# Stibor revisited – a follow-up

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SVERIGES RIKSBANK

# Stibor revisited – a follow-up

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# ■ Foreword

Reference rates have existed for a long time and have largely fulfilled their purpose as benchmarks in the pricing of financial contracts. However, in conjunction with the financial crisis around 2007-2009, it became clear that there were problems that risked undermining the confidence in reference rates around the world. The Riksbank has examined the Swedish reference rate Stockholm Interbank Offered rate, Stibor, on several occasions and over a long period of time.

In 2011 and 2012, the Riksbank conducted a comprehensive review of Stibor. This review brought to light a number of deficiencies in the framework surrounding Stibor and thus resulted in the Riksbank issuing recommendations regarding Stibor to the banks in the Swedish banking system in November 2012. Since then, the recommended measures have been taken by the Swedish Bankers' Association, which has been responsible for Stibor since March 2013. In connection with the recommendations in 2012, the Riksbank undertook to produce a new assessment of Stibor in 2014 in order to follow up on the reform work and review the functioning of the framework surrounding Stibor. This study fulfils the Riksbank's undertaking and also contributes to improving transparency surrounding Stibor and the pricing on the interbank market in general.

The Riksbank is not responsible for the supervision of banks or other institutions or organisations. However, the Riksbank has the statutory task of promoting a safe and efficient payments system; that is, safeguarding financial stability and hence the functioning of financial markets. It is on the basis of that task that the Riksbank analyses Stibor.

The working group was led by Johannes Forss Sandahl, who conducted the study alongside Björn Jönsson, Lisa Marklund and Per Åsberg Sommar.[1] The working group operated under the leadership of a steering committee and in collaboration with a reference group consisting of representatives from the Financial Stability Department, the Monetary Policy Department and the Markets Department of the Riksbank. Olof Sandstedt was chairman of the steering committee.

Stockholm, May 26 2014
*Kasper Roszbach*
Head of the Financial Stability Department

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# ■ Summary

*The Stockholm Interbank Offered Rate (Stibor) is the generic term for a number of reference rates in Swedish krona. These reference rates are used in different ways in the pricing of financial contracts in Swedish krona whose outstanding notional amounts total around 50,000 billion Swedish krona. Stibor is therefore of great significance for Swedish interest rates, the allocation of capital in society and the functioning of financial markets.*

In conjunction with the global financial crisis around 2007-2009, it became clear that there were problems that risked undermining the confidence in reference rates. These have therefore been under review around the world over the last few years. The Riksbank has examined Stibor on several occasions. After a comprehensive review the Riksbank issued recommendations regarding Stibor in the Financial Stability Reports 2012:2 and 2013:1. The purpose was to encourage the banks in the Swedish banking system to take measures to eliminate a number of deficiencies in the Stibor framework.

Since then, the Swedish Bankers' Association[2] has assumed responsibility for Stibor and published a new framework for the reference rate. Therefore, since November 2013, the Riksbank considers that the recommendations regarding Stibor have been met. In connection with the recommendation in 2012, the Riksbank undertook to perform a new assessment of Stibor in 2014 in order to follow up the reform work and review the functioning of the framework surrounding Stibor. The intention with this report is to fulfil this undertaking and present the Riksbank's method for studying Stibor under the new framework, and the conclusions of the study.

The starting point of the study is that Stibor should reflect the interest rates that the banks are willing to offer each other for unsecured loans in Swedish krona. The Riksbank has however discovered that the banks trade to different extents on the markets that form the basis for Stibor, and that the possibilities of comparing Stibor to interest rates in actual transactions hence vary substantially between banks. Even though all of the banks' transactions are taken into account, there is often a lack of executed loans between the banks that can be compared to Stibor. The banks seldom issue unsecured loans to each other at maturities that are longer than one day. However, they make use of other sources of funding with longer maturities that can be used to make a less precise comparison to Stibor.

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2   Hereinafter called the Bankers' Association.

Although the types of transactions that the banks execute vary between maturities, the use of different approaches has made it possible to compare Stibor to interest rates in actual transactions for all maturities except six months. The Riksbank has found that Stibor, since the new framework came into effect, has on average matched the interest rates used in comparable actual transactions for the maturities for which is has been possible to make the comparison. Hence, the Stibor level is accurate in the sense that the reference rate has on average been determined at the interest rate levels it is intended to reflect on days when the banks have executed comparable transactions.

In addition, the results of this study include a few observations that may be worth discussing in the future work on Stibor that is led by the Bankers' Association. The observations pertain to the requirements that the Stibor framework imposes on the banks, and how adapted those requirements are to the conditions prevailing in the interbank market. These observations should not necessarily be regarded as problems and might not necessitate action, but merit being raised because they can affect how Stibor is determined.

# ■ 2 Introduction

Reference rates serve as benchmarks for the pricing of financial contracts. They are most frequently determined on the basis of the banks' assessments of the market interest rates that prevail in the interbank market, rather than on the basis of interest rates in actual market transactions between banks. Consequently, the setting of a reference rate needs to be organised in a way that inspires confidence in that factors relevant for actual pricing will also be expressed in the determination of the reference rate, i.e. as if a real transaction were being executed. A clear and confidence-inspiring framework, and favourable conditions for verifying that reference rates match the interest rates in actual transactions, are key components in this.

## 2.1 The Swedish reference rate Stibor

Stibor is defined as the interest rates that the banks in the so-called Stibor panel offer each other on average for unsecured loans in Swedish krona with a number of different maturities. Stibor is determined on a daily basis for six maturities by the banks in the Stibor panel, i.e. Danske Bank, Handelsbanken, Länsförsäkringar Bank, Nordea, SEB and Swedbank. The Bankers' Association bears responsibility for the framework that regulates the forms under which Stibor is determined, and Nasdaq OMX bears responsibility for the calculation of the reference rate.

Stibor forms the basis for the pricing of interest rate derivatives, which has an outstanding volume of 38,000 billion Swedish krona. The reference rate is also often used in various ways in the pricing of foreign exchange derivatives at an outstanding volume of almost 9,000 billion Swedish krona. In addition, the reference rate is often used as a benchmark in the pricing of financial institutions' loans with variable interest rates to Swedish companies and households, which total around 3,000 billion Swedish krona. Finally, Stibor serves as a basis for the pricing of bonds with variable rates at an outstanding volume of around 750 billion Swedish krona. In total, Stibor is used as a reference rate for loans and financial contracts at an outstanding volume of around 50,000 billion Swedish krona.[3] Stibor is therefore of key importance to the Swedish economy and thus

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3 The amount is based on notional amounts of financial contracts, not market values. It is also a gross amount, which means that the notional amounts for liabilities and assets have been totalled. The amount includes mortgage and corporate loans at variable rates as well as variable rate bonds and interest rate swaps, interest rate forwards and foreign exchange swaps. Sources: Dealogic, Financial Market Statistics, June 2013; Statistics Sweden and Detailed tables on semi-annual OTC derivatives statistics at end-June 2013; Bank for International Settlements (BIS).

to the Riksbank (the Riksbank, 2012a). This applies to both financial stability and monetary policy.

Stibor is important for the functioning of financial markets, not least in the pricing of instruments such as interest rate and foreign exchange derivatives, which are important to the risk management of banks and companies. Confidence in Stibor is thus important to financial stability in Sweden. Stibor also serves as a benchmark for the banks' cost for unsecured loans on the interbank market and hence for credit risk in the banking sector. Consequently, Stibor is also important for the assessment of the stability of the financial system.

As Stibor is used in the pricing of many financial contracts, the reference rate is an important component in the monetary policy transmission mechanism through which the repo rate affects the interest rates encountered by households and companies. Changes in the repo rate ought to affect Stibor and hence also the pricing of the financial contracts linked to Stibor. If this does not function for some reason, monetary policy fundamentals can be affected.

## 2.2  The Riksbank has reviewed Stibor

In the autumn of 2011, the Riksbank initiated a comprehensive review of Stibor. This review brought to light a number of deficiencies in the framework surrounding the reference rate. The deficiencies were linked to the lack of an agent with overall responsibility for Stibor as well as of a clear governance and control structure. In addition, there were deficiencies in the incentives and transparency surrounding the pricing of Stibor and difficulties in verifying how Stibor was determined, particularly for longer maturities. There was therefore reason for the adoption of reforms in these areas to strengthen the confidence in Stibor.

The review therefore resulted in the Riksbank issuing recommendations regarding Stibor directed to the banks in the Swedish banking system in November 2012 and May 2013. Since then, the recommended measures have been taken by the Bankers' Association, which has been responsible for Stibor since March 2013. In connection with the recommendations in 2012, the Riksbank undertook to make a new assessment of Stibor in 2014 in order to follow up on the reform work and review the functioning of the framework surrounding Stibor. This study fulfils that undertaking and also contributes to improving transparency surrounding Stibor and the pricing on the interbank market in general.

## 2.3  A new framework enables a new analysis of Stibor

One of the measures that was undertaken has led the new framework to better enable comparing Stibor with interest rates in actual transactions. One of the requirements of the framework is that it places demands on the banks in the

Stibor panel in terms of documenting the interest rates on which Stibor is based. Also, the banks report to the Riksbank a unique, comprehensive data set for a selection of executed transactions that can be compared with the documented interest rates. Since August 2013, the Riksbank has therefore been able to study the banks' reported interest rates and compare them to interest rates in actual transactions. This report takes as its starting point the new data sets for the period April-December 2013, which enable empirical studies of Stibor under the new framework.

The basis of this study is that Stibor shall reflect the interest rates that the banks in the Stibor panel are willing to offer each other for unsecured loans in Swedish krona. The study is thus based on comparisons of Stibor with interest rates for such executed loans between the Stibor banks. The study is also based on comparisons of Stibor to the interest rates that the banks pay for other unsecured short-term funding.

In order to perform an accurate analysis, there must be a sufficient amount of actual transactions that can be compared to Stibor. The banks however trade to different extents on the market regardless of the maturity or the type of transaction being studied. Therefore the data sets with actual transactions that can be compared to Stibor differ substantially between the banks. Furthermore, the precondition of a sufficient amount of transactions is met to varying degrees for the different maturities. For the T/N[4] maturity, there is a great deal of unsecured loans and deposits in Swedish krona between the Stibor banks that can be used to make a direct comparison. There are, however, very few loans and deposits for the one-week to three-month maturities between the Stibor banks. However, there are other types of transactions with the maturities up to three months that have been executed by the Stibor banks with a wider circle of counterparties. Using these transactions, it has also been possible to study Stibor for maturities longer than T/N, even though transactions did not occur on all days of the period. For the six-month maturity, there have however been too few transactions to perform a reliable comparison.

The study shows that Stibor, for the maturities T/N up to three months, is on average well in line with the interest rates of actual transactions executed by the Stibor banks. This means that the level of Stibor is accurate in that the reference rate on average reflects the interest rate levels that it is intended to reflect during the days on which the banks have executed actual transactions.

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4   The T/N maturity stands for tomorrow next and refers to the maturity between the next banking day and the banking day following that.

## 2.4 International review of reference rates is being conducted

In parallel with the developments around Stibor in Sweden, a comprehensive review of reference rates is also under way internationally due to a number of deficiencies brought to light particularly since the global financial crisis around 2007-2009. The supervisory authorities of several countries such as the UK, US, Canada, Japan and the EU have, since 2009, been reviewing the reference rates Libor (London Interbank Offered Rate), Euribor (Euro Interbank Offered Rate) and Tibor (Tokyo Interbank Offered Rate). In the UK and Denmark, legislation has been introduced to impose minimum requirements on how the Libor and Cibor (Copenhagen Interbank Offered Rate) reference rates are determined.

In parallel with national legislation, the International Organization of Securities Commissions (IOSCO) as well as the European Banking Authority (EBA) and the European Securities and Markets Authority (ESMA) have published principles for reference rates and other benchmarks. These principles aim to form standards for how reference rates and other benchmarks should be determined, examined and supervised, as well as coordinate the work conducted in this field in different countries. In 2013, the Bankers' Association took action to make the Stibor framework compliant with the EBA and ESMA principles, and the Stibor framework specifies that Stibor meets the principles.

A crucial initiative was also taken by the European Commission, which in 2013 published a proposal for a regulation regarding benchmarks, including reference rates (EU Commission, 2013). A regulation constitutes binding legislation for EU Member States, so Stibor will be governed by the regulation if it comes into effect.

In addition, the Financial Stability Board (FSB) has taken the initiative in globally coordinating the current work at national level on reviewing reference rates. These efforts mainly revolve around reviewing existing reference rates and preparing recommendations regarding potential measures.

The Riksbank is monitoring the international reforms and regulations and in the future it might be necessary to adjust the framework for the Swedish reference rate Stibor to the changes taking place. At the same time, it is important to take into account the differences between various reference rates. For example, reference rates often differ in terms of how they are defined, who is responsible for them, the number of participating banks in the determination of them and whether or not banks are committed to trade at their submitted quotes. Such differences may motivate national adaptation of international standards.

# ■ 3 Developments around Stibor after the Riksbank's recommendations

As mentioned previously, reform work around Stibor has taken place in parallel with reforms and reviews of other reference rates around the world. This section describes in more detail the developments that have taken place around Stibor and its framework in the past few years from the Riksbank's perspective.

## 3.1 Reforms were needed

In the autumn of 2011, the Riksbank initiated a comprehensive review of Stibor. The Riksbank conducted interviews with individuals participating in the determination of Stibor and examined the agreement regulating Stibor. In addition, the Riksbank requested transaction data from the banks determining Stibor for the period 2007-2011. These data sets included unsecured interbank loans and deposits. The Riksbank also collected data on these banks' individual Stibor submissions from the start until the close of the submission process in which Stibor was determined for each banking day over the period 1997-2012.

On the basis of this material, the report The Riksbank's Review of Stibor (the Riksbank, 2012a) described the framework surrounding Stibor in a historical and international perspective. Based on the collected data sets, an empirical analysis was also performed. The review identified a number of deficiencies in the framework surrounding Stibor. Briefly, the deficiencies consisted of:

- *Lack of responsibility.* The banks in the Stibor panel were jointly responsible for the agreement that regulated how the reference rate was determined. Hence, there was no individual agent that was responsible for the agreement and that could be held accountable.

- *Lack of governance and control.* Among other factors, there was a lack of an organisation to monitor whether the banks were complying with the Stibor agreement and to deal with queries or complaints regarding Stibor from external parties. Neither was it possible to eliminate the prospect of conflicts of interest and irregular incentives within the banks in the process for the determination of Stibor.

- *Lack of transparency.* The Stibor agreement was not public. Information on what Stibor was and how the reference rate was determined was not available either. This made it difficult for external parties to assess and understand the reference rate.

- *Lack of possibilities to verify Stibor.* There was a lack of the kind of information on market pricing that would have been needed to verify Stibor in interest rates in actual transactions.

- *Inadequate incentives in the submission process when Stibor is determined.* The banks were not committed to lend or accept deposits at their Stibor submissions. Consequently, there was scope for strengthening the incentives to submit accurate Stibor rates by introducing commitments for banks to lend and accept deposits at their submissions. In addition, it was ascertained that Sweden is a relatively small market with few banks on the Stibor panel, which involves a risk of collusion between the banks when Stibor is being determined.

Because these deficiencies could undermine confidence in the reference rate and lead to inefficient pricing of risk in the financial system and a distorted distribution of capital in the economy, reforms to strengthen confidence in Stibor were needed. The review therefore resulted in proposals for a number of reforms of Stibor that were also formulated as recommendations in the Riksbank's Financial Stability Report 2012:2:

- "There should be one agent with the task of taking clear responsibility for how Stibor is determined and who can be held accountable for the functioning of Stibor. As no single agent has this responsibility at present, it will be more difficult to carry out the necessary reforms of the benchmark rate. The organisation in the best position to initiate reform work is the Swedish Bankers' Association, as all banks in the Stibor panel are represented in this organisation at the managing director level. In addition, the Swedish Bankers' Association has a broad range of members who would thereby be given the opportunity of influencing the design of the framework for Stibor. However, it is not self-evident which agents should have the overall responsibility for Stibor in the long term."

- "Clear rules for governance and control require there to be a unified framework with contracts for Stibor that the banks in the Stibor panel can follow. It is also important to establish a clear structure to follow up compliance with this framework and to deal with questions and possible complaints about Stibor. The banks should also prepare a code of conduct for their internal organisations and work with Stibor to reduce the risk of incentives arising that could lead to irregularities when Stibor is determined."

- "To create a transparent framework for Stibor, all contracts, regulations and agreements concerning Stibor should be public and easily accessible. The Riksbank and Finansinspektionen should be given full insight into all discussions and handling of matters concerning Stibor, as part of their supervision of Stibor."

- "To create appropriate incentives and make it possible to verify pricing when Stibor is determined, the banks in the Stibor panel should be obliged to borrow and lend at their offers on request. This will help create an incentive for the banks to ensure that their Stibor submissions are on market terms. To be better able to verify Stibor on the basis of market pricing, it would be best if the banks regularly issued and quoted bid rates for bank certificates in Swedish krona for relevant maturities. A minimum requirement is, however, that the banks regularly quote interest rates for their own bank certificates in Swedish krona."

- "Additionally, the number of maturities for which Stibor is determined should be reduced to cover the most used maturities. The size of the trading units should also be designed to encourage the banks to borrow and lend at each other's submissions. Smaller trading units also increase the possibilities for more banks to participate in the submission process, which could strengthen confidence in Stibor."

In the Financial Stability Report 2013:1, the Riksbank also recommended that:

- "The framework of the Stibor reference rate should be complemented with a requirement for independent follow-up and control. To ensure confidence in Stibor, it is essential that there be a clear structure for following up and overseeing compliance with the framework. In addition, the Riksbank considers that the follow-up should include an independent review. An independent review, for example in the form of an audit performed by a registered public accounting firm, would form an important complement to the Riksbank's oversight and Finansinspektionen's supervision."

## 3.2 New Stibor framework meets the Riksbank's recommendations

Following the Riksbank's recommendation on Stibor in November 2012, the Bankers' Association, together with the banks in the Stibor panel and Nasdaq OMX, embarked on extensive reform work. The new Stibor framework was

published in March 2013, and at the same time the Bankers' Association assumed responsibility for the reference rate from the banks in the Stibor panel that previously held joint responsibility. Since then, the framework has been remedied such that the Riksbank considers that, since the publication of the report Financial Stability 2013:2, the recommendations have been met.

*Responsibility for Stibor and transparency*

- In March 2013, the Bankers' Association announced that it was officially assuming responsibility for the framework surrounding Stibor. Subsequently, on 4 March 2013, the Bankers' Association published a new Stibor framework on its website that contained a clear definition of Stibor.[5]

*Governance and control*

- The new framework led to the establishment of the Stibor Committee as the governing body of the reference rate. The Committee deals with queries and other matters regarding Stibor and comprises representatives from the Stibor banks and observers from the Bankers' Association, Nasdaq OMX and the Riksbank. Since 2014, it has also contained an independent member, which has been a requirement imposed by the EBA/ESMA principles issued in June 2013 (EBA/ESMA, 2013). The highest governing body of Stibor is however the board of the Bankers' Association, which appoints members to the Stibor Committee and makes the ultimate decisions. Decisions pertain to matters such as which new banks should be allowed to participate in the panel.

    In addition, the new framework includes a code of conduct for the banks that determine Stibor with new requirements for the banks' internal governance in order to avoid incentive structures that could lead to Stibor manipulation. It also includes requirements regarding documentation and storing of information on the banks' internal procedures when they determine Stibor.

    The new framework also meets the Riksbank's recommendation that the framework should be devised such that it does not exclude banks that could participate in the Stibor panel. This has been achieved in the new Stibor framework by the introduction of a clear and formal process for banks' application to participate in the Stibor panel.

    The recommendation regarding an independent review and control of Stibor was met in December 2013 in a revised version of the framework.

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5   The website of the Bankers' Association is www.swedishbankers.se.

The requirement stipulates that an external audit shall be conducted of Stibor operations at the Bankers' Association, the Stibor banks and the calculation agent (i.e. Nasdaq OMX) at least once every two years.

*Verification possibilities*

- The new Stibor framework requires the Stibor banks to state each day indicative interest rates at which they believe they can issue certificates in Swedish krona.[6] These interest rates are published daily together with the banks' stated Stibor submissions on Nasdaq OMX's website which provides a further basis for verifying Stibor.

  The framework also requires that the banks document daily all interest rates that form the basis of their Stibor submissions, which they do in their Stibor documentation, which is described in more detail in section 3.3. The banks also document the loans and deposits that have been executed as a consequence of their commitment to trade with the other panel banks at their stated Stibor submissions.

*Incentives in the submission process*

- The new framework has introduced commitments for the banks to lend and accept deposits at their Stibor submissions on request.[7] According to the new framework, each bank also states its Stibor submissions with no knowledge of the other banks' submissions. Hence, incentives for banks to state accurate submissions have strengthened considerably given that they previously could see each other's submissions in the submission process, and at the same time were not committed to trade at the submissions.

  In order to attain a manageable cost for the banks when they need to lend and accept deposits at their submissions, the trading units and the number of maturities for Stibor have been reduced in the new framework. Trading units for maturities up to six months have been reduced from 500 million to 100 million, while Stibor for the nine- and twelve-month maturities has been completely discontinued.[8]

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6   A certificate is a security for trading in the money market, issued for example by a bank or a company with the purpose of borrowing money. Maturity is a maximum of one year.

7   The banks are committed to accept deposits at their Stibor submissions minus no more than 15 basis points.

8   For loans and deposits with Länsförsäkringar Bank, the trading unit is 10 million.

## 3.3 How Stibor is determined today

### WHO DETERMINES STIBOR?

The banks that determine Stibor are part of the Stibor panel, which consists of Danske bank, Handelsbanken, Länsförsäkringar Bank, Nordea, SEB and Swedbank.[9] The Bankers' Association is the administrator of Stibor, and is hence responsible for the Stibor framework which the Stibor banks and the calculation agent Nasdaq OMX are obliged to follow. The complete framework surrounding Stibor can be found in Framework for Stibor (Swedish Bankers' Association, 2013).

### HOW IS STIBOR DEFINED?

Stibor is defined as the interest rates that the banks in the Stibor panel offer each other on average for unsecured loans in Swedish krona for a number of maturities. Stibor is determined daily for the maturities T/N, one week and one, two, three and six months. The reference rate is calculated as an average of the Stibor submissions stated by the banks in the panel for each maturity.

### HOW DO THE BANKS DECIDE THEIR STIBOR SUBMISSIONS?

The Stibor banks state a Stibor submission by maturity every banking day. Each Stibor submission is calculated as the sum of the bank's stated funding rate and stated spread and can therefore be described in three parts (see Figure 1).

**Figure 1. Components of the Stibor submissions of each individual bank**
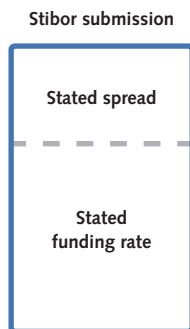
**Stibor submission**



- **Stibor submission:** The rate at which the bank is willing to offer unsecured loans in Swedish krona to the other Stibor banks. The Stibor submission is calculated as the sum of the stated funding rate and the stated spread.

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9   Hereinafter in this report, these banks are called the Stibor banks.

- **Stated funding rate:** The interest rate that a bank thinks it may pay for unsecured funding and is therefore willing to offer for unsecured deposits in Swedish krona. Each day, the banks have the opportunity to determine their funding rates as:
    - Primarily: An interest rate that has been used in an actual transaction. In this case, the interest rate should have been used in an unsecured deposit in Swedish krona from another bank.
    - Secondarily: An indicative rate, at which the bank believes it can borrow and hence is willing to offer for deposits. This rate does not need to be based on the interest rate for an actual deposit. The banks may choose to set this rate as a quoted rate for unsecured deposits in Swedish krona from other banks. The banks may also state a weighted average of interest rates for funding through interbank deposits or issued certificates in Swedish krona, and through issued certificates or commercial paper in euros and US dollars converted into Swedish krona using foreign exchange swaps.[10, 11, 12] The Stibor framework requires that at least 50 per cent of the weight be allocated to interest rates from funding in Swedish krona.
- **Stated spread:** The difference between the bank's stated funding rate and its Stibor submission. By adding a spread, a bank makes it less favourable for other banks to borrow at its Stibor submission. This is desirable for the banks because they otherwise might be forced to lend at interest rates that are too low in the Stibor submission process.

HOW DOES THE SUBMISSION PROCESS FOR THE DETERMINATION OF STIBOR WORK?

Stibor is determined before noon each banking day in three phases:
- **10.30-10.50:** The banks specify their Stibor submissions in a trading system that is administered by Nasdaq OMX. This part of the submission process is closed, meaning the banks cannot see each other's submissions. The Stibor banks internally document their Stibor submissions, stated funding rates and stated spreads to then store this information for five years. The information is stored in the so-called Stibor documentation. The Riksbank has requested access to the Stibor documentation and the banks have

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10  In this study the terms "funding" and "funding rate" are used to describe both deposit and borrowing rates.
11  See the box "Funding of Swedish banks" in The Riksbank's review of Stibor (the Riksbank, 2012a).
12  A foreign exchange swap is an agreement to buy or sell a currency at the daily rate and then sell or buy back the same currency on a later date at a pre-determined rate.

therefore been reporting the documentation to the Riksbank on a quarterly basis since August 2013. The Stibor submissions are also published each banking day on Nasdaq OMX's website.[13]

- **10.50-10.55:** During this phase, the Stibor banks can see each other's submissions and have the right to borrow at each other's Stibor submissions and make deposits at each other's Stibor submissions minus what is known as a regulated bid/offer spread.[14, 15] This spread is thus a regulated difference between the deposit and lending rates at which the banks are committed to trade. This regulated bid/offer spread is no more than 8 basis points for the T/N maturity, no more than 10 basis points for the one-week maturity, and no more than 15 basis points for other maturities.[16] The banks and the Bankers' Association have agreed to the regulated bid/offer-spreads. Their judgments about the levels of the spreads have been made on the basis of their knowledge of the spreads used on the interbank market. In this study, it is therefore a reasonable assumption that the regulated bid/offer-spreads should be viable and representative for the spreads that are used in the interbank market.

  The trading unit for loans and deposits at the Stibor submissions of Danske Bank, Handelsbanken, Nordea, SEB and Swedbank is 100 million Swedish krona. For loans and deposits at Länsförsäkringar Bank's Stibor submissions the trading unit is 10 million Swedish krona. Each bank is entitled to borrow and deposit once at each of the other banks' Stibor submissions for every maturity.

- **10.55-11.00:** The calculation agent Nasdaq OMX calculates Stibor as the mean of the reported Stibor submissions, with three decimal places. In order for Stibor to be calculated and published, at least four banks must provide Stibor submissions. Since there are currently six participating banks in the Stibor panel, this condition is met.

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13  www.nasdaqomx.com/transactions/trading/fixedincome/fixedincome/sweden/stiborswaptreasuryfixing.
14  In bid/offer spread, "bid" refers to the interest rate bid by a bank for deposits and "offer" is the interest rate it offers on loans.
15  During this phase and until the publication of Stibor the submissions are unknown to banks and other participants in financial markets that do not participate in the Stibor panel.
16  Until December 2013, the regulated bid/offer spread was 15 basis points for all maturities. However, the Bankers' Association decided, in consultation with the Stibor banks, to reduce the spreads for the shortest maturities with the aim of creating more apparent commitments for the banks to trade at their submissions upon request.

# ■ 4 Empirical analysis

The empirical analysis is carried out to answer the question as to whether Stibor is accurate in its definition of being the interest rate at which the Stibor banks state they are willing to offer each other unsecured loans in Swedish krona. This study interprets this definition such that Stibor should reflect a market rate, i.e. the marginal cost for loans. This means that today's Stibor-rate should reflect what it costs the banks to raise a new unsecured loan in Swedish krona from each other today. This view of Stibor differs from the term financing cost. While the financing cost represents the cost of a bank's overall current funding, a marginal cost represents the cost for a bank to raise a new loan. The marginal cost of the new loan will then affect the bank's total financing cost.

In addition, the starting point for the study is that the banks' Stibor submissions are offered lending rates applicable only to the bank that asks to borrow from any of the other banks during the time interval 10.50-10.55 at the submission process in which Stibor is determined. This means that the banks' Stibor submissions do not need to correspond perfectly to the interest rates on the loans carried out during the day aside of the Stibor submission process. This means that it may be reasonable to expect differences between the banks' Stibor submissions and the interest rates in actual transactions carried out aside of the Stibor submission process. Over time, however, Stibor submissions should on average be consistent with the interest rates in actual transactions.

The analysis in this study is therefore based on comparisons between Stibor and interest rates in actual transactions that are representative of what Stibor should reflect. The transaction data material contains both the transactions that banks have executed with each other in the Stibor submission process and the transactions that have been executed aside of this submission process. Since the new framework was introduced and the Stibor documentation came into place, conditions for making such comparisons have improved:

- The Stibor submissions are to correspond to the interest rates that the banks in the Stibor panel are willing to offer each other for unsecured loans in Swedish krona, and can hence be compared with the interest rates of such executed loans.

- The stated funding rates are to correspond to the interest rates that the Stibor banks actually pay for unsecured market funding, and can hence be compared with such interest rates.

- The stated spreads ought to correspond to the bid/offer spreads applied by the banks when they execute interbank loans and deposits, issue certificates and execute foreign exchange swaps. This is due to the fact that the stated spread is supposed to be the difference between the interest rate at which the bank is willing to accept deposits and the interest rate that the bank is willing charge for loans. Assuming that the regulated bid/offer spreads in the Stibor framework are viable and applied in practice, they can be compared with the stated spreads of the banks.
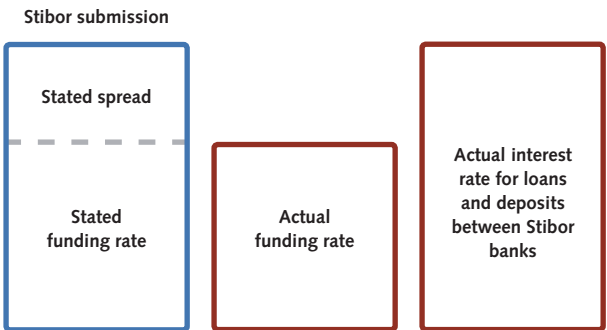
In this section, these comparisons are performed through an empirical analysis consisting of three parts. The section starts with a description of the data sets that form the basis for the analysis.

## 4.1  Data sets

In order to study Stibor, in August 2013 the Riksbank initiated ongoing data collection from the banks in the Stibor panel. The data sets consist in the Stibor documentation and transaction data containing information about transactions that are representative of what Stibor is to reflect. The banks report the data sets with a lag and have been requested to report data for April 2013 and beyond. This study is therefore based on data sets for the period April-December 2013.

Figure 2 provides an illustration of the data sets collected by the Riksbank. The red bars represent the banks' transaction data, and the blue bar represents the Stibor documentation. In this section, only the transaction data sets are described, since the Stibor documentation was described in section 3.3.

**Figure 2. Stibor documentation (blue bar) and transaction data (red bars)**

**Stibor submission**



Stated spread

Stated funding rate

Actual funding rate

Actual interest rate for loans and deposits between Stibor banks

The purpose of collecting transaction data has been to get a picture of the transactions for unsecured funding and lending that the banks execute with the intention to manage their overall liquidity needs in Swedish krona. All banks therefore report transaction data from the functions responsible for their total funding of assets in Swedish krona, which can be obtained both directly in Swedish krona and indirectly in foreign currency converted into Swedish krona using foreign exchange swaps. The banks also report from other units outside of Sweden that manage funding in foreign currency.

The transaction data material includes both transactions that have been executed in the Stibor submission process as well as transactions executed aside of this submission process during the period April-December 2013. Overall, the banks have reported more than 80,000 transactions to the Riksbank. The data sets contain information about interest rates, prices, currencies, counterparties, dates and amounts for the types of transactions through which the banks create unsecured funding or lending through interbank loans, deposits and issued certificates or commercial paper. This corresponds to transactions in the following types of financial contracts:

- Interbank loans and deposits in Swedish krona and foreign currencies
- Issued certificates and commercial paper in Swedish krona and foreign currencies
- Foreign exchange swaps that are used to convert foreign currency into Swedish krona

For interbank loans, deposits and issued certificates or commercial paper, no collateral is provided to the lender. This entails the interest rates on such contracts reflecting both the credit risk in lending money to the counterparty or issuer, and the liquidity risk in tying up liquid funds over a certain period. The interest rates on these contracts should therefore contain the same types of risk premiums as Stibor, which is an offered lending rate for unsecured loans.

Prices of foreign exchange swaps can be used to calculate the interest rate a bank may pay to borrow one currency and then convert the funding into Swedish krona. Since the Stibor banks' funding of assets in Swedish krona consists to a great extent of funding in euros and dollars, access to price information on foreign exchange swaps is important to be able to devise a measure of the banks' actual funding rates in Swedish krona.[17]

In the three following sections, we use the transaction data to calculate funding and lending interest rates in actual transactions. These are then compared with the various components in the banks' Stibor documentation.

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17  The method for this is described in more detail in Appendix 1.

## 4.2 Part 1 – Analysis of interest rates for loans and deposits between the Stibor banks

To start with, we analyse whether the Stibor submissions of the Stibor banks correspond to the interest rates on executed unsecured loans and deposits in Swedish krona between the Stibor banks. Even though the submissions are only valid during the Stibor submission process it is reasonable to expect the submissions to be well in line with the interest rates for this type of transactions also aside of the submission process.

Only a fraction of the transactions in the data set has been executed in the Stibor submission process as a result of requests from banks to lend or borrow at each other's Stibor submissions (see Table 1). Most transactions in the data therefore relate to trading that has been executed aside of the Stibor submission process.

**Table 1. Number of unsecured loan and deposit transactions between the Stibor banks, in total and in the Stibor submission process, April-December 2013**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of transactions | 150 | 8 | 1 | 1 | 0 | 0 |
| Transactions in the Stibor submission process | 5 | 1 | 1 | 1 | 0 | 0 |

Note. There were 188 banking days during the period of April-December 2013.

Source: The Riksbank

The interest rates on actual loans and deposits between the Stibor banks are calculated as the volume-weighted average of the interest rates at which each Stibor bank has provided unsecured loans and deposits in Swedish krona to the other banks in the Stibor panel. The volume-weighting of the interest rate is according to the notional amount for each transaction and is carried out according to step 2 of the calculation that is described in Appendix 1.

In order to study whether the Stibor submissions correspond to the interest rates in actual loans and deposits between the Stibor banks, the differential is calculated between the two interest rate series of each bank. That is, the Stibor submissions of each bank minus the actual rate for loans and deposits issued by the bank to other Stibor banks during the day. One observation therefore corresponds to an interest rate differential that has been calculated for a bank for a day, as a result of the bank having executed transactions that have been possible to compare with the bank's Stibor submission.

The results show that banks rarely execute unsecured loans and deposits with each other, especially with maturities longer than T/N. The total number of observations for maturities of one week to six months is as low as nine. Even for the maturity T/N, the transactions are concentrated in one or a couple of banks,

as evidenced by the low median number of interest rate differentials per bank in relation to the average number of interest rate differentials per bank (see Table 2).

The comparison between the available observations of interest rate differentials shows that the banks' Stibor submissions for the T/N maturity have on average been higher than the equivalent actual interest rates on unsecured loans and deposits between the Stibor banks (see Table 2).[18] The average interest rate differential has however only amounted to 1.54 basis points, while the median of the distribution of interest rate differentials is zero. This suggests that the deviations between the banks' Stibor submissions and equivalent interest rates in actual transactions have been minor. The same is shown in diagram A10 (see Appendix 2), in which the actual interest rate for unsecured loans and deposits with maturity T/N between the Stibor banks is compared with Stibor. The interest rate differentials in Table 2 can be compared with the average differential of 5 basis points for all maturities indicated in The Riksbank's review of Stibor (the Riksbank, 2012a) for the period 2007-2011.

For the one-week maturity, it can be ascertained that the interest rate differential has been 8.86 basis points on average, even though the number of observations for this and the other longer maturities is too low to enable further analysis (see Table 2).

**Table 2. Statistics describing the difference between the banks' Stibor submissions and the actual interest rates for executed loans and deposits between the banks in the period of April-December 2013**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 148 | 7 | 2 | 0 | 0 | 0 |
| Average number of interest rate differentials per bank | 25 | 1 | 0 | 0 | 0 | 0 |
| Median number of interest rate differentials per bank | 15 | 0 | 0 | 0 | 0 | 0 |
| Mean of interest rate differentials, basis points | 1.54** | 8.86 | -1.81 | | | |
| Median of interest rate differentials, basis points | 0.00 | 9.00 | -1.81 | | | |
| Standard deviation of interest rate differentials, basis points | 9.22 | 0.69 | 2.54 | | | |

Note. An interest rate differential is calculated as a bank's Stibor submission minus the same bank's actual interest rate for loans and deposits executed with the other Stibor banks during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. ** = 95 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.

Source: The Riksbank

THE STIBOR SUBMISSIONS ARE ACCURATE FOR THE MATURITY T/N WHERE COMPARISON IS POSSIBLE

The results show that the banks, on average, offer each other slightly higher rates in the Stibor submission process than the rates at which they commonly lend at to each other aside of the submission process. The interest rate differentials are however on average so low that they are within the interval of the regulated bid/offer spreads. As described in Section 3.3, the banks have agreed on these spreads,

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18  The interest rate differential is statistically significant at a confidence level of 95 per cent.

which means that they can be assumed to be representative of the spreads that are actually applicable in the interbank market. The fact that the differentials between the Stibor submissions and the actual lending rates do not on average exceed the regulated bid/offer spreads means that they can be considered eligible. The reason for this is that the actual interest rates are determined depending on the liquidity needs that gave rise to the transaction. If a bank asks to borrow from another bank, it will usually be able to borrow at the other bank's offered lending rate. If the bank instead asks to make a deposit at the other bank it will usually get the bid rate, which should be lower than the offer rate. The fact that the actual interest rates between Stibor banks are lower than the Stibor submissions may therefore be because a bank has placed deposits at another bank's bid rate.

The behaviour of offering slightly higher interest rates in the Stibor submission process than those at which transactions are commonly executed is also to be expected, because in this way the banks can make it less attractive for counterparties to trade at the offered rates when Stibor is determined. This is desirable if the banks prefer to avoid granting unsecured loans to each other.

Also, the representativeness of the interest rates in actual transactions varies from day to day. Hence, from one day to another, they are determined by transactions with varying characteristics due to varying market activity. For example, the variation might result from varying trading volumes and a varying selection of counterparties with which the banks trade from day to day. The interest rates of actual transactions will therefore not be entirely comparable from one day to another. Also, the transactions forming the basis of the actual interest rates might have been executed at other times of the day than when Stibor was determined. Because of this, actual interest rates might include information that is not reflected in Stibor.

## 4.3 Part 2 – Analysis of the Stibor banks' funding rates

Because of the lack of actual loans and deposits between the Stibor banks with maturities longer than T/N, there is a need for further points of comparison for analysing the consistency between Stibor and interest rates in actual transactions. As described in section 3.3, each bank's Stibor submission is calculated as the sum of the bank's stated funding rate and its stated spread. By studying the stated funding rates and assessing the stated spreads, it is therefore possible to analyse the consistency between Stibor and the interest rates in actual transactions, even for the longer Stibor maturities. In this section, it is analysed whether the Stibor banks' stated funding rates in the Stibor documentation correspond to their actual funding rates.

The stated funding rates in the Stibor documentation are calculated by the banks as the weighted average of their stated interest rates for funding through interbank loans, deposits and issued certificates in Swedish krona, and through issued certificates or commercial paper in euros and dollars converted into Swedish krona using foreign exchange swaps, as described in section 3.3.

The actual funding rate is intended to reflect what it would cost each Stibor bank to raise a new unsecured loan in Swedish krona. This interest rate is calculated as the volume-weighted average of interest rates for the Stibor banks' unsecured short-term market funding from a broad selection of counterparties. The transactions forming the basis of this interest rate are limited to the funding of assets in Swedish krona, which can occur in both Swedish krona and foreign currency. The funding rate includes actual interest rates on funding through interbank loans, deposits and issued certificates in Swedish krona, and through interbank loans, deposits and issued certificates or commercial paper in euros and dollars converted into Swedish krona using foreign exchange swaps. For more details about how the actual funding rate is calculated, see Appendix 1.

In order to study whether the stated and actual funding rates correspond to each other, we calculate the differential between the two interest rate series for each bank, i.e. each bank's stated funding rate minus the bank's actual funding rate. An observation therefore corresponds to an interest rate differential that has been calculated for a bank for a day, as a result of the bank carrying out transactions that have been possible to compare with the banks stated funding rate.

The results show that the total number of observations is large enough to perform a statistical test for all maturities except six months. As in the data relating to unsecured loans and deposits between Stibor banks, the transactions are concentrated to one or a couple of banks, especially for maturities T/N, one week and one month. This can be seen once again since the median number of interest rate differentials per bank is low relative to the average number of interest rate differentials per bank.

The comparison of the available interest rate differentials shows that the stated funding rates of the banks have, on average, corresponded to their actual funding rates for all maturities except the one-week, which is the only maturity with a statistically significant interest rate differential (see Table 3).[19] For the six-month maturity, there are far too few observations to be able to make an assessment. Although the average interest rate differential for the six-month maturity is large, Chart A2 in Appendix 2 shows that several transactions were nevertheless executed around the banks' stated funding rates.

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19  The interest rate differential for the one-week maturity is statistically significant at a confidence level of 95 per cent.

**Table 3. Statistics describing the interest rate differential between the banks' stated and actual funding rates in the period of April-December 2013**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 158 | 49 | 44 | 20 | 88 | 7 |
| Average number of interest rate differentials per bank | 26 | 8 | 7 | 3 | 15 | 1 |
| Median number of interest rate differentials per bank | 9 | 3 | 5 | 3 | 13 | 1 |
| Mean of interest rate differentials, basis points | 1.10 | 5.00 | 4.13 | -0.89 | 0.50 | -15.18 |
| Median of interest rate differentials, basis points | -0.31 | 2.61** | 0.75 | -0.82 | -0.71 | -2.05 |
| Standard deviation of interest rate differentials, basis points | 10.59 | 15.20 | 20.93 | 4.29 | 5.57 | 43.71 |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. ** = 95 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.
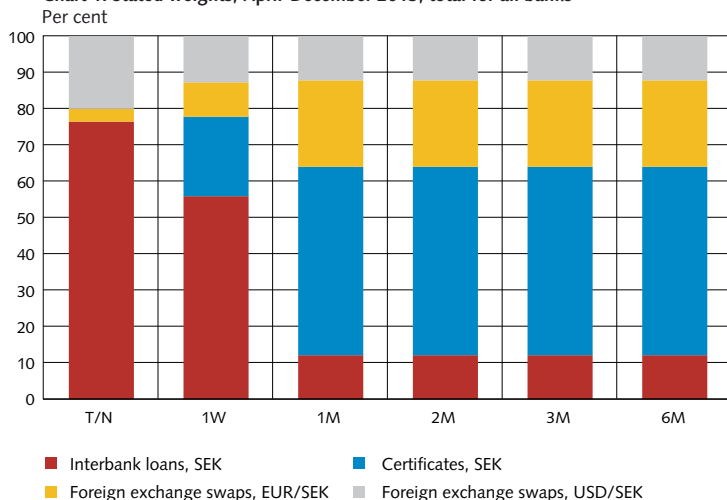
Source: The Riksbank

The only maturity with a statistically significant interest rate differential between the stated and actual funding rates is thus the one-week maturity. The interest rate differential for this maturity is 5.00 basis points (see Table 3). This means the banks have, on average, stated higher funding rates than those at which they actually have borrowed and accepted deposits. Again, a possible reason for the interest rate differential is that the actual funding rate is not always fully representative, i.e. that the interest rates in actual transactions are determined by transactions with varying characteristics due to varying market activity on different days. In terms of the analysis of funding rates, there are however further aspects to take into consideration. These are described below.

### THE BANKS FUND THEMSELVES TO A GREATER EXTENT USING FOREIGN CURRENCIES THAN SWEDISH KRONA

As described in section 3.3, the banks state weights for the relevant funding source, i.e. weights for interbank loans and deposits in Swedish krona, issued certificates in Swedish krona and issued certificates or commercial paper in euros and dollars converted into Swedish krona using foreign exchange swaps. According to the Stibor framework, funding through interbank loans, deposits and issued certificates in Swedish krona must amount to a minimum of 50 per cent of the funding structure stated by the banks when they state interest rates for funding in both Swedish krona and foreign currency. Chart 1 shows the breakdown between the different funding sources stated by the banks in total during April-December 2013. The illustration shows that the banks meet the 50 per cent requirement.

**Chart 1. Stated weights, April-December 2013, total for all banks**
Per cent



Legend:
- Interbank loans, SEK (red)
- Certificates, SEK (blue)
- Foreign exchange swaps, EUR/SEK (yellow)
- Foreign exchange swaps, USD/SEK (grey)

Source: The Riksbank

A review of the funding actually raised by the banks over the same period of time shows that the banks borrowed Swedish krona using foreign exchange swaps to a greater extent than to 50 per cent of the total market funding for all maturities (see Chart 2). This means that the actual weights for the different sources of the funding that banks have implemented during the period April-December 2013, differ from the weights that the banks, in accordance with the Stibor framework, have stated in their Stibor documentation.

**Chart 2. Actual weights and traded volume, April-December 2013, total for all banks**
Per cent (y axis), Swedish krona billion (black line)
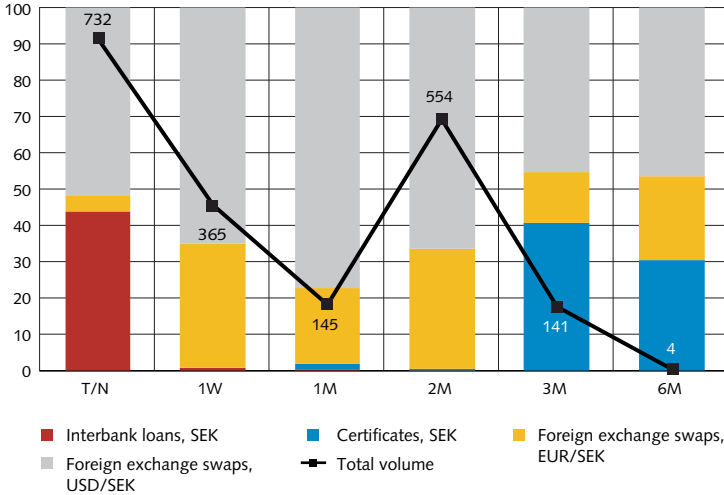


Note. The diagram is based on the market funding that has been used to calculate the actual funding rate as described in Appendix 1.

Source: The Riksbank

Disparities between the banks' stated weights and actual weights of the various funding sources can have several causes. One reason may be that the market funding underlying Chart 2, that is used to devise the actual funding rate (see Appendix 1), does not fully represent the banks' actual funding structure. It is likely that the assumptions made in devising the actual funding rate do not perfectly match how the banks execute their short-term funding.

Another reason may be that the banks base their stated funding rates on the planned structure of their short-term funding, or on how that structure actually appears on the balance sheet. This can differ from how the banks fund themselves over a certain period of time, because they sometimes may have reason to diverge from the planned allocation of the funding raised, for example to achieve the desired funding structure or to benefit from temporary cost advantages through special funding sources.

Another reason for the disparities between the stated and actual weights may be that the banks' short-term funding through interbank loans, deposits and issued certificates in Swedish krona does not amount to the 50 per cent requirement of the Stibor framework. This would involve the Stibor framework requiring the banks to allow interest rates for interbank loans, deposits and issued certificates in Swedish krona to have a greater influence on Stibor than what such interest rates have on short-term interest rates in Swedish krona in practice.

Because the banks' stated weights deviate from the actual weights, there might be reason to question the results in Table 3. The different weightings lead, for example, to the interest rates for interbank loans, deposits and issued certificates in Swedish krona having greater significance for the stated funding rates than for the actual funding rates. One way of verifying the effect of the weighting on the results of the comparison between the stated and actual funding rates is to compare the stated interest rates with the funding rates for each funding source.

LOW DIFFERENTIALS BETWEEN STATED AND ACTUAL FUNDING RATES BY SOURCE OF FUNDING

The results of the comparison by source of funding are shown in tables A1-A6 in Appendix 2. For the funding sources with at least 15 observations, the interest rate differentials between the stated and actual funding rates are statistically significant, with the exception of interbank loans and deposits in dollars converted into Swedish krona using foreign exchange swaps with the T/N maturity.

In terms of interbank loans, deposits and issued certificates in Swedish krona, the average interest rate differential between stated and actual funding rates are consistently negative when they are significant. This suggests that the banks on average state funding rates that are slightly lower than actual funding rates. The interest rate differentials are low enough to be in the interval of the regulated bid/offer spreads, which means that they are acceptable for two main reasons. Firstly, the actual funding rates are determined depending on the liquidity needs that gave rise to the transaction. The actual funding rate of a Stibor bank can be higher than the stated funding rate because the Stibor bank borrowed at another bank's offered lending rate. This rate may well be higher than the Stibor bank's stated funding rate. Secondly, the Stibor framework says that the banks can state their quoted bid rates. It is likely that the banks set these bid rates as low as possible since the bank has an interest in minimising its funding cost.

For funding in euros and dollars that were converted into Swedish krona using foreign exchange swaps, the significant interest rate differentials are negative in almost all cases. All interest rate differentials are lower than the regulated bid/offer spreads and, with the same rationale as in the previous paragraph, it is acceptable that the stated funding rates are lower than the actual funding rates.

It is however the case that the banks on average have stated funding rates that have been higher than their actual funding rates for funding through certificates in euros that have been converted to Swedish krona using foreign exchange swaps. At first glance, this result is not anticipated since it means that banks are able to borrow at lower interest rate levels than the rates they state as funding rates. There is however reason to interpret this result from a few different angles. Firstly, the

average interest rate differential has only been 2.80 basis points while the median interest rate differential has been as low as 0.19 basis points. These differentials can be regarded as relatively low.

Secondly, the rates on converted funding in foreign currency should be viewed in the context that the pricing of foreign exchange swaps differs from the pricing of interbank loans, deposits and certificates. One reason is that the price of a foreign exchange swap depends on the liquidity needs of the buyer and seller in two currencies. Interest rates for interbank loans, deposits and certificates instead only depend on the liquidity needs of the borrower and lender in one currency. So, interest rates on funding in foreign currency converted into Swedish krona do not just depend on liquidity needs in Swedish krona, but also on liquidity needs in euros and dollars. This might lead to the interest rates for converted funding not being representative of the Stibor banks' liquidity needs in Swedish krona.

### THE BANKS HAVE STATED ACCURATE FUNDING RATES IN THE CASES WHERE THE COMPARISON IS POSSIBLE

On the whole, the results of the analysis shows that the interest rate differentials between the available stated and actual funding rates are so narrow on average that they are within the interval of the regulated bid/offer spreads. The only significant average differential between the banks' stated and actual funding rates is the one for the one-week maturity. However, the analysis of the interest rates that the banks have submitted for each funding source shows that the average interest differentials are small and explainable.

## 4.4  Part 3 – Analysis of spreads

The fact that the banks' stated funding rates correspond to their actual funding rates does not answer the question as to whether the banks' Stibor submissions, and hence Stibor, corresponds to interest rates in actual transactions. This is because each bank's Stibor submission is calculated as the sum of the bank's stated funding rate and its stated spread. The ability to assess Stibor submissions, based on the comparison between stated and actual funding rates, therefore requires an assessment of whether the banks' stated spreads are accurate. In this section, it is therefore analysed whether the Stibor banks' stated spreads correspond to the regulated bid/offer spreads according to the Stibor framework.

As mentioned in section 3.3, the banks freely state the spreads they require on top of their funding rates to offer unsecured loans in Swedish krona to the other Stibor banks. These spreads can be seen as bid/offer spreads of sorts, because they correspond to a spread between the banks' funding and lending rates. At the same time, the banks are committed to accept deposits at the relevant Stibor

submission minus a regulated bid/offer spread. The banks in the Stibor panel have together agreed on which regulated spreads are reasonable. These spreads can therefore be assumed to be practically feasible and used in the trading in the interbank market. That is why the banks' stated spreads are compared with the regulated bid/offer spreads in order to judge if the spreads are on market terms and hence accurate.

In order to study how the stated spreads correspond to the regulated bid/offer spreads, we calculate the differential between the two of them for each bank, i.e. each bank's stated spread minus the regulated bid/offer spread under the Stibor framework. One observation therefore corresponds to a differential between the stated spread and the regulated bid/offer spread that have been calculated for one day, as a result that a bank has stated a spread.

The comparison shows that the stated spreads of the banks have on average been higher than the regulated bid/offer spreads for the T/N maturity (see Table 4). For other maturities with statistically significant differentials, the stated spreads have on average been lower than the regulated bid/offer spreads.[20] The average differentials have however only been 2.86 basis points at most.

**Table 4. Statistics describing the differentials between the banks' stated spreads and the regulated bid/offer spreads in the period of April-December 2013**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of differentials | 1059 | 1060 | 1062 | 1060 | 1062 | 1059 |
| Mean of differentials, basis points | 1.74*** | 0.21 | -1.71*** | -2.12*** | -2.86*** | -1.56*** |
| Median of differentials, basis points | 2.00 | 0.00 | -0.50 | -1.50 | -3.50 | -1.98 |
| Standard deviation of differentials, basis points | 3.78 | 4.13 | 3.97 | 3.81 | 3.83 | 2.39 |

Note. A differential is calculated as a bank's stated spread minus the regulated bid/offer-spread during one and the same day. Paired t-test has been used to calculate whether the differentials are on average other than zero.
*** = 99 per cent significance.

Source: The Riksbank

BANKS SYSTEMATICALLY STATE DIFFERENT SPREADS

The differentials between the stated spreads and the regulated bid/offer spreads are in fact clearly asymmetrically distributed (see Charts 3 and A9). This is because the banks systematically state different spreads. While certain banks systematically state spreads that are lower than the regulated bid/offer spreads, others state spreads that are higher. This observation is important to bear in mind when interpreting the results in Table 4 because the statistical test in the table assumes a symmetrical distribution.

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20  All differentials apart from for the one-week maturity are statistically significant at a confidence level of 99 per cent.

**Chart 3. Distribution of differentials between the banks' stated spreads and the regulated bid/offer spreads**

Number of differentials



Interest rate differential, basis points
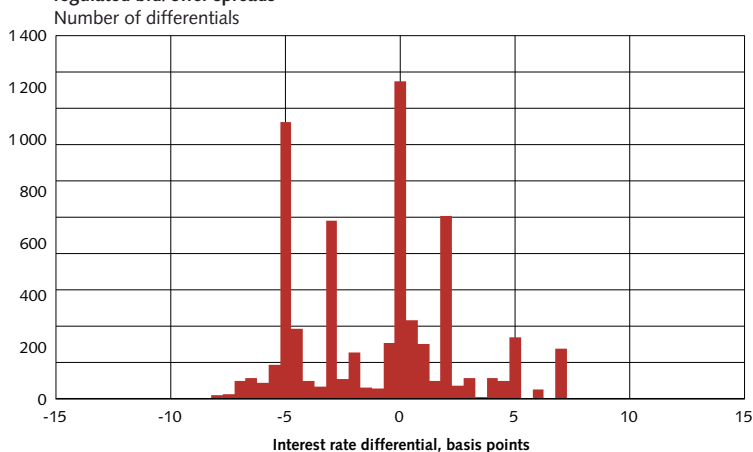
Source: The Riksbank

There may be different reasons as to why the banks systematically state different spreads for various maturities. One reason could be that the banks are willing to lend and accept deposits at different interest rate levels. This is reasonable since the banks have different preferences for lending and depositing in Swedish krona.

Another reason is that the different banks obtain their funding at different interest rates. Because of this, there is reason for the banks' stated funding rates to differ. At the same time, however, each bank shall be prepared to offer a loan to any of the other banks in the panel at its Stibor submission. All of the banks' Stibor submissions should therefore reflect more or less the same credit risk and liquidity preferences. This is one reason for why the banks' Stibor submissions may be at around the same level.

Figure 3 illustrates how the Stibor submissions of six example banks (A-F) are weighted into Stibor. The Stibor submissions of the individual banks consist of their stated funding rate and stated spread. The figure shows that bank C has a higher funding rate than bank D, and that bank C states a lower spread than bank D to reach its Stibor submission. Because of this dynamic, banks with a relatively high funding rates can state relatively low spreads to reach Stibor submissions that are more or less at parity with the Stibor submissions from banks with a lower funding rates. Similarly, banks with relatively low funding rates need to state relatively high spreads.

**Figure 3. An illustrative example showing that the stated funding rates and the stated spreads of the banks (A-F) differ**
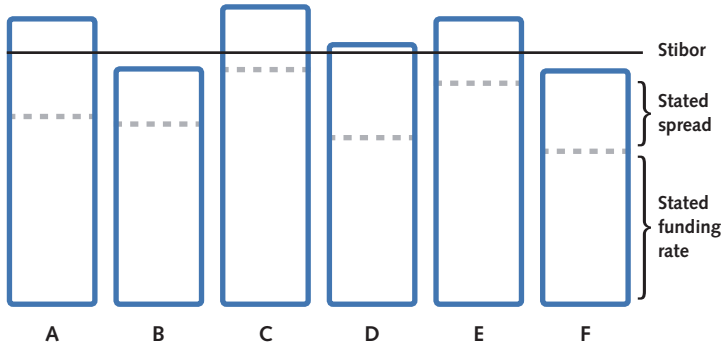


Since the banks' funding rates vary, while at the same time the interest rate at which the banks might have to accept deposits in the Stibor submission process is given by a bid/offer spread regulated under the Stibor framework, banks with low funding rates will have a stronger commitment than those with high funding rates. If the funding rates of the banks differ by more than the regulated bid/offer spreads, banks with low funding rates may be forced to state a high Stibor submission to avoid having to lend to banks with higher funding rates. At the same time, however, this means that a bank with a low funding rate may have to accept deposits at a higher rate than that at which it could otherwise obtain funding on the market aside of the Stibor submission process.

Overall, the results suggest that the banks state spreads that more or less correspond on average to the regulated bid/offer spreads under the Stibor framework. However, the banks systematically state different spreads, which is due to the fact that they have varying liquidity needs and preferences, and that they borrow at different funding rates.

# ■ 5 Conclusion

Since the Riksbank's recommendations about Stibor in 2012 and 2013 the Swedish Bankers' Association has assumed responsibility for Stibor and published a new framework for the reference rate. In connection with the recommendations, the Riksbank undertook to produce an assessment of Stibor in 2014 in order to follow up on the reform work and to review the functioning of the framework surrounding Stibor. This study fulfils this undertaking by a follow-up in two main parts. First, the Riksbank has since November 2013 considered that the Stibor recommendations are met. This is a consequence of the Bankers' Association in March 2013 taking responsibility for Stibor and publishing a new framework for the reference rate. Second, the Riksbank has in this study made use of new data sets that have become available with the new Stibor framework. Based on the new data sets, this study has been conducted to investigate the extent to which Stibor and the interest rates underlying the reference rate are consistent with rates in actual transactions.

The study shows that Stibor has been determined at accurate levels under the new Stibor framework over the period of time on which the study is based and for the days and banks for which it has been possible to compare Stibor with interest rates in actual transactions. The banks however trade on the market to different extents regardless of the maturity or type of transaction that is being studied. Therefore, the data sets with transactions that can be compared with Stibor vary greatly between the banks.

Furthermore, fundamentals for comparing Stibor with interest rates in actual transactions also vary for the different Stibor maturities. For the T/N maturity, there is a great amount of unsecured loans and deposits in Swedish krona between the Stibor banks that can be used for comparing directly with Stibor. For the one week to three-month maturities, there are however very few such loans and deposits between the Stibor banks. However, there are other types of transactions with these longer maturities that have been executed by the Stibor banks with a wider circle of counterparties. Using these transactions, it has also been possible to compare Stibor for maturities longer than T/N. For the six-month maturity, there have however been too few transactions to make a reliable comparison.

It is important to note that reference rates such as Stibor might be regulated by for example the EU Commission going forward. This could entail a requirement for further adjustments to the Stibor framework (EU Commission, 2013). In addition, some observations can be made from the results of this study that might be worth to discuss in the continuing work with Stibor led by the Bankers' Association. These

observations need not constitute problems or require any measures, but deserve to be highlighted because they can affect how Stibor is determined.

### THERE ARE WAYS TO ADJUST THE BANKS' COMMITMENTS TO TRADE UPON REQUEST

Because of the regulated bid/offer spreads in the submission process in which Stibor is determined, banks with a high funding rate have less of an apparent commitment to grant loans at their Stibor submissions than banks with a low funding rate. The fact that the spreads are regulated and fixed in the framework is justifiable, because otherwise the banks could avoid having to accept deposits or lend by applying a wide spread between the deposit and lending rates. By reducing the regulated spreads, the banks' commitments would be strengthened because it would be more attractive for the banks to borrow from or deposit with each other in the Stibor submission process.

This study has shown that the commitments that have applied since March 2013 have only generated eight transactions in 2013, which may be a sign that the commitments have been weak. In December 2013, the Bankers' Association lowered the regulated bid/offer spreads for the maturities T/N and one week to strengthen the banks' commitment to the trade and thereby the incentives to provide accurate submissions. This is also a tool that could be used in the future to further bolster the commitments of the Stibor banks as needed.

### A SCENARIO WITH MARKET STRESS CAN MAKE THE BANKS' COMMITMENTS UNSUSTAINABLE

A relevant perspective on reference rates based on commitments for the panel banks to lend and accept deposits at their stated submissions, is that situations can arise in which the banks do not want to offer each other the same interest rates. Since the banks only state one submission per maturity, it is not possible for the banks to differentiate pricing by counterparty. In a situation when the interbank market experiences financial stress, it might become more difficult for the banks to price risk, while at the same time the riskiness of the different panel banks can be perceived to differ. In such a situation, it is probable that the banks would no longer be willing to offer each other the same interest rates. This could entail an inability to determine the reference rate if the commitment for banks to trade at their stated submissions is not removed. A perceivable way of handling this problem could be to apply a differentiated submission process in which the banks are requested to state a submission for each counterparty, with the commitment to only trade with the relevant counterparty at the relevant submission.

## THE STIBOR FRAMEWORK REQUIREMENTS AND THE BANKS' ACTUAL FUNDING OFTEN DIFFER

This study has highlighted a feature of the Stibor framework that the Riksbank has previously suggested in discussions with the Bankers' Association. Namely, that a minimum of 50 per cent of the funding rates documented by the banks, and which form the basis of their Stibor submissions, should be made up of rates for funding in Swedish krona. It was already a known fact that Swedish krona do not, in practice, constitute such a large share of the Stibor banks' short-term market funding. This study has also confirmed that this is the case, at least for the period April-December 2013. Hence, the framework requires the banks to document funding rates that do not necessarily correspond to their actual funding rates when they determine Stibor, because the banks' funding in Swedish krona may in practice not constitute as much as 50 per cent of total short-term market funding.

There are, however, several reasons for why the Riksbank still finds it motivated to include this requirement in the Stibor framework. One such reason is that Stibor is to reflect an interest rate for loans in Swedish krona. It is therefore appropriate that the interest rates that form the basis of Stibor largely correspond to interest rates for loans in Swedish krona, because Stibor will otherwise largely be influenced by interest rates in foreign currency. By keeping the requirement the Stibor framework also underscores the importance of banks using the markets in Swedish krona to obtain their funding. The framework can have a normative effect in such a way that the Swedish banks are encouraged to assume responsibility for the functioning of the Swedish market by issuing certificates in Swedish krona. In addition, interest rates for loans in Swedish krona provide a more transparent basis for the determination of Stibor than interest rates for loans in foreign currency converted into interest rates in Swedish krona using foreign exchange swaps. This is because it is more complicated to derive an accurate interest rate in Swedish krona based on a foreign exchange swap, than it is based on a loan in Swedish krona.

# ■ Appendix 1. Calculation of actual funding rates for the Stibor banks

In order to conduct part of the analysis, we calculate a transaction-based interest rate for the funding of each Stibor bank in Swedish krona. The interest rate corresponds to the volume-weighted average of the interest rates for the Stibor banks' unsecured short-term market funding in Swedish krona, which can be both in Swedish krona and in foreign currency that has been converted into Swedish krona using foreign exchange swaps. This funding rate is intended to reflect what it would cost each Stibor bank to raise a new, unsecured loan in Swedish krona.

### TRANSACTIONS ON WHICH THE FUNDING RATE IS BASED

When a bank is to raise a new loan it is reasonable for it to approach one of the largest banks on the interbank market in the currency in question, because such banks reasonably have the best access to liquidity in the currency and can hence offer loans at the lowest cost. The assumption is therefore that the representative funding rate is reflected in the transactions executed by the Stibor banks with the largest banks on the interbank markets in Swedish krona, euros and dollars. The definition of the largest banks in this study is provided in Table A1 below.

**Table A1. Selection of counterparties**

| CURRENCY | CONTRACT TYPES | COUNTERPARTIES |
|---|---|---|
| SEK | Interbank loans, deposits, certificates | Stibor banks and RIX participants.[21] |
| EUR | Interbank loans, deposits, certificates, foreign exchange swaps EUR/SEK | The participants in the Euribor panel that are among the 30 largest banks in the world (in terms of total assets) with a minimum credit rating of AA- or which are defined as globally systemically important institutions.[22] |
| USD | Interbank loans, deposits, certificates, commercial paper, foreign exchange swaps USD/SEK | The participants in the Libor panel that are among the 30 largest banks in the world (in terms of total assets) with a minimum credit rating of AA- or which are defined as globally systemically important institutions. |

In the data sets, the internal loans and deposits of the banks are excluded because internal prices might be subsidised and hence do not reflect market pricing. However, the internal foreign exchange swaps of the banks are included because the banks state that these should be priced on market terms. The selection of foreign exchange swaps has been restricted to the swaps in which the converted amount in Swedish krona exceeds 150 million. This distinction has been made

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21  RIX is the Riksbank's funds transfer system.
22  See "2013 Update of Group of Global Systemically Important Banks (G-SIBs)", Financial Stability Board (2013) for the definition of globally systemically important institutions.

to exclude small transactions, since the reported rates in these transactions have often proved misleading due to system-related technicalities.

METHOD FOR CALCULATING THE FUNDING RATE

Table A2 describes the indexes ($i$, $m$, and $j$) used in the actual funding rate, and which values they assume. The table shows how the Stibor maturities are defined when a maturity is to be allocated to each transaction. The maturities one week and longer are defined as an interval of maturities around the date that refers exactly to the relevant Stibor maturity. The reason for this is that there may be grounds for the maturities of individual transactions not corresponding exactly to a Stibor maturity. In order not to exclude such transactions, the maturities are defined as a symmetrical interval.
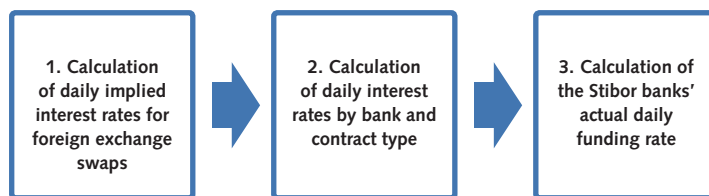
**Table A2. Summary of time series included in the actual funding rate**

| BANKS ($i$) | CONTRACT TYPE ($j$) | MATURITY ($m$) |
| --- | --- | --- |
| Danske Bank | Interest rate for interbank loans and deposits in SEK | Tomorrow-next (T/N) – maturity from the next banking day to the banking day after that |
| Handelsbanken | Implied interest rate in SEK from interbank loans and deposits in EUR | 1 week (1W) – maturity within 5 to 10 calendar days |
| Länsförsäkringar Bank | Implied interest rate in SEK from interbank loans and deposits in USD | 1 month (1M) – maturity within 21 to 45 calendar days |
| Nordea | Interest rate for certificates in SEK | 2 months (2M) – maturity within 46 to 75 calendar days |
| SEB | Implied interest rate in SEK from certificates in EUR | 3 months (3M) – maturity within 76 to 105 calendar days |
| Swedbank | Implied interest rate in SEK from certificates and commercial paper in USD | 6 months (6M) – maturity within 166 to 195 calendar days |

The calculation of the actual funding rate of the Stibor banks is based on the interest rate and volume of each individual transaction. In an initial step, implied interest rates are calculated for foreign exchange swaps in the data sets, because there is no information about them to start with (see Figure A1). Then, the interest rates for the transactions are weighed together to form daily interest rates for each bank and each contract type. The funding rate for each bank and day is then calculated as a product of these interest rate series, based on weights for each bank and contract type.[23]

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23  An alternative method is that used by Duffie et al (2013), in which transactions that take place within a window of several days are weighed in as a whole. Although this entails the transaction-based interest rate incorporating more information, this method entails information from several days being included in the interest rate. Because Stibor is to reflect the interest rate for unsecured loans at a specific point in time, the intention of this study is, to the extent possible, to only incorporate the price information that is relevant at the time when Stibor is determined. The transaction-based interest rates in this study are therefore limited to being based on transactions conducted on the same day.

**Figure A1. Three steps for calculating the actual funding rate of the Stibor banks**

| | | |
|---|---|---|
| **1. Calculation of daily implied interest rates for foreign exchange swaps** | **2. Calculation of daily interest rates by bank and contract type** | **3. Calculation of the Stibor banks' actual daily funding rate** |

STEP 1: CALCULATION OF IMPLIED INTEREST RATES FOR FOREIGN EXCHANGE SWAPS

Using the interest rate parity relationship, the interest rates of foreign exchange swaps can be derived using the daily spot and forward rates. The interest rate parity can be written as:

$$F = S \times \frac{1 + r \times d/360}{1 + r^* \times d/360}$$

Where $S$ is the spot rate, $F$ is the forward rate, $d$ is the number of days to maturity, $r$ is the interest rate in Swedish krona and $r^*$ is the interest rate in foreign currency (euros or dollars). The calculation aims to derive the interest rate in Swedish krona, $r$, for each individual transaction as follows:

$$r = \frac{\frac{F}{S} \times (1 + r^* \times d/360) - 1}{d/360}$$

Besides the interest rate in Swedish krona, the interest rate, $r^*$, in foreign currency is unknown. This is because the banks' data reports do not show the foreign currency interest rate used when the transaction was executed. In order to fully base the calculation on executed transactions, it uses the aggregate volume-weighted interest rate for each bank's funding through interbank loans, deposits and certificates or commercial paper in the foreign currency with the relevant maturity on the relevant day.

## STEP 2: CALCULATION OF DAILY INTEREST RATES BY BANK AND CONTRACT TYPE

For each bank, a time series with daily observations for each type of contract is calculated. The time series consists of the volume-weighted average of the interest rates traded by the bank in question in the contract in question during the day. According to the definitions of bank, $i$, maturity, $m$, and contract type, $j$, in table A2 the volume-weighted interest rates over $k$ observations of the contract is calculated as:

$$r_{i,j}^{m} = \frac{\sum_{k=1}^{K} n_{i,j}^{k,m} r_{i,j}^{k,m}}{\sum_{k=1}^{K} n_{i,j}^{k,m}}$$

where $n$ is the notional amount for the transaction $k$, $r$ is the interest rate for the transaction in question and $K$ is the total number of transactions during the day.

## STEP 3: CALCULATION OF ACTUAL FUNDING RATE PER BANK

The actual funding rate is calculated for each bank as the volume-weighted product of the interest rates $r_{i,j}^{m}$ from stage 2 as:

$$\textit{Actual funding rate}_{i}^{m} = \frac{\sum_{j=1}^{J} r_{i,j}^{m} n_{i,j}^{m}}{\sum_{j=1}^{J} n_{i,j}^{m}}$$

where $n_{i,j}^{m}$ corresponds to the total traded volume for the contract type $j$ with the maturity $m$ for the bank $i$, i.e. $\sum_{k=1}^{K} n_{i,j}^{k,m}$.
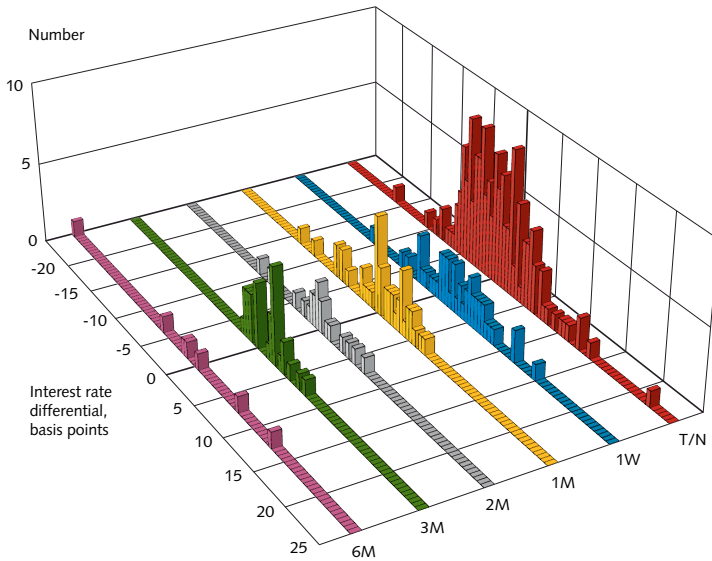
# Appendix 2. Descriptive statistics

**Chart A1. Interest rate differential, Stibor submission minus actual interest rate for unsecured loans and deposits between the Stibor banks**
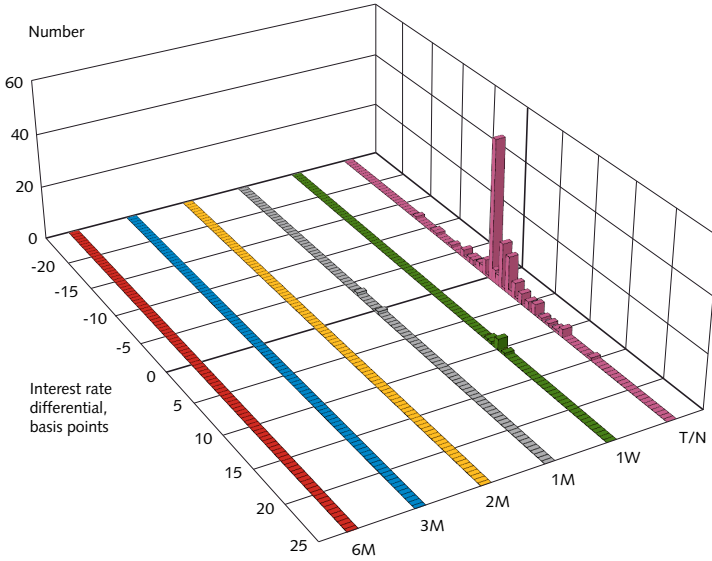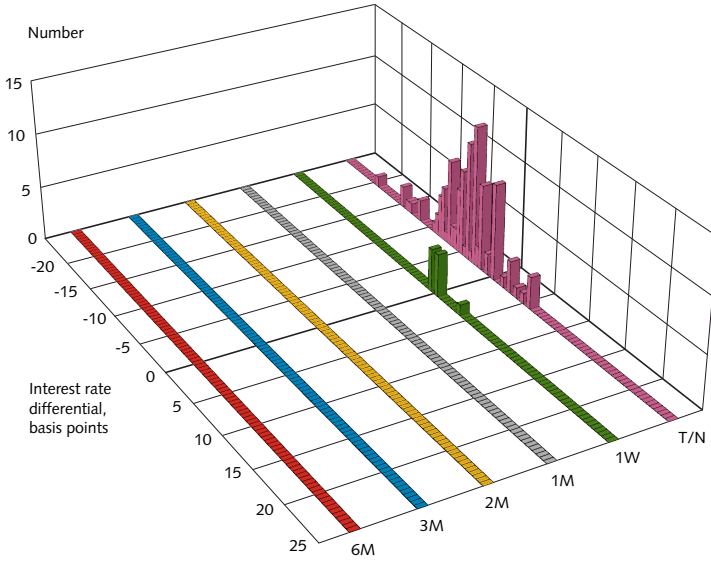


Source: The Riksbank

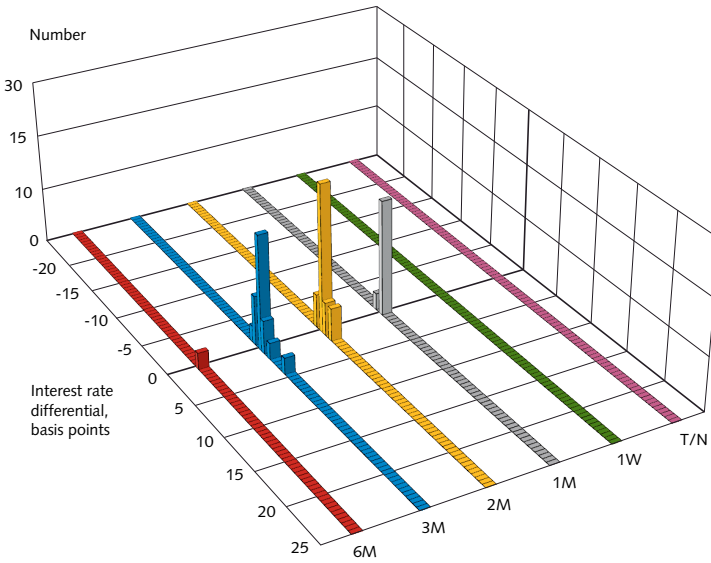**Chart A2. Interest rate differential, stated minus actual funding rate**



Source: The Riksbank

**Chart A3. Interest rate differential, stated minus actual interest rate for funding through interbank loans and deposits in Swedish krona**
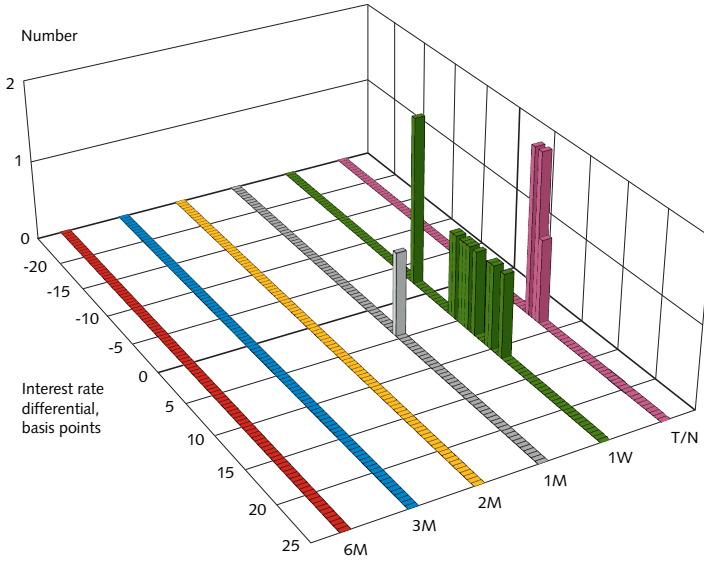
Number



Source: The Riksbank

**Chart A4. Interest rate differential, stated minus actual interest rate for funding through issued certificates in Swedish krona**
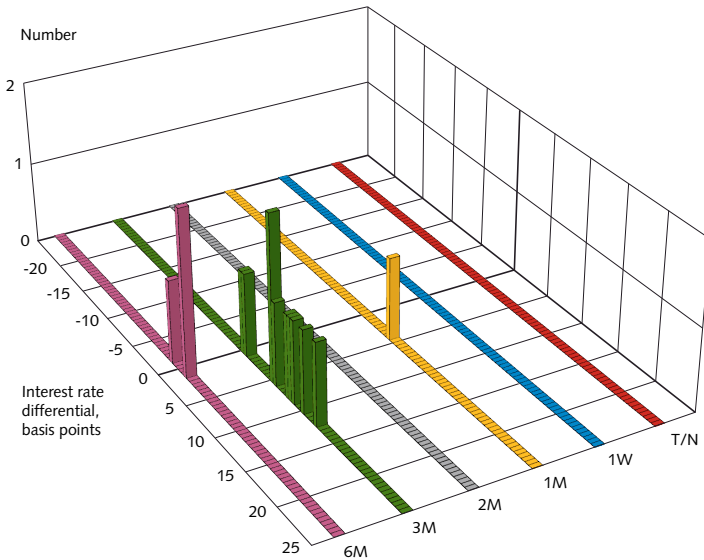
Number



Source: The Riksbank

**Chart A5. Interest rate differential, stated minus actual interest rate for interbank loans and deposits in euros converted into Swedish krona using foreign exchange swaps**



Note. There are three interest rate differentials that exceed 25 basis points that are not included in the chart.
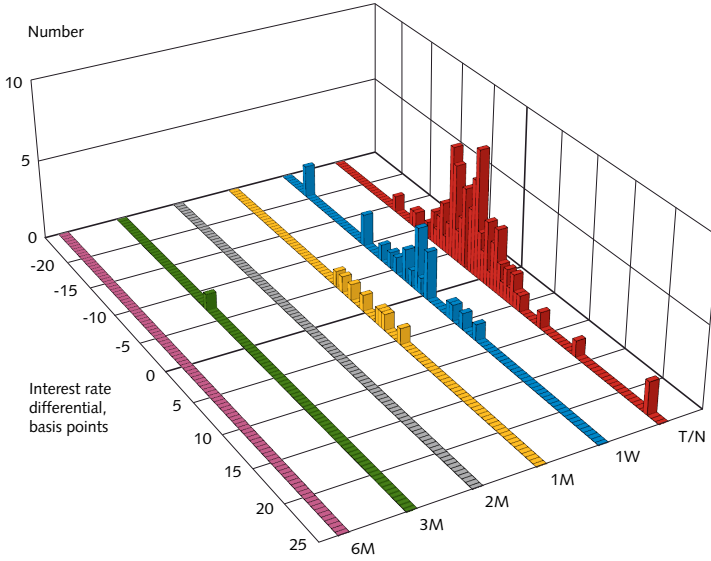
Source: The Riksbank

**Chart A6. Interest rate differential, stated minus actual interest rate for issued certificates in euros converted into Swedish krona using foreign exchange swaps**
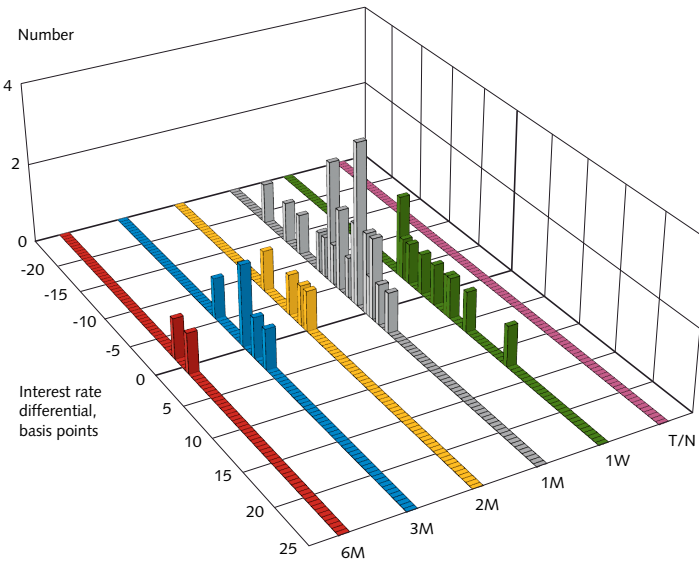


Source: The Riksbank

**Chart A7. Interest rate differential, stated minus actual interest rate for interbank loans and deposits in dollars converted into Swedish krona using foreign exchange swaps**
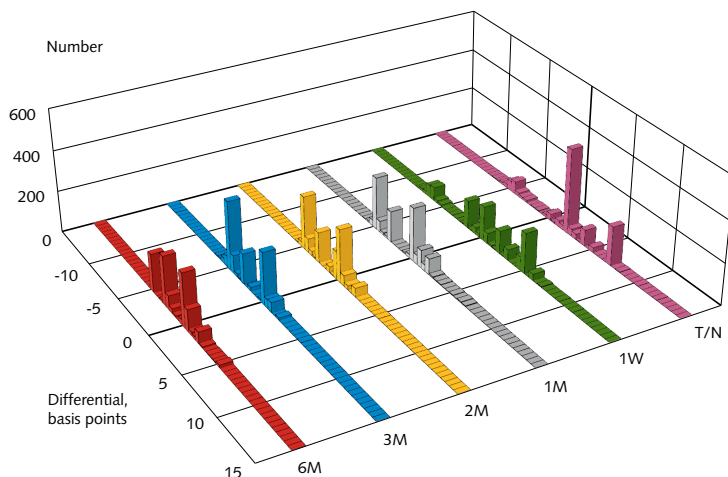


Source: The Riksbank

**Chart A8. Interest rate differential, stated minus actual interest rate for issued certificates and commercial paper in dollars converted into Swedish krona using foreign exchange swaps**



Source: The Riksbank

**Chart A9. Differential, stated spread minus regulated bid/offer spread under the Stibor framework**



Source: The Riksbank

**Table A3. Statistics describing the interest rate differentials between the banks' stated and actual funding rate through interbank loans and deposits in Swedish krona**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 102 | 9 | 0 | 0 | 0 | 0 |
| Average number of interest rate differentials per bank | 17 | 2 | 0 | 0 | 0 | 0 |
| Median number of interest rate differentials per bank | 7 | 0 | 0 | 0 | 0 | 0 |
| Mean of interest rate differentials, basis points | -4.51*** | -0.11 | | | | |
| Median of interest rate differentials, basis points | -4.00 | 0.00 | | | | |
| Standard deviation of interest rate differentials, basis points | 4.34 | 1.27 | | | | |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. *** = 99 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.

Source: The Riksbank

**Table A4. Statistics describing the interest rate differentials between the banks' stated and actual funding rate through issued certificates in Swedish krona**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 0 | 0 | 10 | 15 | 59 | 2 |
| Average number of interest rate differentials per bank | 0 | 0 | 2 | 2 | 9 | 0 |
| Median number of interest rate differentials per bank | 0 | 0 | 1 | 2 | 4 | 0 |
| Mean of interest rate differentials, basis points | | | 19.00 | 0.00 | -0.25** | -55.00 |
| Median of interest rate differentials, basis points | | | 0.00 | 0.00 | 0.00 | -55.00 |
| Standard deviation of interest rate differentials, basis points | | | 40.47 | 0.53 | 0.84 | 77.78 |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. ** = 95 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.

Source: The Riksbank

**Table A5. Statistics describing the interest rate differentials between the banks' stated and actual funding rate through interbank loans and deposits in euros that were converted into Swedish krona using foreign exchange swaps**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 6 | 13 | 1 | 0 | 0 | 0 |
| Average number of interest rate differentials per bank | 1 | 2 | 0 | 0 | 0 | 0 |
| Median number of interest rate differentials per bank | 0 | 0 | 0 | 0 | 0 | 0 |
| Mean of interest rate differentials, basis points | 23.36 | 14.13 | 3.61 | | | |
| Median of interest rate differentials, basis points | 7.32 | 5.67 | 3.61 | | | |
| Standard deviation of interest rate differentials, basis points | 40.09 | 27.79 | | | | |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. The t-test was only performed when the total number of interest rate differentials exceeded 15.

Source: The Riksbank

**Table A6. Statistics describing the interest rate differentials between the banks' stated and actual funding rate through issued certificates in euros that were converted into Swedish krona using foreign exchange swaps**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 0 | 0 | 1 | 0 | 20 | 3 |
| Average number of interest rate differentials per bank | 0 | 0 | 0 | 0 | 3 | 1 |
| Median number of interest rate differentials per bank | 0 | 0 | 0 | 0 | 0 | 0 |
| Mean of interest rate differentials, basis points | | | 3.75 | | 2.80*** | 0.00 |
| Median of interest rate differentials, basis points | | | 3.75 | | 0.19 | 0.65 |
| Standard deviation of interest rate differentials, basis points | | | | | 4.21 | 1.41 |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. *** = 99 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.

Source: The Riksbank

**Table A7. Statistics describing the interest rate differentials between the banks' stated and actual funding rate through interbank loans and deposits in dollars that were converted into Swedish krona using foreign exchange swaps**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 90 | 22 | 8 | 0 | 2 | 0 |
| Average number of interest rate differentials per bank | 15 | 4 | 1 | 0 | 0 | 0 |
| Median number of interest rate differentials per bank | 0 | 0 | 0 | 0 | 0 | 0 |
| Mean of interest rate differentials, basis points | -0.51 | -3.75** | -0.69 | | 10.76 | |
| Median of interest rate differentials, basis points | -1.60 | -1.78 | 0.04 | | 10.76 | |
| Standard deviation of interest rate differentials, basis points | 8.39 | 7.23 | 3.71 | | 26.25 | |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. ** = 95 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.
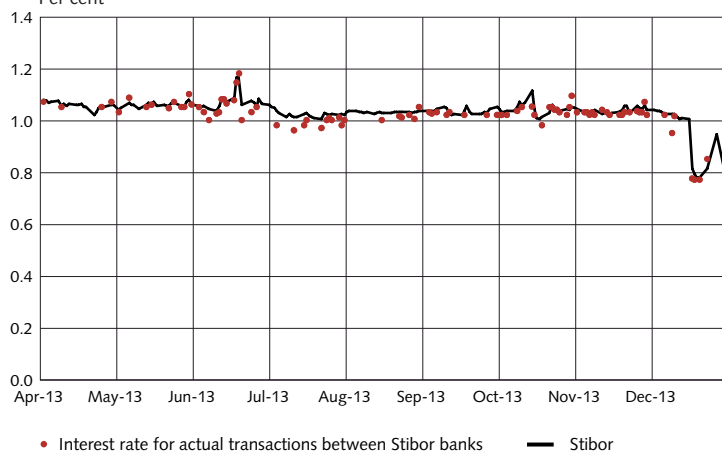
Source: The Riksbank

**Table A8. Statistics describing the interest rate differential between the banks' stated and actual funding rate through issued certificates and commercial paper in dollars that were converted into Swedish kronor via foreign exchange swaps**

|  | T/N | 1W | 1M | 2M | 3M | 6M |
|---|---|---|---|---|---|---|
| Total number of interest rate differentials | 0 | 10 | 25 | 4 | 13 | 2 |
| Average number of interest rate differentials per bank | 0 | 2 | 4 | 1 | 2 | 0 |
| Median number of interest rate differentials per bank | 0 | 0 | 0 | 0 | 3 | 0 |
| Mean of interest rate differentials, basis points |  | 0.63 | -4.56*** | -3.56 | -1.55 | -0.99 |
| Median of interest rate differentials, basis points |  | -0.28 | -2.70 | -2.65 | -0.79 | -0.99 |
| Standard deviation of interest rate differentials, basis points |  | 5.43 | 5.06 | 3.33 | 4.42 | 1.75 |

Note. An interest rate differential is calculated as a bank's stated funding rate minus the same bank's actual funding rate during one and the same day. Paired t-test has been used to calculate whether the interest rate differentials are on average other than zero. *** = 99 per cent significance. The t-test was only performed when the total number of interest rate differentials exceeded 15.

Source: The Riksbank

**Chart A10. Stibor and interest rate for loans and deposits between Stibor banks, T/N maturity, volume-weighted rates**
Per cent



● Interest rate for actual transactions between Stibor banks　　━ Stibor

Source: The Riksbank

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