



LTH
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ENGINEERING

A Study of Stibor

Sweden's Most Important Number and the Rates That Could Come to
Replace It

by

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Abstract

As a working group named AGAR is currently looking into replacements and complements to Stibor, the subject of reference rates will become increasingly relevant in the coming years. This paper therefore investigates Stibor as well as future options for a Swedish reference rate, consolidating information of and opinions on reference rates in Sweden, primarily through the review of previous literature in the field and expert interviews with representatives of organisations in AGAR. The paper identifies four problems with Stibor as of today, which includes a lack of volume on the interbank market as well as a lack of transparency in the Stibor framework. Based on the identified problems and the theoretical background, the paper presents five criteria that a sound reference rate needs to satisfy: achieving transparency, being robust, being market adapted, reflecting appropriate risk and fulfilling BMR. These criteria then serve as a basis in discussing the different considerations that have to be made when constructing a reference rate in Sweden. These considerations include whether a reference rate in Sweden should be transaction-based or assessment-based, whether a transactions-based rate should be unsecured or secured, and how much basis risk a new reference rate would cause. Finally, in view of these considerations, the authors suggest that a predominantly transaction-based, uncollateralized, overnight rate administered by a governmental authority, such as the Riksbank, is suitable to replace Stibor and that the process to switch to such an alternative reference rate should be started promptly.

Key words: Stibor, Libor, ibor rate, reference rate, alternative reference rate, overnight rate

Foreword

Svenska

Denna uppsats är vårt examensarbete på masterprogrammet för Industriell Ekonomi vid Lunds Universitet. Arbetet är skrivet av Anton Nystedt och Cecilia Skoglund under våren 2019.

Vi vill tacka våra handledare för värdefull feedback och handledning under arbetets gång. Tack också till Nordea för hjälp med val av ämne. Framför allt vill vi rikta ett stort tack till alla de som ställt upp på intervjuer, vi är enormt tacksamma för att ni tog er tid att svara på våra frågor.

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English

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List of Abbreviations

AGAR	Arbetsgruppen för Alternativa Referensräntor (Working group for Alternative Interest Rates)
ARRC	Alternative Reference Rates Committee
BBA	British Banking Association
BIS	Bank for International Settlements
BMR	EU Benchmark Regulation
BoE	Bank of England
ECB	European Central Bank
EMMI	European Money Markets Institute
ESMA	European Securities and Markets Authority
FCA	Financial Conduct Authority
FI	Finansinspektionen (Swedish Financial Supervisory Authority)
FRN	Floating rate note
FSB	Financial Stability Board
IBA	ICE Benchmark Administration
IBOR	Interbank Offered Rate
IOSCO	International Organization of Securities Commissions
IRS	Interest Rate Swap
ISDA	International Swaps and Derivatives Association
OIS	Overnight Indexed Swap
OTC	Over-the-Counter
PnL	Profit and Loss

Market terminology

Some financial terms are defined differently by different companies or in different geographical areas. A brief description of market-related terms which are used in the report is laid out below, to avoid confusion in terminology.

Market maker

A market maker is a financial institution, often a bank, that is ready to both sell and buy a certain asset at any given time at publicly quoted prices. It is called market maker since the constantly quoted prices means there is always a market for buyers and sellers, at least to some size.

Market taker

A market taker is a participant that trades in the market at the quoted prices. This means that when they trade they accept the current price levels of the market rather than quote their own prices and wait for the market to move to their levels.

Bid/offer spread

The price at which the market maker is willing to buy an asset is called the bid, the price at which they are willing to sell is called the offer. The spread between the two is the bid/offer spread. How wide the spread is depends on the liquidity and volatility of the market, where a less liquid and more volatile market causes the spread to widen.

Mid

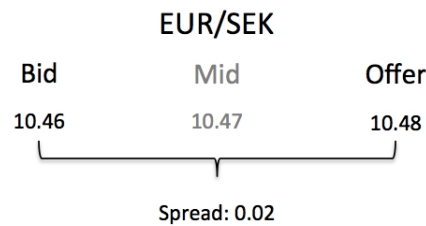
The mid is the average of the bid and the offer, or the offer minus half the spread (or equivalently the bid plus half the spread).

Crossing the spread

Crossing the spread means buying at the offer and/or selling at the bid. A market taker would for example cross the spread by buying at the offer instead of placing their buy order at the bid and waiting for the market to cross the spread.

To clarify, below is an example of how a trade can be executed in EUR/SEK.

Figure 1: The bid/offer spread with mid 10.47



In this case, as illustrated in figure 1, a market taker wanting to sell euros can execute their trade immediately and receive 10.46 kronor per euro. This choice would mean accepting the bid and crossing the spread. Alternatively, if they do not want to cross the spread, they can place a sell order for euros at 10.48 (the offer) and wait for the market to move in their direction.

Figure 2: The bid/offer spread with mid 10.49



Once the market has moved far enough for the bid to match their offer, as illustrated in figure 2, the transaction is done at 10.48 and the market has crossed the spread for them.

Fixing

Fixing is the process of setting a fixed price of a good, commodity or currency. This is in most cases done to more easily evaluate and agree on the price over time.

One example of fixing is the foreign exchange fixing, where the value of one currency relative to another is set once a day. The fixing is done by calculating the median level of all trades during a certain time interval from one currency to another. Another example is the Stibor fixing, where Stibor is set as the average of the Stibor banks' reported rates.

Term rates

Term rates are interest rates that are produced at longer maturities, in contrast to overnight rates. Term rates can be backward-looking, meaning you know the interest rate only at maturity of the contract, or they can be forward-looking, meaning that you know in advance what interest rate will apply over the next period. Stibor 3m is an example of a forward-looking term rate.

Secured and unsecured transactions

A secured transaction is a loan or credit transaction where the lender acquires a security from the borrower which is used as collateral in case the borrower defaults. For example, if a borrower borrows one million Swedish kronas to purchase a home, she can use the home as security to the lender. In case the borrower defaults, the home falls to the lender. The lender is therefore less exposed to default risk.

An unsecured transaction is a transaction where the lender acquires no such security from the borrower. The lender is therefore more exposed to default risk.

Repurchasing agreement

A repurchasing agreement, or repo, is a short term loan where the borrower pledges a security as collateral with the promise to buy the security back at a later point. The transaction is thus a secured transaction.

1

Introduction

1.1 Background

Reference rates, also known as benchmark rates, are a particular set of interest rates used to standardize and facilitate the pricing of financial contracts. When two parties are to enter into a contract, reference rates are often used as a starting point for price negotiations, since the process of setting a price from scratch can be both costly and time consuming. Using a reference rate, the parties only have to agree on a suitable premium¹, reducing the effort required to enter into the contract. For this reason reference rates play an important role in finance, since they improve the liquidity on the market (Riksbanken, 2012).

There exists a number of different reference rates used for different contracts and markets, but the most common ones by far are interbank offered rates (ibor). The interbank offered rates consist of a number of different interbank rates, such as Libor, Euribor and Stibor². They reflect the interest rates the banks in a geographical market offer one another for unsecured loans in a particular currency at different maturities. The interbank offered rates therefore capture the cost for banks to finance themselves as well as the credit risk of the banking sector. Originally, these rates were used for larger corporate loans, but have with time grown massively in popularity. As of 2018, Libor, for example, underpinned a nominal amount of 370 trillion U.S. dollars in financial contracts while the same figure for Stibor was 60,000 billion Swedish kronas (ISDA, 2018; FI, 2018a). Ibor rates can therefore be said to be deeply embedded into the financial system.

However, the uncovering of systematic manipulation of Libor in 2012, known as the Libor Scandal, sent ripples across the world. Suddenly, ibor rate were called into question in regards to their transparency and fixing processes. In the following years, national and international authorities such as the U.K. Treasury, IOSCO and FSB published reports on the state of Ibor rates, asking for a reformation or replacement of the rates (Wheatley, 2012; IOSCO, 2013; FSB, 2014). In response to this, many ibor frameworks were re-evaluated and new, so called alternative reference rates were proposed to replace interbank rates. For some ibor rates the process of replacing them has come quite far. Libor, for instance, is planned to be phased out by 2021.

¹A mark-up which is added to the base rate to reflect the risk of the contract.

²London interbank offered rate, Europe interbank offered rate, Stockholm interbank offered rate.

In Sweden, following the Libor Scandal, Stibor was reviewed by the Riksbank. Although this review led to changes in the framework and process of Stibor, no immediate plans to replace the rate were drafted. However, in 2018 the Swedish Bankers' Association, the organization responsible for Stibor, created the Working Group for Alternative Reference Rates (AGAR) to look into compliments or replacements of Stibor. This group is to present their findings in the later stages of 2019.

1.2 Relevance

As some of the world's largest economies such as the US, the UK and the EU, are preparing a shift away from ibor rates, little has been written or said about the future of Stibor, particularly in academia. This means there is a lack of information that could be useful for finance professionals, academia, as well as the general public, especially since Stibor, through loans, derivatives and other financial contracts, is rooted in the Swedish financial system in such a way that a potential change of reference rate would impact far more than those who work in the financial sector.

Furthermore, with AGAR's on-going investigation into possible replacements or compliments of Stibor, the subject of Swedish reference rates will most likely be discussed more intensely in the coming years. By combining available statistics, economic theory and other relevant information with opinions and perspectives from both a market and a regulatory standpoint, this paper aims to analyse potential future scenarios and discuss their respective consequences. This way, readers of the paper can form their own opinion on the matter using the information and opinions presented.

1.3 Research Questions

The paper seeks to answer the following four research questions:

1. What are the main problems with Stibor as of today?
2. What criteria should a reference rate in Sweden satisfy?
3. What aspects should be considered before changing or replacing Stibor as a reference rate?
4. What are suitable options for a future reference rate in Sweden?

2

Methodology

2.1 Research Process

To answer the research questions, the research process was divided into the following steps:

1. **Data collection:** Collecting information about Stibor through a review of previous reports, quantitative data as well as expert interviews.
2. **Analysis:** Analysing the collected information and data.
3. **Discussion:** Summarising and discussing scenarios based on the analysis.

2.1.1 Data Collection

The data collection process for this study is divided into three parts. In the first stage, previous reports on the subject of Stibor are reviewed to gain an understanding of the subject and collect information that will be useful in the analysis. In the second step, the literature is complemented by quantitative data to support any points made in the reviewed reports and written material. Lastly, expert interviews are conducted.

Previous Reports

While literature on the subject of Stibor and the Stibor process is quite limited, a review of the most recent and relevant reports is conducted. Additionally, key research on Libor and its replacements in EUR, GBP and USD is reviewed, as well as international studies discussing the subject of alternative reference rates. Based largely on this review, chapter 3, which contains the theoretical background is composed.

To find this material, internet searches¹ are made on google, google scholar and hubcat. Literature relevant to understanding reference rates and relevant economic theory is also read, as well as government authored reports.

Quantitative Material

Quantitative material is used to reinforce and illustrate points in the analysis as well

¹Search-words: Stibor, Stibor process, reference rates, alternative reference rates, benchmark rates, Libor, Ibor, Sofr, Sonia.

as verify claims made in reports included in the review mentioned above. The data consists of historical price and volume data and is collected from Bloomberg, FI, Statistics Sweden and the Riksbank.

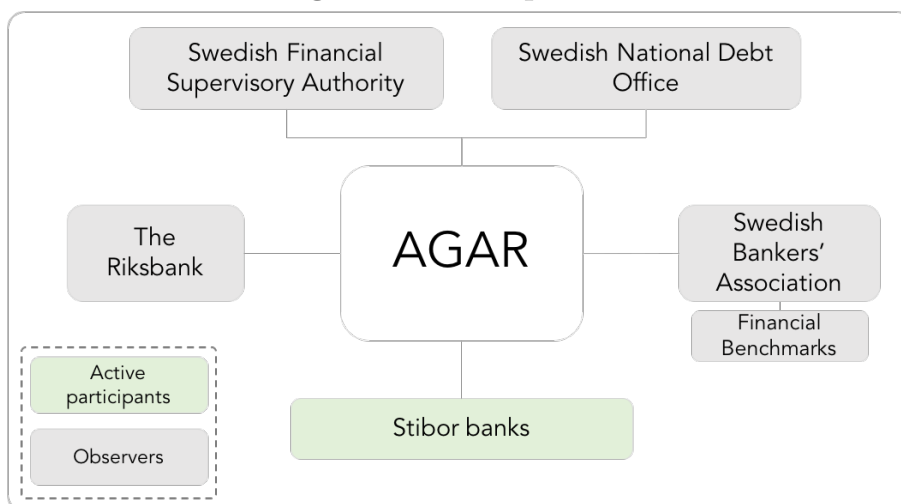
Expert Interviews

The interviews were conducted over the span of two months in late February through the end of March 2019. The interviews were 20 to 60 minutes in length, depending on the availability of the interview subjects. The interviews were conducted either in person or by telephone, again depending on availability. Most interviews were recorded to make sure no important details are lost later in the analysis. Recording the interviews also made it possible to revisit points in the interviews and to pick out quotes correctly. Permission to record was requested from all interview subjects prior to starting the interview.

The interview subjects were selected based on two factors: their knowledge of reference rates and their involvement in AGAR. For this reason, the interview candidates consisted mostly of members of AGAR, whose involved organisations are shown in figure 2.1.

When selecting the people to interview, special consideration was made to ensure that as many different perspectives as possible were represented. It is, for instance, important not to exclusively interview persons with a market perspective, but also, for example, include a regulatory perspective. Lastly, because of the limited time frame of the study, the decision was made to limit the scope of the interviews to Sweden.

Figure 2.1: Organisations represented in AGAR



The seven interviewees chosen were:

- **Johan Bergström:** Swedish National Debt Office, Fund Manager
- **Johannes Forss Sandahl:** The Riksbank, Head of Division, Financial Stability
- **Martin Genander:** Nordea, Wholesale Banking Libor Transitions

- **Klas Granlund:** Swedish Financial Supervisory Authority, Director of Market Analysis
- **Linus Lauri:** Danske Bank, Dealer SEK Rates
- **Jenny Ramstedt:** SEB, Head of Liquidity Management, Group Treasury
- **Jonny Sylvén:** Swedish Bankers' Association, Working Group for Alternative Interest Rates

The interviews were semi-structured in nature. This means that while they followed an interview guide, room was made for diversions depending on the answers from the interview subjects. This method of interviewing allows for greater flexibility during the interviews and better use of interview time (Edwards and Holland, 2013).

The interview guide consisted of predetermined questions selected with each interviewee's area of expertise in mind, to get as much valuable information from them as possible. Some questions were mutual for all interviews, while others were subject-specific. A selection of interview questions can be found in Appendix A.

Confidentiality

Banks are hesitant to share data due to strict banking secrecy. Subsequently, no customer specific data or contracts were disclosed to the authors during the interviews. Furthermore, since Stibor is an important part of the financial system and affects many societal functions, government institutions were hesitant to provide information regarding specific details of the Stibor process. Most notably, details on what happens to Stibor in the case of a financial or national crisis were not disclosed.

2.1.2 Analysis

For the analysis, the aim is to discuss different aspects of a reference rate in Sweden. This includes discussing issues with the current reference rate, Stibor, what requirements a reference rate needs to satisfy, what possible options exist and what the consequences of these options are. To explore these aspects, an analysis framework is developed. The framework consists of three parts:

1. Identifying the key problems of Stibor.
2. Identifying important criteria for a reference rate.
3. Identifying and investigating different considerations for a reference rate in relation to these criteria.

1. Key Problems of Stibor

Based on the theoretical background and information collected during the interviews, the problem areas of Stibor are identified, discussed and analysed by the authors.

2. Criteria for a Sound Reference Rate

Criteria for a reference rate in Sweden are constructed by the authors through analysis of the current use of Stibor as well as the problems the Riksbank, FI, the experts and the authors identify with the present Stibor framework.

3. Considerations for a Reference Rate

Constructing a reference rate can be viewed as a series of choices, where each choice has consequences for the properties and the use cases for the rate. With the help of the theoretical background and interviews, the authors identify these choices. They are then discussed with the criteria in mind, to evaluate which choices are most suitable for the Swedish market.

2.1.3 Discussion

The discussion summarises the points made in the analysis and discusses what a future reference rate in Sweden might look like. The authors use the criteria for a sound reference rate to determine the need to complement or replace Stibor and present their opinion on the suitability of different reference rate proposals.

3

Theoretical Background

3.1 Introduction to Ibor Rates

3.1.1 Libor

London Interbank Offered Rate, or Libor, is a set of benchmark interest rates published daily by Thomson Reuters. It represents the cost for London-based banks to borrow money from other banks, without collateral. It is calculated for five different currencies and seven different maturities. Sometimes referred to as “the world’s most important number”, Libor underpins more than 370 trillion U.S. dollars of loans and derivatives world-wide as of 2018 (ISDA, 2018). While officially first published in the mid 1980’s, its history spans back to the late 1960’s. Following the unveiling of several banks’ systematic rigging of Libor in 2012, an event known as the Libor scandal, Libor is set to be phased out by 2021.

3.1.2 Stibor

Stockholm Interbank Offered Rate, or Stibor, is a Swedish reference rate commonly used in the valuation of Swedish financial contracts. The rate is widely used in contracts with variable interest rate and according to the 2018 report “FI-Analys 14” authored by FI, the Riksbank estimates that Stibor serves as a reference rate for loans and derivatives with a nominal value of approximately 60,000 billion Swedish kronas. The Swedish Bankers’ Association, the organisation responsible for Stibor since March of 2013, defines Stibor as the average interest rate a number of active banks on the Swedish money market, or Stibor banks¹, are willing to lend to one another without collateral (Swedish Bankers’ Association, 2019). Stibor therefore reflects the cost for banks to finance themselves. The Stibor banks contribute with submissions for six different maturities each banking day. Following international discussions on ibor rates, Stibor is subject to investigation in Sweden and could potentially be replaced in the coming years (Swedish Bankers’ Association, 2018a).

¹The Stibor banks are Danske Bank, Handelsbanken, Länsförsäkringar Bank, Nordea, SBAB Bank, SEB and Swedbank.

3.2 The Creation of Ibor Rates

The Greek banker Minos Zombanakis is often credited as the creator of Libor. He was part of the team that organized what is believed to be the first ever syndicated loan pegged to the floating rate known as Libor. This 80 million U.S. dollar loan Manufacturer's Hanover (now a part of JP Morgan) made to the Shah of Iran was set in a time where the global demand for Eurodollars² grew substantially and banks wanted to move part of the funding risk of their increasing balance sheets to their customers. Libor became the solution the London banks could agree upon, creating a way for banks to share the risk of syndicated loans and offer loans to the market with interests that could be renegotiated every three or six months to reflect shifting market conditions (Jones and Ridley, 2012).

During the first few years Libor was mostly used as an interest rate for actual loans that banks made out to the market. This means that there could have been an incentive for banks to overstate their funding costs, in order to increase their interest rate earnings. However, Zombanakis claims that any bank that would inflate their reported number risked being shut out of the syndicate, losing valuable business. Libor was an unregulated, non-official gentlemen's agreement between London banks, enabling them to fuel the growing credit market (Finch and Vaughan, 2016).

The loan market became more complex as it grew in the following decades. Several derivatives such as foreign exchange options (FX options) and interest rate swaps (IRS's) were launched and grew in popularity, creating the need for a standardized floating reference rate. In 1986 the BBA took control over Libor in an effort to increase transparency, efficiency and governance. The establishment of Libor allowed banks to fund themselves through the credit market, via bonds where they paid Libor (David Enrich, 2017).

Following the development of Libor, Stibor was originally created in 1986 by the dominating banks operating in Sweden to serve as a reference rate for a select few loans and derivatives. Previously, the market used yields on short term government bonds as reference rates, but this was seen as an imperfect solution. Among other things, the bond yields depended on the level of government borrowing. They were also subject to "flight to quality" during periods of high volatility, when investors gravitated towards more liquid and less risky debt securities. Banks and companies were subsequently interested in finding a reference rate more closely related to the cost for banks and companies in the private sector to borrow money (Riksbanken, 2012).

SEB issued the first financial contract related to Stibor in October 1987; a floating rate note underpinned by Stibor 3m (Skandinaviska Enskilda Banken, 1987). This financial contract saw great demand from investors and was soon followed by similar contracts (Selander, 1987). As more and more households as well as companies chose loans with floating interest rates, Stibor acquired an increasingly important role in the Swedish economy.

²Eurodollars are U.S. dollar-denominated deposits in non-U.S. banks or at overseas branches of U.S. banks and are not under the regulation of the Federal Reserve Board.

As the derivatives market grew, the role of Libor and Stibor changed with it. By the end of 1999, the derivatives market had ballooned to an outstanding nominal amount of 81 trillion U.S. dollars OTC and 16 trillion U.S. dollars over exchange (BIS, 2000), totalling more than ten times the USA's GDP at that time (the World Bank, 2019). From the original intention of using ibor rates as a way of handing over risks associated with banks' borrowing costs from lender to borrower, it was now a part of countless derivatives and financial instruments with little or no connection to banks' funding costs. As of 2017 the nominal amount of contracts referencing Stibor had grown to 60,000 billion Swedish kronas, whereof 43,000 billion Swedish kronas was in interest rate derivatives (FI, 2018a). The same figure for Libor was 370 trillion U.S. dollars in 2018 (ISDA, 2018).

3.3 The Libor Scandal

In a feature in The Guardian, Finch and Vaughan write about the Libor Scandal, which is a collective term for a number of manipulations of Libor by financial firms and individual traders in the 2000's, peaking in 2008. Since this fraudulent behaviour was unveiled in 2012, more than nine billion U.S. dollars worth of fines have been issued to a number of global financial firms, and several individuals have been found guilty of wire fraud and other charges. It also came to damage the reputation of Libor and ibor rates in general to a point where many are calling for their abolishment.

One of the main drivers for submitting dishonest Libor rates was to extenuate the extent of the credit crisis in 2008, letting the relative stability of Libor send a calming signal to markets. At the start of the financial crisis, scepticism in financial markets grew and cash became a sparse commodity. In an effort to understate the desperation in banks' search for cash, several global banks such as UBS, Barclays and Deutsche Bank submitted Libor rates which they knew were too low. The rationale was that if any of the banks were to stand out with a higher Libor submission, they would be thought of as an outcast - a bank no one would want to lend money to - thereby creating their own demise.

Another incentive for rigging Libor is the major impact it can have on a trader's PnL³. The most infamous case in the Libor Scandal is that of Tom Hayes, a former rates derivatives trader. September 18th 2008, three days after the collapse of Lehman Brothers, Hayes had a portfolio of derivatives with an enormous exposure to JPY Libor, such that every 0.01 percentage increase meant a 750,000 U.S. dollar loss in PnL, and vice versa. In an effort to get ahead of the situation, Hayes reached out to his brokers in London, pleading with them to keep the JPY Libor rates low. He messaged one of them the following:

"I need you to keep it as low as possible, all right? I'll pay you, you know, \$50,000, \$100,000, whatever. Whatever you want, all right?"

JPY Libor fell 1 percentage point that night, while Libor in other currencies soared.

³Profit and Loss, the amount a trader/desk/fund/bank has made or lost over a period of time.

While the full extent of Hayes’ influence on JPY Libor can never be fully known, it has been established beyond doubt that in an effort to keep his PnL afloat he personally managed to influence one of the most important numbers in the world. For this he was sentenced in the UK to eleven years in prison (Finch and Vaughan, 2017).

3.4 Ibor Frameworks

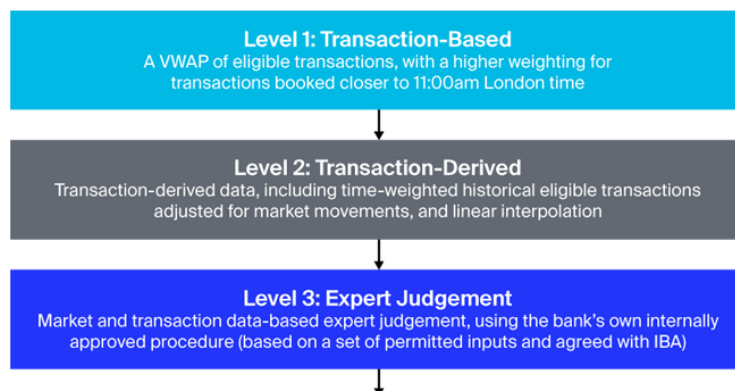
3.4.1 Libor Framework

In 2014, IBA took over the administration of Libor from BBA, naming it ICE Libor. Libor is published 11:55 AM everyday for five currencies (CHF, EUR, GBP, JPY and USD) and seven maturities (overnight⁴, 1 week, 1 month, 2 months, 3 months, 6 months, 1 year). The rate is based on submissions from a panel of 11 to 16 banks, depending on the currency. The exact configuration of each bank panel can be found in Appendix B. ICE Libor Output Statement defines Libor as:

“A wholesale funding rate anchored in LIBOR panel banks’ unsecured wholesale transactions to the greatest extent possible, with a waterfall to enable a rate to be published in all market circumstances”

The so called Waterfall Methodology has been introduced in an effort to make the submissions to Libor more closely related to actual transactions, while still enabling submissions to be made in market circumstances where such transactions are few or non-existent.

Figure 3.1: ICE’s Waterfall Methodology



Source: ICE, 2019a.

Figure 3.1 illustrates the Waterfall Methodology, and the three levels of approaches to extracting the correct submission to Libor. The Level 1 method should be used to the furthest extent possible. The level 3 approach should only be used if transaction

⁴Today until the next business day.

data and transaction-derived data is insufficient (ICE, 2018a).

When all submissions from the panel banks are made, IBA ranks them from highest to lowest and excludes the upper and lower quartile from the calculation. An arithmetic average, rounded to five decimal places, is then calculated from the remaining submissions (ICE, 2019a).

In order for a bank's submissions to be accepted, it must submit numbers for all seven tenors. However, it must not submit numbers for all currencies in order to contribute to Libor. This is why the number of banks in the panel varies from currency to currency. Five or more banks must submit a full set of rates for Libor to be published for any specific currency (ICE, 2018b).

If less than five banks make submissions in any given currency, IBA can republish the previous day's Libor. If the conditions are such that IBA has reason to believe the problem will persist IBA consults the FCA, the Chair of the Libor Oversight Committee and the relevant central bank(s). If it is deemed appropriate, the previous day's Libor could be posted again, adjusted by the delta of a Related Rate. What the Related Rate is depends on the currency, the market's liquidity and volatility, among other factors (ICE, 2018b).

3.4.2 Stibor Framework

The Swedish Bankers' Association is an organisation which represents banks and financial institutions established in Sweden. They have been responsible for the Stibor framework since 2013, when they, after recommendations from the Riksbank, formed a Stibor committee as well as secretariat to manage Stibor related inquiries (Riksbanken, 2012). Later, on January 1st 2019 the subsidiary Financial Benchmarks AB was created to assume this responsibility, absorbing the Stibor committee and secretariat as a part of the organisation (Swedish Bankers' Association, 2018b).

The purpose of the Stibor framework is to govern and control the setting of Stibor, stipulate what rules should apply to Stibor banks and make sure transparency around the Stibor process is achieved (Swedish Bankers' Association, 2018c). For this reason the Stibor framework consists of three parts:

1. Rules regarding regulating and supervising Stibor
2. Rules regarding reporting and calculating Stibor
3. Rules regarding the internal procedures of the Stibor panel

Part one of the framework is overseen by the board of Financial Benchmarks, while the responsibility for part two and three is assigned to the Stibor committee. The Stibor committee consists of representatives of all Stibor banks as well as at least one independent commissioner, nominated by Financial Benchmarks. To minimize the risk of manipulation, no member of the committee is allowed to be directly connected to the reporting of Stibor. The main duty of the committee is to make sure procedures and guidelines are in place for the Stibor banks to report according

to the regulations. It is also responsible for ensuring that the transparency and setting of Stibor is up to the standard of the Riksbank and the Stibor framework (Swedish Bankers' Association, 2019).

The Stibor banks report Stibor each banking day in accordance with part two of the Stibor framework. Primarily, banks should base their Stibor contributions on uncollateralized transactions in Swedish kronas on the interbank market. Secondly, the banks can use quoted interbank levels or a portfolio of certificate of deposits (CDs) to estimate a Stibor rate. This second form of estimation does not require any verification through transaction.

The framework defines Stibor as:

“Stibor (Stockholm Interbank Offered Rate) is a reference rate that shows an average of the interest rates at which a number of banks active on the Swedish money market (‘the Stibor banks’) are willing to lend to one another without collateral at different maturities.”

Stibor is reported for six maturities each banking day: Tomorrow/Next⁵, 1 week, 1 month, 2 months, 3 months and 6 months. A detailed account of the steps in the Stibor process can be seen in table 3.1.

Table 3.1: The process of setting Stibor

Time	Event
10.25-10.45	All banks report interest rates, which during this time are only known by the persons responsible for reporting Stibor at each respective bank.
10.45-10.55	All interest rates are visible for contributors at the Stibor banks. During this time trades can be made between the banks with the reported interest rates.
10.55-11.00	Stibor is calculated by a calculating entity for the different maturities.
11.00	Stibor and the respective interest rates reported by the banks are reported to the public.

Source: Swedish Bankers' Association, 2018d.

To calculate and publish Stibor at least four banks have to report interest rates. If the number of banks is six or less, Stibor is calculated as the arithmetic mean of the reported interest rates. If the number of banks is seven or eight, the bottom and top value is removed before calculation. If the number of banks is nine or higher the two top and bottom values are removed before calculation. Nasdaq OMX is responsible for the consolidation and calculation of Stibor. Thomson Reuters is responsible for

⁵From tomorrow until the subsequent banking day.

publishing.

To ensure that the banks report reliable interest rates each bank has an obligation to trade with the other Stibor banks up to a specified nominal value. The transactions are executed to their submitted rate with the addition of a bid/offer spread of at most 15 basis points⁶. For Nordea, Danske Bank, Svenska Handelsbanken, SEB and Swedbank the limit is set to two billion Swedish kronas, while for Länförsäkringar Bank and SBAB the limit is 200 million Swedish kronas.

3.5 Uses of Ibor Rates

3.5.1 Uses of Stibor

FI as well as ESMA consider Stibor to be integral to Sweden's financial stability (FI, 2018a). The reasons for which they hold this view are manifold. Firstly, since Stibor is defined as the average rate for which Stibor banks are willing to lend to one another without collateral, Stibor reflects the credit risk of the banking sector. Secondly, Stibor is used in most interest and FX derivatives, which companies and banks use to manage risk and thereby has great economic implications for the largest financial actors in Sweden. Stibor is also commonly used in corporate bonds and loans with variable rate. Finally, Stibor has a direct connection to the repo rate as banks' funding costs are directly related to the Riksbanks borrowing rate (Riksbanken, 2012). In this way Stibor is a fundamental part of the transmission mechanism of Swedish monetary policy as it directly transmits changes in the repo rate to the prices of the financial contracts it underpins.

Following FI's assessment of Stibor, in the October 2018 report Commission implementing regulation (EU) 2018/1557, the European Commission added Stibor to their list of critical benchmark rates. The other critical benchmark rates in the EU are Libor, Euribor and Eonia. In practice this means that if Stibor is to be discontinued it cannot be done in a disorderly fashion. For example, regulatory instances in the EU can demand that Stibor has to be reported up to 24 months after the administrators of Stibor, The Swedish Bankers' Association, announce that the reporting will cease (FI, 2018a).

3.5.2 Financial Contracts with Variable Rates

To illustrate what role ibor rates play in different financial contracts and to facilitate the reading of the analysis and discussion, a description of the financial instruments discussed in the paper is given below.

Floating Rate Note

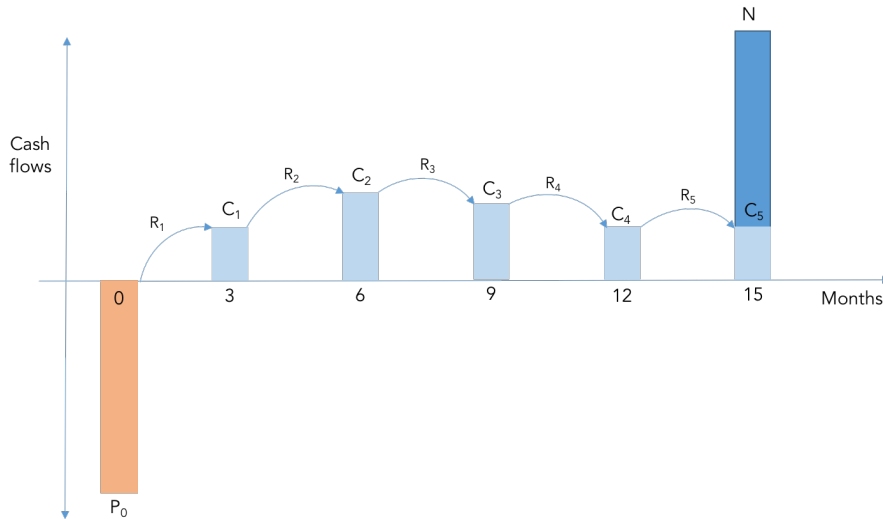
A floating rate note (FRN) is a corporate bond with a variable coupon rate, meaning coupons are determined by a variable interest rate plus a fixed spread (Asgharian and Nordén, 2007). A short market rate is used as the variable interest rate and is often an ibor rate. If, for example, Stibor 3m is used as the variable rate and the

⁶One basis point is equal to one hundredth of a percentage point.

note has quarterly coupons, the size of the next coupon is set by the level of Stibor 3m today, while the size of the following coupon will be determined by the level of Stibor 3m in three months' time. All future coupons are thus unknown except for the immediately subsequent coupon. This is illustrated in figure 3.2.

Figure 3.2: The cash flows of an FRN with quarterly payments

The size of the coupons varies with the floating rate, R_t , as $C_t = N \cdot R_t, t = 1, \dots, 5$.



In a common corporate bond the coupon rate, R , is fixed. This means all coupons are pre-determined through $C = N \cdot R$. The owner of a corporate bond is exposed to an interest rate risk, since an increase in the market interest rates reduces the value of the bond. However, with a floating rate note the coupons are adjusted according to the current interest rate, decreasing the interest risk of the contract.

Interest Rate Swap

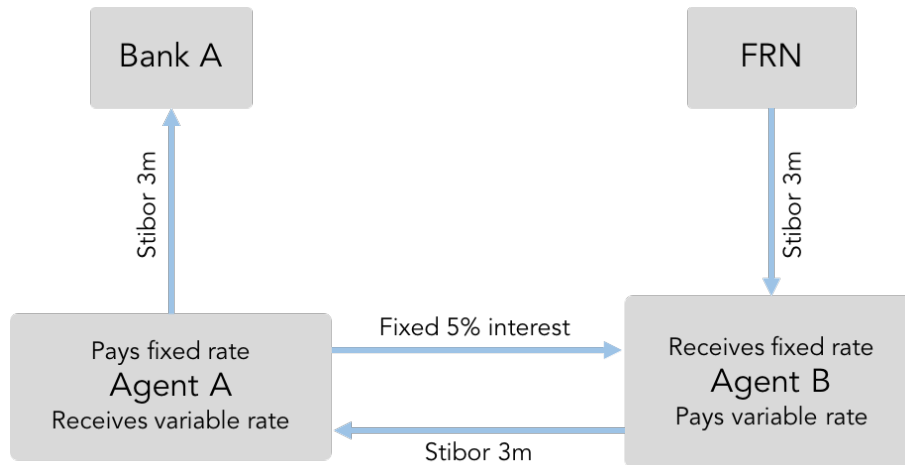
An interest rate swap (IRS) is a financial contract where two or more parties exchange interest rate payments during a certain time period. The most common type of swaps are coupon swaps, also known as plain vanilla swaps, where a fixed rate is exchanged for a variable rate. The stream of fixed payments is called the fixed leg of the swap, while the stream of variable payments is called the floating leg. There are, however, also floating-to-floating swaps, where a floating rate in different tenors is exchanged⁷. As of today, most interest rate swaps use an ibor rate as the variable rate, such as Stibor, Libor or Euribor (Hässel, Norman and Andersson, 2001).

Companies can use interest rate swaps to hedge their exposure to interest rates. For example, if a company believes that interest rates are on the rise, they can swap their floating rate payments to fixed rate payments. It can also be beneficial for a company to swap its floating rate payments to fixed rate payments if they want to have more control of future cash flows. Often interest rate swaps are used by companies that have loans with variable interest rates, but want to fix their future payments to manage their risk.

⁷For example, Stibor 1m against Stibor 3m.

In the example shown in figure 3.3, agent A has a floating rate loan with the variable rate Stibor 3m while Agent B holds an FRN from which she receives Stibor 3m. Agent A enters into an IRS with agent B, exchanging Stibor 3m, for a fixed 5% interest rate. This means that agent A has hedged her exposure to changes in the floating rate. Agent B on the other hand has exchanged their floating rate to a fixed rate.

Figure 3.3: Illustration of a coupon swap with Stibor 3m as variable interest rate



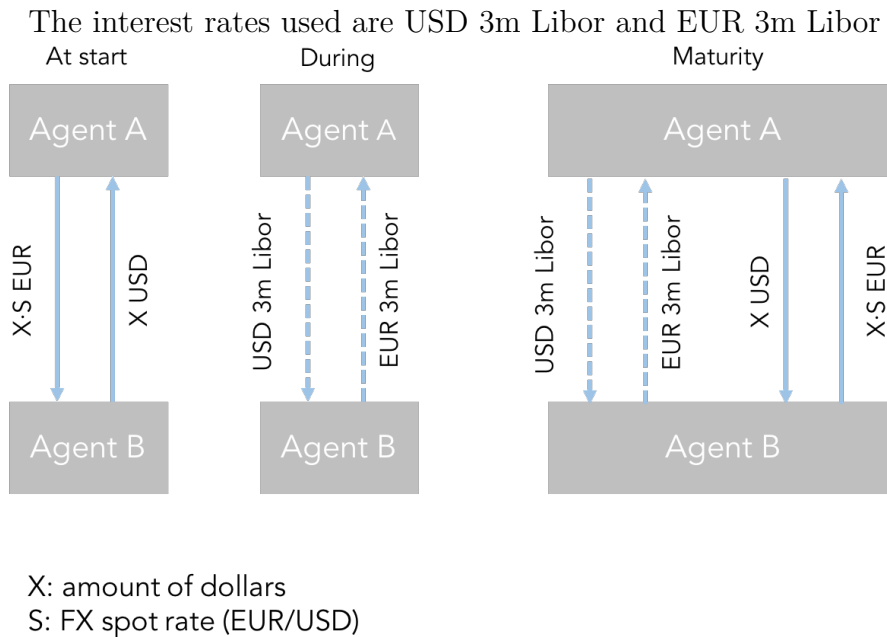
One example of a standardized swap is Stina (Stibor T/N Average), which is a swap where Stibor T/N is exchanged for a fixed rate over a time period, often 3 months (Hydén, 2018). The floating leg is tomorrow/next instead of overnight, which is more common in other currencies, because Stibor does not have an overnight fixing.

Cross-currency Basis Swap

A cross-currency basis swap is a financial contract where one party lends one currency to another party while at the same time borrowing the same value, at spot rates, in another currency to the same party (Baba, Packer and Nagano, 2008). The parties also pay interest on the loans to each other, usually in some ibor rate for the respective currency. At the end of the contract the parties return the principal amounts to each other at the same spot price as when they entered into the contract.

In figure 3.4 below, Agent B lends X USD to Agent A and simultaneously borrows $X \cdot S$ EUR from Agent A, where S is the FX spot rate. The two agents then exchange interest payments in the different denominations periodically during the term until they return the principals at the original spot rate at maturity.

Figure 3.4: Illustration of a cross-currency basis swap in EUR to USD



Source: Baba, Packer and Nagano, 2008.

3.6 Relevant Regulations

As the Libor scandal unravelled, ibor rates came under more intense scrutiny (Cutler and Ridley, 2013). Not only did ibor rates seem to be partially disconnected to the contracts they were underpinning, but their frameworks also allowed for manipulation due to, among other things, a lack of transparency. Many institutions, private actors and legislators moved to take action to protect the integrity of these reference rates and a number of reports and investigations followed. Two of the most important regulations in relation to Stibor is described in the following sections.

The Wheatley's Review of Libor: final report, published in September of 2012, criticised the current state of Libor and suggested a number of changes. This included increased transparency in the Libor process and the need for the market to have a more active role in determining reference rates. FSB as well as IOSCO published reports in the following years with the intention of creating an overarching framework for benchmark rates (IOSCO, 2013; FSB, 2014). As a consequence, BMR was introduced in the EU. The Riksbank also launched investigations in the light of these events and came to propose a number of changes in the framework of Stibor (Riksbanken, 2012; Riksbanken, 2014). The details of BMR and the Riksbank's review are laid out below.

3.6.1 Benchmark Regulation

As recently as 2018, EU Regulation 2016/1011 of 8 June 2016, more commonly known as BMR, came into force, requiring greater control and oversight from administrators and contributors of benchmarks used in financial instruments. BMR is aimed to act as a harmonising framework to ensure the accuracy and reliability of benchmark rates

in EU member states. The regulation addresses problems which previous benchmark rates have suffered from. For example, Article 11 requires input data to a benchmark rate to be more transaction based than before. It also lays down rules for when transaction data is not available and what strategies should be employed to avoid rates being set on the basis of expert opinions.

BMR affects all entities affiliated with the use of benchmark rates, i.e.

- administrators of benchmark rates,
- contributors that report input data to administrators,
- users of benchmark rates, such as firms that issue financial instruments that refer to an index.

All administrators of benchmark rates in Sweden have to apply for either authorization or registration from FI, depending on if they are subject to FI's supervision (FI, 2018b). ESMA also has to keep a public register of all authorised administrators. No administrator for Stibor has been announced yet as the application deadline for registration (or authorization) is not until the year 2020 (ESMA, 2019).

All contributors in Sweden that report to registered or authorized administrators have to be under the supervision of FI (FI, 2018b). Furthermore, they must comply with governance and control regulations as stipulated in Article 16 of BMR. National authorities in Sweden also have the right to demand contributions by supervised contributors, since omitting to report a benchmark rate can undermine the credibility and integrity of the rate (Liebi, 2018). The Stibor banks are considered contributors for Stibor by the BMR.

Users in Sweden may only use benchmarks that are included in the register (FI, 2018b).

3.6.2 The Riksbank Reviews

In 2012, the Riksbank published “The Riksbank’s review of Stibor“ pointing out flaws in the way Stibor was handled. Like many other similar reports published at the time, a number of issues were identified. These included:

- a greater need for an accountable entity to regulate the Stibor process,
- better structure to ensure Stibor’s credibility,
- increased transparency in the Stibor process,
- easier methods to verify Stibor and,
- better incentive structures to ensure that banks report accurate rates.

Following the report, the Swedish Bankers’ Association was assigned responsibility over Stibor and subsequently published a renewed framework complying with The Riksbank’s proposals (Swedish Bankers’ Association, 2012). The Riksbank also published a follow-up investigation in 2014 to evaluate the new framework and make sure that the Stibor panel adhered to the new regulations. This report verified that historically reported Stibor rates were consistent with actual interbank transactions.

3.7 Alternative Reference Rates

As Libor is set to be phased out by 2021, alternative reference rates for all currencies it covers must be developed and integrated with the market. Sofr (USD), Sonia (GBP) and Ester (EUR) are introduced below. The authors have chosen these three rates as their currencies are among the most traded ones in the world, they are far along in the process of replacing Libor, and the official language in each jurisdiction is English which means there is no language barrier when researching these rates.

3.7.1 Sofr

Secured Overnight Funding Rate, Sofr, is the alternative reference rate planned to replace USD Libor and is calculated as the volume-weighted median rate of the transactions in the U.S. Treasury repo market. The Treasury repurchase market trades around 800 billion U.S. dollars daily, which means there is plenty of data on which to base the rate. The New York Federal Reserve has been publishing Sofr daily since April 2018 (Federal Reserve Bank of New York, 2019).

3.7.2 Sonia

Sterling Overnight Index Average, Sonia, is the alternative reference rate planned to replace GBP Libor and is the trimmed⁸ mean of the overnight rates for unsecured transactions in the sterling market. BoE overtook administration of Sonia in 2016, and publishes it daily. A number of reforms were made in 2018, allowing both brokered and bilaterally negotiated transactions to be included in the underlying data set (BoE, 2019).

3.7.3 Ester

Euro Short-Term Rate, Ester, is the alternative reference rate planned to replace EUR Libor and will reflect the eurozone banks' borrowing costs by looking at the trimmed volume-weighted mean of actual uncollateralized overnight transactions between banks in EUR. ECB will begin publishing Ester no later than October 2019 (ECB, 2019).

3.8 Stibor and Swedish Monetary Policy

The following section will outline the main features of Swedish monetary policy. This is done in order to understand the connection between the Riksbanks monetary policy and Stibor, since the Riksbank assesses Stibor to be an important part of the transmission mechanism (Riksbanken, 2012). As will soon be explained, a change in the repo rate has a direct impact on Stibor and the value of the financial contracts Stibor underpins.

⁸Trimmed in this case means removing the top and bottom quartile of the data before doing the calculation.

3.8.1 Lending, Deposit and Repo Rate

The Riksbank's aim with their monetary policy is to ensure that Swedish money retains its value over time. In practice, this means keeping inflation low and stable at around 2% (Riksbanken, 2018a). In order to achieve this goal, the Riksbank uses an interest rate steering system involving three central rates: the lending rate, the deposit rate and the repo rate.

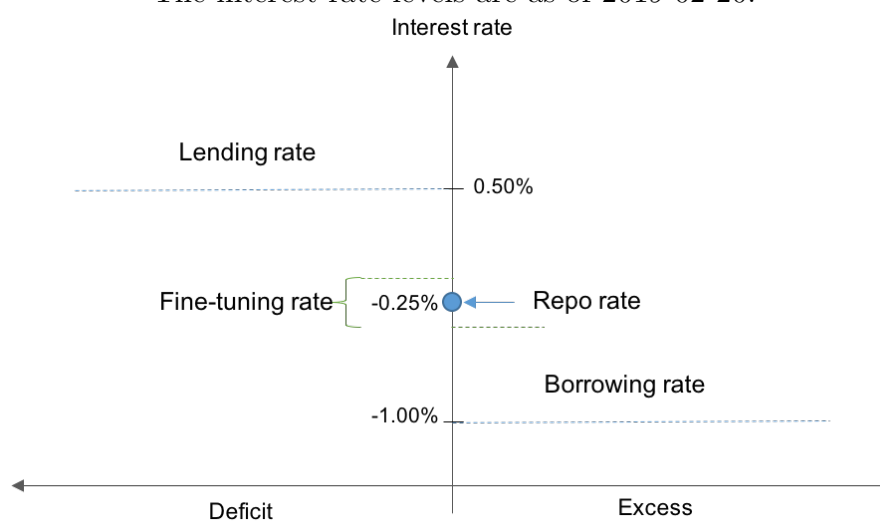
The deposit rate is defined as the rate that banks receive for depositing money overnight in their accounts at the Riksbank (Asgharian and Nordén, 2007). The lending rate is defined as the rate at which banks can borrow money overnight from the Riksbank. The deposit rate is usually 0.75 percentage points lower than the repo rate, while the lending rate is usually 0.75 percentage points higher than the repo rate. This means that the deposit and the lending rate create an interest rate corridor in which the repo rate is contained, as illustrated in figure 3.5.

While the deposit and lending rates have limited use in controlling inflation rates, the repo rate is the Riksbank's main monetary policy tool (Riksbanken, 2018). It is defined as the rate at which banks can lend or deposit money from the Riksbank for a period of seven days and plays a large role in signalling the Riksbank's intentions with their monetary policy for the upcoming period.

The Riksbank also carries out fine-tuning transactions where the interest rate is the repo rate plus a spread of 10 basis points (Hässel, Norman and Andersson, 2001). This is done by the Riksbank to prevent fluctuations in the overnight rate. If the Riksbank believes that an excess or deficit of liquidity in one or more banks is due to a systematic imbalance, the banks may borrow or deposit money at the fine-tuning rate.

Figure 3.5: Illustration of the deposit, lending and repo rate

The interest rate levels are as of 2019-02-20.



Source: Hässel, Norman and Andersson, 2001.

3.8.2 Liquidity Balancing in Banks

Each new banking day many payments are sent to and from banks' different accounts. Since many of these transactions are between accounts of different banks, any given bank will at the end of the day either have an excess or a lack of liquidity. As the Riksbank stipulates that all imbalances in liquidity must be settled at the end of each banking day, banks must either deposit or lend money depending on their situation. To resolve this, a bank can lend or deposit money at the Riksbank for the lending rate and deposit rate respectively. However, the banks are more incentivised to deposit and lend money from each other to a more favourable interbank rate, creating a preference to trade amongst themselves (Asgharian and Nordén, 2007).

3.8.3 The Deposit and Overnight Market

The Swedish deposit market is described by Hässel, Norman and Andersson (2001) essentially as a market for liquidity where banks, larger companies, funds and insurance companies deposit or lend money from other banks for different periods. A normal transaction is of the size 250 million Swedish kronas and the periods range from overnight up to one year. The overnight transactions constitute what is called the overnight market.

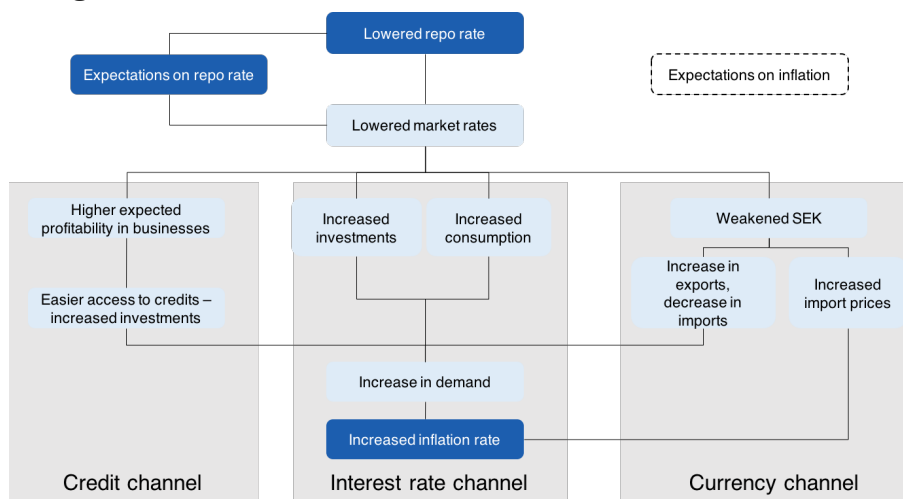
3.8.4 The Interbank Market

Hässel, Norman and Andersson (2001) describe the interbank market as a part of the deposit market where banks deposit and lend money from each other for different periods. The transactions are made bilaterally between banks to even out any excess or missing liquidity.

3.8.5 The Transmission Mechanism

The collection of mechanisms through which changes in the repo rate affect the price stability and inflation in Sweden is known as the transmission mechanism (Hässel, Norman and Andersson, 2001). A change in the repo rate leads to changes in interest rate levels on the market which eventually has effects on the Swedish economy as a whole. This is illustrated in figure 3.6.

Figure 3.6: Illustration of the transmission mechanism



Source: Lagerwall, 2011.

When the Riksbank increases the repo rate, it affects the deposit and lending rate. Any outstanding payments at the Riksbank are therefore subject to higher interest rate, leading to increased financing costs for the banks and subsequently increased interbank rates. The shortest interbank rates, such as the overnight interest rates, are directly affected, since an increase in the repo rate directly increases the short term financing costs of the banks. The longer rates are indirectly affected, since an increase in the repo rate creates expectations of further increases of the repo rate in the future. Believing that the banks' financing cost will continue to be higher in the future, the banks' longer rates are increased (Hopkins, Lindé and Söderström, 2009).

When the interbank rates of different maturity increase, Stibor of those maturities also increases. This in turn leads to changes in the price of many financial contract, affecting countless payment streams. If a financial institution, for example, owns an FRN and Stibor increases, the future payments of the contracts will become larger. This in turn could change the amount the financial institution needs to charge its customers, meaning a change in Stibor indirectly could affect far more than the owners of the contracts underpinned by the rate.

Increased interbank rates also leads to increased yields on government bonds, mortgage bonds and other market rates. Changes to these market rates finally leads to changes in the interest rate of consumers, affecting bank loans and mortgages (Hopkins, Lindé and Söderström, 2009).

4

Analysis

This section contains the analysis part of the paper, as described in the methodology chapter. Firstly, the problems of Stibor are discussed and explored in more detail. Secondly, criteria for a sound reference rate in Sweden are identified. Thirdly, different aspects which must be considered when constructing a reference rate and their implications for the Swedish financial system are analysed.

4.1 Problems with Stibor

Although Stibor has gone through some reformation after the Libor scandal, some remaining issues may be of concern. Based on information gathered via interviews and governmental reports, the authors identified the following areas of improvement:

1. The liquidity of the interbank market
2. The remaining lack of transparency in the Stibor process
3. The number of banks in the Stibor panel
4. The definition of Stibor

These areas are analysed in more detail in the following passages.

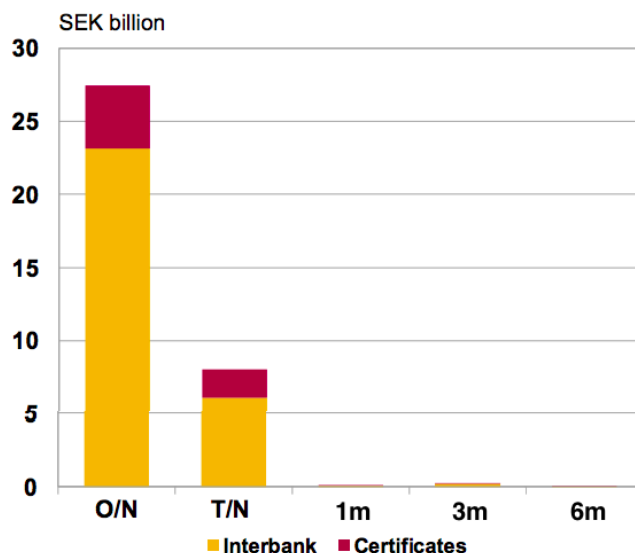
4.1.1 Liquidity of the Interbank Market

The Stibor framework stipulates that Stibor should primarily be based on interbank transaction data (Swedish Bankers' Association, 2018b). This is to ensure that the banks' reported Stibor submissions reflect the interest rate at which they are actually willing to trade with one another. BMR also drills down on this point, upholding the importance of anchoring benchmark rates to real world transactions. In recent years, however, the number of transactions on the Swedish interbank market has been on the decrease, making it more difficult to base the rate on transactions alone.

In the report "FI analys 14: Reference rates are changing" published by FI in 2018, the problem of low interbank market liquidity is raised. The study shows that transactions almost exclusively take place for the shorter maturities, while the longer maturities see very few transactions. This is illustrated in figure 4.1, where

the majority of the transaction volume on the interbank market during 2017 are attributed to the maturities overnight and tomorrow next.

Figure 4.1: Average daily volume on the interbank market in 2017



Source: FI, 2018a.

Perhaps, an even more alarming finding is that for the 3-month tenor, no trades were executed on nearly 90% of the trading days in 2017. This is especially concerning since Stibor 3m is one of Sweden’s most important interest rates, underpinning a large portion of outstanding financial contracts. For instance, according to Klas Granlund at FI, Stibor 3m is the industry standard used in interest rate derivatives, a market with an outstanding nominal value of 40,000 billion Swedish kronas. Furthermore, Jenny Ramstedt, Liquidity Management trader at SEB believes that the liquidity on the interbank market will not improve in the future.

If interbank transactions are not available, the banks are according to the Stibor framework forced to instead base their Stibor submissions on secondary data such as quoted interbank levels, baskets of certificates of deposit¹ (CD) or make “expert assessments”. These CDs do not have to be based on actual transactions, but can instead be priced at the rate at which banks would be comfortable issuing them (FI, 2018a). This means that, as it stands today, longer maturities of Stibor such as the 3-month tenor, could to a large extent be based on secondary data or expert assessments rather than actual transactions.

4.1.2 Lack of Transparency

After the Libor scandal unravelled in 2012, ibor rates were widely criticized for their lack of transparency. To resolve this issue, new frameworks were developed for the

¹A financial contract issued by banks to finance themselves. CDs are promissory notes where the holder of the CD is paid interest for depositing money at the bank for a certain time period.

different ibor rates. Following the Wheatley Review of Libor, the IBA took over the administration of Libor from the BBA and introduced the waterfall methodology to increase the transparency of the rate (ICE, 2018a). In parallel with this development, following the Riksbank's Stibor reports, Stibor also switched to a waterfall methodology to resolve transparency issues. However, despite these actions, Stibor might still not be in the clear because of future international regulations. For instance, BMR will seek to further increase the transparency of critical benchmark rates, Stibor being one of them.

Importance of Transparency

A perceived lack of transparency in Stibor could, in the authors' view, undermine the market's confidence in the reference rate. This is a problem since Stibor is a convenient standard used in many financial contracts (FI, 2018a). A lack of trust would therefore hurt the efficiency of the Swedish financial market and potentially drive away investors. The authors also argue that a lack of transparency could hurt the reputation of Stibor banks, making them less attractive for companies as well as the public. Foreign investors' willingness to invest in Swedish products could also diminish. However, the most fundamental issue is perhaps that a lack of transparency could lead to asymmetric information in the marketplace, which is unfair and arguably undemocratic.

Stibor's Lack of Transparency

There are two ways that one might perceive Stibor as lacking in transparency. Firstly, the fixing of Stibor still depends on expert judgments to some degree. According to Jonny Sylvén, Swedish Bankers' Association, this is something which is undesirable in a reference rate since it makes it harder to verify whether submissions are representative of actual transactions, especially for longer maturities. This is also an issue discussed in the Riksbank report "The Riksbanks review of Stibor" from 2012. Thankfully, the second Riksbank report from 2014 in which they evaluated Stibor's reflection of actual interbank transactions concluded that Stibor submissions in the aggregate do correspond well with actual transaction data. This goes to show that the current method of reporting Stibor has historically yielded a fair valuation. However, despite these positive results, the issue of the incompatibility between transparency and expert judgments is not resolved.

The second issue concerning the transparency with Stibor is that the fixing of Stibor is to some extent a non-public process. Although the Stibor framework is available to read online, parts of the frameworks are banks' internal documents which are not disclosed to the public. For instance, what actions the Stibor banks should take in case a Stibor bank suffers liquidity problems are not mentioned in the framework. Furthermore, interview subjects were reluctant to discuss the matter.

4.1.3 The Number of Stibor Banks

The number of Stibor banks is quite low compared to other ibor panels. While the Libor panel has between 11 and 16 banks depending on the currency (ICE, 2019a) and Euribor has 19 banks (EMMI, 2018a), the Stibor committee only consists of seven. This could potentially be harmful to Stibor since a low number of banks facilitates

manipulation of Stibor. It could also create issues concerning the robustness of the reference rate.

Vulnerability to Manipulation

As of today, the Stibor framework only requires four banks to report their submissions in order for Stibor to be calculated (Swedish Bankers' Association, 2018d). With that few submissions, a small change in one bank's reported rate could change the fixing of Stibor significantly. Furthermore, the fewer the number of banks, the more exposed the system is to the risk of coordinated manipulation. Combining this issue with the lack of transparency in the Stibor process and the fact that a large nominal value depends on Stibor, this could create incentives to manipulate the rate.

Assume, for example, that only four Stibor banks report Stibor one morning. The reported rates for two different scenarios of Stibor 3m are shown in table 4.1.

Table 4.1: Hypothetical Stibor 3m submissions

	Bank A	Bank B	Bank C	Bank D
Scenario 1	2.00%	2.00%	2.00%	2.00%
Scenario 2	2.00%	2.00%	2.00%	1.60%

Source: Author created.

In scenario 1, where no bank is assumed to report fraudulent rates, Bank A through D report 2.0% as their Stibor submission which yields an arithmetic mean of 2.0%. However, if Bank D was to manipulate its Stibor contribution and report 1.6% as in scenario 2, the final Stibor fixing would instead be 1.9%. This means that Bank D alone was able to affect Stibor with 0.10 percentage points by changing its Stibor contribution by 0.40 percentage points. Such a change could present significant incentive for possible manipulation. For instance, a trader with the same PnL exposure as Hayes during the Libor scandal, would have pocketed a 7.5 million U.S. dollar profit from such manipulation.

The above example is an illustrative, but simplified example of the problem and in the Stibor frameworks there are safety procedures in place to prevent this sort of behaviour. Examples of this include the four-eye principle, where at least one other person has to check and verify a bank's Stibor submission, and the fact that banks need to be able to retrospectively report what interest rates, quoted prices or other factors their submission was based on (Swedish Bankers' Association, 2018c; 2018d).

The Robustness of Stibor

In recent years, following the Libor scandal, banks have been withdrawing from the Libor panel. Andrew Bailey, head of the FCA, in a speech from 2017 reports that he has had to persuade many banks to stay in the Libor Panel. The reason for this, he claims, is that many banks feel discomfort in submitting Libor because of the lack of transaction data to base the submissions on. Andrew Bailey also expresses concern that if too many banks leave the Libor panel, the robustness of Libor would be compromised. One could, for example, imagine that the fewer

number of banks report Libor, the less representative it is of banks' financing costs as a whole. Furthermore, a low number of submissions could also make Libor more volatile, creating insecurity on the market place.

In Sweden, efforts have been made to attract more banks to the Stibor panel. Jonny Sylvén of the Swedish Bankers' Association says that they changed the Stibor framework for this reason. The solution they came up with was to lower the barriers of entry into the panel for smaller banks, such as lowering the amount at which they are required to trade. Since these changes, the panel has attracted two additional members: SBAB and LF Bank. Klas Granlund, FI, also mentions this development during an interview, stating that Sweden has seen banks join the panel as opposed to leaving. He sees it as a positive sign that Swedish banks do not seem to want to withdraw from the panel, although he also points out that the addition of SBAB and LF Bank is a small sample to draw any conclusions from.

4.1.4 The Definition of Stibor

By the definition of Stibor, a Stibor bank submitting a Stibor contribution considers at what interest it would be willing to lend to another Stibor bank without posting collateral (Swedish Bankers' Association, 2019). After having reported its contribution, the bank is obliged to trade at their reported rate plus/minus a spread up to a certain limit with the other Stibor banks. This means that the bank can not discriminate among the different Stibor banks, but has to report an interest rate at which it is happy to trade with any members of the Stibor panel. This could have consequences for how banks report their contribution, since all banks in the panel do not necessarily have the same credit rating and liquidity.

For instance, if a bank in the Stibor panel was to have solvency issues, the other banks in the panel would face a difficult decision. Should their contribution be based on the interest rate at which the bank is willing to lend to the majority of the panel or on the interest rate they would offer to the bank facing problems? Furthermore, in times of financial instability it can be difficult for banks to even evaluate the risk on the interbank market, making the banks hesitant to submit a contribution at all (Riksbanken, 2014). According to Jonny Sylvén, these sorts of issues are not discussed in the public Stibor framework. However, the Swedish Bankers' Association acknowledge them as legitimate problems and claim to have a plan in place, though it is not publicly available.

In recent years, it is easy to find examples of Stibor banks facing credit rating problems. For instance, in the wake of the financial crisis, Danske Bank faced issues with the Irish branch of the company, leading to uncertainty in their credit rating (Brennan 2016). Furthermore, Swedbank faced serious liquidity problems during the financial crisis, which resulted in them accepting multiple bailout packages from the Swedish government (Forsberg, 2012). The possibility of Swedish banks facing financial problems is therefore not negligible.

4.2 Criteria for a Sound Reference Rate

Based on expert interviews, available reports on the subject of ibor rates as well as the discussion of the problems with Stibor above, criteria for a sound reference rate have been formulated by the authors and are presented in the following section. The criteria are constructed in order to show what features an ideal reference rate should have and can be used as a guide when constructing a reference rate. This will be useful in section 4.3, as the criteria will be referred to and used to verify the relevance of the discussion topics and evaluate the different options.

Criteria 1: Satisfy BMR

Satisfying BMR, as described in section 3.6.1, is a threshold requirement and an absolute must for all rates which are to be considered as a reference rate in Sweden. BMR is yet to be implemented fully and neither FI nor Swedish Bankers' Association know exactly what the implications will be and whether Stibor will have to be adjusted in any way to comply with the new regulation.

Criteria 2: Transparency

That a reference rate is transparent is imperative to gain the markets trust. As mentioned in chapter 4.1, the transparency of Stibor is still an issue as the rate is influenced by expert judgments to some degree and because parts of the Stibor framework is unavailable to the public. While the Riksbank's 2014 evaluating Stibor showed that the rate has been historically fair and accurate to the financing costs of the banks, the reference rate has to be completely transparent in order to ensure that this remains to be the case.

Criteria 3: Robustness

That a reference rate is robust means that it is difficult to manipulate and that it can be calculated and published under all market conditions. As described in 3.3, the Libor Scandal is a clear example of what can happen if the calculation of a rate allows for manipulation. It also demonstrates the importance of robustness as both market participants and regulators expressed the need for reformation following the scandal.

Criteria 4: Market Adapted

In order for a reference rate to be relevant to the market, it must be well adapted to all its users. This includes having a definition and method of calculation that is easy to understand and demonstrating characteristics such as predictability and avoiding irrational behaviour. As there is no authority which can force the use of any reference rate upon the market, any rate that is not suitable to the market is bound to fail, as users will choose to reference another rate.

Criteria 5: Reflection of Risk

A sound reference rate needs to accurately reflect the type of risk it intends to capture without capturing any other type of risk. As discussed in chapter 4.1, Stibor is intended to capture the risk in the banking sector, but can because of its definition react disproportionately in a scenario where one bank faces liquidity issues. In such a scenario Stibor could therefore capture the risk of one failing bank, rather than the

banking sector as a whole, making it unsuitable in certain situations. A reference rate needs to capture the same type of risk regardless of the market conditions.

4.3 Considerations when Constructing a Reference Rate

When constructing or selecting a reference rate, there are many choices that need to be made and aspects to be considered. These areas of discussion are presented and analysed in the following sections, with the criteria from chapter 4.2 in mind. While real-life examples from abroad are used as a reference point, the discussion is centered around Sweden and what options are plausible and suitable in that market.

4.3.1 Transaction-based or Assessment-based

In this section a comparison between transaction-based and assessment-based rates is made. Transaction-based means that the reference rate is directly calculated from transactions made in the underlying market. The calculation can be done in various ways such as volume-weighted, time-weighted and by excluding certain data points by different criteria. Assessment-based, on the other hand, means that the rate is based on assessments by one or more experts. The experts may have different data and tools at their disposal when conducting the assessment and the process can be more or less standardised. It should be noted that a reference rate in some cases is both transaction- and assessment-based. The following arguments should therefore not be interpreted as arguments for a solely transaction-based or assessment-based rate, but rather the advantages or disadvantages of having one of the methods be more prevailing.

BMR prescribes a waterfall methodology when setting a reference rate, which means that when fixing a rate, transaction data should be prioritised over expert assessments. This does, however, not mean that a future Swedish reference rate cannot be based on expert assessments. BMR still allows for it as long as appropriate measures are in place to ensure a consistent, non-arbitrary approach. While at first glance a transaction-based rate might seem like the obvious better choice due to the person independent nature of it, there are less obvious and more complex advantages and disadvantages with both alternatives.

Transaction-based Rates are More Transparent

Transaction-based rates are in their very nature to some extent more transparent than assessment-based ones, meaning they fulfil criteria 2 in a more satisfactory manner. A rate based solely on actual market transactions using a method of calculation that is publicly available creates no questions or uncertainties for market participants as to what exactly lies behind each day's fixing. This is crucial for the market's confidence in the reference rate, and its willingness to use it in various financial instruments. If the rate's fixing seems arbitrary or the market feels that it does not accurately capture the risk that it is supposed to reflect, it is less relevant as a reference rate.

Transaction-based Rates Could be Less Vulnerable to Manipulation

A point that is closely related to the one above is that transaction-based rates can be harder to manipulate, in accordance with criteria 3. In order to manipulate a transaction-based rate, one must manipulate the underlying data points. Manipulating transactions in this case means trading in a way that is not based on actual supply and demand, but purely intended to drive the market one way or the other. The less liquid the underlying market is, the easier it is to manipulate as a smaller volume is required to achieve the desired effect.

The Swedish financial market, in a global perspective, is small and finding an appropriate market for a transaction-based rate is a difficult task as the number of transactions on any given day is relatively low. However, assuming the rate is calculated as a volume-weighted mean, it must not necessarily be that the transactions are many in quantity, but rather that the total volume is large enough to avoid manipulation. Johnny Sylvén, Swedish Bankers' Association, addressed the Swedish overnight market in an interview and talked about its suitability as a base for a reference rate. The aggregated data on all transactions on the interbank overnight market has been collected by the members of AGAR solely for the purpose of evaluating options for a Swedish reference rate and is not available to the public. According to Sylvén the number of transactions on a typical day is in the low two-digits. This might seem insufficient at first glance, but Sylvén argues that one must not forget to look at the volume of the transactions. On a typical day, one can expect a total turnover in the overnight lending market of about 40 billion kronas. This can for reference be compared to the Swedish equity market which in 2018 had an average daily turnover of 17.8 billion kronas (Nasdaq, 2019). The overnight lending that takes place between banks is significant in size, meaning the exposure one would need to the reference rate in order to economically justify doing fraudulent trades is substantial. He does, however, express concern about character traits of the overnight market that potentially could open up for manipulation: the number of transactions and the daily turnover varies a lot. There are days when the number of transactions are in the low single digits and total turnover is a couple of billion kronas, at best. On days like these, a reference rate based on that market would obviously be vulnerable to fraudulent behaviour.

There are ways to counteract attempts of manipulation. One way is to trim the data set by removing the highest and lowest parts of the data set. For example, when ECB calculate Ester they rank the transactions from highest rate to lowest rate, remove the top and bottom 25 percent in volume terms and calculate the volume-weighted average from the 50 percent that is left (ECB, 2018). This makes it more difficult to manipulate the rate since chances are that if the rate in a transaction is far off the fair value, the transaction will not be included in the calculation. Transactions not included in the calculation can still have an indirect effect on the result since a transaction with a high rate “pushes down” transactions below, so that transactions that otherwise would have been excluded in the calculation are included, thereby making the rate higher. Assuming the underlying market is of sufficient size, one can imagine this effect should be very small and that the costs associated with doing a transaction at a less than optimal rate would outweigh the potential upside of trying to manipulate the rate this way.

A second method of reducing the risk of manipulation is to observe data at random time intervals. This is a method BoE's Sterling Group for Risk-free Rates suggests benchmarks administrators should consider when calculating a rate (BoE, 2018). By collecting data over a longer time period, such as several hours, but only including random parts of it in the calculation, tampering attempts are less likely to be successful and will thus be less tempting.

Finally, a third way to discourage manipulation of the underlying transactions is to have a financial authority monitor the transactions closely. If Swedish banks were to submit their transactions to the Riksbank or another governmental body, the dread of facing inquiries or costly sanctions from regulatory bodies would act as an effective deterrent to deceitful actions.

Expert Assessment are Less Exposed to Variable Market Liquidity

In times of crisis or market failures, liquidity on certain markets can decrease rapidly, sometimes even disappear altogether. The credit crisis of 2008 is one historical example of how quickly market dynamics can change. In a matter of days, nervousness about the situation in the American credit market and uncertainty about how it could come to affect the Swedish financial markets caused the Swedish interbank lending market to almost vanish. The Swedish banks simply did not trust that their peers would be able to repay their loans, even on a very short-term basis (Forsberg, 2012). This example shows that even markets that seem to be virtually risk-free (such as the overnight interbank lending market) can malfunction in desperate times. If this were to happen to the market from which a reference rate is calculated, the fixing of that rate would be made very difficult, if not impossible.

An assessment-based rate could in those cases still be fixed and published, although it would probably be difficult. This means expert-assessed rates could be more in line with criteria 3. The implications of not being able to fix the reference rate can be dire, thousands of billion kronas of financial instruments and loans rely on Stibor today. Not being able to trust that the fixing will be provided every day could worsen a financial crisis substantially as it would likely lead to several markets malfunctioning and instill further distrust in the financial system as a whole.

Expert Assessments Can Work as a Filter for Unwanted Market Phenomena

Transaction-based rates can be exposed to features of the underlying market which may not be desirable. Depending on which risk the rate is supposed to reflect, market phenomena like month-end trading can lead to unwanted and irrational volatility in the reference rate. Linus Laurin, Dealer in SEK rates at Danske Bank, mentioned one aspect of trading which may result in unwanted volatility and misleading rates: if one side of the market (sellers or buyers) is particularly active, the bid/offer spread can be captured in the reference rate, making the fix higher or lower than the actual mid in the market. Below is a simplified explanation of what could happen.

Let's say we are observing a market where participants can borrow and lend money to and from each other overnight. Yesterday the mid was 1.60% and so was the reference

rate's fixing. The market makers start the day by quoting the following rates: 1.50% / 1.70%, which means that market takers can borrow money to an interest rate of 1.70% and lend money to an interest rate of 1.50%. Today is month-end and many companies happen to struggle with their liquidity, and need to borrow money overnight. Market takers cross the spread and hit the market makers' offer, thereby accepting an interest rate of 1.70% for borrowing money. When enough market takers have hit the bid, the market eventually moves a little bit higher, let's say to 1.55% / 1.75% before the daily fixing of the reference rate. Let's assume the following five transactions, presented in table 4.2, have taken place and will be the basis for the daily fixing of the reference rate:

Table 4.2: Fictional transactions used in the numerical example

Side of the Quote	Principal Amount	Rate
Offer	100 000	1.70%
Offer	350 000	1.70%
Offer	300 000	1.75%
Bid	50 000	1.55%
Offer	200 000	1.75%

If the reference rate is a volume-weighted average of the transactions, the fixing would be 1.72%. However, an expert might look at the transactions and the quotes on the market and note that on this day an exceptional amount of corporations were in need of cash, and therefore a majority of the trades that were made were on the right-hand side of the quote. When the data collection started the quote was 1.5% / 1.70%, with a mid of 1.60%. When it closed, the quote was 1.55% / 1.75%, a mid of 1.65%. So, what is the fair rate? If the rate is supposed to reflect the risk premium of the market one might argue that the true rate is somewhere between 1.60% and 1.65%, since that is where the mid has been throughout the day. This is a considerably smaller increase in the rate compared to what the result would have been if the rate was purely transaction-based.

One concern with unwanted volatility in the reference rate is that it makes it less user friendly, in conflict with criteria 4. If a corporation or individual is to be comfortable with including the rate in their finances, the rate must not move unjustifiably much from day to day. How would, for instance, a CFO of a mid-sized company feel if on Monday the interest rate the company pays for their loans is 1.60% and on Tuesday it is 1.72%? Would he accept the bank manager's explanation that while the price for risk on the market has just risen to 1.63%, on this particular day a lot of companies needed to borrow money and that happened to push the reference rate to 1.72%, but that it should be back to around 1.62% again tomorrow? While this might be acceptable amongst market professionals like derivative traders and asset managers it is unlikely that the general public would be comfortable with an interest rate demonstrating such irrational characteristics. Avoiding these kinds of non-desirable movements in the rate is in line with fulfilling criteria 5.

4.3.2 Secured or Unsecured Transactions

In the following section the topic of transaction-based reference rates will be explored. In particular, the choice of using secured versus unsecured transactions as basis for a transaction based reference rate will be discussed.

Examples of Reference Rates Based on Secured and Unsecured Transactions

The transaction-based alternative references rates that have been presented so far to replace Libor can be divided into two categories: secured reference rates and unsecured reference rates. These alternative rates and their respective categories are shown in table 4.3.

Table 4.3: Alternative reference rates categorized by type of transaction they are based on

Categories	Reference rates
Secured reference rates	SOFR, SARON
Unsecured reference rates	ESTER, SONIA, TONA

Source: Schrimpf and Sushko, 2018.

Secured reference rates are based on secured transactions, usually on the repurchase agreement (repo) market. For example, Sofr is based on the Treasury repo market where Treasuries, debt securities issued by the U.S. government, are used as security (Federal Reserve Bank of New York, 2019). Because of the nature of the transactions, secured reference rates are generally considered to be risk free.

Unsecured reference rates are based on unsecured transactions, usually on the interbank or wholesale markets. For example, Ester is based on unsecured transactions between banks on the interbank market (ECB, 2018). No securities are used as collateral for these transactions, but since the transactions are short term and between financial counterparties unsecured reference rates are considered to be nearly risk free.

Market Liquidity

In a report by Schrimpf and Sushko (2019) it is stated that, historically, the choice of using secured or unsecured transactions as a basis for alternative reference rates has to a large extent depended on the liquidity of the respective underlying markets. For example, the underlying market for Sofr regularly exceeds 800 billion U.S. dollars in daily volume (Federal Reserve Bank of New York, 2019) which is partly why it was deemed to be appropriate as a robust, hard-to-manipulate and transparent reference rate.

For the Swedish financial market it is unlikely that the volumes in government bonds are sufficient to support a secured reference rate. According to Finansinspektionen report “FI-analys 14: Reference rates are changing” (2018) the total value of outstanding government bonds in Sweden amounted to 1,100 million Swedish kronas in the last quarter of 2018. This number can be considered quite small compared to the underlying market of Sofr and Johan Bergström at the Swedish National

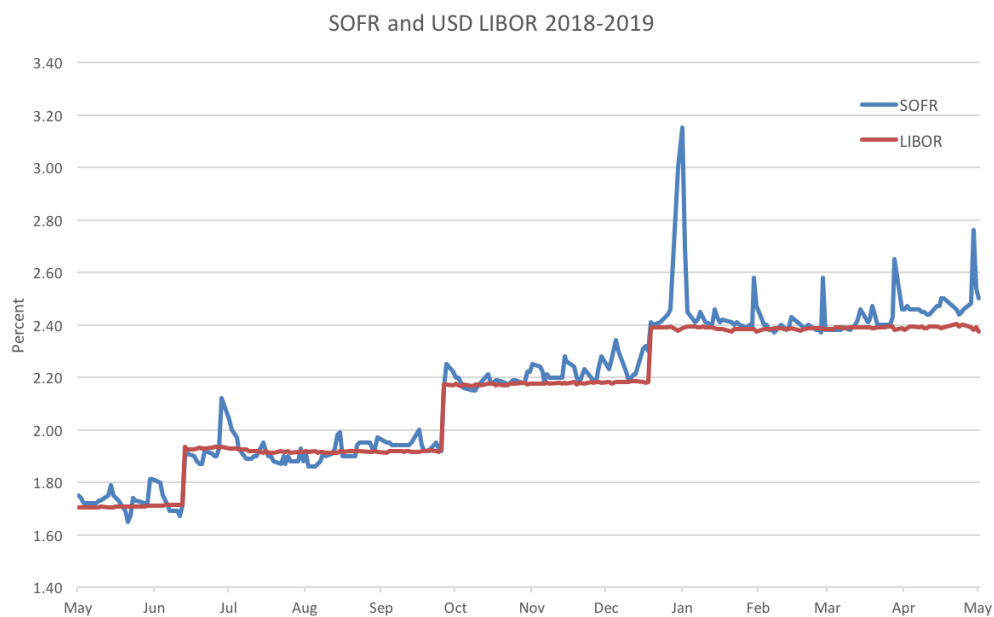
Debt Office stated during an interview that he does not believe the volume is large enough to base a reference rate on. Jonny Sylvén also mentions the lack of volume in the government bond market as an issue for a potential secured reference rate. Instead, he is slightly more optimistic to a solution involving unsecured transactions. According to him, the unsecured overnight market in Sweden has a daily turnover of around 40 billion Swedish kronas which might be enough to support a reference rate.

Volatility in Secured and Unsecured Reference Rates

As discussed in chapter 4.3.1, high volatility in an alternative reference rate is usually unwanted since it causes the value of the contracts underpinned by the rate to fluctuate more. This could in turn unsettle corporations and fund managers who are used to the relatively stable ibor rates and create hesitation, which conflicts with criteria 4. It is therefore important to make sure an alternative reference rate exhibits as little unwanted volatility as possible. However, in certain instances, this has not been the case.

For example, the secured reference rate Sofr has during certain period exhibited higher levels of volatility than USD Libor which it is set to replace. This is illustrated in figure 4.2, where the spikes in Sofr around quarter-ends and year-ends are especially notable. The reason for this behaviour is according to Schrimpf and Sushko (2018) the result of requirements put on banks' balance sheet management around reporting dates due to regulations such as Basel III. For instance, such regulations can put restrictions on the banks' ability to take on more securities during those dates, creating a surplus of Treasuries on the market. This in turn leads to an increase in the repo rates and consequently Sofr. This is also what happened during the most notable spike in Sofr at the end of 2018. A combination of balance sheet regulations and US treasury auctions at the end of the year caused Sofr to soar.

Figure 4.2: Comparison of Sofr and USD Libor



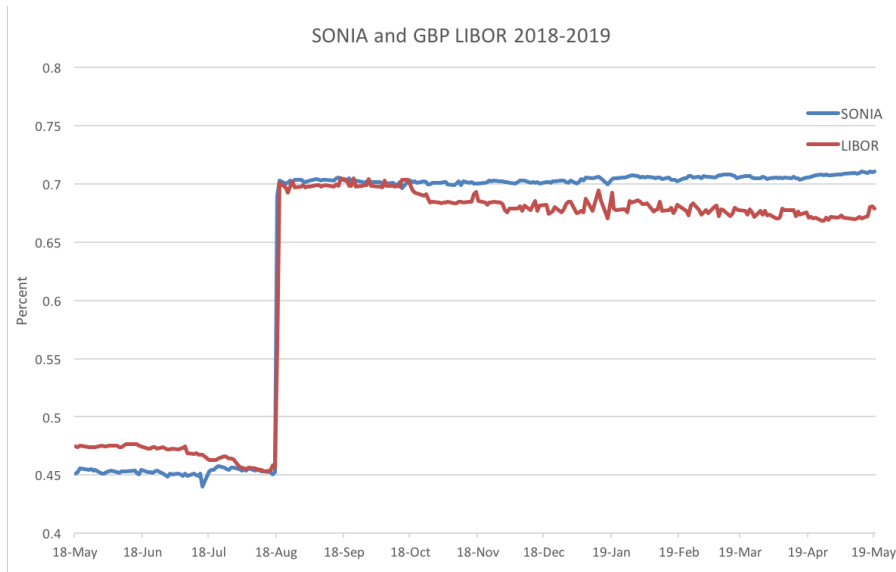
Source: Bloomberg, 2019.

This sort of behaviour has the market wondering whether Sofr will be up to the task of replacing USD Libor (Harris, 2019). For a similar reason Johan Bergström at the Swedish National Debt Office sees a problem with Stibor being replaced with a secured reference rate in Sweden. According to him the price of government bonds in Sweden fluctuates depending on the demand for government bonds on the market and how many government bonds the Swedish National Debt Office issue. A secured reference rate in Sweden could therefore also exhibit spikes during certain periods.

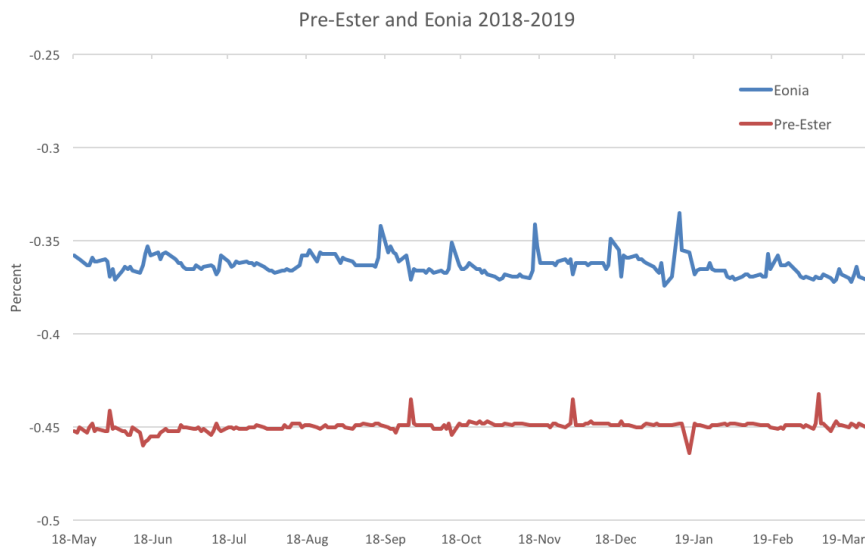
On the other hand, unsecured rates such as Pre-Ester² and Sonia seem to show promise in terms of low volatility. As shown in figure 4.3, these rates seem less volatile than the rates they are sought to replace. In this aspect, an unsecured reference rate could prove more promising than a secured reference rate to replace Stibor in the future.

²Preliminary version of Ester used to evaluate properties and fine-tune the rate before officially publishing it.

Figure 4.3: Comparison of Sonia and Pre-Ester to GBP Libor and Eonia respectively



(a) Sonia and GBP Libor



(b) Pre-Ester and Eonia

Source: Bloomberg, 2019.

4.3.3 Deposit Rate or Lending Rate

Although reference rates such as Stibor, Libor and Euribor are collectively known as ibor rates there are variations in how they are defined. In the following section some aspects of the definition of Stibor are discussed in relation to other ibor rates. The discussion is centered around how design choices of a reference rate affects the fixing and use of the reference rate. Specifically, the effect of defining a Swedish reference rate as a deposit or borrowing rate is explored in greater detail, as well as the choice to hold banks accountable for their ibor rate submissions. The pas-

sage will first outline some differences between Stibor, Libor and Euribor and then proceed with the pros and cons of the different definitions. The discussion seeks to clarify what needs to be considered if one is to use a partly assessment-based reference rate and what implications the definition of such a rate has in different scenarios.

Ibor Rates are Defined in Different Ways

Stibor is defined by the Stibor framework (Swedish Bankers' Associations, 2019) as “a reference rate that shows an average of the interest rates at which a number of banks active on the Swedish money market (‘the Stibor banks’) are willing to lend to one another without collateral at different maturities”. Stibor is thus defined as a deposit rate rather than a lending rate. This means that Stibor banks ask themselves at what interest rate they would be willing to lend to another Stibor bank when reporting their submission. Stibor banks are also under the obligation to trade at their respective submissions up to a certain limit.

Libor on the other hand is defined by the Libor framework (ICE, 2019a) as “a wholesale funding rate anchored in Libor panel banks’ unsecured wholesale transactions to the greatest extent possible, with a waterfall to enable a rate to be published in all market circumstances”. Libor is therefore defined as a lending rate, meaning the Libor banks base their Libor contribution on the interest rate at which they believe they can borrow money from other Libor banks without collateral. Libor banks are not required to trade at their reported Libor submissions.

Euribor is defined by EMMI (2018b) as “the rate at which Euro interbank term deposits are offered by one prime bank to another prime bank within the EMU zone”. This means that Euribor is a deposit rate, where each Euribor bank submits the interest rate they believe a prime bank could deposit money to at another prime bank. The prime bank in question is not an actual bank, but rather a hypothetical prime bank acting in the EMU zone. The submissions are formed by following the Euribor Hybrid Methodology, similar to waterfall methodology of Libor and Stibor. Euribor banks are not obligated to trade at their Euribor submissions.

Market Incentives to Encourage Accurate Submissions

Because the Stibor banks are under the obligation to trade at their reported interest rate, this induces an incentive for them to report accurate rates, since a miscalculation when submitting the rate would negatively affect them. For clarity, an accurate rate is a rate which is in line with what the bank would trade for on the financial market.

Jonny Sylvén at the Swedish Bankers’ Association states that reporting inaccurate rates is undesirable for the banks. A miscalculation in a Stibor submission, he says, could result in a noticeable loss for the Stibor bank. He also thinks there is some pride among the banks to submit a correct rate, since an incorrectly reported rate could be seen as a sign of negligence among the other banks. Having Stibor defined as a deposit rate with an obligation to trade at the submitted rates is therefore a market oriented solution to create stronger incentives for banks to report accurate rates.

For instance, if Bank A reports a low Stibor submission, other Stibor banks would

exploit this by borrowing from Bank A at that submitted rate. In this case, a low Stibor submission would be a rate which is lower than what is available to Bank A on the rest of the market. Bank A would have to finance these loans by sourcing money from elsewhere. Because the rate at which Bank A lent the money was lower than necessary, financing these loans could prove expensive and result in a net loss for the bank. By the same token, if Bank A was to report too high a Stibor submission, this could also have negative implications since the obligation to trade runs both ways. Another bank could in this case exploit this by depositing money at Bank A to Bank A's higher-than-market submitted rate.

In the case of Libor, the situation is different. In this case, the banks report the rate at which they think they could be offered a loan, without any obligation to trade at the submitted rates. This creates a weaker incentive for the banks to report an accurate rate, since the consequences of reporting an inaccurate rate are less severe. Jonny Sylvén also sees this as an issue, emphasizing that there are no direct market consequences for Libor banks to report inaccurate rates.

For example, if Bank A was to report a Libor rate, it is compelled to follow the Libor framework and its waterfall methodology to avoid the risk of litigation. However, there is no direct loss they can suffer from reporting a miscalculated or otherwise inaccurate rate. One could therefore imagine that a Libor bank, in contrast to a Stibor bank, could be more inclined to report an inaccurate rate.

Another issue is that, since Libor is defined as a lending rate, one could imagine that a bank reporting Libor could need more information to create a submission than a Stibor bank would. The reason for this is that if Bank A is to report Libor, it has to consider at what rate other banks would be willing to lend money to Bank A. Therefore, Bank A has to not only be aware of its own finances, but also have information about other banks' financial situation, as well as these banks' perception of Bank A. If Bank A does not have this information, this could force Bank A to make more assumptions when forming its Libor submission. Banks can also be hesitant to reveal their own financing cost, making it potentially difficult to get them to report truthful rates, as submitting lower than fair values could reduce their financing costs and falsely improve the market's view of the bank's credit rating (Finch and Vaughan, 2017).

For Euribor, which is defined as the deposit rate between two prime banks, there are similar issues as with Libor. Since the scenario where one prime bank deposits money at another prime bank is hypothetical, there might be more room for the use of expert judgments. Jonny Sylvén also argues that this is a problem, reasoning that the scenario with two prime banks is entirely hypothetical, and not sufficiently connected to what the banks themselves would trade for. Furthermore, since Euribor banks are not accountable for their submission, the same reasoning as with Libor concerning a lack of market incentives can be applied here. Euribor is currently undergoing a change in methodology to remedy some of these issues and a second stakeholder consultation was recently published on a hybrid methodology (EMMI, 2018c).

In Times of Crisis

Following the reasoning in the previous section, it seems as if Stibor and the way it is defined could in theory be more effective in getting banks to report accurate rates. However, there are disadvantages with this definition that also need to be considered, such as what happens if a Stibor bank faces financial problems.

If a Stibor bank was to face insolvency issues, the process of fixing Stibor would become more difficult. Since Stibor is the rate a Stibor bank would be willing to deposit money for at any other Stibor bank, there is no way to discriminate between the different banks in the fixing process. Thus, a bank cannot offer one rate for the bank in crisis and another rate for the others. In this scenario, the authors argue that banks could be inclined to adjust their Stibor submissions to compensate for the credit rating of the bank in crisis, which means Stibor as a whole could increase in a disproportionate manner. Since Stibor is supposed to reflect the risk of the banking sector as a whole, a disproportionate increase in Stibor due to one credit-stressed bank would signal to the market that the risk in all banks had increased, when in actuality only one bank is affected. Stibor could therefore be less representative of the risk in the financial sector as a whole, and more representative of the weakest bank at any given time. This is in conflict with criteria 5.

On the other hand, if a Stibor bank was to face serious financial problems, the risk in the banking sector as a whole would potentially increase. In the 2018 Article “Interconnectedness in the Swedish financial system”, the Riksbank report that the four largest banks in Sweden³ are tightly linked, meaning a problem in one bank could easily spread to another. It could thus be argued that a large increase in Stibor could be warranted even if only one bank was suffering from problems, since the Swedish banks are so closely interconnected.

Another consequence of a Stibor bank facing financial problems could be that banks would find it difficult to report reliable Stibor submissions. This is due to the fact that a Stibor bank in crisis would lead to increased risk in the banking sector, most likely leading to an increase in market volatility. This increased volatility could make it harder for the banks to know what a reasonable deposit rate would be on the interbank market. To show that increased volatility could lead to uncertainty in the pricing of contracts one can take part of the BIS report “Fixed income market liquidity” of 2016. In the case study of a “flash rally”, where the market experienced an unusually high level of volatility, it was observed that Bank-dealers widened their bid-ask spreads. This was according to the report done in order to contain their risk exposure, since the price of the asset was no longer certain. Similarly, an increase of volatility in the interbank market of Sweden could make it more difficult for banks to determine an accurate interest rate for a loan on the market.

In a worst case scenario, the banks would be so unsure of what interest rate to submit that they would be hesitant to even report a Stibor submission. This is an issue, because if Stibor would not be able to be published, its robustness as a reference rate could be up for question. This would be in conflict with criteria 3. In a speech from 2018, William C. Dudley, President and CEO of FED New York,

³Handelsbanken, Nordea, SEB and Swedbank.

points to the importance of robust reference rates, since they lower transaction costs and increase market liquidity. To maintain market liquidity, it is therefore important for the market that a reference rate can be reported in any situation. Furthermore, if Stibor is not reported, the value of many financial contracts would be uncertain, which could have negative consequences for the financial stability (FI, 2018a).

A lending rate, as in the case of Libor, or a hypothetical rate as in the case of Euribor might not have the same problems. For Libor, each bank reports what rate they would be able to borrow money for regardless of from whom it is borrowing, since there is no credit risk taken by the borrower. Furthermore, since the banks are not obligated to trade at their submitted rates, they do not have to worry about the bank in crisis wanting to borrow at their submitted rate. In Euribor, the situation is similar. Since the question is at what interest rate one prime bank could deposit money at another prime bank, a bank in crisis would most likely not affect the fixing of Euribor disproportionately.

4.3.4 The Need for Term Rates

The central banks of the US, the UK, the EU, Switzerland and Japan have all decided that an overnight rate is the best alternative reference rate in their respective currencies. If an overnight rate is to be considered as the main reference rate in Sweden as well, a discussion around the need for term rates is inevitable. As described in Market Terminology, term rates are rates with a longer maturity such as 1-week, 3-months etc. Term rates can be forward- and backward-looking. When using forward-looking term rates, the coupon for the next period is known at the beginning of the period. When using backward-looking term rates the coupon is known only at maturity.

Term Rates Mostly Useful for Loans and Bonds

The Sterling Group of Risk-Free Rates write that the need for term rates is most prevailing in loan and bond markets due to operational issues (BoE, 2018). The FED's Alternative Reference Rates Committee (ARRC) shares that view and write that participants in cash markets might find the use of an overnight rate unfamiliar (ARRC, 2018). ARRC goes on to say that while some larger corporations with more sophisticated financial infrastructure could adapt to an overnight rate, other participants could struggle with the adjustment.

The Sterling Group of Risk-Free Rates sees very little demand for term rates in the derivatives market, as does ARRC which says that many derivative market participants are already familiar with referencing an overnight rate rather than a term rate. This means that while more sophisticated market participants might settle with just using an overnight rate, in order to fulfil criteria 4 term rates are desirable mostly due to demand in loan and bond markets.

Forward-looking Rates Provide More Overview for Corporations

A major advantage with forward-looking term rates over backward-looking ones are that the coupons are known at the beginning of each period. This enables planning and provides a financial overview of the near future for the user. For the less experienced user, not knowing what interest rate you are going to pay or receive

can be unsettling.

Swedish Financial Market is Centered Around Stibor 3m, But That is Not a Rule of Nature

Stibor 3m is the current standard in the Swedish IRS and bond market. For example, at least 98.5% of all floating corporate bonds issued in SEK which were listed in Bloomberg's database as of April 2019 referenced Stibor 3m. As for the swap market, most trades are done OTC and therefore no public data is available on the exact amount of outstanding swaps that reference the 3-month rate. However, Klas Granlund at FI confirms the 3-month tenor as the industry standard and its use in a majority of swaps, FRN's and corporate loans on the Swedish market.

The extensive use of the 3-month tenor could come to complicate a potential switch to an overnight reference rate. Several of the people⁴ interviewed mentioned this as one of the issues that must be addressed when assessing Sweden's reference rate options. Jonny Sylvén at the Swedish Bankers' Association argues that the concentration around the 3-month tenor is not a rule of nature and that it could come to change if Stibor would be replaced with an overnight rate. He asks, if all rates were to become overnight rates, what would be the point of swapping them to 3-month rates? Sure, the 3-month IRS market is partially driven by all the FRN's that reference 3-month Stibor, but why is it that the FRN's reference a 3-month rate and not an overnight rate? He suggests that alternatives such as backward-looking term rates could be one solution to facilitate the transition if straight-out using the overnight rate is out of the question. However, it might not be a suitable alternative for less sophisticated market participants as they may not be comfortable not knowing what the next coupon will be ahead of time.

4.3.5 How to Create Term Rates From an Overnight Rate

If term rates are deemed necessary, a discussion must be held regarding how such rates can be created from an overnight rate and what the conditions on the Swedish market are.

Backward-looking Rates

Backward-looking rates are fairly straight forward and can easily be created from an overnight rate. When using a backward-looking rate, the payer of the rate is paying the overnight rate, only in less frequent installments. The rate can be calculated as the compound of the daily overnight rates, or as an average. Below, using the fictional rates in table 4.4, is an illustration of two different ways to calculate backward-looking term rates: averaging and compounding.

⁴Linus Laurin (Danske Bank), Johan Bergström (Swedish National Debt Office) and Jonny Sylvén (Swedish Bankers' Association).

Table 4.4: Fictional rates used in the numerical example

Day	Overnight Rate
1	1.10%
2	1.20%
3	1.20%
4	1.30%
5	1.30%

Simple averaging means taking the arithmetic average of each day’s fixing and using that as the rate. This is described by ISDA as “calculation of floating amount when compounding is not specified”. The formula used is given by

$$FA = CA \times FR \times FRDCC$$

where FA is the Floating Amount, CA is the Calculation Amount, FR is the Floating Rate and FRDCC is the Floating Rate Day Count Convention (ISDA, 2009). The Calculation Amount is also referred to as principal or nominal amount in this paper.

In the example above, the Floating Amount, assuming day count convention of actual/360 (as is the case with Stina swaps), would be:

$$\text{Principal} \times \frac{1.10\% + 1.20\% + 1.20\% + 1.30\% + 1.30\%}{5} \times \frac{5}{360} = 0.0169\% \times \text{Principal}$$

This corresponds to an annual rate of $0.0169\% \times \frac{360}{5} = 1.22\%$, which is the average of the daily fixings in the period. This shows that the sum of daily interest payments at the overnight rate is the same as the term rate payment when using the arithmetic averaging method.

Compounding can be more complicated and done in different ways, depending on the preferred method of calculation and whether a spread is added to the floating overnight rate. For the sake of simplicity, only ISDA’s Compounding method assuming the spread is zero will be described. This formula is given by

$$FA = N \times \left[\prod_{t=1}^T \left(1 + (R_t + S) \times d_t - 1 \right) \right]$$

where FA is the Floating Amount, N is the Notional amount, R_t is the floating rate for period t , S is the spread (assumed to be zero) and d_t is the day count fraction for period t . (ISDA, 2009)

Compounding rates can be interpreted as paying interest not only on the principal amount but also on the accumulated interest rate which is yet to be paid. Assuming the overnight rate is positive, the compounding method should therefore yield a higher result than the averaging method. In this case the 5-day rate would be

calculated as

$$\frac{1}{360} \times \left((1+1.10\%) \times (1+1.20\%) \times (1+1.20\%) \times (1+1.30\%) \times (1+1.30\%) - 1 \right) = 0.0174\%$$

of the principal, or $0.0174\% \times \frac{360}{5} = 1.25\%$ annually.

As one can see in the examples of how backward-looking rates can be created, a market for term rates or official fixings of term rates is not necessary for this to be implemented. All that is needed is the daily overnight fixings and an agreed-upon method of calculating the term rates.

For reference, the current convention for Stina swaps and Sterling OIS's is to compound the tomorrow/next and the overnight rates respectively (Nasdaq, 2013; BoE, 2018), while the first Sofr-linked Floating Rate Notes issued used a simple averaging method to calculate the term rate (Bloomberg, 2018). This goes to show that both methods can be relevant and useful.

Forward-looking Rates

Forward-looking rates are more complex to derive from an overnight rate, due to the presence of an *expectation* of future rate levels. Expectations are subjective and finding one equation for the whole market to calculate forward-looking term rates will not be possible. Instead, supply and demand should determine what the fair forward-looking rate is. One way of doing this is through derivatives markets, more specifically swap markets.

As described in chapter 3.5.2, an interest rate swap is a financial contract where a floating rate is exchanged for a fixed rate. In order for the initial value of the contract to be zero, the fixed rate should equal the expectation of the floating rate, so that the expected profit for both parties is zero. One method of creating a forward-looking rate from an overnight rate is to derive it from an overnight indexed swap (OIS) market, that is a swap market where the floating leg is the backward-looking term rate of the overnight rate. The receiver of the floating leg receives the compounded or averaged overnight rates covering the duration of the swap, and the receiver of the fixed rate receives the expectation of the floating rate as it was on the day the contract was created. If a well-functioning OIS market for the overnight reference rate can be established, the fixed rate in the swaps can function as a forward-looking rate for the underlying overnight rate.

Creating a Forward-looking Term Rate Structure Could Be a Lengthy Process

As described previously, backward-looking term rates are straightforwardly derived from an overnight rate and are fairly easy to implement once the preferred method of calculation is established. Forward-looking term rates on the other hand require a well-functioning, liquid swap market for the reference rate, something that can take years to achieve, if it is even possible at all.

To get an idea of what the process of developing forward-looking term rate might look like, one could look to the US and the UK to see what progress has been

achieved there. ARRC describe in their Paced Transition Plan (see Appendix C) how they intend to create a forward-looking term rate for Sofr using swap markets. In it they detail the different steps, starting in the second half of 2018, which will lead to the creation of forward-looking Sofr term rates by the end of 2021. In line with the plan, trading in Sofr futures began in 2018, and is growing rapidly. The head of CFTC⁵ spoke in April of 2019 about the success the launch of Sofr futures has been, averaging more than 100,000 contracts⁶ in daily volume 2019. His view is that trading in Sofr swap markets will demonstrate a similar development in the coming year, laying the groundwork for a smooth transition for the entire market to Sofr (Mondovisione, 2019).

The UK seems to be even further along in establishing a liquid derivatives market for their alternative reference rate, Sonia. Edwin Schooling Latter, director of markets and wholesale policy at the UK's FCA, said in a speech he gave in January 2019 that trading in sterling swaps has increased dramatically over the last two years and that, on a monthly basis, cleared notional in Sonia swaps has surpassed that of GBP Libor swaps (Basar, 2019).

Whether derivatives trading in a future Swedish reference rate would be large enough to derive a forward-looking rate from is difficult, if not impossible, to predict. Since there is no alternative reference rate available today to observe in the market, looking at interest rate derivatives in Stibor is the only indicator of what the market could come to look like. As of 2015, Stina derivatives had a daily traded volume of three billion Swedish kronas, and interest rates swaps traded for 28 billion Swedish kronas daily (Riksbanken, 2016). As can be seen, only a small share of interest rate derivatives trading in Swedish kronas is in short Stina derivatives, the majority is in longer durations as interest rate swaps. While this can be seen as an indicator of a lack of interest in shorter-dated interest derivatives, one could also imagine that part of the traded volume in interest rate swaps would spill over to shorter-dated derivatives if, for example, an overnight reference rate would be introduced in Sweden.

4.3.6 Cross-currency Basis Risks

If a Swedish reference rate differs from other currencies' reference rates in its construction or risk profile, a phenomenon called cross-currency basis risk can occur. Cross-currency basis risk is mainly an issue for traders or investors who deal with cross-currency basis swaps and similar derivatives, but could have implications for a larger part of the Swedish financial market.

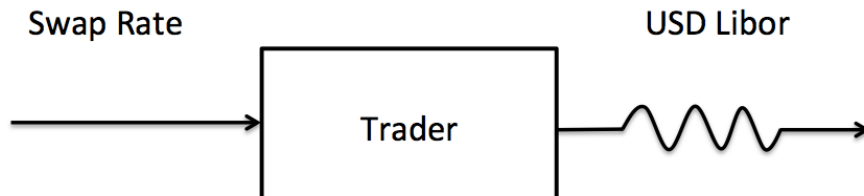
As described in chapter 3.5.2, cross-currency swaps are swaps where a floating rate in one currency (CCY1) is exchanged for a floating rate in another currency (CCY2). If the floating rate for CCY1 behaves differently than the floating rate for CCY2, something called basis risk will occur for the holder of the swap. Basis risk is the

⁵U.S. Commodity Futures Trading Commission, an independent U.S. government agency that regulates futures and option markets.

⁶Contracts vary in size. ICE's 3 month Sofr future has a unit of trading of 4 million U.S. dollars while their 1 month contract has a unit of trading of 12 million U.S. dollars (ICE, 2019b; ICE, 2019c).

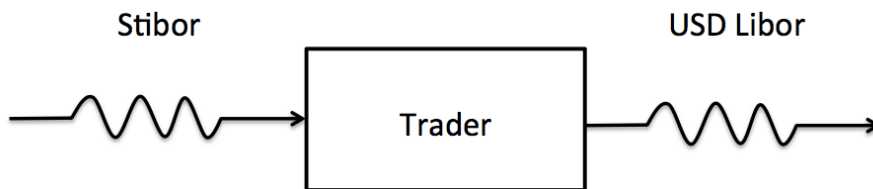
risk that an asset and the security a trader has chosen to hedge said asset with does not correlate in a manner which constitutes a perfect hedge. In the case of the cross-currency basis swap it is easier to understand why the holder has a basis risk if we first look at a situation where the trader only has interest rate exposure in one currency, in the form of an interest rate swap, to see what the difference in risk profile is. This is illustrated in figure 4.4.

Figure 4.4: Exposure from interest rate swap (Fixed - Floating)



As a payer of the floating rate and receiver of a fixed rate, the trader holds an apparent interest rate risk; if USD Libor appreciates, the trader will have to pay more money but will receive the same amount regardless. So the trader makes money if USD Libor drops and loses money if USD Libor goes up. There could be other risks involved for the trader, depending on what his portfolio looks like, but for this argument we need not address them. Now let's look at a trader who holds a cross-currency basis swap instead. This is illustrated in figure 4.5.

Figure 4.5: Exposure from cross-currency basis swap



In this situation the trader is still paying USD Libor, but is receiving Stibor which is also a floating rate. The risk the trader now holds (excluding FX risks) is not that USD Libor will appreciate on its own, but rather that Stibor and USD Libor will deviate from one another. Worst case scenario is if Stibor were to depreciate and USD Libor were to appreciate at the same time. If both rates move simultaneously and equally with one another, the trader is perfectly hedged in regards to interest rates. But, most likely, to some degree the rates will move differently and that risk is called cross-currency basis risk.

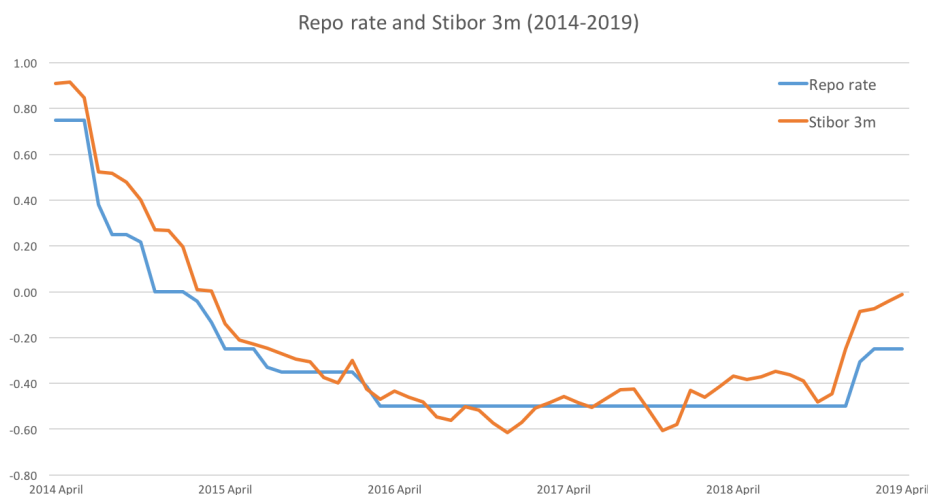
Reducing cross-currency basis risk is an argument for promoting a Swedish reference rate that is similar to other currencies' reference rate, especially major currencies and currencies which trade a lot against the Swedish krona. This is also argued by FI in their 2014 report, and Johan Bergström, funding manager with the Swedish National Debt Office, says that it is imperative that a Swedish reference rate be similar to other major reference rates. Besides the obvious inconvenience for derivative traders and investors, one could imagine that a lot of cross-currency basis risk due to a Swedish reference rate that differs substantially from other reference rates in the world could impact foreign investors willingness to buy and hold Swedish assets, and

would conflict with criteria 4. That in turn affects the liquidity on Swedish FX and rates markets, as well as the Swedish economy as a whole.

4.3.7 Consequences for the Transmission Mechanism

According to the Riksbank (2014) Stibor plays an important role for their monetary policy. The reason for this is that Stibor is the medium through which changes in the repo rate are transmitted to prices and rates on the market. For example, when the Riksbank lower the repo rate with the intention to stimulate the economy, the banks are able to finance themselves to a lower cost than before. Since Stibor reflects the cost for banks to finance themselves on the Swedish market, this means Stibor also decreases, leading to dropped rates on the market as a whole as described in chapter 3.8. In figure 4.6 one can see how much the repo rate affects the level of Stibor by how closely the rates follow each other.

Figure 4.6: Repo rate and Stibor 3m from April 2014 to April 2019



Source: Riksbanken, 2019.

In a scenario where Stibor is replaced by a new alternative reference rate, it is not yet clear how the transmission mechanism would be affected. According to Johannes Forss Sandahl at the Riksbank this is a question which is still being investigated. He says that an alternative reference rate with an overnight tenor should react immediately to changes in the repo rate as the Riksbank implements its monetary policy partly by steering the overnight interest rate in the interbank market. It is yet to be established how a move towards a new reference rate would affect the transmission of short-term rates into longer term rates. However, he says that regardless of which reference rate the Swedish markets will use in the future, monetary policy expectations will be reflected in the pricing of assets and financial contracts in the market. This means that, if a new reference rate was introduced, changes in the repo rate, or expectations thereof, would still be transmitted to the market in a similar manner as today.

Jonny Sylvén, at the Swedish Bankers' Association shares this view. He states that he believes that removing Stibor removes a “filter” in the transmission mechanism, meaning changes in monetary policy could reach the market quicker than with Stibor. He argues that because Stibor submissions are partly based on expert judgments, changes in the repo rate might not be directly transmitted to market. Stibor is therefore an extra step in the process, which could delay the effects of a change in the repo rate.

Internationally, no consensus has been reached regarding how central banks should account for the new reference rates in their monetary policy operations. In the BIS report “Beyond Libor: a primer on the new benchmark rates” (2019) the implications for monetary policy operations are discussed, but no definitive conclusions are reached. The report, however, states that the subject warrants further analysis, something which Forss Sandahl of the Riksbank also agrees with. The fact that the Riksbank merely acts as an observer in AGAR, mostly contributing with data and calculations and not with their own opinions, might also point to the fact that the Riksbank does not have any strong opinions on the matter yet. The Riksbank does, however, show interest in the work of developing a new reference rate since it has delivered a reply to AGAR’s first public consultation. The issue could be of more interest going forward as the effects of alternative reference rates on the transmission mechanism becomes clearer.

5

Discussion

Libor, and subsequently Stibor, were created to facilitate large syndicated loans from banks to corporations. The idea was to transfer part of the risk associated with financing costs from the banks to the loan takers. Since the 1980's, when Stibor first was introduced, its role has changed substantially and it has come to be an intricate part of financial markets far beyond corporate lending. It has grown to have such importance to financial stability that the European Commission considers it one of few critical benchmark rates in Europe.

It should be said that Stibor overall has been a well-functioning reference rate which deservedly has faced little scrutiny compared to Libor. Jonny Sylvén of the Swedish Bankers' Association holds it as an example of a well-functioning ibor rate, FI does not raise any existence-threatening criticism in their latest report from 2018, the Riksbank show in their 2014 report that Stibor has indeed followed the underlying market closely and experts from both Nordea and SEB report non-existent or very slim interest or concern from clients regarding Stibor. However, the authors believe a thorough review of Stibor is motivated due to three reasons: the change in its use cases, its importance in the Swedish economy and the international movement away from ibor rates.

Part of the difficulty surrounding reference rates and Stibor's possible replacement is that no one can stipulate which rate will be used as the industry standard benchmark rate. There is no bank, no financial institution and no government body which holds any authority to force a rate onto the market. It is solely up to the market to decide which rate to use. Therefore, the reference rate which arguably provides the best long-term conditions for a well-functioning market should come to prevail. The authors have through research and interviews sought to identify these desirable conditions, and compressed them to the five criteria for a sound reference rate. With them in mind, a few conclusions are drawn as to what kind of reference rate the Swedish market could come to prefer, and why.

One common, standard reference rate for all Swedish markets allows for great liquidity and smooth processes in creating, trading and hedging financial contracts. Given how many areas of finance benchmark rates are used in, there are reasons to question why the major reference rate should contain an element of credit risk in the bank sector, as is the case with Stibor. The authors argue that in order for the reference

rate to be relevant to a larger part of the financial markets, the derivatives market in particular, the desired effect should be for the reference rate to reflect increases and decreases in risk premia for the market as a whole, rather than specifically for the banking sector. Another reason to stray away from the banking sector specific element in the reference rate is to avoid clashing with other currencies' reference rates. Having a reference rate with a higher degree of credit risk could prove damaging in a risk-off scenario, where the Swedish reference rate could worsen a potential crisis by deterring foreign investors due to its different nature compared to other currencies' rates. The implications of not following other countries' examples, most importantly for major currencies like USD, GBP and EUR, is also discussed in section 4.3.6, Cross-currency Basis Risk, and is a major argument for replacing Stibor with a rate which bears less credit risk.

Another significant argument for replacing Stibor is related to transparency and robustness. As discussed in section 4.1.2, while the majority of Stibor's framework is available to the public, crucial policies such as what rules apply when one or more banks are in crisis are kept under strict confidentiality. This means there is no way for the general public to assess the true robustness of Stibor, and the authors would argue that while this has not yet come to raise questions from market participants or other groups in Sweden, it could potentially be a cause for concern in more stressful times. It can also be argued that the rate which is referenced in more than 60,000 billion Swedish kronas worth of contracts should be more transparent in its calculation process than Stibor is, for democratic and information symmetry reasons. Finally, as discussed in section 4.1.1, the fact that the rate referenced in almost all publicly listed corporate bonds with floating rates in SEK is based on a market with zero transactions in 90% of business days is in the authors' view a major concern and not sustainable in the long haul. One can only assume that the lack of liquidity means that other means of deciding the Stibor banks' submissions, such as expert assessments, must be used. In reality, due to lack of transparency it is not possible to know exactly how the banks compute their submissions each day. While the fact that Stibor historically has been an accurate reflection of the underlying market is comforting and honorable for the involved parties in Stibor, there is no guarantee that this will always be the case. The authors feel that when it comes to what could be the most important number in Sweden - Stibor 3m - relying on trust and assurances is not enough; absolute transparency and waterproof systems are a must.

This boils down to the authors' opinion that an overnight rate, similar to Sofr and Sonia should at least be considered as a potential future Swedish reference rate.

The authors envision a mostly transaction-based rate with a waterfall method in place to ensure robustness in times of sparse liquidity. Ideally, the calculation and potential expert assessments should be conducted by an impartial party, such as the Riksbank. While this might seem unlikely given that the Riksbank only forms part of AGAR as an observer and has no direct role in setting the course for the future of Swedish reference rates as it is today, the Riksbank has replied to the first consultation sent out by AGAR and express informed opinions on the matter. Also, one need not look further than to the EU to find a similar solution. The ECB is

responsible for collecting data, calculating and publishing Ester, indicating that this could be a viable option for Sweden as well.

Furthermore, the authors do not see sufficient activity in the secured overnight market to sustain a reference rate with secured transactions, a view shared by many experts in the field. While using unsecured transactions for the reference rate might mean a small credit risk component is added, the benefit of having a more liquid market on which to base the rate should by far outweigh the potential benefits of having a rate that is closer to risk-free.

Succeeding in establishing a swap market that is liquid enough to produce a robust forward-looking term rate is not a certainty. While this would be desirable and surely an addition many corporate clients would appreciate, the base case should be that it will not be available. Instead, market participants might have to make do with backward-looking term rates. While this could come to drag out the transition to a new rate, the authors believe that the market could adapt to this over time. It is also feasible that banks would offer clients who are not comfortable with backward-looking rates swaps so that they could exchange their next floating coupon for a fixed swap rate instead. This means the forward-looking rate used would not be a daily, public fixing but simply the rate at which the banks would be willing to enter into the swaps with each counterparty.

It should also be addressed that Stibor is indeed a critical benchmark rate and will not disappear overnight. If the major market participants were to agree that Stibor is to be replaced by an overnight rate similar to the one suggested by the authors or something else, the market would by law be given at least two years to adapt to the new conditions before Stibor ceases to exist. One could imagine that during a transition period, two reference rates could be used parallelly in Sweden and that those who wish to swap their Stibor position to the new rate could do so during a window of opportunity. In the long term, however, having two or more different reference rates in Sweden is in the authors' view not a viable option due to lack of liquidity and basis risk which could occur between the two rates.

Even though the weak areas of Stibor as it stands today do not constitute very acute problems or create trust issues, the authors would like to emphasise that there is upside to acting sooner rather than later if a change of reference rate were to take place. Some of the hassle of adapting to a new rate could be eased if the transition takes place simultaneously or in close proximity to a similar change in other major markets. This is a point that FI also allude to in their 2014 report, stating that the process of switching reference rates can be shortened if it were to happen in connection with similar changes abroad.

6

Conclusion

The main problem of Stibor today is a lack of liquidity in the underlying interbank market. Further issues include a lack of transparency in the Stibor process and framework as well as a low number of banks in the Stibor panel. The definition of Stibor as a deposit rate could also be an issue in a scenario where a Stibor bank faces financial problems.

A suitable reference rate in Sweden needs to, at a minimum, satisfy BMR. Furthermore, it must be transparent, robust, well-adapted to the market as well as accurately reflect the risk it is intended to.

When changing or replacing Stibor one needs to consider whether a reference rate in Sweden should be assessment-based or transaction-based. If it is transaction-based, one must consider whether it should be a secured or unsecured rate. Furthermore, one must also consider whether there is a need for term rates and, if so, how such rates could be constructed. If instead the rate is assessment-based, one should consider whether it should be defined as a deposit or borrowing rate. Further considerations include how much cross-currency basis risk the reference rate would cause, as well as how an alternative reference rate would affect the transmission mechanism.

A suitable solution for a future reference rate in Sweden is, in the authors' opinion, an unsecured overnight rate which to a large degree is transaction-based. It should be administered by the Riksbank or another governmental authority, and the aim should be for the change of reference rate to take place as soon as possible, to coincide with reference rate changes in other currencies.

7

References

- ARRC, 2018. The Second Report [pdf]. Available at: <<https://www.newyorkfed.org/medialibrary/Microsites/arrc/files/2018/ARRC-Second-report>> [Accessed 9 May 2019].
- Asgharian, H. and Nordén, L., 2007. *Räntebärande instrument - Värdering och riskhantering*. Lund: Studentlitteratur.
- Baba, N., Packer, F. and Nagano, T., 2008. The spillover of money market turbulence to FX swap and cross-currency swap markets. *BIS Quarterly Review*, March 2008, pp. 73-86.
- Bailey, A., 2017. The future of LIBOR. 27 July 2017, Bloomberg London, UK. Available at: <<https://www.fca.org.uk/news/speeches/the-future-of-libor>> [Accessed 4 May 2019].
- Basar, S., 2019. Sonia Derivatives Rise in Volume. *Markets Media* [online] 28 January. Available at: <<https://www.marketsmedia.com/sonia-derivatives-rise-in-volume/>> [Accessed 10 May 2019].
- BIS, 2000. International Banking and Financial Market Developments. *BIS Quarterly Review*, February 2000. pp.27-32.
- BIS, 2016. Fixed income market liquidity. [pdf] *CDFS Papers No 55*, 21 January 2016, p.11.
- Bloomberg, 2018. *SOFR's growing use means it's when, not if, it replaces Libor* [online] Available at: <<https://www.bloomberg.com/professional/blog/sofrs-growing-use-means-not-replaces-libor/>> [Accessed 9 May 2019].
- BoE, 2018. *Consultation on Term SONIA Reference Rates* [online] Available at: <<https://www.bankofengland.co.uk/-/media/boe/files/markets/benchmarks/consultation-on-term-sonia-reference-rates>> [Accessed 9 May 2019].
- BoE, 2019. *Further Details About SONIA Data* [online] Available at: <<https://www.bankofengland.co.uk/statistics/details/further-details-about-wholesale-interbank-sterling->

market-data> [Accessed 15 May 2019].

Brennan, J. 2016. Fitch says Danske Bank’s Irish mistake will not be repeated. *The Irish times*, [online], 23 August 2016. Available at: <<https://www.irishtimes.com/business/financial-services/fitch-says-danske-bank-s-irish-mistake-will-not-be-repeated-1.2765668>> [Accessed 4 May 2019].

Commision Regulation (EU) 2018/1557 of 17 October 2018 amending Implementing Regulation (EU) 2016/1368 establishing a list of critical benchmarks used in financial markets pursuant to Regulation (EU) 2016/1011 of the European Parliament and of the Council.

Cutler, D. and Ridley, K., 2013. Timeline: How the Libor scandal unfolded. *Reuters*, [online], 6 February. Available at: <<https://www.reuters.com/article/us-libor-rbs-scandal/timeline-how-the-libor-scandal-unfolded-idUSBRE9150TB20130206>> [Accessed 2 May 2019].

Dudley, W., 2018. The Transition to a Robust Reference Rate Regime. 24 May 2018, Bank of England’s Markets Forum 2018, London, England. Available at: <<https://www.newyorkfed.org/newsevents/speeches/2018/dud180524>> [Accessed 5 May 2019].

ECB, 2018. *The euro short-term rate (€STR) methodology and policies* [online] Available at: <https://www.ecb.europa.eu/paym/initiatives/interest_rate_benchmarks/shared/pdf/ecb.ESTER_methodology_and_policies.en.pdf> [Accessed 9 May 2019].

ECB, 2019. *Euro short-term rate (€STR)* [online] Available at: <https://www.ecb.europa.eu/paym/initiatives/interest_rate_benchmarks/shared/pdf/ecb.ESTER_methodology_and_policies.en.pdf> [Accessed 9 May 2019].

Edwards, R. and Holland, J., 2013. *What is qualitative interviewing?* London: Bloomsbury.

Einrich, D., 2017. Libor: A Eulogy for the World’s Most Important Number – Update. *Fox Business* [online] Available at: <<https://www.foxbusiness.com/features/libor-eulogy-for-the-worlds-most-important-number-update>> [Accessed 9 May 2019].

EMMI, 2018a. *Euribor: Panel banks*. [online] Available at: <<https://www.emmi-benchmarks.eu/euribor-org/panel-banks.html>> [Accessed 4 May 2019].

EMMI, 2018b. *Euribor: About Euribor*. [online] Available at: <<https://www.emmi-benchmarks.eu/euribor-org/about-euribor.html>> [Accessed 5 May 2019].

EMMI, 2018c. Second Stakeholder Consultation On Hybrid Methodology For Euribor. Press release, 17 October 2018. Available at: <<https://www.emmi-benchmarks.eu/assets/files/D0385A-2018%20-%20Publication%20Second%20Consultation%20Hybrid%20Euribor-2.pdf>> [Accessed 6 May 2019].

ESMA, 2019. *Benchmark administrators*. [online] Available at: <https://registers.esma.europa.eu/publication/searchRegister?core=esma_registers_bench_entities> [Accessed 2 May 2019].

European Parliament and of the Council, Regulation 2016/1011 of 8 June 2016 on indices used as benchmarks in financial instruments and financial contracts or to measure the performance of investment funds and amending Directives 2008/48/EC and 2014/17/EU and Regulation (EU) No 596/2014.

Federal Reserve Bank of New York, 2019. *Secured Overnight Financing Rate Data*. [online] Available at: <<https://apps.newyorkfed.org/markets/autorates/sofr>> [Accessed 4 May 2019].

FI, 2018a. *FI-analys 14: Referensräntor i förändring* [pdf] Finansinspektionen. Available at: <<https://www.fi.se/contentassets/0f2f5ae87e6e4f0b8c2af671b3d84420/fi-analys-14-referensrantor-2018-11-28.pdf>> [Accessed 30 April 2019].

FI, 2018b. *Benchmarks (BMR) - Summary of the rules*. [online] (2018-06-15), Available at: <<https://www.fi.se/en/markets/benchmarks-bmr/summary-of-the-regulations/>> [Accessed 2 May 2019].

Finch, G. and Vaughan, L., 2016. The Man Who Invented the World's Most Important Number. *Bloomberg* [online] Available at: <<https://www.bloomberg.com/news/features/2016-11-29/the-man-who-invented-libor-iw3fpmcd>> [Accessed 9 May 2019].

Finch, G. and Vaughan, L., 2017. Libor scandal: the man who fixed the world's most important number. *The Guardian* [online] Available at: <https://www.theguardian.com/business/2017/jan/18/libor-scandal-the-bankers-who-fixed-the-worlds-most-important-number?fbclid=IwAR0VoraOcu5Kv_Zylefk-UtHy-fDymbiw52tIkK55_VH8q1-Bv3LPTpr-jA> [Accessed 9 May 2019].

Forsberg, B. 2012. *Fritt fall, Spelet om Swedbank*. Stockholm: Ekerlids.

FSB, 2014. Reforming Major Interest Rate Benchmarks. [pdf] Basel: Financial Stability Board. Available at: <http://www.fsb.org/wp-content/uploads/r_140722.pdf> [Accessed 2 May 2019].

Harris, A. 2019. Libor's Heir Hindered by Repo Volatility in Battle of Benchmarks. *Bloomberg*, [online] 17 January 2019. Available at: <<https://www.bloomberg.com/news/articles/2019-01-17/libor-s-heir-hindered-by-repo-volatility-in-battle-of-benchmarks?fbclid=IwAR3s5HUTu48rDDaZ2d3PLAK4VUG9tGc1TQVCbUXoydYjvYy6ngzMJAqseEY>> [Accessed 4 May, 2019].

Hopkins, E., Lindé, J. and Söderström U., 2009. Den penningpolitiska transmissionsmekanismen. *Penning- och valutapolitik 2:2009*, 30 June 2009, pp. 31-50.

Hydén, M., 2018. Sanningen om Stibor. [PowerPoint presentation] *Nordea Markets*. Available at: <<https://e-markets.nordea.com/api/research/attachment/69171>> [Ac-

cessed 2 May 2019].

Hassel L., Norman, M. and Andersson, C., 2001. *De finansiella marknaderna i ett internationellt perspektiv*. Stockholm: SNS Förlag.

ICE, 2018a. *ICE Benchmark Administration to Publish Test Data for the Evolution of ICE Libor*. [press release] 13 March 2018. Available at: <<https://ir.theice.com/press/press-releases/all-categories/2018/03-13-2018-150112718>> [Accessed 9 May 2019].

ICE, 2018b. Reduced Submissions Policy [online] Available at: <https://www.theice.com/publicdocs/ICE_LIBOR_Reduced_Submissions_Policy.pdf> [Accessed 9 May 2019].

ICE, 2019a. *Libor*. [online] Available at: <<https://www.theice.com/iba/libor>> [Accessed 4 May 2019].

ICE, 2019b. *ICE Futures Europe Three Month SOFR Index Future* [online] Available at: <<https://www.theice.com/products/70005442>> [Accessed 10 May 2019].

ICE, 2019c. *ICE Futures Europe One Month SOFR Index Future* [online] Available at: <<https://www.theice.com/products/70005423>> [Accessed 10 May 2019].

IOSCO, 2013. *Principles for Financial Benchmarks Final Report*. [pdf] Madrid: International Organization of Securities Commissions. Available at: <<https://www.iosco.org/library/pubdocs/pdf/IOSCOPD415.pdf>> [Accessed 2 May 2019].

ISDA, 2009. *Alternative compounding methods for over-the-counter derivative transactions* [online] Available at: <<https://www.isda.org/a/2KiDE/isda-compounding-memo.pdf>> [Accessed 9 May 2019].

Lagerwall, B., 2011. Presentation - Penningpolitik med inflationsmål. [PowerPoint presentation] Stockholm: Sveriges Riksbank.

ISDA, 2018. *The \$370 Trillion Benchmark Challenge*. [online] Available at: <<https://www.isda.org/2018/02/05/the-370-trillion-benchmark-challenge/>> [Accessed 9 May 2019].

Jones, H. and Ridley, K., 2012. Insight: a Greek banker, the Shah and the birth of Libor. *Reuters*, [online] 8 August. Available at: <<https://www.reuters.com/article/us-banking-libor-change/insight-a-greek-banker-the-shah-and-the-birth-of-libor-idUSBRE87702320120808>> [Accessed 9 May 2019].

Liebi, M., 2018. EU Benchmarks Regulation and Market Impact as of 1 January 2018. *PWC*, [online] Available at: <<https://www.pwc.ch/en/insights/regulation/eu-benchmarks-regulation-and-market-impact-as-of-1-january-2018.html>> [Accessed 2 May 2019].

Mondovisione, 2019. *CFTC Chairman Gives Remark at FSB Meeting on Li-*

bor Reform. [online] Available at: <<http://www.mondovisione.com/media-and-resources/new-s/cftc-chairman-gives-remarks-at-fsb-meeting-on-libor-reform/>> [Accessed 10 May 2019].

Nasdaq, 2013. Regelverk för Nasdaq OMX Derivatives Market. [online] Available at: <http://www.nasdaqomx.com/digitalAssets/84/84043_kap_4_ii_130208_final.pdf> [Accessed 9 May 2019].

Nasdaq, 2019. Monthly Report - Total Equity Trading December 2018. *Nasdaq*, [Excel spreadsheet] Available at: <<https://newsclient.omxgroup.com/cdsPublic/viewDisclosure.action?disclosureId=871107lang=en>> [Accessed 9 May 2019].

Riksbanken, 2012. *The Riksbanks review of Stibor*. [pdf] Stockholm: Sveriges Riksbank. Available at: <http://archive.riksbank.se/Documents/Rapporter/Riksbanksstudie/2012/rap_riksbanksstudie_stibor_121128_eng.pdf> [Accessed 30 April 2019].

Riksbanken, 2014. *Stibor revisited – a follow-up*. [pdf] Stockholm: Sveriges Riksbank. Available at: <http://archive.riksbank.se/Documents/Rapporter/Riksbanksstudie/2014/rap_riksbanksstudie_stibor_140526_eng.pdf> [Accessed 30 April 2019].

Riksbanken, 2016. *Den svenska finansmarknaden* [online] Available at: <https://www.riksbank.se/globalassets/media/rapporter/den-svenska-finansmarknaden/svenska/2016/rap_finansm_160831_sve.pdf> [Accessed 10 May 2019].

Riksbanken, 2018a. *What is monetary policy?* [online] Available at: <<https://www.riksbank.se/en-gb/monetary-policy/what-is-monetary-policy/>> [Accessed 2 May 2019].

Riksbanken, 2018b. Interconnectedness in the Swedish financial system. [pdf] *Financial Stability 2018:1*, 23 May 2018, pp. 39-42. Available at: <https://www.riksbank.se/globalassets/media/rapporter/fsr/engelska/2018/fsr-180523/interconnectedness-in-the-swedish-financial-system-article-in-the-financial-stability-report-2018_1.pdf> [Accessed 5 May 2019].

Riksbanken, 2019. *Stibor 3m and the repo rate, 2014-2019*. [online] Riksbanken. Available through: Sveriges Riksbank - Search interest exchange rates <<https://www.riksbank.se/en-gb/statistics/search-interest-exchange-rates/>> [Accessed 5 May 2019].

Schrimpf, A. and Sushko, V., 2018. Beyond LIBOR: a primer on the new benchmark rates [pdf] *BIS Quarterly Review*, March 2019, pp. 29-52.

Selander, J., 1987. SE-Banken tar upp miljardlån. *Svenska Dagbladet Näringsliv*, 2 October 1987, p. 2.

Skandinaviska Enskilda Banken, 1987. *Skandinaviska Enskilda Bankens företagslån 1 oktober 1987/1994 7 december på högst 1.000.000.000 kronor*, [ad] Svenska Dagbladet.

Swedish Bankers' Association, 2012. *Bankförening huvudman för Stibor under*

första kvartalet 2013. [Press release] 6 December 2012. Swedish Bankers' Association. Available at: <<https://www.swedishbankers.se/om-oss/aktuellt/aktuellt-fraan-bankfoereningen/bankfoereningen-huvudman-foer-stibor-under-foersta-kvartalet-2013/>> [Accessed 2 May 2019].

Swedish Bankers' Associations, 2018a. *Arbetsgruppen för alternativa räntor - Meddelanden*. [Press release] 4 December 2018. Available at: <<https://www.swedishbankers.se/fraagor-vi-arbetar-med/arbetsgruppen-foer-alternativa-raentor/meddelanden/>> [Accessed 30 April 2019].

Swedish Bankers' Association, 2018b. *Framework for Stibor - proposed changes*. [pdf] Swedish Bankers' Association. Available at: <<https://www.swedishbankers.se/media/3978/framework-for-stibor-proposals-for-revision-2018.pdf>> [Accessed 2 May 2019].

Swedish Bankers' Association, 2018c. *Stibor framework Part 1*. [pdf] Swedish Bankers' Association. Available at: <https://www.swedishbankers.se/media/4023/ramverk-foer-stibor-del-1-en-v-4_0-den-14-december-2018.pdf> [Accessed 2 May 2019].

Swedish Bankers' Association, 2018d. *Stibor framework Parts 2 and 3*. [pdf] Swedish Bankers' Association. Available at: <https://www.swedishbankers.se/media/3755/ramverket-del-2-och-3-en-5_0-febr-2018.pdf> [Accessed 2 May 2019].

Swedish Bankers' Associations, 2019. *About Stibor*. [online] Available at: <<https://www.swedishbankers.se/en-us/the-swedish-bankers-association-in-english/stibor/about-stibor/>> [Accessed 30 April 2019].

Wheatley, M., 2012. *The Wheatley Review of Libor: final report*. [pdf] London: HM Treasury. Available at: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/191762/wheatley_review_libor_finalreport_280912.pdf> [Accessed 2 May 2019].

The World Bank, 2019. *GDP (current US\$)*. [online] Available at: <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?locations=USname_desc=true> [Accessed 9 May 2019].

Appendix A

Example of Interview Guide

Q: According to you, what are the main problems of Stibor today?

A:

Q: What risk should a reference rate in Sweden capture?

A:

Q: How important is it that Stibor captures the financing costs of banks in Sweden?

A:

Q: What are the largest challenges in switching from Stibor to a new reference rate?

A:

Q: What parties will primarily be affected by a switch of reference rates?

A:

Q: Is it possible to use different reference rates depending on the type of financial contract? For example, a risk free reference rate for derivatives and something like Stibor for loans?

A:

Q: How important is Stibor for the financial stability in Sweden?

A:

Q: What criteria does a reference rate in Sweden need to fulfil?

A:

Q: Should Stibor be replaced to keep up with the international movement towards alternative reference rates?

A:

Q: Is there a need for forward looking term rates?

A:

Q: In a situation where a Stibor bank is facing liquidity issues, how should the other Stibor banks account for this in their Stibor submissions?

A:

Q: What markets do you think could be liquid enough to base a reference rate on?

A:

Q: For a transaction-based reference rate, what except for liquidity is important to make it resilient against manipulation?

A:

Q: Is the money market in Sweden liquid enough to base a transaction-based reference rate on?

A:

Appendix B

Libor Banks and the Currency They Report

Table 7.1: Libor Panel Composition per Currency.

Bank/CCY	USD	GBP	EUR	CHF	JPY
Bank of America N.A (London Branch)	X				
Barclays Bank plc	X	X	X	X	X
BNP Paribas SA (London Branch)		X			
Citibank N.A (London Branch)	X	X	X	X	
Cooperatieve Rabobank U.A.	X	X	X		
Crédit Agricole Corporate & Investment Bank	X	X			
Credit Suisse AG (London Branch)	X		X	X	
Deutsche Bank AG (London Branch)	X	X	X	X	X
HSBC Bank plc	X	X	X	X	X
JPMorgan Chase Bank, N.A. (London Branch)	X	X	X	X	X
Lloyds Bank plc	X	X	X	X	X
Mizuho Bank, Ltd.		X	X		X
MUFG Bank, Ltd	X	X	X	X	X
National Westminster Bank plc	X	X	X	X	X
Royal Bank of Canada	X	X	X		
Santander UK Plc		X	X		

Bank/CCY	USD	GBP	EUR	CHF	JPY
Société Générale (London Branch)		X	X	X	X
Sumitomo Mitsui Banking Corporation Europe Limited	X				X
The Norinchukin Bank	X				X
UBS AG	X	X	X	X	X

Source: ICE, 2019a.

Appendix C

The ARRC's Paced Transition Plan

Figure 7.1: The ARRC Paced Transition Plan

Step	Anticipated Date of Completion
1. Infrastructure for futures and/or OIS trading in SOFR is put in place by ARRC members.	2018 H2
2. Trading begins in futures and/or bilateral, uncleared, OIS that reference SOFR.	End 2018
3. Trading begins in cleared OIS that reference SOFR in the current (EFFR) PAI environment.	2019 Q1
4. CCPs begin accepting new or modified swap contracts (swaps paying floating legs benchmarked to EFFR, LIBOR, or SOFR) that pay SOFR as PAI and are discounted with a SOFR curve. In this stage, market participants are allowed a choice at the time of execution of each trade between clearing contracts that calculate PAI and discounting using either EFFR or SOFR, with both types of contracts cleared within the same clearing guarantee fund. CCPs would gradually lengthen the maturity of contracts accepted for clearing in the new SOFR PAI/discounting environment to ensure that liquidity was adequate to support the new discount curve.	2020 Q1
5. CCPs no longer accept new swap contracts for clearing with EFFR as PAI and discounting except for the purpose of closing out or reducing outstanding risk in legacy contracts that use EFFR as PAI and discount rate. Existing contracts using EFFR as PAI and discount rate and new contracts using SOFR as PAI and discount rate continue to exist in the same pool. Existing contracts roll off over time as they mature or are closed out. Methods for accelerating this close out, and the potential to pre-announce the closure of the CCPs' EFFR-based PAI and discount rate capability, may play a part.	2021 Q2
6. Creation of a term reference rate based on SOFR derivatives	End 2021

Source: ARRC, 2018.