Does Downside Risk of Financial Institutions Predict Future Economic Downturns and Housing Market Crashes?

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ABSTRACT: This study's purpose is to estimate the systemic risk based on the downside risk of large financial institutions and test whether the systemic risk in the financial sector predicts future economic downturns and housing market crashes. The project finds that the newly proposed measure of systemic risk elevates with the start of the Great Recession in 2007, peaks during the heart of the financial crisis in 2008, and levels back out in the ensuing recovery period. The empirical analyses indicate that systemic risk in the financial sector predicts economic downturns seven months into the future, giving financial regulators time to react to possible financial turmoil in the United States. It also predicts housing prices over two years into the future again giving financial institutions and regulators time to respond to potential housing market crashes. Using this type of predictive power provided by the downside risk of financial institutions is imperative in monitoring the financial system. Although there will never be a perfect solution to the financial system's many complexities, more stringent regulation surrounding the risks taken by financial institutions can reduce the probability of another Great Recession.·

KEYWORDS: Economics; Finance; Great Recession; Housing Market Crashes; Downside Risk

Introduction. The global financial crisis, or the Great Recession, occurred in 2007-08 and is often considered the worst financial crisis since the Great Depression in the 1930s. The Great Recession was rooted in the bursting of the U.S. housing market.3 The Great Recession was caused, in part, by greed and negligence of financial institutions in controlling risk. Prior to the credit boom in 2007 and the subprime mortgage industry meltdown that followed, financial institutions were bullish on lending and did not assess the magnitude risk faulty loans would have on their portfolios. When loans began to default at accelerated rates, the liquidity of banks was put into question and the financial sector plummeted, leading to the national and global recession.4 Given the deep integration of investment banks within the global economy, it can be logically inferred that a strong correlation exists between economic distress and the systematic risk of the financial sector.

This study aims to determine whether systemic risk in the financial sector, as measured by average Value at Risk (VaR) of large financial institutions, can successfully predict future downturns in the economy and the housing market. Using large banks' VaR to predict recessions aids in determining policy and regulation to prevent future crises. For example, the financial crisis of 2008 could have been anticipated ahead of time by examining the banks' downside risk. Instead, the market was shocked by the fall of the investment bank and brokerage firm Bear Stearns in March 2008. Given the interconnectedness of large financial institutions, the fall of Bear Stearns sent waves of panic throughout the financial services industry. By September 2008, Lehman Brothers collapsed. While there were other warning signs, the fall of Bear Stearns and Lehman Brothers is often considered as sparking the financial crisis.

Leading up to the crisis, banking sector regulation was minimal. Banks were incredibly levered and had taken on a significant amount of risk. At the time, the idea that asset prices, such as real estate, would continue to rise for the indefinite future was widely accepted. Sub-prime candidates were granted risky mortgages using their homes as collateral. These mortgages were then bundled and sold in the market. When asset prices began falling, borrowers began defaulting on their loans. Many investment banks had large amounts of mortgage-backed securities in their portfolios resulting in devastating losses across the industry. Additionally, because there were very few capital and liquidity requirements financial institutions had difficulty funding their large losses. The overall economy is so tied to large investment banks that their failure can lead global markets into a recession.

As a result of the 2008 crisis, financial regulators enhanced the oversight of financial institutions, introduced new capital, leverage, and liquidity requirements, and affected significant changes in the derivatives and securitization market.8 VaR was used to limit the amount of risk banks can take relative to the capital on hand. Therefore, it can be inferred that VaR of large financial institutions is a significant indicator of the economy's overall stability. This project will attempt to show the industry's average VaR can be used to forecast future downturns.

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Methods. The purpose of this research is to determine whether the systemic risk of the financial sector is a reliable measure to predict future economic and housing market conditions in the United States. The first step is to estimate the 1% Value at Risk (VaR) of the leading financial institutions in the United States. The 1% VaR is the 1st percentile of the daily return distribution, or approximately the average of the second and third lowest daily return observations out of 250 daily returns, calculated for each month using the past year's daily data. This estimation is calculated through Excel's percentile function. The VaR's are computed over an almost 20-year span for the prominent financial firms and averaged to determine the average worst-case downfall for the financial industry as a whole. The average 1% VaR is compared across financial institutions using the Chicago Fed National Activity Index (CFNAI) to determine the correlation between this project's proxy for systemic risk and the future economic states of the country. The final step is to investigate the performance of this project's systemic risk proxy in predicting housing market crashes. Overall, this research aims to prove that excessive risk-taking behavior of financial institutions during the Great Recession led to housing market crashes and macroeconomic downturns

Data and Variables. Largest Financial Institutions in the U.S. Several factors are considered in determining which financial institutions to use as the key ingredients of the systemic risk proxy, particularly the assets under management and the market capitalization of each financial institution. The assets under management and the market cap are valuable consideration points because the financial firms need to have a significant financial impact on the economy to develop an accurate proxy for the systemic risk of the entire financial system. Eleven U.S. financial institutions fell within the top 13 for both assets under management and market capitalization: JP Morgan Chase (JPM), Bank of America (BAC), Citigroup (C), Well Fargo (WFC), Goldman Sachs (GS), Morgan Stanley (MS), U.S. Bancorp (USB), PNC Financial Services (PNC), Capital One Financial (COF), the Bank of New York Mellon (BK), and Charles Schwab Corporation (SCHW). In using these 11 firms, it is assumed that the firms' market value and the size of the assets they hold and manage are influential enough to be used in the estimation of systemic risk of the financial sector. This assumption is tested later in the research.

Table 1 lists the top 15 U.S. bank holding companies ranked by total assets as of March 2019. Their market capitalizations are also shown in Table 1. The full list of bank holding companies with total assets greater than $10 billion are reported by the Federal Financial Institutions Examination Council (FFIEC).7 To understand the weight of the chosen 11 financial firms in the entire financial sector, the ratio of the total assets of those financial firms to the total assets of all financial firms with assets greater than $10 billion was calculated. It was found that the top 11 firms form 65% of the major financial system. Similarly, the ratio of the total market capitalization of the top 11 financial firms to the total market capitalization of all financial firms was calculated and found that the 68% of total market capitalization for all financial firms comes from these 11 financial firms. Thus, one of the project's hypotheses is that the market value and asset size of these 11 financial firms are large enough to be qualified in the estimation of systemic risk of the financial sector. TD Bank was not used in the project's estimation of the financial industry's systematic risk because its data starts in 2015 and therefore does not have enough time-series observations required for the main tests. TIAA was also not used because the FFIEC does not report its market capitalization.

Measuring Economic Downturns. Following the original work of the Federal Reserve Bank of Chicago, this project uses the Chicago Fed National Activity Index (CFNAI) to measure economic downturns. The CFNAI is the weighted average of 85 monthly indicators of national economic activity and is used to predict U.S. economic growth.[1] It is computed monthly and is, historically, very accurate in predicting business cycle fluctuations. Its economic indicators have been drawn from four major categories of data:

- Production and Income (23 indicators)
- Employment, Unemployment, and Hours (24 indicators)
- Personal Consumption and Housing (15 indicators)
- Sales, Orders, and Inventories (23 indicators

The CFNAI is intended to provide a real-time statistic of economic stability in the U.S. market. An index of zero is interpreted as the economy growing at a typical expectancy. A positive value represents above-average economic growth and a negative value indicates a below-average economic growth. If its results are –0.7 or below, it correctly predicts a recession with 86% accuracy.[2]

The CFNAI's proves its importance through its performance in identifying economic downturns compared to the National Bureau of Economic Research (NBER). Figure 1 displays the monthly time-series plot of the CFNAI for April 2000 – June 2019, the sample period used in this project's main empirical analyses. The index is negative and larger in absolute magnitude during bad states of the economy. As shown in Figure 1, the CFNAI level reached historical lows during the Great Recession – -4.38 in December 2008 and -4.75 in January 2009.

Table 1: List of the 15 Largest Banks in the United States

Protein	Gene	Coverage	#peptides	# amino acids	MW (kDa)	Predicted protein function
Outer membrane protein A	OMP A	40.17	8	346	37.2	Adhesin/invasin; binds GlcNAc1,4-GlcNAc epitopes on glycoprotein. Target for immune system
Outer membrane protein X	OMP X	13.45	2	171	18.6	Adhesion and invasion of lung epithelial cells
Outer membrane protein slp	OMP slp	9.57	1	188	20.9	Initial adhesion. Binds to human polymeric immunoglobulin receptor
Flagellin	Flagellin	56.75	21	585	59.9	Motility. Target for immune attack

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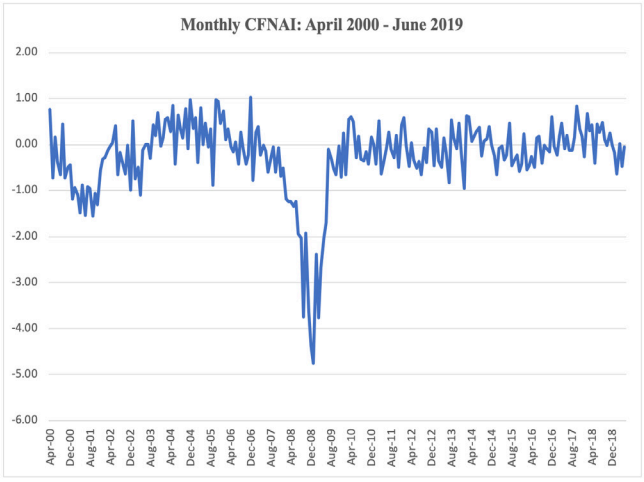

Figure 1: Chicago FED National Activity Index (CFNAI) from April 2000 – June 2019

Over the past 35 years, the CFNAI level has explained almost 40% of the variation in the next quarter's economic output (measured by gross domestic product).6 Figure 2 compares the end-of-quarter CFNAI levels with the quarterly real GDP growth rate over the past 51 years. The correlation between the end-of-quarter CFNAI and the quarterly real GDP growth rate is positive, 72%, and highly significant for the period 1967-2018. In Figure 2, the blue line representing the end-of-quarter CFNAI closely mirrors the red line representing the quarterly real GDP growth. Additionally, the CFNAI moves before the real GDP does. With this information, it can be concluded that the CNFAI is a strong indicator of future economic output because CFNAI and GDP encompass many of the same factors.

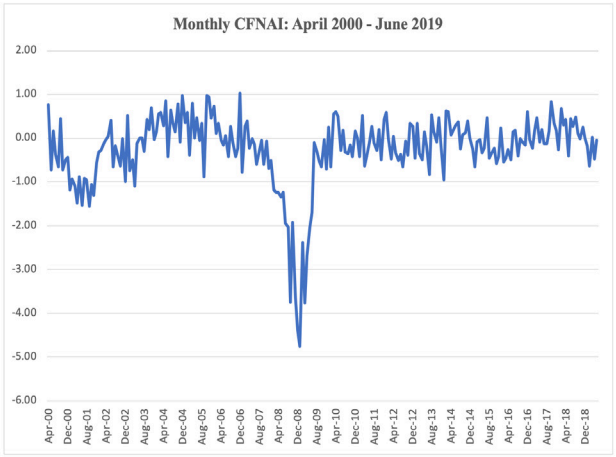

Figure 2. Comparing CFNAI with Real GDP Growth. Presents the time-series plots of the end-of-quarter CFNAI and the quarterly real GPD growth for the sample period of 1967:Q1 – 2018:Q4

Housing Market Index. For this project, the S&P/Case-Shiller U.S. National Home Price Index is used to track the value of single-family housing within the United States. The Case-Shiller index is a widely used indicator of the U.S. housing market and the broader economy.10 Figure 3 shows that the Case-Shiller U.S. National Home Price Index value was 102.54 in April 2000 and peaked at 184.62 in July 2006, indicating that the house prices increased by 80% over the six-year period. The index almost monotonically declined to 133.99 in February 2012, showing a 27% decline during those six years. It took until February 2017 for the index to regain its earlier peak.

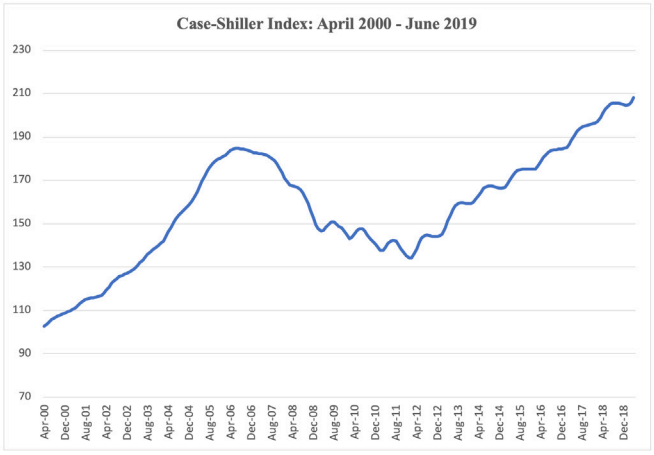

Figure 3. Monthly time-series plot of the Case-Shiller U.S. National Home Price Index for the sample period of April 2000 – June 2019

Value-at-Risk of Financial Institutions. A primary tool for financial risk assessment is the Value at Risk (VaR), which is defined as the maximum loss expected on a portfolio of assets over a certain holding period at a given confidence level (probability).5 For this project, the 1% VaR of financial institutions is estimated using daily equity returns of the largest 11 financial firms for the longest common sample period from May 5, 1999 – June 28, 2019. The one year of daily returns of each institution from May 5, 1999 – April 28, 2000 was used (total of 250 daily returns) to generate the first 1% VaR estimate. This estimate corresponds to the 1st percentile of the daily return distribution, or approximately the average of the second and third lowest daily return observations from May 5, 1999 – April 28, 2000. This is used as a measure of April 2000's 1% VaR. Then, the sample is rolled one month forward and each financial institution's 1% VaR was re-estimated using one year of daily returns from June 1, 1999 – May 31, 2000 to generate the second 1% VaR estimate. The monthly rolling VaR estimation procedure is repeated for each month until the sample is exhausted in June 28, 2019.

The systemic risk of the financial sector is defined as the average of the 1% VaR estimates of the largest 11 financial firms. Note that the original 1% VaR measures are negative since they are obtained from the left tail of the return distribution. The original systemic measure is multiplied by -1 for convenience of interpretation; larger positive values of the systemic risk measure indicate higher catastrophic risk in the financial sector.

Figure 4 displays the monthly time-series plot of the systemic risk of the financial sector (SYSRISK) for the sample period April 2000 – June 2019. As the graph shows, the systemic risk of financial institutions elevated with the start of the Great Recession and peaked during the heart of the financial

crisis. It leveled back out in the ensuing recovery period with a slight increase in 2011.

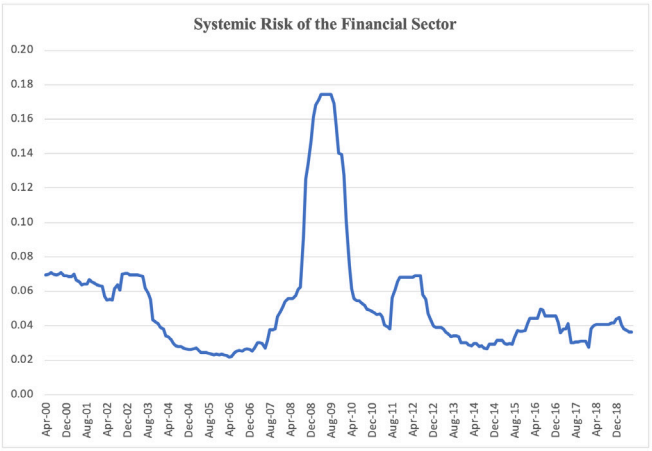

Figure 4. Monthly time-series plot of the systemic risk in the financial sector (SYSRISK) for the sample period of April 2000 – June 2019

Results and Discussion. The following monthly time-series regressions are run to test whether the SYSRISK predicts future economic turndowns and housing market crashes:

$$(1)\ CFNAI_{t+1} = \alpha + \beta \cdot SYSRISK_t + \varepsilon_{t+1}$$

$$(2)\ HOUSE_{t+1} = \phi + \lambda \cdot SYSRISK_t + e_{t+1}$$

where $SYSRISK_t$ is the systemic risk of the financial sector in month t, $CFNAI_{t+1}$ is the Chicago FED National Activity Index in month t+1, and $HOUSE_{t+1}$ is the Case-Shiller U.S. National Home Price Index in month t+1. The slope coefficients (β, λ) in regression equations (1) and (2) will determine whether higher systemic risk in the financial sector predicts lower economic growth and lower home prices in the U.S. The project tests whether the slope coefficients (β, λ) are negative and statistically significant.

Regressing the one-month-ahead CFNAI on SYSRISK generated the following regression output:

$CFNAI_{t+1}$	Coefficients	Std. Err.	t-stat	p-value
Intercept	0.46	0.09	5.29	0.0000
$SYSRISK_t$	-13.91	1.41	-9.85	0.0000

The slope coefficient (λ) on SYSRISK is estimated to be negative, -326.01, and highly statistically significant with a t-statistic of -6.81 (or a p-value of zero). The significantly negative slope coefficient on SYSRISK indicates that an increase in the systemic risk of the financial sector predicts a significant decline in U.S. house prices. The economic magnitude of the slope coefficient can be interpreted as follows: Given that the standard deviation of SYSRISK is 3.29% in the sample, a 2-standard deviation increase in SYSRISK leads to a decline of 21.45 in the Case-Shiller index. This is economically large given that the sample minimum, mean, and maximum values of the Case-Shiller index are respectively 102.54, 157.59, and 207.97 over the estimation period of April 2000 – June 2019. This concludes that the systemic risk of the financial sector accurately predicts housing market crashes.

This project also investigates if the systemic risk of the financial sector has long-term predictive power for economic downturns and housing market crashes or if the predictability evidence provided thus far is just a one-month affair. The following longer-term predictability regressions are run:

$$(3)\ CFNAI_{t+k} = \alpha + \beta \cdot SYSRISK_t + \varepsilon_{t+k}$$

$$(4)\ HOUSE_{t+k} = \phi + \lambda \cdot SYSRISK_t + e_{t+k}$$

where k denotes 2-month-ahead to 12-month-ahead Chicago FED National Activity Index in regression equation (3), and k denotes 12-month-ahead to 36-month-ahead Case-Shiller index in regression equation (4).

Table 2 presents the slope coefficients (β), standard errors, t-statistics, and p-values from the time-series regressions of the two-month-ahead ($CFNAI_{t+1}$) to 12-month-ahead ($CFNAI_{t+12}$) Chicago FED National Activity Index on SYSRISK. A notable point in Table 2 is that SYSRISK predicts the CFNAI seven months into the future because the slope coefficients are statistically significant at least at the 5% level $(|t|>1.96)$ for predicting $CFNAI_{t+2}$ to $CFNAI_{t+7}$. The predictive power of SYSRISK diminishes starting with $CFNAI_{t+8}$ with an insignificant slope coefficient of -2.78 with a t-statistic of -1.64.

Table 2. Predictive Power of SYSRISK for Future Economic Downturns

	Coefficients	Std. Err.	t-stat	p-value
$CFNAI_{t+2}$	-12.19	1.48	-8.22	0.0000
$CFNAI_{t+3}$	-10.19	1.55	-6.57	0.0000
$CFNAI_{t+4}$	-8.20	1.61	-5.10	0.0000
$CFNAI_{t+5}$	-6.53	1.64	-3.97	0.0001
$CFNAI_{t+6}$	-5.19	1.67	-3.12	0.0021
$CFNAI_{t+7}$	-3.84	1.69	-2.28	0.0236
$CFNAI_{t+8}$	-2.78	1.70	-1.64	0.1028
$CFNAI_{t+9}$	-1.84	1.71	-1.08	0.2827
$CFNAI_{t+10}$	-1.06	1.71	-0.62	0.5360
$CFNAI_{t+11}$	-0.37	1.72	-0.22	0.8278
$CFNAI_{t+12}$	0.15	1.72	0.09	0.9288

Table 2 shows that after month t+7, the significance of SYSRISK completely disappears. This concludes that the predictive power of systemic risk in the financial sector is not just a one-month phenomenon. SYSRISK predicts economic downturns seven months into the future, giving financial regulators enough time to react to possible financial turmoil in the United States.

Table 3 presents the slope coefficients (λ), standard errors, t-statistics, and p-values from the time-series regressions of the 12-month-ahead ($HOUSE_{t+12}$) to 36-month-ahead ($HOUSE_{t+36}$) Case-Shiller index on SYSRISK. As shown in Table 3, SYSRISK predicts the housing market index 29 months into the future because the slope coefficients are statistically significant at least at the 5% level $(|t|>1.96)$ for predicting ($HOUSE_{t+2}$)to ($HOUSE_{t+29}$).

The predictive power of SYSRISK diminishes starting with ($HOUSE_{t+30}$) with an insignificant slope coefficient of -78.32 with a t-statistic of -1.83. After month *t+30*, the significance of SYSRISK completely disappears. This concludes that the predictive power of systemic risk in the financial sector is works to predict housing market crashes almost two and

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a half years into the future, giving financial regulators long enough to respond to housing market crashes.

Table 3. Predictive Power of SYSRISK for Housing Market Crashes

	Coefficients	*Std. Err.*	*t-stat*	*p-value*
$HOUSE_{t+12}$	-215.18	38.60	-5.57	0.0000
$HOUSE_{t+24}$	-136.56	41.49	-3.29	0.0012
$HOUSE_{t+25}$	-127.62	41.73	-3.06	0.0025
$HOUSE_{t+26}$	-119.08	41.92	-2.84	0.0050
$HOUSE_{t+27}$	-110.41	42.11	-2.62	0.0094
$HOUSE_{t+28}$	-100.65	42.30	-2.38	0.0183
$HOUSE_{t+29}$	-89.47	42.55	-2.10	0.0367
$HOUSE_{t+30}$	-78.32	42.71	-1.83	0.0682
$HOUSE_{t+31}$	-65.18	42.88	-1.52	0.1301
$HOUSE_{t+32}$	-51.33	43.02	-1.19	0.2343
$HOUSE_{t+33}$	-36.17	43.15	-0.84	0.4029
$HOUSE_{t+34}$	-20.38	43.25	-0.47	0.6380
$HOUSE_{t+35}$	-4.97	43.32	-0.11	0.9088
$HOUSE_{t+36}$	9.69	43.40	0.22	0.8235

Conclusion. This experiment tests the correlation between financial institutions' Value-at-Risk (VaR) and overall macroeconomic activity and the housing market. The sample studied included the largest 11 financial institutions that are quantitatively and qualitatively similar and were strongly impacted by the Great Recession. By evaluating the average downside risk of these financial institutions over time, the project shows how systemic risk in the financial sector increases during recessionary periods. Not surprisingly, the regression analyses yield a statistically significant relationship between average VaR of financial institutions and the CFNAI and the Case-Shiller index. Moving forward, VaR can be viewed as an effective way to predict recessionary downfall; in the hands of regulators and other government officials this information can be used to strategically counteract the incidence of future recessionary periods.

This paper effectively proves that excessive risk-taking behavior of financial institutions during the financial crisis of 2007-2008 led to economic downturns and housing market crashes. Given these findings, it is arguable to say that financial sector performance is an accurate indicator of macroeconomic health. It is important that financial regulators place greater focus on this systemic risk measurement in the future in order to hedge against future economic downturns. By using the relatively simple measure of systemic risk, institutions have the heightened ability to anticipate economic downturns, eliminating economic surprises and the risk of future financial crises. These findings indicate that average VaR of financial institutions can be used as a reliable proxy for systemic risk in the financial sector and can be used to predict future economic downturns and trends in the housing market.

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