

Master's Programme in Economics

Evaluation of the Single Resolution Mechanism in mitigating liquidity crises in banks under resolution

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Abstract

The European Single Resolution Mechanism has been designed to solve bank capitalization problems through the resolution process preserving financial stability and saving taxpayer money. However, banks dealing with capital issues typically may also face liquidity shortfalls. The Single Resolution Mechanism has the capability to provide liquidity through the Single Resolution Fund with a size of around 80 billion euros.

This thesis studies whether Single Resolution Mechanism provides a credible way to mitigate liquidity crises in banks under resolution. After introducing the institutional setting, I cover the resolution cases that have happened since the Single Resolution Mechanism was put into place. Finally, I conduct a resolution stress test following the methods the idiosyncratic crisis of Amamou et al. (2020) using public Pillar 3 reporting data from the end of 2023 for 10 large European banks to estimate the possible liquidity shortfalls of banks going into resolution in a very severe crisis scenario. I find that the possible liquidity shortfalls of up to 182.6 billion euros are of such magnitude that the Single Resolution Mechanism is unable to credibly mitigate them. I note that the possibility of contagion leading to a systemic crisis further underlines the Single Resolution Mechanism's limited capabilities for liquidity assistance

Keywords bank liquidity, bank resolution, banking crises

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Eurooppalainen yhteinen kriisinratkaisumekanismi on suunniteltu ratkaisemaan pankkien vakavaraisuusongelmia kriisinratkaisumenettelyn kautta säilyttäen rahoitusvakautta ja säästämällä veronmaksajien rahaa. Vakavaraisuusongelmissa olevat pankit kohtaavat usein myös maksukykyongelmia. Yhteisellä kriisinratkaisumekanismilla on kyky tukea pankin maksukykyä 80 miljardin euron yhteisellä kriisinratkaisurahastolla.

Tässä tutkielmassa tarkastellaan, tarjoaako yhteinen kriisinratkaisumekanismi uskottavan tavan lieventää kriisinratkaisun kohteena olevien pankkien likviditeettikriisejä. Esiteltyäni institutionaalista rakennetta, käsittelen yhteisen kriisinratkaisumekanismiin käyttöönoton jälkeen tapahtuneita kriisinratkaisutapauksia. Lopuksi toteutan kriisinratkaisustressitestin Amamou et al. (2020) idiosynkraattisen kriisin menetelmien mukaisesti, jossa arvioidaan vakavassa kriisitilanteessa olevien pankkien mahdollisia likviditeettivajeita. Käytän julkisesti raportoitua Pilari 3 dataa kymmenelle suurelle eurooppalaiselle pankille. Mahdolliset, jopa 182,6 miljardiin asti yltyvät likviditeettivajeet ovat niin suuria, ettei yhteinen kriisinratkaisumekanismi pysty ratkaisemaan niitä uskottavalla tavalla. Totean myös, että tartuntavaikutusten mahdollisuus, joka voi johtaa systeemiseen kriisiin, korostaa entisestään yhteisen kriisinratkaisumekanismiin rajallisia mahdollisuuksia likviditeettituen antamiseen.

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Symbols and abbreviations

Abbreviations

SRM	Single Resolution Mechanism
SRF	Single Resolution Fund
SRB	Single Resolution Board
ECB	European Central Bank
NRA	National Resolution Authority
NCB	National Central Bank
ELA	Emergency Liquidity Assistance
FOLTF	Failing or likely to fail
LCR	Liquidity coverage ratio
NSFR	Net Stable Funding Ratio
CBC	Counterbalancing capacity
LOLR	Lender of Last Resort
SPE	Single Point of Entry
MPE	Multiple Points of Entry
SSM	Single Supervisory Mechanism
OLA	Orderly Liquidation Authority

1 Introduction

The global financial crisis of 2008 exposed critical weaknesses in the banking sector. The crisis demonstrated the interconnectedness of the global financial system and the potential for bank failures to trigger systemic risk, with far-reaching consequences for the real economy.

The failures of significant banks cause significant and long-lasting negative effects on the real economy (see Bernanke (1983); Bernanke and Gertler 1990 and Ashcraft (2005)) and therefore it is in the public interest to prevent bank failures. Yet bailouts, seen in the global financial crisis of 2008, preventing such failures are costly, create moral hazard and incentives for financial institutions to grow larger and more complex (Bolton and Oehmke, 2019 pp. 2384).

Bank failures have previously been funded by bailouts using public funding to shield depositors from losses and to protect the financial system from a systemic crisis. To reduce the costs caused to taxpayers and adverse effects on the real economy many developed countries have set up bank resolution schemes, where the idea is to recapitalize the bank by bailing in the holders of equity and subordinated debt and preserve the core banking services in a case it is highly likely that a bank will fail and there is no market solution present. Bank resolution provides a credible way to resolve and recapitalize failing significant banks with minimal disruption and without taxpayer support (Bolton and Martin, 2019 pp. 2384). Using these bail-in tools helps recapitalize the bank to make it solvent again, but the recapitalization does not necessarily help the bank's liquidity position. Uncertainty about a bank's liquidity position can lead to a bank run.

Central banks and supervisory entities regularly test the resilience of banks to adverse scenarios with different types of stress tests which typically

simulate severe but plausible scenarios where either the bank's capital or liquidity is stressed through an economic or financial crisis scenario. Stress tests have previously uncovered weaknesses in the banking system and thus made the system more resilient (Schuermann 2014). Amamou et al. (2020) find argue that previous bank failures can be roughly split up into ones where deposit outflows are very rapid and ones where the bank suffers deposit outflows for a longer period of time and therefore both types of crises should be studied.

The aim of my thesis is to study how the European Single Resolution Mechanism deals with liquidity crises in banks under resolution. My research question is: Does the Single Resolution Mechanism provide a credible way to solve liquidity crises in banks under resolution? I aim to answer this question by reviewing the academic literature related to the topic, studying the Single Resolution Mechanism to assess its capabilities, studying the resolution cases when Single Resolution Framework has been in place, analysing a resolution stress scenario from Amamou et al. (2020) and estimating the sizes of possible liquidity gaps for ten large European banks in a resolution stress test following their methods.

My study consists therefore of a literature review and a resolution stress test where I make use of the scenario from Amamou et al. (2020). The question is of utmost significance since bank resolution mechanisms are crucial for maintaining systemic stability as the failure of a single bank can trigger a domino effect leading to widespread financial contagion. Effective resolution strategies help contain these risks and prevent broader economic disruptions. One of the primary goals of bank resolution is to minimize the financial burden on taxpayers. By having a robust resolution framework with a possibility to offer liquidity assistance, governments can avoid costly bailouts and ensure that the costs of bank failures are borne by shareholders and creditors.

The implementation of the European framework for resolving large banks and the ongoing discussion and legislative work show the interest of European countries in further improving the European resolution capabilities to provide a possibility for pan-European liquidity assistance. The European resolution framework is called the Single Resolution Mechanism (SRM) and it includes the Single Resolution Fund (SRF) with a size of around 80 billion euros, which is used to give liquidity and capital support to banks under resolution.

While the SRM is able to recapitalize banks in the resolution process, uncertainty remains in available funds to provide liquidity to the bank under resolution, as banks coming out of resolution tend to have higher than usual deposit outflow rates (Amamou et. al, 2020). In the Eurosystem, liquidity provision in resolution is largely country-dependent, since provision of emergency liquidity assistance (ELA) is the task of national central banks, and governments have the possibility to provide guarantees as collateral for the ELA. Having a robust cross-border resolution mechanism also answers the challenge of resolving cross-border banks with assets in different jurisdictions.

Amamou et al. (2020) study the liquidity needs in a very severe crisis for banks undergoing resolution using data from 2018 on 86 European banks and find that average liquidity gaps are limited, but significant outliers exist, where the maximum liquidity gap is 157.79 billion euros.

I find that average liquidity gaps in a very severe resolution scenario with a single bank going into resolution can be as much as 58.6 billion euros, but the largest liquidity gaps can amount to 182.6 billion euros. I conclude that the Single Resolution Fund is insufficient in mitigating liquidity crises in banks under resolution in a very severe idiosyncratic scenario and even more so in a systemic crisis.

2 Financial stability under stress

Banks are susceptible to failures due to the maturity mismatch of their balance sheet, bank failures can lead to contagion causing distress to the larger financial sector and lasting impact on the real economy. Central bankers and governments have searched for ways to protect the financial system and real economy from the failure of banks with minimal cost to taxpayers. Bank resolution is one tool designed to preserve financial stability and taxpayer money.

2.1 Bank Run

Bank runs have been a largely studied topic as the maturity mismatch between banks' assets and liabilities gives way to a vulnerability for bank runs as Diamond and Dybvig (1983) showed. Diamond and Dybvig also show that having in place a deposit insurance framework can create a run free equilibrium. Deposit insurances are in place around the world. In the European Union all non-financial deposits are covered up to 100 000 euros per bank (European Commission, 2025). However, financial deposits and wholesale funding do not have such protection. Another way to prevent bank runs is to use deposit freezes, where depositors are not allowed to withdraw large amounts of deposits without proving their need for the withdrawal. However, Altermatt et al. (2024) find that deposit freezes lead to consumption downturn and decrease of bank asset value. They also show that availability of public liquidity assistance to the bank can eliminate bank runs.

Diamond and Kashyap (2016) develop a modified Diamond-Dybvig bank run model where instead of deposit insurance liquidity regulation similar to LCR regulation, a liquidity regulation where banks must hold high-quality liquid assets to cover stressed deposit outflows for the next 30 days, is developed and they show that having liquidity regulation in place incentivizes banks to

hold sufficient liquidity to avoid a bank run, there is a no-run equilibrium that can be achieved in their model. I cover their paper extensively as they construct a theoretical model that shows that bank runs can be avoided with a sufficiently high liquidity requirement for banks. The resolution stress test I cover in Section 5 integrates this assumption into it.

Their model leverages the standard Diamond-Dybvig (1983) model with three dates $T = 0, 1, 2$. The economy consists of depositors, a single bank and a lender of last resort (LOLR). A lender of last resort is an authority which gives emergency liquidity assistance (ELA). The interest rates that the bank must offer are taken as given. The single bank can be thought of as representing the entire banking system. At date $T = 0$ the bank offers a demand deposit which pays either r_1 at date $T = 1$ or r_2 at date $T = 2$ against a unit investment. Diamond and Kashyap (2016, pp. 2275) assume that depositors are sufficiently risk averse that they prefer the banking system to supply one period deposits that are riskless. Once all deposits have been paid back, if there is remaining returns, the bank keeps them as limited liability equity which is paid to the banker at date $T = 2$. The bank can invest in two assets with constant returns to scale. One asset is a liquid asset which returns $R_1 > 0$ per unit invested in the previous period. The other is asset is an illiquid asset where a unit investment at date $T = 0$ returns $R_2 > R_1 * R_1$ at date $T = 2$. The illiquid asset can be liquidated for θR_2 at date $T = 1$, where $\theta R_2 < R_1$ and $\theta \geq 0$. This means that if the bank knows that it must make a payment at date $T = 1$ it is always more efficient to invest in the liquid asset instead of liquidating the illiquid asset. Additionally, Diamond and Kashyap (2016 pp.2276) assume that bank profits are higher from investing in the illiquid asset when depositors hold their deposits until date $T = 2$ than from investing in the liquid asset when depositors hold their deposits only until date $T = 1$. i.e. $\frac{r_2}{R_2} < \frac{r_1}{R_1}$.

A fraction t_s of depositors want to withdraw their deposits at date $T = 1$ in state s and similarly the remainder $1 - t_s$ want to withdraw their deposits at

date $T = 2$ in state s . The realization of t_s is bounded by $0 \leq \bar{t} \leq 1$. Since banks have superior information of their customers, it is assumed that the bank knows t_s exactly.

If the state is s and there is not a bank run, a fraction $f_1 = t_s$ will withdraw r_1 each, requiring $t_s r_1$ in funds from the bank at date $T = 1$. This means that at date $T = 2$ a fraction $f_2 = 1 - t_s$ will withdraw r_2 each requiring $(1 - t_s)r_2$ in funds from the bank at date $T = 2$. Now denote the fraction of the bank's portfolio that is invested in the liquid asset as α_s and the fraction invested in the illiquid asset as $1 - \alpha_s$. Now the value of the bank's equity is

$$\begin{aligned} & \text{Value of equity} \\ &= \begin{cases} (1 - \alpha_s)R_2 + (\alpha_s R_1 - f_1 r_1)R_1 - (1 - f_1)r_2, & \text{if } f_1 r_1 \leq \alpha_s R_1 \\ \text{Max} \left\{ 0, \left(1 - \alpha_s - \frac{f_1 r_1 - \alpha_s R_1}{\theta R_2} \right) R_2 - (1 - f_1)r_2 \right\}, & \text{if } f_1 r_1 > \alpha_s R_1 \end{cases} \quad (1) \end{aligned}$$

Where it must liquidate at least part of the illiquid asset if the withdrawals at date $T = 1$ are higher than the fraction of the bank's portfolio invested in the liquid asset. If the withdrawals are higher than the combined value of the bank's investment in the liquid asset and the liquidated value of the illiquid asset, the bank will default, and the value of equity will be zero. Since liquidating the illiquid asset involves costs, it is always in the interest of the bank to hold enough liquid assets to avoid liquidating any of the illiquid assets. Thus, the bank's automatically incentive compatible liquid asset holdings are

$$\alpha_s^{\text{AIC}} \equiv \alpha_s \geq \frac{t_s r_1}{R_1}.$$

Now to model the risk of a bank run, Diamond and Kashyap (2016, pp. 2277) suppose that a fixed number Δ of patient depositors who would normally hold their deposit in the bank until date $T = 2$ have fears about the solvency of the bank, which they call seeing a sunspot. In the model, all depositors and the bank know Δ and upon seeing the sunspot the depositor must decide if they believe that the others who see the sunspot will decide to withdraw early, i.e.

at date $T = 1$. The depositor must choose whether they decide to join the bank run. This means that now it is possible that a fraction higher than t_s will decide to withdraw early i.e. $f_1 > t_s$.

If the bank will be insolvent with any amount of withdrawals less than $t_s + \Delta$ then all depositors, who see the sunspot will withdraw and consequently the amount of withdrawals will be $f_1 = t_s + \Delta$. Diamond and Kashyap (2016, pp.2278) assume that when the bank is exactly solvent at $f_1 = t_s + \Delta$, none of the patient depositors who see the sunspot will withdraw their deposits. This minimum level of liquid assets required to deter a run can be defined as the minimum stable amount of liquid holdings α_s^{Stable} . A bank with $\alpha_s \geq \alpha_s^{\text{Stable}}$ liquid assets will be run-free.

When also depositors have complete information i.e. observe α_s , Δ and t_s and want run-free deposits, the bank must make itself run-free to attract deposits. When the bank will remain solvent in a run, it is never individually rational for a depositor to react to a sunspot and therefore runs will not happen. If the bank chooses to hold $\alpha_s^{\text{AIC}} = \frac{t_s r_1}{R_1}$ and if

$$t_s + \Delta_s < \frac{t_s r_1 + \left(1 - \frac{t_s r_1}{R_1}\right) \theta R_2 - r_2 \theta}{r_1 - r_2 \theta} \quad (2)$$

then depositors will not run, and the bank is stable with $\alpha_s^{\text{AIC}} = \frac{t_s r_1}{R_1}$ i.e. $\alpha_s^{\text{AIC}} \geq \alpha_s^{\text{stable}}$.

A bank aiming to deter runs and with full information available will choose the fraction of liquid assets it holds as $\alpha_s^* = \max \{\alpha_s^{\text{AIC}}, \alpha_s^{\text{Stable}}\}$ since if the automatically incentive compatible holding of liquid assets is sufficient to deter a run, the bank will hold it as it maximizes the value of its equity, and otherwise the bank will hold the minimum amount of extra liquidity necessary to deter a run since the less liquid assets it holds the more profit it makes as

long as there is no run on the bank. Therefore, the bank must always hold unused liquidity in order to deter a run. When depositors do not have complete information, but instead the bank and a regulator do have complete information, the same arrangement is possible, but only by regulation where the regulator requires the bank to hold a fraction $\alpha_s^* = \max \{ \alpha_s^{\text{AIC}}, \alpha_s^{\text{Stable}} \}$ of liquid assets.

A regulator could require the bank to periodically disclose its liquidity, but these sorts of disclosures are typically made with a delay and are only a point-in-time indicator of the end of quarter or fiscal year. Banks also have the incentive for window-dressing of their liquidity figures. Munyan (2015) shows the tendency of European banks to disguise accounting information around quarter-end dates which form the basis of various regulatory ratios only on the last day of the quarter.

The Liquidity Coverage Ratio (LCR), used to measure the liquidity levels of banks compares the amount of liquid assets to stressed outflows. The requirement is sensitive to this type of manoeuvres since repurchase agreements and reverse repurchase agreements can be used to move the timing of cashflows. This is why Diamond and Kashyap (2016, pp. 2283) argue that the liquidity disclosures and regulations should hold at all dates. This however will cause a problem of limiting the use of liquidity to meet deposit withdrawals since the bank must always have sufficient liquid assets. This problem has an analogy to always requiring at least one taxicab to be at the train station. When there is only one taxicab at the station and a customer wishes to use it, the taxicab may not leave as there must always be one taxicab at the station.

The regulator could require the bank to always hold a certain amount of liquid assets relative to deposits, including after any withdrawals. This is in practice what the LCR requirement is, where the bank must hold enough liquid assets to cover stressed outflows of deposits over the next 30 days where different types of deposits have different outflow rates. The regulation now

applies also after date $T = 1$ so the bank would have to hold a minimum amount of liquid assets $\rho_s r_1 (1 - f_1)$ in addition to the liquid assets required to fund the withdrawals at date $T = 1$ in order to fulfil the liquidity requirement also after paying out the deposits at $T = 1$. Thus, the optimal amount liquid assets held is $\alpha_s R_1 = f_1 r_1 + \rho_s r_1 (1 - f_1)$. With such regulation the value of equity of the bank is

$$E_2(f_1; \rho) = \begin{cases} (\alpha_s R_1 - f_1 r_1) R_1 + (1 - \alpha_s) R_2 - (1 - f_1) r_2 & \text{if } f_1 < \frac{\alpha_s R_1 - r_1 \rho_s}{r_1 (1 - \rho_s)} \\ \left((1 - \alpha_s) - \frac{f_1 r_1 - \alpha_s R_1 + \rho_s (1 - f_1)}{\theta R_2} \right) R_2 & \text{if } f_1 \geq \frac{\alpha_s R_1 - r_1 \rho_s}{r_1 (1 - \rho_s)} \text{ and} \\ + (\rho_s R_1 - r_2) (1 - f_1) & \text{if } f_1 \leq \frac{\alpha_s R_1 + (1 - \alpha_s) \theta R_2 - \rho_s r_1 (1 - \theta R_1) - r_2 \theta}{r_1 - \rho_s r_1 (1 - \theta R_1) - r_2 \theta} \\ 0 & \text{if } f_1 > \frac{\alpha_s R_1 + (1 - \alpha_s) \theta R_2 - \rho_s r_1 (1 - \theta R_1) - r_2 \theta}{r_1 - \rho_s r_1 (1 - \theta R_1) - r_2 \theta} \end{cases} \quad (3)$$

Where the top shows the profits accrued when all withdrawals can be made and the LCR requirement satisfied without liquidating illiquid assets, the second row shows the case when some illiquid assets must be liquidated to exactly satisfy the LCR requirement after withdrawals. The bottom row shows the value of equity when withdrawals are sufficiently large for the bank to become insolvent.

Diamond and Kashyap (2016, pp. 2288) show that there is an LCR $\rho_s \in [0, 1]$ in state s which will deter runs. which satisfies

$$\begin{aligned} & t_s + \Delta \\ & = \frac{\frac{t_s r_1 + \rho_s r_1 (1 - t_s)}{R_1} R_1 + \left(1 - \frac{t_s r_1 + \rho_s r_1 (1 - t_s)}{R_1} \right) \theta R_2 - \rho_s r_1 (1 - \theta R_1) - r_2 \theta}{r_1 \rho_s r_1 (1 - \theta R_1) - r_2 \theta} \end{aligned} \quad (4)$$

when ρ_s is not zero or one. This implies that

$$\rho_s = \frac{\theta R_1 ((1 - t_s - \Delta) r_2 - R_2) + r_1 (\Delta R_1 + t_s \theta R_2)}{r_1 (\Delta R_1 + (1 - t_s - \Delta) \theta R_1^2 - (1 - t_s) \theta R_2)} \quad (5)$$

Therefore, a regulator who knows the state t_s can choose ρ_s so that there is a no run equilibrium. If the regulator must specify an LCR with a constant fraction of liquid assets ρ knowing only the distribution of outcomes, then the value which leads the bank to be stable for all t_s must be specified and an LCR ratio which makes the bank solvent with the highest amount of anticipated withdrawals will make it solvent in all states. Thus, a regulator with knowledge of at least the distribution of outcomes t_s can specify an LCR regulation that provides a no run equilibrium.

Diamond and Kashyap (2016) conclude that optimal regulation integrates the concept of a Lender of Last Resort (LOLR) with the Liquidity Coverage Ratio (LCR) regulation to enhance financial stability. They state that optimally banks should be allowed to borrow against the liquidity they are required to hold under LCR regulation. This borrowing is intended to be used during a run, ensuring that banks can access necessary liquidity without violating the LCR requirements. The LOLR would lend against the liquid assets, providing banks with the flexibility to use these assets in times of crisis while maintaining the required liquidity levels.

To ensure banks hold the appropriate level of liquidity, the model proposes penalties for misreporting withdrawal needs. These penalties would be significant enough to deter banks from underreporting their liquidity needs, aligning their incentives with regulatory goals. The “last taxicab” analogy highlights the issue of requiring banks to hold liquidity that cannot be used even in a crisis. The model addresses this by allowing the required liquidity to be used during a run, provided the bank faces penalties for any deviations from reported needs. This approach ensures that banks are both prepared for normal withdrawals and have access to liquidity during a run, without holding excessive unused liquidity.

The optimal regulation Diamond and Kashyap (2016) put forward is similar to the regulation in place in the European Union where the LCR regulation may be temporarily breached in a crisis and national central banks act as Lenders-of-last-resort (LOLR) providing emergency liquidity assistance to solvent banks against sufficient collateral.

2.2 Contagion between financial intermediaries

A common justification for preventing the failure of large banks is the fear of the failure of one bank causing failures to other banks and such a systemic crisis. The prevalence of financial crises has led to a belief that the financial sector is highly sensitive to shocks. In this section I study whether the academic literature supports the contagion of a crisis between financial intermediaries. I define contagion as the risk that the failure of one financial intermediary leads to the failure of other financial intermediaries, in line with the definition used in the literature (see e.g. Allen and Gale, 2000; Allen, Babus, Carletti, 2011).

In their paper, Allen and Gale (2000) focus on one channel of contagion between financial intermediaries, namely the overlapping claims that different regions or sectors of the banking system have on one another. When one sector or region suffers a bank crisis, the other regions suffer a loss because their claims to the troubled sector or region deteriorate. This can cause a crisis in other regions if the spillover effect is strong enough.

Allen and Gale (2000) assume that agents have complete information about their environment. They leverage a standard Diamond and Dybvig (1983) model, with three dates and consumers who are either early or late consumers, creating an uncertainty of the demand for liquidity. The economy consists of a number of regions and the number of early and late consumers varies by region randomly, while the aggregate demand for liquidity is constant. An interbank market in deposits can provide an interregional insurance

where regions with liquidity surpluses provide liquidity to regions with liquidity shortages. Banks use the interbank markets to exchange deposits at the first date before observing liquidity shocks. When banks in region A face higher than average early demand for deposits they can liquidate their deposits in the banks of region B, who have no problem in providing liquidity since they have faced a lower-than-average early demand for deposits. At the final date, the process is reversed as region A will have less late consumers than region B. This interregional cross holding of deposits works well if there is no excess demand for liquidity in the economy as a whole since cross holdings of deposits can reallocate liquidity within the banking system but they cannot increase the total amount of liquidity. When liquidity is not sufficient in the first period when the early consumers demand liquidity, banks must liquidate their long asset, which is very costly, so banks aim to avoid liquidating the long asset and liquidate their claims on other regions instead. However, this liquidation of claims does not create any more liquidity and only denies liquidity to the troubled region possibly causing bank runs and bankruptcies. Thus, a financial crisis in one region can spread by contagion to other regions because of the cross holdings of deposits. The spreading of the financial crisis depends on the pattern of interconnectedness caused by the cross holdings of deposits. If the financial market is complete, the initial impact of a financial crisis in one region may be dampened. If the financial market is incomplete, each region is connected with a small number of regions or sectors and the initial impact of the financial crisis can be very strong in the neighbouring regions resulting in a crisis in those regions as well. However, this initial impact causes the affected regions to sell their long assets thus depreciating the value of the long asset, and now even unaffected regions are affected by the crises since their claims on the crisis regions have fallen in value. The idea of a region in their model generalizes to differences in banks on several dimensions i.e. different business models or geographical locations. The problem arises from the banks' incentives to be a free rider: first a bank will meet a withdrawal from the short asset and after that with cross holdings from other regions and only after those will it resort to selling its

long asset. Cross holdings from other regions do not create any liquidity, so in case there is excess liquidity demand, the efficient response would be for each bank to simply liquidate some of the long asset and a widespread crisis could be prevented. When the markets are complete, this happens, since banks in troubled regions have direct claims in every other region and there is no way to avoid paying one's share. When markets are incomplete, banks in other regions seek their own interests and refuse to liquidate the long asset until they are in the front line of contagion. Thus, they show that interbank markets can cause contagion between financial intermediaries when markets are incomplete supporting the view that it is of public interest to prevent the failure of an interconnected bank, if interbank markets are incomplete. However, the question remains whether interbank markets are incomplete or complete and as such resilient to the failure of one intermediary.

Contrary to Allen and Gale (2000), Leitner (2005) builds a model where the regulator's role is to facilitate private sector bailouts and he shows that interbank lending may commit banks to help other banks under stress ex-post and he shows that interbank lending can be welfare enhancing since without bailing out the stressed counterpart, the bank faces contagion threat. However, in line with the findings from Allen and Gale (2000), Rochet and Tirole (1996) show that interbank lending induces a higher market requirement for capital, implying an increase in risk. They extend the model of Holmström and Tirole (1997) to include interbank lending where similarly to the case with lending to regular firms requires capital from the financial intermediary, interbank lending requires capital in order to meet the market requirement for capital and this capital is subtracted from the capital available for lending to firms in the real economy.

Allen, Babus and Carletti (2011) study another possible channel of contagion, correlated assets, using a model of six banks which grant loans to risky projects and may cause banks to default. In their model banks diversify their portfolio to reduce risk by exchanging projects between each other. They

model the exchange as a network formation game where they can exchange projects but cannot coordinate the structure of their asset structures. When each bank exchanges projects optimally this can either lead to an unclustered or clustered portfolios, where unclustered banks are connected in a circle, i.e. each bank only exchanges projects with the two banks next to it and clustered banks form groups of three where each cluster holds the same portfolio, but the portfolios of the two clusters are different. Figure 1 shows a visualisation of the possible connections where either banks 4, 5 and 6 end up holding identical portfolios and banks 1, 2 and 3 end up holding identical portfolios or banks end up holding portfolios that each differ from one another. Allen, Babus and Carletti (2011) show that when banks have short-term liabilities, correlated assets between financial intermediaries induce contagion between financial intermediaries as the banks in the cluster have identical balance sheets and if sufficiently many projects in the portfolio of the banks in the cluster fail, all banks will fail.

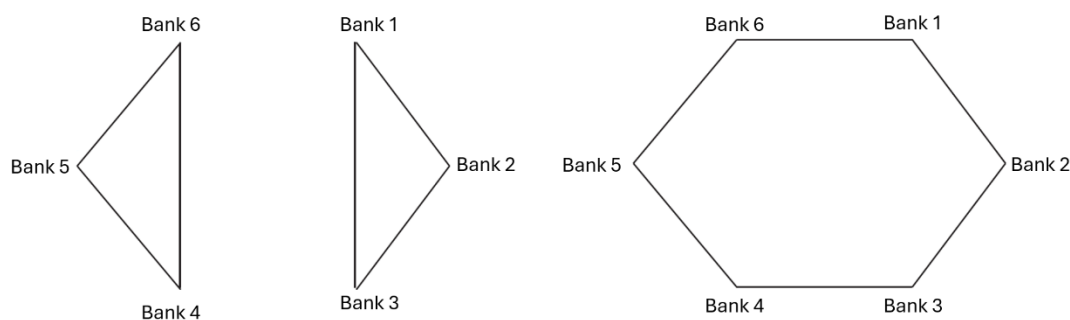


Figure 1: Clustered and unclustered bank formations. The figure shows the clustered structure on the left and the unclustered structure on the right. In the clustered structure banks hold identical portfolios but the two clusters are independent from each other. In the unclustered formation banks are all connected in a circle so that each bank exchanges projects with the neighbouring banks and no two banks hold identical portfolios.

Morrison and White (2013) expand the channels of contagion between financial intermediaries from being connected by interbank lending or correlated assets to sharing a common regulator. They show that if a financial regulator

has a poor initial reputation, a bank failure may cause depositors to lose their trust in the regulator's ability to distinguish between good and bad banks and this loss of confidence of the regulator can cause bank runs on fundamentally sound banks who share the same regulator since depositors are uninformed of the banks' solvency and rely on the regulator to ensure the solvency of each institution. Their model suggests that it may be rational for a regulator to refrain from closing an unsound bank since regulatory corrective action reveals that the regulator is not as skilled in screening sound banks as expected since the failure of a bank shows the failure of regulation.

A contagion of a bank failure to the financial markets is not necessarily a problem per se if there is no negative effect to the real economy. Chodorow-Reich (2013) found that the Lehman bankruptcy had adverse outcomes on the real economy where firms with unhealthy lenders had a lower likelihood of obtaining credit and they reduced employment.

The work by Allen and Gale (2000), Morrison and White (2013) show that there are multiple channels of contagion between financial intermediaries, namely interbank lending, correlated assets between financial intermediaries and a common regulator. Chodorow-Reich (2013) shows that the failure of a systemically important financial intermediary can have adverse effects on the real economy.

2.3 Resolution

The optimal way to carry out a bank resolution is a debated topic with ample literature studying bank resolution from different perspectives. In this section I will study the optimal tightness, timing and form of resolution regimes. In addition, I will study optimal emergency liquidity assistance strategies i.e. at what point should the Lender-of-Last-Resort step in.

Ignatowski and Korte (2014) study the effect of changes in bank resolution regimes on bank behaviour. The introduction of the Orderly Liquidation Authority (OLA) in the United States expanded the use of resolution tools from insured depository banks to a significantly higher number of banks. This change in resolution framework created a quasi-natural event study. It gave the possibility to compare a control and a treatment group using differences in differences since insured depository institutions were subject to resolution laws before the introduction of the OLA, but other financial institutions such as bank holding companies and non-bank financial companies were not subject to resolution laws. Thus, insured depository institutions make up the control group and other financial institutions form the treatment group.

The first indication of likely change in regulation was in June 2009 and the act was passed with immediate effect in July 2010. Ignatowski and Korte (2014) work with quarterly data so they define quarters up to the second quarter of 2009 as pre-treatment quarters and all periods after and including the third quarter of 2010 as post-treatment quarters. Their dataset is a bank level panel data consisting of 5886 individual institutions with quarterly time periods from the third quarter of 2005 to the second quarter of 2012. Their dependent variable is bank risk which is measured primarily from accounting data and secondarily from stock volatility. They find that banks under credible resolution frameworks decrease their risk taking, although their results do not hold for the largest banks.

Bolton and Oehmke (2019) study the resolution of global banks by national regulators and compare two possible resolution approaches, Single-Point-of-Entry (SPE) resolution and Multiple-Point-of-Entry (MPE) resolution. They develop a three-period model of a multinational bank and national regulators to analyse trade-offs between SPE and MPE resolution. The multinational bank has two subsidiaries each located in a different jurisdiction. Each subsidiary invests a fixed amount at date $t = 0$ to provide banking services. The subsidiary funds this investment with a combination of short-term debt due

at date $t = 1$ with face value R_1 , long-term debt due at date $t = 2$ with face value R_{LT} and an equity stake α_0 issued at date $t = 0$.

A holding company issues the equity and the long-term debt of the subsidiaries enabling the subsidiary losses to be automatically passed up to the holding company and the losses to be absorbed by the holders of equity and long-term debt. There are two possible aggregate states: a high aggregate state, where both subsidiaries receive a high cashflow and a low aggregate state, where both subsidiaries receive a low cashflow. In addition to the aggregate states, there is an additional cashflow Δ which one of the subsidiaries receives, i.e. this cashflow is certain to happen but it is uncertain which subsidiary will be its recipient. When the high aggregate state occurs, both subsidiaries can meet their short-term liabilities, but when the low aggregate state occurs, only the subsidiary receiving the idiosyncratic cashflow Δ will be able to meet its short-term liabilities.

When a subsidiary cannot meet its short-term liabilities, short-term creditors run, and the bank is liquidated. Bolton and Oehmke (2019) assume that liquidation is ineffective so that the liquidation payoff is strictly less than the market's expected value of the banking franchise. In The model assumes asymmetric information about long-term cashflows which causes long-term debt and equity to be expensive compared to short-term debt. Since long-term debt and equity are expensive compared to short-term debt, the shareholders of the bank will not want to hold enough long-term debt and equity to absorb potential losses

They assume asymmetric information about long-term cashflows which makes long-term debt and equity expensive compared to short-term debt. The main findings of the study are that SPE is more efficient in principle than MPE but faces implementation constraints. First, when expected transfers in resolution across jurisdictions would be too asymmetric, national regulators fail to set up SPE resolution schemes ex ante. Second, when required ex post

transfers are too large, national regulators ring-fence assets instead of cooperating in SPE resolution.

Schilling (2023) studies the optimal point of resolution action, based on a model where the resolution authority takes over the bank and manages its assets until maturity, but does a worse job in managing the assets than the original management of the bank. She finds that early resolution action can increase bank runs *ex ante* and her analysis suggests that overly aggressive intervention policies are not more stable and efficient than lax policies.

Similarly, Schilling (2024) utilizes a theoretical model of emergency liquidity assistance (ELA) to show that anticipation of ELA provision to a bank can make runs on banks more likely *ex ante* since the provision of ELA enforces a redistribution of funds across different creditor groups of the bank since it allows the bank to survive greater runs by bringing about additional funds to be withdrawn by the withdrawing agent group and the group of depositors that do not withdraw must pay the interest rate, often a penalty rate, of the ELA. Thus, the ELA punishes the group of depositors that do not decide to run on the bank and rewards those who run. This redistribution mechanism can backfire by increasing the incentives to run on the bank.

Rochet and Vives (2004) use a Bayesian model to show that a Lender-of-last-resort (LOLR) facility that works according to Bagehot's (1873) principles - that central banks should lend to solvent but illiquid banks. They argue that even in modern interbank markets investors may face a coordination failure and the effective policy is to complement prudential regulation with a LOLR policy.

However, the empirical evidence suggests that these coordination failures are overplayed in the theoretical papers. Kelly et al. (2025) perform a case study where they look at the emergency liquidity assistance cases from the 21st century where emergency liquidity assistance was granted to an individual

troubled bank and in all cases, it was followed by further assistance, usually in the form a capital injection. They conclude that it is very unlikely that a bank would face only a liquidity shortfall without having solvency or viability problems.

Berndt et al. (2024) study the market implied probabilities of government bailout of global systemically important banks (G-SIBs) after the Global Financial Crisis (GFC). They show that the likelihood of a G-SIB not getting bailed out has risen from 5 percent to 13 percent, a meaningful 170% increase reflected in these banks' debt financing costs. Their study shows that even though the likelihood of a G-SIB not getting bailed out has risen, it remains quite low. This study suggests that the resolution regimes have not solved the too-big-to-fail problem.

Former chairman of the Federal Reserve Ben Bernanke defined too big to fail in the following way: “A too big to fail firm is one whose size, complexity, interconnectedness, and critical functions are such that, should the firm go unexpectedly into liquidation, the rest of the financial system and the economy would face severe adverse consequences” (Bernanke, 2010, pp. 20). He added that governments support too-big-to-fail firms in a crisis because they recognize that the consequences for the broader economy of allowing a disorderly failure greatly outweigh the costs of avoiding the failure. To fully solve the too big to fail problem, it must be possible to handle the failure of a G-SIB without the use of taxpayer funds.

3 Single Resolution Mechanism

The European resolution framework, known as the Single Resolution Mechanism (SRM), is designed to ensure an orderly resolution of failing significant banks in the European banking union with minimum impact on the real economy and on public finances. The Single Resolution Mechanism is a resolution framework which gives clear responsibilities to the Single Resolution Board (SRB), European Central Bank (ECB), National Resolution Authorities (NRAs) and the Single Resolution Fund (SRF). The SRM forms the banking union together with the deposit guarantee schemes and the centralized bank supervision system, the Single Supervisory Mechanism.

3.1 Single Resolution Board

The SRB is in charge of the effective and consistent functioning of the SRM. The SRB oversees drawing up the resolution plans for banks under the supervision of the Single Supervisory Mechanism (SSM) and puts together the resolution scheme once a bank is deemed failing or likely to fail, where it decides whether the distressed bank will require resolution action and what measures will be taken. The SRB also conducts the resolution process if the Single Resolution Fund (SRF) is used in resolution even if the bank is not under SSM supervision. (Regulation (EU) No 806/2014)

3.2 European Central Bank

The ECB is in charge of making the Failing or Likely-to-Fail (FOLTF) assessment for banks under the supervision of the Single Supervisory Mechanism (SSM). Once a FOLTF decision has been made, the SRB must put together a resolution scheme where it decides whether to take resolution action or to liquidate the bank through normal bankruptcy proceedings. (Regulation (EU) No 806/2014)

3.3 National Resolution Authorities

The NRAs carry out the assessment of resolvability of banks in their jurisdictions, remove impediments to resolvability and set the level of minimum requirement for own funds and eligible liabilities (MREL). The NRAs are also in charge of adopting the resolution schemes for banks under resolution in their respective jurisdictions which are not under SSM supervision when the SRF is not used in resolution. (Regulation (EU) No 806/2014). For example, in Finland the Financial Stability Authority is the National Resolution Authority and in Finland it is also responsible of the deposit guarantee scheme.

3.4 Single Resolution Fund

The SRF is an emergency fund, which can be used to ensure the efficient application of resolution tools for resolving banks after bail-ins have been exhausted. The SRF has been built up with contributions from all banks in the banking union. The size of the SRF is 1 percent of the amount of covered deposits of credit institutions in all 21 Banking Union countries which amounts to 77.6 billion euros. The SRF can be used to recapitalize a bank under resolution if at least 8 percent of total liabilities have been bailed in and the contribution from the SRF is at most 5 percent of the total liabilities. (Regulation (EU) No 806/2014)

4 Resolution Cases

The Single Resolution Mechanism (SRM) has been in place since 2015. Since then, there have been only a few cases where a bank has been resolved. Banco Popular Español was sold to Santander in 2017 by the SRB. The Croatian and Slovenian subsidiaries of Sberbank were resolved in 2022. In addition, two Italian banks under the SRM, Banca Popolare di Vicenza and Veneto Banca, were liquidated through normal bankruptcy proceedings after the public interest assessment carried out by the SRB determined that resolution action is not necessary.

4.1 Banco Popular Español

Banco Popular Espanol was a Spanish banking group focusing on providing banking services to households, small and medium enterprises and large corporations. Banco Popular was a relatively large bank with total assets of 147 billion euros and 1644 branches in Spain and over ten thousand employees. The latest resolution plan the SRB had made for Banco Popular Espanol was in 2016. The resolution plan sets out the best assessed way to deal with problems of a bank which is failing or likely to fail. In the resolution plan it is assessed whether it is possible to liquidate the bank under normal insolvency proceedings or whether it is of public interest to resolve the bank (Regulation (EU) No 806/2014). In the 2016 resolution plan, the SRB had decided that Banco Popular Espanol cannot be liquidated under normal insolvency proceedings. The problems of Banco Popular Español started in 2016 when it had losses of around 3,5 billion euros. The bank published this information in February 2017 which led to liquidity problems. It aimed to address these liquidity problems in April 2017 by finding a private buyer without success. Finally on the 5th of June 2017 the European Central Bank (ECB) granted the bank emergency liquidity assistance to deal with its liquidity problems, and

on the 6th of June 2017 it was deemed as failing or likely to fail (FOLTF) which initiated the resolution process.

The SRB decided to use the sale of business tool where SRB facilitated the sale of Banco Popular Espanol to Banco Santander S.A. after writing down and converting the capital instruments of the institution. (SRB. Decision of the Single Resolution Board, 2017)

The public supervisory documents do not disclose the the reason for losses, or the amount of funds injected into Banco Popular Espanol prior to the FOLTF-decision. The BBC reported that Banco Popular Espanol had losses of 3.5 billion euros due to dealing with a portfolio of 40 billion euros of toxic property loans. The bank had three rounds of fundraising from investors and it raised a total of 5.5 billion euros prior to the FOLTF-decision. (BBC 2017)

4.2 European subsidiaries of Sberbank

In 2022 after Russia's invasion into Ukraine and the consequent sanctions by the European Union and the United States on Russia, the Russian state-owned bank Sberbank stopped giving liquidity to Sberbank Europe AG, an Austrian subsidiary of Sberbank Group. The sanctions had a large reputational impact on the bank, and this triggered a wave of deposit withdrawals and impaired the bank's access to wholesale funding markets. The Austrian bank Sberbank Europe AG was the parent company of the Croatian and Slovenian subsidiaries. (SRB. Decision of the Single Resolution Board, 2022a)

After the FOLTF decision of the ECB, the SRB assessed that it was not in the public interest to carry out resolution action on the Austrian parent company Sberbank Europe AG since the functions performed by the bank were not critical and the liquidation of the bank was not likely to have significant adverse effect on financial stability in Austria or other EU member states. (SRB. Decision of the Single Resolution Board, 2022a)

The SRB assessed that the Slovenian subsidiary Sberbank banka d.d. was failing or likely to fail due to its deteriorating liquidity situation and the ECB made the FOLTF-decision. The SRB concluded that resolution action is necessary to ensure the continuity of the lending to small and medium sized enterprises and to avoid significant adverse effects on financial stability. The SRB adopted a resolution scheme where the “sale of business” tool was used and the bank was sold to Nova Ljubljanska Banka d.d. (SRB. Decision of the Single Resolution Board, 2022b)

Similarly, the SRB assessed that Croatian subsidiary Sberbank d.d. was failing or likely to fail due to its deteriorating liquidity situation and the ECB made the FOLTF decision. The SRB concluded that resolution action was necessary to avoid significant adverse effects on financial stability in Croatia since Sberbank d.d. was the eighth largest bank in Croatia. (SRB. Decision of the Single Resolution Board, 2022c)

There is no publicly available information on the size of the liquidity needs of the Sberbank subsidiaries, but there was a rapid large deposit run on the bank following the sanctions on the Russian parent bank and the FOLTF decision was made following a rapid and significant deterioration of the liquidity situation.

4.3 Banca Popolare di Vicenza and Veneto Banca

Veneto Banca experienced material capital depletions and a substantial deterioration in its liquidity position. The Italian government provided Veneto Banca with guarantees to its newly issued liabilities, for EUR 3.5 billion in February 2017 and a further 1.4 billion euros in May 2017. These guarantees enabled Veneto Banca to issue new liabilities and temporarily improved the bank’s liquidity position. The bank further experienced capital depletions and further deterioration in its liquidity position. In June 2017 the ECB made

a FOLTF-decision, and the SRB decided that it was not in the public interest to resolve Veneto Banca as it was no longer a systemically important institution after the deposit outflows that had already occurred. Thus Veneto Banca was put into liquidation. (SRB Decision of the Single Resolution Board, 2017a)

The problems of Banca Popolare di Vicenza were very similar to those of Veneto Banca and happened simultaneously. The bank suffered a sharp decline in revenues and thus experienced capital depletions which led to a loss of confidence in the bank leading to a deterioration in its liquidity position. The Italian government guaranteed liabilities issued by the bank by 3 billion euros in February 2017 and 2.2 billion euros in May 2017. After further deterioration of the bank's capital and liquidity position the ECB made a FOLTF-decision in June 2017. The SRB decided that it was not in the public interest to resolve Banca Popolare di Vicenza as the bank was no longer systemically important after the realised deposit outflows. (SRB Decision of the Single Resolution Board, 2017b)

All together the government support for these two banks amounts to around 10.1 billion euros. In addition to this support, there was also private capital injections. The case of Banca Popolare di Vicenza and Veneto Banca is an example of a crisis that runs for a long time contrary to a deposit run that happens in a few days or weeks.

4.4 Lessons learned from the resolution cases

All the resolution cases after the current resolution regulation has come into place have been such that the liquidity situation of the failing bank has been solved by the buying bank apart from the two-day moratorium set to the Sberbank subsidiaries, which did not solve the liquidity problems but only delayed the need to address them. An external buyer who can provide

liquidity support to the troubled bank is an efficient and straightforward solution to solving the liquidity shortfall of a troubled bank. However, a private buyer may not always be present. In such a case where no buyer is present, the ability of the Single Resolution Mechanism in mitigating liquidity challenges of the failing bank has not been tested yet.

The analysis done by Amamou et al. (2020), which I will discuss in more detail in Section 5.2. splits bank resolution crisis into two different types of crisis, fast burn crises and slow burn crises. Of these crises the failure of the Italian banks' are clearly slow burn crises where reaching the FOLTF-declaration took several years. In contrast the failure Sberbank subsidiaries was a fast burn crisis with the deposit outflows happening in a matter of days. Banco Popular Espanol was also an example of a fast burn crisis as its liquidity position deteriorated quickly in a matter of a few months after it announced the losses it had made the previous year.

5 Resolution stress test

I use the methods of two different very-severe deposit run-off resolution stress test scenarios, an idiosyncratic slow burn crisis and an idiosyncratic fast burn crisis, from Amamou et al. (2020) to study the potential sizes of liquidity gaps in European banks and thus understand how the capabilities of the Single Resolution Mechanism compare to the possible liquidity needs in bank resolution cases.

5.1 Stress tests

Stress testing has been a method for risk management of banks for at least 30 years (Schuermann 2014). The idea of stress testing is to understand the resilience of an exposure to deteriorating conditions such as a decline in house prices (Schuermann 2014). Typically stress tests either take the form of testing sensitivities or scenarios. A sensitivity stress test might test how large of a drop in house prices a financial institution can withstand (Schuermann 2014). A scenario stress test is one that tests the resilience of the bank in a specific scenario such as a severe economic downturn or a financial crisis like the great financial crisis of 2009. Scenario stress tests are a good tool to study the resilience of banks to the scenario in hand.

Stress tests are used regularly by central banks, supervisory entities and resolution authorities to assess the resilience of banks to adverse scenarios. A typical stress test simulates an adverse scenario and tests whether a bank would survive, how much losses it would make and how its capital and liquidity positions would change in the scenario and whether these would be sufficient to support the normal business activities of the bank. (Schuermann 2014)

Typically stress test scenarios are designed to be much worse hypothetical future paths than the expected path of development is because these scenarios can reveal the potential detrimental impact on banks in the scenario, although it may be a highly unlikely one. (Dent et al., 2016)

A problem with scenario stress testing is the problem of forecasting. What sort of scenario could occur in the future and should be tested? The famous phrase “Prediction is very difficult, especially about the future” often attributed to Niels Bohr is one with a deep truth in it. Unlike some natural phenomenon such as the height of humans, the economy and financial markets are not ones that follow normal distributions. A black swan, a highly unlikely event with a substantial impact once it occurs, that should be impossible according to forecasts based on normal distribution models, can occur and have drastic effects. (Taleb 2007).

Taleb claims that it is inherent to humans to be blind to these black swans, and this causes us to focus on a few well-defined sources of uncertainty, a specific list of black swans dismissing the possibility of others that do not come to mind as easily. (Taleb, 2007, p.50)

When designing a scenario, it is easy to lock on to a previous event which triggered a financial crisis and think that the next crisis will be similar to the previous one. However, this may not be the case, as Dent et al. (2016) note that past stress event have not tended to simply repeat themselves. A more fruitful approach may be to conduct scenario stress tests with very unlikely scenarios to better understand the resilience of banks.

Herring and Schuermann (2019) note that the scope of stress tests should be expanded to develop a more robust view of financial resilience. The resolution stress test by Amamou et al. (2020) of which I take the methods for my own resolution stress test, aims to do its part in expanding stress testing and thus building a more robust view of financial resilience.

5.2 Amamou et al. (2020) idiosyncratic crisis

Amamou R., Baumann A., Chalamandaris D., Parisi L. and Torstensson P. (2020) study how large potential liquidity gaps that significant banks in the euro area might face during resolution are, particularly under adverse conditions to understand the liquidity needs of banks in idiosyncratic and systemic crises. The focus is on estimating these gaps under different scenarios, including a very-severe pre-FOLTF (Failing or Likely to Fail) and very-severe post-FOLTF scenario. The point of FOLTF is the point where the bank undergoes resolution in the stress test. They study this using a resolution stress test where it is assumed that each bank undergoes resolution where it is recapitalized but does not receive liquidity help. As a result, they receive the amount of liquidity the bank would need to prevent it failing due to liquidity shortages.

The sample in the paper is 86 significant banks in the euro area, representing approximately 76% of the total assets of euro area banks. The data used in the paper is COREP (Common Reporting) data for maturity ladders and counterbalancing capacity, and FINREP (Financial Reporting) data for balance sheet items. This data is reported by the banks to the ECB (European Central Bank). The data is from the first quarter of 2018. They do not explain why they have chosen this sample for their data, but it is likely that this data includes all the banks that are under the supervision of the ECB.

Contrary to a typical stress test, the assumption in this analysis is that the bank will be declared failing or likely to fail and it will undergo resolution. The idea of this stress test is to understand how much liquidity support the bank will need to prevent failure.

The analysis includes idiosyncratic fast burn and slow burn crisis scenarios with severe and very-severe stress levels both pre- and post-FOLTF.

Altogether this makes eight different scenarios, four different slow burn crisis scenarios and four different fast burn crisis scenarios. The idea behind the split into fast burn and slow burn crises is that the resolution cases that have happened have roughly been split into longer lasting crises that may last around a year and much faster crises that last weeks or days. The slow burn pre-FOLTF period lasts six months with elevated net outflows and decreased inflows and the post-FOLTF period lasts three months with continued elevated net outflows and a haircut applied to the counterbalancing capacity (CBC). A haircut is a reduction of an asset's value reflecting the risk of the asset. The counterbalancing capacity measures the available means the bank has to meet its liquidity outflows. The fast burn pre-FOLTF period lasts four weeks and the post-FOLTF period lasts eight weeks. Amamou et al. (2020) assume that post-FOLTF run-off rates are lower than the run-off rates pre-FOLTF, which they base on observations of a number of real resolution cases. A haircut is applied to the counterbalancing capacity (i.e. available high-quality liquid assets or liquidity buffer) as a proxy for events not modelled, for example asset price falls, higher derivative collateral posting requirements, assets being trapped in foreign subsidiaries etc. Larger banks have a higher haircut due to high likelihood of their failure on having a market impact on asset prices.

Amamou et al. (2020) define the cumulative counterbalancing capacity at time t as:

$$CCBC_t = CBC_0 + \sum_{n=1}^t \Delta CBC_n + \sum_{n=1}^t Inflows_n - \sum_{n=1}^t Outflows_n \quad (6)$$

Where the cumulative counterbalancing capacity at time t is the initial counterbalancing capacity added by contractual changes of the counterbalancing capacity up to time t and the cash inflows from e.g. loans up to time t deducted by cash outflows e.g. from deposit withdrawals up to time t . The initial

point T_1 is the point with the initial data without any stress applied. The point of FOLTF T_2 occurs at four weeks in the fast burn scenario and at six months in the slow burn scenario. The point where the post-FOLTF net outflows stop T_3 is eight weeks after the point of FOLTF in the fast burn scenario and three months after the point of FOLTF in the slow burn scenario.

Amamou et al. (2020) measure three different liquidity gaps where Gap 1 is the needed liquidity to keep the bank's counterbalancing capacity above zero, Gap 2 is the liquidity needed to maintain the level of liquid assets required to meet the new liquidity coverage ratio (LCR) right after the resolution throughout the process and Gap 3 is the liquidity needed to meet the current LCR 100 percent requirement. Gap 2 is the most demanding gap as it requires the same amount of liquid assets to be held after post-FOLTF outflows as which were needed to meet the LCR 100 percent requirement after the pre-FOLTF outflows even though the balance sheet is smaller. Figure 2 illustrates the evolution of liquidity and the measurement of the different gaps. It shows that the liquidity position deteriorates until the FOLTF declaration and keeps decreasing after it until reaching the lowest point, after which the inflows become larger than the outflows.

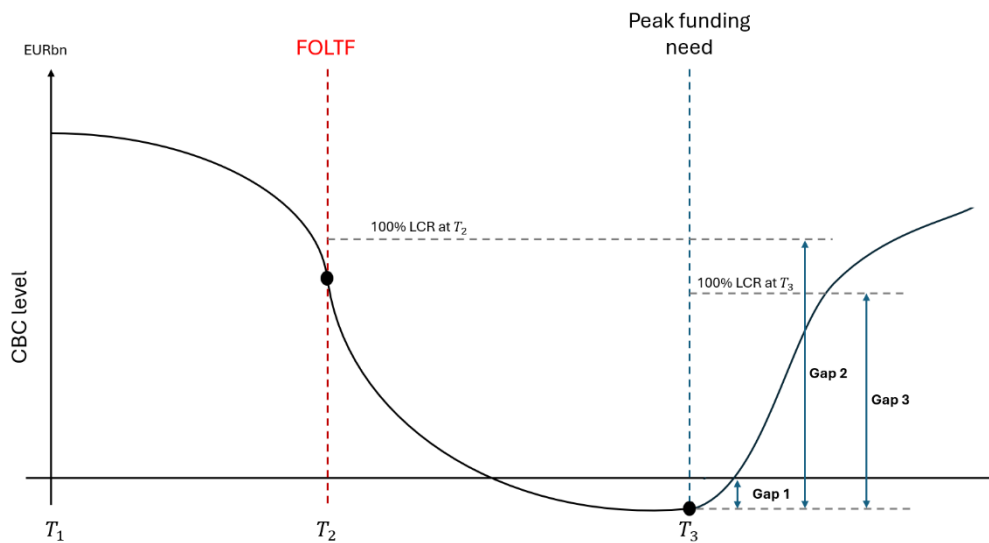


Figure 2: Evolution of the counterbalancing capacity, time on x-axis and size of counterbalancing capacity on y-axis. T_1 is the initially reported level of counterbalancing capacity, resolution occurs at T_2 and net outflows stop at T_3

It is good to note that liquidity is only measured at points T_1 , T_2 and T_3 , and the black line is only an illustration of how the liquidity of a bank may act.

The outflow rates used in the paper are not calibrated but have been assumed as realistic severe outflow rates based on previous crises. Thus, the paper relates to stress tests regularly carried out by central banks to evaluate the resilience of the banking sector. The outflow rates in the very-severe slow burn scenario are shown in Table 1 to help in understanding the magnitude of the deposit outflows. The magnitude of the outflows in the fast burn scenario is 90% of the slow burn scenario.

Item	Pre-FOLTF rates	Post-FOLTF rates
Stable retail deposits	18 %	13.5 %
Other retail deposits	30 %	22.5 %
Operational deposits	50 %	37.5 %
Non-operational deposits from credit institutions	100 %	75 %
Non-operational deposits from other financial customers	100 %	75 %
Non-operational deposits from central banks	40 %	30 %
Non-operational deposits from non-financial corporates	40 %	30 %
Inflows	-20 %	-20 %

Table 1: Slow burn crisis very severe scenario outflow rates used in Amamou et al. (2020)

As seen in Table 1, the resolution stress test assumes that all non-operational deposits from financial customers are withdrawn and 18% of the most stable deposits, the stable retail deposits, are withdrawn. Additionally, inflows are assumed to decrease by 20 percent, which means that e.g. loan payments are not made. From Table 1 it can also be seen that the crises stress only deposits but no other liabilities such as wholesale funding. This choice can potentially have a large impact on the sizes of liquidity gaps since many banks use wholesale funding instead of deposit taking to fund their activities.

The methodology of Amamou et al. (2020) has other additional assumptions affecting the size of liquidity gaps. They assume that only an open bank bail-in is applied to banks in resolution, which means that resolution action does not affect the liquidity of the bank. Additionally, they assume that there is no additional capital injected into the bank, meaning that the bail-in is sufficient to restore required minimum capital levels. The analysis uses a static balance sheet which has a major implication that the troubled bank is not able to generate additional liquidity through securitisation or other measures. This assumption may be realistic in a systemic crisis, but not necessarily in an idiosyncratic scenario. Usually, banks have sufficient collateral to secure funding either from wholesale funding markets or through normal central bank operations.

The LCR requirements after resolution are approximated instead of exact calculation due to the complicated calculation and lack of required data points for an exact calculation.

Amamou et al. (2020) find that average liquidity gaps are limited, but significant outliers exist, where the maximum liquidity gap is 157.79 billion euros. They conclude that under very-severe conditions liquidity gaps can be substantial and the current liquidity support instruments in the euro area are not sufficient to address the gaps.

The assumptions behind the resolution stress test conducted by Amamou et al. (2020) are very similar to the theory put forth by Diamond and Kashyap (2016) which I covered extensively in Section 2. Amamou et al. (2020) study liquidity gaps with a remaining liquidity requirement after the stress has occurred to prevent a bank run, i.e. the last taxicab at the station must always stay at the station. Amamou et al. (2020) assume that the remaining liquidity after the stressed outflows is necessary to avoid a deposit run and this is in line with the theory of Diamond Kashyap (2016). Measurement of liquidity gaps 2 and 3 include the assumption that the bank must have additional unused liquidity to instil trust in the depositors. This is exactly what Diamond and Kashyap (2016) show in their model.

Amamou et al. (2020) note that estimating the level of liquidity gaps in resolution is challenging as liquidity needs in resolution can vary significantly depending on the resolution tool applied, market response and time taken until access to markets is restored to the bank, and the financial situation of the bank at the point of resolution. This scenario is one possible very severe scenario, but not the only possible scenario.

5.3 Data

The data I use in my stress test using the scenario laid out by Amamou et al. (2020) is bank level Pillar 3 Liquidity Coverage Ratio quantitative data of 10 large European banks of which two are the largest banks in Finland and eight others are large banks from central Europe. The data is published publicly by each bank in a standardized way according to Pillar 3 guidelines. The data has been extracted from the banks' own pdf reports. The data includes high quality liquid assets, expected cash inflows in the following 30 days and the deposits, of which the main categories are stable retail deposits, less stable deposits, operational deposits, non-operational deposits, unsecured debt, secured wholesale funding and additional requirements. I use data from the fourth quarter of 2023. The Pillar 3 reporting table can be found in the Appendix.

The data for total liquid assets is reported in the row 'Total weighted assets' which accounts for normal monetary policy operations haircuts which are applied to the assets to calculate the weighted total high-quality liquid assets.

5.4 Methods

I aim to use the same methods as in the idiosyncratic slow burn and fast burn very-severe, very-severe scenarios from Amamou et al. (2020) using a point-in-time static liquidity buffer and deposit base, where the liquidity buffer evolves due to cash outflows and cash inflows based on the stressed run-off rates by Amamou et al. (2020) shown in Table 1. First, severe pre-resolution outflows are modelled by multiplying the total unweighted values of deposits by their respective outflow factor to calculate the net outflows up to the resolution point. Then post-resolution outflow rates, which are 75% of the pre-resolution rates, are multiplied by the original deposit base deducted by the pre-resolution outflows. I calculate the same three liquidity gaps as Amamou et al. (2020) where Gap 1 is the needed liquidity to keep the bank's counterbalancing capacity above zero, Gap 2 is the liquidity needed to maintain the level of liquid assets required to meet the new liquidity coverage ratio (LCR)

right after the resolution throughout the process and Gap 3 is the liquidity needed to meet the current LCR 100 percent requirement.

In the resolution stress test, I use a static balance sheet and liquidity buffer without contractual information on the evolution of the balance sheet or liquidity buffer. I assume that the size of the balance sheet and liquidity buffer evolves only due to deposit outflows and expected cash inflows. Due to the data having limited information on non-operational deposits the outflow rates for non-operational deposits differ slightly from Amamou et al. (2020). A more detailed point-by-point comparison can be found in Section 5.5

In my baseline scenario I define the cumulative counterbalancing capacity at time t as:

$$CCBC_t = CBC_0 + \sum_{n=1}^t Inflows_n - \sum_{n=1}^t Outflows_n \quad (7)$$

Where the sum of inflows and outflows are generated by the assumed stressed conditions, both pre- and post-FOLTF as in Amamou et al. (2020). This equation is based on the equation on p.16 in Amamou et al. (2020) which defines the cumulative counterbalancing capacity. The time periods modelled are the initial situation at $t=0$, the resolution point at $t=1$ and the point when outflows have reached their peak level after resolution at $t=2$. Unlike Amamou et al. (2020) this does not include the contractual changes to the counterbalancing capacity, ΔCBC . However, this difference does not affect the results as a decrease in the counterbalancing capacity is reported as an inflow and vice versa. This means that the net effect of the contractual changes of the counterbalancing capacity are neutral.

In the calculation of liquidity gaps 2 and 3, I model the size of the total net outflows used in calculating the 100 percent LCR requirement by multiplying the initial total net cash outflows by the ratio of the measurement time

deposits to the initial deposits, i.e. I assume that the total net cash outflows decrease in relation to deposits, which is a justified assumption as the outflows are calculated based on the size of deposits.

5.5 Comparison to Amamou et al. (2020) idiosyncratic crisis

There are some differences between my empirical exercise and that of Amamou et al. (2020). The public data I am using is not as granular as the COREP data. I will use a static deposit base and liquidity buffer, which is a point-in-time counterbalancing capacity. The largest difference is in the granularity of deposit types. The data used by Amamou et al. (2020) has information on the counterparties of non-operational deposits and financial and non-financial counterparties are stressed differently whereas my data only has aggregated data on non-operational deposits. I take this into account in the outflow rates. Table 2 shows the details of the differences between Amamou et al. (2020) idiosyncratic scenario and my resolution stress test.

	Amamou et al. (2020)	My resolution stress test
Outflow rates	40% initial outflow for non-operational deposits of non-financial counterparties, 100 % initial outflow for non-operational deposits of financial counterparties	90% initial outflow for all non-operational deposits
Evolution of counterbalancing capacity	Depends on inflows, deposit outflows and contractual changes of the counterbalancing capacity.	Depends on inflows and deposit outflows. Does not include contractual changes to the counterbalancing capacity
Wholesale funding	Not stressed	Not stressed
Datapoint	Q1/2018	Q4/2023

Table 2: Differences between Amamou et al. (2020) and my resolution stress test

Table 2 highlights the differences between Amamou et al. (2020) and my resolution stress test. Where Amamou et al. (2020) have data on Non-operational deposits from financial customers with a pre-FOLTF stress rate of 100% and Non-operational deposits from central banks and non-financial customers with a pre-FOLTF stress rate of 40%, the public data aggregates data to Non-operational deposits for all counterparties, which I stress at a conservative 90% level in the slow burn crisis scenario and with an 81% level in the fast burn crisis scenario. The evolution of the counterbalancing capacity considers the contractual changes in the counterbalancing capacity in Amamou et al. (2020) whereas in my resolution stress test the counterbalancing capacity only evolves based on cash inflows and deposit outflows. Since the contractual changes of the counterbalancing capacity have a corresponding inflow or outflow, the effect of it is neutral. Therefore this difference does not affect the results. Both the idiosyncratic scenario in Amamou et al. (2020) and my resolution stress test only stress deposits and not wholesale market funding. The data used by Amamou et al. (2020) is almost 6 years older than the data I use.

5.6 Results

The banks under the scope of this study are ten large European banks. Out of the three different liquidity gaps measured Gap 2 is the largest for each bank as Gap 2 requires the bank to hold liquid assets at $t = 2$ to meet the LCR - requirement the bank would have had at $t = 1$, the point of the FOLTF-decision. In the fast burn crisis very-severe pre-FOLTF outflow and very-severe post-FOLTF outflow scenario the largest liquidity gap was 164.0 billion euros as is shown in Figure 3.

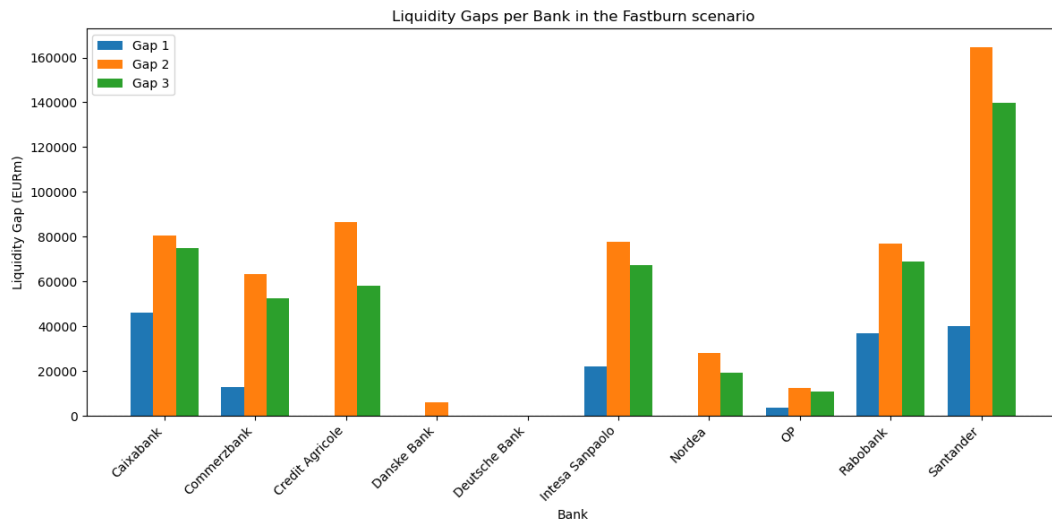


Figure 3: Liquidity gaps per bank in the fast-burn scenario

In the slow burn crisis with very-severe pre-FOLTF outflows and very-severe post-FOLTF outflows the outflow rates are higher and thus the liquidity gaps are also higher, the largest liquidity gap being 182.6 billion euros.

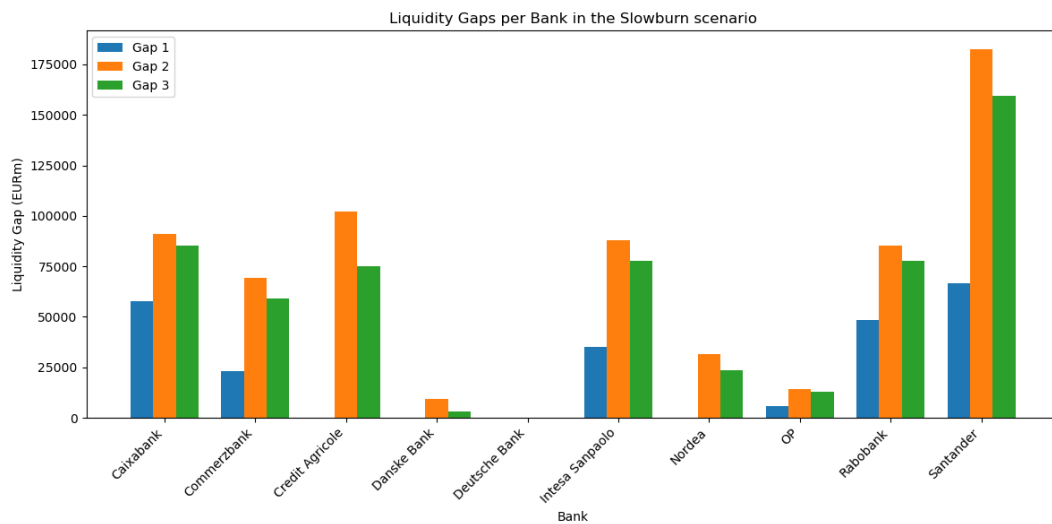


Figure 4: Liquidity gaps per bank in the slow-burn scenario

The liquidity gaps are summarized in more detail in Table 4 in the appendix.

It is good to note that some banks have very high liquidity gaps whereas one bank does not have a liquidity gap at all. This can be explained mainly by the assumption of the crisis that only deposits are stressed and wholesale funding is not stressed. Some banks rely heavily on deposit funding whereas others rely heavily on wholesale funding which is not stressed at all in the resolution stress test scenario of Amamou et al. (2020).

These results show that if such a scenario would occur, even in an idiosyncratic crisis without contagion, the liquidity assistance need of a single bank could be even 180 billion euros. As covered in the literature review, the risk is much larger than the failure of one bank as the problems of a bank can easily spread to other banks through multiple contagion channels.

Table 3 shows the maximum and average sizes of liquidity gaps in my resolution stress test and of Amamou et al. (2020). When comparing maximum liquidity gaps the results are very close even though Amamou et al. (2020) uses data from Q1/2018 and I use data from Q4/2023. The average gap sizes in my resolution stress test are much larger than the average gaps in the scenario of Amamou et al. (2020). This is explained by my small sample which only includes large banks compared to the large sample used by Amamou et al. (2020) which covers 75% of banks' balance sheets in the European Union meaning that Amamou et al. (2020) has many much smaller banks in its data which decrease the average size of the liquidity gaps.

My resolution stress test (EURbn)

	Slow burn			Fast burn		
	Gap 1	Gap 2	Gap 3	Gap 1	Gap 2	Gap 3
Max	66.82	182.57	159.41	45.97	164.66	139.97
Average	20.24	58.62	49.69	13.99	51.89	42.47

Amamou et al. (2020) idiosyncratic scenario (EURbn)

	Slow burn			Fast burn		
	Gap 1	Gap 2	Gap 3	Gap 1	Gap 2	Gap 3
Max	64.75	183.80	157.79	32.59	157.27	126.67
Average	3.39	10.80	9.04	1.15	9.50	7.50

Table 3: Comparison of my results and the results of Amamou et al. (2020)

The size of the banks has a notable correlation with the magnitude of the liquidity gaps. Although this thesis focuses on the magnitude of liquidity gaps to understand the need for liquidity assistance in a very-severe crisis scenario, it is nevertheless of interest to study the relative size of the liquidity gap when comparing to the total assets of the bank as Amamou et al. (2020) also do. In the fast-burn scenario the largest liquidity gap as a share of total assets is 13,2%.

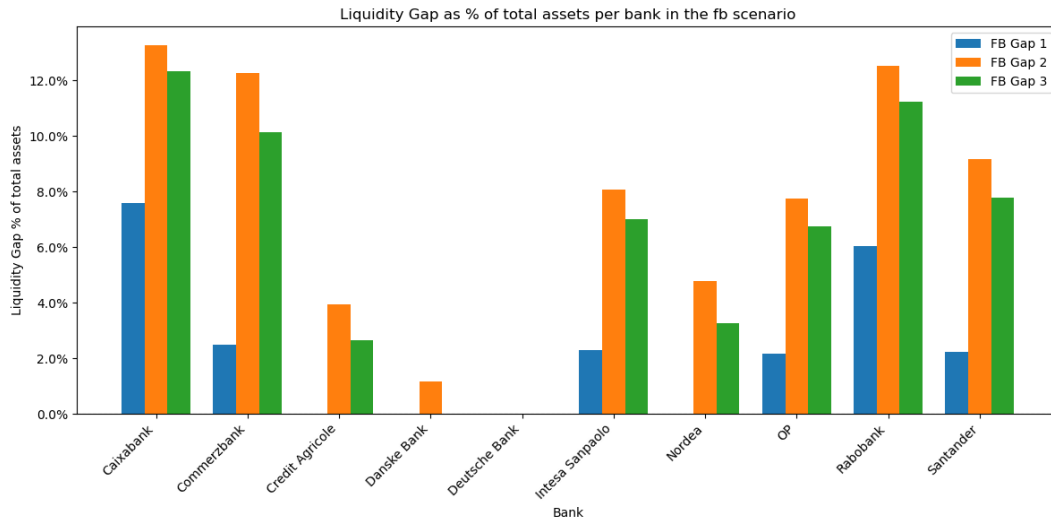


Figure 5: Liquidity gap as a percentage of total assets per bank in the fast-burn scenario

When comparing the sizes of liquidity gaps to the balance sheet in the slow-burn scenario, the largest liquidity gap was again higher due to the higher outflow rates, being at 15.0 percent of total assets.

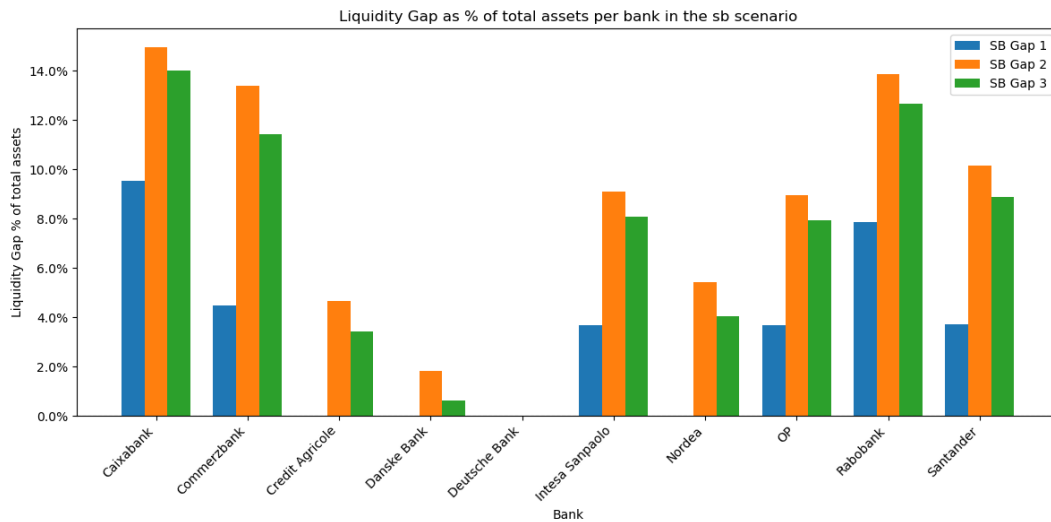


Figure 6: Liquidity gap as a percentage of total assets per bank in the slow-burn scenario

The gaps largest in magnitude are not largest in relative size. The ratio gives

a better understanding of the deposit-reliability of the banks than the magnitude of the gaps.

5.7 Analysis of the relative sizes

The resolution stress test especially stresses the deposits of the banks but does not stress other liabilities on the balance sheet such as wholesale market funding. This would suggest that this resolution stress test is more sensitive to banks whose business depends more on deposit taking than in other forms of liabilities. To understand this connection better a study of the relation between deposit reliability and the size of liquidity gaps is a good illustrative approach. In the figure below is a scatter plot with the share of deposits of the balance sheet on the x-axis and share of the most severe liquidity gap compared to the size of the balance sheet.

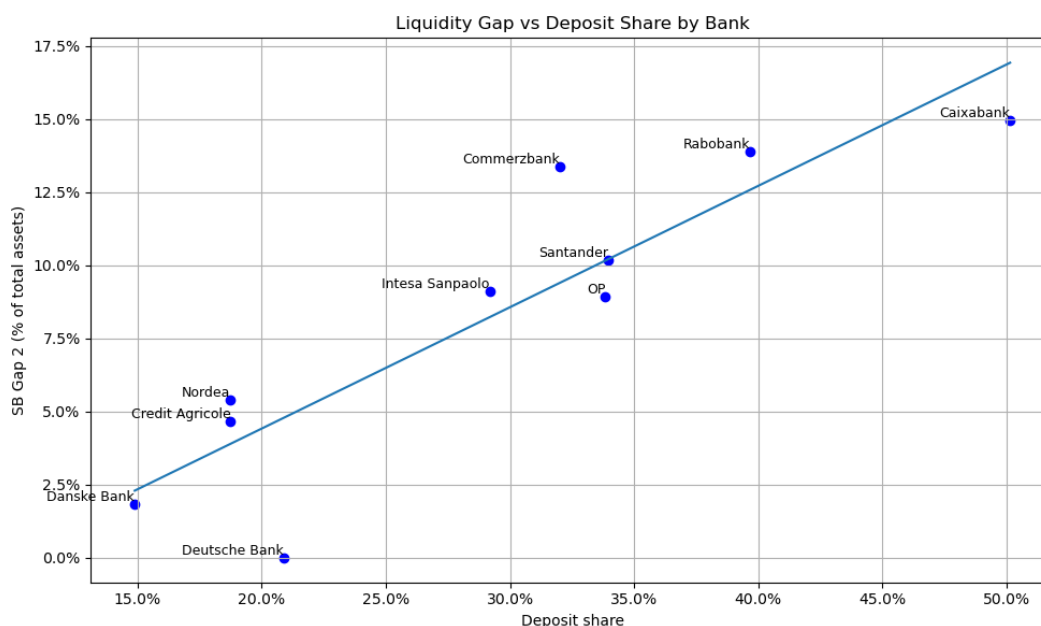


Figure 7: Scatter plot of deposit share and liquidity gap share

From Figure 7 can be seen that the resolution stress test is much harsher on banks which have a higher share of deposits in their balance sheet, but it is

not a perfect correlation. The composition of deposits is related the outflows as riskier deposits have higher outflow rates in the exercise in that a 10 percentage point increase in deposit share is related to a 4,2 percentage point increase in the Liquidity Gap 2 share of total assets in the slow burn scenario.

To better understand the effect of these liquidity gaps on the real economy, Figure 8 below compares the size of Liquidity Gap 2 in the Slow burn scenario to the Gross Domestic Product (GDP) of each bank’s home country.

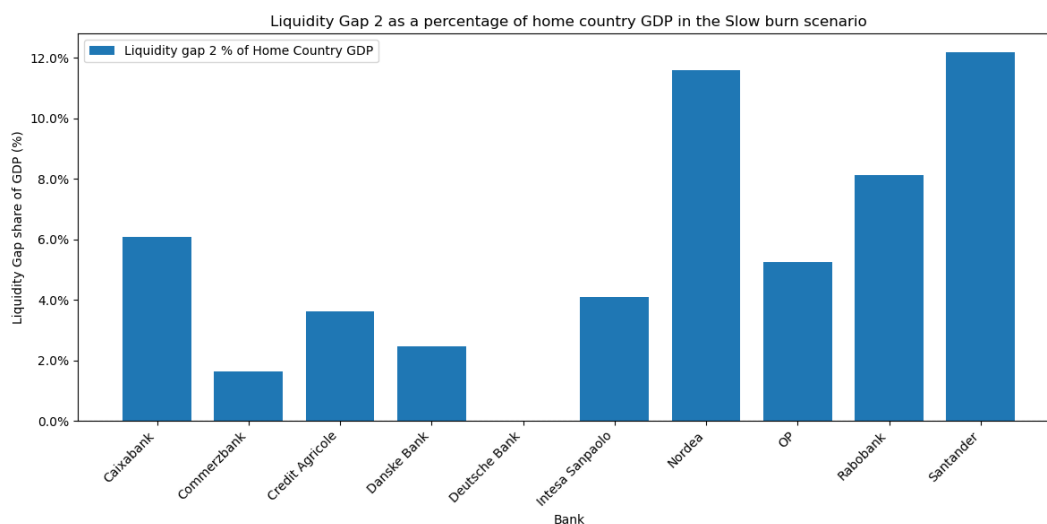


Figure 8: Liquidity Gap 2 as a percentage of home country GDP in the Slow burn scenario by bank

The sizes of these liquidity gaps compare to the home countries GDPs are very significant. Government expenditures in OECD countries amounted 46.3 % in 2021 (OECD, 2025) and financing needs of up to 12 % of a country’s GDP in a severe resolution stress scenario would have vast effects on the respective government’s finances.

5.8 Amamou et al. (2020) systemic crisis

My resolution stress test only considers an idiosyncratic crisis where one bank is affected. In addition to the idiosyncratic bank failures, Amamou et al. (2020) study possible liquidity gaps in a simulated systemic crisis with and without contagion and the 95th percentile liquidity Gap 2 size with contagion is 196,14 billion euros. Furthermore, Amamou et al. (2020) estimate the liquidity gaps when two globally systemically important banks (G-SIB) are resolved, and they find that in such a case on average the liquidity Gap 2 would be 75 billion euros.

The risk of contagion increases the size of liquidity gaps significantly. As covered in the literature review, highly interconnected financial markets increase the likelihood of financial contagion and therefore the failure of one institution carries a contagion risk.

Amamou et al. (2020) conclude that in adverse circumstances the current liquidity support instruments in the European Union, i.e. the Single Resolution Fund (SRF), would be insufficient. They especially note that under systemic events with contagion effects the SRF would be insufficient.

6 Conclusions

The literature study of bank runs, financial contagion, and bank resolutions, as well as the overview of the Single Resolution Mechanism (SRM), the bank resolution cases that the SRM has taken and especially the conducted resolution stress test according to the idiosyncratic crisis scenarios of Amamou et al. (2020) show that while average liquidity gaps are limited, the largest gaps for individual banks are larger than the size of the Single Resolution Fund (SRF). I find that the largest liquidity gap is 182,6 billion euros and the average liquidity gap among the 10 banks studied being 58,6 billion euros. My findings are in line with the findings of Amamou et al. (2020) as they find that the largest liquidity gap is 183,8 billion euros. As the size of the SRF is around 80 billion euros, it is insufficient to cover the liquidity needs in the resolution of an individual bank with a large liquidity gap or even two simultaneous resolutions.

My findings also suggest that banks that use deposits to fund their activities are more sensitive to outflows and have larger liquidity shortfalls. Among the 10 banks studied a 10 percentage point increase in deposit share of total assets was associated with a 4.2 percentage point increase in the size of the liquidity gap of the bank with respect to the total assets.

If contagion leads to a systemic crisis, it is likely that in many cases there would be the need for governments to intervene and as such a risk for taxpayer money use. Considering the fundamental problem of the high risk of bank runs and spreading due to contagion in interconnected banks, as covered in the literature review, it is the case that the Single Resolution Framework has not been able to solve the too-big-to-fail problem as the size of the Single Resolution Fund is not sufficient to handle adverse systemic circumstances. This conclusion of the Single Resolution Mechanism not fully solving the too big to fail problem is in line with the conclusions by Berndt et al.

(2024) where they show that financing costs of too big to fail institutions still reflect a lower risk of failure due to expected government.

A larger liquidity backstop for the SRF would enable it to fund the resolution of large banks even in a systemic crisis. Further legislative work is needed to establish a credible liquidity backstop which collects its funds from the banking sector either ex-ante or ex-post ensuring that taxpayer money is not needed to save systemically important banks. This backstop could be implemented using the European Stability Mechanism, which is already in place and has a capital of 500 billion euros.

Further work with sensitivity analyses to the outflow rates in the resolution stress tests and a scenario stressing wholesale funding would show how banks would react to stronger outflows and the sensitivity of banks to wholesale funding dry ups. Further work could shed light on whether banks taking more deposits are less resilient to financial distress than banks whose balance sheet has a higher share of wholesale funding.

7 Appendix

Table 4 shows the liquidity gaps estimated in my resolution stress test in the fast burn and slow burn scenarios.

Bank	Fastburn Gaps			Slowburn Gaps		
	Gap 1	Gap 2	Gap 3	Gap 1	Gap 2	Gap 3
Caixabank	45970.8	80540.2	74806.2	57846.4	90859.9	85077.4
Commerzbank	12902	63408.4	52317.2	23091.3	69206.2	59173
Credit Agricole	-0	86423	58101.3	-0	102333	75100.2
Danske Bank	-0	5854	-0	-0	9206.9	3056.7
Deutsche Bank	-0	-0	-0	-0	-0	-0
Intesa Sanpaolo	21955.8	77658.4	67356.2	35305.7	87812.2	77756.7
Nordea	-0	27939	19107.1	-0	31625.2	23705.8
OP	3474.2	12401.1	10795.3	5887.8	14343.8	12753.8
Rabobank	36971.4	76906.5	68914.6	48235	85188.3	77806.6
Santander	40130.7	164656	139973	66822.3	182571	159412
Max	45970.8	164656	139973	66822.3	182571	159412
Min	-0	-0	-0	-0	-0	-0
Mean	16140.5	59578.7	49137.1	23718.8	67314.6	57384.2

Table 4: Estimated liquidity gaps (EURm)

Table 5 shows the Pillar 3 LCR disclosure template, with the rows of interest for my study bolded and cells for which data is not reported shaded as grey. This template is the template which banks have reported from which I have extracted the data for my resolution stress test.

Pillar 3 LCR disclosure template			
		Total unweighted assets	Total weighted assets
High-quality liquid assets			
1	Total high-quality liquid assets (HQLA)		
Cash outflows			
2	Retail deposits and deposits from small business customers, of which:		
3	-Stable deposits		
4	-Less stable deposits		
5	Unsecured wholesale funding of which:		
6	-Operational deposits (all counterparties) and deposits in networks of cooperative banks		
7	-Non-operational deposits (all counterparties)		
8	-Unsecured debt		
9	Secured wholesale funding		
10	Additional requirements, of which:		
11	-Outflows related to derivative exposures and other collateral requirements		
12	-Outflows related to loss of funding debt products		
13	-Credit and liquidity facilities		
14	Other contractual funding obligations		
15	Other contingent funding obligations		
16	Total cash outflows		
Cash inflows			
17	Secured lending (eg reverse repos)		
18	Inflows from fully performing exposures		
19	Other cash inflows		
EU-19a	(Difference between total weighted inflows and total weighted outflows arising from transactions in third countries where there are transfer restrictions or which are denominated in non-convertible currencies)		
EU-19b	(Excess inflows from a related specialised credit institution)		
20	Total cash inflows		

Table 5: Pillar 3 LCR disclosure template

Technical details of data processing:

To calculate the liquidity outflows and model the evolution of the high quality liquid assets and derive the liquidity gaps for each bank according to the methodology set out in Amamou et al. (2020) Python was used with the liquidity data for each bank being in an input file and the assumed outflow rates in a separate file. This allows for a flexible update to assumptions and update of data that is used in the scenario. The python code is attached as a separate file to enable the replication of this thesis.

There are four relevant input files that include the bank data, the outflow rates in the scenarios and data on the GDPs of banks' home countries:

The file `Pillar3Bankdata.xlsx` contains the initial bank deposit, liquidity buffer, outflow and inflow data. Line items 1,2,3,4,5,6,7,8,10,11,12,13,14,15 are unweighted values and line items 9,20 and 21 are weighted values which are used in the approximation of the Liquidity Coverage Ratio. Table 5 shows the relevant line items in bolded format.

The file `bs_size.xlsx` includes the balance sheet size and the amount of retail deposits and deposits from small business customers per bank. This file is used in Figure 7 to compare the size of the liquidity gaps to the size of the balance sheet.

The file `outflow_rates.xlsx` includes the outflow rates used in the fast burn and slow burn scenarios for the stressed line items.

The file `gdp_size.xlsx` includes the home country of each bank and the GDP of each bank's home country in millions of euros from 2023.

The python file `liquidity_gap.py` runs the stress test scenarios, produces the graphs and some excel-files as output:

Fastburn_liquidity_buffers_output.xlsx includes the liquidity gaps for each bank in the fast burn scenario.

Slowburn_liquidity_buffers_output.xlsx includes the liquidity gaps for each bank in the slow burn scenario.

Merged_df.xlsx includes the evolution of the deposit base throughout the scenarios

List of banks studied:

Caixabank

Commerzbank

Credit Agricole

Danske Bank

Deutsche Bank

Intesa Sanpaolo

Nordea

OP Group

Rabobank

Santander

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