literature, this study examines how state-level and firm-level economic policy uncertainty (EPU) influences decision-making in both the corporate and banking sectors, and how firm behavior mediates these effects. Specifically, the empirical analysis is designed to test the following hypotheses.

Hypothesis 1 (Bank Responses). Elevated EPU is expected to increase banks' deposit inflows, accompanied by a compositional shift from illiquid time deposits toward more liquid and withdrawal-prone accounts. At the same time, banks are expected to reduce loan supply and reallocate assets toward highly liquid instruments. Such changes in liability composition and asset allocation are consistent with a more cautious balance sheet strategy in response to heightened uncertainty.

Hypothesis 2 (Non-financial firm Responses). Higher levels of EPU are expected to reduce capital investment by non-financial firms, lower their demand for bank loans, and increase their precautionary cash holdings. These adjustments reflect both the option value of waiting under uncertainty and the desire to maintain larger liquidity buffers in the face of unpredictable policy environments.

Hypothesis 3 (Transmission channel). The effects of EPU on bank behavior are mediated by firms' investment and liquidity decisions. Specifically, reductions in corporate investment and increases in cash holdings under high EPU conditions weaken credit demand and alter deposit flows, thereby influencing banks' funding structures, lending activities, and liquidity management.

Together, these hypotheses capture the *firm–bank nexus* in the transmission of policy uncertainty, providing a framework for assessing both the direct effects of EPU on each sector and the indirect effects operating through firm-level behavior.

4 Descriptive Analysis

This chapter presents the descriptive analysis, including summary statistics for key variables of banks and non-bank firms, trends in the firm-level and state-level EPU indices, and evidence on their spatial correlation. These findings provide preliminary insights and inform the specification of the subsequent regression analysis.

4.1 Descriptive Statistics: Bank Main Variables

Table 1 reports the descriptive statistics for the main bank-level variables used in the analysis. On average, banks hold deposits of approximately 1,013,530 thousand USD, with net loans averaging 853,241 thousand USD. Liquid assets average 581,663 thousand USD, while total assets average 1,574,498 thousand USD. The average yield is slightly negative at -1.52%, reflecting periods of low or negative interest rate environments; the yield is calculated as the federal funds rate minus the deposit interest rate. Banks operate, on average, 11 branches and employ around 251 workers. The Bank Herfindahl–Hirschman Index (HHI) has a mean of 0.22, suggesting a moderate degree of market concentration. At the local market level, the average population is approximately 461,192, and the average per capita income is 34,779 USD per zip code, with substantial cross-sectional variation. The dataset contains 853,935 bank-quarter observations covering the period 1994–2023.

Table 1: Descriptive Statistics of Main Variables

Variable	Mean	Std. Dev.	Min	Max
Deposits (thousand USD)	1,013,530.10	19,621,607.86	0.00	2.15e+09
Net Loans (thousand USD)	853,241.43	14,558,729.60	-72.00	1.31e+09
Liquid Assets (thousand USD)	581,663.03	14,402,737.73	0.00	1.57e+09
Assets (thousand USD)	1,574,497.86	32,156,790.16	0.00	3.40e+09
Yield (%)	-1.52	1.85	-6.51	4.25
Total Branches	10.91	105.93	1.00	6,582.00
Employees	251.17	3,808.60	0.00	240,232.00
HHI	0.22	0.12	0.05	1.00
Population	461,191.79	1,170,078.50	456.00	10,123,521.00
Per Capita Income (USD)	34,778.75	15,020.18	7,727.00	471,751.00
Observations	853,935			

Table 2 presents the descriptive statistics for the bank balance sheet composition and maturity structure variables. On average, banks hold deposits of approximately 1,013,530 thousand USD, of which savings deposits account for about 595,760 thousand USD, time deposits for 214,512 thousand USD, and demand deposits for 162,821 thousand USD. Net loans average 853,241 thousand USD, with quarterly averages of commercial and personal loans amounting to 220,540 thousand USD and 172,964 thousand USD, respectively. Real estate loans average 323,852 thousand USD. In terms of liquid assets, banks hold an average of 581,663 thousand USD, including 149,211 thousand USD in cash and reserves, 305,225 thousand USD in securities, and 133,620 thousand USD in treasury holdings. The average leverage ratio is 10.04%, while the average maturity of deposits and liabilities is around 0.44 and 0.43 years, respectively. Loan and asset maturities are longer, averaging 4.11 and 4.15 years.

Table 2: Descriptive Statistics: Bank Balance Sheet and Maturity Variables

Variable	Mean	Std. Dev.	Min	Max
Deposits (thousand USD)	1,013,530.10	19,621,607.86	0.00	2.15e+09
Savings Deposits (thousand USD)	595,760.10	13,831,577.40	0.00	1.60e+09
Time Deposits (thousand USD)	214,512.31	2,279,300.53	0.00	2.92e+08
Demand Deposits (thousand USD)	162,821.31	4,750,483.20	0.00	9.90e+08
Net Loans (thousand USD)	853,241.43	14,558,729.60	-72.00	1.31e+09
Quarterly Avg. Commercial Loans (thousand USD)	220,539.97	3,282,567.49	0.00	2.89e+08
Quarterly Avg. Personal Loans (thousand USD)	172,963.95	3,270,077.37	0.00	2.64e+08
Real Estate Loans (thousand USD)	323,852.39	5,411,613.09	0.00	4.78e+08
Liquid Assets (thousand USD)	581,663.03	14,402,737.73	0.00	1.57e+09
Cash (thousand USD)	149,210.74	4,528,197.04	-178.00	7.60e+08
Securities (thousand USD)	305,225.03	6,591,988.69	0.00	9.30e+08
Treasury Holdings (thousand USD)	133,620.29	2,789,836.81	0.00	2.78e+08
Leverage Ratio (%)	10.04	2.84	1.52	18.97
Deposit Maturity (Years)	0.44	0.28	0.00	5.00
Liability Maturity (Years)	0.43	0.28	0.00	5.00
Loan Maturity (Years)	4.11	3.10	0.12	20.00
Asset Maturity (Years)	4.15	2.52	0.00	19.17
Observations	853,930			

4.2 Descriptive Statistics: Non-Financial Firm Variables

Table 3 reports the descriptive statistics for the main non-financial firm variables in the sample. On average, firms hold total assets of 3,921 million USD, cash holdings of 408 million USD, and investment expenditures of 155 million USD. Average total debt amounts to 1,296 million USD, and firms employ approximately 8.13 thousand workers. The mean leverage ratio is 33.70%, while the average return on assets is 3.18%.

The average dividends-to-net-income ratio is 1.35%, with cash-to-assets and debt-to-assets ratios of 20.19% and 50.25%, respectively. Debt maturity averages 83.11%, and the mean Tobin's Q is 3.74. The dataset comprises 114,935 firm-year observations over the period 1994–2023.

Table 3: Descriptive Statistics of Non-Financial Firm Variables

Variable	Mean	Std. Dev.	Min	Max
Total Assets (million USD)	3,921.05	23,247.63	1.00	1,069,979.00
Cash Holdings (million USD)	408.06	3,578.89	0.79	187,138.00
Investment Expenditures (million USD)	155.10	990.37	0.21	63,646.00
Total Debt (million USD)	1,295.57	7,242.34	1.00	523,763.00
Employees (thousand)	8.13	42.03	0.01	2,300.00
Leverage Ratio (%)	33.70	50.75	0.00	750.20
Return on Assets (%)	3.18	19.63	-83.10	40.77
Dividends to Net Income Ratio (%)	1.35	3.46	-357.14	34.64
Cash to Assets Ratio (%)	20.19	24.36	-7.80	97.93
Debt to Assets Ratio (%)	50.25	23.17	0.10	143.65
Debt Maturity (%)	83.11	24.74	0.00	100.00
Tobin's Q	3.74	12.10	-0.99	213.67
Observations	114,935			

4.3 Descriptive Statistics: EPU Measures

Table 4: Descriptive Statistics for EPU Measures

Variable	**Mean**	**Std. Dev.**	**Min**	**Max**
State-level EPU	68.48	63.25	0.00	1,067.87
Firm-level Policy Uncertainty (Banks)	4.41	2.56	0.00	21.43
Firm-level EPU (Non-financial Firms)	2.65	1.60	0.00	8.16

Notes: This table reports the summary statistics for the three main measures of economic policy uncertainty (EPU) used in the analysis. The *state-level EPU* is constructed from local newspaper archives following Baker et al. (2022), while the *firm-level EPU* measures for banks and non-financial firms are derived from textual analysis of annual 10-K filings. The statistics are computed over the period 1994–2023.

Table 4 reports the summary statistics for the key policy uncertainty measures used in the empirical analysis. The state-level Economic Policy Uncertainty (EPU) index has a mean of 68.48 with substantial dispersion, indicating wide variation across states and over time. On average, firm-level policy uncertainty is higher for banks (mean = 4.41) than for non-financial firms (mean = 2.65), suggesting that banks tend to perceive and report greater exposure to policy-related uncertainty in their disclosures. It is important to note, however, that the state-level and firm-level EPU indices are constructed using different methodologies and data sources—the former from local newspaper coverage and the latter from textual analysis of firms' 10-K filings—and therefore their numerical values are not directly comparable.

4.4 State-Level Policy Uncertainty and Regional Deposit Growth During High-Uncertainty Periods

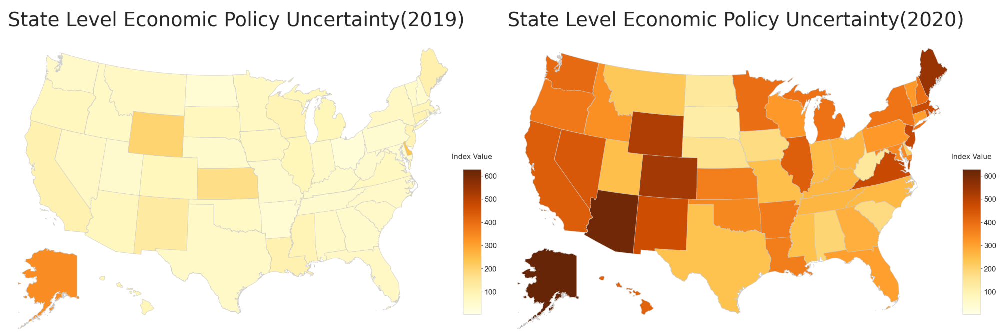

Figure 1: State-Level EPU in 2019 vs. 2020

To illustrate how local uncertainty evolves and potentially transmits through financial channels, we take the COVID-19 period as a representative episode of heightened uncertainty. Figure 1 compares state-level economic policy uncertainty (EPU) across U.S. states in 2019 and 2020. While the 2019 distribution appears relatively uniform, with limited geographic clustering, the 2020 map reveals a sharp increase in uncertainty, particularly in large coastal states such as California, New York, and Texas. This spatial shift coincides with the onset of the COVID-19 pandemic, which triggered a series of unprecedented federal and state-level policy interventions—ranging from emergency shutdown orders and stimulus measures to public health mandates. The intensity and timing of these policies varied significantly across states, giving rise to substantial cross-state heterogeneity in perceived policy risk.

Figure 2 presents the change in county-level deposit growth from 2019 to 2020. In 2019, deposit growth was relatively stable and evenly distributed across regions. In 2020, however, the distribution became highly uneven, with outsized deposit accumulation concentrated in states that experienced elevated policy uncertainty. This spatial transformation is consistent with precautionary financial behavior. The geographic alignment between rising policy uncertainty and elevated deposit growth supports the hypothesis that local uncertainty shocks can propagate through financial channels. In particular, these patterns suggest that state-level uncertainty may influence the liability structure of local banks. These spatial correlations motivate further empirical investigation into how policy risk shapes regional banking dynamics and contributes to the transmission of macroeconomic shocks at the local level.

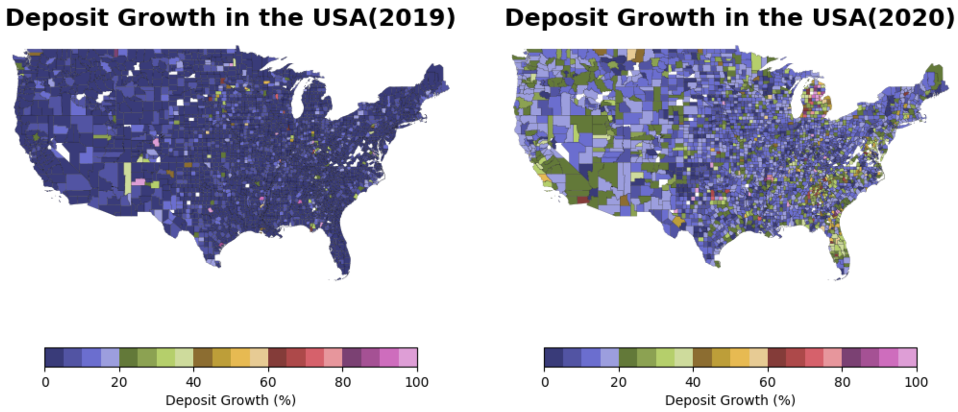

Figure 2: County-Level Deposit Growth (2019 vs. 2020)

4.5 Firm-Level Policy Uncertainty

4.5.1 Firm-Level Policy Uncertainty Over Time

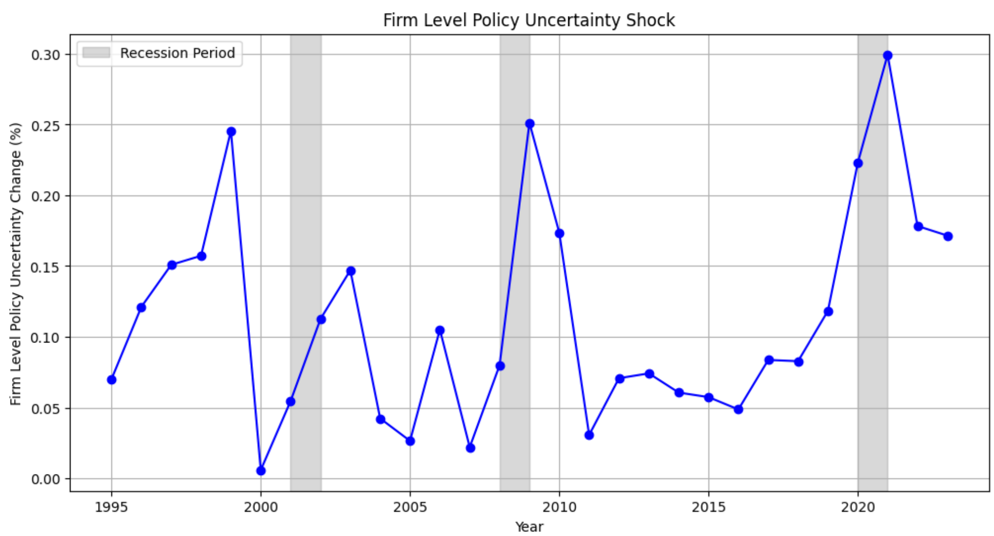

Figure 3: Firm-Level Policy Uncertainty Shocks (1994–2023)

Figure 3 depicts the time series evolution of firm-level policy uncertainty shocks from 1994 to 2023. Spikes in the index coincide closely with major recession episodes and economic disruptions. These include the dot-com bubble around 2001, the global financial crisis in 2008, and the COVID-19 pandemic in 2020. Each of these periods is marked by heightened volatility, regulatory uncertainty, and widespread economic distress, reflected in sharp increases in perceived policy uncertainty.

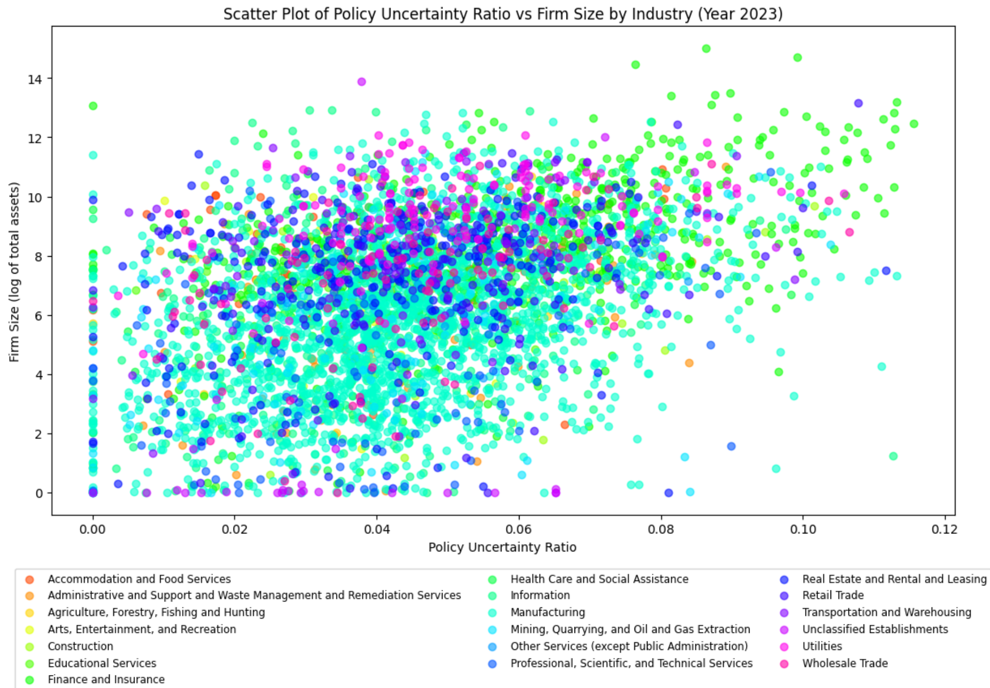

Figure 4: Policy Uncertainty by Firm Size

4.5.2 Firm Size and Policy Uncertainty

Figure 4 illustrates the relationship between firm size, measured as the logarithm of total assets, and the firm-perceived policy uncertainty index. A clear positive correlation emerges: larger firms report higher levels of policy uncertainty. Intuitionally, large firms typically operate across multiple jurisdictions, making them more susceptible to changes in regulatory environments, trade policy, tax rules, and compliance burdens. In contrast, smaller firms are often more localized in operation and less exposed to macroeconomic or geopolitical policy risks.

Furthermore, industry differences are visually apparent. Firms within finance, healthcare, and manufacturing sectors exhibit diverse patterns, suggesting that industry-specific factors mediate how uncertainty is perceived. This reinforces the importance of accounting for both firm-level characteristics and sectoral context when evaluating exposure to policy-related risks.

4.5.3 Industry-Level Firm Policy Uncertainty in 2023

Figure 5 presents a cross-sectional snapshot of firm-level policy uncertainty across major U.S. industries in 2023. The Finance and Insurance sector exhibits the highest level of perceived uncertainty, reaching 6%. This elevated figure likely reflects the sector's heightened exposure to regulatory changes, interest rate volatility, and macro-financial instability. In particular, 2023 witnessed a series of high-profile bank runs in the United States, which may have amplified uncertainty perceptions among financial firms. Following Finance and Insurance, the Utilities and Construction sectors also report relatively high levels of policy uncertainty.

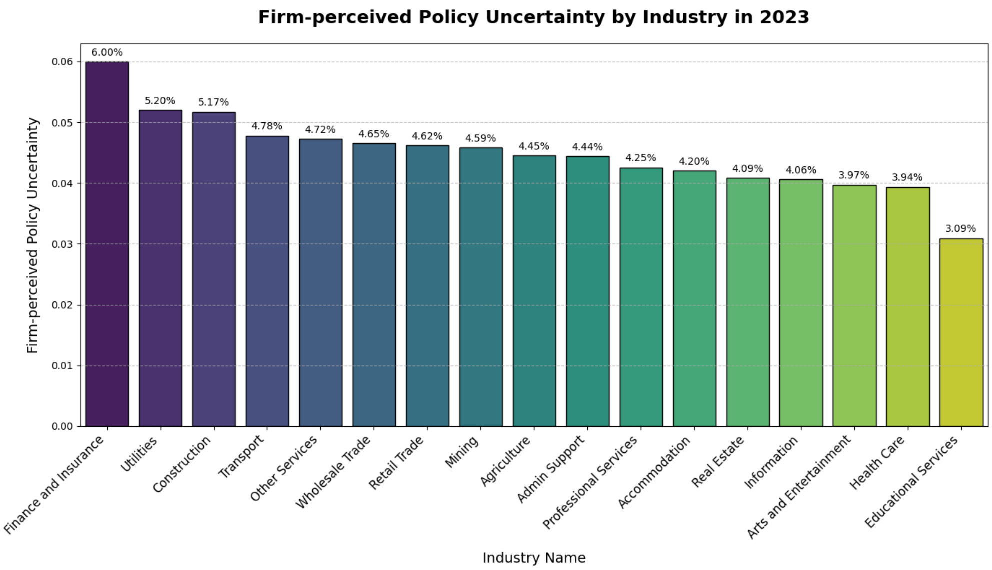

Figure 5: Firm-Perceived Policy Uncertainty by Industry (2023)

These industries are particularly sensitive to ongoing shifts in environmental regulations, infrastructure investment agendas, and evolving energy policy frameworks.

By contrast, sectors such as Education and Healthcare display the lowest levels of firm-perceived uncertainty. These industries often operate under more stable and predictable regulatory environments, with long-term policy commitments related to public funding, licensing, and workforce development. The observed cross-industry variation highlights the heterogeneous ways in which firms perceive and react to policy uncertainty, shaped by industry-specific regulatory exposure, capital intensity, and business model flexibility.

4.5.4 Firm-Perceived Uncertainty, Sentiment, and Financial Constraints

Figure 6 visualizes the interrelationships among three key dimensions of firm perception: firm-level policy uncertainty, corporate sentiment, and financial constraints. Examining the correlations among these variables is particularly important, as lagged sentiment is used as an instrumental variable, and financial constraints are closely linked to firms' borrowing behavior.

Firms with higher uncertainty scores tend to exhibit more negative sentiment, reflecting a diminished outlook in the face of elevated policy ambiguity. This negative correlation suggests that perceived uncertainty directly affects how firms evaluate their operating environment and future prospects.

Moreover, firms experiencing tighter financial constraints also report higher uncertainty and lower sentiment, suggesting that limited financial flexibility may impair a firm's ability to buffer policy shocks. Industry-level clustering in the figure further indicates that these relationships are more pronounced in certain sectors, such as finance and manufacturing. Overall, the evidence highlights the heterogeneous nature of firm responses to uncertainty, and underscores the importance of disaggregated, firm-level analysis when assessing the impact of economic policy uncertainty.

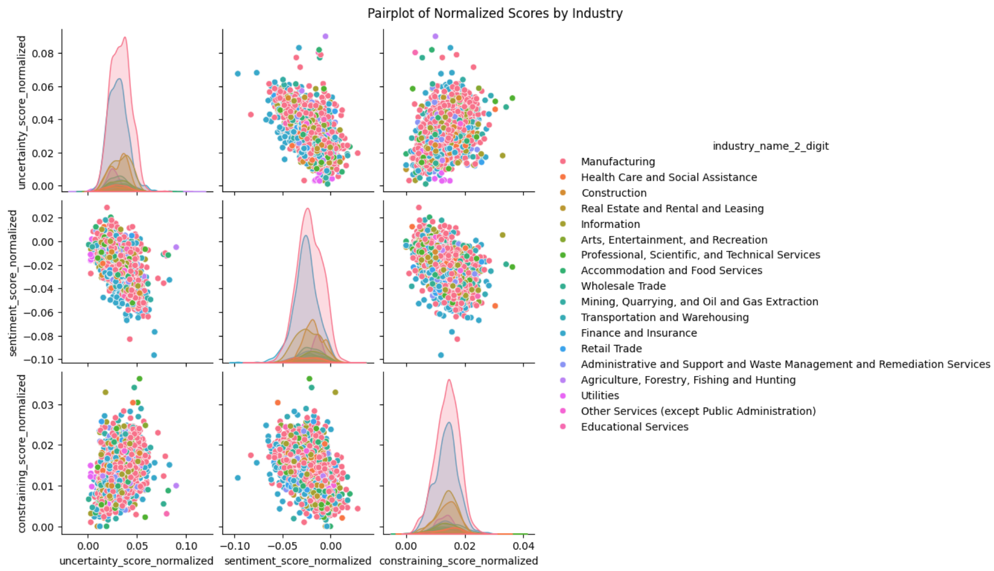

Figure 6: Relationship Among Policy Uncertainty, Sentiment, and Financial Constraints

4.6 Banks' Borrowing and Lending Under Uncertainty

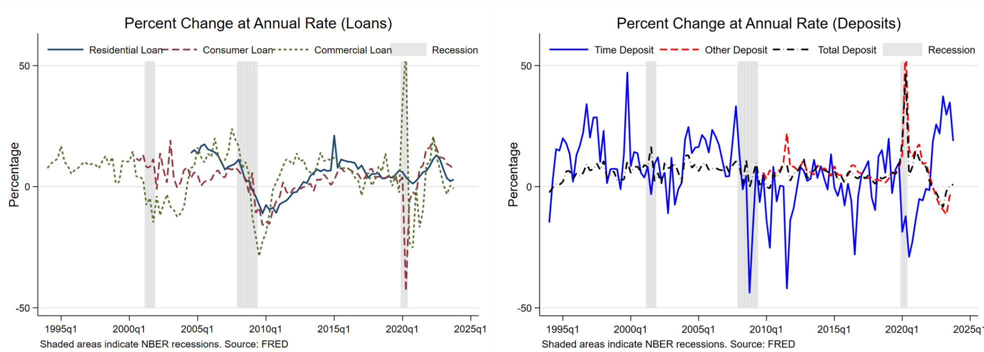

Figure 7: Annual Growth Rates of Loans and Deposits

Figure 7 compares the annual growth rates of loans and deposits, illustrating how banking flows respond to periods of heightened uncertainty. Loan growth across residential, commercial, and consumer categories declines sharply during times of elevated uncertainty, such as the 2008 financial crisis and the COVID-19 pandemic. These contractions reflect reduced credit demand, tighter lending standards, and increased risk aversion among financial intermediaries.

In contrast, deposit balances, particularly non-time deposits, increase significantly during these episodes. In 2020, the shift away from time deposits suggests a stronger preference for liquidity and flexibility. Both households and businesses chose to hold more cash or highly liquid deposits. These patterns highlight how policy uncertainty reverberates through the financial system and reshapes both the asset and liability sides of bank balance sheets.

4.7 Non-Financial Firms' Financial Behavior Under Uncertainty

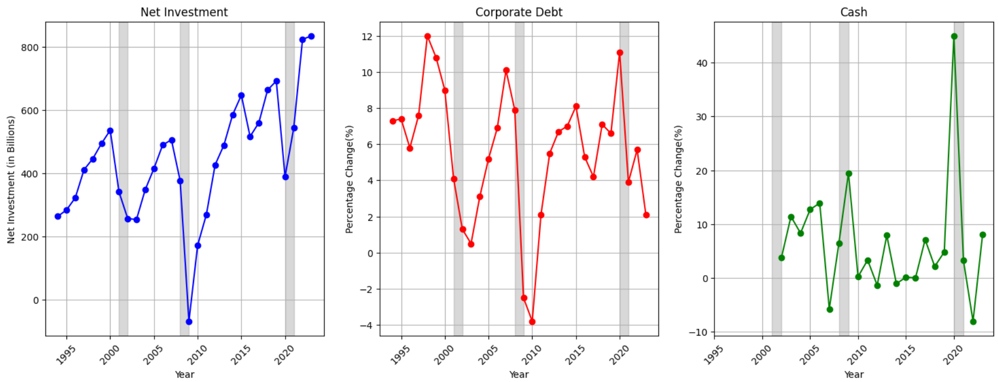

Figure 8: Aggregate Corporate Investment, Debt, and Cash Holdings

Figure 8 presents trends in three key components of corporate financial management: net investment, outstanding debt, and cash holdings. Net investment follows a long-term upward trajectory but declines sharply during periods of heightened uncertainty, particularly during the 2008 financial crisis and the COVID-19 pandemic in 2020. These downturns reflect increased caution and reduced capital spending in response to uncertainty shocks.

Corporate debt displays cyclical fluctuations. During times of high uncertainty, firms tend to reduce their dependence on external borrowing, signaling a shift toward more conservative financial policies. Meanwhile, cash holdings rise significantly during crisis periods, indicating precautionary behavior. The sharp increase in 2020 is particularly striking and is consistent with defensive balance sheet management amid a period of elevated policy uncertainty.

5 Empirical Results

In this section, we examine the effects of state-level and firm-level Economic Policy Uncertainty (EPU) on non-bank firms and banks, and link firm financial behavior to commercial banks through geographic connections to study the mediating role of firms in the transmission of EPU to banks. The main findings are as follows. For non-bank firms, higher firm-level and state-level EPU reduce corporate investment, increase cash holdings, and decrease loan borrowings. For banks, increases in firm-level and state-level EPU are associated with higher deposit inflows, a reduction in uninsured large time deposits, and an increase in more liquid deposit types. Commercial banks also reduce lending and increase their holdings of liquid assets, such as various types of bonds. Firm investment and cash holdings are found to exert a mediating effect in this transmission mechanism. In addition, we examine heterogeneity in the estimated effects across different dimensions. Specifically, we explore how the impact of economic policy uncertainty varies across states, across banks with different characteristics, and across industries.

5.1 State-Level Economic Policy Uncertainty

Using the state-level EPU index of Baker et al. (2022), constructed from flagship state newspapers across the U.S., we capture both regulatory uncertainty originating from state agencies and the local implications of national policy changes. This spatial granularity allows for a nuanced analysis of state-specific exposure. The heterogeneity becomes especially salient during nationwide shocks such as the COVID-19 pandemic, when states with stricter lockdown measures experienced sharper increases in policy uncertainty and unemployment. In these regions, households tend to deplete deposits and firms cut investment, weakening local banks' funding base and loan demand while increasing precautionary demand for liquid assets.

5.1.1 Effects on Banks: Baseline Results

Table 5: Impact of State-Level Policy Uncertainty on Banks

	(1) log_deposits	(2) log_loans	(3) log_liquidity
log_epu_state	**0.0108*****	**-0.0117*****	**0.0151*****
	(0.001)	(0.001)	(0.002)
log_personal_inc	-0.3969***	1.1030***	-0.5594***
	(0.056)	(0.065)	(0.035)
HHI	-0.1086***	-0.0549***	-0.0722***
	(0.006)	(0.007)	(0.007)
log_assets	1.0197***	0.8854***	1.1237***
	(0.004)	(0.005)	(0.003)
yield	0.0022***	0.0416***	-0.0551***
	(0.001)	(0.001)	(0.001)
log_total_numbranch	0.0685***	0.0429***	0.0107***
	(0.001)	(0.001)	(0.001)
log_numemployees	-0.0829***	0.0980***	-0.0942***
	(0.004)	(0.005)	(0.003)
log_popu	0.4058***	-1.1912***	0.5576***
	(0.060)	(0.070)	(0.037)
Bank F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
Observations	808,311	805,323	797,685
Adj. R-squared	0.926	0.908	0.828
Sargan Test (p-val)	0.543	0.477	0.438

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. The reported p-values for the Sargan test correspond to the null hypothesis that all overidentifying restrictions are valid—that is, the instruments are uncorrelated with the error term. A high p-value suggests no evidence against the validity of the instruments, whereas a low p-value indicates potential concerns about instrument exogeneity.

Table 5 presents the results of the IV-GMM estimation examining how state-level economic policy uncertainty (EPU) affects key dimensions of bank balance sheet behavior. The three dependent variables analyzed include log bank deposits, log total loans, and log liquidity holdings. The regressions control for a comprehensive set of bank- and region-level characteristics and include both bank and year fixed effects.

The results suggest that rising state-level EPU exerts a statistically and economically significant impact on commercial bank operations. A one percent increase in the log of state-level EPU is associated with a 0.0108 increase in log deposits, significant at the 1% level. This positive relationship is consistent with a flight-to-safety mechanism: during uncertain times, households and firms reallocate funds into insured bank deposits as a precautionary response. As a result, banks experience increased deposit inflows, strengthening their liability base.

In contrast, column (2) reveals that loan supply is negatively affected by policy uncertainty. The coefficient on log_epu_state is -0.0117, suggesting that higher uncertainty dampens banks' willingness to extend credit. This result supports the interpretation that banks become more cautious in originating new loans when policy outlooks are volatile or ambiguous. This behavior could be driven by increased borrower risk, stricter underwriting standards, or precautionary capital preservation motives.

Column (3) shows a strong positive effect of policy uncertainty on banks' liquidity holdings, with a coefficient of 0.0151. Banks respond to perceived macroeconomic or regulatory risk by increasing their buffer of highly liquid assets, such as government securities or cash equivalents. This reallocation allows banks to maintain flexibility under stress and reduce exposure to maturity transformation risks.

Overall, these findings underscore that uncertainty at the state level reshapes bank balance sheets. Banks not only reduce risky lending activity but also strengthen their liquid asset positions, thereby engaging in a defensive financial decision. This adjustment can have aggregate implications, including reduced credit availability for firms and consumers and a shift in the maturity and risk structure of financial intermediation.

5.1.2 Effects on Banks' Deposit

This paper decomposes banks' deposit liability structures to identify run-prone components. Periods of heightened economic policy uncertainty (EPU) are associated with an overall increase in total deposits, but this masks a significant compositional shift: funds migrate away from illiquid time deposits toward liquid, more withdrawal-prone forms such as demand and savings deposits. This reallocation shortens the average maturity of bank liabilities, elevates liquidity risk, and increases susceptibility to destabilizing outflows.

Table 6 reports the effects of state-level economic policy uncertainty on the structure of bank deposits. The empirical findings indicate a significant shift in depositor behavior in response to rising uncertainty. Specifically, transaction, savings, and demand deposits exhibit a positive and statistically significant association with state-level EPU. This implies that households and businesses tend to move funds into more liquid and easily accessible deposit types during uncertain times, reflecting elevated precautionary motives and stronger liquidity preferences.

Small time deposits—defined as individual certificates of deposit with face values below the regulatory

Table 6: Effects of State-Level EPU on Deposit Composition

	(1) log_trans_demand_save	(2) log_timedep_small	(3) log_timedep_large
log_epu_state	**0.0020****	**0.0095*****	**-0.0190*****
	(0.001)	(0.002)	(0.002)
log_personal_inc	0.3508***	2.2456***	-1.0471***
	(0.085)	(0.151)	(0.174)
HHI	-0.0204***	-0.0914***	-0.0730***
	(0.006)	(0.011)	(0.013)
log_assets	0.8281***	0.8408***	1.0557***
	(0.002)	(0.004)	(0.004)
yield	-0.0119***	0.0120***	0.0186***
	(0.000)	(0.001)	(0.001)
log_total_numbranch	0.0349***	0.0888***	-0.0542***
	(0.001)	(0.002)	(0.002)
log_numemployees	0.1089***	0.0689***	-0.0288***
	(0.002)	(0.003)	(0.004)
log_popu	-0.3751***	-2.5122***	1.1559***
	(0.092)	(0.164)	(0.188)
Bank F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
Observations	806,127	800,136	801,482
Adj. R-squared	0.698	0.360	0.387
Sargan Test (p-val)	0.129	0.327	0.188

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

"large deposit" threshold ($100,000 prior to 2010, increased to $250,000 thereafter)—also tend to rise in periods of heightened uncertainty. While these instruments are technically less liquid than checking accounts, they remain well within the FDIC insurance limit, making them relatively safe from a depositor's perspective. In uncertain times, households and smaller investors may favor such deposits to preserve modest returns while maintaining confidence in both their accessibility and the security of principal.

In contrast, large time deposits—those meeting or exceeding the regulatory threshold ($100,000 prior to 2010 and $250,000 thereafter)—decline sharply as policy uncertainty rises. This pattern suggests a form of disintermediation among high-net-worth individuals and institutional clients who are more likely to withdraw uninsured funds to reduce exposure to potential losses. Since any amount above the FDIC coverage cap is vulnerable to default risk, such withdrawals become more pronounced during periods of regulatory or political instability, when perceived risks to bank solvency intensify.

These findings highlight a dual mechanism at play: while banks attract more deposits in aggregate, particularly in liquid forms, they also accumulate liabilities that are more sensitive to shifts in depositor sentiment. In the presence of regionally concentrated policy shocks, this dynamic may increase the banking system's exposure to withdrawal runs or liquidity shortfalls, raising concerns about financial stability under decentralized uncertainty shocks.

Taken together, the results provide further evidence that state-level policy uncertainty reshapes not only the aggregate volume of bank funding but also the composition and fragility of liabilities. In subsequent sections, we examine how this liability-side adjustment interacts with asset-side responses to produce systemic balance sheet shifts in the banking sector.

5.1.3 Effects on Banks' Loans and Liquidity Allocation

This result investigates how banks adjust their loan supply and liquidity holdings in response to elevated state-level economic policy uncertainty (EPU). Table 7 reports IV-GMM estimation results, using log-transformed outcomes related to loan issuance and liquid asset holdings as dependent variables.

The regression results suggest that banks engage in substantial balance sheet reallocation in response to rising state-level economic policy uncertainty. Specifically, higher uncertainty leads to a significant contraction in loan issuance. Columns (1) and (2) show that both average commercial and real estate loan balances decline as the state EPU index rises. These results support the hypothesis that uncertainty discourages risk-taking, prompting banks to pull back on credit supply, particularly to commercial borrowers and small businesses that are more vulnerable to cyclical risk.

At the same time, banks appear to strengthen their liquidity positions. As shown in columns (3) and (4), there is a statistically significant increase in both cash holdings and security investments. The rise in cash is likely driven by higher reserve balances held at the Federal Reserve, which serve as precautionary buffers to mitigate funding shocks. Additionally, banks expand their holdings of liquid and low-risk securities, such as U.S. Treasuries and agency bonds. This shift in asset composition reflects a broader strategy of "de-risking," whereby banks reduce exposure to credit risk and reallocate toward safer, more marketable assets.

Table 7: Effect of State-Level EPU on Loans and Liquidity Allocation

	(1)	(2)	(3)	(4)
	log_qavgciloans	log_qavgreloans	log_cash	log_securities
log_epu_state	**-0.0161*****	**-0.0158*****	**0.0082*****	**0.0111*****
	(0.006)	(0.002)	(0.002)	(0.002)
log_personal_inc	0.1151***	-0.0750***	0.0698***	-0.2039***
	(0.011)	(0.006)	(0.009)	(0.010)
HHI	-0.0746***	-0.1764***	-0.0203	0.1563***
	(0.018)	(0.010)	(0.014)	(0.015)
log_assets	0.8782***	0.9688***	0.6867***	1.0866***
	(0.004)	(0.002)	(0.003)	(0.003)
yield	-0.0040***	0.0151***	0.0163***	-0.0140***
	(0.001)	(0.000)	(0.001)	(0.001)
log_total_numbranch	0.0238***	0.0676***	0.0251***	0.0515***
	(0.003)	(0.002)	(0.003)	(0.003)
log_numemployees	0.2047***	0.0565***	0.0811***	-0.2189***
	(0.004)	(0.002)	(0.003)	(0.004)
log_popu	-0.0356***	0.1796***	-0.0638***	0.0708***
	(0.012)	(0.006)	(0.010)	(0.011)
Bank Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	562,624	595,316	808,054	785,282
Adjusted R^2	0.283	0.587	0.200	0.243
Sargan Test (p-value)	0.839	0.986	0.883	0.882

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

Overall, the results reveal a clear pattern of asset-side risk management under uncertainty. By contracting loan supply and expanding liquid asset holdings, banks adopt a more defensive stance to preserve capital and ensure short-term liquidity. This behavior, while prudent from an individual institution's standpoint, may collectively suppress credit availability and amplify the real effects of uncertainty shocks. Therefore, macroprudential policy frameworks should account for such dynamics, and efforts to improve regulatory clarity and economic outlook could help mitigate excessive credit retrenchment during uncertain periods.

5.1.4 Effects on Maturity Structure

Table 8: Effects of State-Level EPU on Balance Sheet Maturity Structure

	(1) depyears	(2) loanyears	(3) liabilityyears	(4) assetyears
log_epu_state	**-0.0031*****	**0.0932*****	**-0.0028*****	**0.0352*****
	(0.000)	(0.003)	(0.000)	(0.002)
log_numemployees	0.0543***	-0.9193***	0.0752***	0.0601***
log_personal_inc	-0.0024	-0.2316*	0.0064	0.2709***
HHI	-0.0075***	0.0378*	-0.0049*	0.0366**
log_assets	-0.0289***	0.5438***	-0.0394***	-0.0753***
yield	0.0030***	-0.0046**	0.0032***	0.0054***
loan_to_dep	0.0417***	-0.2073***	0.0317***	0.0657***
liquidity_to_assets	0.0197***	-0.2657***	0.0097	0.3621***
log_total_numbranch	-0.0209***	0.2671***	-0.0278***	0.0078***
log_popu	0.0019	0.2609**	-0.0078	-0.2782***
L.depyears	0.8976***			
L.loanyears		0.9353***		
L.liabilityyears			0.8937***	
L.assetyears				0.9266***
Bank F.E.	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes
Observations	673,964	680,761	684,249	684,205
Adj. R-squared	0.819	0.889	0.811	0.882
Sargan Test (p-val)	0.109	0.000	0.123	0.250

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

To investigate how regional economic policy uncertainty shapes the maturity structure of commercial bank balance sheets, this subsection estimates an IV-GMM specification with lagged dependent variables and bank and year fixed effects. The dependent variables include average maturity of deposits, loans, total liabilities, and total assets (denoted respectively as `depyears`, `loanyears`, `liabilityyears`, and `assetyears`).

On the asset side, the erosion of stable funding prompts banks to reduce business lending and reallocate resources toward highly liquid instruments—such as excess reserves, trading securities, and agency mortgage-backed securities (MBS). These assets carry lower credit risk and offer greater flexibility in managing potential deposit outflows. However, in the process, the maturity of bank liabilities declines more sharply than that of their assets, thereby creating a duration mismatch. This structural shift weakens the traditional maturity transformation function of banks and heightens their vulnerability to runs, particularly when uninsured depositors, facing heightened uncertainty or rising interest rates, choose to withdraw funds. To mitigate these risks, banks increase their holdings of liquid assets for both transactional and precautionary purposes, a tendency that is especially pronounced when their funding base is dominated by demand deposits.

As shown in Table 8, rising state-level EPU significantly shortens liability-side maturities while lengthening asset-side maturities—exacerbating the maturity mismatch on bank balance sheets. Specifically, a 1% increase in log_epu_state leads to a 0.0031-year reduction in deposit maturity and a 0.0028-year decline in overall liability maturity, both statistically significant at the 1% level. These results suggest that under uncertainty, banks prefer to issue shorter-term or on-demand liabilities, likely as a way to maintain funding flexibility and reduce rollover risk.

In contrast, the coefficients on loan and asset maturities are both positive and significant. Higher uncertainty is associated with a 0.0932-year increase in the average maturity of loans and a 0.0352-year increase in total asset maturity. This suggests a reallocation of bank capital into longer-term investments, such as mortgage loans or long-duration securities, which are often considered safer in credit quality but less liquid.

This divergence in liability and asset maturity adjustments results in an amplified maturity mismatch. While banks protect against liquidity shocks on the funding side, their allocation toward longer-duration assets exposes them to potential interest rate or rollover risks if uncertainty persists. Such a mismatch may undermine balance sheet resilience during prolonged economic shocks or tightening monetary cycles.

Control variables align with theoretical expectations. Banks with higher loan-to-deposit ratios and larger size tend to exhibit longer loan and asset maturities. Institutions with greater liquidity-to-asset ratios appear more inclined toward long-duration investments. Lagged dependent variables confirm strong persistence in maturity structures, justifying the use of dynamic panel estimation.

These findings contribute to a growing literature on the role of uncertainty in shaping financial intermediation risks. Unlike traditional credit contraction mechanisms, the adjustment here operates through the term structure of balance sheets. This structural fragility—long assets funded by short liabilities—raises new concerns for financial regulators and policymakers seeking to safeguard bank liquidity and systemic stability under decentralized policy uncertainty.

5.1.5 Effects on Non-Financial Firms

Table 9: Impact of State-Level EPU on Non-Financial Firms

	(1)	(2)	(3)
	log_investment	log_debt	log_cash
log_epu_state	**-0.0074***	**-0.0131***	**0.0192***
	(0.001)	(0.002)	(0.001)
firm_size	0.4955***	0.8111***	0.7656***
	(0.003)	(0.004)	(0.002)
roa	0.2027***	-0.3475***	0.2094***
	(0.011)	(0.018)	(0.010)
dividends_ratio	0.0016***	0.0004	-0.0025***
	(0.001)	(0.001)	(0.001)
debt_assets	0.0583***	0.4671***	-0.0059
	(0.006)	(0.010)	(0.006)
cash_ratio	-0.2125***	-2.2631***	3.8796***
	(0.016)	(0.025)	(0.015)
debt_maturity	0.1338***	1.4518***	-0.2290***
	(0.014)	(0.022)	(0.013)
tobins_q	0.0081***	0.0142***	0.0012***
	(0.000)	(0.000)	(0.000)
log_emp	0.6130***	0.2107***	0.2388***
	(0.005)	(0.008)	(0.004)
Industry F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
Observations	72,697	72,697	72,803
Adj. R^2	0.791	0.741	0.842
Sargan Test (p)	0.547	0.164	0.209

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

To understand how firms respond to rising economic policy uncertainty, this subsection develops a mediation framework that centers on corporate balance sheet behaviors.

Table 9 presents strong evidence that economic policy uncertainty leads to defensive restructuring of corporate balance sheets. On the investment margin, a 1% increase in log_epu_state reduces capital investment by 0.0736 log points, statistically significant at the 1% level. This implies that firms tend to delay or scale back expansion plans in the face of heightened uncertainty.

On the financing side, debt issuance declines even more sharply, with a coefficient of –0.1312. This suggests that firms not only face greater external financing frictions under uncertainty, but may also voluntarily choose to deleverage to mitigate future rollover risk. Reduced leverage helps preserve flexibility, especially when credit markets tighten or policy ambiguity makes cost-of-capital estimates unreliable.

In contrast, the cash channel exhibits a markedly different pattern. The coefficient on cash holdings is +0.1921, also highly significant, indicating that firms actively accumulate liquidity reserves when uncertainty rises. This behavior aligns with the "precautionary liquidity" hypothesis—where firms stockpile cash to buffer against potential adverse shocks to demand, supply chains, or credit access.

5.1.6 Corporate Cash Holdings as a Mediating Channel

To examine how firm-side behavior mediates the effects of economic policy uncertainty on the banking sector, I build a mediation model centered on corporate liquidity management. In particular, the analysis focuses on the role of firm-level cash holdings in moderating the transmission of state-level economic policy uncertainty to key bank outcomes, including deposits, net lending, and liquid asset holdings. The main explanatory variable is the interaction between the average firm-level cash holdings ratio and policy uncertainty ($cash\_equivalents\_ratio\_firm \times log\_epu\_state$), with results reported in Table 10.

The baseline effects of *log_ epu_ state* remain consistent with earlier findings: rising uncertainty significantly increases bank deposits (coefficient = 0.0042, $p < 0.1$), reduces net loans (–0.0168, $p < 0.01$), and raises bank liquidity (+0.0242, $p < 0.01$). However, when the interaction term is introduced, clear heterogeneous transmission patterns emerge.

Specifically, the coefficient on the interaction term in the deposits regression is negative (–0.0005, $p < 0.01$), indicating that the marginal impact of policy uncertainty on deposit inflows diminishes when firms hold more cash. This suggests that precautionary saving motives at the firm level can substitute for household or business deposits during periods of heightened uncertainty.

In the liquidity regression, the positive coefficient on the interaction term (+0.0006, $p < 0.01$) implies that firms' elevated cash holdings prompt banks to adopt more defensive liquidity positions, consistent with a precautionary alignment across the financial system. In contrast, the net loans regression yields a negative interaction effect (–0.0007, $p < 0.05$), implying that cash-rich firms borrow less during uncertain periods, indirectly contributing to a contraction in credit supply from banks.

Moreover, the firm-level cash holdings ratio independently influences all three banking outcomes. Higher cash reserves are associated with increased deposits and liquidity, but lower net lending, underscoring the broader influence of corporate financial decisions on bank balance sheet dynamics.

These results provide compelling evidence of a "firm-to-bank" transmission mechanism. As firms respond to uncertainty by increasing cash buffers and curbing external financing, they alter banks' funding composition, asset allocation, and lending behavior. The mediation mechanism not only strengthens the micro-foundation for understanding how uncertainty propagates across sectors but also highlights corporate liquidity management as a critical channel through which macro-financial vulnerabilities are amplified.

Table 10: Mediating Effects of Corporate Cash Holdings on Bank Outcomes

	(1) log_deposits	(2) log_loansnet	(3) log_liquidity
log_epu_state	**0.0042***	**-0.0168*****	**0.0242*****
	(0.002)	(0.002)	(0.005)
cash_equivalents_ratio_firm	**0.0024****	**-0.0017****	**0.0023***
	(0.001)	(0.001)	(0.001)
cash×log_epu_state	**-0.0005*****	**0.0006*****	**-0.0007****
	(0.000)	(0.000)	(0.000)
log_personal_inc	0.7812	0.0121***	-0.1155***
	(0.523)	(0.004)	(0.007)
HHI	0.3930	-0.8116***	3.2025***
	(0.588)	(0.092)	(0.170)
log_assets	1.0094***	0.9854***	1.0428***
	(0.012)	(0.001)	(0.002)
yield	0.0018***	0.0088***	-0.0071***
	(0.000)	(0.000)	(0.001)
log_total_numbranch	0.0046***	-0.0022**	-0.0166***
	(0.001)	(0.001)	(0.002)
log_numemployees	-0.0118	0.1054***	-0.1430***
	(0.009)	(0.001)	(0.002)
log_popu	-0.8353	-0.0032	0.1332***
	(0.547)	(0.004)	(0.008)
Bank F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
Observations	808,192	805,203	807,850
Adj. R^2	0.838	0.777	0.392
Sargan p-value	0.484	0.656	0.499

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

5.1.7 Firm Investment as a Mediating Channel

This result investigates how firm investment behavior mediates the transmission of economic policy uncertainty to the banking sector. To formalize this mechanism, I construct a mediation model incorporating firm-level net investment rates (*net_inv*) and its interaction with state-level policy uncertainty (*log_epu_state*). The empirical specification includes three bank-level outcomes—deposits, net loans, and liquidity—as dependent variables. Table 11 presents the IV-GMM regression results.

The baseline results confirm the direct impact of policy uncertainty on bank behavior. Rising *log_epu_state* significantly increases deposits (coefficient = 0.0265, $p < 0.01$), reduces net lending (–0.0697, $p < 0.05$), and increases bank liquidity (+0.1155, $p < 0.05$). These effects are consistent with banks adopting a precautionary stance during periods of heightened macroeconomic uncertainty.

In parallel, firm-level net investment exerts significant influence on banking outcomes. Higher investment is associated with increased deposits (+0.0013, $p < 0.01$), greater loan provision (+0.0028, $p < 0.05$), and reduced liquidity buffers (–0.0044, $p < 0.1$), suggesting that banks actively support corporate expansion through credit supply and balance sheet adjustments.

However, the introduction of the interaction term *net_inv* × *log_epu_state* reveals a dampening effect. The coefficients are negative and statistically significant across all three outcomes: –0.0003 for deposits, –0.0006 for loans, and –0.0010 for liquidity. These results indicate that under high uncertainty, the otherwise expansionary effect of firm investment on bank behavior is significantly weakened. In other words, uncertainty not only reduces investment appetite directly but also constrains the capacity of investment to influence banks' deposit intake, lending activity, and liquidity posture.

This mechanism highlights a second, investment-based channel in the broader "firm-to-bank" transmission framework. When firms delay capital expenditures under uncertainty, banks respond by tightening credit, holding more liquid assets, and reducing exposure to investment-driven balance sheet expansion. This complements the earlier findings on the cash holdings channel, together forming a coherent narrative about how firm behavior under uncertainty shapes the dynamics of bank asset allocation and risk management.

5.1.8 Regional Heterogeneity in the Transmission of State-level to Banks

To further investigate whether the transmission effects of economic policy uncertainty vary across regions, I divide the sample based on the level of state-level EPU into two subsamples: high-uncertainty states and low-uncertainty states. Separate IV-GMM estimations are then conducted for each group to evaluate the impact of policy uncertainty on three key aspects of bank behavior—deposits, credit supply, and liquidity allocation. Table 12 reports the regression results.

The estimation reveals substantial regional heterogeneity in the transmission mechanism of policy uncertainty.

First, regarding deposit behavior, banks in high-uncertainty states experience a significantly stronger inflow of deposits in response to rising EPU (coefficient = 0.0264, $p < 0.01$), compared to a much smaller but still significant effect in low-uncertainty states (0.0055, $p < 0.01$). This suggests a more pronounced

Table 11: Firm Investment and the Transmission of Policy Uncertainty to Bank Balance Sheets

	(1) log_deposits	(2) log_loansnet	(3) log_liquidity
log_epu_state	**0.0265*****	**-0.0697****	**0.1155****
	(0.003)	(0.031)	(0.056)
net_inv	**0.0013*****	**0.0028****	**0.0044***
	(0.000)	(0.001)	(0.002)
net_inv × log_epu_state	**-0.0003*****	**-0.0006****	**-0.0010***
	(0.000)	(0.000)	(0.001)
log_personal_inc	-0.5960*	0.9856*	-2.4107**
	(0.360)	(0.573)	(1.038)
HHI	-0.9857	0.4917	0.4100
	(0.641)	(0.686)	(1.251)
log_assets	1.0409***	0.9648***	1.0922***
	(0.031)	(0.014)	(0.024)
yield	-0.0007	0.0154***	-0.0187***
	(0.003)	(0.003)	(0.006)
log_total_numbranch	0.0578***	-0.0058***	-0.0096**
	(0.009)	(0.002)	(0.004)
log_numemployees	-0.0845***	0.1208***	-0.1798***
	(0.014)	(0.010)	(0.018)
log_popu	0.5814	-1.0156*	2.5295**
	(0.360)	(0.599)	(1.085)
Bank Controls	Yes	Yes	Yes
Market Controls	Yes	Yes	Yes
Bank F.E.	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes
Observations	811,231	808,226	810,888
Adj. R^2	0.916	0.743	0.342
Sargan p-value	0.788	0.861	0.763

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

"flight-to-safety" response among households and firms in high-uncertainty regions, where risk-averse agents increasingly allocate resources to the banking system during turbulent times.

Second, bank lending contracts more sharply in high-uncertainty states. The coefficient on *log_ epu_ state* is –0.0187 (significant at the 1% level), compared to –0.0077 in low-uncertainty states. This implies that banks operating in more uncertain environments adopt a more conservative credit policy, either due to rising borrower risk or internal precautionary constraints.

Third, banks in high-uncertainty states significantly increase their holdings of liquid assets in response to policy uncertainty shocks (coefficient = 0.0391, $p < 0.01$), more than three times the effect observed in low-uncertainty states (0.0122, $p < 0.01$). This pattern underscores banks' preference for liquidity and their efforts to buffer against potential liquidity shortfalls during uncertain periods.

Taken together, these results suggest that banks located in regions with higher political and regulatory uncertainty react more defensively to EPU shocks. They do so by increasing liquidity buffers, curbing loan growth, and absorbing greater inflows of precautionary deposits. These findings highlight the importance of accounting for regional heterogeneity when designing macroprudential policies. In particular, banking institutions in high-uncertainty states may require closer supervision with respect to liquidity risk management and credit allocation capacity, given their amplified sensitivity to policy-induced shocks.

Table 12: Regional Heterogeneity: IV-GMM Estimates by State-Level Policy Uncertainty

	High-Uncertainty States			**Low-Uncertainty States**		
	(1) log_deposits	(2) log_loans	(3) log_liquidity	(4) log_deposits	(5) log_loans	(6) log_liquidity
textbflog_epu_state	**0.0264*****	**-0.0187*****	**0.0391*****	**0.0055*****	**-0.0077*****	**0.0122*****
	(0.003)	(0.004)	(0.005)	(0.002)	(0.002)	(0.003)
log_personal_inc	-0.3519*	0.3722	0.2996**	-1.0197***	1.2474***	-1.3480**
	(0.213)	(0.235)	(0.149)	(0.316)	(0.366)	(0.584)
HHI	-0.1176***	-0.1737***	-0.0632***	-0.0462***	-0.0903***	0.0617***
	(0.020)	(0.022)	(0.019)	(0.004)	(0.005)	(0.008)
log_assets	0.9341***	0.9083***	1.0524***	1.0765***	0.8970***	1.1507***
	(0.013)	(0.016)	(0.010)	(0.017)	(0.021)	(0.031)
yield	0.0037	0.0675***	-0.0769***	0.0053***	0.0396***	-0.0605***
	(0.003)	(0.003)	(0.003)	(0.001)	(0.001)	(0.002)
log_total_numbranch	0.1270***	0.0791***	0.0152**	0.1015***	0.0337***	0.0117***
	(0.009)	(0.010)	(0.007)	(0.001)	(0.001)	(0.002)
log_numemployees	-0.0390***	0.0761***	-0.0381***	-0.1606***	0.1072***	-0.1476***
	(0.005)	(0.007)	(0.005)	(0.014)	(0.018)	(0.026)
log_popu	0.3556	-0.3681	-0.4041**	1.0900***	-1.3286***	1.3845**
	(0.227)	(0.250)	(0.159)	(0.342)	(0.396)	(0.632)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	164,202	163,010	164,009	644,109	642,313	643,960
Adj. R^2	0.887	0.892	0.818	0.937	0.923	0.810
Sargan p-value	0.888	0.412	0.180	0.544	0.311	0.773

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

5.1.9 Bank Heterogeneity

To explore how balance sheet conditions shape banks' behavioral responses to economic policy uncertainty, I divide the sample into two groups based on bank-level leverage: high-leverage banks and low-leverage banks. Separate IV-GMM regressions are conducted to assess how policy uncertainty influences bank deposits, loan supply, and liquidity asset holdings in each group. The estimation results are presented in Table 13.

The findings reveal substantial heterogeneity in balance sheet responses depending on bank leverage.

In the high-leverage group (Columns 1–3), policy uncertainty exerts a small but significant positive effect on deposit growth (coefficient = 0.0029, $p < 0.01$) and a negative effect on lending (–0.0097, $p < 0.01$), while the impact on liquidity assets is statistically insignificant. These results suggest that high-leverage banks respond to heightened uncertainty primarily through adjustments on the liability side of the balance sheet—by absorbing more deposits and contracting credit—but have limited flexibility on the asset side. This likely reflects capital constraints and refinancing frictions, which limit their ability to proactively reallocate portfolios toward liquid assets.

In contrast, low-leverage banks exhibit a more balanced and aggressive adjustment strategy. As shown in Columns 4–6, the coefficient on *log_ epu_ state* is 0.0123 for deposits, –0.0145 for loans, and 0.0196 for liquid assets, all significant at the 1% level. This indicates that low-leverage banks not only attract precautionary deposits and reduce credit exposure but also actively boost their liquidity buffers. Their stronger capital position enables them to deploy multidimensional strategies to mitigate the impact of policy uncertainty shocks.

Overall, leverage appears to play a moderating role in the firm-to-bank transmission mechanism. High-leverage banks, constrained by thinner capital cushions, exhibit a narrow defensive response concentrated on the liability side. In contrast, low-leverage banks behave more flexibly and adopt comprehensive risk management strategies that span both sides of the balance sheet. These findings highlight the importance of incorporating bank-specific balance sheet conditions—particularly leverage—into the design of targeted macroprudential tools and crisis policy responses.

5.2 Firm-Level Economic Policy Uncertainty

5.2.1 Effects on Non-Financial Firms

This subsection presents the IV-GMM regression results that estimate the impact of firm-level policy uncertainty on corporate financial decisions. Table 14 reports coefficient estimates for four dependent variables: investment, debt, cash holdings, and leverage.

When firm-level economic policy uncertainty rises, firms tend to cut back on investment out of precautionary motives. Column (1) shows that policy uncertainty has a significantly negative effect on corporate investment, with a coefficient of –0.2191. This finding suggests that as uncertainty increases, firms become more risk-averse and reluctant to undertake irreversible, long-term investment projects. In parallel, column (2) reports a negative coefficient of –0.1051 for debt issuance, indicating that firms also scale back borrowing

Table 13: Heterogeneous Effects of Policy Uncertainty by Bank Leverage

	High-Leverage Banks			**Low-Leverage Banks**		
	(1) log_deposits	(2) log_loans	(3) log_liquidity	(4) log_deposits	(5) log_loans	(6) log_liquidity
log_epu_state	**0.0029*** **	**-0.0097*** **	**0.0009**	**0.0123*** **	**-0.0145*** **	**0.0196*** **
	(0.001)	(0.002)	(0.003)	(0.001)	(0.001)	(0.003)
log_personal_inc	0.2712*	0.7059***	-0.5278	-0.3997***	1.1991***	6.5472***
	(0.138)	(0.241)	(0.431)	(0.055)	(0.060)	(0.656)
HHI	0.0363**	-0.0393	0.0070	-0.1173***	-0.0608***	0.3256***
	(0.018)	(0.031)	(0.057)	(0.006)	(0.006)	(0.028)
log_assets	0.9178***	0.9092***	1.2014***	1.0321***	0.8856***	0.9010***
	(0.014)	(0.025)	(0.043)	(0.004)	(0.005)	(0.014)
yield	0.0071***	0.0359***	-0.0598***	0.0037***	0.0426***	-0.0011
	(0.001)	(0.002)	(0.004)	(0.001)	(0.001)	(0.001)
log_total_numbranch	0.0332***	0.0272***	0.0065***	0.0768***	0.0476***	0.0074*
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.004)
log_numemployees	0.0232*	0.0803***	-0.1619***	-0.0972***	0.0970***	-0.0246**
	(0.013)	(0.024)	(0.041)	(0.003)	(0.004)	(0.012)
log_popu	-0.2884*	-0.7687***	0.5528	0.3999***	-1.2935***	-7.1658***
	(0.148)	(0.258)	(0.462)	(0.059)	(0.065)	(0.709)
Bank F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Observations	202,695	202,354	202,636	605,616	602,969	596,251
Adj. R^2	0.979	0.942	0.855	0.911	0.898	–0.462
Sargan p-value	0.035	0.508	0.878	0.460	0.482	0.524

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

Table 14: Impact of Firm-Level Economic Policy Uncertainty on Non-Financial Firms

	(1) log_investment	(2) log_debt	(3) log_cash	(4) log_leverage
log_policy_uncertainty_ratio	**-0.2191*** **	**-0.1051*** **	**0.3794*** **	**0.2112*** **
	(0.029)	(0.016)	(0.026)	(0.042)
firm_size	0.4990***	0.8100***	0.7524***	0.0105***
	(0.003)	(0.004)	(0.003)	(0.004)
roa	0.2239***	-0.3369***	0.1908***	-0.1991***
	(0.011)	(0.017)	(0.010)	(0.016)
dividends_ratio	0.0020***	0.0005	-0.0027***	0.0009
	(0.001)	(0.001)	(0.001)	(0.001)
cash_ratio	-0.2426***	-2.1692***	3.8367***	-2.4011***
	(0.016)	(0.023)	(0.014)	(0.022)
debt_assets	0.0721***	0.5071***	-0.0136**	0.4889***
	(0.006)	(0.009)	(0.006)	(0.009)
debt_maturity	0.1419***	1.4508***	-0.2169***	1.2742***
	(0.014)	(0.020)	(0.012)	(0.019)
tobins_q	0.0060***	0.0104***	0.0011***	0.0182***
	(0.000)	(0.000)	(0.000)	(0.000)
log_emp	0.6215***	0.2186***	0.2261***	0.0199***
	(0.005)	(0.007)	(0.004)	(0.007)
Industry Fixed Effects	YES	YES	YES	YES
Year Fixed Effects	YES	YES	YES	YES
Observations	81,217	81,217	81,217	80,918
Adjusted R-squared	0.787	0.749	0.840	0.309
Sargan Test (p-value)	0.330	0.469	0.759	0.576

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

under uncertain policy environments, likely reflecting a desire to avoid the fixed obligations.

Interestingly, column (3) reveals that policy uncertainty has a strong positive effect on cash holdings, with a coefficient of 0.3794. This result underscores a precautionary liquidity motive: in the face of heightened uncertainty, firms accumulate cash buffers to protect against potential disruptions in access to external capital markets. Despite the decline in new debt issuance, column (4) shows that leverage increases in response to policy uncertainty, with a positive coefficient of 0.2112. One plausible explanation is that rising uncertainty depresses equity valuations, thereby mechanically increasing leverage ratios.

Taken together, the regression results suggest that firms respond to rising policy uncertainty by adopting a conservative financial strategy: cutting investment, reducing new debt issuance, and accumulating liquidity, while allowing leverage ratios to rise passively through capital structure effects rather than engaging in aggressive deleveraging. Finally, the p-values from the Sargan tests, reported at the bottom of the table, are all above conventional significance thresholds, indicating that the instrumental variables used in the IV-GMM estimation are valid. This supports the robustness of the estimated coefficients and enhances the credibility of the identification strategy.

5.2.2 Effects on Banks: Baseline Results

Table 15 reports the IV-GMM estimates assessing the impact of firm-level policy uncertainty on key components of bank balance sheets. Across all specifications, the coefficient on the log of the firm-perceived policy uncertainty ratio is statistically significant.

Column (1) shows a positive and significant association between policy uncertainty and bank deposits. The coefficient of 0.2197 suggests that deposit inflows into the banking sector increase notably during the high uncertainty period. This finding is consistent with a flight-to-safety dynamic, in which both households and firms reallocate financial resources into bank accounts to preserve liquidity during times of heightened uncertainty.

In column (2), the effect of policy uncertainty on net loan issuance is negative and statistically significant. The estimated coefficient of –0.0739 implies that banks scale back credit supply in response to elevated uncertainty. This likely reflects greater caution in lending decisions due to increased concerns about borrower creditworthiness and the macroeconomic outlook. Such a contraction in credit availability may dampen real economic activity, especially during prolonged periods of uncertainty.

Column (3) reveals a positive relationship between uncertainty and banks' liquidity ratio. The coefficient of 0.1526 indicates that banks respond to heightened uncertainty by increasing their holdings of liquid assets—such as cash reserves and short-term government securities—to bolster short-term financial flexibility. This pattern aligns with precautionary liquidity hoarding behavior, whereby institutions build buffers to mitigate potential funding disruptions or borrower defaults.

Finally, column (4) explores the relationship between policy uncertainty and bank leverage. The estimated coefficient of –0.3470 is highly significant, indicating that bank leverage decreases when uncertainty rises. This finding suggests that leverage in the banking sector is countercyclical with respect to policy

Table 15: Impact of Firm-Level Policy Uncertainty on Banks: Baseline Result

	(1) log_deposits	(2) log_loansnet	(3) log_liquidity	(4) log_lr_ugl
log_policy_uncertainty_ratio	**0.02197****	**-0.0739****	**0.1526****	**-0.3470*****
	(0.091)	(0.036)	(0.076)	(0.035)
log_assets	1.3097***	1.0217***	0.9216***	0.1736***
	(0.017)	(0.008)	(0.014)	(0.006)
log_total_numbranch	-0.0352	-0.0380***	0.1271***	-0.0185***
	(0.022)	(0.009)	(0.018)	(0.005)
log_numemployees	-0.3602***	0.0158**	-0.1344***	-0.0606***
	(0.019)	(0.008)	(0.016)	(0.006)
HHI	1.3576***	-0.3573***	0.0821	-0.8170***
	(0.184)	(0.070)	(0.153)	(0.058)
log_popu	-0.0854	-0.1128***	0.0892	-0.0726***
	(0.090)	(0.036)	(0.075)	(0.026)
log_personal_inc	0.2520***	0.0889***	-0.0942	-0.0401*
	(0.082)	(0.032)	(0.069)	(0.024)
r_depo	-0.1230***			
	(0.043)			
r_loan		-0.0247***		
		(0.006)		
yield			0.0462***	-0.0085
			(0.014)	(0.012)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	7,901	7,771	7,901	7,979
Adj. R-squared	0.469	0.785	0.411	0.116
Sargan Test (p-val)	0.498	0.695	0.171	0.937

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

uncertainty—banks strengthen their capital positions by either reducing liabilities or increasing equity in response to elevated risk.

5.2.3 Effects on Banks' Lendings

Table 16: Impact of Firm-Level EPU on Banks' Lendings

	(1) log_qavgciloans	(2) log_qavgreloans	(3) log_qavgpersccards	(4) log_security_cash
log_policy_uncertainty_ratio	**-1.2243*** **	**-1.0964*** **	**-1.0386*** **	**0.2190** **
	(0.204)	(0.170)	(0.333)	(0.096)
log_assets	0.3462***	1.0024***	0.9146***	0.8779***
	(0.034)	(0.033)	(0.065)	(0.018)
yield_1	-0.0109***	-0.0291***	-0.0078	0.0006
	(0.003)	(0.003)	(0.006)	(0.001)
log_total_numbranch	0.1214***	1.3727***	-0.1145**	0.0654***
	(0.028)	(0.027)	(0.053)	(0.023)
log_numemployees	1.0520***	-0.8101***	0.6329***	0.0712***
	(0.033)	(0.033)	(0.064)	(0.020)
HHI	-6.6889***	-3.2522***	5.6894***	-0.1269
	(0.326)	(0.321)	(0.618)	(0.192)
log_popu	-0.0543	-1.3524***	1.7029***	-0.3563***
	(0.147)	(0.109)	(0.217)	(0.095)
log_personal_inc	-0.1826	0.8778***	-1.8194***	0.1938**
	(0.135)	(0.101)	(0.202)	(0.086)
Bank F.E.	YES	YES	YES	YES
Year F.E.	YES	YES	YES	YES
Observations	7,864	7,741	7,077	7,894
Adj. R-squared	0.561	0.542	0.259	0.306
Sargan Test (p-val)	0.303	0.557	0.853	0.445

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

To further examine how economic policy uncertainty influences bank behavior, this analysis disaggregates the loan portfolio into specific categories—commercial and industrial loans, real estate loans, and personal credit card loans—while also evaluating changes in banks' liquid asset holdings. The results, presented in Table 16, reveal a consistent pattern: policy uncertainty suppresses lending activity across all loan types, while simultaneously encouraging a buildup of securities and cash holdings.

Column (1) shows that a 1% increase in the firm-perceived policy uncertainty index is associated with a 1.22% reduction in commercial and industrial loans. This indicates that banks become significantly more conservative in their business lending, likely due to rising concerns about firm solvency and broader credit risk under uncertain policy environments. Column (2) reports a similarly negative effect on real estate loans, with a coefficient of -1.10. Given the sensitivity of real estate markets to macroeconomic fluctuations, this result suggests that banks retreat from property-related credit during turbulent periods.

Column (3) highlights the impact on unsecured consumer credit, where policy uncertainty leads to a

1.04% decrease in personal credit card lending. This suggests heightened risk aversion among banks in extending credit to households, particularly in segments that lack collateral and are more susceptible to income volatility. These consistent declines across loan categories underscore that banks adopt a defensive posture when faced with rising policy uncertainty, cutting back on lending activity even in consumer-facing sectors.

In contrast, column (4) demonstrates that policy uncertainty significantly increases banks' holdings of liquid assets, such as securities and cash. A 1% increase in uncertainty results in a 0.22% rise in the log of securities and cash holdings. This shift reflects a precautionary portfolio reallocation strategy: instead of investing in illiquid or risky credit instruments, banks prioritize liquidity and capital preservation.

Overall, these findings highlight a clear behavioral pattern in bank balance sheet management under policy uncertainty. Banks respond by reducing exposure to riskier credit—both in business and consumer segments—and increasing holdings of safe, liquid assets. This "credit contraction–liquidity buildup" dynamic has meaningful implications for the real economy, particularly in periods of heightened uncertainty. In the next section, this transmission channel is connected to firm-level financing outcomes and investment behavior to further analyze the broader impact of uncertainty on financial intermediation and capital allocation.

5.2.4 Industry Heterogeneity

To explore cross-industry heterogeneity in corporate responses to economic policy uncertainty, we divide the full sample into manufacturing and non-manufacturing firms and estimate the effects separately. Table 17 presents the IV-GMM regression results for both groups, focusing on investment, debt financing, and cash holdings.

The results reveal notable heterogeneity in how firms adjust their financial behavior in response to elevated policy uncertainty. Among manufacturing firms, policy uncertainty leads to a substantial reduction in investment, with a coefficient of –0.382 (significant at the 1% level). Debt issuance also declines moderately (–0.081), while cash holdings rise considerably (+0.312). This pattern indicates a strong "defensive adjustment" strategy, where capital-intensive manufacturers respond to uncertainty by pulling back on fixed investment and financing, while simultaneously hoarding liquidity.

Non-manufacturing firms exhibit a similar directional response but with attenuated magnitudes. Investment falls by –0.180 and debt by –0.119, both statistically significant, while the increase in cash holdings is more modest at +0.107. Interestingly, these firms also show greater responsiveness in managing debt maturity and financial structure, suggesting they possess more flexibility to absorb uncertainty shocks through marginal financial reconfiguration, rather than large-scale balance sheet contraction.

These contrasting responses reflect deeper structural distinctions between sectors. Manufacturing firms are typically more capital-intensive, face longer production cycles, and suffer from greater irreversibility in investment decisions. Consequently, they are more exposed to policy shocks and more likely to delay or cancel investment plans in the face of uncertainty. Their precautionary motive is also stronger, prompting larger cash buffers. Non-manufacturing firms, often in service industries, tend to have more adaptable

Table 17: Industry Heterogeneity in Responses to Firm-level Policy Uncertainty

	Manufacturing Firms			Non-Manufacturing Firms		
	(1) log_investment	(2) log_debt	(3) log_cash	(4) log_investment	(5) log_debt	(6) log_cash
log_policy_uncertainty_ratio	**-0.3824*****	**-0.0813*****	**0.3121*****	**-0.1802*****	**-0.1188*****	**0.1068*****
	(0.033)	(0.021)	(0.035)	(0.052)	(0.024)	(0.014)
firm_size	0.6296***	0.7311***	0.7683***	0.3930***	0.8855***	0.7581***
	(0.003)	(0.005)	(0.004)	(0.005)	(0.006)	(0.003)
roa	-0.0308***	-0.3622***	0.2097***	0.3741***	-0.3088***	0.0594***
	(0.012)	(0.020)	(0.012)	(0.023)	(0.030)	(0.018)
dividends_ratio	0.0006	0.0011	-0.0019***	0.0119***	-0.0036	-0.0104***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.002)
cash_ratio	-0.6671***	-1.7998***	3.7175***	0.1969***	-2.4205***	4.1536***
	(0.017)	(0.029)	(0.017)	(0.032)	(0.043)	(0.025)
debt_assets	0.0037	0.3219***	-0.0032	0.2038***	1.9306***	-0.0520***
	(0.006)	(0.010)	(0.006)	(0.020)	(0.026)	(0.016)
debt_maturity	0.1328***	1.4663***	-0.1755***	0.1574***	1.2928***	-0.2640***
	(0.015)	(0.026)	(0.015)	(0.025)	(0.034)	(0.020)
tobins_q	0.0078***	0.0092***	0.0025***	0.0041***	0.0120***	-0.0006**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
log_emp	0.4490***	0.4324***	0.2138***	0.7281***	0.0232**	0.2268***
	(0.006)	(0.011)	(0.006)	(0.007)	(0.010)	(0.006)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	46,024	46,024	46,024	35,193	29,941	35,193
Adjusted R^2	0.857	0.757	0.854	0.700	0.768	0.830
Sargan Test (p-value)	0.409	0.223	0.321	0.243	0.569	0.475

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Sargan test p-values correspond to the null hypothesis that all overidentifying restrictions are valid (instruments uncorrelated with the error term). A higher p-value indicates no evidence against instrument validity.

operations and financing structures. Their strategic response involves managing leverage and minimizing financial fragility through cautious debt reduction rather than cash accumulation.

The observed heterogeneity carries several policy implications. Policymakers should recognize that uncertainty shocks do not affect all sectors uniformly. In particular, manufacturing may require targeted stabilization tools to preserve investment activity during volatile periods. More broadly, heightened uncertainty appears to shift firm balance sheet behavior toward liquidity hoarding and reduced financing, which may weaken aggregate credit demand and propagate uncertainty through financial channels. Enhancing policy transparency and reducing ambiguity in fiscal or regulatory outlooks could help anchor firm expectations and mitigate these macro-financial spillovers.

6 Event Study Specification

To trace the dynamic effects of policy uncertainty shocks on outcomes of interest, I adopt an event study specification following a distributed leads and lags framework. The estimating equation is:

$$y_{st} = \alpha + \sum_{j=2}^{J} \beta_j (\text{Lag } j)_{st} + \sum_{k=1}^{K} \gamma_k (\text{Lead } k)_{st} + \mu_s + \lambda_t + X'_{st}\Gamma + \epsilon_{st} \tag{8}$$

In this equation, y_{st} represents the outcome variable for state s at time t, such as bank deposits, loans, or liquidity. The coefficients β_j capture the effect of the policy uncertainty shock j periods after the event, while γ_k measure anticipatory effects k periods before the event. The model includes state fixed effects μ_s to absorb time-invariant unobserved heterogeneity across states and time fixed effects λ_t to control for aggregate shocks affecting all states simultaneously. The term $X'_{st}\Gamma$ denotes a vector of time-varying control variables such as economic fundamentals or demographics, and ϵ_{st} is the error term. This flexible framework allows me to visualize and test for both pre-trends and dynamic treatment effects in the periods surrounding the policy uncertainty shock.

I select the COVID-19 outbreak period as the representative event for our event study because it constitutes an exogenous, large-scale shock that generated unprecedented levels of economic policy uncertainty. At the national level, policymakers faced rapidly evolving public health challenges, supply chain disruptions, and macroeconomic instability, leading to frequent and unpredictable changes in fiscal, monetary, and regulatory policies. At the state level, heterogeneous policy responses—such as variations in lockdown measures, business restrictions, and stimulus distribution—introduced substantial cross-state divergence in economic policy uncertainty. This unique combination of nationwide volatility and state-specific policy heterogeneity makes the COVID-19 period an ideal setting for examining the impact of uncertainty shocks on firms, banks, and their interactions.

6.1 Event Study: Financial Response to the COVID-19 Shock

To further understand how firms and banks respond to large-scale uncertainty shocks, we examine the COVID-19 pandemic as a natural experiment. Using an event study framework, we track the dynamics of corporate and banking balance sheet components around the onset of COVID-19. Figures 9 and 10 display the estimated responses for key financial indicators, with time normalized such that zero denotes the onset of the crisis.

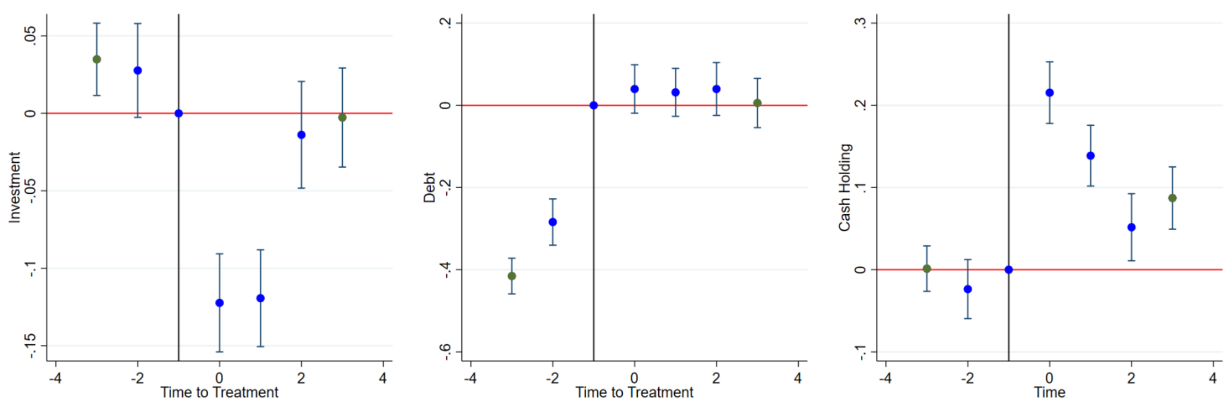

Figure 9: Corporate Response to the COVID-19 Shock

Figure 9 illustrates the corporate sector's adjustment in investment, debt issuance, and cash holdings. The left panel shows that firms sharply reduced investment following the onset of the pandemic, with a noticeable and statistically significant decline relative to pre-crisis levels. This suggests heightened uncertainty led to a postponement of capital expenditures and a conservative reassessment of long-term projects.

The middle panel shows a significant decline in debt issuance, indicating that firms deliberately avoided taking on new financial obligations during a period of extreme macroeconomic risk. This deleveraging behavior reflects heightened risk aversion and a preference for financial flexibility.

In contrast, the right panel shows a pronounced increase in cash holdings post-COVID, consistent with precautionary motives. Firms responded by hoarding liquidity as a buffer against future uncertainty and funding constraints. Taken together, the event study provides strong evidence of a shift toward financial conservatism, with firms cutting investment and borrowing while increasing cash reserves.

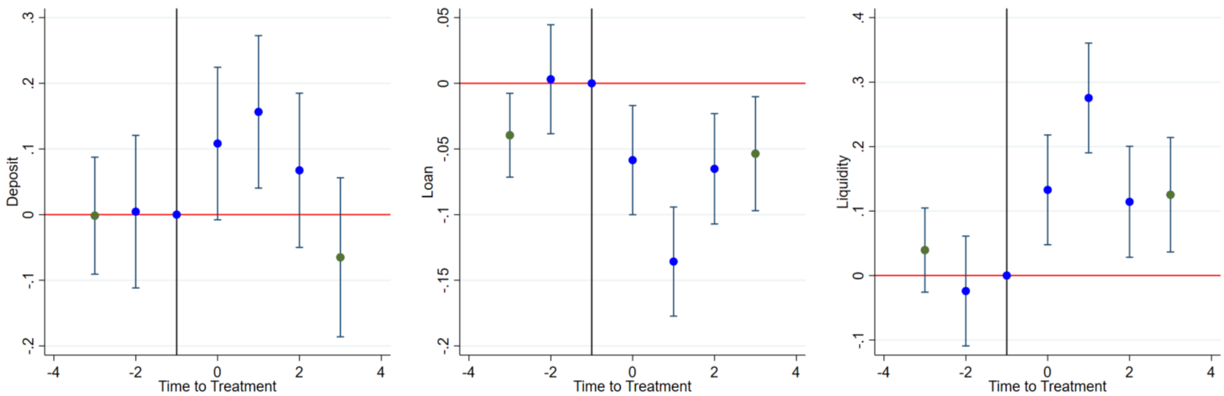

Figure 10: Bank Response to the COVID-19 Shock

Figure 10 presents the corresponding responses for banks. The left panel indicates that deposit levels remained relatively stable around the time of the COVID-19 shock, with no strong or statistically significant changes. This stability likely reflects the combined effects of government stimulus programs, household precautionary saving, and sustained trust in the banking system.

The middle panel shows a clear and sustained decline in loan issuance following the pandemic. This contraction in credit supply suggests that banks either faced weakened loan demand or actively tightened credit standards due to elevated borrower risk and economic uncertainty.

The right panel reveals a significant and persistent increase in liquidity holdings. Banks increased their reserves and safe asset holdings as part of a defensive balance sheet strategy, prioritizing liquidity and capital preservation over credit expansion. This pattern is consistent with classic crisis-time behavior in banking, characterized by liquidity hoarding and cautious asset management.

Overall, the event study reveals a parallel pattern across the corporate and banking sectors: both responded to the COVID-19 shock with a marked shift toward financial conservatism. Firms curtailed investment and debt, while increasing liquidity. Banks reduced lending and expanded liquid asset buffers. These responses highlight how macroeconomic uncertainty leads to significant real and financial adjustments that propagate through balance sheets, with potential implications for credit markets, investment, and broader economic recovery.

7 Local Projections

Following the methodology of Jordà (2005), I employ a local projection framework to examine the dynamic response of various bank balance sheet components to state-level economic policy uncertainty (EPU) shocks. The empirical specification is given by:

$$\Delta_h \log (y_{i,t+h}) = \alpha_{b,h} + \beta_h \Delta log(EPU\_State_t) + \delta_1 X_t + \delta_2 M_t + \varepsilon_{i,t+h}, \tag{9}$$

where $\Delta_h \log (y_{i,t+h}) = \log (y_{i,t+h}) - \log (y_{i,t})$ denotes the cumulative change in the logarithm of a bank-level outcome variable over horizon h. The coefficient β_h traces out the impulse response of bank outcomes to a one-period change in EPU.

The vector X_t includes four lags of bank-specific controls: the logarithm of total assets, the logarithm of the number of branches, and the logarithm of the number of employees. The vector M_t includes four lags of market-level variables measured at the county level, including the Herfindahl-Hirschman Index (HHI) of bank concentration, the yield spread (defined as the long-term interest rate minus the federal funds rate), population, and per capita income. Standard errors are clustered at the bank level, and the model includes bank fixed effects $\alpha_{b,h}$ to account for time-invariant unobserved heterogeneity.

7.1 Dynamic Balance Sheet Response to Policy Uncertainty: Local Projections

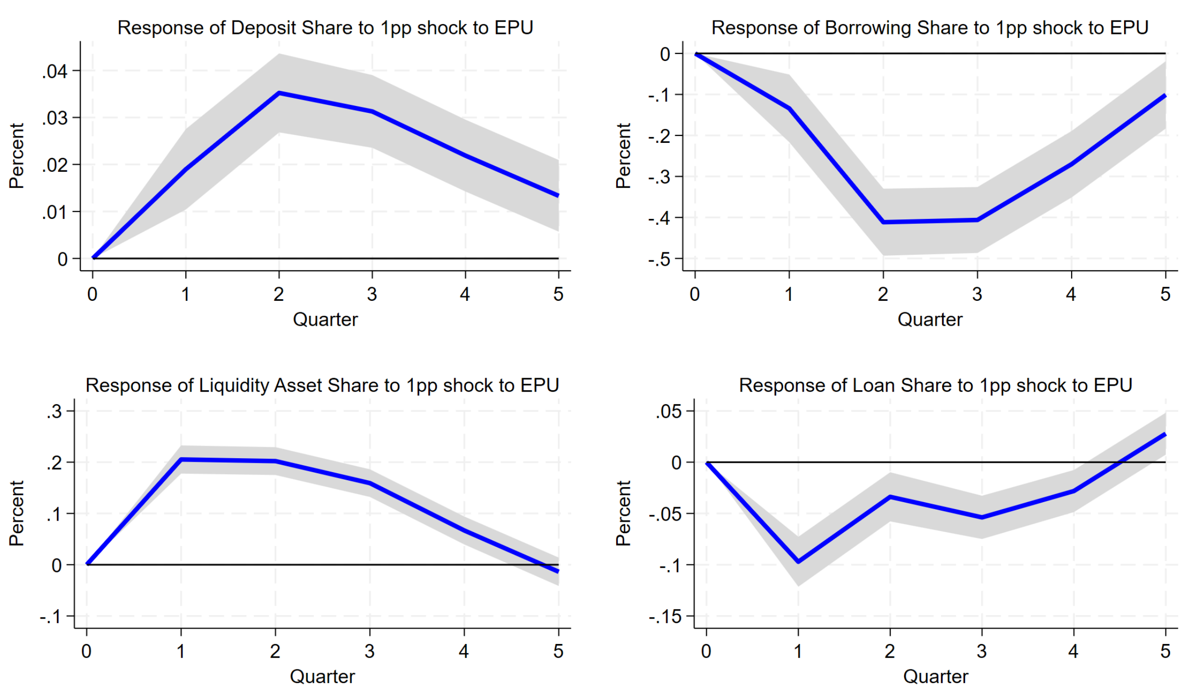

Figure 11: Impulse Responses of Bank Balance Sheet Components to Policy Uncertainty Shocks

Figure 11 presents the dynamic response of banks' balance sheet structures to economic policy uncertainty shocks, estimated using the local projections method. The analysis traces how key components of bank liabilities and assets evolve following a one-percentage-point increase in firm-level economic policy uncertainty.

On the liability side, the share of deposits rises significantly, peaking in the second quarter after the shock. This pattern reflects a classic "flight-to-safety" mechanism, as firms and households reallocate funds into bank deposits to avoid exposure to market volatility and uncertainty. Simultaneously, banks reduce their reliance on short-term market-based funding sources, such as wholesale borrowing, suggesting a shift toward more stable and low-risk liability structures.

On the asset side, banks respond by increasing their holdings of liquid assets—including cash, reserves, and high-grade securities—within one to two quarters after the shock. This behavior is consistent with precautionary liquidity hoarding, as institutions seek to strengthen their liquidity positions in anticipation of potential funding stress or market disruptions. In contrast, the share of loans declines persistently over the projection horizon, indicating a more conservative stance in credit allocation and reduced risk appetite.

Overall, the results reveal a dual-sided adjustment strategy in response to heightened policy uncertainty. Banks simultaneously strengthen their liquidity buffers and reduce credit exposure, reshaping both sides of the balance sheet to enhance resilience. These findings provide micro-level evidence on how financial institutions respond to uncertainty shocks by reconfiguring their financing and investment structures to mitigate risk and preserve stability.

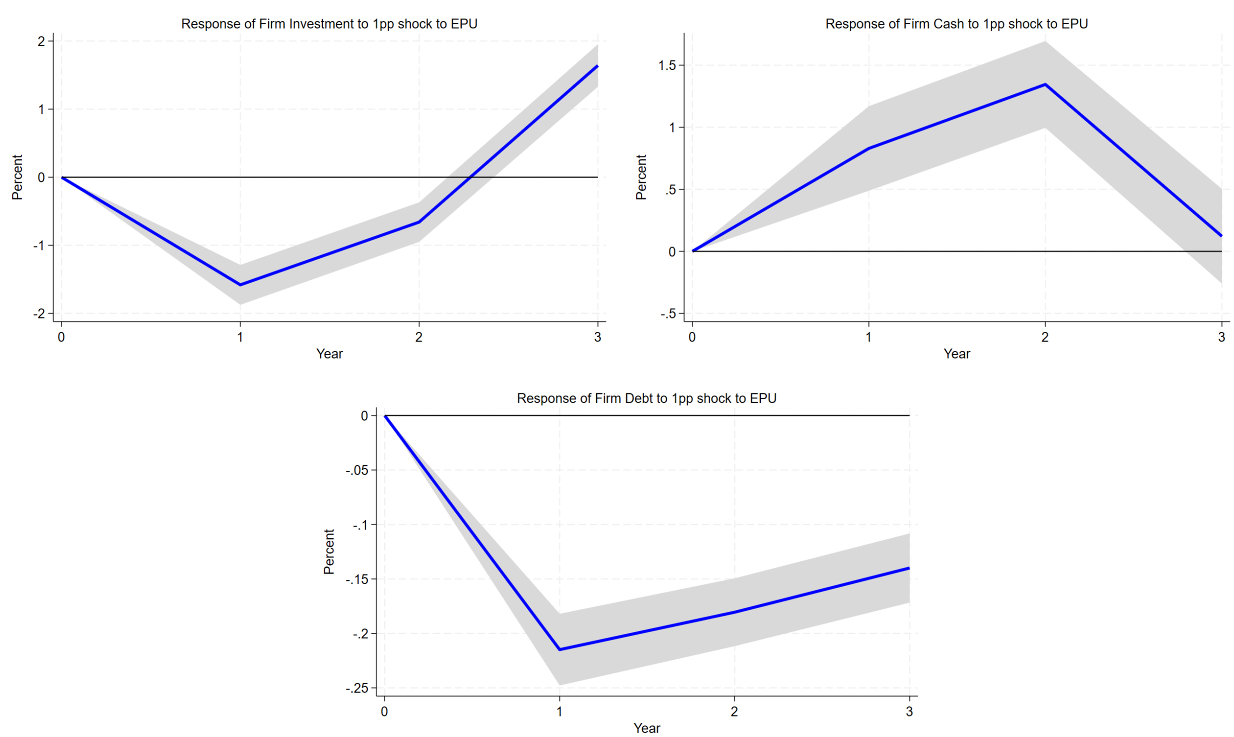

Figure 12: Impulse Responses of Firm's Financial Decision to Policy Uncertainty Shocks

Figure 12 presents the local projection estimates of firm financial responses to a one–percentage point increase in economic policy uncertainty (EPU). Panel (a) shows that firm investment exhibits a significant decline of approximately 1.5% in the year following the shock, before gradually recovering and turning positive by the third year. Panel (b) indicates that firm cash holdings rise persistently in response to heightened uncertainty, peaking at around 1.4% in the second year, suggesting a precautionary savings motive. Panel (c) demonstrates that firm debt decreases modestly, with the largest reduction of roughly 0.2% occurring in the first year, followed by a gradual recovery. Together, these results imply that heightened EPU leads firms to reduce capital expenditure, increase liquidity buffers, and lower leverage in the short run, consistent with a precautionary and risk–averse adjustment in financial decision–making.

8 DSGE Model with Uncertainty Shocks

8.1 Modeling Uncertainty Shocks via Time-Varying TFP Volatility

The model builds upon the frameworks of Gertler and Karadi (2011), Bernanke et al. (1999), and Rannenberg (2016), and extends them by introducing an uncertainty shock that operates through time-varying total factor productivity (TFP) volatility. In periods of elevated uncertainty, we assume that firms experience both a negative shock to average productivity and an increase in the dispersion of productivity outcomes.

In the production sector, the output of an individual intermediate goods producer i is modeled using a Cobb–Douglas production function:

$$Y_t(i) = \left(K_t^S(i)\right)^{\alpha} \left(\exp(a_t) l_t(i)\right)^{1-\alpha},$$

where $K_t^S(i)$ denotes the capital input, $l_t(i)$ is the labor input, α is the capital share in production, and $\exp(a_t)$ captures time-varying total factor productivity.

The evolution of TFP follows the process:

$$a_t = \rho_a a_{t-1} - e_t \sigma_{z,t},$$

where ρ_a represents the persistence of TFP, e_t is a zero-mean exogenous technology shock, and $\sigma_{z,t}$ denotes the time-varying volatility of the shock. This formulation allows the magnitude of productivity shocks to fluctuate over time, thus embedding an uncertainty shock that operates through changes in volatility.

The uncertainty process itself evolves according to:

$$\sigma_{z,t} = (1 - \rho_{\sigma_z})\bar{\sigma}_z + \rho_{\sigma_z} \sigma_{z,t-1} + \sigma_{\sigma_z} e_{\sigma,t},$$

where ρ_{σ_z} captures the persistence of uncertainty, $\bar{\sigma}_z$ is the steady-state volatility level, $e_{\sigma,t}$ is an exogenous uncertainty shock orthogonal to e_t, and σ_{σ_z} is its standard deviation. This structure captures not only uncertainty shocks but also their own volatility—commonly referred to as "volatility-of-volatility"—thereby allowing the model to reflect deeper shifts in the economic environment during turbulent times. We use this uncertainty shock to capture periods of heightened uncertainty.

8.2 Households

The model features a representative household that derives utility from consumption and disutility from labor supply. Preferences are described by the following intertemporal utility function:

$$E_t \sum_{i=0}^{\infty} \beta^i \left[\ln(C_{t+i} - hC_{t+i-1}) - \chi \frac{(l_{t+i}^s)^{1+\varphi}}{1+\varphi} \right], \tag{10}$$

where C_t denotes a CES (constant elasticity of substitution) consumption bundle composed of differentiated goods, and l_t^s represents labor supply. The parameter $\beta \in (0,1)$ is the subjective discount factor, $h \in [0,1)$ captures the degree of internal habit formation, $\chi > 0$ governs the weight on labor disutility, and $\varphi > 0$ is the inverse of the Frisch elasticity of labor supply.

The habit formation term hC_{t-1} introduces a preference for consumption smoothing over time, implying that utility depends not only on current consumption but also on its deviation from past levels.

The household saves via two types of financial assets: bank deposits and government bonds. Both assets are one-period nominal instruments and are assumed to be perfectly safe in nominal terms. As such, they are treated as perfect substitutes and earn the same nominal return in equilibrium.

Let B_{t-1}^T denote the total nominal financial assets held by the household at the end of period $t-1$, which yield a gross nominal return of R_{t-1} in period t. The household earns labor income from supplying labor to firms at a real wage rate w_t, and receives dividend income from its ownership of retail firms and capital producers. It also pays lump-sum taxes T_t to the government.

The household's nominal budget constraint in period t is given by:

$$P_t C_t = w_t P_t l_t + P_t \text{profit} t + Rt - 1 B_{t-1}^T - B_t^T - P_t T_t, \tag{11}$$

where P_t is the aggregate price level, profit_t denotes total real profit income from firm ownership, and T_t is the lump-sum tax obligation. B_t^T is the total nominal savings held in the form of bank deposits or government bonds at the end of period t.

In sum, the household chooses sequences of consumption C_t, labor supply l_t^s, and asset holdings B_t, B_t^g to maximize expected lifetime utility, subject to the intertemporal budget constraint and given initial asset positions.

8.3 Banking Sector

This subsection develops the banking block of the model, following the structure of Gertler and Karadi (2011), with modifications to emphasize debt-based intermediation and working capital provision. A fraction of households is designated as bankers who intermediate funds by issuing loans to firms. These bankers are risk-neutral and face an exogenous probability of exit each period. Specifically, in every period, a banker exits the financial system with probability $1-\theta$, at which point they consume all of their accumulated net worth $N_t^b(q)$. Departing bankers are immediately replaced by newly entering bankers who receive a small endowment N_n^b from the household sector. This turnover mechanism introduces a natural decay and renewal process into aggregate bank capital.

Unlike equity-based financing in the original Gertler-Karadi framework, our model assumes that banks provide credit in the form of two distinct loan products. The first is intertemporal lending $L_t^e(q)$, which supports entrepreneurs' capital purchases and is repaid at the beginning of the following period. The second is working capital lending $L_t^r(q)$, which provides liquidity to retail firms for financing contemporaneous wage and capital rental payments, and is repaid by the end of the same period. This dual-loan structure enables the model to separately capture the dynamics of investment and liquidity constraints under financial frictions.

Bankers must satisfy an incentive compatibility constraint to prevent moral hazard. After accepting deposits from households, they could choose to divert a fraction $\lambda \in [0,1]$ of intertemporal loans for personal consumption and declare bankruptcy. To ensure that such deviation is not profitable, the expected continuation value of a banker must exceed the potential gains from diversion. This yields the constraint

$$V_t^b(q) \geq \lambda L_t^e(q), \tag{12}$$

where $\lambda \in [0,1]$ captures the enforceability of contracts. The expected lifetime value of a banker is defined as

$$V_t^b(q) = E_t\left\{\sum_{i=0}^{\infty}(1-\theta)\theta^i\left(\prod_{j=0}^{i}\frac{1}{R_{t+1+j}^r}\right)N_{t+1+i}^b(q)\right\}, \quad R_{t+1}^r = \frac{R_t}{\Pi_{t+1}}, \tag{13}$$

with R_t as the gross nominal interest rate and Π_{t+1} as gross inflation. Because default does not occur in equilibrium, household deposits are risk-free and yield the nominal interest rate R_t.

Working capital loans are assumed to be frictionless, riskless, and repaid within the same period. As a result, the interest rate on such loans equals the deposit rate, and banks earn zero profits from providing them. These loans do not contribute to banker net worth or influence the expected value function. Thus, all meaningful amplification in the model arises through intertemporal lending to capital-constrained entrepreneurs.

The banker's balance sheet identity equates total loan issuance with the sum of internal net worth and external deposits:

$$P_t L_t^e(q) = P_t N_t^b(q) + B_t(q), \tag{14}$$

where P_t is the price level and $B_t(q)$ denotes nominal deposits. The evolution of net worth reflects the returns on past lending net of deposit repayments, adjusted by exogenous asset shocks:

$$P_t N_t^b(q) = \left[R_t^b P_{t-1} L_{t-1}^e(q) - R_{t-1} B_{t-1}(q)\right]\exp(e_t^z), \tag{3}$$

$$= P_{t-1}\left[(R_t^b - R_{t-1})L_{t-1}^e(q) + R_{t-1} N_{t-1}^b(q)\right]\exp(e_t^z), \tag{4}$$

where R_t^b denotes the gross return on bank loans (after accounting for bankruptcy losses), and e_t^z captures idiosyncratic variation in loan performance.

The incentive constraint binds in equilibrium, allowing us to express loan issuance as a leverage ratio over banker net worth:

$$L_t^e = \phi_t^b N_t^b, \tag{15}$$

where ϕ_t^b denotes the bank leverage multiplier. Aggregate net worth consists of retained earnings from surviving bankers and new endowments to entrants:

$$N_t^b = N_{et}^b + N_n^b, \tag{16}$$

where the surviving portion of bankers contribute

$$N_{et}^b = \theta z_{t-1,t} N_{t-1}^b, \tag{5}$$

with the return on capital given by

$$z_{t-1,t} = \left(\frac{(R_t^b - R_{t-1})\phi_{t-1}^b + R_{t-1}}{\Pi_t} \right) \exp(e_t^z). \tag{6}$$

Exiting bankers consume the remainder of net worth:

$$C_t^b = (1-\theta) z_{t-1,t} N_{t-1}^b. \tag{7}$$

Normalizing the incentive constraint by banker net worth leads to

$$\lambda \phi_t^b = \frac{V_t^b}{N_t^b}, \tag{17}$$

which reveals that leverage is fundamentally linked to the expected return on net worth. This ratio captures the profitability of the banking sector and its ability to sustain credit growth over time.

To understand the cyclical behavior of bank credit, we log-linearize the incentive constraint. The linearized condition becomes

$$\widehat{\phi}_t^b = (\widehat{V_t^b / N_t^b}) = \sum_{i=0}^{\infty} (\theta \beta^2 z^2)^i \phi^b \frac{R^b}{R} \left(E_t \widehat{R}_{t+1+i}^b - \widehat{R}_{t+i} \right), \tag{8}$$

which can be re-expressed recursively as

$$\hat{\varphi}_t = E_t \left\{ \beta \theta^2 z \hat{\varphi}_{t+1} + \phi^b \frac{R^b}{R} \left(\hat{R}_{t+1}^b - \hat{R}_{t+1} \right) \right\}, \tag{18}$$

where $\hat{\varphi}_t \equiv \hat{L}_t^e - \hat{N}_t^b$ denotes the deviation of leverage from its steady state.

The recursive dynamics of $\hat{\varphi}_t$ illustrate how fluctuations in lending returns influence credit supply. When loan spreads widen, the profitability of bank intermediation increases, leading to higher net worth and expanded lending. Conversely, when spreads compress or economic shocks erode asset returns, bank capital falls, leverage contracts, and loan supply shrinks. This dynamic feedback loop captures the core amplification mechanism whereby banking sector constraints translate financial shocks into persistent macroeconomic fluctuations.

8.4 Entrepreneurial Sector

In this model, capital accumulation is undertaken by a continuum of risk-neutral entrepreneurs, following the framework developed by L. Christiano, Rostagno, and Motto (2010), with several key modifications. At the end of each period t, entrepreneurs purchase capital K_t^j at the market price P_tQ_t, where Q_t is the relative price of capital goods. In period $t+1$, the capital is rented out at a real rate r_{t+1}^k and the undepreciated portion is sold at the updated capital price Q_{t+1}. Accordingly, the gross real return on capital is given by

$$R_{t+1}^K = \Pi_{t+1}\frac{r_{t+1}^k + Q_{t+1}(1-\delta)}{Q_t}, \tag{9}$$

where Π_{t+1} denotes gross inflation and δ is the depreciation rate.

Entrepreneurs are subject to an idiosyncratic productivity shock ω_{t+1}^j, drawn from a log-normal distribution with unit mean and variance σ^2. This shock captures heterogeneity in realized returns across entrepreneurs. The total value of assets held by entrepreneur j at the beginning of period $t+1$ is given by $\omega_{t+1}^j R_{t+1}^K P_t Q_t K_t^j$.

Capital is financed through a combination of internal net worth $P_tN_t^j$ and bank loans $P_tL_t^j = P_t(Q_tK_t^j - N_t^j)$, where R_t^L denotes the nominal interest rate on loans. The loan contract is static in nature: the interest rate R_t^L is set at time t and does not adjust ex-post based on the realized value of ω_{t+1}^j. Entrepreneurs default when their realized asset value falls below their debt obligations. The threshold shock $\bar{\omega}_t$ that separates repayment from default is determined implicitly by the condition

$$\bar{\omega}_t R_{t+1}^K P_t Q_t K_t^j = R_t^L P_t L_t^j.$$

In the event of default ($\omega_{t+1}^j < \bar{\omega}_t$), the bank seizes the entrepreneur's capital returns but recovers only a fraction $(1-\mu)$, where μ captures losses due to bankruptcy frictions.

Each entrepreneur faces a probability $1-\gamma$ of exiting at the end of each period. Departing entrepreneurs consume all of their accumulated wealth, while a new cohort of entrepreneurs enters with transfers from the household sector to maintain a constant entrepreneurial population. At the beginning of period $t+1$, the bank does not observe the realization of ω_{t+1}^j, so it sets the loan contract based on expected returns. The expected revenue from lending to entrepreneur j is given by

$$\begin{aligned}\text{Loanrev}_{t+1}^j =& R_t^L P_t L_t^j \int_{\bar{\omega}_{t+1}^j}^{\infty} f(\omega^j)d\omega^j \\ &+ (1-\mu) R_{t+1}^K P_t Q_t K_t^j \int_0^{\bar{\omega}_{t+1}^j} \omega^j f(\omega^j) d\omega^j.\end{aligned}$$

The first term captures repayment from solvent entrepreneurs, while the second reflects partial recovery from defaulted loans.

To ensure incentive compatibility and consistency with the return on bank assets, the loan contract must satisfy a zero-profit condition in expectation:

$$E_t\left\{ R_t^L P_t L_t^j \int_{\bar{\omega}_{t+1}}^{\infty} f(\omega')d\omega' + (1-\mu) R_{t+1}^K P_t Q_t K_t^j \int_0^{\bar{\omega}_{t+1}} \omega' f(\omega')d\omega' \right\} = P_t L_t^j E_t R_{t+1}^b. \tag{11}$$

Because the loan interest rate R_t^L is set ex-ante and does not reflect ex-post outcomes, the contract lacks dynamic risk-pricing. Thus, to balance the lending market in expectation, the following condition must hold:

$$\begin{aligned} P_t L_t^j R_t =& R_{t+1}^L P_t L_t^j \int_{\bar{\omega}_{t+1}^j}^{\infty} f(\omega^j) d\omega^j \\ &+ (1-\mu) R_{t+1}^K P_t Q_t K_t^j \int_0^{\bar{\omega}_{t+1}^j} \omega^j f(\omega^j) d\omega^j . \end{aligned} \tag{12}$$

Entrepreneurs choose the optimal level of capital and borrowing to maximize their expected net profits. Their optimization problem is

$$\max_{L_t^j, K_t^j} E_t \Bigg\{ \omega' R_{t+1}^K P_t Q_t K_t^j - (1-\mu) R_{t+1}^K P_t Q_t K_t^j \int_0^{\bar{\omega}_{t+1}} \omega' f(\omega') d\omega' \tag{19}$$

$$- R_t^L P_t L_t^j \int_{\bar{\omega}_{t+1}}^{\infty} f(\omega') d\omega' \Bigg\}. \tag{20}$$

Let $\phi_t^e = \frac{Q_t K_t^j}{N_t^j}$ denote the entrepreneur's leverage ratio, and assume all entrepreneurs face the same threshold $\bar{\omega}_{t+1}$. A log-linear approximation of the entrepreneur's first-order condition reveals a positive relationship between leverage and the credit spread:

$$E_t \widehat{R}_{t+1}^K - E_t \widehat{R}_{t+1}^b = \chi^l (\widehat{K}_t + \widehat{Q}_t - \widehat{N}_t), \quad \chi^l > 0. \tag{13}$$

The total net worth of entrepreneurs evolves as:

$$N_t = \gamma V_t + W_t^e, \tag{14}$$

where V_t is the equity value of surviving entrepreneurs and W_t^e is the transfer to new entrants. The value of entrepreneurial equity is derived from the realized returns net of loan repayments and subject to a stochastic shock e_t^V:

$$V_t = \left[\int_{\bar{\omega}_t}^{\infty} \left(\omega' R_{t+1}^K Q_{t-1} K_{t-1} - R_t^L L_{t-1} \right) f(\omega') d\omega' \right] \exp(e_t^V). \tag{15}$$

Exiting entrepreneurs consume their equity value:

$$C_t^e = (1-\gamma) V_t. \tag{16}$$

The default threshold is given by:

$$\bar{\omega}_t = \frac{R_{t-1}^L (Q_{t-1} K_{t-1} - N_{t-1})}{R_t^K Q_{t-1} K_{t-1}}. \tag{17}$$

Lastly, the return on bank loans is derived as:

$$R_t^b = \frac{\text{Loanrev}_t^j}{P_{t-1} L_{t-1}^j} = \left[R_{t-1}^L \int_{\bar{\omega}_t}^{\infty} f(\omega^j) d\omega^j + (1-\mu) R_t^K \frac{\phi_{t-1}^e}{\phi_{t-1}^e - 1} \int_0^{\bar{\omega}_t} \omega^j f(\omega^j) d\omega^j \right]. \tag{18}$$

This entrepreneurial sector forms the core of the financial accelerator mechanism in the model, where endogenous fluctuations in net worth, leverage, and risk premia interact with capital accumulation and bank lending to amplify macroeconomic shocks.

8.5 Capital Goods Producers

Capital goods producers are owned by households and are responsible for producing new capital goods using a convex adjustment technology. Specifically, they produce:

$$1 - \frac{\eta_i}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 \tag{21}$$

units of effective capital from one unit of physical investment I_t, where $\eta_i \geq 0$ denotes the investment adjustment cost parameter that governs the curvature of the cost function. This specification captures the idea that rapid changes in the investment rate are costly, introducing smoothness into the capital accumulation process.

Capital goods are sold to entrepreneurs at the relative price $P_t Q_t$, where P_t is the nominal price level and Q_t is the real price of capital. The term Q_t can be interpreted as the shadow value of installed capital, reflecting its marginal efficiency.

The capital goods producers choose the investment path $\{I_t\}_{t=0}^{\infty}$ to maximize their expected real profits, which are given by:

$$E_t\left\{\sum_{i=0}^{\infty}\beta^i \frac{\varrho_{t+i}}{\varrho_t} I_{t+i}\left[Q_{t+i}\left(1 - \frac{\eta_i}{2}\left(\frac{I_{t+i}}{I_{t+i-1}} - 1\right)^2\right) - 1\right]\right\}, \tag{22}$$

where β is the household discount factor and ϱ_t denotes the marginal utility of real income (i.e., the stochastic discount factor from the household's perspective). The term inside the summation captures the net benefit from investing: the revenue from selling effective capital, adjusted for investment adjustment costs, net of the unit cost of investment.

This formulation implies that capital goods producers internalize the intertemporal costs of changing investment rates. When investment growth accelerates, adjustment costs increase, reducing the effective units of capital produced per unit of investment expenditure. As a result, the model introduces endogenous sluggishness in capital accumulation, allowing it to better replicate the empirical investment dynamics observed during periods of economic volatility.

8.6 Retailers

Retailers operate under monopolistic competition and are owned by households. A continuum of retailers, indexed by $i \in [0, 1]$, each produces a differentiated good that enters a final consumption bundle aggregated via a CES technology. Retailers face nominal rigidities in the spirit of Calvo (1983) and must finance a portion of their production costs through short-term working capital loans.

8.6.1 Demand for Retail Goods

Demand for the good produced by retailer i is given by:

$$Y_t(i) = \left(\frac{p_t(i)}{P_t}\right)^{-\varepsilon} Y_t, \tag{23}$$

where $p_t(i)$ is the price of good i, P_t is the aggregate price level, Y_t is total final goods demand, and $\varepsilon > 1$ is the elasticity of substitution across varieties. This implies that each retailer faces a downward-sloping demand curve.

8.6.2 Production Technology and Input Demand

Retailers hire labor $l_t(i)$ at wage w_t and rent capital services $K_t^S(i)$ at rental rate r_t^k. The production function follows a standard Cobb–Douglas form with a stochastic productivity shock:

$$Y_t(i) = \left(K_t^S(i)\right)^{\alpha} \left(\exp(a_t) l_t(i)\right)^{1-\alpha}, \tag{24}$$

where a_t is a temporary technology shock that follows an AR(1) process. The term $\exp(a_t)$ captures time-varying total factor productivity, while α denotes the capital share.

8.6.3 Working Capital Loans

Retailers must pre-finance a fraction of their wage and capital rental expenses through short-term loans from banks. Let ψ_L and ψ_K denote the proportions of wage and capital costs that must be paid in advance, respectively. The working capital loan required by retailer i is:

$$L_t^r(i) = \psi_L w_t l_t(i) + \psi_K r_t^k K_t^S(i), \tag{25}$$

which is repaid at the end of the period with the gross risk-free interest rate R_t. This financial friction introduces an interest rate channel through which monetary policy and uncertainty shocks can influence real production decisions. It also contributes to the procyclicality of aggregate lending, as total loans largely consist of financing for entrepreneurial and retail activity.

8.6.4 Price Rigidity and Optimal Price Setting

Retailers are subject to Calvo-style nominal price rigidities. In each period, only a fraction $1-\xi_P$ of firms are allowed to reoptimize their prices, while the remaining fraction ξ_P adjust prices according to a mechanical indexation rule. Specifically, for non-reoptimizing firms, the updated price evolves as a weighted average of steady-state inflation Π and lagged inflation Π_{t-1}, governed by the indexation parameter γ_P:

$$p_t(i) = p_{t-1}(i) \cdot \Pi^{1-\gamma_P} \cdot \Pi_{t-1}^{\gamma_P}. \tag{26}$$

Let p_t^* denote the newly chosen price by optimizing retailers. The aggregate price level then evolves as:

$$P_t = \left[(1-\xi_P)(p_t^*)^{1-\varepsilon} + \xi_P \left(P_{t-1}\Pi^{1-\gamma_P}\Pi_{t-1}^{\gamma_P}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}. \tag{27}$$

Firms that are allowed to reoptimize choose p_t^* to maximize the expected present discounted value of profits:

$$\max_{p_t^*} E_t \Bigg\{ \sum_{i=0}^{\infty} (\beta\xi_P)^i \frac{\varrho_{t+i}}{\varrho_t} \Bigg[\left(\frac{p_t^*}{P_{t+i}} \prod_{k=1}^{i} \Pi^{1-\gamma_P} \Pi_{t+k-1}^{\gamma_P} \right)^{1-\varepsilon} - mc_{t+i} \left(\frac{p_t^*}{P_{t+i}} \prod_{k=1}^{i} \Pi^{1-\gamma_P} \Pi_{t+k-1}^{\gamma_P} \right)^{-\varepsilon} \Bigg] Y_{t+i} \Bigg\}, \tag{28}$$

where ϱ_{t+i} denotes the stochastic discount factor, and mc_{t+i} is the nominal marginal cost. The optimization reflects the trade-off between setting a higher markup and the risk of being unable to reoptimize in future periods due to nominal rigidity.

This structure implies that aggregate price dynamics are influenced by both current and past inflation, as well as the frequency of price reoptimization, and plays a central role in the model's monetary transmission mechanism.

8.7 Monetary Policy and General Equilibrium

Monetary policy in the model operates by setting the nominal risk-free interest rate, which in turn determines the deposit rate received by households and the cost of funds in the broader economy. The central bank follows a conventional interest rate feedback rule that responds to deviations of inflation and output from their respective targets. Specifically, the monetary policy rule is specified as:

$$\begin{aligned} R_t - 1 = & (1-\rho_i)\left[R - 1 + \psi_\pi \left(\log(\Pi_t) - \log(\Pi)\right) + \psi_y \left(\log(GDP_t) - \log(GDP_t^*)\right)\right] \\ & + \rho_i (R_{t-1} - 1) + e_t^i, \end{aligned} \tag{19-20}$$

where R_t denotes the gross nominal interest rate set by the monetary authority, and Π_t is the gross inflation rate. The parameters ψ_π and ψ_y capture the sensitivity of the policy rate to deviations of inflation and output from their target levels. The term GDP_t^* represents the natural level of output—that is, the level that would prevail under fully flexible prices. R denotes the steady-state nominal interest rate consistent with long-run equilibrium, and $\rho_i \in (0,1)$ measures the degree of interest rate smoothing or policy inertia. Finally, e_t^i is an i.i.d. monetary policy shock that introduces exogenous variation in the interest rate beyond systematic policy responses.

This interest rate rule implies that the central bank raises the nominal interest rate when inflation rises above its target or when output exceeds potential, thereby helping to stabilize the economy. The inclusion of interest rate smoothing ensures gradual policy adjustments over time, which reflects empirical features of monetary policy conduct in many advanced economies. In equilibrium, this policy rule anchors inflation expectations, influences intertemporal consumption and investment decisions, and plays a critical role in determining the dynamic behavior of the model in response to structural shocks.

8.8 Resource Constraints

The general equilibrium of the model is governed by a set of resource constraints and dynamic laws that ensure consistency across the real and financial sides of the economy. One important friction arises from price dispersion, which results from staggered price setting. Specifically, the degree of inefficiency due to price dispersion is captured by the variable S_t, which evolves according to the following law of motion:

$$S_t = (1-\xi_P)\left(\frac{\Pi_t}{\Pi_t^*}\right)^{\varepsilon} + \xi_P\left(\frac{\Pi_t}{\Pi_{t-1}^{\gamma_P}\Pi_{t-2}^{1-\gamma_P}}\right)^{\varepsilon} S_{t-1}, \tag{21}$$

where $\xi_P \in (0,1)$ denotes the degree of price rigidity, ε is the elasticity of substitution across varieties, Π_t is the current gross inflation rate, and Π_t^* is the steady-state inflation rate. Price dispersion reduces allocative efficiency in the economy, and the variable S_t quantifies the magnitude of this inefficiency. However, in the log-linearized (first-order) approximation of the model around the steady state, S_t does not explicitly enter the system of equations.

Aggregate consumption in the economy is composed of the consumption of three types of agents: households, entrepreneurs, and bankers. The total consumption C_t^P is defined as:

$$C_t^P = C_t + C_t^e + C_t^b, \tag{22}$$

where C_t is the consumption of representative households, C_t^e is consumption by entrepreneurs (typically upon exiting the economy), and C_t^b is the consumption of exiting bankers. These components of consumption jointly determine the demand for final goods.

Total output Y_t is allocated to four uses: investment I_t, total consumption C_t^P, capital utilization costs, and expected losses due to entrepreneur default. The resource constraint that equates output with these uses—adjusted for the price dispersion factor S_t—is given by:

$$Y_t = S_t\left(I_t + C_t^P + \frac{R_t^K}{\Pi_t}Q_{t-1}K_{t-1} - \mu\int_0^{\bar{\omega}_t}\omega f(\omega)d\omega\right), \tag{23}$$

where $\mu \in (0,1)$ captures the degree of asset loss in the event of entrepreneur default, and $f(\omega)$ is the probability density function of the idiosyncratic shock to entrepreneur capital productivity. The integral term captures the expected capital loss due to entrepreneurs whose shock realization ω falls below the default threshold $\bar{\omega}_t$.

The economy's aggregate production function is Cobb-Douglas in form and combines effective labor and physical capital:

$$Y_t = (K_{t-1})^{\alpha}(A_t l_t)^{1-\alpha}, \tag{24}$$

where $\alpha \in (0,1)$ denotes the capital share of income, A_t represents the level of technology (TFP), and l_t is the quantity of labor employed. This production function ensures constant returns to scale and enables productivity shocks to propagate through the real side of the model.

In terms of national accounting, GDP is defined as the sum of investment, household consumption, and government expenditure:

$$GDP_t = I_t + C_t + G_t, \tag{25}$$

where G_t denotes exogenous government spending, which is assumed to be constant in the baseline model such that $G_t = G$. This definition facilitates the calibration of the model to empirical data and allows for standard fiscal policy extensions if needed.

The law of motion for physical capital stock K_t incorporates both depreciation and convex investment adjustment costs:

$$K_t = (1-\delta)K_{t-1} + I_t \left(1 - \frac{\eta_I}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2\right), \tag{26}$$

where δ is the depreciation rate of capital, and η_I governs the convexity of adjustment costs. This formulation penalizes large changes in investment and introduces intertemporal smoothness in the capital accumulation process.

Finally, total credit L_t in the economy is the sum of two loan components:

$$L_t = L_t^e + L_t^r, \tag{27}$$

where L_t^e represents loans extended to entrepreneurs for purchasing capital, and L_t^r denotes working capital loans extended to retailers for covering factor payments. This decomposition highlights the distinct roles of investment and working capital finance in the transmission of financial shocks and monetary policy.

8.9 Calibration of Non-Policy Parameters

This subsection documents the calibration strategy for the non-policy parameters of the model. These parameters are selected to reflect empirical regularities observed in the macroeconomic literature, while also ensuring that the model produces plausible steady-state behavior.

The household discount factor is set at $\beta = 0.9958$, corresponding to an annualized interest rate of approximately 1.7%. The inverse Frisch elasticity of labor supply is set to $\varphi = 0.25$, implying a relatively elastic labor response to changes in the real wage. Habit formation in consumption is captured by $h = 0.6$, introducing inertia into consumption dynamics that is commonly observed in empirical data. The production function features a capital share $\alpha = 0.33$, consistent with national income accounts, while the depreciation rate of capital is calibrated to $\delta = 0.025$.

Capital adjustment is costly in the short run, reflected in a relatively high adjustment cost parameter $\eta_i = 4$, which dampens excessive volatility in investment dynamics. Price-setting frictions follow the Calvo pricing mechanism, with a probability of non-adjustment $\xi^P = 0.67$, meaning that on average prices remain unchanged for roughly three periods. The elasticity of substitution across differentiated goods is set to $\varepsilon = 6$, a common value in New Keynesian models.

On the banking side, the fraction of bank assets that can be diverted by bankers is set to $\lambda = 0.2351$, and the survival probability of bankers is $\theta = 0.9915$, implying an average banking career of over 100 periods.

Table 18: Calibrated Values of Non-Policy Parameters

Parameter	**Description**	**Value (Full Model)**
β	Household discount factor	0.9958
φ	Inverse Frisch elasticity of labor supply	0.25
h	Habit formation in consumption	0.6
α	Capital share in production	0.33
δ	Depreciation rate of capital	0.025
η_i	Capital adjustment cost parameter	4
ε	Elasticity of substitution across differentiated goods	6
ξ^P	Calvo probability of not resetting price	0.67
λ	Fraction of bank assets divertible by bankers	0.2351
θ	Survival probability of bankers	0.9915
N^b	Transfer to newly entering bankers	0.0001
ψ_L	Share of labor cost prepaid by retailers	1
ψ_K	Share of capital rental cost prepaid by retailers	1
σ	Standard deviation of idiosyncratic productivity shock	0.35
μ	Fractional cost in case of entrepreneur default	0.2981
γ	Survival probability of entrepreneurs	0.975
W^e	Transfer to newly entering entrepreneurs	0.0088

New bankers receive a small transfer $N^b = 0.0001$ from the household sector, ensuring positive but minimal entry wealth.

Retailers are assumed to prepay all labor and capital rental costs, with $\psi_L = \psi_K = 1$, simplifying the working capital requirement structure. Entrepreneurial risk is modeled via idiosyncratic productivity shocks with standard deviation $\sigma = 0.35$. The cost of financial distress, expressed as a loss in capital value during default, is set to $\mu = 0.2981$. Entrepreneurial persistence is governed by a survival probability $\gamma = 0.975$, while newly entering entrepreneurs receive a transfer $W^e = 0.0088$ from the household sector to start their capital accumulation.

These parameter values are chosen in line with the empirical macro-finance literature, particularly L. J. Christiano, Motto, and Rostagno (2014), Gertler and Karadi (2011), and Gertler and Kiyotaki (2010), and jointly ensure that the model produces quantitatively reasonable steady-state outcomes and dynamic responses.

8.10 Dynamic Responses to an Uncertainty Shock

Figure 13 presents the impulse responses of uncertainty shock. The shock is characterized not only by a decline in average productivity but, more importantly, by a rise in the dispersion of productivity across firms.

A central feature of the shock is a sharp decline in total factor productivity (TFP), capturing both a deterioration in average productivity and disruptions in resource allocation efficiency. The rise in uncertainty dispersion increases informational frictions and reduces firm-level efficiency, contributing to the observed decline in TFP. Simultaneously, precautionary behavior intensifies across the economy. In the banking sector, heightened uncertainty induces a reallocation toward safer and more liquid assets. As a result, household deposits rise significantly in the initial periods, reflecting increased demand for liquidity and precautionary saving.

In contrast, bank lending declines immediately following the shock, as financial intermediaries adopt a more conservative stance in credit provision. The contraction in loans, together with the increase in deposits, is accompanied by a temporary rise in deposit interest rates, consistent with general equilibrium conditions under excess liquidity. The reduction in investment activity—another prominent response—stems from both firms' reduced access to external finance and their increased valuation of waiting under uncertainty. Lower capital valuation further amplifies the investment slowdown.

Importantly, commercial banks display countercyclical behavior in net worth dynamics. Their net worth initially increases, likely due to the inflow of deposits and rebalancing toward low-risk assets. At the same time, bank leverage decreases persistently, indicating a strategic deleveraging in response to heightened uncertainty. On the other hand, entrepreneurial firms experience the opposite adjustment: their net worth declines, due to falling asset values and reduced profitability, while leverage increases temporarily as firms rely more heavily on external borrowing in the face of internal funding constraints. These asymmetric responses between financial intermediaries and firms reflect their differing roles and risk exposures in the economy.

Other variables, including inflation and consumption, respond in a qualitatively consistent manner: ag-

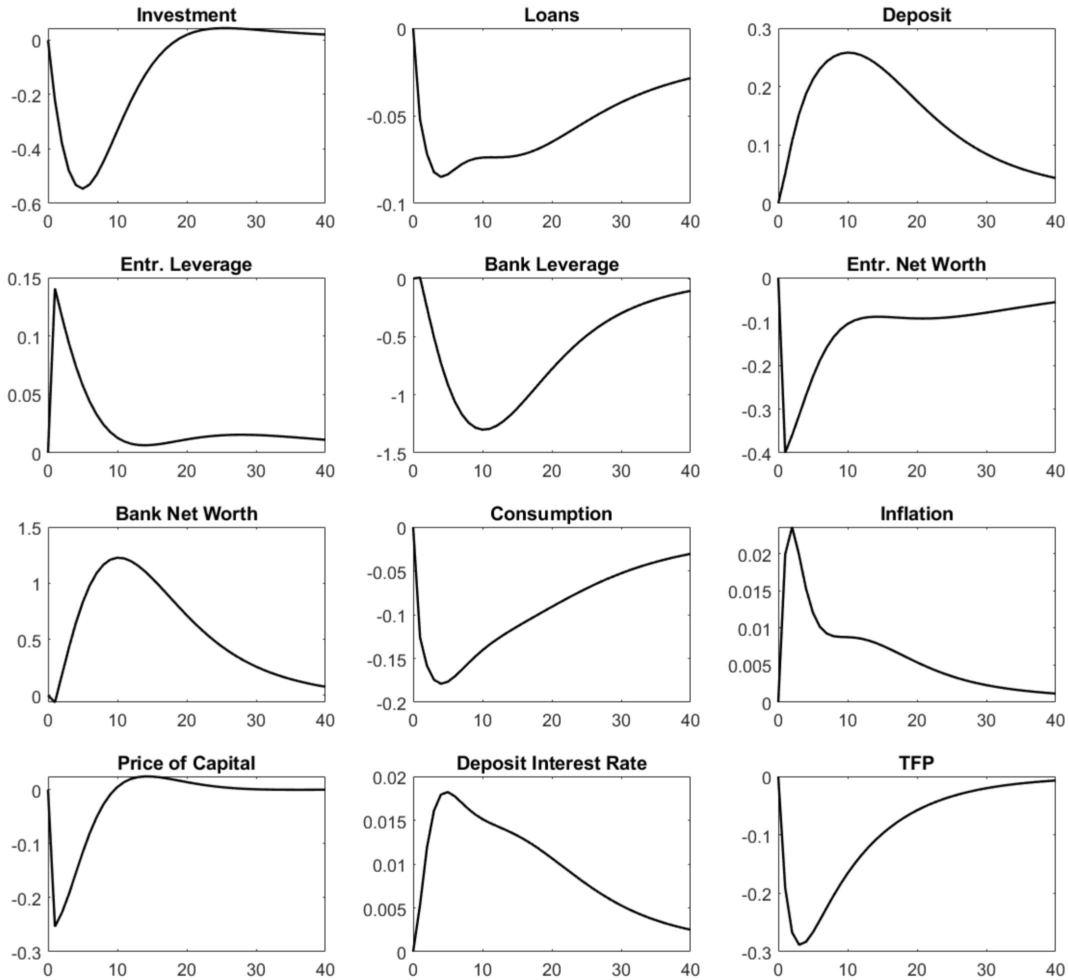

Figure 13: Impulse Responses to an Uncertainty Shock

gregate demand contracts, leading to a temporary decline in inflation and household expenditure. Over time, most variables return to their steady-state levels, although the adjustment is slow for capital-intensive sectors. Overall, the responses confirm that uncertainty shocks operate through both real and financial channels, causing reallocation of resources, contraction of investment and credit, and shifts in leverage and liquidity positions across sectors.

9 Policy Implications and Conclusion

9.1 Policy Implications

The findings of this dissertation have important implications for financial regulation, monetary policy, and macroprudential oversight. As economic policy uncertainty (EPU) plays a critical role in shaping the behavior of both firms and banks, effective policies should aim to reduce uncertainty amplification and strengthen institutional resilience.

First, improved policy coordination and communication at both the federal and state levels can help stabilize expectations. Unanticipated and fragmented policy shifts exacerbate firm-level caution and bank deleveraging. Enhancing the predictability of regulatory and fiscal policies may mitigate precautionary behavior and improve capital allocation.

Second, financial regulators should explicitly monitor banks' exposure to uncertainty shocks, particularly through deposit composition, liquidity buffers, and asset-liability mismatches. Banks concentrated in high-EPU states or dependent on runnable deposits are especially vulnerable to sudden shifts in expectations.

Third, macroprudential tools—such as countercyclical capital buffers, stress testing, and dynamic liquidity requirements—can help dampen the procyclical amplification of uncertainty through the banking system. These tools should incorporate forward-looking measures of policy uncertainty alongside traditional balance sheet indicators.

Fourth, uncertainty-based early warning systems, especially those using machine learning models, can complement supervisory monitoring and risk assessment. EPU measures derived from firm-level text data and regional news sources provide timely signals of risk buildup.

9.2 Conclusion

This dissertation has examined the effects of economic policy uncertainty on firm investment and bank risk-taking using a combination of textual analysis, causal inference, machine learning, and structural modeling. The evidence shows that elevated uncertainty reduces corporate investment, increases precautionary liquidity, and leads to more conservative lending behavior by banks.

The construction of firm-level and state-level EPU indices allows for a more granular understanding of how uncertainty is perceived and transmitted across the economy. Empirical results from IV regressions and dynamic methods confirm the negative real and financial effects of uncertainty. Machine learning models demonstrate the predictive value of uncertainty exposure for financial distress. A DSGE framework further highlights the amplification mechanisms through bank leverage and precautionary behavior.

Overall, the findings underscore the importance of managing uncertainty as part of macro-financial policy design. Reducing uncertainty and strengthening institutional buffers are essential steps toward improving financial stability and economic resilience.

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Appendix

A.1 Data Source

Bank data. I obtain commercial banks' balance sheet and income statement information from the Call Reports (Consolidated Reports of Condition and Income), available quarterly from 1994 to 2023. These reports are accessed via the FFIEC (Federal Financial Institutions Examination Council) Central Data Repository's Public Data Distribution platform. All insured national and state-chartered commercial banks, savings banks, thrifts, and credit unions are required to submit Call Reports. In addition, I use the Compustat IQ Banking database and the FR Y-9C reports to obtain consolidated financial statements for U.S. bank holding companies. Daily stock price data for publicly listed banks is obtained from the CRSP database.

Deposit data. Branch-level deposit information is sourced from the FDIC's Summary of Deposits (SOD), an annual survey of branch office deposits submitted by all FDIC-insured institutions with physical branch locations. The data is aggregated to the bank-county level and used at annual frequency.

Firm investment data. Firm-level variables are drawn from Compustat quarterly data covering 1994 to 2023, including all publicly listed U.S. non-financial firms. I construct a firm-level net investment ratio defined as capital expenditures minus depreciation over total assets. These firm-level measures are then averaged across firms within each state to generate a state-level net investment index.

Economic policy uncertainty index. I use the state-level EPU index developed by Baker et al. (2022), available at `https://www.policyuncertainty.com/state`. This text-based index captures policy-related uncertainty using local newspaper coverage and provides state-level variation in economic uncertainty.

Climate-related risk data. Data on severe weather and extreme climate events are obtained from the National Centers for Environmental Information (NCEI). The database includes 48 types of events—ranging from localized phenomena such as thunderstorms and flash floods to regional disasters like hurricanes and winter storms. I use county-level data on property and crop damage as proxies for climate-related risk.

State-level political composition. Data on state legislature composition from 2009 to 2021 are digitized from the National Conference of State Legislatures (NCSL). Historical data (1994–2008) are obtained from Carl Klarner's dataset hosted on Harvard Dataverse. For each chamber, I compute the Partisan Herfindahl-Hirschman Index (HHI) and a political alignment index ranging from -1 to 1, where 1 indicates full Democratic control and -1 indicates full Republican control.

Local economic variables. County-level unemployment data are sourced from the Local Area Unemployment Statistics (LAUS) program. Population and per capita income data are obtained from the U.S. Bureau of Economic Analysis (BEA).

Federal funds rate. The effective federal funds rate series is retrieved from the Federal Reserve Economic Data (FRED) maintained by the Federal Reserve Bank of St. Louis.

Firm-level EPU index. I also use a firm-level policy uncertainty index derived from the Management Discussion and Analysis (MD&A) sections of 10-K annual reports filed by publicly listed U.S. firms from 1994 to 2023. These sections contain forward-looking statements about business conditions, regulatory risks, and macroeconomic expectations. Natural language processing (NLP) techniques are applied to extract policy-related uncertainty. Text preprocessing includes tokenization, stop-word removal, stemming, and sentence segmentation prior to index construction.

A.2 Variable Definition

Table 19 reports the definitions and construction formulas for the non-financial firm variables used in the empirical analysis. Most accounting variables are obtained from the Compustat database. All variables are expressed in the units indicated, and ratios are calculated as percentages unless otherwise noted.

B.1 Deposits Demand Estimation via the BLP Model

To analyze household deposit demand in a competitive banking environment, we adopt the framework of the Berry-Levinsohn-Pakes (BLP) random coefficients discrete choice model, as developed in Berry, Levinsohn, and Pakes (1995), extended by Nevo (2001), and recently applied in the banking context by Wang, Whited, Wu, and Xiao (2022). This approach allows for heterogeneity in household preferences for bank characteristics and provides a flexible structure to estimate substitution patterns across deposit products. Specifically, we estimate demand for deposits using variation in observed bank attributes—such as the number of branches and the number of employees per branch—as well as market-level variation in economic policy uncertainty (EPU). We additionally incorporate bank and time fixed effects to absorb unobserved heterogeneity.

The indirect utility that household i derives from depositing funds in bank j in market t is given by:

$$u_{ijt} = \alpha_i r_{jt} + \beta_i x_{jt} + \gamma_i z_t + \xi_{jt} + \varepsilon_{ijt}, \tag{29}$$

where r_{jt} denotes the deposit interest rate offered by bank j in market t, x_{jt} is a vector of observable bank characteristics (e.g., branch network, service quality), and z_t is the state-level economic policy uncertainty index, which captures time-varying macroeconomic risk perceived by households. The term ξ_{jt} represents unobserved bank characteristics known to the consumer but not to the econometrician, and ε_{ijt} is an idiosyncratic error term, assumed to follow the standard Type I extreme value distribution. The coefficients α_i, β_i, and γ_i capture consumer-specific sensitivities to interest rates, non-rate bank characteristics, and macroeconomic uncertainty, respectively. Heterogeneity in these taste parameters is critical for capturing realistic substitution patterns across deposit options.

Each consumer chooses the deposit product that provides the highest utility among the available alternatives, including outside options such as Treasury securities and physical cash. Formally, consumer i chooses bank j if and only if $u_{ijt} \geq u_{ikt}$ for all k in the choice set $\mathcal{A}^d$. Under the logit structure implied by the distributional assumptions on ε_{ijt}, we obtain the following expression for the market share of bank j in market t:

$$s_{jt}(r_j \mid f) = \sum_{i=1}^{I} \mu_i \frac{\exp(\alpha_i r_{jt} + \beta_i x_{jt} + \gamma_i z_t + \xi_{jt})}{\exp(\alpha_i f + \beta_i x_0 + \gamma_i z_t + \xi_0) + \exp(\beta_i x_c + \gamma_i z_t + \xi_c) + \sum_{m=1}^{J} \exp(\alpha_i r_{mt} + \beta_i x_{mt} + \gamma_i z_t + \xi_{mt})}, \tag{30}$$

Table 19: Variable Definitions for Non-Financial Firm Variables

Variable	**Definition / Formula**
Total Assets (million USD)	Book value of total assets (AT).
Cash Holdings (million USD)	Cash and short-term investments (CHE).
Ivestment Expenditures (million USD)	Capital expenditures (CAPX), measured as funds used to acquire, upgrade, or maintain physical assets such as property, industrial buildings, or equipment.
Total Debt (million USD)	Sum of long-term debt (DLTT, Long-Term Debt – Total) and debt in current liabilities (DLC, Debt in Current Liabilities).
Employees (thousand)	Number of employees (EMP).
Leverage Ratio (%)	$\frac{\texttt{DLTT}+\texttt{DLC}}{\texttt{AT}} \times 100$, where DLTT = Long-Term Debt – Total, DLC = Debt in Current Liabilities, and AT = Total Assets.
Return on Assets (%)	$\frac{\texttt{IB}}{\texttt{AT}} \times 100$, where IB = Income Before Extraordinary Items, AT = Total Assets.
Dividends to Net Income Ratio (%)	$\frac{\texttt{DVT}}{\texttt{NI}} \times 100$, where DVT = Dividends – Total, NI = Net Income.
Cash to Assets Ratio (%)	$\frac{\texttt{CHE}}{\texttt{AT}} \times 100$, where CHE = Cash and Short-Term Investments, AT = Total Assets.
Debt to Assets Ratio (%)	$\frac{\texttt{DLTT}+\texttt{DLC}}{\texttt{AT}} \times 100$, where DLTT = Long-Term Debt – Total, DLC = Debt in Current Liabilities, AT = Total Assets.
Debt Maturity (%)	$\left[1 - \frac{\texttt{DD1}}{\texttt{DLC}+\texttt{DLTT}}\right] \times 100$, where DD1 = Debt Maturing Within One Year, DLC = Debt in Current Liabilities, DLTT = Long-Term Debt – Total.
Tobin's Q	$\frac{\texttt{AT}+\texttt{PRCC\_F}\times\texttt{CSHO}-\texttt{CEQ}}{\texttt{AT}}$, where PRCC_F = Closing Price at Fiscal Period End, CSHO = Common Shares Outstanding, CEQ = Common Equity, AT = Total Assets.

where μ_i is the share of total household wealth held by consumer type i, x_0 and ξ_0 correspond to Treasury bills, and x_c and ξ_c represent the characteristics of cash holdings. The inclusion of these outside options is essential for capturing realistic household portfolio decisions, especially under heightened uncertainty.

Finally, the deposit demand function for bank j is given by the product of its market share and the total wealth available for allocation across deposit vehicles:

$$D_j(r_j \mid f) = s_j(r_j \mid f) \cdot W, \tag{31}$$

where W denotes aggregate household wealth in the market. This formulation captures how deposit demand responds not only to changes in interest rates and bank attributes, but also to fluctuations in macroeconomic uncertainty. In particular, by incorporating the economic policy uncertainty index z_t directly into the utility specification, the model allows us to trace how increased uncertainty shifts household preferences across liquid and illiquid assets. This extension is especially relevant in periods of financial stress, when precautionary motives dominate and bank-specific features may play a secondary role in household deposit allocation decisions.

The estimated coefficients from this model are presented in Table 20. The coefficient on the log of the state-level EPU index (`log_epu_state`) is positive and statistically significant at the 1% level. This result implies that, all else equal, increases in economic policy uncertainty are associated with higher demand for bank deposits. One plausible interpretation is that during periods of heightened uncertainty, households shift a greater portion of their portfolios toward safe, liquid, and insured financial instruments such as bank deposits—consistent with the precautionary savings motive and flight-to-safety behavior.

C.1 Bank Run Empirical Specification

In this section, we estimate the relationship between banks' exposure to run risk and their future distress using panel data regressions. We implement two complementary approaches: a binary response model for default probability using a complementary log-log (cloglog) regression, and a continuous response model using OLS regression for future Z-scores.

The benchmark specification is given by:

$$\text{Distress}_{i,q+n} = \beta_1 \cdot \log(\text{EPU\_State}) + \mathbf{X}'_{i,q} \cdot \beta + \gamma_i + \delta_q + \varepsilon_{i,q} \tag{32}$$

In this specification, the dependent variable $\text{Distress}_{i,q+n}$ denotes either a default indicator (in the cloglog regression) or the bank's Z-score (in the OLS specification), measured n quarters ahead. The main explanatory variable $\text{RunRiskRatio}_{i,q}$ captures the post-shock leverage ratio under the authors' proposed run-risk simulation. The term $\log(\text{EPU\_State})$ denotes the logarithm of state-level economic policy uncertainty, included to control for exogenous risk factors affecting bank behavior.

To assess heterogeneous effects by bank fragility status, we include two triple interaction terms: one for non-fragile banks ($\text{RunFlag} = 0$) and one for fragile banks ($\text{RunFlag} = 1$), where the interaction involves

Table 20: BLP Demand Estimation for Bank Deposits

	Deposit
log_epu_state	0.141***
	(0.024)
log_numbranch	1.013***
	(0.004)
log_numemp_numbran	1.121***
	(0.008)
price	-0.362***
	(0.074)
Year Fixed Effects	Yes
Observations	12,985
Adjusted R-squared	0.88

Notes: This table reports the estimation results from the BLP demand model for bank deposits. The dependent variable is consumer deposit demand at the bank-market level. Robust standard errors are in parentheses. All regressions include year fixed effects. *** denotes significance at the 1% level.

the run risk ratio and the change in interest rates (RateDiff). These terms allow the effect of rising rates to vary depending on the bank's underlying vulnerability.

The vector of controls $\mathbf{X}_{i,q}$ includes standard time-varying bank characteristics such as: $\text{Leverage}_{i,q}$ (Tier 1 capital ratio), $\log(\text{Assets}_{i,q})$ (log of total assets), $\text{RWA/Assets}_{i,q}$ (risk-weighted asset ratio), $\text{Trading/Assets}_{i,q}$, $\text{Loans/Assets}_{i,q}$, Return on Assets $(\text{RoA})_{i,q}$, and Non-interest income to gross income $(\text{NII/GI})_{i,q}$.

All regressions include bank fixed effects γ_i and year fixed effects δ_q to absorb time-invariant bank heterogeneity and macroeconomic trends. Standard errors are clustered at the bank level.

Estimation results in Table 21 show that higher EPU is significantly associated with increased default probability and lower future Z-scores. The Run Risk Ratio is a strong predictor of distress: banks identified as fragile have a significantly higher likelihood of default and lower financial resilience. Furthermore, the interaction terms confirm that fragile banks are more vulnerable to rising interest rates, consistent with the theoretical underpinnings of the model.

B.2 XGBoost Classification

We use the same set of predictors as in the cloglog model: log(EPU_state), the Run Risk Ratio, its interaction with interest rate changes, and standard bank-level controls such as leverage, log(assets), ROA, RWA-to-assets, trading-to-assets, loans-to-assets, and NII-to-GI.

The XGBoost model is trained using 5-fold cross-validation on the full sample. Hyperparameters (such as learning rate, max depth, number of trees, and regularization strength) are selected via randomized search to optimize AUC.

The performance of the XGBoost model is evaluated using the out-of-sample Area Under the Curve (AUC), precision-recall metrics, and calibration plots. Feature importance is assessed using SHAP values to ensure interpretability and comparison with the structural cloglog model.

To assess the predictive role of state-level economic policy uncertainty (EPU) in driving systemic bank default risk, we develop a machine learning classification model using XGBoost. The model incorporates both macro-level uncertainty and micro-level balance sheet data, allowing for nonlinear interactions between risk channels. As shown in Figure 14, the classifier performs exceptionally well: the confusion matrix in panel (a) indicates a 98.3% accuracy rate for non-defaulting banks and 94.4% for defaults. The ROC curve in panel (c) yields an AUC of 0.962, and the precision–recall curve in panel (b) demonstrates sustained robustness even under class imbalance.

Crucially, the feature importance rankings presented in panel (d) confirm the centrality of log(EPU_state) as a top predictor. Even after accounting for traditional indicators such as leverage, the runnable risk ratio, and unrealized losses, state-level EPU contributes significantly to model performance. This highlights the powerful and persistent role of regional policy uncertainty in shaping the fragility of financial institutions.

In sum, the XGBoost results provide robust evidence that macroeconomic policy uncertainty—especially at the state level—is not merely a background risk but a direct driver of systemic vulnerability in the banking sector. The predictive power and interpretability of the model confirm and extend the findings from

Table 21: The Effect of EPU on Bank Run

	(1) Default (cloglog)	*(2) Z-score (OLS)*
log(EPU_state)	0.6404***	-0.3001***
	(0.098)	(0.037)
Run Risk Ratio	-0.3551***	0.8569***
	(0.013)	(0.008)
Leverage Ratio	0.3174***	-1.9289***
	(0.021)	(0.015)
log(Assets)	0.0079	-3.1883***
	(0.042)	(0.045)
RWA / Assets	-0.0164***	-0.0110***
	(0.003)	(0.001)
Trading / Assets	0.0715***	-0.0721*
	(0.020)	(0.039)
Loans / Assets	0.0101**	-0.0947***
	(0.005)	(0.003)
Return on Assets (ROA)	-4.7037***	95.9981***
	(0.388)	(0.045)
Non-Interest Income / Gross Income	0.0175	-0.0459**
	(0.308)	(0.023)
Bank Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Observations	653,372	653,372
Adjusted R^2	–	0.881

Notes: Robust standard errors are reported in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Figure 14: XGBoost Classification Performance and Feature Importance

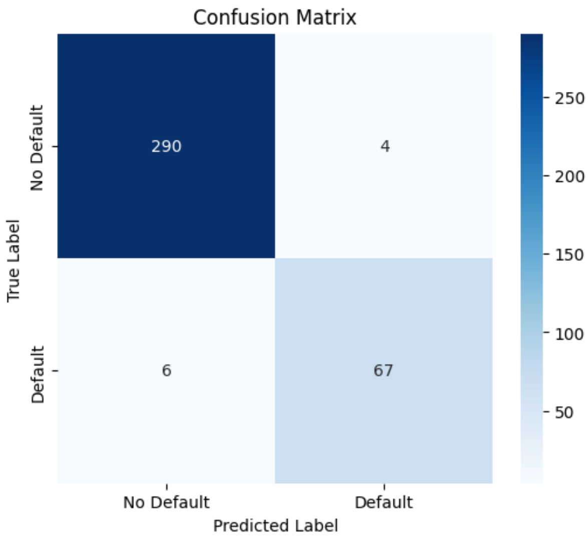

Figure 15: (a) Confusion Matrix

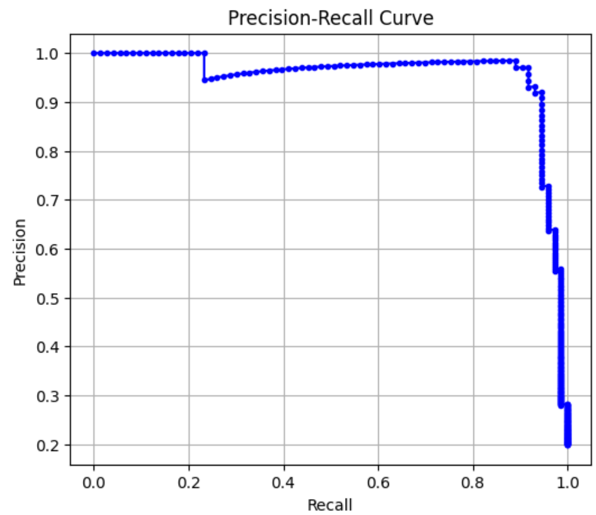

Figure 16: (b) Precision–Recall Curve

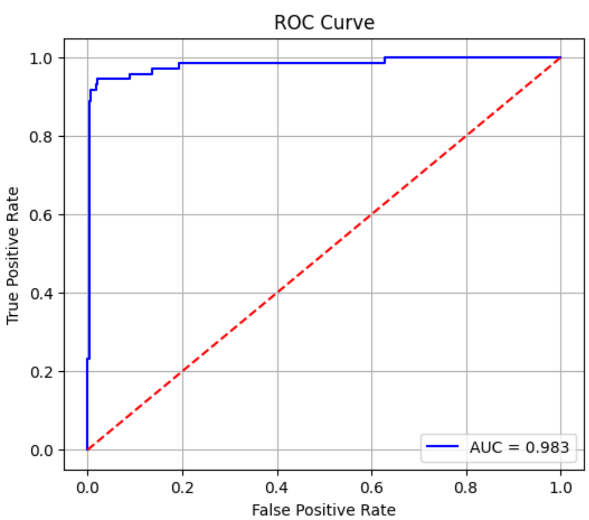

Figure 17: (c) ROC Curve

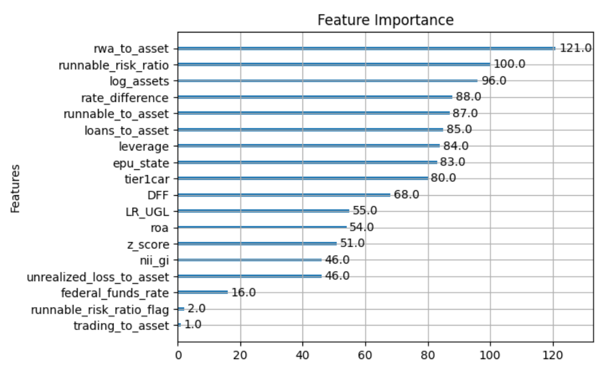

Figure 18: (d) Feature Importance (SHAP)

traditional econometric estimation.