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Risk Management

# Managing Intraday Liquidity

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Christian Buschmann Frankfurt School of Finance & Management
Holger Westermann Commerzbank

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# 1. Introduction

According to Jurgilas and Žikeš (2012), almost every central bank regime distinct between overnight liquidity and intraday liquidity in their monetary policy frameworks. This distinction can be either done explicitly, in terms of interest rates charged, or implicitly, through different eligibility criteria for collateral.

However, it is striking that only a functioning market for overnight liquidity exists. Since a developed market for intraday liquidity in which market participants actively allocate their intraday liquidity needs does not exist and the theoretical and empirical literature, e.g. Bech and Garrat (2003) or Manning et al. (2009), suggests that banks have incentives to delay the settlement of non-contractual payment obligations, banks need to have a sophisticated intraday liquidity management system to be liquid within a business day and to avoid consequences of arbitrary behaviour of other institutions. Therefore, in this article we provide an overview how commercial banks can manage their intraday liquidity.

The remainder of this article is structured as follows: in Section 2, we give an overview onto the global set-up banks need to manage their intraday liquidity properly. In Section 3, we discuss the interaction of Basel III's liquidity ratios and a bank's intraday liquidity. In Section 4, we describe the determinants of intraday liquidity and, in Section 5, how costly intraday liquidity can be. Section 6 provides an overview on how banks can report and steer their intraday liquidity. Finally, Section 7 concludes this paper and derives policy recommendations.

# 2 Global Set-up for Intraday Liquidity Management

To understand the mechanics of intraday liquidity management properly, we first need to distinct between end-of -day liquidity management and intraday liquidity. While end-of-day liquidity management can be characterised by allocating excess liquidity or null liquidity between the bank's treasury hubs and respective time zones, intraday liquidity management is concerned with the management of means within a certain time zone. As shown in Figure 1 below, managing a European bank's end-of-day liquidity starts at the bank's Asian treasury hubs Tokyo and Singapore. From these locations, excess liquidity or null liquidity will be transferred to Europe and, from there, to the American treasury hub to end the business day there. At the beginning of the new business day, this process will be re-started. In Asia, liquidity will be concentrated in Euro, US-Dollar, Pound Sterling and Swiss Franc by squaring liquidity in Asian currencies by the usage of FX swaps[2] and transferring the remaining liquidity balance via money market transaction[3] to Europe. This process of squaring local currencies and transferring liquidity in form of major currencies is alike in other treasury hubs. In this sense, every treasury hub can be interpreted a single ledger[4].

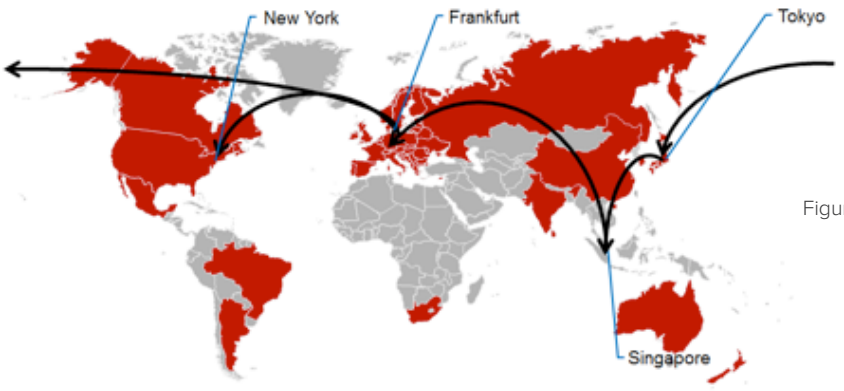


Figure 1: End of Day Liquidity Management

[1] Since a developed market for intraday liquidity does not exist, some market participants have agreed up on bilateral liquidity facilities. Within these agreements, one party has the right to draw intraday liquidity up to a pre-defined amount wihtin a business stay. For this facility, the facility provider receives an annual fee.

Later that day in Europe, the bank's group treasury department clears the European currencies and transfers them at the end of the European business day via money market transaction to the treasury hub in the Americas. Within its mandate, the treasury in the Americas clears American currencies and squares the excess liquidity or null liquidity in the US-market. Since the end of the American business is congruent with the bank' global business day, the bank is completely squared in all currencies after the business hours in the United States.

Like end-of-day liquidity, intraday liquidity act within in the above mentioned time zones. However, business hours vary between these different time zones: Continuous Linked Settlement (CLS) payments, for example, are concentrated in the European time zone where most of the time critical payments occur. The CLS clearing system is broadly used to mitigate settlement risk[5] for FX settlement transactions. To achieve this, it is necessary that all payments are executed globally at the same time, no matter the local time of day.

For the Asian time zone, payments are performed at the end of the business so that these payments and those clearing a relatively riskless since most of the core business are settled within in the business day – see Figure 2. This risklessness stems from the fact that time-critical payments are performed at the end of the business day and most settlement transactions were already executed.

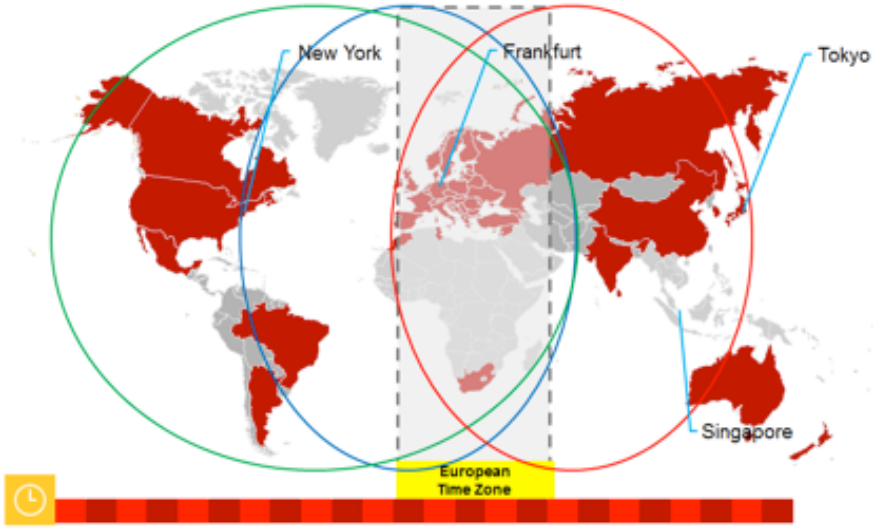


Figure 2: End-of-Day Liquidity Management

What Figure 2 implicitly reports is that the main intraday events are concentrated in the European time zone. At the end of a global business day, the bank is squared in its liquidity position: Excess liquidity could either be allocated to other market participants or to the central bank accounts in each of the bank's treasury hub. Vice versa, a liquidity deficit can be neutralised by borrowing money from other market participants.

In the Asian time zone intraday flows out of the CLS System are processed towards the end of the business day were banks have more certainty about their intraday flows and liquidity position. Therefore, these payments are less critical from a liquidity steering perspective than CLS payments in the European or American time zone.

[2] The acronym "FX" is an abbreviation for "Foreign Exchange". A FX swap is a combination of FX spot transaction and simultaneously agreed reciprocal FX forward transaction. One of the involved parties buys US-Dollar against Euro in a spot transaction and sells the bought amount of US-Dollar in forward transaction at once.

[3] A money market transaction is simple liquidity providing transaction in which liquidity is allocated between units with a liquidity surplus and units with a liquidity deficit.

[4] A ledger is an accounting area which summaries all bank accounts in each treasury hub.

[5] Settlement risk, also known as the Herstatt risk, is the risk a one counterparty of bi-lateral transaction does not meet its obligation while the other counterparty already fulfilled its contractual commitment to the first counterparty.

In Europe, banks' intraday activities and time-relevant payments[6] are focused in the first half of a business day within the European Clearing time (07:00 a.m. – 12:00 p.m.). These activities are accompanied with the highest degree of uncertainty regard the bank's needs of intraday liquidity.

In the American time zone, there are only minor counter flows so that time-based payments are settled through the bank's intraday credit line at the U.S. Federal Reserve System (FED). In contrast to central bank facilities in other time zones, the FED provides, in addition to secured intraday liquidity facility, an unsecured intraday liquidity facility which has a time-dependent charge.[7]

# Liquidity Ratios and Intraday Liquidity

## 3.1 Intraday Liquidity and Liquidity Regulation

In the wake of the global financial crisis, liquidity management became one of the greatest attention-getters for practitioners, academics, and, of course, regulators. Albeit Basel III's liquidity ratios cover a time from overnight to one month, liquidity coverage ratio (LCR) and from one month to a year, net stable funding ratio (NSFR), it is quite surprising that intraday liquidity and intraday liquidity risk management was not in that very spotlight.

According to Buschmann and Heidorn (2014) the LCR is a simple linear ratio that promotes bank's short-term resilience to liquidity shocks and, by setting a limit for it, ensures that a sufficient amount of HQLA is maintained by a bank to offset cash outflow in a stressed environment. The net stable funding ratio (NSFR) is an addition to the liquidity coverage ratio and yields at the long-term funding of banks. Simply speaking, the NSFR reflects "The Golden Banking Rule" by postulating that long-term assets should be backed by long-term liabilities to reduce roll-over risks. Therefore, the NSFR is that banking rule put in one single ratio. While both liquidity measures a are created to ensure long-term resilience of bank liquidity risk profiles, they feature, apparently, no connection to banks' intraday liquidity.

While intraday liquidity was disregarded by the regulators for a long time, this changed with the publication of the policy paper of the Basel Committee of Banking Supervision (BCBS)'s policy paper on monitoring tools for intraday liquidity risk management in 2013. Also, regulatory bodies in the euro area, in the UK and in Switzerland started efforts on monitoring and reporting intraday liquidity risk. Albeit this regulatory developments, intraday liquidity was already recognised by banks before as a relevant steering variable prior the financial crisis and the publications of the BCBS policy paper. The costs of steering intraday liquidity and the risk of steering it, make intraday liquidity relevant for clearing houses and all bank-involved in clearing transactions.

[6] Time-relevant payments are needed to be executed at a certain point in time. If the bank fails to execute the payment when it is due, the bank needs to do penalty payments or will suffer a loss in reputation.

[7] An example how this unsecured intraday facility works can be found in the appendix.

[8] While the LCR and the NSFR are global liquidity regulation, there are also national ones which have to be taken into account when managing intraday liquidity. The German Liquiditätsverordnung (LiqV) requires banks to maintain certain commitments to ensure liquidity at all times. In addition, Germany's Mindestanforderungen an das Risikomangement – MaRisk requires bank to withstand a liquidity stress within a survival period of 30 days. According to MaRisk, banks should consider BCBS documents in their risk assessment. Local liquidity provision will be discontinued as soon as Basel's LCR has to be fulfilled by 100%.

## 3.2 Internal Models

To determine banks' liquidity and liquidity risk, products' legal maturities will be replenished with a going-concern market case (base case for most banks) and a stress case. The difference of the liquidity needs of both scenarios determines the volume of the liquid asset buffer – the bank's stress counterbalancing capacity.

Since modelled cash flow assumptions may largely differ from actual cash flows during a business day, cash outflows can be bigger than expected in a bank's models. The difference between expected and actual cash flow is called "model-risk"[9]. To quantify and, as consequence of this, to assess this model risk in a proper way, it is crucial for each and every banking organisation, to put intraday liquidity risk under intense scrutiny. The reason for this is simple: While models are, by definition, a simplification or approximation of reality, they do not fully account to client's turnovers within a business day. Here, the challenge is to model customer's behaviour properly in between because at the end of each business day, a bank's liquidity position is relatively stable and congruent to the model-based cash-flow assumptions. While these models grab the bank's liquidity position at the end of the business day, intraday liquidity management tries to match intraday liquidity needs when they arise.

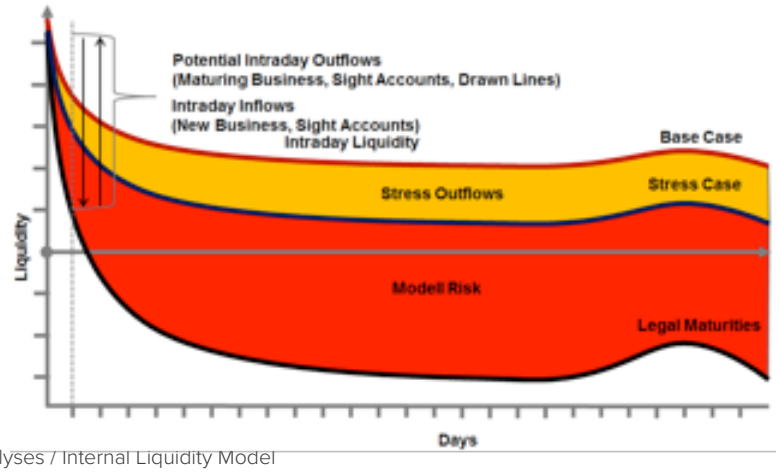


Figure 3: Liquidity Gap Analyses / Internal Liquidity Model

## 3.3 Minimum Reserve and Liquidity Management

The European Central Bank (ECB) requires banks located in the European Monetary Union (EMU) to hold deposits on accounts with their national central bank. These are called Minimum Reserve Requirements (MRR). The amount of the reserve is fraction of the total customer deposits and issued short-term notes, held at the respective bank and is a measure to protect customer deposits. Albeit, central bank reserve requirements are still in place and are likely to remain so, this liquidity provision is de facto replacement by Basel's liquidity ratios.

However, the held minimum reserve got a tremendous practical advantage: It serves de facto as an end-of-day and intraday liquidity buffer: The minimum reserve allows the bank to cover unexpected end-of-day fluctuation. Hence, held minimum reserves are smoothing the intraday liquidity steering efforts for banks itself and therefore cause stabilization of the money market in the EMU. The ability of a bank to counteract unexpected cash outflows interacts with the account balance, so-called basis capacity, of the minimum reserve: The higher the account balance is the larger are the banks capacities to encounter act unexpected fluctuations. Lastly, since liquidity is effectively bound for a specific purpose, held minimum reserves are lowering the inflows in LCR-ratio. As the deposit basis for the minimum reserve calculation is already reflected in LCR runoff factors, there is a double counting. This has minor impacts as long the reserve rates stays at 1% of the deposit base but could cause problems when the reserve amount should be increased to ensure smother liquidity management.

[9] In addition to our definition of model risk, the common literature, e.g. Hull (2012), distinguishes between the two types of model risk: first, that a model reflects a wrong prices at a time a product is bought or sold and second, a model reflect the wrong "greeks" and therefore banks hedge their risk inefficiently.

# 4 Intraday Liquidity Drivers

The main drivers of bank intraday liquidity are commercial payments and payments from market making and trading activities. These payments can be largely divided into TARGET 2-payments and payments within the EBA clearing system.[10] TARGET 2-payments are subdivided into three different types of payment and consist of payments which are highly urgent and timed, such as payments for security clearing or pay-in SEPA transactions. Payments with a certain priority, so-called urgent payments, such as bank-to-bank payment, e.g. money markets, and foreign exchange transactions, are not cleared by CLS. Lastly, all other payments via TARGET 2 are summarized as "normal" value date payments. Payments under the EBA-clearing framework are sub-divided into four different types of payments: Payments for "EURO1", a net system guaranteed by a collateral pool, STEP 1-payments which have to be prefunded, SEPA clearing payments – here, the settlement result will be paid as high urgent payment – and in-house payments / bank-internal settlements with no intraday liquidity impact.

Managing these different types of commercial payments properly, a bank's treasury department can substantially mitigate the banks' intraday liquidity risk but can also mitigate other risks which emerge from other banking operations, namely operational risks and credit risk / settlement risks. As Figure 3 below show, banks need to manage the triangle of intraday liquidity risk, operational risk and credit / settlement risk. Here, the challenge is to keep this triangle in balance since reducing one of the named risk types cause an immediate increase of one of the other risks.

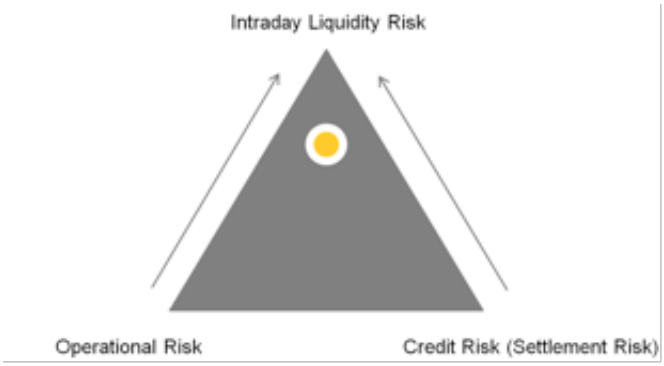


Figure 3: Intraday liquidity and other risks mitigation

Figure 3 essentially shows that reducing operational risks by executing early payments or reducing settlement risk can only be achieved by taking willingly higher intraday liquidity risks. The same is true vice versa. Therefore, managing intraday liquidity risk is balancing several kinds of risk at the same time.

To achieve this balance over a business day, banks schedule their payments in accordance to their urgencies. Hence, TARGET 2-payments (high urgent and urgent) will be executed at first, while the execution of other payments, such like the ones under the FBE-framework, are postponed to a future point in time of the same business day.

[10] EBA CLEARING is a bank-owned provider of pan-European payment infrastructure solutions. The company was established in June 1998 by 52 major European and international banks with the mission to own and operate EURO1, the only privately owned real time gross settlement (RTGS)-equivalent, large-value payment system on a multilateral net basis.

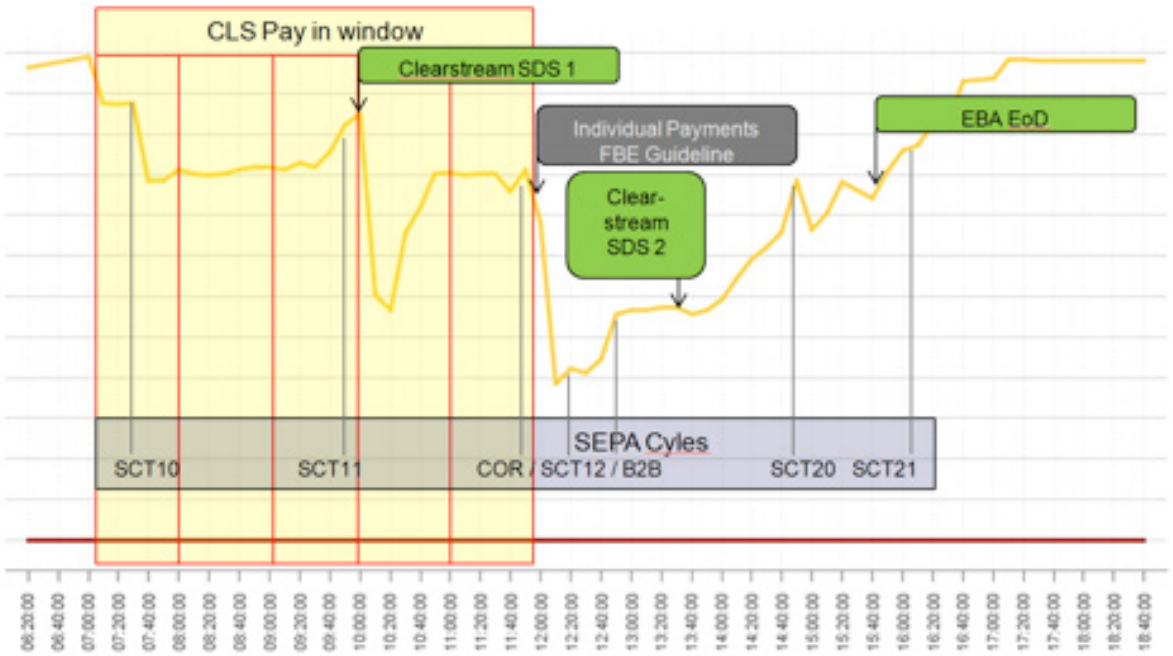


Figure 4: Intraday liquidity curve and its major drivers

Between 08:00 a.m. and 12:00 p.m. CET, the payment window of CLS is open. During this time, payments within the 5 CLS payment cycles take place. What can be clearly seen from Figure 4 above is that amount of available liquidity (yellow line) is exposed to fluctuations during the business day. Payments are executed in so-called cycles, meaning that firstly an accumulation and netting of up-coming payments takes place. In a second step, this net accumulation will be executed. After each payment cycle, the bank's available liquidity will drop considerably. These SEPA cycles are performed during the whole business day and even after the closing of the CLS pay window. Nevertheless, the major SEPA activities are concentrated together with major securities settlements in the early morning hours of the European business day. Hence, the rest of the business day is driven by individual payments, being made in line with the FBE guidelines on liquidity management. The amount intraday liquidity will be augmented to reach the necessary level at the end of the bank's business day.

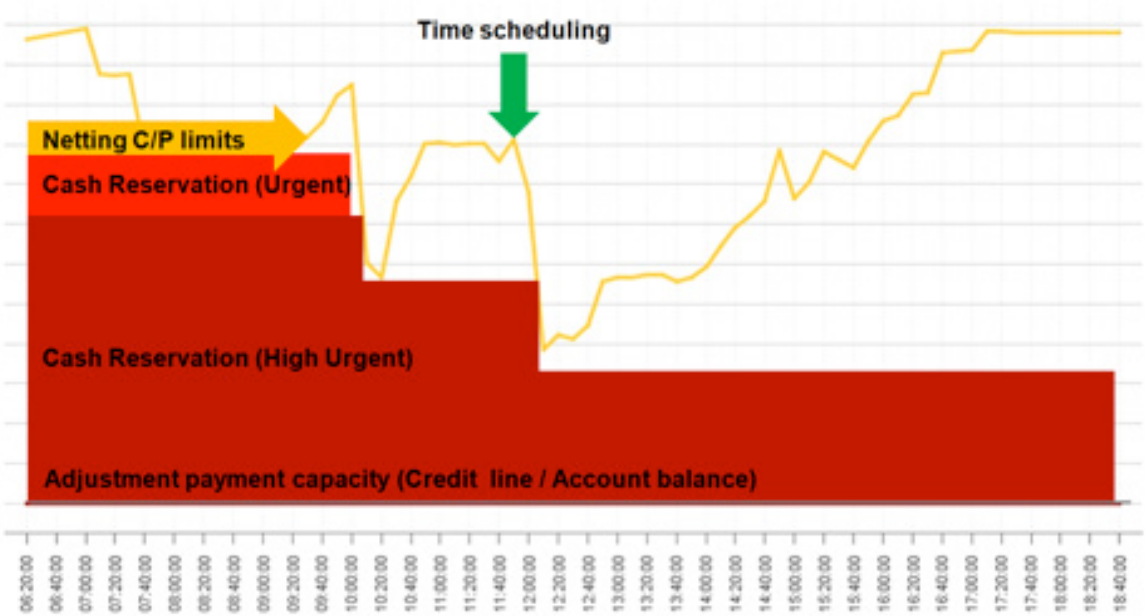


Figure 5: Intraday Liquidity Curve and Steering Measures

Eventually, banks steer their intraday liquidity by rationing payments. While Figure 4 largely illustrates the time schedule of daily payments, Figure 5 provides information from which sources the liquidity for these payments is taken from. In principle, a bank's treasury department manage these payment operations by dedicating liquidity to certain type of payments. Also, a certain payments to counterparties will be postponed until the respective counterparty made their payment to the bank itself. Effectively, this procedure can be seen as a limit for cash settlement and is highlighted as "Netting C/P limits" in Figure 5 above. The residual of the scheduled payments are made by "dedicated cash holdings". For instance, the bank's treasury department dedicates a certain amount of available liquidity to highly urgent payments and another one to urgent payments. This reservation of means varies from day to day and is derived from the operations of the previous business days. Lastly, other, non-timely urgent payments are managed throughout the business day by using account balances and credit lines. This approach can also be accompanied by a pre-defined time schedule: Some banks are setting internal time limits until which payments have to be due. To ensure an unobstructed liquidity management these deadlines are normally set around 12:00 p.m. according to the FBE guidelines.

# 5. Intraday Liquidity Costs

Managing intraday liquidity properly does not come at a cheap. Indeed, managing this special type of liquidity is linked to some costs. These costs depend, of course, on the bank's business model and treasury strategy: In the first place, the bank needs to define for how long the payment capacity should be maintained to protect the business model. Should it be a year or a week? In the next step, the bank needs to define, through measurement and stress testing, its required payment capacity. With regard to assets, the bank also needs to define in which types of assets, e.g. cash, bonds, repurchase agreements, etc. or asset classes, central bank eligible, HQLA-securities[11] defined by Basel III, risk-weighted assets (RWA) as collateral will be hold. Lastly, intraday liquidity costs depend on the chosen funding strategy. Hence, the funding sources and the funding profile of the collateral define the gross funding cost, while the net funding costs are derived by the difference between the income of the assets used as collateral and funding structure of this collateral.

Regarding the asset strategy for the payment portfolio, the risk-weighted assets strongly influence the decision about credit risk within the payment portfolio; In any case, charges on risk-weighted assets have to be taken into account when budgeting intraday liquidity. In this process, the implied costs of Basel's liquidity regulation (LCR, NSFR) need to be also to be taken in account.

To give an impression on the formation of liquidity costs, we want to provide the following, simplified, example: When it comes to central bank liquidity, the ECB directly determines the costs of liquidity provision by setting the interest rate for the liquidity and indirectly by setting haircuts for pledged securities: To back received central bank liquidity with the appropriate amount of collateral, one should be aware that the collateral value, CVi, is equal the asset's market value, MVi, reduced by the asset's haircut, HCi. Since the haircut depends on the credit tenor risk and the liquidity of the asset, the collateral value originates by:

(1) $CV_i = MW_i * (1 - HC_i)$

The market value of the asset is simple function of the asset's notional amount Ni and its market price Pi:

(2) $MV_i = P_i * N_i$

Albeit only the collateral value is necessary to collateralize the required central bank liquidity, CBL, because CVi = CBL, the market value together the haircut determines the extent of the liquidity costs: The lower the credit quality of the underlying asset, the higher the haircut is and therefore, the higher the notional amount has to be. Ceteris paribus, the lower the market price of the asset, the higher the notional amount has to be.
However, what can be seen from the formulas above is that the costs of central bank liquidity arise not only from financing the haircuts but also from the credit quality of the asset. In addition to several haircut regimes employed by various central banks around the globe, the credit risk of the issuer of the asset plays a crucial role in determining the costs of the payment portfolio. Figure 6 shows the interaction between asset classes and their relative funding towards the interbank rate / EURIBOR which serves as a funding benchmark: The funding spread is function of credit quality and maturity.

[11] Under Basel III's liquidity regulation, banks have to maintain an adequate stock of unencumbered high-quality liquid assets (HQLA) to guarantee their short-term resilience towards severe liquidity stresses. These HQLA assets are predominantly government bonds.

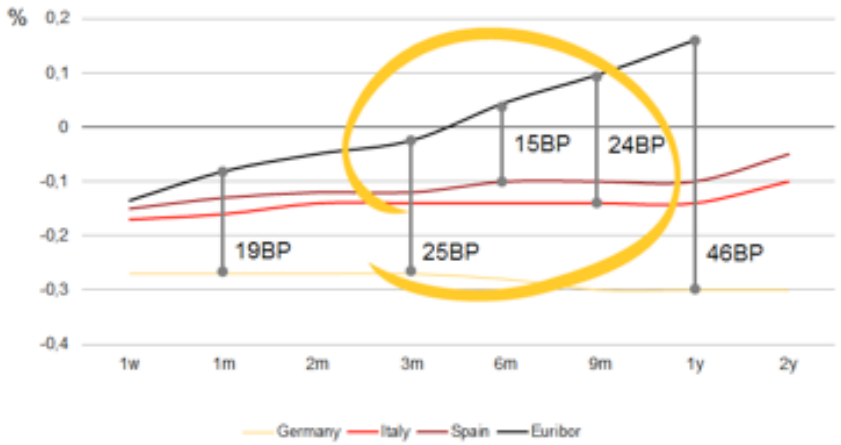


Figure 6: Stylized Asset Classes and Funding Spreads[12]

Since the average credit risk of the EMU banking sector is higher than the one of single EMU sovereign states, taking the EURIBOR-curve as the benchmark for funding causes a negative carry for asset positions held in German, Italian, or Spanish Government bonds. As the example above shows, holding German Bunds would create, no matter which maturity is held, the highest negative carry / or the liquidity costs for the liquid asset buffer. Same is true for other sovereign assets from the countries of the European monetary union. As a consequence, the funding spreads and the agreed funding duration are the key drivers of liquidity costs.

# 6 Reporting and Steering Intraday Liquidity

After having a discussion on how to set up a proper intraday liquidity risk management globally and after discussing how to manage to intraday liquidity with its determinants as well as risk drivers and its costs, we finally look at how to steer and how to report intraday liquidity. Here, is it necessary to be aware of the issues which may arise from intraday liquidity risk steering and reporting.

In accomplishing a proper steering and reporting, banks should follow reporting guidelines set by the regulator in authority. The reporting and the steering will be carried out in defined currencies.[13] In addition, a bank's timed payment obligations are steered and reported at the same time. Here, a bank needs to validate the possibility of timed payment obligations, like payments via CLS payment instructions. In addition, there need to be a validation for time sensitive settlements. This type of payment needs to be steered to avoid reputational risk through becoming a counterparty risk itself.

The ability to act describes a bank's facilities to steer their available liquidity within time zones and meeting contractual issues as a service provider. Another, crucial item in intraday liquidity risk management is mitigating credit risk by recognising unadvised cash payments. Finally it had to be considered if secondary nostro accounts have an impact on intraday liquidity, most of these account are acting equal to ancillary systems which have to be reported under BCSBS 248. The steering and measurement activities should concentrate on major liquidity drivers. As long as accounts are netted with the major account in the respective currency the liquidity transfer between these accounts should be seen as the relevant for intraday steering and monitoring. Nevertheless it should be ensured that these account have a minor impact to the banks overall intraday liquidity position.

[12] Source: Indicative figures based on market intelligence.

[13] Here, the BCBS (2013) recommends that national regulators should consider currencies whose aggregate liabilities exceed the amount of 5% of a bank's total liabilities.

# Conclusion

In this article, we carved out the importance and functionality on banks' intraday liquidity management. We provide an overview how banks can set-up their intraday liquidity manage globally and steer their intraday liquidity within different time zones. We explain how Basel's liquidity measures interact with intraday liquidity and illustrate the determinants and accompanying costs of intraday liquidity. Finally, we discuss intraday liquidity can be reported.

Overall, this article should create awareness to an often overlooked issue in daily liquidity (risk) management: Intraday liquidity management. Hence, this article aims at three different target groups: bankers, regulators, and central bankers. Firstly, the liquidity managers of banks can easily understand what intraday liquidity risk management is all about and how banks can set up their intraday liquidity risk management and manage its intraday liquidity. Secondly, since regulation gain more and more importance, regulators, especially the Basel Committee, need to understand the relevance and complexity of intraday liquidity management for banks to set up a reasonable regulation. Lastly risk can be mitigated by taking other risks, but not avoided. Due to the BCBS 248 regulation, the awareness that intraday liquidity is not the solution to mitigate other risks will rise and lead to enhanced settlement models taking intraday liquidity into account.

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## Appendix: Calculation FED charges

To calculate fees charged by the FED on uncollateralized daylight overdrafts, the FED maintains minute-by-minute information on account holders' daylight overdraft and collateral balances, through its automated applications. A bank's daily intraday overdraft fee is equal to the effective daily rate multiplied by the average uncollateralized intraday overdraft for the day.

The FED calculates and assesses fees on the basis of two-week reserve maintenance periods. The fee is equal to the sum of daily uncollateralized daylight overdraft charges incurred minus the fee waiver for the maintenance period.

Banks without regular access to the FED's discount window are not eligible for intraday overdrafts, zero prices for collateralized intraday overdrafts, or the fee waiver. Hence, these banks are charged a penalty fee for any intraday overdrafts they incur. The intraday overdraft penalty rate is equal to the regular FED's intraday overdraft fee plus additional 100 basis points, or 150 basis points, with a minimum of minimum charge of USD 25.