RISK APPETITE AND MACROECONOMIC OUTCOMES

A Master's Thesis

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Ankara
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The Graduate School of Economics and Social Sciences
of
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by

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In Partial Fulfillment of the Requirements for the Degree of
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By Hasan Mirasyedi

I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

RISK APPETITE AND MACROECONOMIC OUTCOMES

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This thesis examines the macroeconomic effects of risk-appetite shocks using a proxy-SVAR approach with high-frequency external instruments. While asset-pricing theory assigns a central role to time-varying risk premia, identifying their causal impact on real activity remains challenging due to the endogenous response of financial indicators to macroeconomic news. Using a purified cross-asset Risk-Appetite Index from Bauer et al. (2023) as an external instrument for monthly data spanning 1990-2022, we find that a one-standard-deviation increase in risk aversion—equivalent to a 3.8 index point rise in the VIX—generates significant contractionary effects: industrial production declines by 0.66% with effects persisting for over a year, the consumer price index falls by 0.17% over 15 months, and the federal funds rate drops by 9.9 basis points at month 3, remaining below baseline for 26 months. Durable consumption exhibits a sharp 1.2% decline on impact, highlighting the credit-channel transmission. These effects are nearly double those from traditional Cholesky identification, which understates real impacts and produces implausible long-run price dynamics. Risk-appetite shocks account for 20.5% of industrial production forecast error variance at the three-month horizon under our identification. Robustness checks using the excess bond premium reveal potential contamination from other financial shocks, as evidenced by puzzling long-run price reversals, validating our choice of the cross-asset risk-appetite measure. These findings underscore the importance of proper identification for understanding financial-macro linkages and establish risk-appetite fluctuations as quantitatively important drivers of business cycle dynamics.

Keywords: financial shocks, high-frequency external instruments, proxy-SVAR, risk appetite, risk premia

ÖZET

Risk İştahı ve Makroekonomik Sonuçlar

Mirasyedi, Hasan
Yüksek Lisans, İktisat Bölümü
Tez Danışmanı: Dr. Öğr. Üyesi Burçin Kısacıkoğlu

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Bu tez, yüksek frekanslı dışsal araçlarla tanımlanan yapısal VAR yöntemiyle risk-iştahı şoklarının makroekonomik sonuçlarını nicel olarak analiz etmektedir. Finansal değişkenler makroekonomik haberlere içsel olarak tepki verdiği için, zamana bağlı risk primlerinin reel faaliyet üzerindeki nedensel etkisini saptamak güçtür. Bu engeli aşmak amacıyla, 1990–2022 dönemine ait aylık ABD verilerinde Bauer et al. (2023) tarafından geliştirilen arındırılmış çapraz-varlık Risk-İştahı Endeksi dışsal araç olarak kullanılmaktadır. Riskten kaçınmada bir standart sapmalık artış—VIX endeksinde 3,8 puanlık yükselişe eşdeğer—belirgin daraltıcı sonuçlar doğurmaktadır: sanayi üretimi %0,66 gerileyerek bir yıldan fazla süreyle anlamlı kalırken, tüketici fiyat endeksi 15 ay boyunca %0,17 düşmekte ve federal fonlar faizi 3. ayda 9,9 baz puan azalarak 26 ay boyunca baz çizginin altında seyretmektedir. Dayanıklı tüketim harcamaları anlık olarak %1,2 oranında keskin bir düşüş sergileyerek kredi kanalı üzerinden iletimi öne çıkarmaktadır. Bu etkiler, reel tepkileri bastıran ve uzun vadeli fiyat dinamiklerinde tutarsızlıklar üreten geleneksel Cholesky tanımlamasının neredeyse iki katıdır. Önerilen tanımlama altında risk-iştahı şokları, üç aylık öngörü ufkunda sanayi üretiminin tahmin hatası varyansının %20,5'ini açıklamaktadır. Aşırı tahvil primi kullanılarak yapılan sağlamlık kontrolleri, uzun vadeli fiyat tersine dönüşleri gibi şaşırtıcı sonuçlarla diğer finansal şok kaynaklı olası bulaşmayı ortaya koyarak, çapraz-varlık risk-iştahı ölçütü tercihini doğrulamaktadır. Bulgular, finansal-makro ilişkilerde doğru tanımlamanın önemini vurgulamakta ve risk-iştahı dalgalanmalarının konjonktür dalgalanmalarını yönlendirmedeki nicel önemini ortaya koymaktadır.

Anahtar Kelimeler: finansal şoklar, proxy-SVAR, risk iştahı, risk primleri, yüksek frekanslı dışsal araçlar.

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CHAPTER 1

INTRODUCTION

Asset-pricing theory assigns a central role to the price of risk in determining returns and financing conditions (Cochrane, 2005). Because that price fluctuates with investors' risk appetite, sudden changes in risk premia can reprice credit, alter borrowing capacity, and propagate through spending and production. Understanding the macroeconomic consequences of those risk-appetite shocks is essential for both researchers and policymakers.

However, an important obstacle in understanding such effects is the simultaneity between risk appetite and macro conditions. Bad times decrease risk appetite, whereas lower risk appetite may amplify bad times (Bernanke et al., 1999; Adrian et al., 2019). In particular, the indicators that proxy for risk sentiment—the excess-bond-premium in corporate spreads (Gilchrist and Zakrajšek, 2012), the risk-aversion component of the VIX (Bekaert et al., 2013), intermediary leverage (Adrian and Shin, 2010), or the risk-appetite index of Bauer et al. (2023)—adjust almost instantaneously to macroeconomic announcements. Simple correlations therefore cannot pin down the direction of causality. Early empirical studies relied on recursively ordered VARs (Sims, 1980), but—as stressed by Christiano et al. (1999)—their zero-impact restrictions flip whenever the ordering of variables changes. Contemporary work instead exploits external instruments that isolate high-frequency surprises in announcement windows—for example monetary-policy shocks (Gertler and Karadi, 2015), gold-price responses to uncertainty news (Piffer and Podstawski, 2018), or narrative tax innovations (Mertens and Ravn, 2013). The resulting proxy-SVAR framework of Stock and Watson (2012), further formalized by Montiel Olea et al. (2021), identifies only the structural shock correlated with the chosen instrument, leaving other disturbances unrestricted.

This thesis adopts that strategy to quantify risk-appetite shocks from 1990:01 to 2022:03. Two daily instruments supply the exogenous variation. First, the cross-asset Risk-Appetite Index of Bauer et al. (2023) extracts the common factor in fourteen equity, credit, bond-volatility and foreign-exchange measures. Second, the excess bond premium of Gilchrist et al. (2021) isolates the component of corporate-bond spreads unrelated to expected default. Following Altavilla et al. (2017), each daily series is "purged" of predictable reactions to forty-one Bloomberg macro-news surprises and to intraday monetary-policy shocks from Bauer and Swanson (2023). Residuals are summed within each month and used as external instruments. First-stage tests show that the risk-appetite index is a strong predictor of reduced-form innovations (Robust F-statistic of 20.5), whereas the excess-bond-premium is weaker on its own but useful for robustness.

We examine the effects of risk appetite shocks in a five-variable VAR: the logarithms of industrial production, the headline consumer price index, and real PCE-durables, together with the effective federal funds rate and the CBOE VIX. A 12-lag specification follows Gertler and Karadi (2015). Following their approach, we estimate reduced-form VAR coefficients using the full 1990-2022 sample, then apply the external instruments for identification only in periods where they are available. Identification is invariant to any reordering of these variables because the proxy-SVAR targets only the column of the impact matrix that correlates with the instruments.

Asset-pricing theory clarifies the economic content of the identified shock. In a consumption-based framework, expected excess returns equal the product of two components: the quantity of risk (beta) and the price of risk (lambda). The quantity of risk measures how strongly an asset's returns covary with aggregate consumption, while the price of risk—determined by investors' risk aversion times consumption volatility—captures the market-wide compensation per unit of risk (Cochrane, 2005). Because post-war U.S. consumption volatility is remarkably stable—below 2% per year (Campbell, 2003)—time variation in risk premia must stem mainly from fluctuations in risk aversion. Habit models generate counter-cyclical swings in risk aversion when consumption falls relative to habit (Campbell and Cochrane, 1999); intermediary models tie it to balance-sheet constraints (He and Krishnamurthy, 2013; Adrian and Shin, 2010). A rise in risk aversion raises the price of risk one-for-one and widens required premia.

A one-standard-deviation increase in risk aversion—equivalent to a 3.8 index point rise in the VIX—induces a 0.66% decline in industrial production, with effects remaining statistically significant for over a year. The CPI falls by 0.17% over 15 months, while durable consumption drops 1.2% on impact. The federal funds rate declines by 9.9 basis points at month 3 and remains below baseline for 26 months. Forecast-error variance decompositions attribute 20.5% of three-month industrial-production volatility to these shocks, with contributions gradually diminishing over the forecast horizon. While results prove qualitatively robust to alternative instrument specifications, the excess bond premium produces some puzzling long-run price dynamics when used alone. Comparison with recursive Cholesky identification reveals that traditional methods understate real effects by nearly half and generate implausible price responses, highlighting the value of external instruments for identification.

Our results show that the transmission mechanism is consistent with the Bernanke-Gertler-Gilchrist financial accelerator (Bernanke et al., 1999). Higher premia raise external-finance costs, erode net worth, and reduce investment; lower premia do the opposite. A number of DSGE studies capture these dynamics by introducing reduced-form "risk-premium shocks," yet the data-driven evidence on the size and persistence of such shocks remains limited. By providing new causal estimates, the present work seeks to complement and inform that theoretical research.

This study aims to shed light on risk-aversion shocks by pairing high-frequency external instruments with the proxy-SVAR approach. In doing so, it provides evidence on the size and persistence of these shocks since 1990 and explores how they propagate through the financial-accelerator channel. The aim is that the empirical results will complement existing DSGE work and help clarify the macroeconomic relevance of fluctuations in risk appetite.

Chapter 2 details data construction and instrument cleaning, Chapter 3 sets out the econometric framework, Chapter 4 presents the empirical results and robustness checks, and Chapter 5 concludes.

CHAPTER 2

DATA

The estimation window runs from January 1990—when the CBOE VIX first becomes available—through March 2022, the last month for which the daily excess-bond-premium (EBP) series is currently published. Table 2.1 summarizes the five endogenous variables that enter the VAR; each is observed at a monthly frequency and is fed into the model in the exact form reported in the third column.

Table 2.1: Endogenous monthly variables: source and transformation

Series	**Source**	**Transformation in VAR**
Industrial production	FRED	$100 \times \ln(\text{IP})$
Consumer price index	FRED	$100 \times \ln(\text{CPI})$
Real PCE durables	FRED†	$100 \times \ln(\text{Durable})$
Federal funds rate	FRED	Level (%)
VIX (implied volatility)	FRED	Level (Index)

† Back-cast with BEA's durables price index; see text.

The official U.S. Bureau of Economic Analysis (BEA) series for real durable-goods personal consumption expenditures begins in 2007. For the earlier part of the sample we deflate nominal PCE-Durables with the BEA's durables price index and then splice the resulting back-cast to the published series at January 2007.

A single scaling factor aligns the levels, yielding a continuous measure in billions of chained 2017 dollars that is fully consistent with BEA methodology. All real-activity variables—CPI, industrial production, and real durables—enter the VAR in logarithms scaled by 100 to convert percentage movements into additive units. Financial variables (VIX, federal-funds rate) remain in levels because their economic interpretation is tied to their absolute changes.

To capture daily fluctuations in investors' risk appetite, we combine two complementary high-frequency indicators. Bauer et al. (2023) develop a cross-asset risk-appetite index by extracting the common component of 14 risk indicators drawn from equity, fixed-income, credit and foreign-exchange markets. They estimate the index via an iterative principal-component procedure that deals with missing data. The index includes the S&P500 and NASDAQ composites, implied volatility measures such as the VIX and MOVE indices, corporate bond spreads and exchange-rate measures. The series is published as a z-score, so daily innovations are simply $\Delta \mathrm{RAI}_d = \mathrm{RAI}_d - \mathrm{RAI}_{d-1}$. We obtain the latest RAI series from the replication files of Bauer et al. (2023); their data span January 1988 to May 2022.

Gilchrist et al. (2021) construct daily excess-bond-premium measures using TRACE corporate-bond transaction data. The EBP is defined as the part of corporate-bond credit spreads that cannot be explained by expected default risk and therefore captures the effective risk-bearing capacity of financial intermediaries. The authors provide aggregate as well as short-, medium- and long-maturity EBP series; in their analysis the short-term EBP spikes during periods of financial stress—such as the peaks of the COVID-19 pandemic and the 2007–09 global financial crisis—and subsides around the 2015 interest-rate liftoff. We use the aggregate daily EBP series released by the Federal Reserve

Bank of Atlanta, which currently spans July 2002 through March 2022[1].

Daily financial instruments may respond to information released during macroeconomic announcements or FOMC meetings, potentially contaminating their use as exogenous variation. To address this concern, we purge each instrument of predictable reactions by regressing its daily change on two comprehensive sets of high-frequency surprises. First, following Altavilla et al. (2017), we control for the complete set of 41 Bloomberg Economic Calendar macro-news surprises they identify, spanning all major U.S. macroeconomic releases including employment indicators, price indices, production data, housing statistics, confidence surveys, and GDP components. Second, we include monetary policy surprises constructed from intraday futures movements around FOMC announcements, from Bauer and Swanson (2023). This approach ensures that our instruments capture only the unexpected component of daily financial market movements, orthogonal to the full spectrum of scheduled information releases.

The cleaning procedure is implemented through a daily regression for each instrument $x \in \{\text{RAI}, \text{EBP}\}$:

$$\Delta x_t = \alpha + \beta_1 \text{MP}_t + \beta_2 \text{MN}_t + \varepsilon_t \tag{2.1}$$

where Δx_t denotes the daily change in instrument x, MP_t represents the monetary policy surprise on day t, and MN_t is the 41-dimensional vector of macro-news surprises from Altavilla et al. (2017). The residual $\hat{\varepsilon}_t$ captures the unexpected component of the instrument's movement, purged of responses to scheduled announcements. Due to data availability, the full specification with all 41 macro controls applies from January 2000 onward, when the Bloomberg macro-news series are all available.

[1] https://www.atlantafed.org/research/publications/policy-hub/2021/09/24/12--term-structure-of-excess-bond-premium

To construct monthly instruments suitable for VAR estimation, we aggregate the cleaned daily residuals to monthly frequency. Specifically, the monthly instrument is computed as $Z_m = \sum_{t \in m} \hat{\varepsilon}_t$. The resulting monthly series preserve the exogenous variation in the original instruments while removing predictable responses to the comprehensive set of scheduled information releases.

The following figures show the instruments over time. Note that Bauer et al. (2023) originally constructs their index such that increases indicate higher risk appetite (lower risk aversion). For consistency with the other variables in our analysis—where increases in the VIX and EBP indicate heightened risk aversion—we multiply the RAI by -1. This ensures that increases in all risk indicators correspond to "risk-off" episodes.

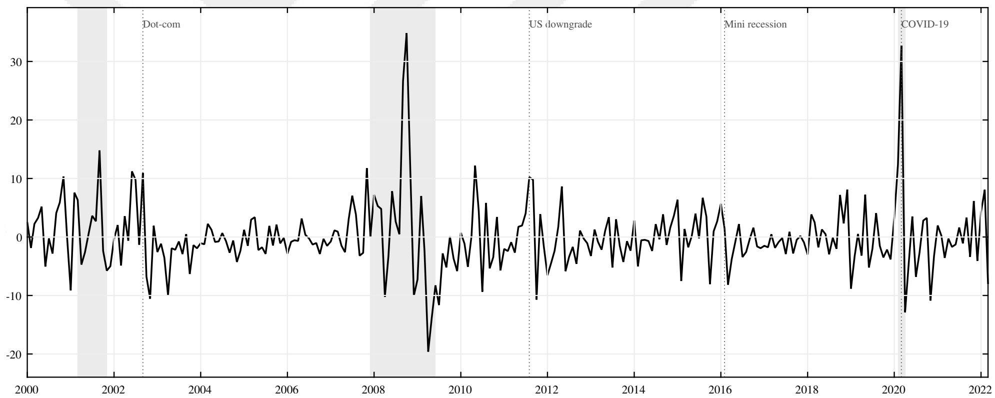

Figure 2.1: Purified Bauer et al. (2023) Risk Appetite Index. Shaded bars denote NBER recessions.

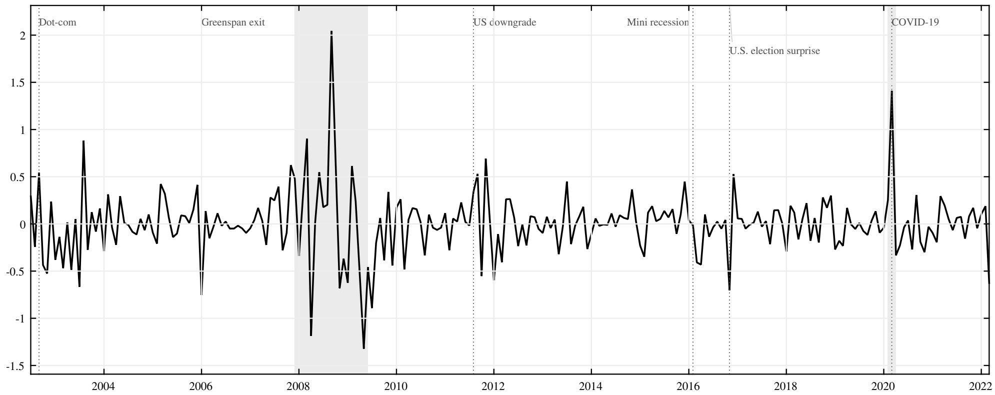

Figure 2.2: Purified Daily Excess Bond Premium changes from Gilchrist et al. (2021). Shaded bars denote NBER recessions.

CHAPTER 3

METHODOLOGY

The monthly data set contains 387 observations (1990:01 – 2022:03). The $K = 5$ endogenous variables are stacked as

$$y_t = [\ln \text{IP}_t,\ \ln \text{CPI}_t,\ \ln \text{Durable}_t,\ \text{FFR}_t,\ \text{VIX}_t]'$$

where VIX the CBOE implied-volatility index, FFR the effective federal funds rate, and the remaining three entries are the logarithms of the headline consumer price index, industrial production, and real PCE–Durables (billions of chained 2017 dollars). Following the monthly VAR of Gertler and Karadi (2015), we use 12 lags.

We consider a structural VAR model,

$$\mathbf{B}_0 y_t = \mathbf{B}_1 y_{t-1} + \cdots + \mathbf{B}_{12} y_{t-12} + \varepsilon_t, \qquad \varepsilon_t \sim (\mathbf{0}, \mathbf{I}_K), \tag{3.1}$$

where $y_t \in \mathbb{R}^K$ is a K-dimensional vector of observed variables at time t, $\mathbf{B}_0 \in \mathbb{R}^{K \times K}$ is the contemporaneous impact matrix, $\mathbf{B}_\ell \in \mathbb{R}^{K \times K}$ are coefficient matrices for $\ell \in \{1, 2, \ldots, 12\}$, and $\varepsilon_t \in \mathbb{R}^K$ is a vector of orthonormal structural shocks, with the last element $\varepsilon_t^{\text{RA}}$ representing the risk-appetite shock of interest.

Pre-multiplying by $\mathbf{B}_0^{-1}$ yields the reduced-form VAR,

$$y_t = \mathbf{A}_1 y_{t-1} + \cdots + \mathbf{A}_{12} y_{t-12} + u_t, \qquad u_t \sim (\mathbf{0}, \mathbf{\Sigma}_u), \tag{3.2}$$

where $\mathbf{A}_\ell = \mathbf{B}_0^{-1}\mathbf{B}_\ell$ and $u_t = \mathbf{B}_0^{-1}\varepsilon_t$. This establishes the mapping between reduced-form innovations and structural shocks,

$$u_t = \mathbf{B}\varepsilon_t, \qquad \mathbf{B} \equiv \mathbf{B}_0^{-1}, \tag{3.3}$$

where $\mathbf{B} \in \mathbb{R}^{K\times K}$ is the impact matrix. The covariance restriction $\mathbf{\Sigma}_u = \mathbf{B}\mathbf{B}'$ yields $K(K+1)/2$ unique moments, but $\mathbf{B}$ contains K^2 unknown parameters, leaving $K(K-1)/2$ degrees of freedom that must be addressed through identification restrictions.

Stacking the reduced-form equations in a companion representation with $p = 12$ lags,

$$Y_t = \mathbf{F}Y_{t-1} + V_t, \quad \mathbf{F} = \begin{bmatrix} \mathbf{A}_1 & \mathbf{A}_2 & \cdots & \mathbf{A}_{11} & \mathbf{A}_{12} \\ \mathbf{I}_K & \mathbf{0} & \cdots & \mathbf{0} & \mathbf{0} \\ \vdots & \ddots & & \vdots & \vdots \\ \mathbf{0} & \cdots & & \mathbf{I}_K & \mathbf{0} \end{bmatrix},$$

where:

- $Y_t = [y_t', y_{t-1}', \ldots, y_{t-11}']' \in \mathbb{R}^{Kp}$: stacked state vector
- $V_t = [u_t', \mathbf{0}', \ldots, \mathbf{0}']' \in \mathbb{R}^{Kp}$: stacked innovation vector
- $\mathbf{F} \in \mathbb{R}^{Kp\times Kp}$: companion matrix
- $\mathbf{I}_K$: $K \times K$ identity matrix
- $\mathbf{0}$: $K \times K$ zero matrix

Under the stability condition $\rho(\mathbf{F}) < 1$ (spectral radius), the VAR inverts to MA form:

$$y_t = \sum_{h=0}^{\infty} \mathbf{C}_h u_{t-h}, \qquad \mathbf{C}_h = \mathbf{J}\mathbf{F}^h\mathbf{J}', \quad \mathbf{J} = [\mathbf{I}_K \; \mathbf{0}_{K\times K(p-1)}], \tag{3.4}$$

where h denotes the horizon index, $\mathbf{C}_h \in \mathbb{R}^{K\times K}$ are the MA coefficient matrices, and $\mathbf{J} \in \mathbb{R}^{K\times Kp}$ is a selection matrix consisting of the $K \times K$ identity matrix followed by $K \times K(p-1)$ zeros. Combining equations (3.3) and (3.4), the structural MA representation becomes

$$y_t = \sum_{h=0}^{\infty} \mathbf{C}_h \mathbf{B} \varepsilon_{t-h} = \sum_{h=0}^{\infty} \mathbf{\Theta}_h \varepsilon_{t-h}, \tag{3.5}$$

where $\mathbf{\Theta}_h = \mathbf{C}_h\mathbf{B}$ are the structural impulse-response matrices that map structural shocks onto current and future values of the observables.

For comparison with earlier studies, a benchmark Cholesky decomposition is applied to $\mathbf{\Sigma}_u$. The ordering

$$y_t = [\ln \text{IP}_t,\ \ln \text{CPI}_t,\ \ln \text{Durable}_t,\ \text{FFR}_t,\ \text{VIX}_t]'$$

follows a plausible intra-month information hierarchy. Real-side indicators (industrial production and consumer durables expenditures) are placed first, reflecting their slow-moving nature and publication lags that prevent them from responding contemporaneously to financial variables within the month. Prices (CPI) can respond to real activity but are generally published mid-month, before monetary policy decisions. Following Christiano et al. (1999), the federal-funds rate is ordered after real variables and prices, allowing monetary policy to respond within the month to macroeconomic conditions. The VIX occupies the bottom position, as financial-market volatility can react almost instantaneously to all macroeconomic and policy news—a convention also adopted by Gertler and Karadi (2015) when examining financial shocks. Because Cholesky identification hinges on zero-impact restrictions implied by this ordering, any re-ordering would yield different structural interpretations—hence the need to defend a specific hierarchy.

Crucially, the recursive ordering affects only the Cholesky-based impulse responses that we report for comparison. The baseline identification of risk-appetite shocks employs external instruments in the spirit of Gertler and Karadi (2015). While traditional Cholesky decomposition imposes zero restrictions on the upper triangle of $\mathbf{B}$ based on our recursive ordering, we follow the proxy-SVAR approach of Stock and Watson (2012) and Mertens and Ravn (2013) for our main identification.

Following Gertler and Karadi (2015), we identify the risk-appetite shock $\varepsilon_t^{\mathrm{RA}}$ as the last element of ε_t. Let Z_t be a vector of instrumental variables and let $\varepsilon_t^q = [\varepsilon_{1,t}, \ldots, \varepsilon_{K-1,t}]'$ be the vector of structural shocks other than the risk-appetite shock. To be a valid set of instruments for the RA shock, Z_t must be correlated with $\varepsilon_t^{\mathrm{RA}}$ but orthogonal to ε_t^q, as follows:

$$E[Z_t \varepsilon_t^{\mathrm{RA}}] = \phi \neq 0 \tag{3.6}$$

$$E[Z_t \varepsilon_t^{q'}] = \mathbf{0} \tag{3.7}$$

To obtain estimates of the elements in the vector $\mathbf{b}$ (the last column of $\mathbf{B}$), proceed as follows: First, obtain estimates of the vector of reduced form residuals u_t from the ordinary least squares regression of the reduced form VAR in equation (3.2). Then let $u_{5,t}$ be the reduced form residual from the equation for the VIX and let $u_{q,t}$ be the reduced form residual from the equation for variables $q \in \{1, \ldots, K-1\}$. Also, let $b_q \in \mathbf{b}$ be the response of $u_{q,t}$ to a unit increase in the RA shock $\varepsilon_t^{\mathrm{RA}}$. Then we can obtain an estimate of the ratio b_q/b_5 from the two stage least squares regression of $u_{q,t}$ on $u_{5,t}$, using the instrument set Z_t.

Intuitively, the first stage isolates the variation in the reduced form residual for the VIX that is due to the structural RA shock. It does so by regressing $u_{5,t}$ on Z_t

to form the fitted value $\hat{u}_{5,t}$. Given that the variation in $\hat{u}_{5,t}$ is due only to $\varepsilon_t^{\mathrm{RA}}$, the second stage regression of $u_{q,t}$ on $\hat{u}_{5,t}$ then yields a consistent estimate of b_q/b_5:

$$u_{q,t} = \frac{b_q}{b_5}\hat{u}_{5,t} + \xi_t \tag{3.8}$$

where $\hat{u}_{5,t}$ is orthogonal to the error term ξ_t, given the assumption that Z_t is orthogonal to all the structural shocks other than the RA shock $\varepsilon_t^{\mathrm{RA}}$. An estimate for b_5 is then derived from the estimated reduced form variance-covariance matrix $\mathbf{\Sigma}_u$. We are then able to identify b_q.

Our primary instrument is the risk-appetite index[1] Z_t^{RAI} detailed in Chapter 2. Following Gertler and Karadi (2015), we assess robustness using alternative instrument specifications: the excess bond premium Z_t^{EBP} alone, and the stacked vector $Z_t = [Z_t^{\mathrm{RAI}},\ Z_t^{\mathrm{EBP}}]'$ combining both instruments. For our baseline specification using Z_t^{RAI}, the instrument relevance is confirmed by a Robust F-statistic of 20.5, well above conventional critical values for weak-instrument concerns.

With $\widehat{\mathbf{b}}$ in hand, the h-step response of variable j to a unit RA shock is

$$\mathrm{IRF}_j(h) = e_j'\mathbf{C}_h\widehat{\mathbf{b}}, \qquad h = 0, \ldots, 48, \tag{3.9}$$

where e_j is the j-th unit vector and $\mathbf{C}_h$ are the MA coefficients from equation (3.4). Similarly, the share of the H-month-ahead forecast-error variance of variable j explained by RA shocks is

$$\mathrm{FEVD}_j^{\mathrm{RA}}(H) = \frac{\sum_{h=0}^{H-1}\left(e_j'\mathbf{C}_h\widehat{\mathbf{b}}\right)^2}{\sum_{h=0}^{H-1} e_j'\mathbf{C}_h\mathbf{\Sigma}_u\mathbf{C}_h' e_j}. \tag{3.10}$$

Following Gertler and Karadi (2015), we obtain pointwise 68% confidence bands via a wild bootstrap procedure with 1,000 replications. Each bootstrap iteration re-estimates the entire procedure—from VAR estimation through the estimation

[1]The published RAI rises with risk appetite; we multiply it by -1 so that larger values correspond to higher risk aversion, matching the sign of the VIX.

of $\widehat{b}$—to capture finite-sample uncertainty in the proxy-SVAR framework.

CHAPTER 4

RESULTS AND DISCUSSION

This chapter presents the empirical results from our structural VAR analysis of risk-appetite shocks. We begin in Section 4.1 by examining the validity and relevance of our external instruments through first-stage regression diagnostics. Section 4.2.1 presents the main impulse response functions from the proxy-SVAR identification, tracing the dynamic effects of risk-appetite shocks on macroeconomic variables. In Section 4.2.2, we decompose forecast error variance to quantify the importance of risk-appetite shocks for business cycle fluctuations. Section 4.3 assesses the robustness of our findings using alternative instrument specifications and sample periods, while comparing our results with traditional Cholesky identification. Throughout the analysis, we provide economic interpretation of the empirical findings and relate them to the theoretical predictions and existing empirical literature.

4.1 First-Stage Results

Table 4.1 reports first-stage regression results for our external instruments. The results strongly support the relevance of our baseline instrument. The RAI specification yields a robust F-statistic of 20.53, well above the rule-of-thumb threshold of 10 suggested by Stock and Yogo (2005), indicating a strong instrument. The positive and highly significant coefficient of 0.396 ($p < 0.01$)

confirms that increases in the risk-appetite index—reflecting heightened risk aversion—are associated with VIX innovations.

Table 4.1: First-Stage Regression Results

	(1) RAI	(2) EBP	(3) RAI and EBP
RAI	0.396***		0.352***
	(0.087)		(0.094)
EBP		3.966**	2.124*
		(1.687)	(1.153)
R^2	0.378	0.123	0.412
Adjusted R^2	0.376	0.119	0.407
Robust F-statistic	20.53	5.53	12.10
Observations	267	237	237

Notes: Dependent variable is the VIX residual from the VAR equation.
Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.10
Critical value for weak instruments: F > 10

In contrast, the EBP alone produces a weaker first-stage relationship with a robust F-statistic of 5.53, falling below the weak-instrument threshold. Despite the positive and significant coefficient of 3.966 ($p < 0.05$), the low F-statistic raises concerns about weak-instrument bias when using the EBP in isolation. When both instruments are used jointly (column 3), the robust F-statistic of 12.10 exceeds the critical value, with the RAI maintaining a highly significant coefficient of 0.352 ($p < 0.01$) and the EBP contributing a marginally significant coefficient of 2.124 ($p < 0.10$). These results justify our choice of RAI as the primary instrument, with alternative specifications serving to verify the stability of our findings.

4.2 Baseline Results

4.2.1 Impulse Response Functions

Figure 4.1 presents the impulse responses to a one-standard-deviation risk-appetite innovation, comparing an external instrument approach (proxy-SVAR) with traditional recursive (Cholesky) ordering. Following our sign-normalization convention, a positive shock represents increased risk aversion that raises risk premia. This specification aligns with the theoretical predictions of Bernanke et al. (1999) (BGG), where such disturbances trigger asset price declines that erode corporate net worth and activate the financial-accelerator mechanism through balance-sheet channels.

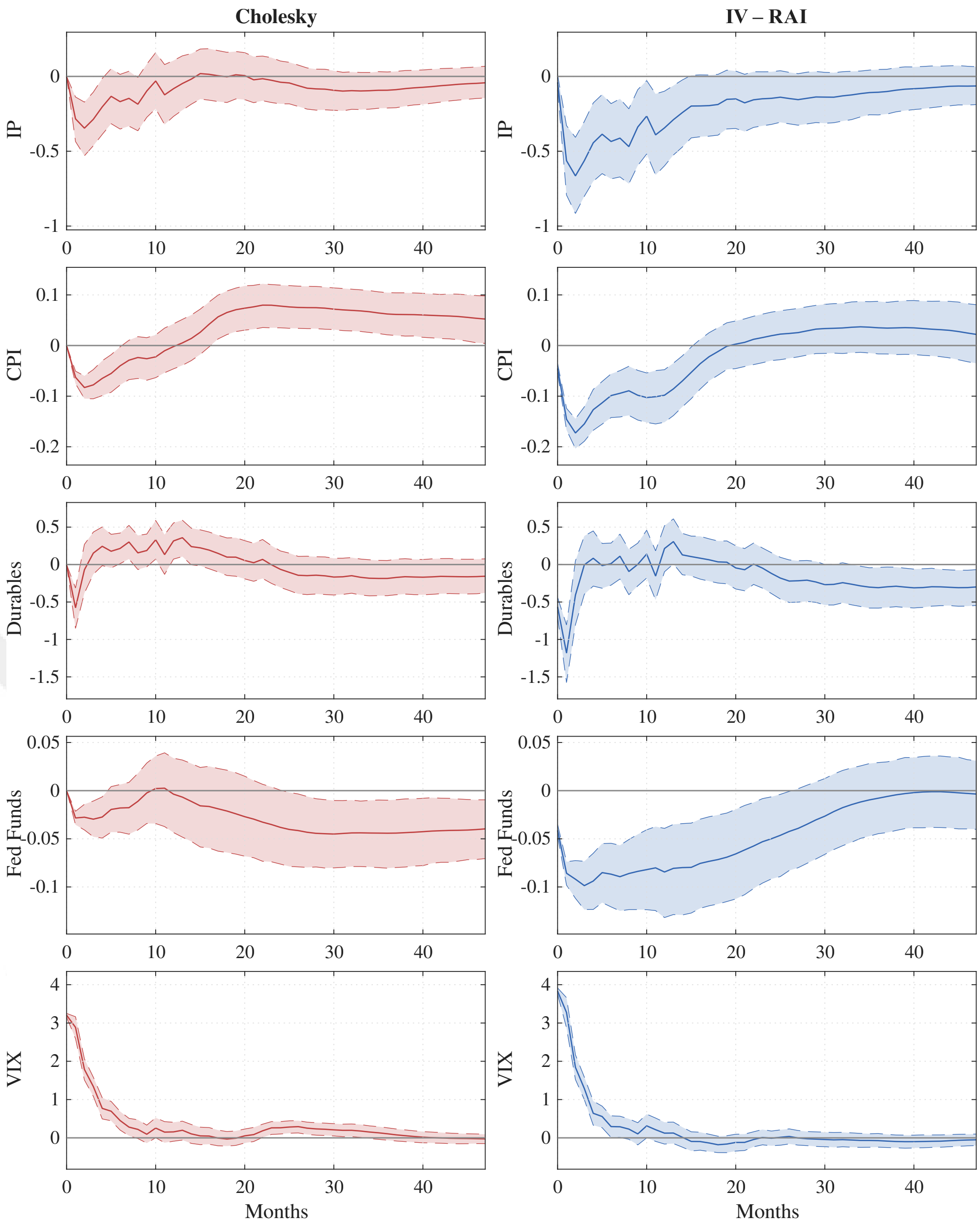

Figure 4.1: Impulse responses to a one-standard-deviation risk-appetite shock: recursive vs. external-instrument identification (RAI)

The proxy-SVAR results reveal substantial financial market disruption. The VIX index jumps by approximately 3.8 index points on impact and remains significantly elevated for roughly seven months. This sustained increase in implied volatility depresses asset valuations across multiple months, setting in motion the core propagation mechanism of the BGG framework. As asset values deteriorate, the riskiness of lending increases, leading to a widening of the excess bond premium faced by borrowers. This divergence between risk-free rates and corporate borrowing costs serves as a powerful amplification mechanism.

The real economy responds sharply to these tightened financial conditions. Industrial production contracts by approximately 0.7%, with the decline remaining statistically significant through month 14. As firms face higher borrowing costs and reduced credit availability, they cut investment spending and scale back production, leading to a persistent decline in economic activity. The response exhibits gradual diminishing in magnitude over time, consistent with the slow adjustment of capital stocks and employment. Notably, the output contraction under proxy-SVAR identification is nearly double that implied by the recursive approach (0.66% versus 0.35% at peak), highlighting how traditional methods may substantially underestimate the macroeconomic consequences of financial disruptions.

The divergence between identification schemes becomes particularly pronounced when examining price and durable goods dynamics. Under proxy-SVAR identification, the CPI declines by 0.17% with effects persisting for 15 months, while durable goods expenditure plummets by 1.2% on impact. The disinflationary pressure emerges as households increase precautionary saving and shift portfolios toward risk-free assets, withdrawing liquidity from goods markets and reducing aggregate demand. In contrast, the Cholesky identification yields implausible results: a modest 0.08% CPI decline that reverses to a 0.8% increase by month 17, casting doubt on the recursive scheme's validity. The sharp durables contraction under proxy-SVAR reflects the confluence of tightened credit, wealth destruction, and elevated risk aversion. As asset price declines erode household wealth, heightened uncertainty triggers precautionary saving and portfolio shifts toward risk-free assets. Durable goods, with their high costs and credit dependence, are especially vulnerable to this combination of wealth erosion and uncertainty.

The monetary policy response differs markedly between identification schemes. Under proxy-SVAR identification, the federal funds rate declines by 9.9 basis points at month 3 and remains below baseline for 26 months, reflecting standard countercyclical policy. As output and prices fall together, the central bank eases to stimulate economic activity—both by reducing returns on safe assets to discourage excessive precautionary saving and by lowering borrowing costs across the economy. The Cholesky identification produces different results: a 3 basis-point decline at month 3 that loses significance by month 5, followed by an increase of approximately 4 basis points from month 25 onward. These contrasting patterns suggest that identification assumptions substantially affect the estimated policy responses to risk-appetite shocks.

The proxy-SVAR identification generates hump-shaped impulse responses across all variables, consistent with both theoretical predictions and empirical regularities documented in the business cycle literature. The persistence and magnitude of these responses align with the predictions of models featuring financial frictions, where disruptions to credit markets have long-lasting effects on real activity. The Cholesky identification, by contrast, fails to produce such patterns and generates several implausible sign reversals, indicating its inability to properly identify the structural shock of interest. These findings underscore the importance of employing appropriate identification strategies when analyzing the transmission of financial shocks to the real economy, particularly given the substantial differences in both the magnitude and persistence of the estimated effects.

4.2.2 Forecast Error Variance Decomposition

Figure 4.2 reports the share of forecast error variance attributable to risk appetite shocks at various horizons. The decomposition reveals striking differences between proxy-SVAR and Cholesky identification in both the magnitude and timing of risk appetite shocks' contribution to macroeconomic fluctuations.

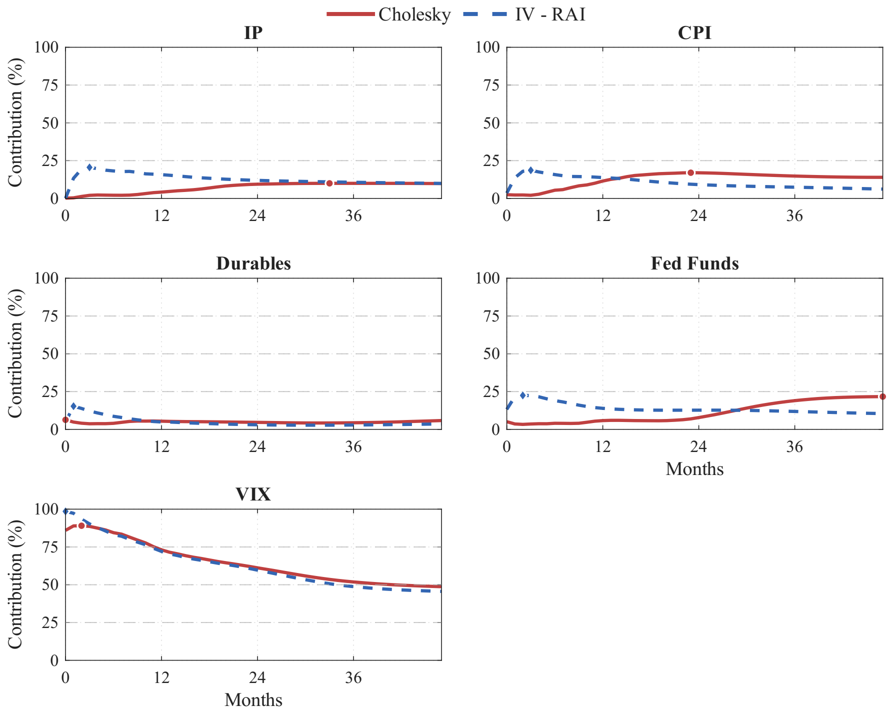

Figure 4.2: Forecast Error Variance Decomposition: Cholesky versus Instrumental Variable Identification (RAI)

The proxy-SVAR identification demonstrates that risk appetite shocks constitute a substantial source of business cycle variation, particularly at short horizons. For industrial production, the shock accounts for 20.54% of forecast error variance at month 3 under proxy-SVAR identification—more than double the peak contribution of 9.98% observed under Cholesky identification at month 33. This stark difference in both magnitude and timing underscores the importance of proper identification: the proxy-SVAR reveals that risk appetite shocks drive approximately one-fifth of industrial production fluctuations in the near term, with effects materializing rapidly and dissipating gradually. The Cholesky decomposition, by contrast, suggests a delayed and more modest role for these shocks.

The contribution to CPI variance exhibits divergent patterns across identification schemes. Under proxy-SVAR identification, risk appetite shocks explain 18.62% of CPI forecast error variance at month 3, reflecting the immediate disinflationary pressure from the contractionary shock. The Cholesky identification yields a delayed peak of 17.02% at month 23, followed by a puzzling persistence that maintains contributions above 13% through the entire forecast horizon. At the 47-month horizon, Cholesky attributes 13.96% of CPI variance to risk appetite shocks, while the proxy-SVAR shows a more plausible decline to 6.17%, consistent with the transitory nature of financial shocks on price levels.

Durable consumption displays the most pronounced differences in initial impact. The proxy-SVAR identification reveals that risk appetite shocks account for 15.33% of durable consumption variance at month 1, capturing the immediate credit-channel effects on interest-sensitive spending. This contribution declines monotonically, reaching 3.58% at the long horizon. The Cholesky identification, however, shows a peak contribution of only 6.31% at impact, less than half the proxy-SVAR estimate, and maintains contributions between 4% and 6% throughout the forecast horizon. The sharp initial response and subsequent decay under proxy-SVAR identification aligns with theoretical predictions about the transmission of financial shocks through credit markets.

The monetary policy response, as measured by federal funds rate variance decomposition, further highlights the identification challenge. Both methods yield similar peak contributions—22.46% at month 2 under proxy-SVAR versus 21.67% at month 47 under Cholesky—but with dramatically different timing. The proxy-SVAR shows that risk appetite shocks drive nearly one-quarter of federal funds rate variation in the immediate aftermath of the shock, consistent with prompt monetary policy response to financial market disruptions. The contribution then gradually declines to 10.45% at the long horizon. The Cholesky identification, conversely, shows steadily increasing contributions over the entire forecast horizon, suggesting an implausible delayed and intensifying monetary response to the initial shock.

For the VIX itself, the proxy-SVAR identification indicates that risk appetite shocks explain 98.53% of the variance on impact, confirming the instrument's relevance. This contribution declines to 45.62% at month 47. The Cholesky identification shows a lower initial contribution of 85.97%, peaking at 89.04% at month 2, with both methods converging to similar long-run values near 46-49%.

Overall, the forecast error variance decomposition analysis reinforces the conclusions from the impulse response functions. The proxy-SVAR identification reveals risk appetite shocks as powerful but transitory drivers of business cycle fluctuations, with immediate and substantial effects on real variables that decay over time. The Cholesky identification, by contrast, produces delayed responses with implausible persistence, particularly for nominal variables and policy rates. These findings underscore the value of external instruments in identifying structural shocks and quantifying their macroeconomic importance.

4.3 Robustness Analysis

4.3.1 Alternative Instrument Specifications

To assess the robustness of our findings, we re-estimate the proxy-SVAR using alternative external instruments: (i) the excess bond premium (EBP) as a standalone instrument, and (ii) the combination of RAI and EBP. These alternatives allow us to evaluate whether our main conclusions depend critically on the specific choice of instrument.

Figure 4.3 presents impulse responses across the three instrument specifications. Despite differences in first-stage strength, all specifications produce qualitatively similar dynamics with notable variations in magnitude and persistence.

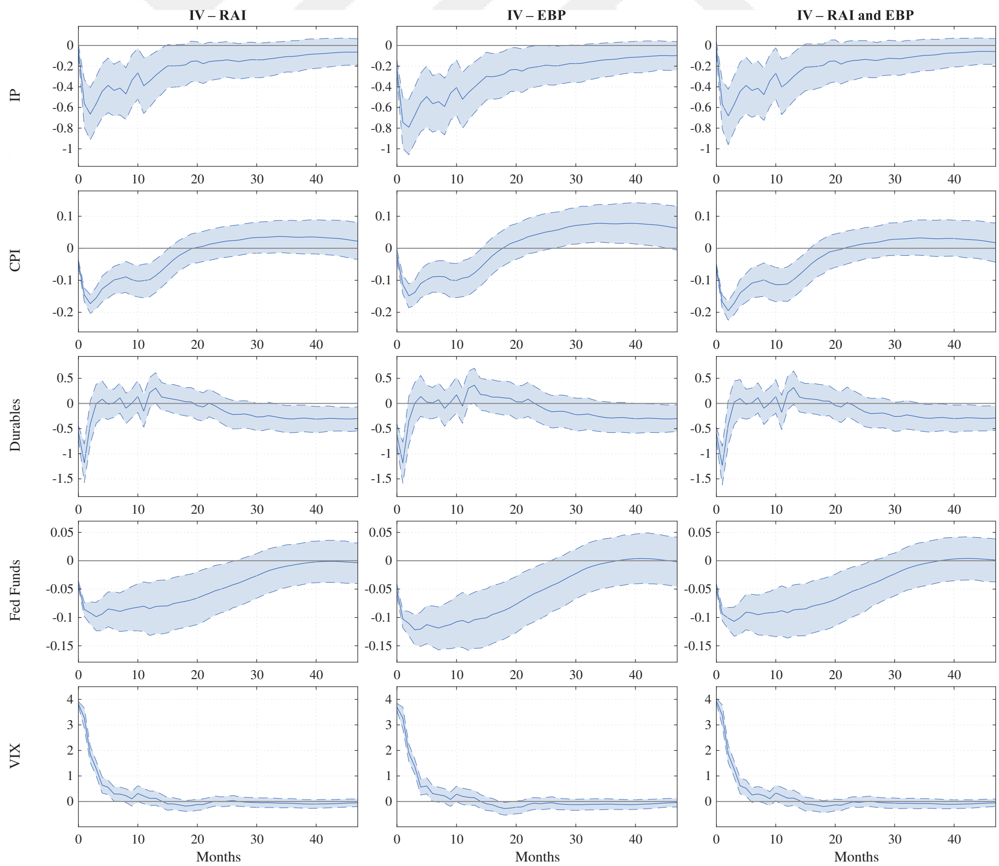

Figure 4.3: Impulse Response Functions Across Alternative External Instruments

All specifications generate contractionary effects on real activity. Industrial production declines by 0.66% under the baseline RAI, while the EBP specification yields a stronger response of 0.79% at month 2, despite its weaker first-stage F-statistic of 5.53. The combined specification produces an intermediate decline of 0.68%. While the EBP's stronger response might initially suggest it better captures variation in industrial production, the implausible long-run price dynamics under this specification raise concerns about potential contamination from other structural shocks. The more moderate responses under the RAI and combined specifications may provide more reliable estimates of the true risk appetite shock effect.

Price responses exhibit downward pressure across all specifications, with the CPI declining by 0.15-0.19% and the combined specification producing the largest impact. However, the identification schemes differ markedly in their long-run dynamics. The EBP specification displays a troubling sign reversal, with CPI responses turning significantly positive from month 27 through month 46—a pattern reminiscent of the implausible price dynamics under Cholesky identification. While the response eventually returns to statistical insignificance, this behavior suggests that the EBP may conflate risk appetite shocks with other structural disturbances that have different long-run implications. In contrast, both the RAI and combined specifications maintain coherent price effects throughout the forecast horizon, indicating their superior ability to isolate pure risk appetite shocks.

Durable consumption and monetary policy responses prove remarkably stable across instruments. Durables decline by 1.18% under both individual instruments and 1.23% under the combined specification. The federal funds rate falls by 9.9-12.2 basis points at month 3, with all specifications maintaining significance for approximately 26-27 months. This consistency across different financial market indicators reinforces the systematic nature of policy responses to risk appetite shocks.

The combined specification yields the largest peak responses for several variables—CPI (0.19%), durables (1.23%), and VIX (3.95 index points). While these stronger magnitudes might suggest efficiency gains from incorporating multiple instruments, the interpretation requires caution. Given that the RAI remains highly significant ($p < 0.01$) while the EBP achieves only marginal significance ($p < 0.10$) in the combined first-stage regression, and considering the EBP's problematic long-run dynamics, the amplified responses may reflect contamination rather than improved identification. The close alignment between the RAI-only and combined specifications for most variables suggests that adding the EBP provides limited additional information while potentially introducing noise from confounding shocks.

The alternative instrument analysis reveals similar short-run dynamics across specifications—real contractions, price declines, and monetary accommodation—but divergent long-run behavior. The EBP's problematic sign reversals, reminiscent of Cholesky identification, contrast with the RAI's economically plausible responses throughout the forecast horizon. These findings validate our choice of the RAI as the primary instrument for cleanly identifying risk appetite shocks.

To further assess the robustness of our findings, Figure 4.4 presents forecast error variance decompositions across the three instrument specifications. These decompositions complement the impulse response analysis by quantifying the relative importance of risk appetite shocks under each identification approach.

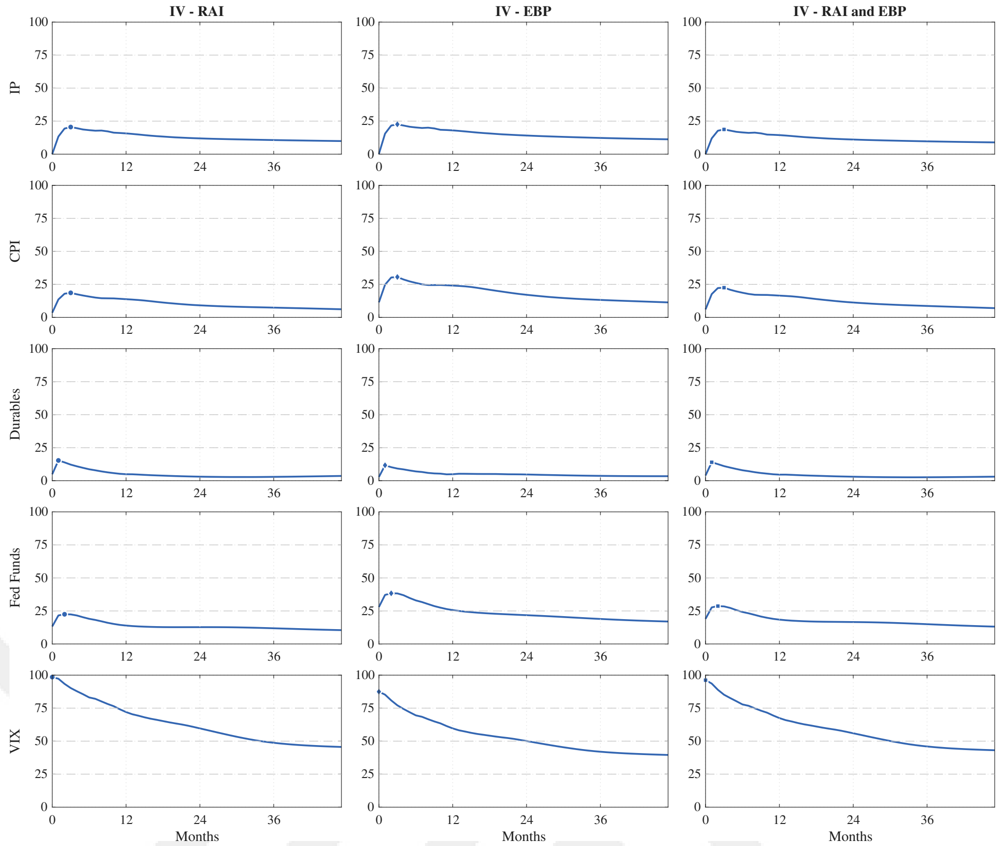

Figure 4.4: Forecast Error Variance Decomposition Across Alternative External Instruments

The variance decompositions reveal substantial differences across instruments, particularly for nominal variables. Under the EBP specification, risk appetite shocks account for a large 30.6% of CPI variance at the 3-month peak compared to 18.6% under the RAI and 22.5% under the combined specification. Similarly, the EBP attributes 38.4% of federal funds rate variance to risk appetite shocks, nearly double the 22.5% share under the RAI. These outsized contributions persist at long horizons, with the EBP maintaining an 11.4% share of CPI variance at month 47 versus 6.2% under the RAI.

For real variables, the differences are more moderate but still economically meaningful. Industrial production variance contributions peak at 22.6% under the EBP versus 20.5% under the RAI, while durable consumption shows the opposite pattern with the RAI yielding higher contributions (15.3% versus

11.7%). The combined specification generally produces intermediate results, though closer to the RAI for most variables, consistent with the first-stage evidence that the RAI dominates the identification.

These variance decomposition patterns reinforce concerns about the EBP's identification validity. The excessive variance shares for nominal variables and policy rates, combined with the problematic long-run price dynamics observed in the impulse responses, suggest the EBP captures a broader set of financial disturbances beyond pure risk appetite shocks. In contrast, the RAI produces economically plausible variance contributions that align with theoretical predictions about the transitory nature of financial market disruptions.

4.3.2 Subsample Stability

We examine the pre- and post-2008 periods separately as a robustness check. To test the stability of our results across different sample periods, we split the sample at May 2009 and re-estimate the proxy-SVAR for both subperiods using our baseline RAI instrument.

Table 4.2 reports first-stage results for both subperiods. Both the pre-crisis period (113 observations, F-statistic = 27.13) and post-crisis period (142 observations, F-statistic = 11.30) exceed the critical value of 10, confirming instrument validity throughout.

Table 4.2: First-Stage Regression Results by Subsample

	Pre-Crisis (1990:01-2009:05)	Post-Crisis (2009:06-2022:03)
RAI	0.259***	0.285***
	(0.050)	(0.085)
Constant	-0.131	0.057
	(0.223)	(0.235)
R^2	0.343	0.225
Adjusted R^2	0.337	0.220
Robust F-statistic	27.13	11.30
Observations	113	142

Notes: Dependent variable is the VIX residual from the VAR equation.
Robust standard errors (HC1) in parentheses. *** p<0.01, ** p<0.05, * p<0.10
Critical value for weak instruments: F > 10

Figures 4.5 and 4.6 compare the Cholesky and IV-identified impulse responses for the pre- and post-crisis periods, respectively. The IV identification continues to reveal stronger contractionary effects than the recursive approach in both subsamples, confirming that addressing endogeneity is crucial regardless of the sample period.

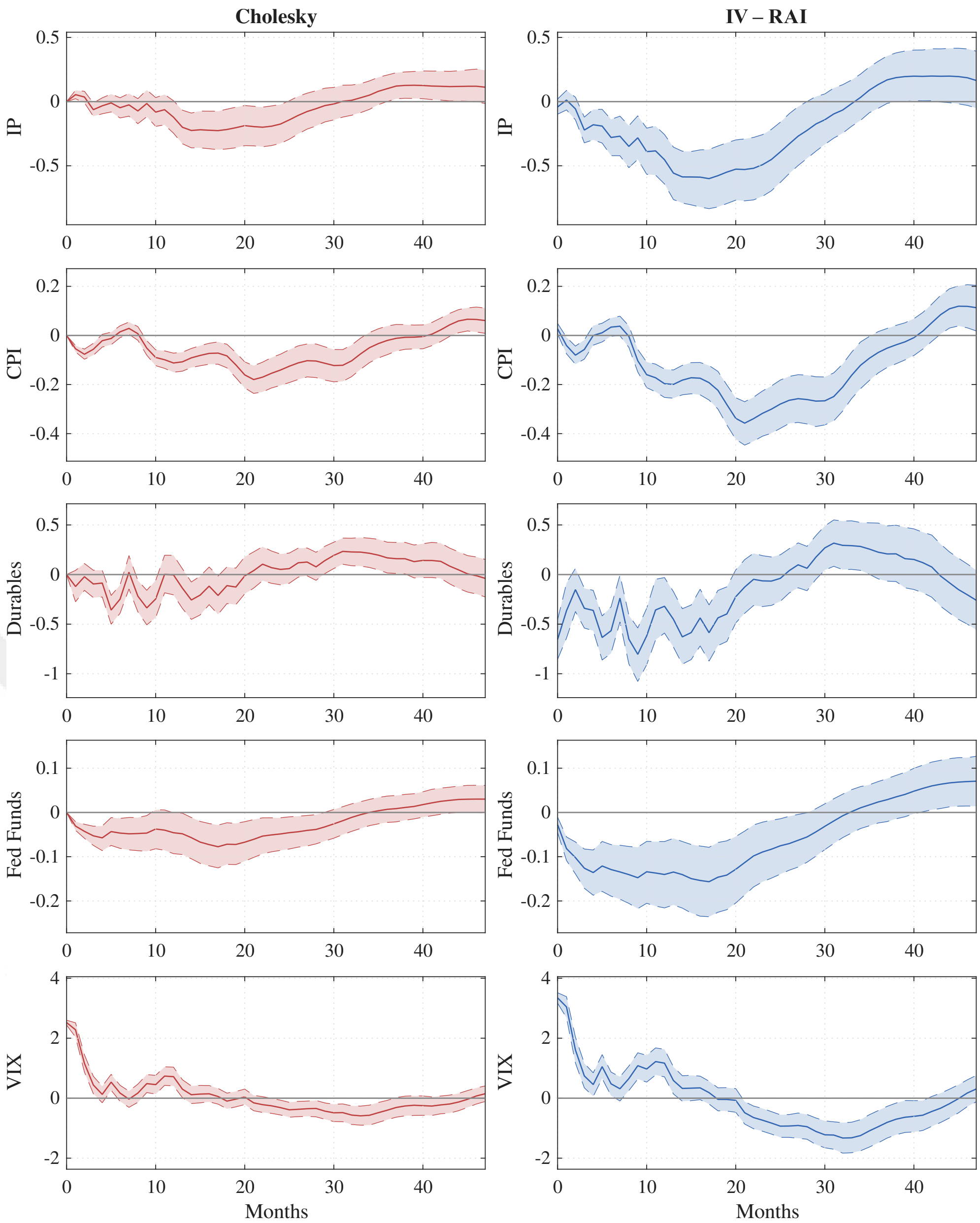

Figure 4.5: Impulse Response Functions: Pre-Crisis (1990:01-2009:05)

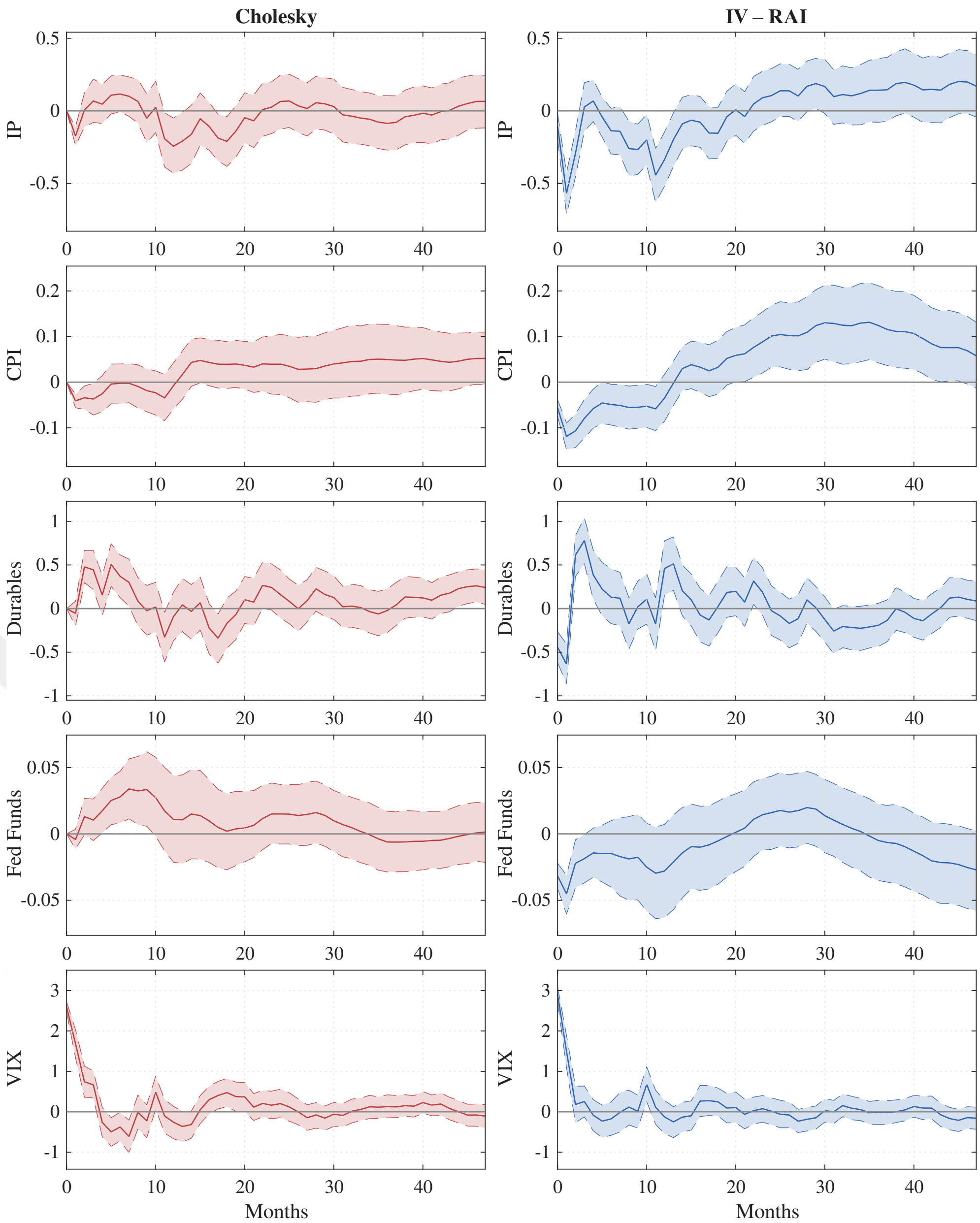

Figure 4.6: Impulse Response Functions: Post-Crisis (2009:06-2022:03)

The qualitative dynamics of risk appetite shock transmission remain consistent across subsamples. In both periods, an increase in risk aversion generates contractionary effects: industrial production declines (0.60% pre-crisis, 0.57% post-crisis at peak), prices fall, durable consumption contracts, and monetary policy responds accommodatively. The persistence of these co-movements across both pre- and post-crisis periods reinforces the robustness of our identification approach.

While the timing of responses shifts somewhat—with post-crisis effects more front-loaded—the overall pattern remains intact. Industrial production, CPI, and durables all exhibit negative responses that persist for multiple months. The federal funds rate declines in both periods, confirming systematic monetary accommodation. The VIX increases by comparable magnitudes (3.3 points pre-crisis, 2.9 points post-crisis), validating the stability of our shock identification.

Some quantitative differences emerge across subsamples. Price responses moderate post-crisis (peak of -0.36% to -0.13%), potentially reflecting structural changes in inflation dynamics. Notably, in the post-crisis period, prices exhibit a significantly positive response between months 20-42 before returning to neutral, a pattern not observed in the pre-crisis sample. The federal funds rate response attenuates from 15.7 to 4.5 basis points, likely due to zero lower bound constraints. However, these variations in magnitude do not alter the fundamental finding that risk appetite shocks generate significant contractionary effects transmitted through financial market channels.

CHAPTER 5

CONCLUSION

This thesis has examined the macroeconomic effects of risk-appetite shocks using a proxy-SVAR approach with high-frequency external instruments. By exploiting daily variation in financial market indicators purged of predictable responses to macroeconomic announcements, we provide new causal evidence on how fluctuations in investors' risk aversion propagate through the economy.

Our main findings reveal that risk-appetite shocks generate pronounced contractionary effects consistent with financial accelerator mechanisms. A one-standard-deviation increase in risk aversion drives a 3.8-point rise in the VIX that remains elevated for seven months, setting in motion broad macroeconomic disruptions. Durable consumption plummets 1.2% on impact as households face tightened credit conditions, negative wealth effects from asset price declines, and heightened uncertainty that triggers precautionary saving and portfolio shifts toward risk-free assets. Industrial production contracts by 0.66% and remains significantly depressed through month 14, reflecting how firms cut investment and scale back production in response to higher borrowing costs and reduced credit availability. The 0.17% CPI decline over 15 months emerges as risk-averse households withdraw liquidity from goods markets, reducing aggregate demand. The federal funds rate falls by 9.9 basis points at month 3 and remains below baseline for 26 months, with the central bank easing both to stimulate activity and reduce incentives for precautionary saving. These effects prove nearly double those from traditional Cholesky identification, which understates real impacts and produces implausible price dynamics, underscoring the importance of proper identification for understanding financial-macro linkages.

The forecast error variance decompositions reveal that risk-appetite shocks account for approximately one-fifth of industrial production volatility at business cycle frequencies, with contributions of 20.5% at the three-month horizon that gradually dissipate over two years. This transitory but substantial impact underscores the importance of financial market disruptions for short-run macroeconomic dynamics.

Our identification strategy proves crucial for these conclusions. The comparison with traditional Cholesky decomposition reveals how improper identification can lead to understated real effects and implausible long-run price dynamics. The proxy-SVAR approach, by targeting only the structural shock correlated with our external instruments, avoids the arbitrary zero restrictions that plague recursive identification schemes. Among our instruments, the cross-asset Risk-Appetite Index of Bauer et al. (2023) emerges as particularly well-suited for identifying pure risk-appetite disturbances, while the Excess Bond Premium appears contaminated by other financial shocks that generate puzzling long-run behavior.

These findings carry important implications for monetary policy. Risk-appetite shocks appear as contractionary demand shocks—with output and prices declining together—prompting straightforward policy responses. Our results confirm systematic monetary accommodation, with the federal funds rate falling 10 basis points and remaining below baseline for 26 months. This sustained easing matches the persistent but diminishing real effects we document, consistent with standard monetary policy responses to observed declines in output and inflation.

The analysis faces several limitations that suggest avenues for future research. First, our linear VAR framework may not fully capture potential asymmetries between risk-on and risk-off episodes, nor state-dependent effects that could amplify financial shocks during crises. Second, the sample period includes extraordinary monetary policy interventions—particularly quantitative easing programs—that may have altered the transmission of financial shocks in ways our constant-parameter model might not adequately accommodate. These limitations highlight the need for continued research to better understand the complex dynamics of risk-appetite shocks across different market conditions and policy regimes.

Future work could extend this analysis in several directions. Time-varying parameter models might help examine whether the transmission of risk-appetite shocks has evolved with changing financial market structures and monetary policy frameworks. International spillover analysis could investigate how risk-appetite shifts propagate across borders through integrated financial markets, potentially amplifying or dampening domestic effects. These extensions would provide a fuller picture of how risk-appetite shocks operate in an evolving and interconnected global financial system.

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