

**GALATASARAY UNIVERSITY  
INSTITUTE OF SOCIAL SCIENCES  
BUSINESS ADMINISTRATION DEPARTMENT**

**LIQUIDITY REGULATIONS AND THE  
DETERMINANTS OF TURKISH BANKS' LIQUIDITY  
BUFFERS**



**MASTER'S THESIS**

**Buket MENTEŐOĐLU**

**Thesis Advisor: Ass. Prof. Dr. OĐuzhan BAHADIR**

**JUNE 2020**

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## **PREFACE**

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**Buket MENTEŞOĞLU**

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## ABBREVIATIONS

|              |                                                      |
|--------------|------------------------------------------------------|
| <b>BASEL</b> | : Basel Banking Regulation and Supervision Committee |
| <b>BCBS</b>  | : Basel Committee on Banking Supervision             |
| <b>BIS</b>   | : Bank for International Settlements                 |
| <b>BRSA</b>  | : Banking Regulation and Supervision Agency          |
| <b>BU</b>    | : Bottom-up                                          |
| <b>CBRT</b>  | : Central Bank of the Republic of Turkey             |
| <b>FE</b>    | : Fixed Effect                                       |
| <b>FSA</b>   | : Financial Services Authority                       |
| <b>FSAP</b>  | : Financial Sector Assessment Program                |
| <b>FX</b>    | : Foreign Currency                                   |
| <b>GDP</b>   | : Gross Domestic Product                             |
| <b>HQLA</b>  | : High Quality Liquid Assets                         |
| <b>IID</b>   | : Independent and Identically Distributed            |
| <b>ILG</b>   | : Individual Liquidity Guidance                      |
| <b>IMF</b>   | : International Monetary Fund                        |
| <b>LCR</b>   | : Liquidity Coverage Ratio                           |
| <b>LGD</b>   | : Loss Given Default                                 |
| <b>LOLR</b>  | : Lender of Last Resort                              |
| <b>NSFR</b>  | : Net Stable Funding Ratio                           |
| <b>PD</b>    | : Probability of Default                             |
| <b>RE</b>    | : Random Effect                                      |
| <b>SDIF</b>  | : Savings Deposit Insurance Fund                     |
| <b>TBA</b>   | : Turkish Bank Association                           |
| <b>TBS</b>   | : Turkish Banking System                             |
| <b>TD</b>    | : Top-down                                           |
| <b>TL</b>    | : Turkish Lira                                       |

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## RÉSUMÉ

L'objectif de cette étude est de mettre en avant les dispositions prises pour la liquidité conformément aux normes internationales dans le secteur bancaire, qui est la partie la plus importante du secteur financier en Turquie et d'essayer d'expliquer les facteurs qui déterminent la tendance de détention des actifs liquides des banques (tampon de liquidité) à l'aide d'indicateurs macroéconomiques propres à chaque pays et d'indicateurs bancaires.

Le secteur bancaire revêt une importance capitale car il couvre une grande partie du volume des marchés financiers et, d'autre part, la plupart de l'épargne des ménages est conservée sur des comptes de dépôt dans les banques. Avec l'achèvement du processus de restructuration du secteur bancaire turc en 2002, les activités bancaires se sont accélérées et continuent de progresser sous la surveillance des organismes de réglementation et de surveillance. À ce stade, le secteur bancaire turc fournit toutes les transactions et tous les services bancaires, qui sont également fournis dans les pays développés du monde aux particuliers et aux personnes morales, et soutient la croissance et le développement en répondant aux besoins de crédit du secteur réel.

53 banques opèrent dans le secteur bancaire turc et la taille des actifs du secteur a augmenté régulièrement, dépassant le produit intérieur brut (PIB) en 2015. En juin 2019, le ratio de la taille des actifs du secteur bancaire au PIB était à son plus haut niveau avec 106%. Le principal facteur qui a soutenu la croissance des actifs du secteur a été les prêts, qui ont connu une augmentation progressive au cours des 10 dernières années. Dans ce processus, la part des titres dans le portefeuille du système bancaire a diminué, et les banques ont financé le secteur réel et les ménages en transférant leurs fonds des titres aux prêts, en tenant compte de leurs rendements d'intérêts. Les dépôts, en revanche, ont augmenté régulièrement au cours des 10 dernières années et sont devenus la principale source de financement du secteur. En revanche, la part des dépôts dans le total des passifs a diminué au cours de ce processus et le financement hors

dépôt est devenu important. Le principal élément qui a enregistré la plus forte croissance de la dette au cours des dernières années a été les fonds autres que les dépôts en raison de prêts accordés par des banques étrangères. L'augmentation de la liquidité mondiale et la baisse des taux d'intérêt mondiaux ont rendu l'utilisation de fonds étrangers par le secteur plus attrayante en termes de maturité et de coût. Bien que la rentabilité du secteur ait augmenté au cours des 10 dernières années, la rentabilité en dollars américains a diminué en raison de la dépréciation de la livre turque. Les revenus d'intérêts sont restés la principale source de revenus du système bancaire turc. La limite minimale légale d'adéquation des fonds propres est fixée à 8% dans la réglementation BÂLE, mais les banques turques doivent respecter le ratio minimal d'adéquation des fonds propres fixé prudemment à 12% par l'Agence de régulation et de surveillance bancaire<sup>1</sup>. Le ratio d'adéquation des fonds propres du système bancaire turc est supérieur au taux cible et le secteur dispose de suffisamment de fonds propres pour gérer les risques potentiels.

En revanche, le fait que le système dispose de fonds propres suffisants ne suffit pas pour gérer les risques, mais la question de la liquidité, qui constitue le point central de cette étude, est une autre question importante en termes de gestion des risques dans les banques. La liquidité, dans son acception la plus générale, fait référence à la capacité des actifs ou des instruments financiers à revenir en espèces à tout moment sans perte de valeur. Le risque de liquidité survient lorsque les banques ne respectent pas pleinement et à temps leurs obligations en raison de la congestion de trésorerie ou de l'inadéquation des flux de trésorerie causée par le manque d'entrées de trésorerie. (FMI, 2010) Le risque de liquidité est une menace sérieuse dans le système bancaire, car la banque en déficit de trésorerie pourrait devoir céder ses actifs en dessous de son coût ou de sa valeur de marché et / ou les coûts de financement de la banque augmenteront. L'inadéquation des échéances est la principale source de risque de liquidité dans le système bancaire. La maturité des passifs au bilan est plus courte que la maturité des actifs, provoquant une pénurie de liquidités. Plus précisément, les banques émettent de la dette à court terme (dépôts) en échange d'actifs à long terme

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<sup>1</sup> Règlement sur la Mesure et l'évaluation de l'adéquation des fonds propres des Banques:

<https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=21192&MevzuatTur=7&MevzuatTertip=5>

(prêts) utilisés par des particuliers, des entreprises ou le gouvernement. Les flux de trésorerie provenant des actifs bancaires sont généralement constitués de petits paiements s'étalant sur un long horizon. En revanche, la banque s'engage à remplir ses obligations dans un délai beaucoup plus court. Toutes ces activités créent une asymétrie d'échéances entre les actifs et les passifs des banques.

Dans la littérature, deux types de risques de liquidité apparaissent généralement. Le risque de liquidité de financement est défini comme la probabilité que la banque ne soit pas en mesure de faire face à ses dettes immédiatement au cours d'une certaine période. La liquidité du marché est la capacité d'exécuter d'importantes opérations sur titres à faible coût et avec un effet de prix minimum.

Les mesures prises dans le cadre du processus de restructuration du système bancaire en Turquie ont accru la résistance contre les risques du secteur, de sorte que le Secteur Bancaire Turc (SBT) a été moins touché que les autres pays lors de la crise financière mondiale de 2008. Avec la crise financière mondiale, le rôle important de la liquidité dans le bon fonctionnement du secteur bancaire et des marchés financiers a de nouveau été compris. Le monde a été témoin du changement rapide des conditions du marché, où il y avait des marchés d'actifs vivants et de faibles coûts de financement avant la crise, et à quelle vitesse les actifs liquides pouvaient fondre. Lorsque l'effondrement des fonds combiné à la baisse de la liquidité sur le marché, le choc de liquidité s'est propagé rapidement et a provoqué de graves pertes dans le système financier interconnecté en prenant de l'ampleur avec la vente d'actifs bien inférieurs à leurs prix réels.

Bien que les banques soient en bonne condition en termes d'adéquation des fonds propres au cours de cette période, elles étaient soumises à des tensions principalement en raison d'un manque de liquidités. Cette leçon coûteuse tirée de la crise a encouragé les banques et les organismes de réglementation et de surveillance compétents à élaborer des politiques plus complètes et plus prudentes en matière de gestion du risque de liquidité. Le Comité de Surveillance Bancaire de Bâle (Comité de Bâle) a publié un certain nombre de principes visant à renforcer la gestion de la liquidité afin de

renforcer la résilience des banques et leur protection contre les crises futures. En plus des réglementations quantitatives déterminant le niveau de liquidité minimum telles que le ratio de couverture de liquidité et le taux de financement net stable, des outils de suivi qualitatif développés dans les questions de gestion et de contrôle des risques ont été définis et guidés.

D'autre part, le règlement sur la mesure et l'évaluation de l'adéquation de la liquidité des banques, entré en vigueur le 1er novembre 2006, visait à réglementer les principes et procédures permettant aux banques d'assurer et de maintenir un niveau de liquidité suffisant pour faire face à leurs engagements.<sup>2</sup> Il a également mis en œuvre des normes internationales établies après la crise de 2008. Avec le règlement sur le calcul du ratio de couverture des liquidités des banques, entré en vigueur le 21 mars 2014, les procédures et principes de conservation des liquidités suffisantes et de qualité suffisante pour faire face à leurs sorties nettes de trésorerie ont été déterminés afin d'ajuster le minimum niveau de liquidité.<sup>3</sup> En outre, un guide de bonnes pratiques sur la gestion des risques de liquidité a été publié en mars 2016 afin d'améliorer la capacité des banques à gérer les risques.<sup>4</sup>

Les tests de résistance constituent un autre outil important pour évaluer les profils de risque de liquidité des banques. Les tests de résistance à la liquidité permettent d'évaluer globalement si les ressources internes des banques sont suffisantes pour résister à des conditions défavorables. Les banques visent à capturer le risque de pouvoir créer des ressources suffisantes pour faire face à ses obligations à court terme après des sorties de trésorerie soudaines, en évaluant si les sources de financement disponibles sont suffisantes pendant une période de crise définie.

Ces réglementations encouragent les banques à honorer leurs obligations à leur échéance et à maintenir en même temps des liquidités suffisantes, c'est-à-dire à créer

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<sup>2</sup> Règlement sur la Mesure et l'évaluation de l'adéquation de la Liquidité des Banques:  
<https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=10749&MevzuatTur=7&MevzuatTertip=5>

<sup>3</sup> Règlement sur le Calcul du Ratio de Couverture de Liquidité des Banques:  
<https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=19498&MevzuatTur=7&MevzuatTertip=5>

<sup>4</sup> Guide de Bonnes Pratiques sur la Gestion des Risques de Liquidité:  
[https://www.bddk.org.tr/ContentBddk/dokuman/mevzuat\\_0096.pdf](https://www.bddk.org.tr/ContentBddk/dokuman/mevzuat_0096.pdf)

des réserves de liquidité pour gérer les chocs, sans avoir besoin du soutien de liquidité des banques centrales. Les banques devraient créer des tampons de liquidité à partir des actifs les plus liquides qui peuvent être vendus facilement et rapidement avec des pertes mineures. Il peut s'agir de trésorerie et d'équivalents de trésorerie, de titres hautement fiduciaires émis par des trésors de pays ou des banques centrales et des titres de créance similaires.

Au cours de la période précédant la crise, la définition de tampons de liquidité susceptibles de faire face à un stress de liquidité a été acceptée comme la capacité des entrées de trésorerie à faire face aux sorties de trésorerie, se concentrant ainsi sur la liquidité de la dette. Au cours de la période de crise, l'accent a été mis sur la liquidité des actifs ces derniers temps, car de nombreuses classes d'actifs semblent être moins liquides que prévu. Dans ce contexte, il est avancé que les actifs utilisés comme tampons devraient appartenir à la classe d'actifs liquides de haute qualité. Dans les études précédentes, alors que le ratio prêt / dépôt était utilisé comme principal critère de risque de liquidité, dans cette étude, l'indicateur de liquidité a été déterminé comme la part d'actifs liquides de haute qualité dans l'actif total en se concentrant sur la liquidité des actifs.

Il existe un nombre limité d'études<sup>5</sup> dans la littérature qui examinent directement les déterminants des comportements de détention du coussin de liquidité des banques, et les analyses sont généralement effectuées avec des variables spécifiques aux banques, des variables macroéconomiques et des dynamiques spécifiques aux pays. La principale question à laquelle cette étude cherche une réponse est de savoir ce qui détermine les préférences des banques de conserver les actifs liquides dans leurs bilans comme amortisseurs de risques potentiels au lieu de générer des bénéfices. Quelles variables propres aux banques affectent la tendance des banques à détenir des actifs liquides et quels sont les effets des conditions macroéconomiques, des périodes de crise et des réglementations légales sur les tampons de liquidité?

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<sup>5</sup> Aspachs et al. (2005), Vodová (2011), Delechat et al. (2012), Bonner et al. (2013), Chen et Phuong (2014).

Un autre objectif de cette étude est d'évaluer les déterminants des tampons de liquidité dans le secteur bancaire turc en tenant compte des situations spécifiques à chaque pays. Comme on le sait, la Turquie a restructuré le secteur bancaire en 2001 après la crise régionale et pris un certain nombre de dispositions pour améliorer la résistance aux chocs des banques. Ainsi, la réglementation après la crise locale du système bancaire turc, moins touché par la crise mondiale de 2008 que les autres pays, a donné aux banques turques la possibilité de créer des tampons de liquidité avant les autres pays. En revanche, la baisse des swap de défaut de crédit (SDC) et des notes de crédit des économies fragiles comme la Turquie sont devenues des indicateurs importants. Par conséquent, les modèles analysant l'effet de ces facteurs sur les tampons de liquidité devraient apporter une contribution importante à la littérature.

À ces fins, 5 modèles économétriques à effets fixes différents ont été examinés par analyse de données de panel. Ces modèles sont répertoriés comme suit: modèle bancaire, modèle bancaire et macroéconomique, modèle de crise, modèle de réglementation, modèle d'événements déclencheurs.

Dans la section d'analyse de cette étude, 20 banques de dépôts, couvrant 90% des actifs du secteur bancaire turc, ont été analysées au cours des périodes 2006T1-2019T2 en utilisant la méthode de régression par panel à effet fixe dans laquelle les différences entre les banques ont été éliminées. Contrairement aux études de la littérature, le ratio de liquidité variable dépendant utilisé dans les analyses a été conçu dans le concept de ratio de couverture de liquidité. En d'autres termes, le rapport des actifs liquides de haute qualité au total des actifs bancaires a été déterminé comme une variable dépendante.

Selon les résultats de l'analyse, une relation négative et statistiquement significative a été trouvée entre la taille des actifs bancaires et les tampons de liquidité. En d'autres termes, on peut dire que les grandes banques détiennent généralement des actifs moins liquides. Une forte relation positive a été déterminée entre le ratio d'adéquation des fonds propres et la taille du coussin de liquidité. Pour voir l'effet de sources de fonds stables sur les tampons, la variable de dépôt d'épargne est incluse

dans l'analyse et il existe une relation négative entre cette variable et les tampons de liquidité. D'après ce résultat, il est conclu que les banques avec des sources de fonds plus stables ajustent leurs tampons en conséquence et ont tendance à détenir des actifs moins liquides grâce à ces fonds. Parmi les variables propres à la banque, le ratio des prêts non performants est une autre variable qui donne des résultats significatifs dans l'étude. Comme prévu et conformément aux études précédentes dans la littérature, une relation positive a été trouvée entre les prêts non performants et les tampons de liquidité. En revanche, aucune relation statistiquement significative n'a été trouvée entre le rendement des actifs et les taux de marge d'intérêt nets, inclus dans les indicateurs de performance, et les tampons de liquidité des banques.

Compte tenu des résultats liés aux indicateurs macroéconomiques, une relation négative a été trouvée entre la croissance réelle du produit intérieur brut et les tampons de liquidité des banques. Il a été conclu que les banques turques conservaient moins d'actifs liquides pendant les périodes de croissance économique et augmentaient les réserves pendant la période de ralentissement économique. De plus, aucune relation significative n'a été trouvée entre les autres variables macroéconomiques, l'inflation et les taux d'intérêt et les tampons de liquidité.

Aucune corrélation significative n'a été trouvée entre la variable indicatrice de crise utilisée pour analyser afin de voir l'impact des périodes de crise sur la tendance des banques à détenir des actifs liquides et des tampons de liquidité. Grâce aux mesures proactives prises par la Agence de Régulation et Surveillance Bancaire (ARSB) pendant la période précédant la crise, on peut conclure que les tampons bancaires ne sont pas affectés par la variable de crise.

La variable muette de régulation qui examine l'effet du ratio de couverture des liquidités, qui est l'un des dispositifs mis en place par le Comité de Bâle pour renforcer le système bancaire après la crise de 2008, n'a pas trouvé de sens dans l'analyse.

Dans cette étude, les effets de deux indicateurs qui pourraient également affecter les tampons de liquidité des banques ont été étudiés. Pour autant que je sache, cela n'a

pas été évalué dans des études antérieures. Selon les résultats, la variation des SDC et des notations de crédit et l'interaction de ces deux variables n'ont pas eu d'effet significatif sur les tampons de liquidité des banques turques.

Par conséquent, dans cette étude, les actifs liquides détenus par les banques turques sont évalués dans le cadre du coussin de liquidité, qui est défini conformément aux dernières réglementations. Lors de ces évaluations, un ensemble complet de variables avec des indicateurs spécifiques aux banques, macroéconomiques et spécifiques aux pays a été utilisé. Cependant, d'autres variables peuvent expliquer la variable dépendante et ne peuvent pas être incluses dans cette analyse. D'autre part, outre de nombreux facteurs qui affecteront la liquidité, il est nécessaire de considérer la dimension comportementale de la liquidité et la difficulté de modéliser cette partie. De telles analyses ne seront possibles qu'avec la présence de données plus détaillées. Actuellement, les données publiques ont été essayées pour être utilisées aussi efficacement que possible.

D'un autre côté, étant donné que le problème de liquidité est également un problème d'inadéquation des échéances comme suggestion pour d'autres études, des résultats beaucoup plus sensibles peuvent être obtenus en considérant les dimensions des échéances des postes du bilan dans l'analyse. Des résultats beaucoup plus significatifs peuvent être obtenus si les données pertinentes peuvent être collectées dans de futures études. De plus, l'inclusion d'éléments hors bilan, qui font partie du processus de création de liquidité, sera une étape importante dans le développement de l'étude. En effet, les transactions sur produits dérivés occupent une place importante dans la réglementation des liquidités de Bâle parmi les transactions hors bilan. Enfin, la sélection et l'agencement des variables en fonction de la dynamique du pays analysé est également très important. Par exemple, dans cette étude, les SDC et les effets de notation, qui font partie de la dynamique du pays, ont été pris en considération.

**Mots-clés:** Risque de liquidité, Tampons de liquidité, Ratio de couverture de la liquidité, Bâle III, Test de résistance à la liquidité, Secteur Bancaire Turc

## **ABSTRACT**

The purpose of this study is to put forward the arrangements made for liquidity in accordance with international standards in the banking sector, which is the most important part of the financial sector in Turkey and to explain the factors that determine banks' liquid asset holding tendency (liquidity buffers) with the help of macroeconomic - country specific indicators and banking indicators.

The banking sector has key importance since it covers a large portion of the volume of financial markets and most of the household savings are kept in deposit accounts in banks. With the completion of the restructuring process of the Turkish banking sector in 2002, banking activities gained momentum and continue to progress under the surveillance of regulatory and supervisory agencies. As of the current stage, the Turkish banking sector provides all banking transactions and services, which is also provided in the developed countries of the world to individuals and legal entities, and supports growth and development by meeting the credit needs of the real sector.

53 banks operate in the Turkish Banking Sector and the asset size of the sector has increased steadily, exceeding the gross domestic product (GDP) in 2015. As of June 2019, the ratio of asset size of the banking sector to GDP is at its highest level with 106%. (BRSA, 2019) The most important factor supporting the sector's asset growth was loans, which showed gradual increases in the last 10 years. In this process, the share of securities in the portfolio of the banking system decreased, and the banks funded the real sector and households by transferring their funds from securities to loans, taking into account their interest returns. Deposits, on the other hand, increased steadily in the last 10 years and became the most important source of funding in the sector. Besides, the share of deposits in total liabilities decreased in this process and non-deposit funding became important. The key item that showed the highest growth

in terms of debt in recent years has been non-deposit funds due to loans from foreign banks. Increasing global liquidity and decreasing global interest rates have made the sector's use of funds from abroad more attractive in terms of maturity and cost. Although the profitability of the sector has increased in the last 10 years, the profitability in US Dollars has decreased due to the depreciation in Turkish Lira. Interest income remained the main source of income in the Turkish banking system. The legal minimum limit for capital adequacy is set at 8% in BASEL regulations, but Turkish banks must meet the target minimum capital adequacy ratio set prudently at 12% by the Banking Regulation and Supervision Agency<sup>6</sup>. The capital adequacy ratio of the Turkish banking system is above the target rate and the sector has the enough capital to manage potential risks.

On the other hand, the fact that the system has adequate capital is not sufficient to manage the risks, but the liquidity issue, which constitutes the focus of this study, is another important issue in terms of risk management in banks. Liquidity, in its most general sense, refers to the ability of assets or financial instruments to return to cash at any time without losing value. Liquidity risk is the failure of banks to fulfill their obligations fully and on time due to lack of cash flow or cash flow mismatch due to lack of cash inflows. (IMF, 2010) Liquidity risk is a serious threat in the banking system, as the bank with a cash deficit may have to dispose of its assets below its cost or market value and/or the bank's funding costs will increase. Maturity mismatch is the main source of liquidity risk in the banking system. The maturity of the liabilities on the balance sheet is shorter than the maturity of the assets, causing liquidity shortage. More specifically, banks issue short-term debt (deposits) in exchange for long-term assets (loans) used by individuals, companies or the government. Cash flows from bank assets generally consist of small payments spanning a long horizon. On the other hand, the bank undertakes to fulfill its obligations in a much shorter time. All these activities create a maturity mismatch between banks' assets and liabilities.

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<sup>6</sup> Regulation on the Measurement and Evaluation of Capital Adequacy of Banks: <https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=21192&MevzuatTur=7&MevzuatTertip=5>

In literature, two types of liquidity risks generally come to the fore. Funding liquidity risk is defined as the probability of the bank not being able to meet its debts immediately within a certain period. Market liquidity is the capacity to execute large securities transactions at a low cost and with a minimum price effect.

The actions taken in the restructuring process of the banking system in Turkey has increased the resistance against the risks of the sector so Turkish Banking Sector (TBS) has less affected than other countries in the 2008 global financial crisis. With the global financial crisis, the important role of liquidity in the healthy functioning of the banking sector and financial markets has once again been understood. The world has witnessed the rapid change of the market conditions, where there were live asset markets and low funding costs before the crisis, and how quickly liquid assets could melt. When the meltdown of funds combined with the drop in liquidity in the market, the liquidity shock spread rapidly and caused serious losses in the interconnected financial system by gaining momentum with the sale of assets much lower than their real prices.

Although banks were in good condition in terms of capital adequacy in this period, they were under stress mainly due to liquidity shortage. This costly lesson learned from the crisis encouraged banks and competent regulatory and supervisory agencies to develop more comprehensive and prudent policies on liquidity risk management. The Basel Banking Supervision Committee (Basel Committee) has published a number of principles to strengthen liquidity management in order to make banks more resilient and protect against future crises. In addition to the quantitative regulations determining the minimum liquidity level such as Liquidity Coverage Ratio and Net Stable Funding Rate, qualitative monitoring tools developed in risk management and control issues were defined and guided.

On the other hand, the Regulation on Measurement and Assessment of Liquidity Adequacy of Banks, which came into force on November 1, 2006<sup>7</sup>, aimed to regulate

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<sup>7</sup> Regulation on Measurement and Assessment of Liquidity Adequacy of Banks: <https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=10749&MevzuatTur=7&MevzuatTertip=5>

the principles and procedures for banks to ensure and maintain a sufficient liquidity level to meet their liabilities. It has also implemented international standards set after the 2008 crisis. With the Regulation on Calculation of Liquidity Coverage Ratio of Banks, which came into force on March 21, 2014<sup>8</sup>, the procedures and principles for keeping the banks with sufficient high quality liquid assets to meet their net cash outflows were determined in order to adjust the minimum liquidity level. Also, a Good Practice Guide on Liquidity Risk Management was published in March 2016<sup>9</sup> in order to improve banks' ability to manage risks.

Another important tool for evaluating banks' liquidity risk profiles is stress tests. Liquidity stress tests provide a comprehensive assessment of whether banks' internal resources are sufficient to withstand adverse conditions. The banks aim to capture the risk of whether they will be able to create sufficient resources to meet its short-term obligations after sudden cash outflows, by assessing whether the available funding sources are sufficient during a defined stress period.

These regulations encourage banks to fulfill their obligations when they are due, and at the same time maintain sufficient liquid assets, ie to create liquidity buffers to manage shocks, without the need for central banks' liquidity support. Banks should create liquidity buffers from the most liquid assets that can be sold easily and quickly with minor losses. These can be cash and cash equivalents, high-trust securities issued by country treasures or central banks, and similar debt instruments.

In the pre-crisis period, the definition of liquidity buffers that could meet liquidity stress was accepted as the capacity of cash inflows to meet cash outflows, thus focusing on debt liquidity. In the crisis period, the emphasis is on asset liquidity in recent times as many asset classes seem to be less liquid than expected. In this context, it is argued that the assets used as buffers should be in the high quality liquid asset class. In previous studies, while the ratio of loan to deposit was used as the main

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<sup>8</sup> Regulation on Calculation of Liquidity Coverage Ratio of Banks:  
<https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=19498&MevzuatTur=7&MevzuatTertip=5>

<sup>9</sup> Good Practice Guide on Liquidity Risk Management:  
[https://www.bddk.org.tr/ContentBddk/dokuman/mevzuat\\_0096.pdf](https://www.bddk.org.tr/ContentBddk/dokuman/mevzuat_0096.pdf)

liquidity risk criterion, in this study, the liquidity indicator was determined as the share of high quality liquid assets in total asset by focusing on asset liquidity.

There are a limited number of studies<sup>10</sup> in the literature that directly examine the determinants of banks' liquidity buffer holding behaviors, and analyzes are generally carried out with bank-specific variables, macroeconomic variables and country-specific dynamics. The main question in which this study seeks an answer is what determines the banks' preferences to keep liquid assets in their balance sheets as buffers for possible risks instead of generating profit. Which bank-specific variables affect banks' tendency to hold liquid assets and what are the effects of macroeconomic conditions, crisis periods and legal regulations on liquidity buffers?

Another aim of this study is to evaluate the determinants of liquidity buffers in the Turkish banking sector by considering country-specific situations. Turkey, in 2001 restructured the banking sector after the regional crisis and made a number of arrangements to improve the resistance to shocks of banks. Thus, the regulations after the local crisis in the Turkish Banking system, which was less affected by the 2008 global crisis than other countries, gave Turkish banks the opportunity to create liquidity buffers before other countries. On the other hand, the decline in CDS and credit notes fragile economies like Turkey have become important indicators. Therefore, models analyzing the effect of these factors on liquidity buffers are expected to make an important contribution to the literature.

For these purposes, 5 different fixed effect econometric models were examined by panel data analysis. These models are listed as follows: Banking Model, Banking and Macroeconomic Model, Crisis Model, Regulation Model, Trigger Events Model.

In the analysis section of the study, 20 deposit banks, covering 90% of the Turkish banking sector assets, were analyzed in the 2006Q1-2019Q2 periods using the fixed-effect panel regression method in which the differences between the banks were

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<sup>10</sup> Aspachs et al. (2005), Vodová (2011), Delechat et al. (2012), Bonner et al. (2013), Chen and Phuong (2014).

eliminated. Unlike studies in the literature, the dependent variable liquidity ratio used in the analyzes was designed in the concept of liquidity coverage ratio. In other words, the ratio of high-quality liquid assets to total bank assets was determined as a dependent variable.

According to the results of the analysis, a negative and statistically significant relationship was found between bank asset size and liquidity buffers. Therefore, it can be said that large banks tend to hold less liquid assets. A strong positive relationship was determined between the capital adequacy ratio and the liquidity buffer size. To see the effect of stable fund sources on buffers, the savings deposit variable is included in the analysis and there is a negative relationship between this variable and liquidity buffers. According to this result, it is concluded that banks with more stable fund sources adjust their buffers accordingly and tend to hold less liquid assets thanks to these funds.

Among the bank-specific variables, the ratio of non-performing loans is another variable that gives meaningful results in the study. As expected and in line with previous studies in the literature, a positive relationship was found between non-performing loans and liquidity buffers. On the other hand, there is no statistically significant relationship between asset return and net interest margin rates, included in performance indicators, and banks' liquidity buffers.

Considering the results related to macroeconomic indicators, a negative relationship was found between the real growth of gross domestic product and the liquidity buffers of banks. It was concluded that Turkish banks kept less liquid assets in the periods of rise in the economy and increased buffers during the economic downturn period. In addition, no significant relationship was found between the other macroeconomic variables, inflation and interest rates, and liquidity buffers.

No significant correlation was found between the crisis dummy variable used to analyze to see the impact of crisis periods on banks' tendency to hold liquid assets and liquidity buffers. As a result of the proactive measures taken by the Banking

Regulation and Supervision Agency (BRSA) in the pre-crisis period, it can be concluded that bank buffers are not affected by the crisis variable.

The regulation dummy variable that examines the effect of liquidity coverage ratio, which is one of the arrangements brought by the Basel committee to make the banking system stronger after the 2008 crisis, has been found meaningless in the analysis.

In this study, the effects of two indicators that are also thought to affect the liquidity buffers of banks were investigated. As far as I know, this has not been evaluated in previous studies. According to the results, the change in CDS and credit ratings and the interaction of these two variables did not have a significant effect on the liquidity buffers of Turkish banks.

Consequently, the liquid assets holding of Turkish banks are evaluated within the scope of liquidity buffer, which is defined in accordance with the latest regulations. While making these evaluations, a comprehensive set of variables with bank-specific, macroeconomic and country-specific indicators were used. However, there may be other variables that explain the dependent variable and cannot be included in this analysis. On the other hand, besides many factors that will affect liquidity, it is necessary to consider the behavioral dimension of liquidity and the difficulty of modeling this part. Such analyzes will only be possible with the presence of more detailed data. Currently, public data has been tried to be used as efficiently as possible.

Considering the liquidity problem is also a maturity mismatch problem as a suggestion for further studies, much more sensitive results can be obtained by considering the maturity dimensions of the balance sheet items in the analysis. Much more meaningful results can be obtained if the relevant data can be collected in future studies. In addition, the inclusion of off-balance sheet items, which are part of the liquidity creation process, will be an important step in the development of the study. This is because derivative transactions have an important place in Basel liquidity regulation among off-balance sheet transactions. Finally, the selection and

arrangement of variables according to the dynamics of the analyzed country is also very important. For example, in this study, CDS and rating effects, which are among the dynamics of the country, were taken into consideration.

**Keywords:** Liquidity Risk, Liquidity Buffers, Liquidity Coverage Ratio, Basel III, Liquidity Stress Test, Turkish Banking Sector



## ÖZET

Bu çalışmanın amacı, Türkiye’de finans sektörünün en önemli parçası olan bankacılık sektöründe uluslararası standartlara uygun olarak likiditeye ilişkin yapılan düzenlemeleri ortaya koyarak bankaların likit varlık tutma eğilimini (likidite tamponlarını) belirleyen faktörleri makroekonomik - ülkeye özgü göstergeler ve bankacılık göstergeleri ile açıklamaya çalışmaktır.

Türkiye’de bankacılık sektörü finansal piyasalar içindeki sermaye hacminin büyüklüğünden ve hanehalkı tasarruflarının büyük bir kısmının bankalarda mevduat hesaplarında tutulmasından ötürü kilit öneme sahiptir. 2002 yılında Türk bankacılık sektörünün yeniden yapılandırılma sürecinin tamamlanmasıyla bankacılık faaliyetleri ivme kazanmış olup düzenleyici ve denetleyici kurumların gözetiminde ilerleme kaydetmeye devam etmektedir. Geline aşama itibarıyla Türk bankacılık sektörü dünyanın gelişmiş ülkelerinde yer alan tüm bankacılık işlem ve hizmetleri bireylere ve tüzel kişilere sunmakta reel sektörün kredi ihtiyacı karşılanarak büyüme ve kalkınmaya destek olmaktadır.

Türk Bankacılık Sektöründe 53 banka faaliyet göstermekte olup sektörün aktif büyüklüğü istikrarlı bir şekilde artarak 2015 yılında gayrisafi yurt içi hasıla (GSYH) büyüklüğünü geçmiştir. Haziran 2019 itibarıyla bankacılık sektörü aktif büyüklüğünün GSYH’ye oranı %106 ile tarihi en yüksek seviyesindedir. Sektörün aktif büyümesini destekleyen en önemli faktör son 10 yılda kademeli artışlar gösteren krediler olmuştur. Bu süreçte bankacılık sisteminin portföyünde bulunan menkul kıymetlerin payı ise azalma kaydetmiş, bankalar faiz getirilerini de dikkate alarak fon yatırımlarını menkul kıymetlerden kredilere aktararak reel sektör ve hanehalkını fonlamıştır. Mevduat ise son 10 yılda istikrarlı bir şekilde artarak sektörün en önemli fonlama kaynağı olmuştur. Öte yandan, mevduatın toplam pasifler içindeki payı bu süreçte azalarak mevduat dışı

fonlama da önemli hale gelmiştir. Son yıllarda borçlar tarafında en yüksek büyümeyi gösteren kilit kalem, yabancı bankalardan alınan kredilere bağlı mevduat dışı fonlar olmuştur. Artan küresel likidite ve küresel faiz oranlarındaki düşüş sektörün yurt dışından fon kullanımını vade ve maliyet açısından daha cazip hale getirmiştir. Sektörün karlılığı da son 10 yıllık süreçte artış göstermiş olsa da Türk Lirası'ndaki değer kaybından ötürü ABD Doları cinsinden karlılık azalmıştır. Faiz geliri, Türk bankacılık sistemindeki ana gelir kaynağı olmaya devam etmiştir. Sermaye yeterliliği için yasal asgari sınır BASEL düzenlemelerinde %8 olarak belirlense de Türk bankalarının Bankacılık Düzenleme ve Denetleme Kurumu tarafından ihtiyaten %12 olarak belirlenen hedef minimum sermaye yeterlilik oranını karşılamaları gerekmektedir. Türk bankacılık sisteminin sermaye yeterlilik oranı hedef oranın üzerinde olup sektör olası riskleri yönetebilecek düzeyde sermayeye sahiptir.

Öte yandan sistemin yeterli sermayeye sahip olması riskleri yönetmek için tek başına yeterli olmamakla birlikte bu çalışmanın temel odağını oluşturan likidite konusu da bankalarda risk yönetimi açısından bir diğer önemli husustur. Likidite, en genel anlamıyla, varlıkların veya finansal araçların değer kaybetmeden herhangi bir zamanda paraya dönme kabiliyetini ifade etmektedir. Likidite riski ise bankaların nakit sıkışıklığı veya nakit girişlerinin eksikliğinden kaynaklanan nakit akışı uyumsuzluğu nedeniyle yükümlülüklerini tam ve zamanında yerine getirememesi durumudur. (IMF, 2010) Likidite riski, bankacılık sisteminde ciddi bir tehdittir, çünkü nakit açığı bulunan banka varlıklarını maliyetinin veya piyasa değerinin altına satmak zorunda kalmasına ve/veya nakit sıkışıklığını gidermek için yüksek fonlama maliyetlerine katlanmasına sebep olabilmektedir. Vade uyumsuzluğu bankacılık sistemindeki likidite riskinin ana kaynağıdır. Bilançodaki yükümlülüklerin vadelerinin varlıkların vadelerinden daha kısa olması likidite sıkıntısına neden olmaktadır. Daha spesifik olarak, bankalar bireyler, şirketler veya hükümet tarafından kullanılan uzun vadeli varlıklar (krediler) karşılığında kısa vadeli borç (mevduat) ihraç etmektedir. Banka varlıklarından nakit akışları, genellikle uzun bir ufka yayılan küçük ödemelerden oluşur. Öte yandan, banka yükümlülüklerini çok daha kısa sürede yerine getirmeyi taahhüt eder. Tüm bu faaliyetler bankaların varlık ve yükümlülükleri arasında bir vade uyumsuzluğu yaratmaktadır.

Literatürde genel olarak 2 tür likidite riski öne çıkmaktadır. Fonlama likidite riski bankanın belirli bir süre içinde borçlarını derhal yerine getirememesi olasılığı olarak tanımlanmaktadır. Piyasa likiditesi ise büyük menkul kıymet alım satımlarını düşük maliyetle ve minimum fiyat etkisiyle hızlı bir şekilde yürütme kapasitesidir.

Türkiye’de bankacılık sisteminin yeniden yapılanma sürecinde alınan aksiyonlar sektörün risklere karşı direncini artırmış olup 2008 küresel finansal krizinden diğer ülkelere göre bankacılık sistemi daha az etkilenmiştir. Küresel finansal krizle birlikte bankacılık sektörünün ve finansal piyasaların sağlıklı işleyişinde likiditenin önemli rolü bir kez daha anlaşılmıştır. Dünya krizden önceki canlı varlık piyasaları ve düşük fonlama maliyetlerinin olduğu piyasa koşullarının kriz ortamında hızla değişimine ve likit varlıkların ne kadar çabuk eriyebileceğine tanık olmuştur. Fonların erimesi piyasadaki likidite düşüşüyle birleştiğinde likidite şoku hızlı bir şekilde yayılmış varlıkların gerçek fiyatlarının çok daha altında satışıyla hız kazanarak birbirine bağlı finansal sistemde ciddi tahribatlara neden olmuştur.

Bankalar bu dönemde sermaye yeterliliği açısından iyi durumda olmalarına rağmen temelde likidite sıkıntısı nedeniyle stres altına girmiştir. Krizden çıkarılan bu maliyetli ders, bankalar ile yetkili düzenleyici ve denetleyici kuruluşları likidite risk yönetimi konularında daha kapsamlı ve ihtiyatlı politikalar geliştirmeye teşvik etmiştir. Basel Bankacılık Denetim Komitesi (Basel Komite), bankaları daha dirençli hale getirmek ve gelecekteki krizlere karşı korumak amacıyla likidite yönetimini güçlendirmek üzere bir dizi prensipler yayımlamıştır. Likidite Karşılama Oranı ve Net İstikrarlı Fonlama Oranı gibi asgari likidite düzeyini belirleyen sayısal düzenlemelerin yanı sıra risk yönetimi ve denetimi konularında geliştirilen niteliksel izleme araçları tanımlanarak rehberlik edilmiştir.

Öte yandan Türkiye’de 1 Kasım 2006<sup>11</sup> tarihinde yürürlüğe giren ve halen yürürlükte olan Bankaların Likidite Yeterliliğinin Ölçülmesine ve

<sup>11</sup> Bankaların Likidite Yeterliliğinin Ölçülmesine ve Değerlendirilmesine İlişkin Yönetmelik: <https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=10749&MevzuatTur=7&MevzuatTertip=5>

Değerlendirilmesine İlişkin Yönetmelik bankaların varlıklarının yükümlülüklerini karşılayabilecek şekilde yeterli likidite düzeyini sağlamaları ve sürdürmelerine ilişkin usul ve esasları düzenlemeyi amaçlamıştır. Ayrıca 2008 krizinden sonra belirlenen uluslararası standartları da uygulamıştır. 21 Mart 2014 tarihinde yürürlüğe giren ve halen yürürlükte olan Bankaların Likidite Karşılama Oranı Hesaplamasına İlişkin Yönetmelik ile bankaların asgari likidite düzeyini belirlemek amacıyla net nakit çıkışlarını karşılayabilecek seviyede yeterli yüksek kaliteli likit varlık stoku bulundurmalarına ilişkin usul ve esaslar belirlenmiştir.<sup>12</sup> Ayrıca bankaların riskleri yönetme kabiliyetlerini geliştirmeleri açısından Mart 2016'da Likidite Riskinin Yönetimine İlişkin İyi Uygulama Rehberi yayımlanmıştır.<sup>13</sup>

Bankaların likidite risk profillerinin değerlendirilmesine ilişkin bir diğer önemli araç ise stres testleridir. Likidite stres testleri, bankaların kendi iç kaynaklarının olumsuz koşullara dayanmaya yeterli olup olmadığına dair kapsamlı bir değerlendirme yapılmasını sağlamaktadır. Banka, mevcut fonlama kaynaklarının tanımlanmış bir stres dönemi boyunca yeterli olup olmadığını değerlendirerek ani fon çıkışlarından sonra kısa vadeli yükümlülüklerini yerine getirmek için yeterli kaynak yaratıp yaratamayacağı riskini yakalamayı amaçlamaktadır.

Bahse konu düzenlemeler, bankaları vadesi geldiğinde yükümlülüklerini yerine getirmeleri için teşvik ederek aynı zamanda merkez bankalarının likidite desteğine ihtiyaç duymadan şokları yönetmek için yeterli düzeyde likit varlık tutmalarını yani likidite tamponları oluşturmalarını sağlamaktadır. Bankalar, ufak kayıplarla kolayca ve hızlı bir şekilde satılabilen en likit varlıklardan likidite tamponları oluşturmalıdır. Bunlar nakit ve nakit benzerleri, ülke hazineleri veya merkez bankaları tarafından ihraç edilen / garanti edilen yüksek güvenilirlikli menkul kıymetler ve benzeri borçlanma araçları olabilmektedir.

<sup>12</sup> Bankaların Likidite Karşılama Oranı Hesaplamasına İlişkin Yönetmelik: <https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=19498&MevzuatTur=7&MevzuatTertip=5>

<sup>13</sup> Likidite Riskinin Yönetimine İlişkin Rehber: [https://www.bddk.org.tr/ContentBddk/dokuman/mevzuat\\_0096.pdf](https://www.bddk.org.tr/ContentBddk/dokuman/mevzuat_0096.pdf)

Kriz öncesi dönemde likidite stresini kaldırabilecek likidite tamponlarının tanımı nakit girişlerinin nakit çıkışlarını karşılama kapasitesi olarak kabul edilmiş ve böylece borç likiditesine odaklanılmıştı. Kriz döneminde, birçok varlık sınıfının beklenenden daha az likit olduğu görüldüğünden son dönemlerde vurgu varlık likiditesinedir. Bu bağlamda, tampon olarak kullanılan varlıkların yüksek kaliteli likit varlık sınıfında olması gerektiği savunulmaktadır. Önceki çalışmalarda temel likidite riski ölçütü olarak genelde kredinin mevduata oranı kullanılırken bu çalışmada varlık likiditesine odaklanılarak likidite göstergesi yüksek kaliteli likit varlıkların aktif içindeki payı olarak belirlenmiştir.

Literatürde bankaların likidite tamponu tutma davranışlarının belirleyicilerini doğrudan inceleyen sınırlı sayıda çalışma<sup>14</sup> bulunmaktadır ve analizler genellikle bankaya özgü değişkenler, makroekonomik değişkenler ve ülkeye özgü dinamiklerle gerçekleştirilmiştir. Bu çalışmanın yanıt aradığı temel soru, bankaların bilançolarındaki likit varlıkları kâr üretmek yerine oluşabilecek risklere karşı tampon olarak tutma tercihlerini nelerin belirlediğidir. Hangi bankaya özgü değişkenler bankaların likit varlıkları tutma eğilimini ne yönde etkilemektedir ve makroekonomik koşullar, kriz dönemleri ve yasal düzenlemelerin likidite tamponları üzerindeki etkileri nelerdir?

Bu çalışmanın bir diğer amacı, Türk bankacılık sektöründeki likidite tamponların belirleyicilerini, bankaya özgü ve makro ekonomik değişkenlerin yanı sıra ülkeye özgü durumları da dikkate alarak değerlendirmektir. Bilindiği gibi Türkiye, 2001 bölgesel krizinden sonra bankacılık sektörünü yeniden yapılandırdı ve bankaların şoklara karşı direncini artırmak için bir dizi düzenleme yaptı. Böylelikle, 2008 küresel krizinden diğer ülkelere göre daha az etkilenen Türk Bankacılık sistemindeki yerel krizden sonraki düzenlemeler, Türk bankalarına diğer ülkelerden daha önce likidite tamponları oluşturma fırsatı vermiştir. Öte yandan, Türkiye gibi kırılgan ekonomilerde CDS ve kredi notu düşüşleri önemli göstergeler haline gelmiştir. Bu sebeple bu

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<sup>14</sup> Aspachs et al. (2005), Vodová (2011), Delechat et al. (2012), Bonner et al. (2013), Chen and Phuong (2014).

faktörlerin likidite tamponlarına etkisini analiz eden modellerin literatüre önemli katkı sağlaması beklenmektedir.

Bu amaçlar doğrultusunda 5 farklı sabit etki ekonometrik modeli panel veri analizi ile incelenmiştir. Bu modeller şu şekilde sıralanmıştır: Bankacılık Modeli, Bankacılık ve Makroekonomik Model, Kriz Modeli, Düzenleme Modeli, Tetikleyici Olaylar Modeli.

Bu çalışmanın analiz bölümünde Türk bankacılık sektörü varlıklarının % 90'ını kapsayan 20 mevduat bankası, 2006Ç1-2019Ç2 dönemlerinde, bankalar arasındaki farklılıkların giderildiği sabit etkili panel regresyon yöntemi kullanılarak analiz edilmiştir.

Literatürdeki çalışmalardan farklı olarak, analizlerde kullanılan bağımlı değişken likidite oranı likidite karşılama oranı konseptinde tasarlanmıştır. Başka bir deyişle, yüksek kaliteli likit varlıkların toplam banka varlıklarına oranı bağımlı değişken olarak belirlenmiştir.

Analiz sonuçlarına göre, banka aktif büyüklüğü ile likidite tamponları arasında negatif ve istatistiksel olarak anlamlı bir ilişki bulunmuştur. Başka bir deyişle, büyük bankaların daha az likit varlık tutma eğiliminde olduğu söylenebilmektedir. Sermaye yeterliliği rasyosu ile likidite tampon büyüklüğü arasında ise pozitif yönde güçlü bir ilişki tespit edilmiştir. İstikrarlı fon kaynaklarının tamponlar üzerindeki etkisini görmek için, tasarruf mevduatı değişkeni analize dahil edilmiştir ve bu değişken ile likidite tamponları arasında negatif bir ilişki vardır. Bu sonuca göre, daha istikrarlı fon kaynaklarına sahip bankaların tamponlarını buna göre ayarladıkları ve bu fonlar sayesinde daha az likit varlık tutma eğiliminde oldukları sonucuna varılmıştır. Bankaya özgü değişkenler arasında, takipteki kredilerin oranı çalışmada anlamlı sonuçlar veren bir diğer değişkendir. Beklendiği gibi ve literatürdeki önceki çalışmalara paralel olarak, takipteki krediler ile likidite tamponları arasında pozitif bir ilişki bulunmuştur. Öte yandan, performans göstergelerine dahil edilen aktif getirisi ve

net faiz marjı oranları ile bankaların likidite tamponları arasında istatistiksel olarak anlamlı bir ilişki bulunamamıştır.

Makroekonomik göstergelerle ilgili sonuçlar dikkate alındığında, gayri safi yurtiçi hasılanın reel büyümesi ile bankaların likidite tamponları arasında negatif bir ilişki bulunmuştur. Türk bankalarının ekonomideki yükseliş dönemlerinde daha az likit varlık tuttuğu, ekonomik gerileme döneminde ise tedbiren tamponları artırdığı sonucu çıkarılmıştır. Ayrıca, modellerde diğer makroekonomik değişkenler olan enflasyon ve faiz oranları ile likidite tamponları arasında anlamlı bir ilişki bulunamamıştır.

Kriz dönemlerinin bankaların likit varlık tutma eğilimi ve likidite tamponları üzerindeki etkisini incelemek için kullanılan kriz kukla değişkeni ile tamponlar arasında anlamlı bir ilişki bulunamamıştır. Bankacılık Düzenleme ve Denetleme Kurumu (BDDK) tarafından kriz öncesi dönemde alınan proaktif tedbirlerin bir sonucu olarak banka tamponlarının kriz değişkeninden etkilenmediği çıkarımı yapılabilmektedir.

2008 krizinden sonra bankacılık sistemini daha güçlü hale getirmek için Basel komitesinin getirdiği düzenlemelerden biri olan likidite karşılama oranının tampon büyüklüğü üzerindeki etkisini inceleyen düzenleme kukla değişkeni anlamsız çıkmıştır.

Bu çalışmada, bankaların likidite tamponlarını etkilediği düşünülen iki göstergenin etkileri araştırılmıştır. Bildiğim kadarıyla bu daha önceki çalışmalarda değerlendirilmemiştir. Sonuçlara göre CDS ve kredi notlarındaki değişimin ve bu iki değişkenin etkileşiminin Türk bankalarının likidite tamponları üzerinde önemli bir etkisi olmamıştır.

Sonuç olarak bu çalışmada, Türk bankalarının likit varlık tutma eğilimleri yürürlükteki en son düzenlemelere uygun olarak tanımlanan likidite tamponu kapsamında değerlendirilmiştir. Bu değerlendirmeler yapılırken bankaya özgü,

makroekonomik ve  lkeye  zg  g stergelere sahip kapsamlı bir deęiřkenler k mesi kullanılmıřtır. Bununla birlikte, baęımlı deęiřkeni a ıklayan ve bu analize dahil edilemeyen bařka deęiřkenler de olabilmektedir.  te yandan, likiditeyi etkileyecek bir ok fakt r n yanı sıra, likiditenin davranıřsal boyutunu ve bu kısmı modellemenin zorluęunu da dikkate almak gerekir. Bu t r analizler ancak daha ayrıntılı ayrıntılı verilerin varlıęıyla m mk n olacaktır. řu anda, kamuya a ık veriler m mk n olan en verimli řekilde kullanılmaya  alıřılmıřtır.

Dięer taraftan, sonraki  alıřmalar i in  neri olarak likidite sorununun aynı zamanda bir vade uyumsuzluęu problemi olduęu d ř n ld ę nde, analizdeki bilan o kalemlerinin vade boyutları dikkate alınarak  ok daha hassas sonu lar ortaya  ıkarılabilecektir. İleriki  alıřmalarda ilgili veriler toplanabilirse  ok daha anlamlı sonu lar elde edilebilir. Ayrıca, likidite yaratma s recinin bir par ası olan bilan o dıřı kalemlerin analizlere dahil edilmesi  alıřmanın geliřtirilmesi a ısından  nemli bir adım olacaktır.   nk  bilan o dıřı iřlemler arasında  zellikle t rev iřlemler Basel likidite d zenlemesinde b y k yer tutmaktadır. Son olarak, analiz edilen  lkenin dinamiklerine g re deęiřkenlerin se ilmesi ve d zenlenmesi de  ok  nemlidir.  rneęin, bu  alıřmada,  lkenin dinamikleri arasında yer alan CDS ve derecelendirme etkileri dikkate alınmıřtır.

**Anahtar Kelimeler:** Likidite Riski, Likidite Tamponları, Likidite Karřılama Oranı, Basel III, Likidite Stres Testi, T rk Bankacılık Sekt r 

## 1. INTRODUCTION

After 2001, completing the restructuring of the Turkish Banking Sector, the economy grew rapidly, savings and investments increased. The banking sector has been a determining factor in this rapid economic growth. The rapid growth of total investments and the increase in foreign resource were realized with the contributions of the banking sector. Banking is a major sector affecting the whole economy, as well as being the most important element of the Turkish financial system. 53 banks operate in the Turkish Banking Sector and the asset size of the sector has increased steadily, exceeding the Gross Domestic Product (GDP) in 2015. The most important factor supporting the sector's asset growth is loans, while most important source of funding is deposit. The capital adequacy ratio of the Turkish banking system is above the target rate and the sector has the enough capital to manage potential risks. On the other hand, the fact that the system has adequate capital is not sufficient to manage the risks, but the liquidity issue, which constitutes the focus of this study, is another important issue in terms of risk management in banks.

Liquidity refers to the ability of securities or financial instruments to turn to cash without any loss of value at any time. (Blackwell, 1981) Liquidity risk is one of the basic risks that banks have to undertake while performing their activities. The most basic banking function is the use of resources collected in short terms and in small amounts (deposit) in large and long terms (loans). Liquidity risk is the situation in which the bank fails to meet its obligations in a timely manner. (Nikolaou, 2009)

With the global financial crisis, liquidity's important role in the healthy functioning of the banking sector and financial markets has been recognized again. The world has witnessed the rapid change of the market conditions, where there were live asset markets and low funding costs before the crisis and how quickly liquid assets could dry. (Amihud, 2014) When the drying of the funds combined with the drop in liquidity in the market, the liquidity shock accelerated with the rapidly sale of assets far below their real prices (fire-sales), causing serious destruction in the interconnected financial system.

Although banks were in good condition in terms of capital adequacy in this period, they were under stress mainly due to liquidity shortage. While evaluating banks' liquidity positions and measuring funding risks, indicators such as credit to deposit ratio were used, but these indicators did not provide an adequate risk analysis since they ignored stable funding sources other than deposits and, most importantly, not considering the maturity structure of assets and liabilities. (Jobst, 2017)

This costly lesson learned from the crisis encouraged banks and regulatory and supervisory agencies to develop more comprehensive and prudent policies on liquidity risk management. The Basel Banking Supervision Committee (Basel Committee) has published a number of principles to strengthen liquidity management in order to make banks more resilient and protect against future crises. In addition to the quantitative regulations determining the minimum liquidity level such as Liquidity Coverage Ratio and Net Stable Funding Rate, also qualitative monitoring tools developed in risk management and control issues were defined and guided.

Another important tool for evaluating banks' liquidity risk profiles is stress tests. Liquidity stress tests provide a comprehensive assessment of whether banks' internal resources are sufficient to withstand adverse conditions. It allows the adequacy of existing funding sources to be assessed during a defined stress period. However, the parameters that make up a good stress test are not clear in the context of global validity. Practices differ greatly not only between supervisory communities but also in countries and the banking sectors. (BIS, 2013)

In accordance with regulatory policies establishing liquidity buffers has been vital ensuring banks to have adequate liquidity level in all economic conditions. Thus in order to be able to resist the bank-specific or market-wide liquidity crisis, these buffers which consist of high quality liquid assets can be sold or subject to collateral to provide liquidity. The deficiency of liquidity buffers reduces the ability of banks to take action, especially under stressful conditions or in crisis periods and causes them to experience liquidity shortages. (End, 2010)

The main question here is the banks' preferences for cost of keeping the liquid assets in their balance sheet as a buffer against the problems instead of profit generation. (Santomero, 1984) The most basic issue that makes the liquidity risk difficult is the reverse relationship between liquidity and return. While the return of the asset with high liquidity and short term is low, the return gets higher and the liquidity of the asset decreases. For example, the most liquid asset is the cash that banks hold in their balance sheet, but cash has no return. (Altıntaş, 2006).

The purpose of this study is to investigate the factors that determine the liquidity buffers created by banks aiming to increase their profitability on the one hand and on the other hand, to be prepared for the liquidity shortages situations they may be exposed to.

There are a limited number of studies in the literature that examine directly the determinants of holding liquid asset behaviors of banks, and the analyzes were generally carried out with bank-specific variables, macroeconomic variables and country-specific dynamics.

Benefited from bank-specific and macroeconomic variables, Aspachs et al. (2005) studied to find out the determinants of UK banks' liquidity buffers. Vodová (2011) investigated Czech commercial banks' liquidity determinants, Deléchat et al. (2012) examine the behavior of Central America banks' holding liquid assets, Bonner et al. (2013) assessed the determinants of banks' liquidity holdings in OECD countries, Chen and Phuong (2014) tried to find the impact of bank-specific, bank-idiosyncratic and macroeconomic factors on liquidity buffers in America.

This study adds to the literature by differentiating the liquidity proxy from the traditional ones that frequently using in the literature and it has been determined according to the most up-to-date definitions, thus allowing the newest applications to be reflected in the literature. In addition, in this study discusses the liquidity shortage stemming from the foreign borrowings in fragile economies such as Turkey. It is considered that this review will contribute significantly to the literature especially in such developing country analysis.

Another aim of this study is to evaluate the determinants of liquid buffers in the Turkish banking sector by taking into account the country-specific situations besides bank-specific and macro-economic variables. As known, Turkey restructured its banking sector after the 2001 regional crisis and made a series of regulation to enhance the resistance of banks against the shocks.

Thus, the regulations after the local crisis in Turkish Banking system, which was less affected by the 2008 global crisis than other countries, give the opportunity for Turkish banks to create liquidity buffers earlier. At the current stage, in this study, liquid asset holding behaviors of banks have been evaluated by using the new generation liquidity ratio designed within the scope of Basel regulations.

On the other hand in fragile economies like Turkey, CDS and credit rating downgrades has become important indicators so the model that analyzed the effect of those to the liquidity buffers is expected to make a significant contribution to the literature.

For these purposes, 5 different fixed effects econometric models are examined by panel data analysis. These models are listed as follows: Banking Model, Banking and Macroeconomic Model, Crisis Model, Regulation Model, Trigger Event Model.

In the second part of the study, the restructuring process of the Turkish banking system after the 2001 local crisis and the developments since then have been evaluated structurally and with numerical analysis.

In the third part of the study, the concepts of liquidity and liquidity risk are discussed conceptually and information was given regarding funding and market liquidity risks.

In the fourth and fifth parts, the regulatory studies made by the Basel Committee and the Banking Regulation and Supervision Agency (BRSA) regarding the liquidity are presented with their historical development. In addition, in the fifth section, details

regarding the calculation of liquidity coverage ratio and concept of liquidity buffers are given and the Turkish Banking Sector' current liquidity situation is evaluated.

In the sixth part of the study, the necessity of liquidity stress test and the stress test methods commonly used in practice are discussed in detail and a literature review is included.

The seventh part of this study presents a literature study for the determinants of liquidity buffers and an econometric analysis for the Turkish Banking Sector.

In the eighth part, besides a general evaluation of the results of the analysis, the contribution of the study to the literature, the aspects to be developed and suggestions for further studies are included.

## **2. TURKISH BANKING SECTOR**

### **2.1. Restructuring Period in Turkish Banking Sector**

In Turkey the deteriorating economic conditions in the 1990s has also affected the banking sector significantly. The main reason for the problems in the system was institutional deregulation policies. Practices such as easy conditions for banks to enter the sector, coverage of all savings deposits under insurance, unlimited deposit acceptance in foreign currency and giving the Treasury the opportunity to finance budget deficits by borrowing from commercial banks have been the predictors of crises in the banking sector. (Çolak, 2001: 15-30).

In accordance with the policies for developing, the efficiency of the supervision and surveillance system in the financial markets and providing independent decision mechanisms Banking Regulation and Supervision Agency (BRSA) established.

In addition, Savings Deposit Insurance Fund (SDIF) was determined by Banking Law No. 4389, which was passed in June 1999. These two agencies formally began functioning in August 2000. The problems caused by delays in the implementation of the regulations envisaged in the program became more apparent as of the third quarter of the year. As a result of these factors, the fluctuation of November 2000 was followed by the February 2001 crisis.

The local crisis experienced in November 2000 has had negative effects on the Turkish Banking Sector as well as on the country's economy. The economy downturned, inflation reached 70% (Turkish Statistical Institute (TSI), interest rates exceeded 100% (Central Bank Republic of Turkey (CBRT)) and without overcome these economic crises the effect of political crisis added and The Turkish Banking System suffered a major collapse in the February 2001. During the crisis, the liquidity needs of public banks could not be met, the demand for foreign currency and excessive rising interest rates were the basis of this collapse.

The main reason for the banking crises in November 2000 and February 2001 is that banks have a fragile structure. The main weaknesses of the system are the inadequate capital, the small-scale banking structure, the high weight of public banks in the sector, the high sensitivity to market risks such as maturity mismatch and uncontrollable open positions, insufficient internal audit, risk management and corporate governance and the presence of a weak assets structure. (BRSA, 2001)

In order to eliminate the instability that emerged after the November and February crises and to establish the infrastructure for the restructuring of the economy, the government has implemented the “Strong Economy Transition Program”. One of the main elements of this program has been determined as the restructuring of the banking sector. In this framework, the "Banking Sector Restructuring Program" was prepared and put into practice on May 15, 2001. (BRSA, 2001)

The restructuring program set in the banking system in the year 2001 was the most comprehensive program ever applied so far for the banking sector. Under this program, total balance sheet structure of banking sector, composition of risks, corporate organization for audit of banking sector, resolution processes employed in banking, and risk management processes of banks were all completely restructured. Furthermore, financially weak and strong banks were identified, through decisions taken on ad hoc basis, weak banks were transferred to Saving Deposits Insurance Fund (SDIF), and the shareholders' equity of the banking sector was largely reinforced and strengthened. (TBA, 2019)

Restructuring process in banking sector was based on four fundamental elements, namely: (TBB, 2019)

- Resolution of the financial problems of the banks within the organization of SDIF as soon as possible;
- Financial and operational restructuring of state banks;
- Restoring the health of private banks affected negatively from the recent crises
- Completion of legal and corporate rearrangements aiming to enhance the efficiency of supervision and audit in banking sector and to make the banking sector more effective, efficient, and competitive.

All legal arrangements, independent institutions and boards established have completely changed the working conditions of the sector and the Turkish Banking Sector has taken a strong structure. High capital adequacies, effective internal audit, control and risk management mechanisms have enabled banks to operate extremely healthy. In addition to these, with the implementation of international standards, the sector is equipped with strict supervision and control mechanisms (Beck, 2009)

After 2001, after completing the restructuring of the banking sector, the economy grew rapidly, savings and investments increased. The banking sector has been a determining factor in this rapid economic growth. The rapid growth of total investments and the increase in foreign resource were realized with the contributions of the banking sector. Positive developments in the sector started to attract foreign capital as well; since 2005, there has been an intensive capital inflow into the banking sector. (Kunt, 2017)

During the 2008 global financial crisis and after the global conditions began to get harder, the banking sector continued to function properly without seeking resources, support from the government and continued to finance the economic activity.

Post-restructuring developments are summarized as follows. (Keskin et al, 2019)

- With the rapid growth in the economy and banking sector in 2002, the share of loans in the balance sheet increased rapidly.
- Main banking indicators has begun to reach the European Union countries' levels.
- The ratio of gross domestic product to banking sector asset size has reached the average of the developing country.
- Banking regulations have become fully compatible with international standards.
- With the amendment made to the Enforcement and Bankruptcy Law in 2003, a bankruptcy postponement arrangement was introduced.
- The loan usage of individual consumers in foreign currency is prohibited.
- In 2013, macro prudential measures were introduced in order to increase total savings, especially through consumer loans.
- Loans are significantly diversified; besides large firms, the share of loans extended to individuals and small and medium sized enterprises (SME) increased.
- The conversion of deposits to loans (loan to deposit ratio) has reached higher levels compared to developing countries.
- Banks played an important role in financing large infrastructure projects such as energy, transportation and communication.

## **2.2. Current Situation in Banking Sector**

The banking sector is a major sector affecting the whole economy, as well as being the most important element of the Turkish financial system. The relative share of the banking sector in the financial system may differ in each country depending on the level of economic and social development. The size of the banking sector balance sheet in Turkey constitutes nearly 90% of the financial system. (TBA, 2019) Despite the developments in other branches of the financial sector after 2001, the weight of the banking sector in the system remains by far.

As of June 2019, there are 53 banks operating in Turkish Banking Sector. Turkish Banks divide 3 categories according to their function as Deposit banks, Development and Investment banks, Participation (Islamic) banks. As of June 2019, the system has 34 Deposit banks, 13 Development and Investment banks ve 6 Participation banks.

Also according to their ownership structure banks can be divided 3 categories as state-owned, foreign, private and the details are presented in Table 1.

Table 1: Bank Groups According to the Ownership Structure

| <b>BANK GROUPS ACCORDING TO THE OWNERSHIP STRUCTURE</b> |           |
|---------------------------------------------------------|-----------|
| <b>STATE-OWNED</b>                                      | <b>12</b> |
| Deposit                                                 | 3         |
| Participation                                           | 3         |
| Development and Investment                              | 4         |
| Sdif                                                    | 2         |
| <b>FOREIGN</b>                                          | <b>28</b> |
| Deposit                                                 | 21        |
| Participation                                           | 3         |
| Development and Investment                              | 4         |
| <b>PRIVATE</b>                                          | <b>13</b> |
| Deposit                                                 | 8         |
| Development and Investment                              | 5         |
| <b>GRAND TOTAL</b>                                      | <b>53</b> |

Source: The Banks Association of Turkey (TBB), [https://www.tbb.org.tr/modules/banka-bilgileri/banka\\_sube\\_bilgileri.asp](https://www.tbb.org.tr/modules/banka-bilgileri/banka_sube_bilgileri.asp) , Date:10.05.2020  
 Participation Banks Association of Turkey (TKBB), <https://www.tkbb.org.tr/banka-genel-bilgileri>, Date:10.05.2020

Deposit banks, also referred to as commercial banks, form the framework and the most important structure of banking. Commercial banking can be defined as intermediary firms engaged in buying and selling of money and securities that are substitutes for money.

The main function of deposit banks; it is to collect the savings of the savers and to evaluate these funds as loans in the most suitable areas for both themselves and the national economy, especially in the financing of the real economy. (Werner, 2016)

Development banks operate mostly in developing countries and investment banks operate in developed countries. Investment banks are financial institutions that provide intermediary and consultancy services to institutional investors with excess funds in the capital market developed countries, and do not give direct credit to businesses, but meet their medium and long term funding needs. Investment banks advise firms in need of funds by mediating the sale of their securities, selling, guaranteeing and consulting them and by doing so, they guarantee the interest and principal payment of the bonds issued by these firms. (Erdem, 2014)

Development banks, on the other hand, are financial institutions that aim to accelerate industrial development by providing resources and technical assistance to firms that lack capital or new investments to be made by large industrial companies in developing countries.

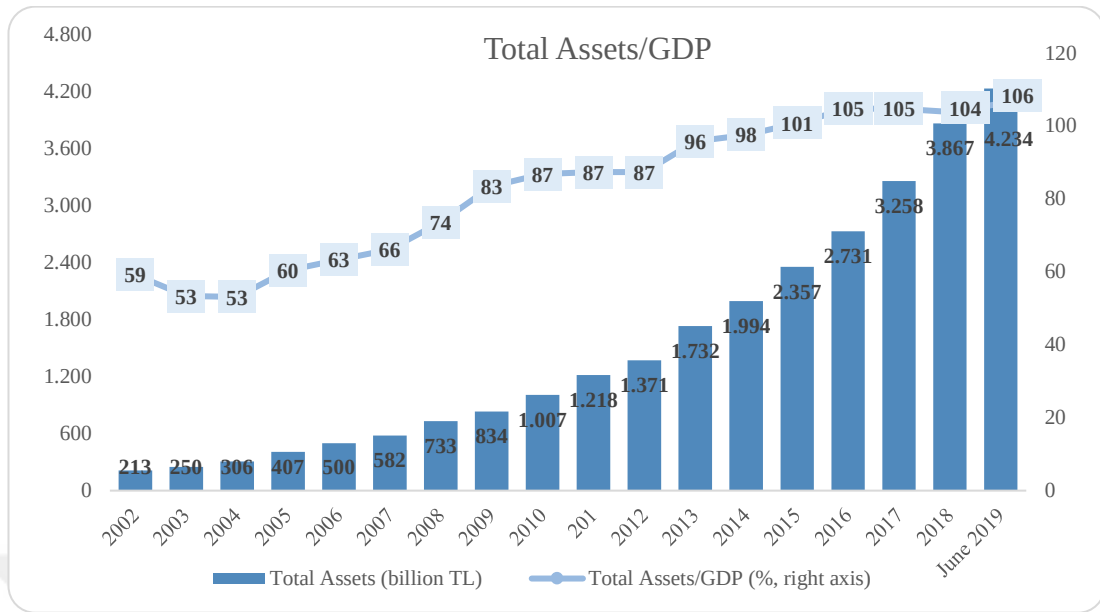
Participation banks (Islamic banks) offer interest free financial instrument or banking facilities required by trade and industry to purchase the machines, equipment and real estate. The fundamental structure of this system is to share both profits and losses with the savers, without providing a guaranteed fixed income. (Varsak, 2017).

### **2.2.1. The Asset Structure of Turkish Banking Sector**

The asset size of the Turkish Banking Sector has been continuously increasing in the last decade, and as of June 2019, the asset size of the system is 4,234 billion Turkish Lira (TL). The ratio of sector assets to gross domestic product (GDP) has increased steadily and remained above 100% after 2015. As of June 2019, it is at its historical highest level with 106%. (see Graph 1)

Distribution of selected assets and their share of total assets by years are given in Table 2. In the period of June 2019, 60% of the sector's assets consist of loans, 14% of securities, 10% of cash and cash equivalents, 5% of required reserves and 11% of other assets.

Graph 1: Total Assets to GDP Ratio



Source: Banking Regulation and Supervision Agency (BRSA),

<https://www.bddk.org.tr/BultenAylik/tr/Home/Gelismis> Date: 10.05.2020

Turkish Statistical Institute (TSI), <http://www.tuik.gov.tr/UstMenu.do?metod=kategorist> Date: 10.05.2020

Table 2 present asset structure of TBS for the period between 2010 and June 2019.

Table 2: Asset Structure of TBS

| (billion TL)           | 2010         | 2011         | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | June 2019    |
|------------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>ASSETS</b>          |              |              |              |              |              |              |              |              |              |              |
| Cash and Cash Equ.*    | 86           | 104          | 93           | 111          | 124          | 151          | 222          | 262          | 412          | 436          |
| Required Reserves      | 22           | 50           | 100          | 156          | 172          | 206          | 184          | 227          | 159          | 198          |
| Loans                  | 526          | 683          | 795          | 1,047        | 1,241        | 1,485        | 1,734        | 2,098        | 2,394        | 2,540        |
| NPLs**                 | 20           | 19           | 23           | 30           | 36           | 48           | 58           | 64           | 97           | 116          |
| Securities             | 288          | 285          | 270          | 287          | 302          | 330          | 352          | 402          | 478          | 586          |
| Other Assets           | 86           | 95           | 113          | 131          | 156          | 186          | 239          | 270          | 424          | 474          |
| <b>Total Assets</b>    | <b>1,007</b> | <b>1,218</b> | <b>1,371</b> | <b>1,732</b> | <b>1,994</b> | <b>2,357</b> | <b>2,731</b> | <b>3,258</b> | <b>3,867</b> | <b>4,234</b> |
| <b>SHARE OF ASSETS</b> |              |              |              |              |              |              |              |              |              |              |
| Cash and Cash Equ.*    | 8%           | 9%           | 7%           | 6%           | 6%           | 6%           | 8%           | 8%           | 11%          | 10%          |
| Required Reserves      | 2%           | 4%           | 7%           | 9%           | 9%           | 9%           | 7%           | 7%           | 4%           | 5%           |
| Loans                  | 52%          | 56%          | 58%          | 60%          | 62%          | 63%          | 64%          | 64%          | 62%          | 60%          |
| NPLs**                 | 2%           | 2%           | 2%           | 2%           | 2%           | 2%           | 2%           | 2%           | 2%           | 3%           |
| Securities             | 29%          | 23%          | 20%          | 17%          | 15%          | 14%          | 13%          | 12%          | 12%          | 14%          |
| Other Assets           | 9%           | 8%           | 8%           | 8%           | 8%           | 8%           | 9%           | 8%           | 11%          | 11%          |

\* Sum of Cash, Receivables from Central Bank, Money Market and banks items

\*\*Gross non-performing loans

Source: BRSA, <https://www.bddk.org.tr/BultenAylik/tr/Home/Gelismis> Date: 10.05.2020

Loans have increased steadily in the last 10 years and have been the most important factor to support the active growth of the sector. In addition, the share of loans in the assets increased from 52% to 64% with gradual increases in this period.

Despite the increasing loan share in total assets the share of securities declined from 29% to 14% in the last decade. This decrease in securities was balanced by increasing the share of cash and cash equivalents and other assets in total assets. In this period, the banking sector also placed the resources in loans and the central bank. Since security trading does not a primary function of the banking, the banks may have transferred their fund investments from securities to loans by considering their interest returns at that period.

The growth rate of the securities portfolio remained relatively small at a period when interest rates were declining and the borrowing demand for the public sector reduced. This trend also indicates that the banking sector plays its intermediary function more efficiently in the financing of the private sector, and that the crowding-out pattern in the economy is weakening, and that economic growth is being driven by the rising private sector loans. (Eschenbach, 2004)

In addition, with the Central Bank of Republic of Turkey's (CBRT) more supportive position in monetary policy in liquidity management and the increase in required reserves in foreign currency and gold in relation to the Reserve Option Mechanism (Işıl et al., 2016), reserve requirements and CBRT accounts increased in recent years.

As of June 2019, 55% of the 2,540 billion TL loan was extended to commercial and corporate companies, 25% to small, medium-sized enterprises (SMEs) and 20% to individual consumers (including credit cards).

The sectors with the highest credit volume in the Turkish banking system are listed as respectively: (BRSA, 2019<sup>15</sup>)

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<sup>15</sup> [https://www.bddk.org.tr/ContentBddk/dokuman/veri\\_0023\\_08.pdf](https://www.bddk.org.tr/ContentBddk/dokuman/veri_0023_08.pdf)

- Construction with 9%,
- Electric, gas and water resources with 8%,
- Wholesale brokerage with 6.5%,
- Agriculture with 4%,
- Research, Consulting, Advertising and Other Activities with 3.9%,
- Retail Trade and Personal Products with 3.8%,
- Textile and Textile Products Industry with 3.4%,
- Main Metal Industry with 3.3%,
- Food, Beverage and Tobacco Industry with 3%
- Hotels with 2.7%

Non-performing loans (NPL) to loans ratio in banking sector realized as 4,36% in June 2019. (see Graph 2) NPL is a loan in which the debtor defaults because they have not met the expected payments for a certain period. The defined period also differs depending on the sector and form of loan. Generally, though the duration is 90 days or 180 days and these loans are also called "bad debt". (ECB, 2017) In the Turkish Banking System, after more than 90 days have passed without paying the installments accepted or interest, a bank loan is considered non-performing.

Increasing NPLs is an indicator of deterioration in credit quality and consequently asset quality of the banks. The deterioration in the quality of banks' loan portfolio was the main reason for the banking system problems and financial crises in developed economies. Indeed, the increase in NPLs, banking mortgages in the U.S., highlights the link between macroeconomic and financial shocks, and the relationship between friction in the credit market and the risk of financial instability. (Messai et al., 2013)

NPLs have gained more attention in recent years. Many studies examined bank failures and found that asset quality is an indicator of bankruptcy. (Barr et al, 1994). Since banks have highly distorted loans before bankruptcy, a large amount of bad credit in the banking system often causes a bank failure. NPLs are among the main causes of recession problems. Every bad loan in the finance sector increases the likelihood of leading the company to hardship and unprofitable. Therefore, non-performing loans are likely to prevent economic growth and reduce economic

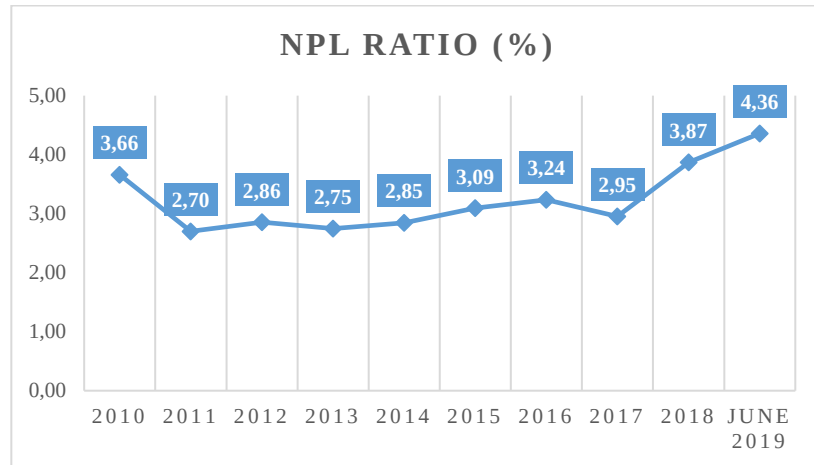
efficiency (Hou, 2007). For these reasons, it is one of the most important ratios followed by banking sector. Non-performing loans ratio is calculated to the formula below:

$$NPL\ Ratio = \frac{Nonperforming\ Loans}{Total\ Loans}^{16}$$

Graph 2 shows non-performing loans ratio of TBS for the period between 2010 and June 2019.

While this ratio has remained at the level of 3% in the Turkish Banking Sector until 2018, the US Dollar reached its historical highest level against Turkish Lira with the exchange rate crisis experienced in August 2018, which also negatively affected the banking sector. Then the rate have started to increase and as of June 2019 non-performing loans to total loans ratio in banking sector realized as 4.36%. (BRSA, 2019<sup>17</sup>)

Graph 2: Non-performing Loans Ratio of TBS



Source: BRSA, <https://www.bddk.org.tr/BultenAylik/tr/Home/Gelismis> Date: 10.05.2020

Another important asset of the Turkish banking system is securities. Securities, which amounted to TL 586 billion as of June 2019, have been measured according to International Financial Reporting Standarts 9: Financial Instruments (IFRS-9) as three types since 2018 with the implementation of IFRS-9.

<sup>16</sup> Non-performing loans are included.

<sup>17</sup> [https://www.bddk.org.tr/ContentBddk/dokuman/veri\\_0023\\_08.pdf](https://www.bddk.org.tr/ContentBddk/dokuman/veri_0023_08.pdf)

These assets within the scope of IFRS 9 are measured as amortised cost, fair value through other comprehensive income (FVTOCI) and fair value through profit or loss (FVTPL). (PwC, 2017)

A financial asset is measured at amortised cost if both of the following conditions are met: (IFRS Paragraph 9.4.1.1)

- the asset is kept in a business model, which is to hold the assets to collect contractual cash flows; and
- the contract terms of the financial asset will only cause cash flows that are interest payments on principal and principal balance on specific dates.

The total amount of the Turkish Banking Sector amortized cost securities in June 2019 is TL 251 billion and this constitutes 43% of the total securities. (BRSA, 2019<sup>18</sup>)

Fair value through other comprehensive income (FVTOCI): Assets are classified and measured at fair value through other comprehensive income if they are held in a business model whose purpose is achieved by both collecting contractual cash flows and selling financial assets. (IFRS 9, Financial Instruments) There have been TL 308 billion FVTOCI in Turkish Banks which is %53 of total sector securities.

Fair value through profit or loss (FVTPL): any financial assets that are not held in one of the two business models mentioned are measured at fair value through profit or loss. (IFRS 9, Financial Instruments) The amount of FVTPL is TL 27 billion in the sector and its share %5 in total securities.

### **2.2.2. The Liability Structure of Turkish Banking Sector**

Distribution of selected liabilities and their share of total liabilities by years are given in Table 3. In the period of June 2019 54% of the sector's liabilities consist of deposits while 13% of due to banks, 11% of equities, 5% of issued securities, 4% of fund from repo transactions and 14% of other liabilities.

<sup>18</sup> [https://www.bddk.org.tr/ContentBddk/dokuman/veri\\_0023\\_08.pdf](https://www.bddk.org.tr/ContentBddk/dokuman/veri_0023_08.pdf)

Table 3: Liability Structure of TBS

| (billion TL)        | 2010         | 2011         | 2012         | 2013         | 2014         | 2015         | 2016         | 2017         | 2018         | June 2019    |
|---------------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| <b>LIABILITIES</b>  |              |              |              |              |              |              |              |              |              |              |
| Deposits            | 617          | 695          | 772          | 946          | 1,053        | 1,245        | 1,454        | 1,711        | 2,036        | 2,273        |
| Due To Banks        | 122          | 167          | 173          | 254          | 293          | 361          | 418          | 475          | 563          | 565          |
| Repo Trans.         | 58           | 97           | 80           | 119          | 137          | 157          | 138          | 99           | 97           | 161          |
| Securities Issued   | 3            | 18           | 38           | 61           | 89           | 98           | 116          | 145          | 174          | 204          |
| Equities            | 135          | 145          | 182          | 194          | 232          | 262          | 300          | 359          | 422          | 449          |
| Other Liabilities   | 72           | 95           | 125          | 159          | 190          | 234          | 305          | 469          | 576          | 581          |
| <b>Total Assets</b> | <b>1,007</b> | <b>1,218</b> | <b>1,371</b> | <b>1,732</b> | <b>1,994</b> | <b>2,357</b> | <b>2,731</b> | <b>3,258</b> | <b>3,867</b> | <b>4,234</b> |
| <b>SHARE (%)</b>    |              |              |              |              |              |              |              |              |              |              |
| Deposits            | 61%          | 57%          | 56%          | 55%          | 53%          | 53%          | 53%          | 53%          | 53%          | 54%          |
| Due To Banks        | 12%          | 14%          | 13%          | 15%          | 15%          | 15%          | 15%          | 15%          | 15%          | 13%          |
| Repo Trans.         | 6%           | 8%           | 6%           | 7%           | 7%           | 7%           | 5%           | 3%           | 2%           | 4%           |
| Securities Issued   | 0%           | 2%           | 3%           | 3%           | 4%           | 4%           | 4%           | 4%           | 5%           | 5%           |
| Equities            | 13%          | 12%          | 13%          | 11%          | 12%          | 11%          | 11%          | 11%          | 11%          | 11%          |
| Other Liabilities   | 7%           | 8%           | 9%           | 9%           | 10%          | 10%          | 11%          | 14%          | 15%          | 14%          |

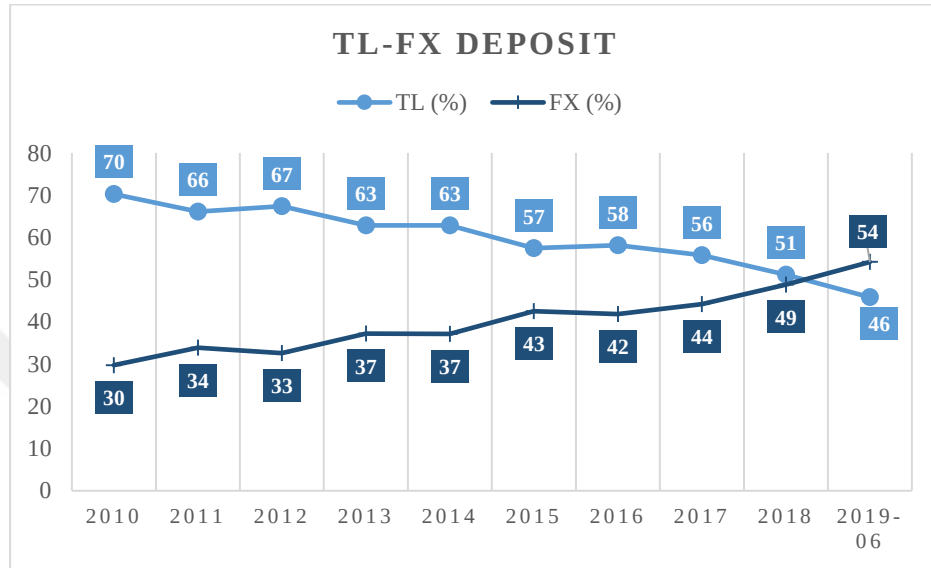
Source: BRSA, <https://www.bddk.org.tr/BultenAylık/tr/Home/Gelismis>, Date: 10.05.2020

Deposits have increased steadily in the last 10 years and have been the most important funding source of the sector. On the other hand, the share of deposits in total liabilities declined from 61% to 53% with gradual decreases in this period. This decrease in deposits have been balanced by increasing the share of issued securities in last decade.

Total deposits of banking sector increased from 617 billion TL in 2010 to 2.3 trillion TL in June 2019. As of June 2019, 46% of deposits in Turkish Banking system are in Turkish lira and 54% in foreign currency. The foreign currency (FX) deposit rate has started to increase especially since 2013 with the depreciation of the Turkish Lira (TL). (see Graph 3) In August 2018, currency crisis experienced in Turkey, foreign currency deposits share surpassed the share of Turkish Lira deposits in the balance sheet. When adjusted for the exchange rate effect, an increase was also observed in FX deposits. In 2019, both domestic and corporate customers' demands for foreign currency increased due to the economic slowdown due to macroeconomic conditions, interest rates, fluctuations in exchange rates, increasing uncertainty due to local elections and speculative behaviors. In this context, the total deposit increase in the first half of the year emerges from FX deposits. At the same time, the slowdown

in the increase in deposits makes it difficult to provide funds, while causing an effect that limits credit volume and asset growth. Despite the economic slowdown, the fact that the deposit grows faster in nominal terms compared to recent years, the rise in deposit interest rates is also effective.

Graph 3: Deposit Distributions by Currency



Source: TBB, [https://verisistemi.tbb.org.tr/index.php?/tbb/report\\_mali](https://verisistemi.tbb.org.tr/index.php?/tbb/report_mali), Date: 10.05.2020

In terms of types, 63% of total deposits consist of savings deposits, 34% from commercial and other deposits and 3% from public deposits. As of June 2019, the share of demand deposits in total deposits is 23%. Deposits with a maturity of 1-3 months according to the opening dates have the highest share in the sector and this rate is 51%. (BRSA, 2019)

Non-deposit funds increased from TL 255 billion to TL 1.5 trillion, while the balance sheet share of non-deposit funds grew from 25% to 36%. In last decade, the key item showing the highest growth at the liabilities side was the non-deposit funds linked to loans borrowed from foreign banks. The funds provided by Turkish banks from abroad are as follows:

- Banks Deposits
- Loans
- Syndication Loans
- Securitization Loans

- Repo
- Subordinated Loans
- Securities Issued Abroad

In rising global liquidity, the use of funds from abroad by the banking sector has become more attractive as regards maturity and cost. The fall in global interest rates has allowed the banking sector to replace long-term liabilities in an environment in which TL's costs have increased. So, the use of non-deposit funds has increased in last decade. (TBB, 2019)

Due to the significant depreciation of TL, increasing geopolitical tension and tightening foreign financial conditions in August and after 2018, there has been a serious fluctuation in financial markets. As a result, the substantial increase in the country's risk premium and credit ratings agencies' downgrades became also important in terms of the cost of foreign borrowings, the rollover of the current funds and the new borrowing from abroad.

As of June 2019, the funds provided by banks through repo have reached 161 billion TL. While the funds provided from the repo market continued to rise in Turkey, there has been an increase in the funds obtained by the Central Bank in recent years. Banking sector, along with the improvement in foreign liquidity conditions, increased the use of long-term resources from foreign markets, especially for financing infrastructure projects. (Muraleedharan, 2014)

In addition, securities issued by banks have increased in the last decade. As another funding source of the sector, the share of issued securities in total liabilities reached 5%. As of June 2019, there are 204 billion TL issued securities in Turkish banks and these are important for increasing the diversity of non-deposit funding sources. 92.5% of the international issuances worth 157.6 billion TL have been issued in FX (25.4 billion USD).

The equity of the shareholders of sector has increased from 135 billion TL to 449 billion TL in the last decade. The main determinants of the equity increase in the

sector in recent years have been the increase in profitability, paid capital increases and the increase of reserve funds arising from the inclusion of bank profits within the bank.

On the other hand, owing to the development of risk management strategies, the implementation of country programs, and the steady increase of loan volume, the share of shareholders' equity in the overall balance sheet decreased. (Sümer, 2016) In the period 2010-2013, shareholders' equity shares in total liabilities were 13% on average. This rate first surpassed 13% in 2012 and then fell to 11% in June 2019 due to the increasing risk emerging from FX loans, in conjunction with macro-prudential initiatives and acceleration of TL's devaluation. (TBB, 2019)

### 2.2.3. Income Statement of Turkish Banking Sector

The Turkish Banking sector's net profit increased in the 2010-2018 period, from TL 22 billion to TL 54 billion. (see Table 4) The main reason for the increase in the net profit of the sector is the increase in net interest incomes after special provisions. However, profitability decreased in US dollars, from USD 15 billion in 2010 to USD 10 billion.

In the period 2010-2018, the sector's asset profitability has been in a declining trend. The return on assets ratio was 1.8% as of December 2018. On the other hand, return on equity also showed a declining trend during the period 2010-2018 and return on equity in 2018 was 14.7%

Table 4: Income Statement of TBS

| (billion TL)                     | 2010       | 2011       | 2012       | 2013       | 2014       | 2015       | 2016       | 2017       | 2018       |
|----------------------------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Interest Income                  | 77         | 88         | 110        | 111        | 139        | 164        | 195        | 247        | 368        |
| Interest Expenses                | 39         | 49         | 58         | 53         | 73         | 87         | 103        | 134        | 222        |
| <b>Net Interest Income</b>       | <b>39</b>  | <b>39</b>  | <b>52</b>  | <b>57</b>  | <b>66</b>  | <b>77</b>  | <b>91</b>  | <b>113</b> | <b>146</b> |
| After Special Provisions         | 33         | 35         | 44         | 47         | 52         | 62         | 70         | 94         | 111        |
| Non-interest Income              | 16         | 20         | 21         | 26         | 29         | 31         | 35         | 40         | 54         |
| Operating Expenses               | 30         | 36         | 44         | 51         | 53         | 58         | 66         | 68         | 99         |
| <b>Non-interest Income (Net)</b> | <b>-14</b> | <b>-16</b> | <b>-23</b> | <b>-25</b> | <b>-24</b> | <b>-27</b> | <b>-31</b> | <b>-28</b> | <b>-45</b> |
| Profit Before Tax                | 27         | 25         | 30         | 31         | 31         | 33         | 47         | 61         | 66         |
| Tax Provisions                   | 5          | 5          | 7          | 6          | 7          | 7          | 10         | 12         | 12         |
| <b>Net Profit of Period</b>      | <b>22</b>  | <b>20</b>  | <b>24</b>  | <b>25</b>  | <b>25</b>  | <b>26</b>  | <b>38</b>  | <b>49</b>  | <b>54</b>  |

Source: BRSA, <https://www.bddk.org.tr/BultenAylık/tr/Home/Gelismis>, Date: 10.05.2020

Interest income remains the main source of income in the Turkish banking system. In the period of 2010-2018, approximately 75% of interest income consists of interests taken from loans.

As the share of the securities portfolio decreased in the balance sheet, the share of interest income from financial assets decreased in total interest income. The decrease in the share of deposits in total liabilities decreased the interest paid on deposits. However, interest paid to banks and interest paid to securities issued increased significantly.

The interest margin declined in the banking sector in 2010, after exceeding 5% in 2009. The sector's interest margin rose from 3.5% to 4.1% in the period 2011-2018, achieving 3.9% in 2018. The maturity structure of the bank sector's balance sheet was also efficient in narrowing the interest margin in a cycle in which interest rates showed an growing trend parallel to the tightening in global liquidity conditions. (TBB, 2019)

The most significant reason for the decrease reported as the ratio of non-interest expenditures to non-interest income is the restriction applied to the fees and commissions paid to individual customers by the banking sector.

#### **2.2.4. Capital Adequacy and Liquidity Position of Turkish Banking Sector**

The legal minimum limit for capital adequacy is set at 8% (legal ratio) in BASEL regulations. The minimum limit for the target, which is determined prudently by the BRSA, is 12% (target ratio). Capital adequacy ratio calculated by banks according to the formula below cannot be less than 12%.

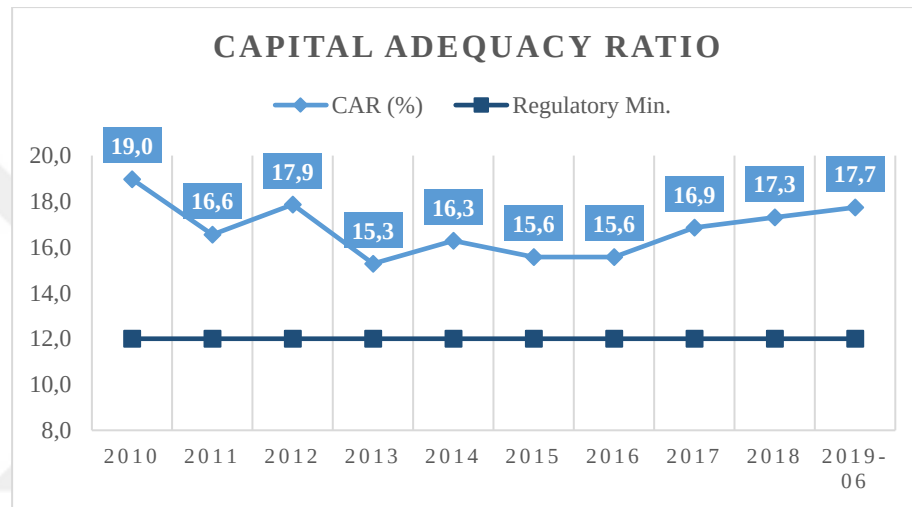
$$\text{Capital Adequacy Ratio (CAR)} = \frac{\text{Capital}}{\text{Risk - Weighted Assets}}$$

Until 2007, the capital adequacy ratio of more than 20% has been on a downward trend since 2009 due to rapid growth and balance sheet shifts. Along with the rapid growth in loans, the increase in risk-weighted assets over legal equity and the return

on equity, which fluctuated below the capital cost, were effective in this decrease. The depreciation in TL exacerbated the decline in CAR, in addition to the impact of macro prudential measures. This is because FX loans are included in risk-weighted assets whereas capital are based on the TL assets. (TBA, 2019)

Graph 4 points out capital adequacy ratios of TBS for the period between 2010 and June 2019.

Graph 4: Capital Adequacy Ratio of TBS



Source: BRSA, <https://www.bddk.org.tr/BultenAylık/tr/Home/Gelismis>, Date: 10.05.2020

While the capital adequacy ratio was 17.3% as of December 2018, it was 17.7% as of June 2019. (see Graph 4) Compared to 2018, the relatively stable exchange rate, the decrease in credit appetite, additional capital injections and reasonable risk-weighted assets provided a more stable CAR. Therefore, the CAR of the Turkish banking sector, which is above the legal limit and target ratios; shows that the sector is in a position to manage its risks thanks to its sufficient equity.

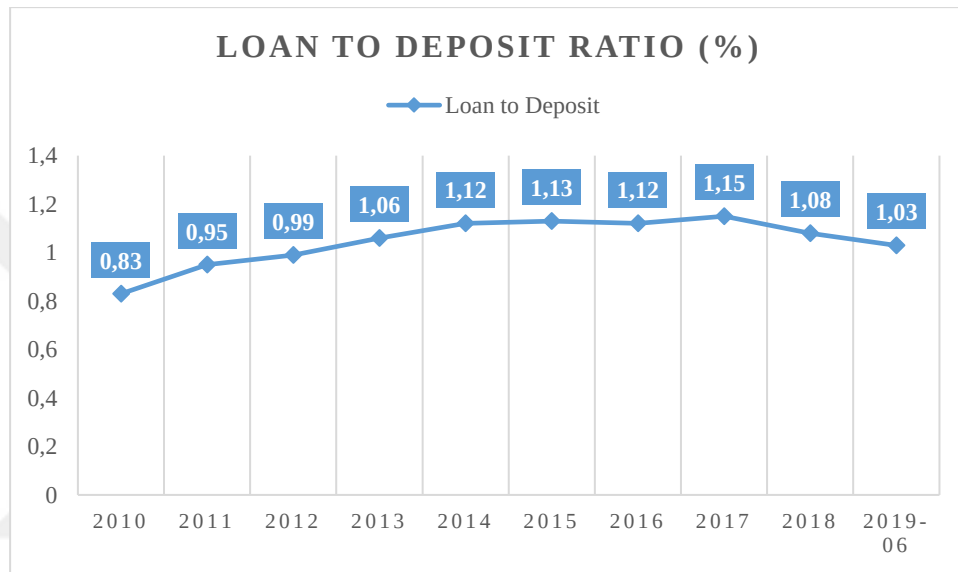
On the other hand, in the calculation of capital adequacy, 90% of risk-weighted assets are credit risk amounts, 8% are operating risk amounts and 2% are market risk amounts. (2019, BRSA)

Loan growth over the 2010-2017 period was higher than the rise in deposits. While the average annual deposit growth in the period 2007-2018 was 17%, loan growth was 22%. The rise in the gap between loan and deposit growth, particularly in

2010-2012, was the source of macro prudential measures. In 2015 and 2016, loan growth lost momentum and converged to deposit growth with the decline in economic growth rates.

In the last period, loans, which is the largest asset item in the banking sector, constituted 60% of total assets and deposit, which is the largest funding item, constituted 53.7% of total liabilities.

Graph 5: Loan to Deposit Ratio of TBS



Source: BRSA, <https://www.bddk.org.tr/BultenAylik/tr/Home/Gelismis>, Date: 10.05.2020

In June 2019, the loan to deposit ratio was 103%, (see Graph 5) and when calculating this rate, development and investment banks, which have not deposit collection function, were not included in the calculations.

Moreover, the net FX position in the banking sector followed a balanced course. As a result, foreign exchange deficits increased in the balance sheet, but this was offset by off-balance sheet transactions.

### 3. LIQUIDITY AND LIQUIDITY RISK CONCEPTS

Liquidity, in its most general sense, refers to the ability of assets or financial instruments to turn to cash at any time without losing value. (Amihud, 2014) Another common definition of the concept of liquidity is the expression of sufficient cash in circulation that reveals the monetary situation, which includes central bank liquidity, which has the capacity of central banks to supply the required liquidity to the financial system. These concepts of liquidity interact with each other. The concept of liquidity in the banking sector is the ability of the bank to pay its debts or collateral obligations without unacceptable losses when the payment day comes and to finance the market's credit needs. (BIS, 2008)

Liquidity risk is the condition where the bank fails to meet its obligations in a timely manner as a result of the cash flow mismatch due to the lack of cash or cash inflows to cover the cash outflows completely and timely. Liquidity risk is a serious threat in the banking system, as the bank with a cash deficit may have to dispose of its assets below its cost or market value and/or the bank's funding costs will increase. Also it is the most significant risk that has been attempted to be managed since the beginning of the banking history and its consequences are usually catastrophic. (Douglas, 2001)

Maturity mismatches are the main source of liquidity risk in the banking system. (Haan and End, 2013) The fact that the maturities of the liabilities on the balance sheet are shorter than the maturities of the assets causes the liquidity shortage. More specifically, banks issue short-term debt (deposits) in exchange for long-term assets (credits) used by individuals, companies or the government. Cash flows from bank assets typically consist of small payments spread over a long horizon. (i.e. allocation of ten-year mortgage loan installments). On the other hand, the bank undertakes to pay

off its obligations in a much shorter period. (i.e. the average weighted deposit maturity is about 32 days). All these activities create a maturity mismatch between banks' assets and liabilities.

Where there is a liquidity risk, the maturity of the resources on the liability side of the balance sheet is renewed in a shorter time than the maturity of those on the asset side. There is no risk in the case of due resource is renewed or a new alternative resource is found, otherwise liquidity risk arises.

In case of a cash outflow from obligations without providing cash inflows from the bank's assets, failure to extend the maturity of these obligations or to provide new resources will disrupt payments. The disruption of payments will quickly trigger the need for new liquidity, realizing this situation will cause a rapid cash outflow from the bank and eventually become unable to carry out bank activities. In the Banking Law No. 5411 which regulating the activities of banks, deficiencies in liquidity may counted as one of the reason for the bank' transfer process to the Savings Deposit Insurance Fund (SDIF). (Kutlukaya et al, 2013) Therefore, powerful liquidity risk management should be carried out by increasing funding or transforming assets quickly and at reasonable cost and collecting sufficient sources. Banks are required to have appropriate liquidity risk management procedures in proportion to their size, liquidity risk profiles and complexity, as a single standard is not consistent with each bank. In general, liquidity risk is handled in two ways, namely funding risk and market liquidity risk:

### **3.1. Funding Liquidity Risk**

Funding liquidity risk is the danger that a bank cannot be able to meet its current and future cash flow requirements if its liabilities and/or cash inflows are disrupted. (ECB, 2002)

Drehmann et al (2009) describes funding liquidity risk as the possibility of the bank becoming unable to settle liabilities immediately over a specific period. They also explained the difference between funding liquidity and funding liquidity risk. While funding liquidity is a binary concept in terms of whether or not the bank is

capable to fulfill its liabilities, funding liquidity risk may take an infinite number of values since it is related to the distribution of future results.

Brunnermeier and Pedersen (2009) describe funding liquidity as the ability to collect cash by selling assets or new borrowing in a short time. According to IMF (2008) funding liquidity is the ability of a solvent bank' to make agreed-upon payments in a timely fashion. IMF (2010) also identifies funding liquidity risks a risk that a bank will not capable to meet its short-term payments by raising the funds from unsecured sources such as very short term loans from other banks or the issuance of deposits and commercial paper. In the Best Practice Guideline on Management of Liquidity Risk published by BRSA 2016, funding liquidity risk is defined as the risk of not being able to meet its debts and liabilities without being exposed to any unexpected losses and default.

The funding capacity of a bank depends on whether it is capable of managing planned and unplanned cash outflows (including loss of funding sources) against cash inflows related to maturing assets, the rollover risk arising from any existing maturity mismatches, and the ability to access unsecured retail/wholesale funding markets. (Jobst, 2017)

The most severe form of funding liquidity risk is when deposit escapes from the bank begin. In this case, depositors demand their money before their due dates and cause the liquidity demand to occur to the extent that the banks cannot meet. When funding liquidity risk spreads to more than one bank, it will become a concern for supervisory authorities. Because the situation has become systematic and the market liquidity risk increase. This will affect the asset market as well as the interbank market. (Castagna, 2013)

Funding liquidity risk is closely related to interbank liquidity risk. Therefore, banks are linked by a common liquidity market. Difficulty of any bank may lead to a narrowing of a common liquidity pool that connects all banks and the liquidity shortage to other banks. This type of spreading mechanism is faster if there is an intensive connection between banks. These links can be through bank payment systems, balance sheet links and, more generally, cross liabilities between banks (deposits, money market loans, loan commitments). (Türküner, 2016)

### 3.2. Market Liquidity Risk

Market liquidity is the capacity to quickly conduct large securities trades at low cost and with minimal price effects and its durability is critical for financial stability and real economic activity. Fallen market liquidity decreases the efficiency of funds which are intermediated from savers to borrowers and may hinder economic expansion. (Deutsche Bundesbank, 2008).

According to Worldbank (2014) market risk is the potential change in a bank's earnings or value due to fluctuations in market rates or prices, such as interest rates, foreign exchange rates, equity prices or commodity prices. Market liquidity risk is related to whether a bank can sell large amounts of securities at a low cost and limited price effect. (IMF, 2015f).

Market liquidity is reflected in volume (for example, turnover ratios) and price-based metrics (bid-ask spreads, market effect of large trades). (Jobst, 2017) This represents the systemic and undistributable part of the liquidity risk. There are two important issues regarding this feature of liquidity risk: First, it points to the similarity of liquidity risk in different market areas such as bond and stock markets. The second relates to their pricing. Market liquidity risk is considered as a cost or premium in the asset pricing literature, which positively affects the price of an asset. (Holmström, 1993). Acharya and Pedersen (2005) expressed the relationship between liquidity risk and price as a two-way internal situation. Thus, it affects market decisions due to optimal portfolio distribution and market practices due to transaction costs. The higher the premium, the greater the risk of liquidity.

In the Best Practice Guideline on the Management of Liquidity Risk published by BRSA 2016, the risk of market liquidity defines as an asset cannot be sold or closed without affecting the market price due to insufficient market depth or deterioration of market conditions, and the market price of a position cannot be formed for any reason. (BRSA, 2016)

The level of market liquidity risk (valuation haircuts) impacting projected cash inflows from asset sales and the collateralization of secured funding are influenced by: (BIS, 2016)

- banks' asset concentrations,
- downgrades of marketable assets,
- banks' liquidity buffer composition,
- the amount of funding needed for foreign currency (FX),
- the relevance of derivatives trading for liquidity risk management,
- to what point the assets could be encumbered and are subject to haircuts when used as collateral,
- accessibility of funding by potentially reusable securities received as collateral.

Liquidity crises derive as shocks are multiplied through liquidity spirals. It describes how liquidity dries up when its providers run out of capital and need to decrease their positions. A market price collapse creates stronger restrictions on the resources of traders such as reducing their funding liquidity and therefore traders provide less liquidity to market. As the capability to fund trading activity reduces, so does market liquidity. This leads a vicious cycle that creates liquidity crises. The drop in market liquidity lowers prices and worsens funding problems, which reduces market liquidity and increases volatility when market conditions are rolled down. (Amihud, 2014)

#### 4. BASEL LIQUIDITY REGULATIONS

The studies carried out by the Basel Committee on Banking Supervision (BCBS) and Bank for International Settlements (BIS) Research Task Force regarding the liquidity risk to strengthen the banking sector are presented chronologically in the Table 5 below.

Table 5: Basel and BIS Studies

| INITIATIVES                                                                                                                                                                                                                                                                                                       | RELATED DOCUMENTS                   |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Basel Committee on Banking Supervision</b>                                                                                                                                                                                                                                                                     |                                     |
| The Liquidity Working Group (WGL) was established to review the national authorities' liquidity control and the basic principles of liquidity risk management were transferred to the Liquidity Coverage Ratio (LCR) and Net Stable Funding Rate (NSFR).                                                          | BCBS (2008a)                        |
| Guidelines have been published on 17 principles for liquidity risk management processes specific to medium, large and complex banks.                                                                                                                                                                              | BCBS (2008b)                        |
| Within the framework of Basel III, Minimum liquidity requirements is introduced by two objective metrics (LCR and NSFR) complemented by other monitoring tools to be applied internationally.                                                                                                                     | BCBS (2010a, 2012a, 2013a and 2014) |
| Principles for Sound Stress Testing Applications and Supervision have been developed in the review of supervisors on the application of stress testing principles that integrate liquidity risk in the establishment of banks' stress test frameworks.                                                            | BCBS (2012b)                        |
| A guide has been published on the design of monitoring indicators proposed for intraday liquidity management in order to enable bank supervisors to monitor banks' intraday liquidity risk management and their ability to meet their payment and payment obligations on time and even under stressful scenarios. | BCBS (2013b)                        |
| <b>Bank for International Settlements Research Task Force</b>                                                                                                                                                                                                                                                     |                                     |
| In liquidity stress testing, the existing sectoral and supervisory practices are handled in order to developing methodologies especially in terms of solvency and contagion stress tests interactions.                                                                                                            | BCBS (2013c)                        |
| The current risk factors literature on liquidity stress has been reviewed, consistent with the LCR scope.                                                                                                                                                                                                         | BCBS (2013d)                        |
| They outlined various approaches to model the interaction between liquidity and solvency risks from a macro prudential perspective.                                                                                                                                                                               | BCBS (2015)                         |
| They surveyed impact analysis of liquidity requirements and their interactions with capital requirements.                                                                                                                                                                                                         | BCBS (2016b)                        |

Source: BCBS (2008a, 2008b, 2010a, 2012a, 2012b, 2013a, 2013b, 2013c, 2013d, 2014, 2015 and 2016b)

#### **4.1. International Framework for Liquidity Risk Measurement, Standards and Monitoring-December 2010**

This document, which presents the liquidity section of the Basel Committee's reforms to strengthen global capital and liquidity regulations in order to create a more resistant banking sector, consists of four sections.

In the first section, it is emphasized that the aim of the reforms is to reduce the risks that extend from the financial sector to the real economy by improving the ability of the banking sector to absorb shocks caused by financial and economic stress. They announced that they developed two minimum standards as a complement to the principles in the risk management and supervision guide on funding liquidity risk published in 2008.

In the second part, details about these two standards are shared. Liquidity Coverage Ratio (LCR), which aims to make banks' short-term liquidity risk profile more durable, has been developed. LCR ensures that the bank has enough high quality liquid assets to survive in a stress scenario up to one month.

$$LCR = \frac{\text{Stock of high quality liquid assets}}{\text{Total net cash outflows over the next 30 calendar days}} \geq \%100$$

Another aim is to provide additional incentives for banks to continuously finance their operations with more stable funding sources, to provide resistance over a longer period. In this context, Net Stable Funding Ratio (NSFR) which has a one-year time period, has been added to the liquidity framework to ensure the sustainable maturity structure of assets and liabilities.

$$NSFR = \frac{\text{Available amount of stable funding}}{\text{Required amount of stable funding}} \geq \%100$$

In the third section, there are criteria (monitoring tools) that will provide supervisors with great convenience in monitoring liquidity risk in addition to the developed standards. These are listed below.

- Contractual maturity mismatch
- Concentration of funding
- Available unencumbered assets
- LCR by significant currency
- Market-related monitoring tools

In the fourth section, the implementation of the standards including the scope of the application and the transition period is explained.

#### 4.2. Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools- 2013

This standard, which examines more comprehensively the criteria developed with LCR defined in the framework published in December 2010, consists of similar sections as before. The Committee made progressive arrangements at LCR so that the economy can meet the funding needs of the banking sector while meeting the standards at a reasonable level. In this context, it is stated that LCR will implemented as of January 1, 2015 and will increase step by step until it is 100% (January 1, 2019) as seen on Table 6.

Table 6: LCR Min. Regulatory Ratios

|                           | 1 January<br>2015 | 1 January<br>2016 | 1 January<br>2017 | 1 January<br>2018 | 1 January<br>2019 |
|---------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| <b>Min.<br/>FX LCR</b>    | <b>40%</b>        | <b>50%</b>        | <b>60%</b>        | <b>70%</b>        | <b>80%</b>        |
| <b>Min.<br/>Total LCR</b> | <b>60%</b>        | <b>70%</b>        | <b>80%</b>        | <b>90%</b>        | <b>100%</b>       |

In addition, in this document, changes were made in the high quality liquid assets (HQLA) and net cash outflows definitions were changed with the LCR revisions. With the change made in HQLA the list of assets that can consider in this category has been expanded.

On the NSFR side, it was announced that the Committee continued its observations to prevent undesirable results and that it will be implemented as a minimum standard as of January 1, 2018. The NSFR is defined as the available amount of stable funding, divided by the required amount of stable funding. This longer-term structural ratio must be greater than 100%. The NSFR creates additional incentives for banks to address liquidity mismatches by funding their activities by more stable sources of funding. Stable funding is defined as equity and liability financing that is expected to be available over a one year horizon under stress conditions, according to the Available Stable Funding factors. (BIS, 2013)

Central bank borrowing is not considered stable funding, in order not to create incentives for banks to rely on it. Required funding is determined by the liquidity characteristics of a bank's assets and contingent exposures, as reflected in the Required Stable Funding factors. (End, 2010)

#### **4.3. Monitoring Tool for Intraday Liquidity Management - April 2013**

In this document, intraday liquidity is defined as the funds that can be accessed during the working day, which usually enables banks to pay in real time. Intraday liquidity risk is the risk that a bank cannot effectively manage intraday liquidity; which is that it cannot fulfill its obligation to pay at an expected time and may affect its own liquidity position and the situation of other parties. (BIS, 2013)

It has been demonstrated that banks should actively manage their intra-day liquidity positions by fulfilling their obligations on time under both normal and stressful conditions, thus contributing to the proper functioning of payment systems.

It was stated that LCR standards published in 2013 aim to provide short term resistance but do not include intraday liquidity. A series of quantitative tools have been developed to monitor the banks' intraday liquidity risks and their ability to meet their payment obligations on time, in consultation with the Committee's Payment and Settlement Systems (CPSS). These 7 monitoring tools are divided into three groups (see Table 7) according to the they can be applied to.

Table 7: Liquidity Risk Monitoring Tools

| <b>MONITORING TOOLS</b>                                                |
|------------------------------------------------------------------------|
| <b>Applicable to all banks</b>                                         |
| Maximum daily intraday liquidity use                                   |
| Current intraday liquidity at the start of the working day             |
| Total payments                                                         |
| Time-specific obligations                                              |
| <b>Applicable to banks that provide correspondent banking services</b> |
| Value of payments made on behalf of correspondent banking customers    |
| Day-to-day credit lines to customers                                   |
| <b>Applicable to directly participating banks</b>                      |
| Intraday output                                                        |

Source: BCBS, 2013

#### 4.4. Net Stable Funding Ratio - December 2014

NSFR is an important part of Basel III reforms. This rate necessitates maintaining a stable funding structure for banks' on and off-balance sheet activities. In addition, it aims to reduce the potential problems in ordinary funding sources that will cause the liquidity situation to deteriorate, which increases the risk of failing to meet the bank's liabilities, thereby preventing the emergence of larger systemic risks. By promoting a long-term and deposit-based funding structure, NSFR aims to reduce banks' excessive dependence on short-term wholesale funding. (BCBS, 2014)

NSFR will be a minimum standard on January 1, 2018. NSFR was first published in December 2010. Since then, the Committee has entered a strict review of the standard. With the revised standard of October 2014, focusing on banks' funds area and compliance with LKO was increased.

Changes made by the review regarding the “required stable funding” expressing the denominator value of the ratio comprises as follows.

- short-term risks carried in banks and other financial institutions,
- risks based on derivative products and
- assets used as the starting margin in derivative contracts.



## 5. REGULATIONS ON LIQUIDITY IN TURKISH BANKING SYSTEM

### 5.1. Regulation on Measurement and Evaluation of Banks' Liquidity Adequacy - November 2006

The purpose of the Regulation on Measurement and Assessment of Liquidity Adequacy of Banks, which came into force on 1 November 2006, is to regulate the procedures and principles for banks to ensure and maintain a sufficient liquidity level to meet their liabilities.

In the calculation of total liquidity adequacy ratio (LAR) and foreign currency liquidity adequacy ratio, the first maturity tranche is determined as 0 to 7 days and the second maturity tranche is 0 to 31 days. Table xxx provides minimum required LARs with two different tranches.

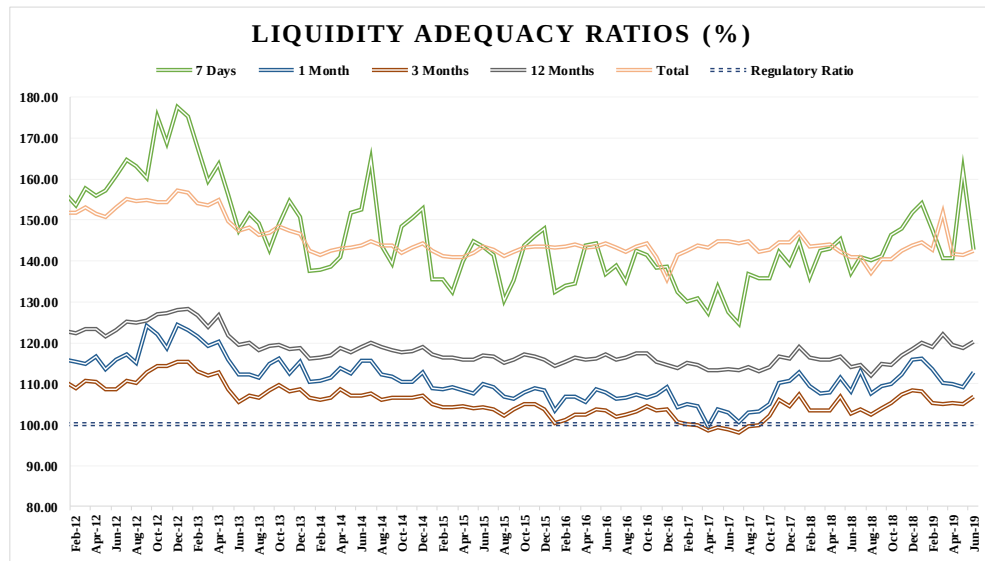
Table 8: Min. LARs

| Minimum Liquidity Adequacy Ratio |       |      |
|----------------------------------|-------|------|
| First Maturity Tranche *         | Total | 100% |
|                                  | FX    | 80%  |
| Second Maturity Tranche          | Total | 100% |
|                                  | FX    | 80%  |

\* weekly simple arithmetic mean of total LARs for the tranche

The total liquidity adequacy ratio in TBS is presented in Graph 6 in all maturities. As can be seen from the graph, the Turkish banking system's liquidity adequacy is well above the minimum requirements. Especially in recent years, the sector has more assets than to meet its liabilities in all maturities.

Graph 6: TBS Liquidity Adequacy Ratio



Source: BRSA

## 5.2. Regulation on Calculation of Banks' Liquidity Coverage Ratio - March 2014

The purpose of the Regulation on the Calculation of Liquidity Coverage Ratio of Banks, which came into force on March 21, 2014, is to determine the procedures and principles for banks to have sufficient high quality liquid asset stock to meet their net cash outflows in order to determine the minimum liquidity level.

Banks must have a sufficient amount of high-quality liquid assets to finance their cash outflows for thirty days. The reason for choosing thirty days is that the actions of the country and central banks to save the financial system will typically take place within 30 days in a financial crisis environment. This period also gives central banks time to take reformative measures to stabilize the financial system. The liquidity level of the banks is measured by calculating the sum of Turkish Lira and foreign currency on a consolidated and non-consolidated basis and the foreign currency liquidity coverage ratio on a consolidated and non-consolidated basis. Consolidated and unconsolidated total liquidity coverage ratio cannot be less than one hundred percent and consolidated and unconsolidated foreign currency liquidity coverage ratio cannot be less than eighty percent. However, there is a gradual transition to these rates in line with Table 6.

### 5.2.1. LCR Components and Calculation of LCR

The liquidity coverage ratio consists of three components. These are stock of high quality liquid assets, cash outflows and cash inflows. (BCBS, 2014) High-quality liquid assets have high potential for easy and quick turning into cash. The numerator includes cash, central bank reserves, high quality sovereign bonds and a proportion of high quality corporate bonds and/or covered bonds. Level 1, Level 2A and Level 2B are the three types of liquid assets with reducing quality levels. When determining the LCR, Level 1 assets are not discounted, while Level 2A and Level 2B assets are discounted at 15% and 50%, respectively.

Table 9: Components of LCR

|                                                                                                                       | WEIGHTS                        |
|-----------------------------------------------------------------------------------------------------------------------|--------------------------------|
| <b>A. HIGH QUALITY LIQUID ASSETS</b>                                                                                  | <b>Weights<br/>(1-Haircut)</b> |
| Level 1 Assets                                                                                                        | 100%                           |
| <i>Coins, Banknotes and CBRT</i>                                                                                      | 100%                           |
| <i>Marketable Securities Representing Claims on or Guaranteed by Institutions Rated and Assigned a 0% Risk Weight</i> | 100%                           |
| <i>Marketable Securities Representing Claims on Institutions Rated and Assigned a non 0% Risk Weight</i>              | 100%                           |
| Level 2 Assets                                                                                                        | 50% to 85%                     |
| <i>Level 2A Assets</i>                                                                                                | 85%                            |
| <i>Level 2B Assets</i>                                                                                                | 75% to 50%                     |
| <b>B. CASH OUTFLOWS</b>                                                                                               | <b>Run Off Rates</b>           |
| Unsecured Funding                                                                                                     | 5% to 100%                     |
| Secured Funding                                                                                                       | 0% to 100%                     |
| Funds Provided by Structured Financial Instruments                                                                    | 100%                           |
| Off Balance Sheet Liabilities                                                                                         | 0% to 100%                     |
| <b>C. CASH INFLOWS</b>                                                                                                | <b>Inflow Rates</b>            |
| Secured Lending                                                                                                       | 0% to 100%                     |
| Unsecured Lending                                                                                                     | 0% to 100%                     |
| Other Cash Inflows                                                                                                    | 0% to 100%                     |

Note: In LCR calculation, the portion of total cash inflows exceeding 75% of total cash outflows is not taken into account.

The run-off rates for cash outflows which are expected to occur within 30 days range from 5% to 100% depending on the property of the borrowings. In the same way the inflow rates for cash in lows expected to occur within 30 days range from 0% to 100% depending on the nature of the lending.

Net cash outflows are determined by the total expected cash outflows minus total expected cash inflows and reflect the net amount of funding that may disappear within the 30 days under a stress scenario. Table 9 summarize the components of LCR with their subcategories and weights.

The liquidity coverage ratio is calculated by dividing the high quality liquid asset stock into net cash outflows. The unconsolidated total and foreign currency liquidity coverage ratios are calculated by taking the weekly simple arithmetic average of the liquidity coverage ratios to be calculated daily over the total of Turkish Lira and foreign currency.

On the other hand consolidated total and foreign currency liquidity coverage ratios are calculated by taking the monthly simple arithmetic average of the liquidity coverage ratios to be calculated daily over the total of Turkish Lira and foreign currency. A simulation of how the liquidity coverage ratio is calculated for a given week is provided by Table 10.

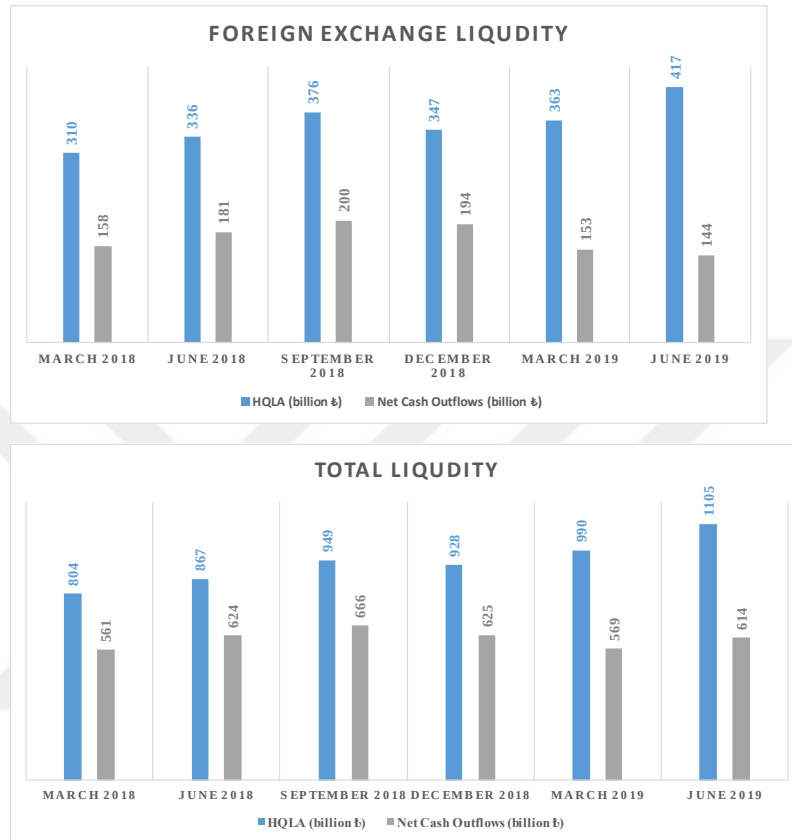
Table 10: An Example of LCR Calculation

| LCR Calculation Example                          |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|--------------------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 24-30 JUNE 2019<br>Week*                         | Day-1 |       | Day-2 |       | Day-3 |       | Day-4 |       | Day-5 |       | Day-6 |       | Day-7 |       |
|                                                  | FX    | TOTAL | FX    | TOTAL | FX    | TOTAL | FX    | TOTAL | FX    | TOTAL | FX    | TOTAL | FX    | TOTAL |
| A. Stock of HQLA<br>(numerator, billion ₺)       | 372   | 645   | 371   | 647   | 372   | 666   | 372   | 660   | 372   | 650   | 372   | 650   | 372   | 650   |
| B. Net Cash Outflows<br>(denominator, billion ₺) | 194   | 437   | 193   | 436   | 192   | 450   | 194   | 442   | 190   | 437   | 192   | 442   | 195   | 447   |
| DAILY FX LCR<br>(A/B) (%)                        | 191,4 |       | 192,2 |       | 193,4 |       | 191,3 |       | 196,1 |       | 194,4 |       | 190,7 |       |
| DAILY TOTAL LCR<br>(A/B) (%)                     |       | 147,6 |       | 148,3 |       | 148,0 |       | 149,3 |       | 148,7 |       | 147,1 |       | 145,2 |
| FX LCR<br>(Average of 7 days) (%)                | 192,8 |       |       |       |       |       |       |       |       |       |       |       |       |       |
| TOTAL LCR<br>(Average of 7 days) (%)             | 147,7 |       |       |       |       |       |       |       |       |       |       |       |       |       |

\* Amounts are simulated as an example, they do not reflect actual values.

The latest data on FX LCR and Total LCR elements in the Turkish banking sector are presented in Graph 7. Accordingly, it is obvious that the banking sector has high quality liquid assets that can meet the cash outflows in both FX and total LCR.

Graph 7: FX and Total HQLA and Net Cash Outflows in Recent Years



Source: TBA

### 5.3. Best Practice Guide to Management of Liquidity Risk-March 2016

Banks are required to have sufficient capital in return for significant risks, such as liquidity risk, to which they are exposed or will remain while performing their activities and to improve their ability to manage the mentioned risks. However, the “Regulation on Internal Systems of Banks and Internal Capital Adequacy Assessment Process (ICAAP)”, which is expected to be taken as a basis in risk management practices and internal capital requirement calculations, is limited in scope and content. On the other hand unique practices are not possible in banks with different scale and operating structures. It revealed the need to prepare guides showing management practices and how to calculate their capital requirements.

In addition, these guides can eliminate the negative criticism of the banks' current regulations regarding the management of the risks they are exposed to (credit, liquidity, operational risk) are insufficient or lack sufficient details.

Thus, in order to meet the need for a guiding on liquidity risk management, which is also a part of the internal capital adequacy assessment process, the Best Practice Guide for the Management of Liquidity Risk was published on 31 March 2016.

In this guide, which contains principles aimed at ensuring the efficiency and adequacy of liquidity risk management, the following topics are generally covered. (BRSA, 2016)

- Liquidity risk management structure,
- Organizational structure in liquidity risk management,
- Strategies, policies and procedures regarding liquidity risk,
- Liquidity risk management process,
- Emergency and contingency plan and business continuity plan.

#### **5.4.Draft Regulation on Banks' Net Stable Funding Ratio Calculation - September 2018**

With this draft regulation, the work has started to include the NSFR standard, which is implemented by the Basel Committee in January 2018, in the BRSA regulations.

The purpose of the draft regulation is to determine the procedures and principles to ensure that banks make stable funding in order to prevent the risk of funding that they may be exposed to in the long term from deteriorating their liquidity levels.

The current stable fund includes the portion of banks' liabilities and equity expected to be permanent; necessary stable fund refers to the part of the assets that are expected to be funded on the balance sheet assets and off-balance sheet liabilities.

The quarterly simple arithmetic average of the consolidated and unconsolidated net stable funding ratio calculated monthly, cannot be less than a hundred percent as of March, June, September and December.

### **5.5. Liquidity Buffers**

Banks should establish a liquidity buffer consisting of high quality liquid assets that are not subject to collateral, ensuring adequate liquidity level in all economic conditions. Thus in order to be able to resist the bank-specific or market-wide liquidity crisis, these assets can be sold or subject to collateral to provide liquidity. The deficiency of liquidity buffers reduces the ability of banks to take action, especially under stressful conditions or in crisis periods and causes them to experience liquidity shortages.

In the pre-global financial crisis, banks had insufficient motivation to protect themselves against such threats. Since they had to bear a certain cost to hold liquid assets as buffers, and they could also have the perception that liquidity stresses were very unlikely and central banks would intervene to supply liquidity in the markets under stress. (End, 2009)

Regulations should therefore promote banks to fulfill their obligations when due, while at the same time ensuring that they can sustain liquidity buffers to manage shocks without relying on central bank liquidity support. BCBS (2010) (CEBS (2009, 2010a)).

Discussions on the definition and composition of liquidity buffers that can handle liquidity stress began in the pre-crisis period. Before the crisis started, the cash inflow and borrowing capacity to meet the cash outflows were considered as a buffer and thus focused on debt liquidity. In the crisis period, many asset classes were experienced to be less liquid than anticipated, and currently the emphasis is on asset liquidity. (BIS, 2013) In this context, it has been determined which assets used as buffers will be in the high quality liquid asset class.

Banks should create liquidity buffers from the most liquid assets that can be sold easily and quickly, by enduring minor losses. Such assets should be enough to satisfy the pressing needs of liquidity shocks. These include cash, high-credibility securities issued / guaranteed by country treasures or central banks, and similar debt instruments (e.g. issued by public institutions or multilateral development banks). Banks can also use secondary liquid assets to expand their buffer content to complete the stress period with harmless or low losses. The liquidity buffer consists of a mixture of suitable assets. There should be enough diversity in the types of liquid assets held by banks, taking into account concentration limits. Banks should consider their values after applying appropriate discounts against liquid assets, price fluctuations due to credit and market risk.

In this context, the characteristics of the assets to be included in the liquidity buffer are as follows: (BRSA, 2014)

**Unencumbered:** When the bank needs liquidity, there is no legal or operational constraint to hinder the use of assets.

**Low Credit Risk:** The assets with less risk, higher credit rating of the issuer and the credit priority of the person holding the asset are more liquid.

**Low Market Risk:** Securities issued in a currency with low duration or volatility or in a low inflation environment and/or low exchange volatility are more liquid.

**Low Correlation Risk:** Banks should not be reliant on liquid assets which trigger the adverse trend risk<sup>19</sup>. Assets issued by financial institutions are less liquid when the financial system is hit by a liquidity shortage, so these kinds of securities should not be included in the buffer.

**Ease and Accuracy in Assessment:** When market participants are able to agree on the value or valuation of an asset, the liquidity of the asset is comparatively higher.

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<sup>19</sup> General adverse trend risk is a situation that indicates the probability of the counterparty's default have a positive correlation with general market risk factors. The specific adverse trend risk refers to the risk that arises when there is a positive correlation between the amount of risk due to the nature of the transaction performed and the probability of default by the counterparty.

(i.e. the price estimate is easily calculated and not dependent on a vast number of assumptions or does not require the use of private information)

**Liquidity History of Assets:** Banks should prefer assets with a background that has been accepted as a reliable liquidity source in the markets even under difficult market conditions. Some types of assets, such as high-quality government bonds, can become the safest options in a systemic crisis.

**Existence of an Active, Large and Liquid Market:** Assets should typically be traded or quoted in developed, deep and active markets, where the gap between purchase and sale prices is small and sufficient number of market participants, market concentration remains low, high trading volumes are realized. Thus, assets can be easily used in liquidity supply when requested.

## 6. LIQUIDITY STRESS TEST

Liquidity stress tests are studies to ensure a comprehensive assessment of whether banks' internal resources (in the form of liquidity buffers) are sufficient to withstand adverse conditions. It aims to capture the risk of whether the bank will be able to create sufficient resources to meet its short-term obligations after sudden fund outflows by evaluating the adequacy of the available funding resources over a defined stress period. These tests often examine the resilience of individual banks or the banking sector, without directly considering liquidity support as the lender of last resort (LOLR) of central banks. (Jobst, 2017)

Van den End (2008) developed a stress test model that modeled the market and funding liquidity risk by including feedback effects (secondary effects) that capture both behavioral and reputational effects.

The Bank of England (Aikman et al., 2009) tried to combine funding liquidity risk and solvency risk in the Risk Assessment Model (RAMSI) for Systemic Institutions. Within the framework of the study, banks' liquidity positions are simulated based on other variables such as capitalization under stress and decreased trust among market participants under stress.

Wong and Hui (2009) examined the effects of market losses on banks' debt service position. By simulating these losses leading to deposit outflows, they clearly demonstrated the link between default risk and deposit outflows.

Barnhill and Schumacher (2011) have developed a more general empirical model that comprehensively addresses the causes of solvency shocks and analyzes the longer-term effects of funding shocks.

Schmieder et al. (2012) created an Excel-based tool that models the increase in funding costs caused by changes in banks' solvency.

The model created by Jobst (2014) addresses the maturity mismatch between assets and liabilities that affect the financial stability of the bank. Evaluations were made based on the characteristic features of banks, changes in risk profiles and common changes in market conditions.

Hesse et al. (2014) tried to integrate banks' solvency and liquidity resistance into macro-financial connections within the framework of a stress test.

## **6.1. Stress Test Methods**

### **6.1.1. Bottom-Up (BU) Macro Liquidity Stress Test**

In the bottom-up (BU) approach, financial institutions calculate the impact of shocks on balance sheets based on non-aggregated data. Since banks' portfolios contain a large number of instruments, each with its own price, revaluation of the portfolio requires information on a large number of market prices. Financial institutions generally facilitate this process by matching each element of the portfolio with a common group of risk factors. (Beşe, 2007)

Bottom-Up macro stress tests are often an important part of the IMF Financial Sector Evaluation Programs (FSAP). Before the crisis and until the early stage of the crisis liquidity stress tests consisted of simplified bank-type scenarios based mostly on on-balance sheet items' implied cash flow testing and did not pay much attention other possible cash flows (margin call etc.), off-balance sheet position and risks or the foreign currency liquidity profile. In addition to this situation, the fact that scenarios related to both market and funding liquidity are generally optimistic was insufficient to reveal potential risks during the crisis. A case study by Ong and Čihák (2010) indicates that the risks could not be identified due to deficiencies here, by pointing out both the severity of the scenarios and the scope of other tests. (BIS, 2013)

In more recent FSAPs, the scope of liquidity stress tests has been expanded, utilizing more complex methods and, more importantly, more comprehensive data used by the relevant authorities. The scenarios are designed to be based on a combination of macroeconomic scenario modeling and expert judgment, taking into account current system conditions and data access constraints. In addition to cash flow tests, Basel III ratios and maturity mismatch analysis are included, making a clear link between solvency and liquidity for financing costs.

The following explanations regarding the bottom up stress test are included in the Best Practice Guide on the Stress Tests to be Used by Banks in Capital and Liquidity Planning, published by the Banking Regulation and Supervision Agency:

The bottom-up stress test is applied on a credit or counterparty (borrower) basis. The statistical relationship between the risk determinants of a specific sector or credit class and the variables in the scenario is revealed. Credit risk levels transition probabilities and matrix are obtained on the basis of portfolio, product, sector, collateral type. Thus the probability of default (PD) under stress is attained from the debtor and collateral information. In addition, Loss Given Default (LGD) is calculated as a function of elements such as collateral type, default timing, shifts in collateral value curve and depreciation and other expenses of the collateral. It is important to use borrower specific these analyzes in risk based pricing, budgeting and planning, economic capital modeling and risk appetite and setting limits. (BRSA, 2016)

### **6.1.2. Top-Down (TD) Macro Liquidity Stress Test**

Top-down stress testing has become increasingly valuable for regulators in recent years, as policymakers have become increasingly aware that stable financial institutions do not ensure financial stability ultimately (Crockett, 2000). On the other hand, the crisis demonstrated the lack of robust and sophisticated stress test methods in banking and as the economy exploded extreme stress scenarios became hard to understand. (BCBS, 2009) The mild stress tests in the scenario did not challenge enough the financial strength and business structures of banks. To get their own views on the effects of stress situations, regulators developed audit-focused stress testing activities that objectively analyze the own estimates of the banks. (Daniëls et al, 2017)

Authorities use internal models to test the flexibility of individual banks or the financial system from top to bottom. Financial institutions in some countries may not have the capacity to estimate the impact of shocks on their portfolios. In this case, the organization that coordinates the stress test analysis study can use system-based variables to calculate the impact of shocks by adopting the "top-down" approach.

Although significant progress has been made in the bank debt payment test (solvency), liquidity risk modeling is still in its early stages especially in macro stress tests. In the past fifteen years, a number of modeling approaches have been developed, including flexibility assessment under specific macroeconomic scenarios and frameworks in which dynamic-systemic effects are integrated into the model. (Anderson et al, 2018)

On the other hand, even limited there are also stress test models including liquidity risk and feedback effects in the financial sector, and hence systemic liquidity effects. Scenarios are generally designed as simulated shocks applied to bank portfolios where there is market and funding liquidity risk. In most models, banks' responses to shocks affect market liquidity (deductions on assets through sales of balance sheet assets at cheap or at a loss) or funding liquidity (liquidity cuts through interbank network effects in some cases). (BIS, 2013)

In the Best Practice Guide on Stress Tests to be Used by Banks in Capital and Liquidity Planning published by the Banking Regulation and Supervision Agency in March 2016, the following statements regarding stress testing are included:

In the top-down stress test application, credit pools are created from loans with similar qualities (in areas such as internal degree, collateral quality) and the statistical relationship (eg, through regression) between the variables in the scenario and the historical data of the credit pools is determined. PD and LGD are obtained on the basis of credit pools, thereby achieving the net loss projection. The calibration of the model for the current and subsequent periods, and its retrospective testing with the bank's own internal loss data is very important. Top-down stress tests are applicable for portfolios with similar risk characteristics, such as personal loans and credit cards, but

only secondly for portfolios such as commercial loans or project finance. (BRSA, 2016)

### **6.1.3. Combination of Bottom-up and Top-down Approaches**

Liquidity stress testing applications are also available, which include a combination of bottom-up and top-down approaches. Austrian Central Bank, which has studies on this subject, developed a second-round effect approach by adding behavioral responses to the bottom-up stress test design in the liquidity stress test. (Breuer, 2018) In this approach, after the stress scenarios provided to banks, banks specify when and what steps will be taken to reduce the impact of stress scenarios. In the second step, behavioral responses analysis and potential secondary effects were identified by the supervisor or the central bank. Two scenarios are defined, which are the combination of market and market and idiosyncratic shocks. Stress-effect cash flows, securities flow and profit and loss effects were estimated by banks from the bottom up. Based on the separate behavioral responses template, secondary effects were identified by the Central Bank of Austria, and stress-influenced cash flows were retested with a top-down approach. (Jobst, 2017)

In summary, liquidity stress tests consist of three scenarios derived from scenario results and banks' behavioral responses to the combined scenario. Based on the reported behavioral responses, Austrian officials concluded that the complete depletion of liquid assets was due to secondary effects.

The advantage of such top-down and bottom-up stress tests is that they allow the use of cash flows rather than the stock approach and measure market liquidity shocks based on counter-balancing capacity. (BIS, 2013)

In addition, they capture potential second-round effects. However, the approach has a number of disadvantages. Data density is high; Unless a fully matured maturity mismatch reporting template is available, a targeted data collection study should precede the stress test. These are costly and ultimately data quality may not be very good. Finally, the effects in the second round need to be estimated from the expert

judgment and related literature, as well as the data produced in the exercise. (ECB, 2013)

## **6.2. Liquidity Stress Test Framework**

### **6.2.1. The Organization Applying Stress Test**

It is quite clear that the institution that will perform the analysis has a macro perspective and evaluation capacity to evaluate the soundness of the entire financial sector and the need for access to the data to be used in these evaluations. In this framework, the macro perspective of central banks, as supervisory and regulatory authorities and the final application authority, contributes significantly to stress test analysis. Especially in developing countries that will conduct stress test analysis for the first time, the analyzes are made by the members of the Financial Sector Assessment Program (FSAP) delegation carried out by the IMF and the World Bank. On the other hand, the central banks or supervisors conduct stress test analysis in countries that are more advanced or have more experience in stress test analysis. Some of the countries that carry out the stress test analysis or where the analyzes are conducted by the FSAP delegation also compare the results by ensuring that stress tests are applied by financial institutions. (Cihak, 2007)

In this context, the institutions that will apply stress tests are summarized as follows according to their approaches. (Hilbers, 2004)

- Top-down stress tests by banks, using the constraints and assumptions set by supervisors,
- Top-down stress tests carried out by supervisors based on their assumptions and drafts,
- Top-down stress tests by supervisors using assumptions and drafts created by global authorities such as FSAP, BIS officials,
- Top-down stress tests by FSAP officials using their own assumptions and drafts.

### **6.2.2. Scope of Stress Test and Data**

While determining the scope and data related to the stress test to be performed, the number of organizations to be included in the analysis should represent a significant majority of the system. Since the inclusion of too many banks with small montages in the analysis will make calculations difficult and cumbersome, the market shares of the banks to be included are used as a limiting criterion. In country analysis, the number of banks is usually determined to cover at least 80% (Jobst, 2017) of the total banking sector assets.

Although in liquidity stress tests it is not very common in practice, considering the connections with each other and their systemic importance, the inclusion of non-bank financial institutions as well as banks will add depth to the studies. (Virolainen, 2004) However, it is obvious that the analysis will be more difficult due to these institutions' different balance sheet structure and reporting techniques. Besides these institutions can be audited by different authorities.

Liquidity stress tests are carried out at the bank level based on detailed data (granular data). The coverage of these tests depends on the accuracy, quality and availability of the data. The data includes confidential information (based on publicly available data in countries such as Norway and America) collected from reporting to supervisory agencies, and in many cases also includes maturity breakdown of categories of assets and liabilities. The analyzes are generally carried out on the data compiled as of the end of the quarter or the end of the current fiscal year.

### **6.2.3. Scenario Designing**

The scenarios to be considered in the stress test should be created under various assumptions by using the model or by looking at the general macroeconomic structure. In order to understand the behavior of the financial system, a suitable model should be developed depending on the depth of the system.

Considering that the main purpose of system-oriented stress tests is to understand the effects of important changes in the economic environment on the

financial system, ideally the basis of stress test scenarios is the macroeconometric model or simulation model. The use of macro models provides a forward-looking and consistent structure in analyzing the fundamental relationships between the financial system and the real economy. On the other hand, considering that these macro models generally do not include variables related to the financial sector, a “satellite model” that matches a group of macroeconomic variables with the variables related to the financial sector is used in practice. Such a satellite model explains the variables related to the asset quality of banks in a certain period of time as a function of other variables and systemic variables on a bank basis. In other words, the satellite model is used to match the external shocks assumed with the macro model to the asset quality shocks on a bank basis. (Jobst, 2017)

However, liquidity models cannot be established in most macro stress test analyzes. The main reason for this is that it is very difficult to quantify the multiple dimensions of liquidity risk with a single model. After determining the scope of the liquidity stress test under various assumptions by looking at the general macroeconomic structure, the content and severity of the scenarios, external stress assumptions and the criteria for passing/falling the test are defined. (Blaschke, 2001)

Liquidity stress tests assess banks' short-term or, in some cases, medium-term durability with insufficient returns on their uncollected receivables with sudden and large amounts of fund outflows. Some tests aimed to create reverse stress tests by increasing the dosage of shocks (until they break) to cause severe stress in addition to the “traditional” tests that reflect liquidity positions under specified scenarios. These tests usually include: (Cihak, 2007)

Cash flow mismatch is analyzed for different risk periods, focusing on the sudden and substantial withdrawal of short-term funds and the adequacy of selling free assets (without mortgages) to withstand these shocks under stress conditions; or analyzes based on liquidity ratio over a longer risk period.

FSAP stress tests, on the other hand, evaluate the changes in banks' financing conditions under different negative scenarios within the framework of existing

liquidity risk management measures. By developing a more stable fund profile, these policy measures increase banks' resistance to fund shocks by: (Nier et al, 2014)

- Liquidity buffer requirements encourage banks to have sufficient liquid assets to meet their outflows during stress.
- Stable funding requirements ensure that illiquid assets are financed by stable sources of finance.
- Required reserves enable banks to keep certain amounts of reserves in the central bank.
- Restrictions on open foreign exchange positions and / or foreign currency funding aim to limit banks' exposure to foreign exchange risk.

#### **6.2.4. Methodology of Stress Testing**

Most applications combine implied cash flow modeling and standard liquidity risk measures classified according to the Basel III liquidity framework according to national and/or international regulatory standards.

Implied cash flow (ICF) tests focused on the adequacy of existing assets to withstand these shocks under stressful conditions, taking into account the sudden, substantial withdrawal of funds and the valuation of debts. Asset-liability mismatch analysis involves testing of cash inflows and outflows over different maturities. (Jobst, 2017)

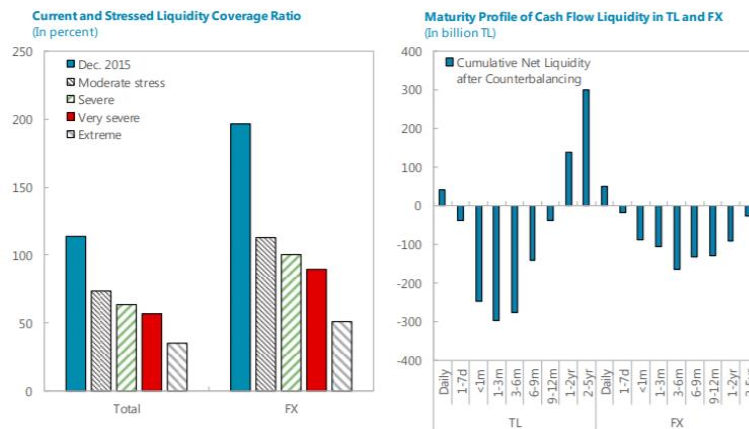
Basel III liquidity measures expect banks to maintain a stable funding structure, limit maturity conversion, and have sufficient assets to meet their funding needs in times of stress. (BCBS, 2010b, 2010, 2012b and 2013a). The framework is based on two standard rates Liquidity Coverage (LCR) and Net Stable Funding Rate (NSFR) applied to banks. These rates are estimated approximately based on contractual maturities and assumptions about the credit quality of securities. To support the implementation of liquidity risk measures by national regulatory and supervisory agencies, standard liquidity ratios have been determined and national reporting frameworks have been developed. (BCBS, 2013a)

Many of these rates are considered as non-cumulative measures of potential liquidity shortage for stress periods involving banks' short- and medium-term resistance to the individual and overall system. Liquidity Adequacy Ratio organized in Turkey is an example of such ratios.

FSAP publishes financial system evaluations and technical stress tests grades for developed and developing countries. In the FSAP assessment (IMF, 2017), the last one for our country in 2017, the analysis for liquidity is presented in Table 12.

Table 11: FSAP Turkey Liquidity Stress Tests Results

Figure 10. Turkey: Results of the Liquidity Stress Tests of Major Banks



Source: IMF, February 2017, Turkey Financial Sector Assessment Program Financial System Stability Assessment, p.35.

In the FSAP assessment, the top 10 deposit banks holding more than 80 percent of bank assets for liquidity stress testing were covered. In their analysis, stressed liquidity coverage ratios are generated after different levels of cash outflow scenarios are implemented. Scenarios designed with different severity are as follows:

**Moderate Stress Scenario:** 10%-20% run-off on retail deposits for large/other banks, 10% percent corporates deposits, discounting high quality liquid assets by 5% and assuming zero inflows from the central bank or the interbank market.

Severe Stress Scenario: 10%-30% run-off on retail deposits for large/other banks, 15% on corporates deposits, discounting high quality liquid assets by 5% and assuming zero inflows from the central bank or the interbank market.

Very Severe Stress Scenario: 15%-30% run-off on retail deposits for large/other banks, 20% percent on corporates deposits, discounting high quality liquid assets by 5% and assuming zero inflows from the central bank or the interbank market.

Extreme Stress Scenario: With higher run-off degree and higher degree stressed inflows are designed.

As a result, IMF staff assessed that by representing potentially large negative cash flow conditions up to 12 months, severe liquidity stress that can be predicted in the adverse scenario could decrease liquidity coverage capability by half (TL) or more (FX). It is also stated in this scenario that this kind of liquidity stress may cause banks to cut credit lines and increase the pressure on nonfinancial corporates and households.

## **7. THE DETERMINANTS OF TURKISH BANKING SECTOR'S LIQUIDITY BUFFERS**

### **7.1. Literature Review**

Aspachs et al. (2005) study to find out the determinants of UK banks' liquidity buffers with the help of idiosyncratic and macro variables. Particularly, they try to examine how central bank lender of last resort (LOLR) policy affect banks' liquidity positions. They use balance sheet and income statement data, for a panel of 57 UK banks over the period 1985Q1 to 2003Q4. Dependent variables are liquidity ratio-1 (in terms of total assets) and liquidity ratio-2 (in terms of total deposits) while independents are support (central bank LOLR), interest margin (individual return on loans minus cost of funds), profit (profit to total assets), loan growth, Tobin's Q ((market value of equity + book value of other liabilities)/total assets), size (log of total assets), GDP growth, short term interest rate. Liquid assets described as composition of cash, reverse repos, bills and commercial papers and comprise in addition all types of investments securities. To capture well the degree of liquidity mismatch they use an alternative liquidity ratio as the ratio of liquid assets to total deposits (liquidity ratio-2) and running all regressions for these alternatives.

The regression models are estimated by General Methods of Moments (GMM) procedure and they find strong evidence of the existence of the support from the central bank in case of liquidity shortage banks are prone to hold lower liquidity buffer. Another finding is that banks are keeping more liquid assets in the weak economic growth environment while reducing liquidity buffers in a strong economic growth times. In terms of interest rates the results suggest that while the policy rates are increasing banks are holding smaller amount liquid assets. In a more in depth regarding to effect of bank specific variables, they find that banks' liquidity buffers were

associated with bank characteristics such as, net interest margin, size and profitability coefficients are insignificant while loan growth coefficient is significant. They find that stronger loan growth reduce banks' liquidity buffers.

Dinger (2009) emphasized that banks with foreign owned play a balancing role in the banking systems of emerging economies, and this role can be associated with banks' access to more diversified liquidity resources. It aims to contribute to the literature in its articles since there is no empirical evidence about the liquidity behavior of international banks and its effects on total banking system liquidity. In the analysis, 378 banks from ten emerging Central and Eastern European economies are analyzed as of 1994-2004. They evidence that foreign-owned banks hold less liquid assets than domestic banks in normal times but relatively higher shares of liquid assets in times of crisis. Another important finding is that the presence of transnational banks significantly reduces the risk of total liquidity shortages in emerging economies.

Heider et al (2009) researched, in the existence of counterparty risk, the functioning and potential collapse of the interbank market. They tried to show how the asset risks of banks impacts funding liquidity on the interbank market. They use the model to clarify the various policy responses that have been implemented to ease tensions. They listed the interbank market regimes, which could occur as follows: i) normal state with low interest rates; ii) chaos with adverse selection and high rates; and iii) market collapse with liquidity hoarding. The interbank market regimes represent developments prior to and during the financial crisis.

As a result, they prove that an equilibrium in which all banks operate in the interbank market and in which liquidity is re-allocated seamlessly can not be reached reflecting in particular the level and distribution of risk between banks. Whereas a number of factors affect the decisions of banks to trade in interbank markets, their model emphasizes the role of counterparty risk as an important component for understanding the events. They also argue that asymmetric information on risk can rationalize the long-term nature of interbank market tensions, despite the unprecedented liquidity provided by central banks.

In their study Acharya, Shin and Yorulmazer (2011) have examined the effects of financial crises and resolution processes on holding liquid assets of banks and developed a theoretical framework for banks' tendency to choose hoarding liquid assets in their portfolios with a strategic approach. Their hypothesis is that banks, which suffered during the financial crisis, would sell their balance sheet assets cheaply (fire-sales) in order to overcome the liquidity problem while the other banks which wishing to buy these risky assets well below their real costs, hold more liquid assets. Their findings point to a balance between keeping liquid assets and investing in risky assets, and also banks with high risk appetite hold less liquidity.

In the study of Vodová (2011), Czech commercial banks' liquidity determinants have been investigated, similar to previous studies it benefited from bank-specific and macroeconomic variables. 4 different liquidity ratios are designed as dependent variables. These are listed as the ratio of liquid assets to total assets, the ratio of liquid assets to deposits and short-term liabilities, the ratio of loan to total assets and the ratio of loan to deposit and short-term funding. The results showed that there is a positive connection between the bank liquidity and non-performing loans, capital adequacy, and interest rates and interbank transactions. The inflation rate, business cycle, and financial crisis have proven to have a negative impact on liquidity. On the other hand, according to the findings, there is no relation between the size and liquidity of banks.

Deléchat et al. (2012) examine the determinants of banks' liquidity buffers in Central America by using bank-specific and macroeconomic indicators. The variables used in the empirical estimations are as follows: liquidity ratio (liquid assets to customer deposits and short-term funding), capitalization (equity to total assets), profitability (net interest income to average earning assets), loan-loss reserves ratio (loan-loss reserves to gross loans), bank size (total assets), ownership, real GDP growth, interest rate spread (difference between average lending and deposit rate), inflation rate, history of banking crisis.

The paper studies using a panel data sets of the region's 100 commercial banks over 2006 to 2010. Due to the large number of banks and a relatively small number of time periods they use the Generalized Methods of Moments (GMM) for estimation methodology. In this study the liquidity buffers is defined as the liquid assets to

deposits ratio and they find that holding prudential liquid assets is related to bank size, capitalization, loan-loss reserve ratio, profitability and financial development. The results suggest that liquidity holdings increase with bank size the opposite of the other studies. Liquidity buffers are also negatively related to the loan-loss reserve ratio and the net interest margin. The coefficient of capitalization variable is negative and significant means that better capitalized banks would tend to hold less liquidity.

Bonner et al. (2013) assess the determinants of banks' liquidity holdings using bank-specific, institutional and policy variables. Their primary objective is to find out whether liquidity regulations are replacing banks' tendency to hold liquid assets. For this purpose they use balance sheet data for nearly 7000 banks from 30 OECD countries over a ten-year period from 1998 to 2007. In the study dependent variable as a measure of liquidity holdings is very narrowly defined. While designing the liquidity buffer proxy they have just focused on cash and due from banks as percentage of total assets. Also for robustness check they have benefited from the literature's (Aspachs et al. (2005) or Delechat et al. (2012)) liquidity ratio which is defined as liquid assets over total deposits. Independent variables are defined as bank size (total assets (TA) and TA squared over GDP), profit (profits over TA), capital ratio (equity as percentage of TA), deposit (total retail deposits over TA), disclosure (an index describing countries' disclosure requirements), concentration (share of the three largest banks' assets in economy-wide bank assets), DGS (the ratio of state-underwritten deposits to average savings).

The model is estimated pooled OLS estimations with robust standard errors. As a result bank-specific and institutional variables have significant impact on banks' liquidity holdings. For example banks' liquidity holdings are increasing when profit and deposit go up. On the other hand disclosure requirements increases liquidity buffers whereas concentration reduces banks' incentives to hold liquid assets. In other words without liquidity regulation, banks' liquidity buffers are determined by business model, profitability, deposit holdings, size and country-specific disclosure requirements, concentration of the banking sector variables. The presence of liquidity regulation substitutes most of these factors, making them insignificant determinants of liquidity buffers. On the other hand disclosure requirement and bank size have remained significant.

In their study, Chen and Phuong (2014) try to find the impact of bank-specific, bank-idiosyncratic and macroeconomic factors on the amount of the bank liquidity buffer. They mainly focus on relation between securitization and loan deposit operations and liquidity buffers size since these activities can be manipulated by banks in order to minimize the influence of regulatory agencies on bank liquidity management.

For the analysis a data set have been collected over the period 1997Q1 to 2010Q4 and contained 468.721 bank-quarters. The level of liquidity buffer has been defined as dependent variable and measured by liquid assets (sum of Fed funds sold and securities purchased under agreements to resell, securities held to maturity, available for sale securities) to total assets. Bank-idiosyncratic variables are securitization, deposit-lending synergy while bank-specific variables are size, net income, total equity capital and macroeconomic factors as follows: the business cycle, monetary policy and crisis periods.

According to their panel regression results securitization of the loan decreases the motivation for the bank to hold liquid assets. In addition, when the Federal Reserve Board tightens monetary policy, banks have to use their liquidity reserve therefore the liquidity buffer reduces. Banks incline to hold liquid assets during economic crisis while holding fewer liquid assets during the normal and recovery periods. The other important finding in this paper is that bank size significantly and positively affects the size of the liquidity buffer.

Davydov et al (2018) investigate the cyclicity of bank liquidity creation with the help of the methodology of Berger and Bouwman (2009) liquidity creation measures. They analyze the relation between GDP growth and liquidity creation of Russian banks from 2004 to 2015 by taking into account potential differences across various bank types. They observe that fluctuations in the business cycle relate positively to the creation of bank liquidity. They also show that state banks and foreign banks have no action more or less procyclical in term of creating liquidity than private domestic banks do. They also find that for the generation of liquidity the level of procyclicality is higher than for the lending. Therefore, whereas bank ownership does

not affect the cyclical nature of creating bank liquidity, banks' actions in creating liquidity will intensify volatility in the business cycles. They argue that these observations have some consequences: banks' liquidity creation activity may lead to expanding changes in the business cycle, as liquidity creation has been shown to have positive effects on economic activities.

Banerjee & Mio (2018) tried to estimate the causal effect of liquidity regulation on bank balance sheets. They used the implementation of tighter liquidity regulation by the UK Financial Services Authority (FSA), which published a new quantitative Individual Liquidity Guidance (ILG) requirement that would require banks to hold a sufficient stock of high quality liquid assets to meet a hypothetical stress scenario. In the analysis, 81 non-ILG banks and 90 regulated banks included. As dependent variable the ILG measured by the following ratio:  $ILG\ ratio = \frac{\text{High quality liquid assets}}{\text{Net stressed out flows}}$  so the minimum firm-specific ILG target set.

According to the Probit regression of ILG treatment prediction results they proved that banks subject to ILG did not adjust their balance sheet size to comply with the liquidity regulation, but changed the composition of both their assets and liabilities. On the liquidity side, banks substantially increased HQLA's share and on the liabilities side, banks increased funding from more stable non-bank and non-financial corporate deposits, and reduced their dependency on less stable short-term wholesale and non-UK funding.

Regarding the price impact, they do not find evidence that tightening liquidity regulation has increased the interest rate on non-financial sector loans or interest rate paid on non-financial deposits in the UK.

## **7.2. Conceptual Framework**

Previous studies have shown that banks' liquidity buffer is a function of idiosyncratic (bank-specific) and macroeconomic conditions. In this section, determinants of liquidity buffers that are used in the analysis have been established by using the literature and their expected effects to liquidity have been tried to explained.

### Bank size

Bank size, which is one of the bank-specific factors, has been included the models in almost all studies and it has significant effects on banks' liquid asset holding behavior. The risks carried by banks, borrowing and lending decisions and fund management strategies may differ according to their scales. At times of liquidity or systemic crises, attention is focused on small and medium-sized banks. (Altıntaş, 2018). The intuition is that larger banks can easily access the financial systems or different funding sources without any restrictions.

Kashyap et al. (2002) have found that bank size negatively affect the liquidity level with smaller banks being hold more liquid assets due to the constraints in accessing capital markets. Dinger (2009), Deléchat et al. (2012) also have found that significant negative interaction between liquidity buffer and bank size at Eastern European and Central America banks. However, there is a contradiction between these two studies that Deléchat et al. (2012) argue that there is a point at which bank size begins exhibiting a marginal decreasing effect on liquidity while findings of Dinger (2009) argue the opposite. The study explained the differences in the distribution of bank size in both regions. In Central America, banks are quite high concentration of assets in a few large banks while European banks' concentration is lower. In terms of bank size distribution, the Turkish Banking System is similar to the Central America banks and in this study similar results with Deléchat et al. (2012) are expected.

Bonner et al. (2013) have shown that bank's size can have a negative effect on liquidity holdings with the argument that bigger banks are expected to have less volatile cash flows.

Chen and Phuong (2014) also have found negative relation between bank liquidity buffer and bank size with the explanation that large banks are more effective in managing their liquid assets and have greater capability to find out external funds.

## Capital

In banking, capital is important not only to cover possible losses, but also in terms of ability to pay debts, in other words, liquidity adequacy. Since banks with strong capital can evaluate their free capital in lower income but more liquid placements, they can more easily fulfill their depositors' withdrawal requests during times of crisis or panic. (Altıntaş, 2018).

Capital adequacy represents the strength of the bank, acts as a buffer to cover unexpected expenses/losses incurred by banks, and increases the bank's solvency. (Noman et al., 2015).

In literature, there have been two different expected relationship between capital and liquidity buffer as negative relationship and positive one. Main intuitions the effect of capitalization on bank's liquidity buffer; one is well capitalized banks can reach easily to markets and therefore hold less liquid assets the other is that if higher capitalization is an indicator of a prudent business model, well capitalized banks have higher liquidity buffers.

Berger and Bouwman (2009) have studied two theories with the approaches of capital reduces bank liquidity creation and capital makes banks capable of absorbing more risk, and thereby allows them to create more liquidity. According to the results of the study, the direction of the relationship between capital and liquidity depends on the size of the bank: Higher capital give opportunity to large banks to create more liquidity while decrease the small banks' liquidity creation.

In their study, Deléchat et al. (2012) have evidence that capitalization is negative effect on liquidity holding, yet Bonner et al. (2013) have not found any significant relation between capital and the size of liquidity buffer.

### Profitability

Deléchat et al. (2012) have stated that profitability has negative effect on bank's liquidity buffer since for more profitable banks it can be easier to generate self-funding so they are more prone to decline the liquidity. On the other hand, Aspachs et al. (2005) have highlighted that the size of the liquid assets should assess according to the opportunity cost of holding liquid assets and returns from loans. Nevertheless, in their study there is no evidence regarding the correlation profit and liquidity buffer. Bonner et al. (2013) have proved that profitability is one of the determinants of liquidity buffers and there is a positive relationship in countries where there are no liquidity regulations in the banking system.

### Non-performing loans

Non-performing loans reveal the riskiness of the loan portfolio of the banks and give clues about the asset quality. As the decrease in cash flows from loans due to the deterioration in asset quality will increase the risk perception of the banks so they are expected to increase liquidity buffers to meet the potential losses and cash outflows. Vodova (2011) have observed that the ratio of non-performing loans has positive significant impact on liquidity by means this precautionary approach, banks try to balance higher credit risk with buffers.

### Deposit

Deposits are the most significant source of funding for banks and sudden outflows may cause banks to experience liquidity problems. Subcategories of deposits are also substantial and the term-sight deposits and stable-less stable deposits compositions of banks affect the tendency of holding liquid assets. Therefore, the excess savings deposits amount, which are unlikely to be withdrawn, create stable funding for the bank, thus allowing hold less liquid assets. Dinger's (2009) study indicate that relationship between the deposits and bank liquidity is significantly negative. According to Bonner et al. (2013), retail deposits are considered as the most stable source of funding.

## GDP

GDP can be considered as the proxy of business cycle or economic cycle. The term business cycle refers to fluctuations in economy over a period of time namely decreases and increases in economic activity, production, trade, output of services, etc. (Zarnowitz, 1992) Upward and downward movements of real GDP measure the business cycle. Banks can keep their liquid assets and lending policies more tight and prudent in times of economic slowdown, while loosening the policies during periods of boom. Therefore, the liquid asset holding behavior of banks is countercyclical and it is possible to see similar findings in many studies in the past.

Gaytan and Ranciere (2001) highlighted that financial instability and liquidity problems develop with volatile levels of economic growth.

Aspachs et al. (2005) reveal that banks would hold liquidity during the economic bust on the grounds that lending would not be a good opportunity and besides this, they put forth that during the recession periods, the liquidity provided by central banks to stimulate the economy could be stacked by banks and cause an abundance of liquidity. Their empirical results have proven that there is an inverse relation between real GDP growth and liquidity buffers.

Deléchat et al. (2012) explained the cyclical behavior of the liquidity holding similar to Aspachs et al. (2005) by stating that banks would hoard liquidity in troubled periods and emphasized the negative relationship between GDP growth and liquidity.

Vodova (2011) have found a negative relationship between the business cycle and liquid assets by revealing that during the recovery period liquid assets of banks which wishing to meet the increasing credit demands would decrease.

Chen and Phuong's (2014) study also indicate that banks' liquidity buffer reduces as GDP growth increases.

## Interest Rates

As regards the effect of the interest rate on liquidity buffers most of studies have evidenced negative relationship. Interest rates are the monetary policy instruments used by central banks to stimulate growth (Laxton, 2003) and the frictions may affect the counter cyclical behavior of liquidity like GDP growth. The common intuition is that liquidity is low when the policy rate is high and liquidity buffers are high when the rate is low.

Aspachs et al. (2005) accepted short-term interest rates as an indicator of monetary policy and stated that the UK banks reacted with less liquidity buffers when the policy rates increased, while the banks kept extra liquidity when central banks made interest rate cuts to revive the economy. They have found statistically significant negative relation between short-term interest rate and size of liquidity buffers.

Deléchat et al. (2012) have worked for to test the opportunity cost of holding liquid assets thus used interest rate spread between lending and borrowing, but there is no evidence about the relation.

## Inflation

Inflation or consumer price index is a measure of the general price level within a region. It is negatively associated with national currency's purchasing power, and governments and central banks will maintain low levels of inflation in order to keep the economy running smoothly. (Fischer, 1986)

High inflation rate is an indicator of macroeconomic instability and give hints about macroeconomic conditions. In a macroeconomic environment which testing the higher inflation rates, with the perception that the economy is deteriorating banks may tend to hold liquid assets. From this perspective, liquidity buffers are expected to increase when inflation rates increase.

Vodova (2011) state that higher inflation rise the vulnerability of banks to nominal values of loans provided to customers and expect positive impact on liquidity. However, according the results inflation has negative impact on bank liquidity.

Audo (2014) and Horváth et al.(2014) have found no significant effect while Tseganesh's (2012) study suggest positive relationship with liquidity and inflation.

### CDS and Ratings

A credit default swap (CDS) is a contract between two sides in which one side purchases protection from another side against losses derived from the borrower who cannot pay the debt. (CFA, 2014) More basically CDS is an insurance against the certain credit facts like default. (Choudhry, 2006b).

CDS spread is the yearly amount that the insurance buyer must pay the insurance seller over the period of the contract. For a company or country, it is desirable to have low spreads since CDS spreads reflect their credibility and potential defaults. On the other hand, high CDS premiums are added the interest rates and increase the borrowing costs of countries or companies.

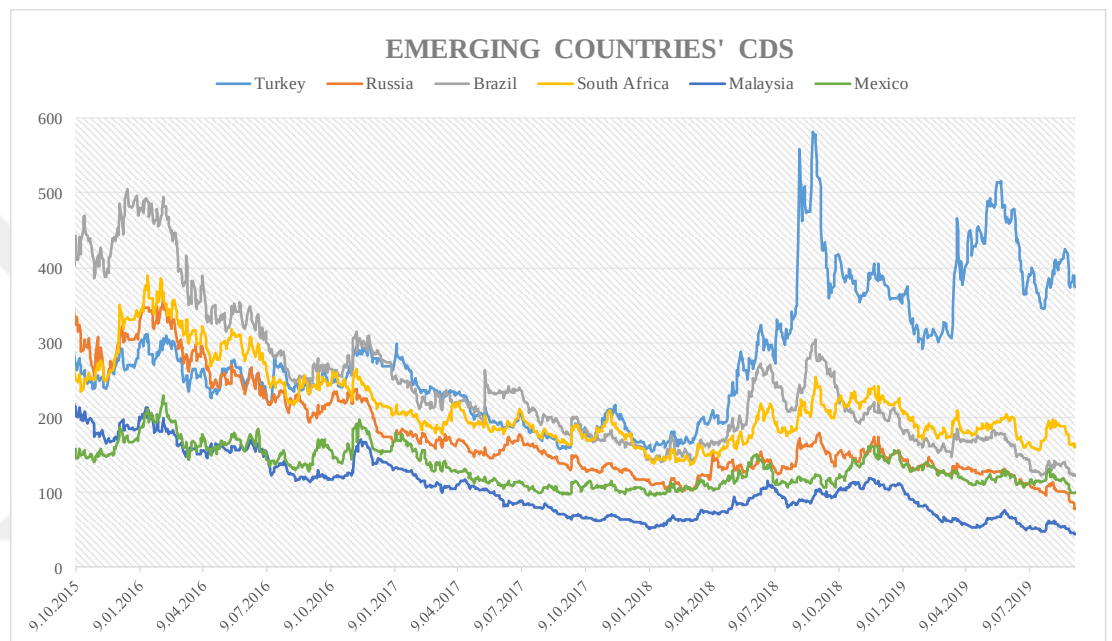
A credit rating is an assessment of a particular credit agency on an organization (government, company, or individual)'s ability and willingness to meet its financial obligations in complete and within the due dates specified. It also reflects a debtor's probability of default. It is also indicative of a debt instrument's credit risk – whether it is a loan or a bond issue. (CFI)

Banks may have contractual payment commitments in foreign borrowings. Based on the contract of borrowing, the repayment/early payment status of such debts may occur according to changes in the rating notes, CDS spreads, banks' capital adequacy ratio thresholds or other various criteria specified in the contracts.

In recent years, rising Turkey CDS premium and credit rating downgrades may cause negative effect to liquidity besides increase the Turkish banks' cost of funds from abroad. Graph 8 presents the emerging countries' five year CDS spreads and Turkey

have been negatively differentiated from its peer countries especially after the August 2018. Banks' borrowing agreements contain trigger event conditions (such as reaching the CDS premium 500 bpt., credit rating' downgrades, CAR thresholds, etc.) and when these conditions realize, banks may have to repay their debt before they are due or send additional collateral (margin call). So the banks may face to sudden liquidity shortages.

Graph 8: Emerging Countries' CDS Spreads



Although in literature there are no studies investigating the relationship between CDS, ratings and liquidity, the relationship worth to examining due to the increased risk of Turkey.

From this point of view rising CDS premium in a certain level and experiencing rating downgrades in specific notches will increase the risk perception of the banks so they are expected to increase liquidity buffers to meet the potential demand, like margin calls or repayments from their creditors. Therefore, the expected relation is that realization of trigger events can force banks to hold more liquid assets.

## Crisis

The global financial crisis of 2008 has driven many economies around the world into liquidity shortages and banks have had difficulty in fulfilling their obligations particularly increasing deposit demands. On the other hand, the serious haircut of the liquid assets of the banks caused the liquidity to dry out. In this respect, while the negative impact of the crisis on liquidity is inevitable, it is considered that banks' tendency to hold liquid assets may increase in order not to suffer in crisis periods. In addition, low credit demands during crises will ensure that liquid assets are retained. As a matter of fact, while Vodova (2011) and Choon et al (2013) have found an inverse relationship between liquidity level and crisis, Deléchat et al. (2012), Chen and Phuong (2014) have reveal that in stress times banks would hold liquid assets as a buffer so this address the positive relationship.

Compared to other countries Turkey was relatively less affected by the 2008 global financial crisis. Since the Turkish banking system was restructured in the 2001 local crisis, there was no need for a cash prevention package for the banking system in the 2008 crisis. Many of the rescue package and regulations applied to countries which affected by the crisis, has already been implemented after the February 2001 crisis in Turkey. From this point of view for Turkish Banking Sector, there may be no significant relation with liquidity buffers and global financial crises.

## Regulation

The purpose of quantitative liquidity regulations is to maintain that banks have sufficient liquid assets to meet their liabilities during a predefined period of stress. In the absence of liquidity regulation, banks may hold less liquid assets than they should have, considering that they will be supported by the central bank when there is a liquidity shortage. (Bonner et al., 2013)

Vodova (2011) set forth that the presence of prudential regulation force the banks to be liquid enough, so there can be positive relation with buffers and regulations. Furthermore according to Bonner et al. (2013), the regulation may change

or complement the business model and incentives of banks to keep liquid assets. As a result of their analysis the presence of regulation make the determinants of liquidity buffers meaningless since regulation construct a quantitative buffer.

### **7.3. Dataset and Variable Descriptions**

In this study, a balanced panel dataset is formed for 20 deposit banks (see Appendix 3) covering 90% of the Turkish Banking System, over the period 2006Q1 to 2019Q2. Investment banks which have no function to collect deposit and also Islamic banks which do not have sufficient data in the mentioned period have been excluded from the analysis. On the other hand, the reasons for starting the analysis period from 2006 are to eliminate unobservable data risk to create a balanced panel and improve data quality. As mentioned in the first section, there are 53 banks in the sector in total and for these reasons, 20 of these banks are included in the scope of analysis. Thus, the data set, which has 1080 observations in total, shows a typical long-panel structure with 20 banks and 54 period for each variable. Since CDS data started in 2008, only in Trigger Event Model that contain this variable 920 observations have been used. The dependent variable used in empirical analysis is liquidity ratio while bank-specific independent variables are bank size, capital adequacy ratio, net interest margin, profitability, non-performing loans and deposit. Macroeconomic and country characteristics independent variables are GDP, interest rates, inflation, CDS while also crisis, regulation and rating dummy variables have been used for controlling their effect on liquidity buffers. Table 12 covers the summary of all variables that are included in this study with their notation, measurement and expected relation sign. While bank-specific data collect from The Banks Association of Turkey database that is publicly available, macroeconomic and country characteristic ones are taken from Turkish Statistical Institute and Thomson Reuters Eikon databases.

Dependent variable, liquidity buffer (liq), is measured by the ratio of liquid assets to total assets following previous studies. However, the definition of liquid assets differentiate between research in literature; in some studies it is narrowly defined as cash and due from banks, while in the other studies it has a broader definition that includes cash and due from banks, trading portfolios, reserve requirements, reverse repo transactions. In this review, different from the previous

ones liquid assets are identified within the framework of high-quality liquid assets as being compatible with Basel Standards' liquidity buffer content described in Chapter 5. Cash, central bank reserves (including required reserves excluding blocked accounts), marketable securities are taken as high quality liquid assets. In addition, blocked accounts in the receivables from the central bank are excluded and the free securities portfolio that can be used freely in the liquidity shortage without any restrictions is considered.

Bank size (size) is measured by taking the natural logarithm of total assets as in the literature. Generally, there are two capital (car) measurement criteria in the literature, namely the ratio of capital to total assets or capital adequacy ratio. As being reflect the Basel Standards in this study capital adequacy ratio which measured by the capital divided to risk weighted assets has been preferred.

As proxies of profitability net interest margin (nim) which measured by the difference between interest income and interest expense to total assets and return on assets (roa) which measured by profit to total assets are added to analysis in accordance with literature. Furthermore, since the data is quarterly, net interest margin and return on asset have been annualized in order to compare the period performances more accurately.

The ratio of non-performing loans providing information on asset quality is calculated by dividing non-performing loans to gross loans as in all reviews.

In most of the analyzes, the measurement criterion of deposit (dep) is considered as the ratio of deposits to total assets, while in others, the share of savings deposits in total deposits has been defined as proxy, taking into account the sub categories of deposits. In this review the share of savings deposits in total deposits is accepted as the proxy of deposits in order to see the effect of bank' stable funds on liquidity buffers.

Table 12: Dependent and Independent Variables in the Econometric Analysis

| Variables                                             | Notation | Measurement                                                                                           | Expected Sign |
|-------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------|---------------|
| <b>1. Dependent Variable</b>                          |          |                                                                                                       |               |
| Liquidity Ratio                                       | LIQ      | high quality liquid assets/total assets                                                               | -             |
| <b>2. Independent Variables</b>                       |          |                                                                                                       |               |
| <b>2.1. Bank Characteristics</b>                      |          |                                                                                                       |               |
| Bank size                                             | SIZE     | logarithm of total assets                                                                             | negative      |
| Capital                                               | CAR      | capital adequacy ratio= capital/risk weighted assets                                                  | positive      |
| Net Interest Margin                                   | NIM      | difference between the interest income and the interest expense to total assets                       | negative      |
| Profitability                                         | ROA      | profit/total assets                                                                                   | negative      |
| Non-performing loans                                  | NPL      | the ratio of nonperforming loans to total gross loans                                                 | positive      |
| Deposit                                               | DEP      | saving deposit/total deposit                                                                          | negative      |
| <b>2.2. Macroeconomic and Country Characteristics</b> |          |                                                                                                       |               |
| GDP growth                                            | GDP      | quarterly real GDP growth                                                                             | negative      |
| Short term interest rate                              | IR       | 3 month benchmark rate                                                                                | negative      |
| Inflation                                             | INF      | Yearly consumer price index changes                                                                   | positive      |
| CDS                                                   | CDS      | logarithm of Turkey 5 year credit default swap spread                                                 | positive      |
| <b>2.3. Dummy Variables</b>                           |          |                                                                                                       |               |
| Crisis                                                | CRI      | Crisis = 1 for crisis period and 0 for otherwise                                                      | positive      |
| Regulation                                            | REG      | reg=1 for 2015 and later (LCR)                                                                        | positive      |
| Rating                                                | RAT      | RAT=1 for quarters where downgrade is experienced by either Fitch, S&P or Moody's and 0 for otherwise | positive      |

Quarterly real GDP growth (gdp) data is seasonally adjusted while inflation (inf) reflect the year-over-year change of consumer price index. 3-month average benchmark index have been used as short-term interest rate (ir) indicator. CDS variable (cds) has been smoothed taking the natural logarithm of the Turkey's 5-year CDS spreads. Crisis dummy (crisis) defined as 1 for 2008Q3 to 2009Q4 and 0 for otherwise, regulation dummy (reg) 1 for 2015 and later and rating dummy represent the quarters where downgrade is experienced by either Fitch, S&P or Moody's.

In addition, Table 13 provides descriptive statistics of all variables included the empirical analysis and the correlation matrix of each variables are given the Appendix 1.

Table 13: Descriptive Statistics

| Variable | Obs. | Mean      | Std. Dev. | Min.       | Max.      |
|----------|------|-----------|-----------|------------|-----------|
| liq      | 1080 | 0,1981891 | 0,0966861 | 0,0359521  | 0,7107271 |
| size     | 1080 | 17,10257  | 1,618051  | 12,96623   | 20,22956  |
| car      | 1080 | 0,1641606 | 0,034382  | 0,0925     | 0,4686    |
| nim      | 1080 | 0,0443409 | 0,0136308 | -0,0087806 | 0,0982237 |
| roa      | 1080 | 0,0150738 | 0,012534  | -0,0793597 | 0,0697765 |
| npl      | 1080 | 0,0411365 | 0,0321706 | 0          | 0,4519    |
| dep      | 1080 | 0,6050103 | 0,1450895 | 0,0000578  | 0,8677717 |
| gdp      | 1080 | 0,0461068 | 0,0488382 | -0,154855  | 0,1105193 |
| ir       | 1080 | 0,019564  | 0,3189162 | -0,850229  | 0,7315606 |
| inf      | 1080 | 0,0951815 | 0,0363715 | 0,0399     | 0,2452    |
| cds      | 920  | 5,439291  | 0,3023389 | 4,852874   | 6,037823  |

#### 7.4. Methodology

In this study the observations consist of both cross-sectional (banks) and time series properties which proper to definition of panel dataset. As panel data studies combine horizontal cross-sectional (firm, country, entity, bank, etc.) and time series observations to have more observations, the results provide more informative and reliable estimates. Therefore, the main advantage of panel data is that it produces more

efficient estimations. (Hsiao, 2003). Also, it allows performing econometric analysis even in samples with short time series or few cross-sectional data. (Gujaratti, 2003) In analyses with time series data multicollinearity, which defined there is a relationship between independent variables, is a common problem. With the use of panel data, the values of the independent factors change depending on the two dimensions (period and entity-specific), so there is less multicollinearity problem between the explanatory variables. (Baltagi, 2008)

Since panel data is related to individuals, firms, countries etc. throughout the time, it is certain that heterogeneity exists in these units. Panel data estimation techniques can clearly take into account such heterogeneities by allowing some cross-section variables. (Matyas et al, 1996)

Taking all these advantages of panel data into account, a panel data regression model have been considered for this study.

A simple linear panel data model is most commonly expressed as:

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \quad (1)$$

$$\varepsilon_{it} = \eta_i + v_{it} \quad (2)$$

$$i=1 \dots N$$

$$t=1 \dots T$$

where,

$Y_{it}$  dependent variable for i. unit at t. period

$\alpha$  constant term

$\beta$  coefficient matrix

$X_{it}$  independent variable for i. unit at t. period

$\varepsilon_{it}$  error term

$\eta_i$  unobservable time-invariant effect for i. unit

$v_{it}$  remain disturbance for i. unit at t. period

Before the estimation of the model, some assumptions are made based on whether the parameters are valued by unit and/or period. The models with varying constant coefficient are most common in the panel data analysis and these models can

be classified depending on whether the coefficients are assumed to be fixed or random. In other words the main issue in a model is to decide whether there is a relationship between unobservable time-invariant unit specific effect and independent variables.

### Fixed Effect Models

In fixed effect (FE) model unobservable time-invariant effects ( $\eta_i$ ) assumed to be fixed and the basic prediction is that if these variable do not change over time, any change in the dependent variable should result from effects outside these fixed properties. Also other assumptions;

$$v_{it} \sim IID(0, \sigma_v)$$

meaning that disturbances independent and identically distributed and stochastic.

$$Corr(X_{it}, v_{it}) = 0$$

meaning that the explanatory variables are independent of the disturbances.

$$Corr(X_{it}, \eta_i) \neq 0$$

meaning that the explanatory variables are dependent of the unit's error term.

FE investigates the relationship (country, person, company, etc.) between explanatory and dependent variables in an unit (gender, country, bank, firm). Each business or individual has its own characteristics that may or may not affect explanatory variables. (Nickell, 1981) For instance, being a public bank or private bank may affect the bank's liquidity holding behaviors or a country's geopolitical location may have an impact on its export-import activities. By using FE, it is suppose that the dependent or explanatory variables can be affected or biased by within the unit specific something and this impact needs to be controlled. FE erases the effect of these time-invariant features so that it can be possible to evaluate the real impact of the independent variables on the dependent variable. FE do not function properly with data where within cluster variation is minimal or for variables that change slowly over time. (Kohler, 2009)

## Random Effect Models

The random effects model is an appropriate specification if N units are selected randomly from a huge population. In random effect (RE) model main assumptions are:

$$\eta_i \sim IID(0, \sigma_\eta),$$

meaning that unobservable time-invariant effect independent and identically distributed and stochastic.

$$v_{it} \sim IID(0, \sigma_v)$$

meaning that disturbances independent and identically distributed and stochastic.

$$Corr(\eta_i, v_{it}) = 0$$

meaning that unobservable time-invariant effects are independent of disturbances.

$$Corr(X_{it}, v_{it}) = 0$$

meaning that the explanatory variables are independent of the disturbances.

$$Corr(X_{it}, \eta_i) = 0$$

meaning that the explanatory variables are independent of the unit's error term.

To sum up with according to these assumptions, in the random effects model, in contrast to the fixed effects model, the variation between unobserved unit effects ( $\eta_i$ ) is random and is not correlated dependent or independent variables included in the model. (Bartels, 2009)

If the differences between the units are considered to have some effects on the dependent variable, it is more appropriate to use the random effects model. The advantage of random effects is to include time-invariant variables to the model. It is important to identify individual characteristics that may or may not affect dependent variables. The problem here may be the absence of some variables, so these omitted variables cause bias in the model. (Greene, 2006)

Given the above information, in this study since the number of time series (T) is higher than the number of panels (N) and also bank-specific effects may impact the dependent variable therefore, the effects of these variables can be controlled, so it is likely that the model of fixed effects is more suitable. In addition to this intuitive approach, the Hausman test is used to determine whether a fixed effect or a random effect model would be preferred. Table 14 contains the results of the Hausman tests.

### 7.5. Model Specification

In this study, the determinants of banks' liquidity buffers are tried to be explained by using 5 different models. Explanation of variables that the notations represent are given in Table 12.

Banking Model:

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 DEP_{it} + \varepsilon_{it}$$

Banking and Macroeconomic Model:

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 NIM_{it} + \beta_3 NPL_{it} + \beta_4 DEP_{it} + \beta_5 GDP_{it} + \beta_6 INF_{it} + \varepsilon_{it}$$

Crisis Model:

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 ROA_{it} + \beta_4 NPL_{it} + \beta_5 DEP_{it} + \beta_6 CRI_{it} + \varepsilon_{it}$$

Regulation Model

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 DEP_{it} + \beta_6 IR_{it} + \beta_7 REG_{it} + \varepsilon_{it}$$

Trigger Event Model:

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NPL_{it} + \beta_4 DEP_{it} + \beta_5 CDS_{it} + \beta_6 RAT_{it} + \beta_7 (CDS_{it} * RAT_{it}) + \varepsilon_{it}$$

## Diagnostic Analysis

In this section, the characteristics of the data and models are examined and pre and post-tests have been conducted in order to determine the appropriate methods for analyzes.

In studies involving time dimension, almost all statistical conclusions are based on the assumption of stationary of the time series. The stationary time series converges to a certain value over time. More specifically, it has a constant mean and variance. Therefore, if the time series does not reveal regular periodic changes, it is stationary. On the other hand, if the process is not stationary, the behavior of the series will be valid only for the estimated period under consideration however; a generalization cannot be made about the series for other periods. (Breitung, 2005) For these reasons, if the series is not stationary, statistical conclusions should be made after stationary. Unit root tests are methods developed to test the stability of the time series. In this context, the stability of the variables to be used in the analyzes was tested with CIPS Panel Unit Root Tests and Phillips-Perron Time Series Unit Root Tests. According to the test results, non-performing loans and inflation are determined as non-stationary. These series are made stationary by taking their primary differences and test results for all variables are presented in the Appendix 2.

The next issue that needs to be analyzed for models with unit and time effects is to evaluate whether the model is coincidental or constant. According to the results of the Hausman Test conducted to test the random effects model against the fixed effects model, the fixed effects estimator was observed to be the most effective estimator for all models.

Table 14: Hausman Tests Result

|                                                     | chi <sup>2</sup> | Prob>chi <sup>2</sup> |
|-----------------------------------------------------|------------------|-----------------------|
| Banking Model                                       | 62.57            | 0.0000                |
| Banking and Macroeconomic Model                     | 50.87            | 0.0000                |
| Crisis Model                                        | 52.54            | 0.0000                |
| Regulation Model                                    | 45.16            | 0.0000                |
| Trigger Event Model                                 | 36.85            | 0.0000                |
| Test: Ho: difference in coefficients not systematic |                  |                       |

Cross-sectional dependence is a problem in macro panels with long time series (over 20 periods) and this study has long time series so it needs to be test the cross-sectional dependency. In addition, ignoring cross-sectional dependence in estimation of model may cause to bias results. The Breusch-Pagan LM test of independence helps to diagnose that whether residuals across units are correlated or not.

Table 15: Breusch-Pagan LM Test of Independence

|                                                         | chi <sup>2</sup> | Prob>chi <sup>2</sup> |
|---------------------------------------------------------|------------------|-----------------------|
| Banking Model                                           | 806.199          | 0.0000                |
| Banking and Macroeconomic Model                         | 1,304.364        | 0.0000                |
| Crisis Model                                            | 894.810          | 0.0000                |
| Regulation Model                                        | 809.305          | 0.0000                |
| Trigger Event Model                                     | 794.834          | 0.0000                |
| Test: Ho: Residuals across entities are not correlated. |                  |                       |

Heteroscedasticity is a concern, since the regression of ordinary least squares (OLS) assumes that all residuals are derived from a sample with homoscedastic. To

satisfy the regression assumptions and be able to trust the results, the residuals should have a constant variance.

Table 16: Modified Wald Test for Groupwise Heteroskedasticity in Fixed Effect Regression Model

|                                                                    | chi <sup>2</sup> | Prob>chi <sup>2</sup> |
|--------------------------------------------------------------------|------------------|-----------------------|
| Banking Model                                                      | 1,663            | 0.0000                |
| Banking and Macroeconomic Model                                    | 2,190            | 0.0000                |
| Crisis Model                                                       | 1,670            | 0.0000                |
| Regulation Model                                                   | 1,647            | 0.0000                |
| Trigger Event Model                                                | 1,585            | 0.0000                |
| Test: Ho: homoskedasticity (the residual variances are all equal.) |                  |                       |

In long panels serial correlation causes the standard errors of the coefficients to be smaller than they actually are and higher R-squared. Errors in a regression model should not follow a pattern. The most common type of autocorrelation, first-order autocorrelation, is present when an observed error tends to be influenced by the observed error that immediately precedes it in the previous time period. It is named as first-order autocorrelation because only one time period separates the two correlated error term observations.

Table 17: Wooldridge Test for Autocorrelation in Panel Data

|                                          | F      | Prob>F |
|------------------------------------------|--------|--------|
| Banking Model                            | 31.136 | 0.0000 |
| Banking and Macroeconomic Model          | 22.701 | 0.0001 |
| Crisis Model                             | 25.198 | 0.0001 |
| Regulation Model                         | 32.005 | 0.0000 |
| Trigger Event Model                      | 27.005 | 0.0001 |
| Test: Ho: no first order autocorrelation |        |        |

According the findings at Table 15, Table 16, Table 17, cross-sectional dependency, heteroscedasticity and autocorrelation, problems have been determined. In order to meet regression assumptions and get robust results standard errors of coefficients should be adjusted. Having cross-sectional dependence besides the heteroscedastic and autocorrelated disturbances Hoechle (2007) suggests using Driscoll and Kraay standard errors. So in this study Driscoll-Kraay standard errors are the best calibration for model.

## 7.6. Analysis Results of Models

The empirical findings of the all models are summarized in Table 18.

### 7.6.1. Banking Model

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 DEP_{it} + \varepsilon_{it}$$

Where

$\alpha$ , represents constant term,

$SIZE_{it}$ , represents the bank size in terms of total asset for i. bank at t. period,

$CAR_{it}$ , represents the capital adequacy ratio for i. bank at t. period,

$NIM_{it}$ , represents annualized net interest margin for i. bank at t. period,

$NPL_{it}$ , represents non-performing loans ratio for i. bank at t. period,

$DEP_{it}$ , represents the share of customer deposit in total deposit for i. bank at t. period,

$\varepsilon_{it}$ , represents error term.

According to banking model findings, In Turkish Banking System (TBS) bank size has significantly negative relation on the liquidity buffers supporting the previous studies. Banks with large asset share in the sector have easier access to financial systems and have more diversified funding sources besides the wide-base deposit customers, although small banks have relatively limited funds capacity and may face greater blow in possible withdrawing due to the high customer concentrations. Thus it

can be concluded that small banks more prone to have buffering against possible liquidity shortages.

Furthermore, as approximately 80% of total sector assets in TBS are concentrated in the first 10 banks, small banks added in the sample together with these banks give opportunity to offered a more accurate gauge of the distinction in terms of holding liquid asset behavior.

In addition, there is a significant positive relation between capital adequacy ratio and liquidity buffers in this model. As stated in the Framework section, literature includes studies that find negative as well as positive relationships in terms of capital. According to these results, the relationship between high quality liquid assets and capital supports the second theory of Berger and Bouwman (2009) and it can be inferred that large Turkish banks with high capital adequacy can generate more liquidity so create more buffers.

On the other hand, the fact that banks with high capital adequacy ratio, which expresses the ratio of equity to risky assets, have a less risky asset portfolio (e.g. government bonds instead of credit) may have contributed positively to the bank's high quality liquid assets.

Finally, deposit have been another variable, which provided meaningful results in the banking model. The deposit variable is in negative relationship with liquidity, in line with previous studies and expectations. In this report, as stated in the Framework section, deposits are defined more broadly and include small-scale savings deposits to see the impact of stable funding sources. The diversity of the funding structure and the type of funding provide important details about the bank's liquidity risk profile. Under stress conditions, the Bank's dependency on sources of wholesale funding is a factor that lowers its resistance to liquidity shocks. Within this aspects, the proportion of deposits and particularly saving deposits will display the more stable funding ability of the bank, thereby minimizing the risks and thus reducing additional buffers.

To sum up, in the first model, where the effects of bank-specific variables on liquidity buffers are examined, whereas large banks and banks with stable deposit sources tend to hold less liquid assets, large banks with high capital adequacy appear to have more buffers. On the other hand, profitability and non-performing loans had no significant effect on buffers in this specification.

### 7.6.2. Banking and Macroeconomic Model

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 NIM_{it} + \beta_3 NPL_{it} + \beta_4 DEP_{it} + \beta_5 GDP_{it} + \beta_6 INF_{it} + \varepsilon_{it}$$

Where

$\alpha$ , represents constant term,

$SIZE_{it}$ , represents the bank size in terms of total asset for i. bank at t. period,

$NIM_{it}$ , represents annualized net interest margin for i. bank at t. period,

$NPL_{it}$ , represents non-performing loans ratio for i. bank at t. period,

$DEP_{it}$ , represents the share of customer deposit in total deposit for i. bank at t. period,

$GDP_{it}$ , represents the quarterly real GDP growth at t. period,

$INF_{it}$ , represents the yearly inflation rate at t. period,

$\varepsilon_{it}$ , represents error term.

In the Banking and Macroeconomic specification, GDP and inflation variables have been added to the model in order to observe the effect of the economic cycle on the banks' liquid assets. The analysis shows that there is a significant negative relationship between real GDP growth and liquidity buffers as expected, but there is no evidence of the relationship with inflation. According to these outcomes, it can be concluded that Turkish banks lowered their buffers during periods of growth due to the expansion in the economy, as they consider that they would have no liquidity problems.

Also, during economic rises the anticipated benefit from risky assets and risky cash flows are high. Conversely, the risk capability of the risky cash flow is low during the economic downturn but there are strong incentives to purchase low-priced assets. (Yorulmazer 2011). Banks may also wish to hold liquid assets during those cycles to buy low-priced assets. The shrinking credit demand experienced in parallel with periods of economic downturn can steer new bank investments to more low-risk liquid assets.

On the other side, as in the former banking model, the negative link between liquidity buffer and size and deposit variables have remained to be significant in this model.

### 7.6.3. Crisis Model

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 ROA_{it} + \beta_4 NPL_{it} + \beta_5 DEP_{it} + \beta_6 CRI_{it} + \varepsilon_{it}$$

Where

$\alpha$  , represents constant term,

$SIZE_{it}$ , represents the bank size in terms of total asset for i. bank at t. period,

$CAR_{it}$ , represents the capital adequacy ratio for i. bank at t. period,

$ROA_{it}$ , represents annualized return on equity for i. bank at t. period,

$NPL_{it}$ , represents non-performing loans ratio for i. bank at t. period,

$DEP_{it}$ , represents the share of customer deposit in total deposit for i. bank at t. period,

$CRI_{it}$ , represents the crisis dummy variable at t. period,

$\varepsilon_{it}$ , represents error term.

A third model have been designed to assess the influence of crisis periods on banks' liquid assets. According to the results of the analysis, there is no significant connection between the crisis dummy variable and the liquidity buffers of the banks. Some of the literature findings have suggested that banks have more liquid assets as buffers against potential outflows during the crisis time, and therefore the relationship

between crises and buffers will be positive. Nevertheless, in this study, the fact that no changes were observed in bank buffers during crisis periods indicates that Turkish banks were less affected by the global financial crisis than other countries. As stated in framework section compared to other countries Turkey was relatively less affected by the 2008 global financial crisis. Since the Turkish banking system was restructured in the 2001 local crisis. Many of the rescue package and regulations applied to countries which affected by the crisis, has already been implemented after the February 2001 crisis in Turkey. So the analysis result support the argument that global financial crisis's effect on Turkish Banking Sector especially in terms of liquidity is limited.

Looking at the other variables in the crisis model; while the bank size, capital adequacy and deposit variables remained significant, it was also found that non-performing loans had positive effects on liquidity buffers in line with previous studies and expectations. Accordingly, it can be concluded that Turkish banks may hold more liquid assets with precaution given their potential losses during times of asset quality deterioration and rise in non-performing loans.

#### 7.6.4. Regulation Model

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NIM_{it} + \beta_4 NPL_{it} + \beta_5 DEP_{it} + \beta_6 IR_{it} + \beta_7 REG_{it} + \varepsilon_{it}$$

Where

$\alpha$ , represents constant term,

$SIZE_{it}$ , represents the bank size in terms of total asset for i. bank at t. period,

$CAR_{it}$ , represents the capital adequacy ratio for i. bank at t. period,

$NIM_{it}$ , represents annualized net interest margin for i. bank at t. period,

$NPL_{it}$ , represents non-performing loans ratio for i. bank at t. period,

$DEP_{it}$ , represents the share of customer deposit in total deposit for i. bank at t. period,

$IR_{it}$ , represents the short term interest rate at t. period,

$REG_{it}$ , represents the regulation dummy variable at t. period,

$\varepsilon_{it}$ , represents error term.

The regulation model analyzed the effect of Basel's liquidity-coverage ratio regulation on Turkish banks' liquidity buffers. As stated in the conceptual framework section, it was envisaged that banks would increase their liquid assets in order to adapt to the regulations. According to analysis result, there is no statistically significant relation between regulation and Turkish banks' liquidity buffers.

As specified in Section 5, prior to the Liquidity Coverage Ratio, the BRSA's Regulation on the Measurement and Evaluation of Liquidity Adequacy governed the procedures and guidelines for supplying and sustaining a sufficient level of liquidity for banks to meet their obligations. While the liquidity ratios started to be legally regulated after the global financial crisis, the regulation of the BRSA gave Turkish banks the opportunity to prepare liquidity buffers much earlier. Therefore, it can be clarified that regulation has no effect on buffers according this analysis.

On the other hand, this approach was combined with short-term interest rates, and its effects at balances have been studied. No substantial connection has been established, however.

#### 7.6.5. Trigger Event Model

$$LIQ_{it} = \alpha + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NPL_{it} + \beta_4 DEP_{it} + \beta_5 CDS_{it} + \beta_6 RAT_{it} + \beta_7 (CDS_{it} * RAT_{it}) + \varepsilon_{it}$$

Where

$\alpha$ , represents constant term,

$SIZE_{it}$ , represents the bank size in terms of total asset for i. bank at t. period,

$CAR_{it}$ , represents the capital adequacy ratio for i. bank at t. period,

$NPL_{it}$ , represents non-performing loans ratio for i. bank at t. period,

$DEP_{it}$ , represents the share of customer deposit in total deposit for i. bank at t. period,

$CDS_{it}$ , represents the credit default swap spread at t. period,

$RAT_{it}$ , represents the credit rating downgrades dummy variable at t. period,

$CDS_{it} * RAT_{it}$ , represents the interaction credit default swap spread and credit rating downgrades at t. period,

$\varepsilon_{it}$ , represents error term.

As stated in Framework section there may be conditions in banks' borrowing contracts that require them to repay their debts before maturity, provide additional collateral or increased their borrowing cost.

These conditions can be consist of both country and bank-specific:

- downgrades of credit rating to specific levels,
- increase in CDS spreads in certain critical levels,
- country's declaration of moratorium,
- change of ownership structure of the bank,
- fall of bank' capital adequacy ratio below legal limits,
- the increase in non-performing loans ratio to certain critical levels.

In case one or more of these situations occur, lenders have the right to make requests from the banks, such as early payment, additional collateral or increasing interest rates. While meeting these requests banks might suffer unexpected deficits of liquidity. Considering the cash outflows that may occur by realizing these conditions the Trigger Event Model has been created to investigate the its impact on liquid asset holding behavior of banks. As far as I know, there is no studies in the literature examine the triggering conditions in contractual borrowings of banks.

Turkey is the country more fragile and volatile against the risks, particularly in recent times. Increasing CDS premiums and consecutive credit rating downgrades realized the country-specific trigger conditions that listed above. Turkey negatively separated from other developing countries by and in terms of CDS (see Graph 8) and credit ratings in recent years. Moreover, since borrowing contracts in other countries (especially developed countries) may not be directly dependent on these conditions, in previous studies may not evaluate this issue. From this aspect, it is worth to investigate these and therefore I consider that the Trigger Event Model will contribute to the literature and country applications in a similar situation.

CDS spread and rating dummy variables are added to the banking model and the interaction variable CDS-Rating is included to check the case when these two effects occur simultaneously. There have been no significant outcomes of those impacts on banks' liquid assets in the model analysis results. Banks can guarantee that when these triggering events occur, the counterparty does not practice the right to claim early repayment as a consequence of its negotiations with creditors. For this reason, the liquidity effect of CDS and rating triggered borrowings may have been irrelevant, and in future studies can observe this effect with a more compact measure that considers other conditions in foreign funding contracts. (i.e. CAR, NPL level thresholds, change in ownership structure, etc.)



Table 18: Estimation Results

| Dependent Var.: LIQ                       |                       | Banking Model        | Banking and Macroeconomic Model | Crisis Model         | Regulation Model     | Trigger Event Model  |
|-------------------------------------------|-----------------------|----------------------|---------------------------------|----------------------|----------------------|----------------------|
| Bank Characteristics                      | SIZE                  | -0,037***<br>(0,004) | -0,043***<br>(0,004)            | -0,035***<br>(0,005) | -0,036***<br>(0,007) | -0,029***<br>(0,003) |
|                                           | CAR                   | 1,042***<br>(0,095)  |                                 | 1,028***<br>(0,105)  | 1,045***<br>(0,094)  | 0,744***<br>(0,108)  |
|                                           | NIM                   | -0,309<br>(0,257)    | -0,353<br>(0,287)               |                      | -0,315<br>(0,272)    |                      |
|                                           | NPL                   | 0,430<br>(0,271)     | 0,156<br>(0,044)                | 0,497*<br>(0,291)    | 0,437<br>(0,278)     | 0,508<br>(0,323)     |
|                                           | DEP                   | -0,130***<br>(0,049) | -0,203***<br>(0,043)            | -0,132***<br>(0,044) | -0,128***<br>(0,052) | -0,183***<br>(0,046) |
|                                           | ROA                   |                      |                                 | -0,282<br>(0,291)    |                      |                      |
| Macroeconomic and Country Characteristics | GDP                   |                      | -0,192***<br>(0,026)            |                      |                      |                      |
|                                           | IR                    |                      |                                 |                      | -0,0002<br>(0,006)   |                      |
|                                           | INF                   |                      | -0,050<br>(0,087)               |                      |                      |                      |
|                                           | CDS                   |                      |                                 |                      |                      | -0,002<br>(0,007)    |
|                                           | CDS*RAT               |                      |                                 |                      |                      | -0,009<br>(0,011)    |
| Dummy Variables                           | CRI                   |                      |                                 | -0,004<br>(0,009)    |                      |                      |
|                                           | REG                   |                      |                                 |                      | -0,003<br>(0,007)    |                      |
|                                           | RAT                   |                      |                                 |                      |                      | 0,043<br>(0,061)     |
|                                           | Constant              | 0,759***<br>(0,080)  | 1,052***<br>(0,074)             | 0,699***<br>(0,083)  | 0,730***<br>(0,126)  | 0,670***<br>(0,047)  |
|                                           | OBS                   | 1,080                | 1,080                           | 1,080                | 1,080                | 920                  |
|                                           | Within R <sup>2</sup> | 31.5%                | 14.7%                           | 31.4%                | 31.5%                | 17.2%                |
|                                           | Prob > F              | 0.0000               | 0.0000                          | 0.0000               | 0.0000               | 0.0000               |

Notes: Driscoll-Kraay standard errors.

\*\*\*, \*\* and \* denotes level of significance at 1%, 5% and 10% respectively.

## 8. CONCLUSION AND SUGGESTIONS

Prudent regulations regarding liquidity adequacy in the pre-financial crisis period in Turkey were developed in line with the liquidity standards that started to be applied at the global level after the crisis and show a great similarity with world practices. In this study, liquidity regulations, one of the Basel regulations to make the banking system more resistant, and in line with the Basel and local crises the regulations made by the BRSA are discussed in detail. At the current stage, the Turkish Banking Sector is fully compliant with these standards and is well positioned in terms of liquidity adequacy.

Thanks to these regulations, banks create buffers to be prepared for sudden liquidity shocks. On the other hand, the importance of stress tests that banks use to check their current situation and to see how long they can withstand possible crises is explained.

The aim of this study is to explain the determinants of liquidity buffers of Turkish banks, created to absorb risks in line with the regulations, with bank-specific and macroeconomic indicators.

The main question here is how do banks adjust their liquidity buffers? Which bank-specific variables affect banks' tendency to hold liquid assets, and in what direction is this impact? What are the effects of macroeconomic conditions, crisis periods, and legal regulations on liquidity buffers? This study seeks to answer these questions.

In order to find answers to these questions, 20 deposit banks covering 90% of the Turkish banking sector assets were analyzed for 2006Q1-201Q2 periods in the

research section of this study using the fixed effect panel regression method in which the differences between banks were fixed.

As distinctive the studies in the literature, the dependent variable liquidity ratio used in the analyzes was designed in the concept of liquidity coverage ratio. In other words, it is formulated as the ratio of high quality liquid assets without any restrictions to total bank assets. It is considered that the nominator of this ratio consists of balance sheet items that are most suitable for the definition of liquidity buffer. In some studies in the literature, it is very important that the securities included in liquid assets are not subject to any collateral, however, as such, the liquidity can be freely used and converted into cash, as in the definition of buffer. In this study, in terms of securities more granular data were studied and the encumbered securities which subject to collateral were not considered as liquid assets.

According to the results of the analysis, a negative and statistically significant relationship was found between the bank asset size and the liquidity buffers. In other words, it can be said that large banks tend to hold less liquid assets. While large banks have easy access to fund resources, and the diversity of resources and customers provide the bank with space for any liquidity shortages, small banks are buffering to be more prepared for sudden exits because of the high concentration of resources and customers in case of any difficulties.

A strong positive relationship was determined between the capital adequacy ratio and the liquidity buffer size. This relation can be evaluated as the banks with high capital adequacy have a less risky asset portfolio so that their assets are composed of high quality liquid assets.

In order to see the effect of stable fund sources on buffers, the savings deposit variable is included in the analysis, and there is a negative relationship between this variable and liquidity buffers. According to this result, it can be deduced that banks with more stable fund resources adjust their buffers accordingly and tend to hold less liquid assets thanks to these funds.

Among the bank-specific variables, the ratio of non-performing loans was another variable that gave meaningful results in the study. As expected and in line with the previous studies in the literature, a positive relationship was found between non-performing loans and liquidity buffers. The increasing npl rate as a precursor of the deterioration in asset quality may require banks to hold more liquid assets.

On the other hand, no statistically significant relationship was found between return on asset or net interest margin rates, which are included in the performance indicators, and the liquidity buffers of banks. In general, negative relationships were determined between profitability indicators and liquidity buffers in literature because of the preference of banks to place assets that can generate profit instead of holding liquid assets.

Considering the results regarding macroeconomic indicators, a negative relationship was found between the real growth of gross domestic product and the liquidity buffers of banks. It can be interpreted that the Turkish banks hold less liquid assets due to the upturn in the economy, and the liquidity buffers will increase in the period of economic downturns due to being prepared for possible liquidity shortages and shrinking credit demands.

In addition, no significant relation was found between inflation and interest rates, which are other macroeconomic variables in the models, and liquidity buffers. Therefore, real GDP growth, which is one of the main indicators of the macroeconomic environment, explained the best and only macroeconomic impact on the liquidity buffers of banks.

No significant relationship was found between the crisis dummy variable used to examine the impact of crisis periods on banks' tendency to hold liquid assets and liquidity buffers. As a result of these proactive measures taken by BRSA in the pre-crisis period, banks may not need to increase their buffers.

There is no significant relationship between the regulation dummy and liquidity buffers, which examines the effect of the liquidity coverage ratio on the buffer size, which is one of the arrangements brought by the Basel committee to make the banking

system more resilient after the 2008 crisis. After the local crisis, the liquidity regulation made by BRSA prepared the Turkish banks for liquidity buffers in advance.

In this study, the effects of two indicators, which are thought to affect banks' liquidity buffers, were investigated. To my knowledge, this has not been evaluated in previous studies. According to results The change in CDS and credit ratings and the interaction of these two variables did not have a significant effect on Turkish banks' liquidity buffers. It is understood that although these variables reach certain threshold levels may cause sudden liquidity problems in the banks; the guarantees that banks will not require any cash outflow due to the negotiations they have made with the creditors do not necessitate additional buffering.

Consequently, in this study, the liquidity tendency of Turkish banks was evaluated within the scope of liquidity buffer, which was defined in accordance with the latest regulations in force. While making these evaluations, a comprehensive set of variables with bank-specific, macroeconomic and country-specific indicators was used. However, there may be other variables that explain the dependent variable and cannot be included in this analysis. On the other hand, besides many factors that will affect liquidity, it is necessary to take into account the behavioral dimension of liquidity and the difficulty of modeling this part. Such analyzes will only be possible with the presence of more detailed granular data. At present, publicly available data have been tried to be used in the most efficient way as possible. For example, under stress conditions, banks' dependence on non-deposit funding sources may decrease its resistance to liquidity shocks. So the contribution of this factor to buffers can be examined thanks to more detailed data on non-deposit foreign sources.

On the other hand, considering that the liquidity problem is also a maturity mismatch problem, taking into account the maturity dimensions of the balance sheet items in the analysis may yield much more sensitive results. So much more meaningful results can be produced if the relevant data can be collected in future studies.

In addition, it will be an important step for future studies to include off-balance sheet items, which are part of the liquidity creation process, as in analyzed in Berger and Bouwman (2009a) studies,. Moreover, among off-balance sheet transactions, especially derivative transactions have a large place in Basel liquidity regulation. If

data access can be provided, including the effects of off-balance sheet transactions on the liquidity of banks can contribute significantly to this type of works.

Finally, the selection and arrangement of variables according to the dynamics of the analyzed country is also very important. For example, in this study, CDS and rating effects, which are among the dynamics of the country, were taken into consideration. Moreover especially in fragile economies struggling with high inflation like Turkey while evaluating the impact of the interest rates on liquidity or whatever, adjusting the interest rate with inflation and making the analysis with real interest rates, will produce more accurate and qualified results.



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**APPENDICES**

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## Appendix 1: Pearson Correlation Coefficients

|             | <b>liq</b> | <b>size</b> | <b>car</b> | <b>nim</b> | <b>roa</b> | <b>npl</b> | <b>dep</b> | <b>gdp</b> | <b>ir</b> | <b>inf</b> | <b>cds</b> |
|-------------|------------|-------------|------------|------------|------------|------------|------------|------------|-----------|------------|------------|
| <b>liq</b>  | 1          |             |            |            |            |            |            |            |           |            |            |
| <b>size</b> | 0.101*     | 1           |            |            |            |            |            |            |           |            |            |
| <b>car</b>  | 0.4601*    | -0,053      | 1          |            |            |            |            |            |           |            |            |
| <b>nim</b>  | 0.0888*    | -0.2181*    | 0,025      | 1          |            |            |            |            |           |            |            |
| <b>roa</b>  | 0.2665*    | 0.2951*     | 0.1657*    | 0.4984*    | 1          |            |            |            |           |            |            |
| <b>npl</b>  | 0.0935*    | -0.1451*    | 0.1181*    | 0.0892*    | -0.355*    | 1          |            |            |           |            |            |
| <b>dep</b>  | -0.2373*   | -0,0251     | -0,0534    | 0,0513     | -0.1233*   | -0,0577    | 1          |            |           |            |            |
| <b>gdp</b>  | -0.0628*   | -0,0032     | -0.1457*   | -0.2147*   | -0.086*    | -0.1368*   | -0.0851*   | 1          |           |            |            |
| <b>ir</b>   | -0.1187*   | 0.1689*     | -0.0868*   | -0.2657*   | -0.1611*   | -0.0826*   | -0,0231    | 0,0369     | 1         |            |            |
| <b>inf</b>  | -0.0774*   | 0.1828*     | 0.0906*    | -0.0897*   | -0.0868*   | 0.1037*    | 0,0278     | -0.2335*   | 0.5996*   | 1          |            |
| <b>cds</b>  | -0.0615    | 0.0994*     | -0.0192    | -0.0653*   | -0.0979*   | 0.0221     | 0.0495     | -0.3457*   | 0.4622*   | 0.5426*    | 1          |

\*, Correlation is significant at the 0.05 level

Appendix 2: CIPS Panel Unit Root Tests & Phillips-Perron Time Series Unit Root Tests

| <b>Variables</b> | <b>CIPS<br/>(constant)</b>            | <b>CIPS<br/>(constant &amp; trend)</b>            |
|------------------|---------------------------------------|---------------------------------------------------|
| <b>LIQ</b>       | -3.838***                             | -4.099***                                         |
| <b>SIZE</b>      | -2.202**                              | -2.653*                                           |
| <b>CAR</b>       | -3.083***                             | -3.468***                                         |
| <b>NIM</b>       | -2.357***                             | -2.745**                                          |
| <b>ROA</b>       | -2.851***                             | -3.042***                                         |
| <b>NPL</b>       | -1.847                                | -2.212                                            |
| <b>D.NPL</b>     | -5.694***                             | -5.942***                                         |
| <b>DEP</b>       | -2.472***                             | -3.206***                                         |
|                  | <b>Phillips-Perron<br/>(constant)</b> | <b>Phillips-Perron<br/>(constant &amp; trend)</b> |
| <b>GDP</b>       | -2.795*                               | -2.769                                            |
| <b>IR</b>        | -3.064**                              | -3.212*                                           |
| <b>INF</b>       | -2.059                                | -2.489                                            |
| <b>D.INF</b>     | -6.683***                             | -6.686***                                         |
| <b>CDS</b>       | -5.197***                             | -6.084***                                         |

\*\*\*, \*\* and \* denotes level of significance at 1%, 5% and 10% respectively.

## Appendix 3: Bank List

| <b>BANK LIST*</b>               |
|---------------------------------|
| AKBANK T.A.Ş.                   |
| ALTERNATİFBANK A.Ş.             |
| ANADOLUBANK A.Ş.                |
| BURGAN BANK A.Ş.                |
| CITIBANK A.Ş.                   |
| DENİZBANK A.Ş.                  |
| FİBABANKA A.Ş.                  |
| HSBC BANK A.Ş.                  |
| ICBC TURKEY BANK A.Ş.           |
| ING BANK A.Ş.                   |
| QNB FİNANSBANK A.Ş.             |
| ŞEKERBANK T.A.Ş.                |
| T.C. ZİRAAT BANKASI A.Ş.        |
| TURKLAND BANK A.Ş.              |
| TÜRK EKONOMİ BANKASI A.Ş.       |
| TÜRKİYE GARANTİ BANKASI A.Ş.    |
| TÜRKİYE HALK BANKASI A.Ş.       |
| TÜRKİYE İŞ BANKASI A.Ş.         |
| TÜRKİYE VAKIFLAR BANKASI T.A.O. |
| YAPI VE KREDİ BANKASI A.Ş.      |
| *Sorted alphabetically.         |

## **BIOGRAPHY**

Buket MENTEŞOĞLU was born on September 30, 1990 in Yenimahalle/Ankara. After completing her high school education at Ankara Nermin Mehmet Çekiç Anatolian High School, she started bachelor education life in Ankara University Department of Statistics in 2008 and graduated in 2012. She started her career as a Project Assistant at the Defense Industry Directorate in December 2012. Then, in November 2014, she continued professional life with the title of Statistician at the Capital Markets Board of Turkey. She is currently working as a Banking Specialist at the Banking Regulation and Supervision Agency, where she started working in March 2016. In addition, she continues her education life in Galatasaray University Department of Business Administration with a thesis.



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