DEUTSCHE BUNDESBANK EUROSYSTEM

Technical Paper

A financial stress indicator for Germany

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Non-technical summary

Research Question

Composite indicators that summarize information from a broad range of financial variables are used for macroprudential surveillance of the financial system on a regular basis. Composite indicators of financial stress, in particular, measure systemic risks in various financial market segments by condensing information on asset price-based variables, such as yield spreads and asset price volatilities.

Contribution

This paper presents the methodology to compute the Bundesbank's Financial Stress Indicator (FSI) for Germany. The FSI summarizes information on financial markets stress in the segments of credit risk, liquidity risk and market risk. The FSI is computed from 2002 onwards at a weekly frequency. It thus provides a timely gauge of financial stress in the German financial system.

Results

Judged by this measure of financial stress, the German financial system has experienced its most severe financial stress period since 2002 during the 2008 global financial crisis, with highly elevated levels in all three dimensions of financial stress. The indicator also points to historically high stress levels during the euro area sovereign debt crisis in the early 2010s. Recent readings of the indicator, by contrast, indicate a historically low stress level.

Nichttechnische Zusammenfassung

Fragestellung

Zusammengesetzte Indikatoren, die Informationen aus einer Vielzahl von Finanzvariablen zusammenfassen, werden regelmäßig für die makroprudenzielle Überwachung des Finanzsystems verwendet. Zusammengesetzte Indikatoren für Finanzstress messen systemische Risiken in verschiedenen Finanzmarktsegmenten, indem Informationen zu Vermögenspreisvariablen wie Renditeaufschlägen und Preisvolatilitäten von Vermögenswerten komprimiert werden.

Beitrag

In diesem Papier wird die Methodik zur Berechnung des Finanzstressindikators (FSI) der Deutschen Bundesbank für Deutschland vorgestellt. Der FSI fasst Informationen zum Stress an den Finanzmärkten in den Segmenten Kreditrisiko, Liquiditätsrisiko und Marktrisiko zusammen. Der FSI wird ab 2002 wöchentlich berechnet. Damit liefert er einen zeitnahen Indikator für den finanziellen Stress im deutschen Finanzsystem.

Ergebnisse

Gemessen an dieser Messgröße für den finanziellen Stress hat das deutsche Finanzsystem während der globalen Finanzkrise 2008 seine schwerste finanzielle Stressphase seit 2002 durchlebt, wobei der Stress in allen drei Segmenten stark erhöht war. Der Indikator deutet auch auf historisch hohe Stressniveaus während der Staatsschuldenkrise im Euroraum Anfang der 2010er Jahre hin. Die jüngsten Messwerte des Indikators deuten dagegen auf ein historisch niedriges Stressniveau hin.

A financial stress indicator for Germany*

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Abstract

This paper describes the Bundesbank's weekly financial stress indicator for Germany. The indicator condenses several financial market variables into a summary measure of financial stress. It represents a contemporaneous, market-based indicator that captures the materialisation of systemic risk along three different risk dimensions - credit, liquidity and market risk. Judged by this measure, the German financial system has experienced its most severe financial stress period since 2002 during the 2008 global financial crisis, with highly elevated levels in all three dimensions of financial stress. The indicator also points to historically high stress levels during the euro area sovereign debt crisis in the early 2010s. Recent readings of the indicator, by contrast, indicate historically low levels of financial stress.

JEL classification: E44, E51, G12, G17
Keywords: diffusion index, factor model, financial conditions, financial stability

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1 Introduction

Composite indicators that summarize information from a broad range of financial variables form an integral part of the macroprudential monitoring toolkit at the Deutsche Bundesbank. One of the tools used in its financial system surveillance is a weekly composite financial stress indicator (FSI) for Germany. This paper presents the methodology to compute the Bundesbank's Financial Stress Indicator (FSI) for Germany.

The FSI represents a contemporaneous, market-based indicator that captures the *materialisation* of systemic risk along three different risk dimensions -- credit, liquidity and market risk. It is calculated from a variety of financial market variables observed at a weekly frequency, using a principal components approach. Figure 1 depicts the resulting indicator. The FSI indicates that the German financial system experienced the most severe financial stress period during the 2008 global financial crisis, with highly elevated levels in all three dimensions of financial stress. The FSI also points to historically high stress levels during the euro area sovereign debt crisis in the early 2010s. During the sovereign debt crisis, credit risks were particularly high, owing to sharply rising CDS spreads among banks. Recent readings of the indicator, by contrast, indicate historically low levels of financial stress, owing to low levels of credit risk and market risk. The methodology to compute the FSI is laid out in what follows.

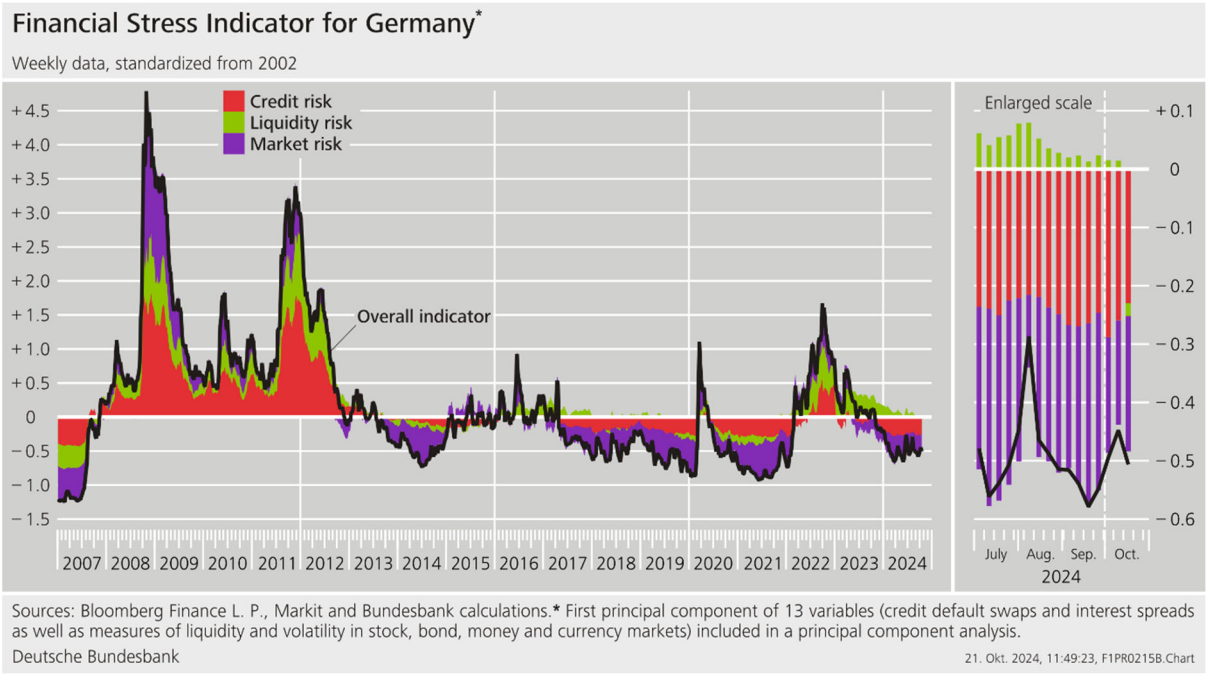

Figure 1: Financial stress indicator for Germany

2 Construction of the financial stress indicator

The notion of “financial stress” refers, in principle, to a systemic disruption in financial market activity. From a practical perspective, financial stress is a latent variable of the economy that cannot be directly observed. However, various observable financial market variables can provide evidence of the “symptoms” associated with financial stress. For example, variables measuring implied or realised volatility in various market segments capture the level of uncertainty and risk aversion of investors. In addition, increases in credit spreads or declines in the valuation of risky assets can reflect the degree of asymmetric information and risk pricing. Moreover, declines in the valuation of risky assets or increases in the valuation of safe assets captures reduced readiness to hold risky assets. Furthermore, increases in liquidity spreads and refinancing spreads captures reduced willingness to hold illiquid assets.

While individual financial market variables can reflect various symptoms of financial stress, composite indicators of financial stress capture contemporaneous systemic stress in financial markets by summarizing information on various asset price-based indicators, such as yield spreads and asset price volatilities.[2] To be able to trace the source of stress, the financial market variables used to construct the FSI are divided into three groups: credit risk, liquidity risk and market risk. Each category contains selected asset price-based indicators that capture stress in the respective dimension.

The following variables enter into the *credit risk* group: the spread between 6-month EURIBOR and 6-month Bund yields, capturing credit risk in the unsecured interbank market; the spread between 3-month EURIBOR and EUREPO yields, capturing credit risk in the secured interbank market; the CDS spread on German government bonds with a maturity of 5 years denominated in euro, capturing credit risk in the sovereign bond market; CDS spreads for up to 12 German Other Systemically Important Institutions (O-SIIs) with a maturity of 5 years denominated in euro, capturing credit risk of financial corporations; and CDS spreads for up to 25 German non-financial corporations with a maturity of 5 years denominated in euro, capturing credit risk in the non-financial corporate sector.

The following variables make part of the *liquidity risk* group: the EUR/USD cross-currency basis swap spread as a measure of liquidity risk in the foreign exchange market; the spread between the yields on 5-year bonds issued by the KfW and 5-year Bund yields; and the spread between 5-year yields on public sector Pfandbriefe and Bund yields of matching maturity. The latter two variables can be seen as measures of liquidity risk in different segments of the sovereign bond market.

Finally, the *market risk* group comprises the following variables: The VDAX implied stock price volatility index is used as an indicator of equity market risk; the average of one-month implied volatilities of the exchange rates of the euro relative to the US dollar, the Japanese yen and the British pound captures foreign exchange market risk; and the historical 30-

[2] See, e.g., the Composite Indicator of Systemic Stress (CISS) proposed by Hollo et al. (2012) for the euro area and the Country-Level Index of Financial Stress (CLIFS) developed by Duprey et al. (2017) for members of the European Union.

day volatility of yields on Bunds with 2, 5, 10 and 30-year residual maturities capture market risk in the (sovereign) bond market segment.

The FSI is estimated using principal component analysis. Formally, let $X_t = \{x_{1,t}, \dots, x_{N,t}\}$ denote an $N \times 1$ vector of financial time series observed over the period $t = 1, 2, \dots, T$. Each time series in X_t is standardised by subtracting the sample mean from the series and then dividing by the sample standard deviation. The vector containing all individual financial market variables X_t is assumed to admit an approximate factor model representation (Stock and Watson, 2002):

$$X_t = \Lambda F_t + W_t$$

where F_t is a $r \times 1$ vector of common factors, Λ is an $N \times r$ matrix of factor loadings, and W_t is an $N \times 1$ vector of idiosyncratic components. F_t are mutually orthogonal and uncorrelated with W_t. The idiosyncratic components W_t are stationary with zero mean, and they may exhibit weak cross-sectional and serial correlation. Without loss of generality, the number of factors is set to $r = 1$. Hence, the factor F_t is of dimension 1×1 in period t, with an $N \times 1$ vector of factor loadings λ. Factors and loadings are consistently estimated using principal components (Stock and Watson, 2002).

The factor F_t is thus estimated as the first principal component extracted from the vector X_t, and it represents the FSI. The first principal component should capture sufficient synchronisation of the financial market variables such that it can be interpreted as financial stress. The variance share of the first principle component in case of the FSI exceeds 60%, which is satisfactory and comparable to the literature. A decomposition into the contributions of the three risk categories to overall financial stress can be obtained by utilizing the estimated factor and its loadings and disregarding the idiosyncratic component.

The FSI can be compared to the Bundesbank's monthly composite indicator of financial conditions (CIFC) that is broader than the FSI and also comprises quantity-based measures and other macro-financial indicators that capture information from different segments of the financial system, e.g., on financial intermediaries and the non-financial sector (see Metiu, 2022). There is some overlap between the data used to compute the FSI and the credit risk, liquidity risk and market risk subindicators of the CIFC. The sum of these three subindicators of the CIFC is closely correlated with the FSI at 0.96. The liquidity risk subindicator of the CIFC and its FSI counterpart are virtually identical, with a correlation coefficient equal to 0.99. There is, however, also a very close association between the credit risk and market risk subindicators and their FSI counterparts, with a correlation of 0.90 and 0.93, respectively. Minor differences exist due to partly different underlying indicators used to construct the subindicators. Figure 1 illustrates the close association between the FSI and the CIFC for Germany. The largest deviation between the two indicators occur during periods when the development of non-market based indicators diverges from the development of financial market-based measures during the early and the late part of the sample.

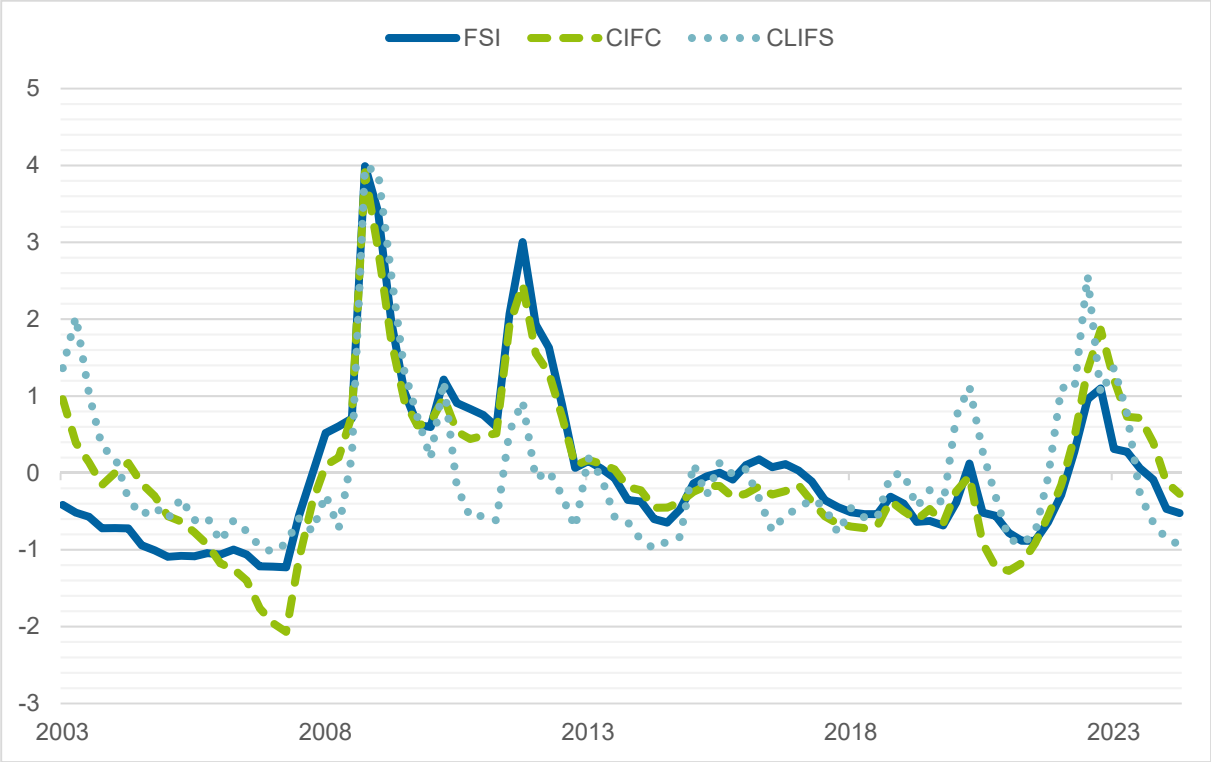

Figure 2: Financial Stress Indicator (FSI), Composite Indicator of Financial Conditions (CIFC) and Country-Level Indicator of Financial Stress (CLIFS) for Germany

Another useful comparison is between the FSI and the CLIFS index for Germany computed regularly by the ECB (see also Duprey et al., 2017). The CLIFS is also calculated from market-based measures and comprises three market segments: The equity market, the bond market and the foreign exchange market. Unlike the CIFC, which is a broader-based indicator of financial conditions, the FSI and the CLIFS are both financial stress indicators that are narrower in scope. There is a relatively strong positive association between the FSI and the CLIFS, with a contemporaneous correlation coefficient of 0.62. The biggest differences exist in the period before the global financial crisis and during the euro area sovereign debt crisis. One possible explanation for the differences could be that the CLIFS measures credit risk through yield differences between government bonds and Bunds. This is likely to cause significant differences, especially in the case of Germany, during the euro crisis, for example.

3 Conclusion

Composite indicators that summarize information from a broad range of financial variables are used for macroprudential surveillance of the financial system on a regular basis. Composite indicators of financial stress, in particular, measure systemic risks in various financial market segments by condensing information on asset price-based variables, such as yield spreads and asset price volatilities.

This paper has described the methodology to compute the weekly financial stress indicator used by the Bundesbank as part of its financial surveillance toolkit. This indicator summarizes information on financial markets stress in the segments of credit risk, liquidity risk and market risk, computed from 2002 onwards at a weekly frequency. Hence, the financial stress indicator is an important tool for providing timely information on disruptions to the normal functioning of the financial system. However, to obtain a holistic view of systemic risks, the indicator should not be considered in isolation, but as part of a broader overall risk assessment.

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