

A systemic risk indicator for the Swedish banking system

Following and analysing systemic risk in the financial system is a central component of the Riksbank's activities. In this box we present an estimate of systemic risk according to an indicator that can identify different risks, such as liquidity and solvency risks, in the Swedish banking system.⁹⁰ The indicator shows that the risk in the banking system rose substantially in the 2008 financial crisis. Thereafter the indicator fell somewhat to again rise in the second half of 2010, as unease on the financial markets again increased as a result of the problems in public finances in the euro area.

The Riksbank is broadening the underlying material for its analysis of stability in the financial system

In its assessment of the stability of the financial system the Riksbank uses various types of quantitative methods. The development of these methods has come into focus since the last financial crisis, both internationally and in Sweden. To broaden the base for stability analysis, the Riksbank carefully follows international work to develop tools, measures and indicators in the area, as well as conducting its own development initiatives. In its Financial Stability Report the Riksbank regularly presents methods developed both by the Riksbank itself and existing methods that are adapted to Swedish conditions. In this Financial Stability Report we describe a systemic risk indicator for the Swedish banking system.

Systemic risk in the banking system is an important element in assessing financial stability

One of the functions of the Riksbank is to promote a safe and efficient payment system. This means that the Riksbank must act to ensure that the financial system will be able to maintain its basic functions, such as mediation of payments, converting savings into funding and risk management. If the financial system cannot fulfil its basic functions, considerable social costs may ensue. Carefully following and analysing systemic risk, that is the risk of costly functional disruptions in the financial system as a whole, is therefore an important part of the Riksbank's work on financial stability.⁹¹ Since the banks are an important part of the financial system, the systemic risk that exists in the banking sector is an important part of assessing financial stability.

⁹⁰ A more detailed examination of the methods on which the systemic risk indicator is based can be found in "A systemic risk indicator for the Swedish banking system", *Economic Commentary no 7*, 2011, Sveriges Riksbank, www.riksbank.se.

⁹¹ See *The Riksbank and Financial Stability, 2010*, Sveriges Riksbank, for a more extensive discussion of systemic risks and the Riksbank's financial stability work.

Systemic risk in the banking sector cannot be described using one single measure

To make an assessment of systemic risk in the banking sector various types of tools, measures and indicators can be used. One tool used today by the Riksbank is stress tests. Stress tests are carried out on the banks' capital ratios and on their liquidity buffers. In that way the banks', and to some extent the banking system's, resilience to both loan losses and liquidity strains can be illustrated. However, there are several reasons for stress tests not necessarily giving a full picture of the systemic risk in the banking sector. A first reason is that stress tests often rely on historical correlations and previous experience. This entails a risk that the stress tests are not sufficiently forward-looking, which in turn may result in changed circumstances in the banking sector not being identified in the stress tests. A second reason for the stress tests not always giving a full picture of the systemic risks is that there is a risk that important systemic aspects will be overlooked because individual institutions, rather than the entire banking system, are in focus.⁹² A third reason is that they do not necessarily identify important institutional factors, such as implicit state commitments. All in all, these reasons mean that supplementary methods may be of great benefit in modulating the picture of systemic risk in the banking sector when making stability assessments.

The systemic risk indicator is a broad measure of systemic risk derived from individual probabilities of distress

The systemic risk indicator presented in this box can supplement the capital and liquidity stress tests by giving a picture of the future probability of all banks in the Swedish banking system becoming distressed. By distressed is meant a situation in which the value of the banks' assets become too low in relation to their liabilities. Simultaneously taking into account the value of the assets and liabilities means that the systemic risk indicator can identify different types of problem. Consequently, the systemic risk indicator can give a more complete picture of systemic risk in the banking sector by identifying risks regardless of whether they derive from solvency problems, liquidity problems or any other type of problem. The systemic risk indicator is also to a certain extent forward-looking, which means that it is not influenced by historical correlations to the same extent as the stress tests.

The data on which the current systemic risk indicator is based consists of information on the level and volatility of the asset value of the banks studied and the level and structure of the liabilities of the banks studied. This information is weighted into a probability of

⁹² Interactions and correlations between individual institutions may mean that the total risk in a system consisting of several institutions is greater than the risk obtained by only adding together the individual institutions' risks.

individual banks becoming distressed. The weighting is done by first producing an approximate market value for the assets of the banks studied and volatility for this value.⁹³ The idea is then to compare the value of the assets with a critical threshold consisting of the short-term liabilities and half of the long-term liabilities of each bank. If the value of a bank's assets falls under this critical threshold the bank is distressed. By measuring the distance between the asset value and the critical threshold a probability of distress can be obtained.⁹⁴

The method used in this box to obtain probabilities of distress for individual banks means that all factors affecting the level of and volatility for the market value of the banks' assets and the level and structure of the banks' liabilities will be reflected in the individual banks' probability of distress. This means in turn that the individual banks' probabilities of distress can provide a picture of both banks' solvency position and their liquidity situation.

To be able to calculate a systemic risk indicator that identifies the risk in the banking system as a whole it is not sufficient to study the individual banks' probabilities of distress. Instead a joint probability is required for the entire banking system. This joint probability is necessary to capture information on how interaction and correlation between banks contributes to risk in the entire system. If the covariation is not taken into account there is a risk that the systemic aspect of the risk indicator will be lost. The reason for this is that many of the systemic risks in the banking sector probably arise as a consequence of several banks, under certain conditions, being affected in a similar way by adverse disruptions. Hence covariation is probably an important part of all systemic risk indicators. It is therefore important to bring to together the individual banks' probabilities of distress so that a systemic risk indicator can be constructed.

There are several different ways of calculating a joint probability of distress on the basis of information about the individual banks. In this box the CIMDO approach is used.⁹⁵ On the basis of the individual banks' probability of distress we can use this method to derive the probability of all banks becoming distressed at the same time.⁹⁶

93 The calculations approximate the asset value as the sum of the market value of the banks' outstanding shares and the banks' liabilities. See H. Byström, "Merton Unraveled: A Flexible Way of Modeling Default Risk, *The Journal of Alternative Investments*, 8(4) 39-47, 2006. The banks' liabilities and the volatility of the assets' market value are obtained from the Creditedge database, which is provided by Moody's KMV, while the market value of the banks' outstanding shares is obtained from Bloomberg. The value of the banks' liabilities and the volatility of the asset value are interpolated from monthly to daily frequency. To eliminate the jumps in these series that exist in connection with the reporting dates the series are HP-filtered.

94 This probability can be calculated by making a distribution assumption for the distance to the critical threshold.

95 See M.A. Segoviano and C. Goodhart, "Banking Stability Measures", Working Paper WP/09/4 International Monetary Fund, 2009 and M.A. Segoviano, "Consistent Information Multivariate Density Optimization Methodology", *Discussion Paper 557*, Financial Markets Group, London School of Economics, 2006.

96 The probability of all banks becoming distressed at the same time is called joint probability of default or JPoD in Segoviano och Goodhart, 2009.

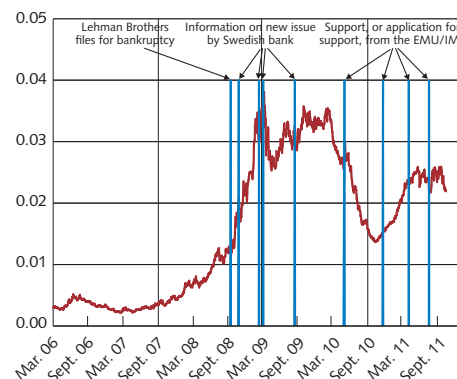
The systemic risk indicator presented in this box is the probability of all banks becoming distressed. Chart B4:1 shows the estimated systemic risk indicator for the period February 2006–October 2011. The four major Swedish banks – Handelsbanken, Nordea, SEB and Swedbank – are included in the calculations.

Development of the systemic risk indicator between 2006 and 2011

Chart B4:1 shows the systemic risk indicator assuming a comparatively low value in 2006 and 2007. In connection with increasing financial unease in the first half of 2008 the indicator increases somewhat. In the second half of 2008, when the acute part of the financial crisis breaks out, the systemic risk indicator rises substantially. The rise in the systemic risk indicator in 2008 and 2009 captures both the impaired liquidity situation in the financial system and the risks associated with large loan losses in some Swedish banks' lending to the Baltic countries. From the beginning of 2010 the indicator falls back because the problems in the banking sector appear to be manageable. The fact that many economies around the world seem to be entering a period of recovery also inspires confidence, which is probably also reflected in the systemic risk indicator. Towards the end of 2010, however, it becomes obvious that the problems in the financial sector, and the fiscal policy measures implemented in the wake of the financial crisis, have resulted in an unsustainable fiscal situation in several countries. Among other things, this leads to Greece, Ireland and Portugal needing to seek international support to cope with their fiscal commitments. Furthermore, in late summer of 2011 there are signals that the economic recovery is not as strong as previously forecast. All in all this again leads to intensified unease in financial markets. This is reflected in the rise in the systemic risk indicator from the end of 2010 until October 2011.

Finally, it can be noted that the time series in Chart B4:1 indicates that the probability of all the investigated banks falling into distress simultaneously is small. There are several reasons for this. One reason is that the probability of a single bank falling into distress is generally small. This, in turn, means that the probability of all banks falling into distress simultaneously will be even smaller. But even if the systemic risk indicator renders a small probability of all the four major Swedish banks falling into distress simultaneously, it also indicates that there is currently an elevated systemic risk in the Swedish banking system comparable to the risk that was indicated during the fall of 2008.

Chart B4:1. Systemic risk indicator, March 2006 – October 2011
Probability in per cent



Note: Vertical lines in the chart indicate the following important dates. 15/9 2008: Lehman Brothers files for bankruptcy. 27/10 2008 and 17/8 2009: information on new issue of shares by Swedbank. 10/2 2009 and 4/3 2009: information on new issue of shares by Nordea and SEB. 4/5 2010 and 21/7 2011: Greece receives rescue package. 22/11 2010 and 6/4 2011: Ireland and Portugal apply for rescue package. The systemic risk indicator constitutes the probability of all four major banks becoming distressed at the same time. This probability is designated JPoD in Segoviano and Goodhart (2009).

Sources: Bloomberg, Moody's KMV and the Riksbank