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How safe are deposits under the Dutch Deposit Guarantee Scheme?

A study on the chance of non-repayment of small depositors

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Abstract

This paper analyzes the adequacy of the Dutch Deposit Guarantee Scheme by exposing the Dutch banking sector to increasing levels of bank defaults and asset losses, and assessing the impact of this stress on the Dutch Deposit Guarantee Scheme. Given that concise information regarding the workings of the Deposit Guarantee Scheme and the bail-in proposition is scarce this paper offers an accessible overview and history of both. Analyses on the impact of bank defaults and bank asset losses on the Dutch Deposit Guarantee Scheme are done on a quarterly basis from 2012Q2 to 2018Q1 to determine whether the Dutch Deposit Guarantee Scheme has become less likely to fail over time. The key findings of this paper are that the Dutch Deposit Guarantee Scheme has become safer over time and that the Dutch Deposit Guarantee Scheme is able to deal with stress levels sufficiently large that its adequacy is not in doubt.

Keywords: Deposit Guarantee Scheme, Dutch Banking, Dutch Deposit Guarantee, Deposit Guarantee Fund

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1. Introduction

This paper aims to establish the adequacy of the Dutch Deposit Guarantee Scheme by subjecting it to increasing levels of bank defaults and asset losses for defaulting banks, to arrive at a stress level where the Dutch Deposit Guarantee Scheme would be unable to pay out all eligible depositors.

Deposit guarantee schemes, also known as deposit insurance schemes, are an important tool used by many states to provide stability to financial markets and especially to the banking sector. Depositors in many countries, including the Netherlands, rely blindly on their country's deposit guarantee scheme to safeguard their deposits. Despite the large role deposit guarantee schemes therefore play, analyses regarding their safety and more specifically their exact adequacy have so far not been done. While research regarding the optimal design of individual deposit guarantee schemes so as to ensure a stable financial system (Ayadi & Lastra, 2010; Beat & Walter, 2009; Hoggarth, Jackson, & Nier, 2005; Payne, 2015) is available, research regarding the adequacy of country's individual deposit guarantee schemes is scarce. Carmassi, Dobkowitz, Evrard, Parisi, Silva and Wedow (2018) model a European Deposit Insurance Scheme and show its performance in different scenarios, concluding a European Deposit Insurance Scheme would be adequate up to levels of extreme stress. However, given that a European Deposit Insurance Scheme does not yet exist this does not establish the adequacy of the Dutch Deposit Guarantee Scheme. This paper therefore aims to contribute to the literature by establishing the safety of deposits covered under the Dutch Deposit Guarantee Scheme in the current framework.

To establish the adequacy of the Dutch Deposit Guarantee Scheme this paper first determines the probability of default for Dutch banks over the period of 2012Q2 to 2018Q1. This is done through combining bank-specific, macro-financial and banking-sector indicators and their respective coefficients found in the model developed by Betz, Opricâ, Peltonen and Sarlin (2014), with data on Dutch banks. Subsequently, banks are ranked according to their probability of default for each quarter and two scenarios are evaluated in which either the 3% of banks or 10% of banks most likely to fail default at the same time.

The banks defaulting in these scenarios are then subjected to asset losses of 5% to 25% as in Carmassi et al. (2018), following which banks' shareholders and creditors are subjected to write-

downs to the extent needed to absorb these asset losses. If losses cannot be absorbed by shareholders and creditors, the Deposit Guarantee Scheme is forced to contribute.

Subsequent to the scenarios used in Carmassi et al. (2018), scenarios entailing increased stress through a larger percentage of banks defaulting or larger asset losses imposed on defaulting banks are evaluated to determine at what level of stress the limit of the Dutch Deposit Guarantee Scheme is reached, prior to having the Deposit Guarantee Scheme resort to alternative financing. Given that one of these alternative sources of financing is government funds, a scenario is then established in which the Dutch Deposit Guarantee Scheme would draw upon government funds up to the amount that the Dutch government used to support the banking sector during the previous crisis.

The paper is organized as follows. A short background on deposit guarantee schemes and their development is provided in Chapter 2, after which a theoretical approach is used in Chapter 3 to delineate the hierarchy and layers of the Dutch Deposit Guarantee Scheme. Alternative resolution options will be studied 3, as well as cases where countries' deposit guarantee schemes have been stretched to its limits in the past. In the final part of Chapter 3 an analysis on the opinion of the largest political parties in the Netherlands regarding the role of the government in the multilayered safety net is provided. Findings from Betz et al. (2014) regarding the predictive power of key indicators such as bank-specific, country-specific banking sector and country-specific macro-financial indicators are described in Chapter 4. Chapter 5 describes the data used to determine the probability of distress for Dutch banks, as well as the data used to determine the capacity of banks and the Dutch Deposit Guarantee Scheme to absorb losses. Subsequent to the analysis of the probability of default for Dutch banks using the model created by Betz et al. (2014), the methodology of Carmassi et al. (2018), which is used to subject the Dutch Deposit Guarantee Scheme to increasing levels of stress, is described in Chapter 6. Furthermore, Chapter 6 describes the method used to determine whether banks' loss-absorption capacity is sufficient, and describes the extension to the model by Carmassi et al. (2018) used to determine the limit of the Dutch Deposit Guarantee Scheme. Chapter 7 analyzes whether the bail-in proposition combined with the Dutch Deposit Guarantee Scheme is sufficient to deal with the scenarios imposed, by simulating these scenarios for the period of 2012Q2 to 2018Q1 and establishing the level of bank defaults and bank asset losses needed to render the Dutch Deposit Guarantee Scheme unable to safeguard small deposits. Chapter 8 presents a conclusion to the paper and answers the research question.

2. Background

2.1 Why do Deposit Guarantee Schemes exist?

Deposit guarantee schemes instituted by states have two key roles. Primarily, deposit insurance schemes are meant to minimize, if not completely eliminate, the presumed riskiness of bank deposits by small depositors. Given that deposit insurance lowers the likelihood of non-repayment of deposits, this should decrease the chances of a bank run owing to depositors having increased certainty that their deposits will be repaid (Barth, Lee, & Phymiwasana, 2006). The inherent vulnerability of banks to bank runs due to fractional reserve banking[1] means that absent some sort of deposit insurance fears of non-repayment of deposits are not unfounded. This role of the deposit insurance scheme was illustrated during the financial crisis of 2008 when, in an attempt to calm depositors, the Federal Deposit Insurance Corporation raised their maximum deposit insurance amount to $250,000 in October 2008 (FDIC, 2010) while almost all other developed countries also raised their maximum insurance amounts with some countries even opting for a blanket guarantee (OECD, 2011).

The second role of deposit insurance schemes is to shift the burden of monitoring banks from (small) depositors to a supervisory institution (OECD, 2011). Absent a deposit insurance scheme each depositor would be obligated to constantly supervise their bank(s) which is impractical due to both time demands and due to limited knowledge. A deposit insurance scheme thus frees up depositors' time and allows the economy to run more efficiently (Nicholas & Ketcha, 2007).

For these reasons, starting in 1924 in Czechoslovakia (McCarthy, 1980), state deposit insurance schemes were instituted. At the end of 2015 state deposit insurance schemes were in effect in 114 states[2], up from 47 in 1995 (Ognjenovic, 2017). As can be seen in Figure 1, this includes effectively

[1] Fractional reserve banking is the most practiced form of banking worldwide (Mishkin, 2012) and is a form of banking where banks holds only a fraction of deposits in cash available for withdrawal.

[2] According to the International Association of Deposit Insurers the total number is 106 (International Association of Deposit Insurers, 2016), after correcting for multiple funds in one country in their overview. However, this overview does not list Spain (Banco de España, n.d.), China (Zhou, 2016), Denmark (Garantifonden for Indskydere og investorer, 2016), Cyprus (Association of Cyprus Banks, 2018), Andorra (Associació de Bancs Andorrans, 2015), Latvia (Financial and Capital Market Commission, 2009), Indonesia (Lembaga Penjamin Simpanan, n.d.) and Chile (Demirgüç-Kunt, Kane, & Laeven, 2014).

all developed countries (with New Zealand and Israel as notable exceptions, being the only OECD countries (OECD, 2018b) without an explicit deposit insurance scheme).

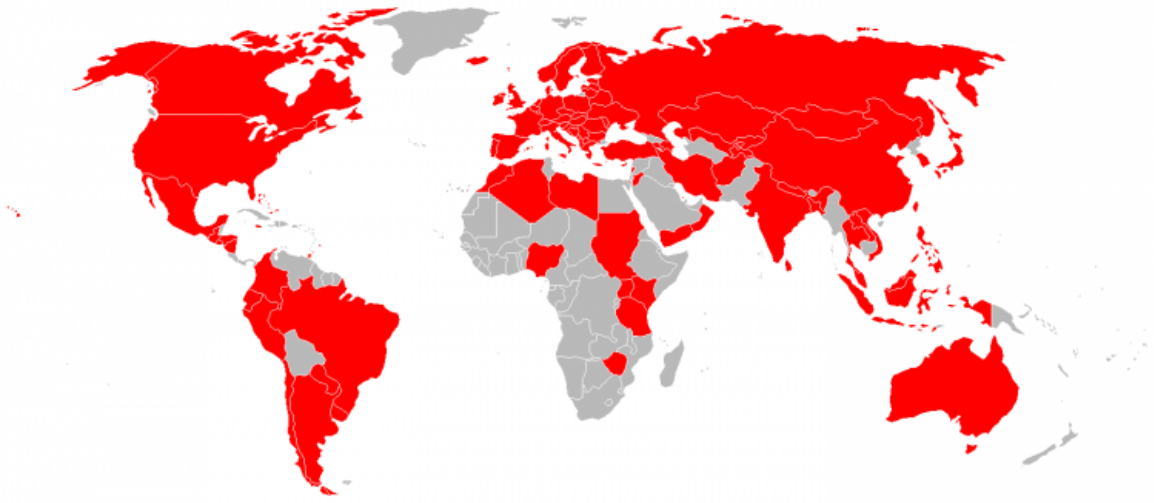

Figure 1. Deposit Insurance Schemes globally on a per-country basis. Countries with a deposit insurance scheme in red.

2.2 International comparison of the Dutch Deposit Insurance Scheme

While nearly all developed countries have an explicit state deposit insurance scheme, details regarding its practical workings and coverage differ. As can be seen in Table A1, since 2010 the majority of OECD countries have opted to raise coverage including government guarantees to at least $100,000 (27 out of 33) while all EU member states have since 2013 set their coverage to €100,000 as per Directive 2009/14/EC (European Parliament and the Council, 2009). At the end of 2013, the Netherlands still differed from other EU member states in some aspects. While the majority (22 out of 28) of EU member states had already set up an ex-ante funded system in 2013 the Netherlands had not[3]. An ex-ante funded scheme is a scheme in which banks accumulate funds over time in a fund that is established to pay out depositors in case the deposit guarantee scheme is activated. This in contrast to an ex-post funded scheme in which no prior accumulation happens, rather banks only pay at the time of activation of the deposit guarantee scheme (see also Section

[3] While an ex-ante funded system had been planned to go into effect July 1st, 2012 (De Nederlandsche Bank, 2011a) and later July 1st, 2013 (De Nederlandsche Bank, 2012) the ex-ante fund was launched November 26th 2015 (De Nederlandsche Bank, 2015c).

2.4). Furthermore, while the majority (23 out of 28) had legally separated the deposit insurance fund from the central bank, ministry of finance or banking supervisory agency, the Netherlands had not. Aside from these aspects, the Netherlands used the same mechanisms and role[4] for their deposit insurance scheme as the majority of OECD countries (in 81.5% of the aspects).

Two other factors on which the Netherlands differs from the majority of OECD countries are not necessarily aspects of the deposit insurance scheme but are nevertheless related to it, being whether the government has guaranteed bank assets since 2008 and whether there has been significant nationalization of banks since 2008. Whereas the Netherlands has both guaranteed bank assets and nationalized banks, the majority of OECD countries (respectively 24 out of 33 and 20 out of 33) have not done so. Both of these deviations from the norm can (partly) be explained by the Netherlands having a banking sector that is both large relative to GDP at 600% of GDP in 2008[5] (De Nederlandsche Bank, 2015d) and highly concentrated with the five largest credit institutions accounting for 86.7% of assets in 2008[6] (Statista, 2018). Research into the stability of banks during the recent crisis found that banks in concentrated markets take greater risks and are more likely to go into liquidation or need regulatory intervention (Atkins, Li, Ng, & Rusticus, 2016). The Netherlands serves as a stark example with three out of the four large banks needing state support in some form during the crisis (De Nederlandsche Bank, 2015d).

While differences between deposit insurance schemes in EU countries were already small in 2010 and 2013, Directive 2014/49/EU (European Parliament and the Council, 2014a) further harmonized deposit insurance schemes in all EU countries leading to uniform repayment periods, ex-ante funding and uniform information provision.

[4] Possible roles being a paybox system where the Deposit Guarantee Scheme can only repay depositors, paybox plus where the Deposit Guarantee Scheme has certain supervisory and risk management roles, risk-minimizing roles where an important role of the Deposit Guarantee Scheme is to manage balance sheet risks and loss-minimizing roles where the Deposit Guarantee Scheme can also, for example, transfer deposits to another bank if this is a more cost-effective option rather than paying out depositors directly.

[5] In December 2017 this percentage had declined to 337% (De Nederlandsche Bank, 2018).

[6] In December 2016 this percentage had declined slightly to 84.7% (Statista, 2018).

2.3 Deposit Insurance Schemes in the 2008 Financial Crisis

The 2008 global financial crisis was a major test for deposit insurance schemes in many European countries. In September 2007 Northern Rock, a British bank, received liquidity support from the Bank of England. Rather than soothing depositors, the announcement caused a bank run on Northern Rock (The Economist, 2007). Given that at the time the British deposit insurance scheme operated as a coinsurance scheme where depositors were insured for approximately 90% of their first £35,000, incentives for depositors were strongly in favor of a bank run (Shin, 2009) so as to avoid a 10% loss on their deposits. It was only after an effectively blanket guarantee was given on all deposits that the bank run stopped (Eaglesham, Larsen, Giles, & Saigol, 2007).

Just over a year after the Northern Rock bank run, Landsbanki went into bankruptcy (De Nederlandsche Bank, 2008). This Icelandic bank had expanded to the Netherlands and to England under their brand name "Icesave", offering depositors high interest rates of up to 5% in the Netherlands, higher than the 4% interest rates being offered by Dutch banks at that point in time. Between May and October 2008 Icesave raised approximately €1.6 billion from 120,000 Dutch depositors (NOS, 2008). Landsbanki's default on October 6th, 2008 came at a time when the Dutch Deposit Guarantee Scheme, similar to in England during the Northern Rock bank run, worked on a coinsurance principle where the first €20,000 was guaranteed completely while the sum between €20,000 and €40,000 was only 90% insured (Consumentenbond, 2008). To ease depositors' concerns the Dutch Minister of Finance announced on respectively October 7th and 9th that the Deposit Guarantee Scheme limit would be raised to €100,000 for one year, mirroring the response of the British central bank (De Nederlandsche Bank, 2008), and that the Dutch central bank would guarantee Dutch depositors' funds rather than Dutch depositors having to rely on the Icelandic Deposit Guarantee Scheme (De Nederlandsche Bank, 2008a).

Almost exactly a year later, on October 19th, 2009, it became apparent that the increase in deposit guarantee coverage had not completely eased depositors' concerns when the Dutch bank DSB went bankrupt and the Dutch Deposit Guarantee Scheme was again activated (De Nederlandsche Bank, 2009). It later became apparent that this failure to ease depositors' concerns was partly due to public knowledge of the workings of the deposit insurance scheme being limited, with depositors overestimating the repayment period and being uncertain regarding the applicability of the deposit insurance scheme to non-systemic banks (Lazarov, 2017).

A larger test of the deposit insurance scheme and in a sense a failure of the deposit insurance scheme to live up to its promises came in the form of the banking crisis in Cyprus (see also Section 3.4.5). In March 2013 an agreement was reached between Cyprus' president and the Eurogroup to rescue the Cypriot financial sector, funded partly through the "Troika" consisting of the IMF, European Commission and the ECB, and partly through a bail-in of both uninsured (>€100,000) and insured (<€100,000) depositors. This plan was eventually not followed through on due to rejection by the Cypriot parliament, however the damage to the credibility of the EU-wide promise of an absolute guarantee on small deposits had already been done (Phylaktis, 2015). An agreement was eventually reached in which insured depositors were spared from losses and uninsured (>€100,000) depositors saw their deposits written down more heavily. This write-down of large deposits was deemed necessary due to the fact that the Cypriot government was unable to both save the country's banking sector and fully protect all deposits (Kiriazidis, 2017). The solution to the Cypriot crisis was thus the first well-known[7] example of the bail-in mechanism that would later be broadly implemented.

2.4 Move to ex-ante funded scheme

A change to ex-ante (prior) funding rather than ex-post (subsequent) funding is intended to (partly) alleviate two downsides to a deposit insurance scheme. The first negative aspect of ex-post funded deposit guarantee systems is that they act, to some extent, pro-cyclically. When an ex-post funded deposit guarantee scheme is called upon, several market-distorting events happen. First, other member banks are called upon to provide financing to the defaulting bank. Given that bank failures are usually concentrated both geographically and in time (Cañón & Margaretic, 2014) this could jeopardize banks that might otherwise have been able to continue functioning normally or lead to other banks being unable to sufficiently finance the defaulting bank. In case other banks are unable to sufficiently finance the defaulting bank the government has to step in, which means the burden is partially spread over uninvolved parties.

[7] Amagerbanken A/S, a Danish bank, was the first bank where senior bank creditors were bailed in (Levring, 2016).

A second negative aspect of deposit guarantee schemes, which is partly related to the first, is that of moral hazard. Banks that believe themselves to be too big to fail would be well served by taking more risk, given that potential higher profits accrue to the bank while the cost for negative outcomes would be borne by others (Dam & Koetter, 2012). An ex-ante funded scheme partly alleviates this downside due to the fact that banks are forced to contribute prior to a failure and therefore share in their own rescue costs. It has also been argued that instituting an explicit deposit insurance scheme decreases rather than increases moral hazard, since countries without an explicit deposit insurance scheme often have an implicit deposit insurance scheme[8] in which case introducing an explicit deposit insurance scheme may imply a reduction in the perceived safety net (Gropp & Vesala, 2004). While Gropp and Vesala find this to be the case for smaller banks given that risk-taking of smaller banks decreases, large banks appear to be unaffected which supports the interpretation that larger banks believe themselves to be too big to fail.

Ex-ante funding on the other hand guarantees that banks pay into a fund in good years to be used to offer support in bad years if needed, alleviating the procyclic aspect of the scheme. Furthermore, ex-ante schemes offer the possibility of differentiated premiums, making the scheme more "fair" by ensuring riskier banks contribute more through risk-weighted premiums. A final advantage is that the credibility of the deposit insurance fund is increased thanks to funds being readily available (De Nederlandsche Bank, 2011a).

Important downsides of ex-ante funding vis-à-vis ex-post funding are that ex-ante funding carries fund management costs, though these are relatively small at 0.08% of the total fund size[9] (De

[8] An implicit deposit guarantee scheme being one where the government does not explicitly guarantee deposits but it is nonetheless (implicitly) assumed by depositors that the government will rescue banks that are failing.

[9] While 0.08% is non-negligible, the costs made are hard to avoid. 90% of the expenses consist of interest expenses which is unavoidable given the obligation of the Deposit Guarantee Fund to invest these deposits at the Dutch central bank's deposit facility, which currently offers -0.4% interest. The reason costs are not at least 0.4% is that this data is from the year the Deposit Guarantee Fund was established and funds came in throughout the year. The remaining 10% of costs consist of an application for a BIC code and SWIFT account (€21,000 or 6% of costs) and an independent auditors fee (€14,000 or 4% of costs). Removing interest expenses from the equation therefore reduces total costs in the first year to 0.007%. Management of the Deposit Guarantee Fund does not receive remuneration.

Nederlandsche Bank, 2018a), and more importantly that being required to contribute to an ex-ante fund decreases the available money for productive use by banks (Groeneveld, 2009).

2.5 Move towards bail-in

Though an ex-ante funded scheme offers advantages over an ex-post funded scheme, as delineated in the previous paragraph, this does not entirely eliminate the possibility of a government bail-out being necessary, especially for larger banks. During the financial crisis of 2008 many banks had to be saved through government intervention leading to critics arguing for stronger separation of banks from public funds (Kroes, 2009). As a response to this criticism steps have since been taken to decrease the chances of public funds again being called upon. Harmonization of deposit insurance schemes across the EU through Directive 2014/49/EU was followed by a framework aimed at situations in which letting a bank default normally (and thus activating the deposit guarantee fund) would cause harm to public interest and/or cause financial instability (Bank Resolution and Recovery Directive, 2014). The Bank Recovery and Resolution Directive ("BRRD") was adopted in May 2014 and had to be implemented by member states at the start of 2015 (European Commission, 2018). Whereas previous to the BRRD there was no clear, agreed upon procedure to be followed in the event of a bank failure, which is widely considered to have been a contributing factor to effective resolution of banks during the crisis, the BRRD serves as a blueprint for countries on how to handle (potential) insolvency of financial institutions (Binder, 2016)

The BRRD can be seen as a concession to criticism regarding state-funded bail-outs given that the BRRD establishes the obligation of shareholders and creditors to contribute to the losses of the failing institution, all the way up to large (>€100,000) deposit holders. A visual representation of the differences in creditor hierarchy pre-BRRD vs post-BRRD is offered in Figure B1. The key objective of the BRRD is to ensure bail-outs using public money are avoided (European Commission, 2016). This is accomplished primarily through imposing losses on the private sector rather than on the public sector, while secondary mechanisms aim to make it both less likely that a bank comes into difficulty and, if this does happen, make the process uniform and clear. An extended analysis of the methods by which the BRRD makes bank failures less likely and the changes the BRRD brings to the procedures to be followed in case a bank comes into difficulty is done in Section 3.2.

3. Theoretical study

3.1 Delineation of Deposit Guarantee Scheme

To assess the adequacy and safety of the Deposit Guarantee Scheme in the Netherlands it must first be delineated how this scheme functions. This section will therefore provide an overview of the layers of the Dutch Deposit Guarantee Scheme and when these layers can be called upon. For a graphical overview, see Figure B2. In short, this hierarchy is as follows:

3.1.1 Dutch Deposit Guarantee Scheme Hierarchy:

- Decision by the Dutch National Bank on the appropriate course of action for a given bank (De Nederlandsche Bank, 2015a).
- The bail-in hierarchy, starting at equity holders and potentially continuing all the way to large deposits (>€100,000) held by retail and small-to-medium enterprises ("SMEs") (European Central Bank, 2016). See also Section 3.2.
- The Deposit Guarantee Fund (De Nederlandsche Bank, 2015b).
- An extra contribution by all Dutch banks that hold covered deposits (De Nederlandsche Bank, 2011c).
- Potential temporary external funding attracted by the Dutch Deposit Guarantee Foundation (Article 29.14, paragraph 4 of the Besluit bijzondere prudentiële maatregelen, beleggerscompensatie en depositogarantie, 2006).
- Public funds provided by the state to the Dutch National Bank (Article 4a of the Bankwet, 1998)

Whether the Deposit Guarantee Scheme is activated is decided by the Dutch central bank. As stated in the Financial Supervision Act (in Dutch: "Wet Financieel Toezicht"):

> If the Dutch central bank judges a holder of a Dutch banking license to be unable to repay (a) payable deposit(s) for reasons directly related to its financial position or to be unable to fulfill obligations arising from investor claims and the bank appears to be unable to do so in the foreseeable future; or if a court has ruled, for reasons relating directly to the financial position of the bank, to suspend the rights of deposit holders or investors to recover their claim from said bank, the Dutch central bank has 5 business days to activate the Deposit

> Guarantee Scheme and to announce the decision to do so. (Artikel 3:260 of the Wet Financieel Toezicht, 2017)

After announcing the activation of the Deposit Guarantee Scheme the central bank will inventorise the deposit holders of the bank and determine which deposit holders are eligible for repayment under the Deposit Guarantee Scheme, following which the Dutch central bank will reimburse eligible depositors within 20 business days[10]. After eligible deposit holders have been repaid, the Deposit Guarantee Fund will repay the Dutch central bank[11] (De Nederlandsche Bank, 2018c).

The Deposit Guarantee Fund is a legally separate entity from the Dutch central bank that has as its sole task to reimburse the Dutch central bank for payouts to eligible depositors under the Deposit Guarantee Scheme. However, the Dutch central bank decides when to initiate pay-outs, which deposits are eligible and who the board of the Deposit Guarantee Fund consists of[12]. Furthermore, the Dutch central bank supports the Deposit Guarantee Fund in its tasks and provides the financial resources required for these tasks (Article 3:259a of the Wet Financieel Toezicht, 2018). The Deposit Guarantee Fund therefore is a legal entity separate from the Dutch central bank without being fiduciarily independent. The reason the Deposit Guarantee Fund was instituted rather than having the central bank assume these responsibilities was, on the one hand, because this was beneficial from an accounting point of view and, more importantly, to conform to European Law prohibiting monetary financing (Besluit bijzondere prudentiële maatregelen, beleggerscompensatie en depositogarantie, 2006).

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[10] Currently 20 business days (De Nederlandsche Bank, 2018b), the legal maximum repayment period will decrease to 15 business days in 2019, 10 in 2021 and 7 in 2024. However, the ambition is to lower the repayment period to within 7 days starting in 2019 (De Nederlandsche Bank, 2017b).

[11] There is some uncertainty regarding whether the Dutch central bank pays out to eligible depositors and is reimbursed by the Deposit Guarantee Fund, or whether the Deposit Guarantee Fund pays out to eligible depositors. Initially the decision was made to have the Deposit Guarantee Fund pay out to eligible depositors directly (Minister van Financiën, 2015), however the most recent information from the annual report of the Deposit Guarantee Fund states the central bank pays out after which the Deposit Guarantee Fund reimburses the central bank (De Nederlandsche Bank, 2018c).

[12] The board currently consists of Bert Boertje (chair), Jan Marc Berk and Martin Heerma (De Nederlandsche Bank, 2018c). Bert Boertje and Jan Marc Berk both work for De Nederlandsche Bank, the Dutch central bank, whereas Martin Heerma works at the Ministry of Finance (as of June 23rd, 2018).

The Deposit Guarantee Fund is funded through a process of several steps. The primary funding the Deposit Guarantee Fund can call upon immediately is the balance of ex-ante contributions. These contributions are received from all banks that hold covered deposits. Total contributions per bank are split between a base contribution and a risk-weighted contribution, where the base contribution depends on a bank's covered deposits and the risk-weighted contributions are determined by the bank's total covered deposits, the bank's proportion of risk-weighted deposits, and a risk factor (European Parliament and the Council, 2014a). Both base and risk-weighted contributions are multiplied by a macro-prudential factor and a target size for the fund, and are divided by the number of terms allotted to fill the Deposit Guarantee Fund (Article 29.14, paragraph 4 of the Besluit bijzondere prudentiële maatregelen, beleggerscompensatie en depositogarantie, 2006). The target size for the base and risk-weighted fund each is 0.4% of covered deposits, meaning the fund will grow to approximately 0.8% of covered deposits[13], while the number of terms is 34[14].

A bank's risk profile is determined by its capitalization, liquidity- and financing profile, the quality of its assets, the business model and management, and the potential losses this bank exposes the Deposit Guarantee Scheme to. Using these five risk indicators a risk category of I to IV is arrived at that can impact risk-weighted contributions by a factor of 0.5 to 2.0 (Appendix B of the Besluit bijzondere prudentiële maatregelen, beleggerscompensatie en depositogarantie, 2006). Macroprudential assessments can lower contributions up to a factor of 0.75 of original contributions, where normal economic circumstances mean a factor of 1, and can also increase contributions up to a factor of 1.25.

Example calculation of a bank's contributions

As an example, bank A has covered deposits of €5 billion. The macroprudential assessment by the central bank is that the financial sector is in a normal state and therefore the

[13] Approximately 0.8% due to risk-weighting allowing for a higher or lower total size of the risk-weighted portion than 0.4% of covered deposits.

[14] The total number of terms is determined by the number of quarters between the first evaluation moment and the date at which the Deposit Guarantee Fund needs to have reached its target size. For the Dutch Deposit Guarantee Fund this is respectively the first quarter of 2016 and July 2024.

macroprudential factor is 1, and bank A's risk category is III corresponding to a risk weighting percentage of 150% (a factor of 1.5). Total risk-weighted deposits guaranteed by the Deposit Guarantee Fund are assumed to €100 billion.

The non-risk weighted base contribution by bank A is therefore as follows:

$$Contribution\ at\ time\ t = \ covered\ deposits\ bank\ A * \left(\frac{1}{terms}\right) * target\ size\ (\%) * macroprudential\ factor$$

$$Contribution\ at\ time\ t = \ €5{,}000{,}000{,}000 * \left(\frac{1}{34}\right) * 0.004 * 1 = €588{,}235$$

This corresponds to 1.17 basis points per quarter in terms of covered deposits.

Bank A's risk-weighted contribution is then as follows:

$$Contribution\ at\ time\ t = \left(\frac{risk-weighted\ covered\ deposits\ bank\ A}{total\ risk-weighted\ covered\ deposits}\right) * \left(\frac{1}{terms}\right) * target\ size\ (\%) * macroprudential\ factor * total\ covered\ deposits$$

$$Contribution\ at\ time\ t = \frac{€7{,}500{,}000{,}000}{€100{,}000{,}000{,}000} * \left(\frac{1}{34}\right) * 0.004 * 1 * €100{,}000{,}000{,}000 = €822{,}353$$

This corresponds to 1.76 basis points per quarter in terms of covered deposits. Bank A would thus contribute a total of approximately 2.93 basis points per quarter in terms of covered deposits to the Deposit Guarantee Fund.

The size of the ex-ante fund was approximately €801 million on November 30th 2017 (up from €448 million ultimo 2016 (De Nederlandsche Bank, 2018c)) and is intended to grow to €4.5-5.1 billion in 2024, which amounts to 0.8% of covered deposits (Tweede Kamer, 2018) (see also Figure 2).

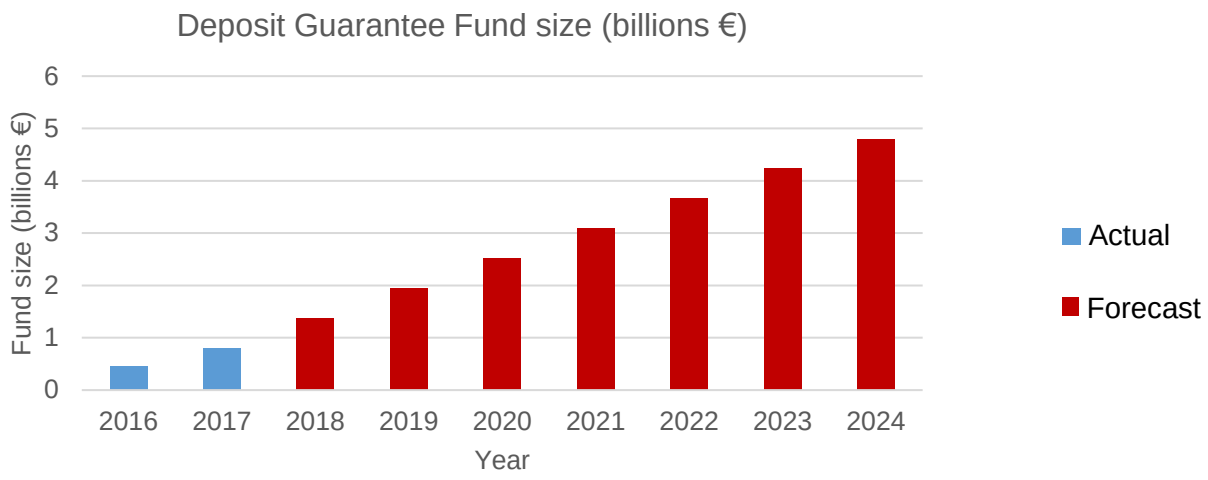

Figure 2. Deposit Guarantee Fund size. Based on actual data and assuming constant growth to the target level of €4.8 billion in 2024.

Given that the preferred method of default is that the defaulting bank bears the heaviest burden, the assets and ex-ante contributions to the fund of the defaulting bank will first be used to repay depositors, subsequent to which the general portion of the ex-ante fund will be called upon which consists of the risk-weighted contributions of other member banks. The final portion of the ex-ante fund that can be called upon is the portion of the fund containing the individual non-risk weighted base contributions of other member banks[15] (Article 29.05 of the Besluit bijzondere prudentiële maatregelen, beleggerscompensatie en depositogarantie, 2006; De Nederlandsche Bank, 2011c).

If the combined funds of the banks' assets and the ex-ante contributions to the fund are insufficient to reimburse eligible depositors, an ex-post contribution maximized at 0.5% of each banks' respective covered deposits can be levied. In extraordinary circumstances, and with explicit permission from the Dutch central bank, higher contributions than the 0.5% limit could be levied. Lower contributions could also be levied based on a bank being unable to contribute the required

[15] These individual balances of other banks are used as follows. The total sum needed from the individual balances is determined, after which each bank's percentage of covered deposits is used to set individual bank contributions. For example, if the total sum needed from individual balances is €100 million and bank A has 2% of covered deposits while bank B has 7% of covered deposits, €2 million from bank A's individual balance can be used and €7 million from bank B's individual balance can be used.

amount without getting into solvability or liquidity problems themselves, a decision which is made by the Dutch central bank (European Parliament and the Council, 2018). Given the approximate current total covered deposits of €486 billion (Tweede Kamer, 2018) the current maximum ex-post contribution corresponds to approximately €2.43 billion.

If the additional ex-post contribution is still insufficient to cover deposits, or if funds from banks are unavailable on a sufficiently short term, the Deposit Guarantee Fund is allowed to attract external financing. Negotiations with market parties to provide external financing are in the final stages (ultimo February 2018) (Tweede Kamer, 2018). Under certain conditions this external financing can also originate from deposit guarantee schemes in other EU member states[16] (European Banking Authority, 2016). If, however, financing from third parties would be unavailable[17], the government provides a final source of financing:

"The (European) Guideline for Deposit Guarantee Systems explicitly states that member states have the obligation to ensure the Deposit Guarantee will be upheld."[18] (Tweede Kamer, 2018).

The chance of the government having to provide (temporary) financing to the Deposit Guarantee Fund in the event of a banking crisis is non-zero, given that during the 2008 crisis the amounts raised by ex-ante and ex-post contributions combined would have been insufficient to adequately fund the Deposit Guarantee Fund[19]. It is as of yet unclear what level of temporary external funding could be attracted. Due to the chance of government financing being necessary and public malcontent with these government bail-outs, an additional source of financing from the private sector would in the future have to be utilized prior to any government bail-out. As mentioned

[16] Amongst others: Deposit guarantee schemes from other EU member states can only be borrowed from if ex-post contributions have already been levied, if the borrowing deposit guarantee scheme does not have an outstanding balance with another deposit guarantee scheme and the total sum cannot exceed 0.5% of covered deposits in the borrowing state (Article 12 (European Parliament and the Council, 2014a))

[17] Given that the crisis causing the Deposit Guarantee Fund to be depleted might also negatively impact market parties that would provide third party financing.

[18] "In de Richtlijn depositogarantiestelsels is expliciet vastgelegd dat een lidstaat de verantwoordelijkheid heeft zeker te stellen dat de depositogarantie gestand wordt gedaan."

[19] On August 1st, 2010 the total outstanding capital injections as a percentage of GDP were 6.31%, equaling approximately €40 billion in capital injections. Furthermore, asset relief programs at 10.79% of GDP and debt guarantees at 9.14% of GDP meant the total government support financial institutions amounted to 26.24% of GDP or €168 billion (De Nederlandsche Bank, 2011b; European Central Bank, 2018c).

previously in Section 2.5, this lead to the development of the BRRD in which a central place is reserved for bail-in possibilities.

The Deposit Guarantee Scheme can also be used in combination with either the bail-in tool or with other resolution options if this ensures continued access of depositors to their funds (Article 3:265e of the Besluit bijzondere prudentiële maatregelen, beleggerscompensatie en depositogarantie, 2006). If the Deposit Guarantee Scheme is utilized in this way the Deposit Guarantee Scheme can contribute funds up to the amount it would have had to contribute if covered deposits had been written down assuming regular insolvency proceedings, where the sum contributed can therefore not exceed the total covered deposits of a bank.

3.2 The bail-in proposition

First it is important to understand what a bail-in means in practice. If a bank is failing and requires recapitalization, the bail-in tool allows resolution authorities to force the bank to draw upon several layers of creditors and to either convert their debt into equity or to write down liabilities. Combined with the fact that a bail-in prevents creditors from pulling funding out of the bank, this allows the bank to continue functioning rather than needing to be shut down while a restructuring takes place, thereby avoiding disruption to the financial system.

3.2.1 Delineation of the bail-in proposition

The primary intention of the bail-in section of the BRRD is to ensure government bail-outs will no longer be needed[20] (or have a lower chance of being needed) (European Commission, 2014). While other measures in the BRRD focus on making banks safer and more stable, bail-in only comes into play when banks are experiencing some form of stress.

Using bail-in to resolve the bank is only allowed if the resolution authority determines that three conditions are met (De Nederlandsche Bank, 2017a):

- The bank is currently failing or is likely to fail in the near future;

[20] "During the crisis, those challenges were a major factor that forced Member States to save institutions using taxpayers' money. The objective of a credible recovery and resolution framework is to obviate the need for such action to the greatest extent possible." (Bank Resolution and Recovery Directive, 2014)

- Market solutions and regular supervision tools offered by the resolution authority are unlikely to resolve the situation within a reasonable timeframe;
- Resolution of the bank is in the public interest. This condition partly ties in to the "no creditor worse off" principle where the resolving authority has to determine whether it would be possible to achieve the resolution objectives through regular insolvency proceedings (i.e. bankruptcy) compared to whether insolvency proceedings would negatively impact the resolution objectives. These objectives, as listed by the Single Resolution Board, are as follows (Single Resolution Board, 2017b):
    - to ensure the continuity of critical functions;
    - to avoid significant adverse effects on financial stability;
    - to protect public funds;
    - to protect depositors; and
    - to protect client funds and assets.

If these conditions are met, the bail-in tool can be used to recapitalize the bank and to return the bank to a state of both short – and long term viability (De Nederlandsche Bank, 2017a).

To recapitalize the bank, different classes of equity and debt will be either written down or converted. The first layer that needs to be drawn upon to absorb losses consists of two sublayers: the reserves and shares, and relevant capital instruments, where relevant capital instruments are additional Tier 1 and Tier 2 capital instruments[21] and where Tier 1 and Tier 2 capital instruments are written down sequentially. These two sublayers combine to form the "Write-down and conversion of capital instruments tool". These layers are classified differently from the other bail-in layers due to the fact that the write-down and conversion of capital instruments tool can also be applied to banks outside of a full-scale bail-in event, if the relevant resolution authority believes the bank is no longer viable absent some form of resolution and believes writing down and converting capital instruments alone is sufficient to restore the bank to viability (European Parliament and the Council, 2014b). Only after these first two layers of Tier 1 and Tier 2 capital

[21] The definition of relevant capital instruments is laid out in article 2(1)(69) and (73) of the BRRD (Bank Resolution and Recovery Directive, 2014), which in turn refers to article 52(1) of Regulation (EU) No 575/2013 and article 63 of Regulation (EU) No 575/2013 (European Parliament and the Council, 2013)

have fully absorbed losses and have thus been written down or converted to common equity Tier 1 instruments and this does not recapitalize the bank to the extent that the bank once again meets its minimum capital requirements while also restoring market confidence does the resolution authority move on to the third layer of bail-in instruments (De Nederlandsche Bank, 2017a).

This third layer consists of debt instruments while excluding subordinated liabilities[22] given that these have already been included in Tier 2 capital instruments. In writing down the assets in this layer, unsecured creditors, unsecured claims from derivative contracts and uncovered (>€100,000) corporate deposits from large corporates are called upon. This third layer is slightly convoluted given that senior unsecured bonds, unsecured claims from derivative contracts and uncovered (>€100,000) corporate deposits from large corporates are all ranked pari passu in the hierarchy. This could potentially lead to problems given that in a situation of duress it could be necessary to exclude, for example, unsecured claims from derivative contracts given that including these would further destabilize the wider banking sector (IMF, 2017). There is currently little room to exclude these liabilities from bail-in, although it is allowed to exclude liabilities under limited circumstances such as for operational reasons or to prevent contagion (Article 44 paragraph 3 of Directive 2014/59/EU, 2014). In case liabilities are excluded the European Single Resolution Fund can be used to cover the gap in funding caused by exclusion of liabilities, this is however only allowed if:

(i) shareholders and creditors have previously contributed to loss absorption and recapitalization to the tune of at least 8% of total liabilities and own funds;

(ii) the total sum provided by the Single Resolution Fund is limited to the lesser of 5% of the bank's total liabilities and own funds, or the means available to the Single Resolution Fund plus any amounts that could be raised through ex-post contributions within the following three years[23];

[22] Subordinated liabilities are debt securities that are inherently ranked lower than other debt, subordinate referring to the subordinate status in relationship to normal debt. Subordinated debt is riskier for an investor due to its low rank in insolvency proceedings and therefore tends to offer higher interest rates than "normal" debt.

[23] The 5% rule can be overruled if all unsecured creditors are written down or converted.

The final layer of debt instruments that can be called upon is the layer of unsecured retail and SME-deposits (>€100,000). These deposits have "simple priority" while secured deposits (<€100,000) have so-called "super priority" (Article 108(a) and (b), Bank Resolution and Recovery Directive, 2014; Cœuré, 2013), signifying that while unsecured deposits rank below secured deposits, they are prioritized above all other layers. All layers ranked above unsecured deposits such as covered deposits, claims by tax authorities and employee claims (salaries, pension benefits), liquidation expenses and the collateralized part of secured creditors, cannot be called upon in the event of bail-in (Single Resolution Board, 2017a).

3.2.2 Advantages of the bail-in tool

The purpose of the bail-in proposition is to shift the cost of (potential) bank failures from the public to the shareholders and creditors of banks (European Commission, 2014). This not only makes the system fairer due to the costs of bank failures falling on those that would in turn profit from a positive performance, it also partly levels the playing field between banks of different sizes and importance. Prior to the bail-in proposition, it could be argued that "too big to fail" banks had an unfair advantage when it came to raising capital and in particular funding due to the fact that investors assumed they were relatively safe, since letting a bank that was too big to fail default on its creditors would trigger a cascade of defaults. The bail-in proposition theoretically alleviates this advantage meaning investors should demand compensation that is more in line with actual risk. Research by Schäfer, Schnabel & Weber di Mauro (2016) finds that legal implementation of bank resolution regimes leads to negative effects on banks' stock returns and an increase in credit default swap ("CDS") spreads, with a slightly larger effect on stock returns and CDS spreads of globally systemically important banks than on non-global systemically important banks. Their research also showed that while the implementation of bail-in propositions into law has a negative effect on banks' stock returns and led to an increase in CDS spreads, actual bail-in events such as Cyprus in 2013 lead to a stronger response, with a statistically significant larger impact on globally systemically important banks.

An aspect further increasing compensation required for investors is the uncertainty inherent in the bail-in proposition. Given that the decision to activate the bail-in is dependent on a qualitative, discretionary decision by the national resolution authority, which in the Netherlands is de Nederlandsche Bank, and that resolution authorities can decide to which extent to move assets out

of a failing bank, this cannot be fully priced into the market and this uncertainty therefore leads to an increase in compensation required (Gleeson, 2012). Possibly balancing out the upward pressure on compensation demanded from banks by creditors is the theoretical downward pressure on the cost of large deposits due to the increased safety of the bank owing to increased monitoring by creditors given their increased stake in ensuring continuity of the bank. A further aspect that could lead to downward pressure on the cost of deposits is the fact that due to the institution of a bail-in regime small deposits have become safer since this adds yet another layer of security (Williams, 2013).

3.3 Other resolution options

Resolution authorities have more options at their disposal to resolve failing institutions than solely the bail-in proposition. These other options can either be applied separately or in combination with the bail-in tool as per Article 37 paragraph 4 of the BRRD (2014). For a graphical overview of the options available, see Figure B3.

3.3.1 Bridge institutions

Resolution authorities have the option of establishing a bridge institution when a bank gets into distress. As stated in Article 41 paragraph 2 of the BRRD (2014), the aim of a bridge institution is to maintain critical functions of the bank while a sale of the institution to a market party is prepared[24]. This is accomplished by transferring the systemically important parts of the distressed bank to an entity set up by the applicable resolution authority specifically to maintain the bank's functions (Article 40 paragraph 2a, Bank Resolution and Recovery Directive, 2014). Bridge institutions are meant to be a temporary solution, with a theoretical maximum lifespan of 2 years (Article 41 paragraph 5, Bank Resolution and Recovery Directive, 2014). This lifespan can be extended for one-year periods indefinitely if the resolution authority deems such extensions to be necessary for a sale to another entity or if such an extension is necessary for the continuity of

[24] "Subject to any restrictions imposed in accordance with Union or national competition rules, the management of the bridge institution shall operate the bridge institution with a view to maintaining access to critical functions and selling the institution or entity . . ., to one or more private sector purchasers when conditions are appropriate . . ." (Bank Resolution and Recovery Directive, 2014)

essential banking or financial services (Article 41 paragraph 6, Bank Resolution and Recovery Directive, 2014).

3.3.2 Asset separation ("Bad banks")

A second option available to resolution authorities is to separate the assets of the financial institution. This can be a viable option when parts of the bank in distress are deemed to be imporperly valued by the resolution authorities while other parts of the bank are viable as a going concern (World Bank, 2017). If this tool is used, an asset management vehicle is created by the resolution authority that is either wholly or partially owned by resolution authorities or resolution financing arrangement authorities[25] (Article 42 paragraph 2, Bank Resolution and Recovery Directive, 2014), and where the management of the vehicle is performed by the resolution authority (Article 42 paragraph 4, Bank Resolution and Recovery Directive, 2014). The purpose of this newly created vehicle is to receive some or all of the assets, rights and liabilities of one or more institutions under resolution or of bridge institutions (Article 42 paragraph 2, Bank Resolution and Recovery Directive, 2014).

The goal of this newly created vehicle is to wind down the impaired assets transferred to the vehicle in such a way that it optimizes the value of the assets for a possible sale. Given that the asset separation tool in itself cannot be used to resolve a financial institution completely this tool must always be used in conjunction with another resolution tool (Article 37 paragraph 5, Bank Resolution and Recovery Directive, 2014).

3.3.3 Sale of business

A final option available to resolution authorities, the sale of business tool enables resolution authorities to sell (parts of) the institution in distress to one or more market parties. Key point in

[25] It is unclear whether this asset management vehicle would necessarily be owned by the country in question's resolution authority or whether this owner could also be the Single Resolution Board. As stated in Article 42 (Bank Resolution and Recovery Directive, 2014): "An asset management vehicle shall be a legal person that meets all of the following requirements:

(a) it is wholly or partially owned by one or more public authorities which may include the resolution authority or the resolution financing arrangement and is controlled by the resolution authority;
(b) it has been created for the purpose of receiving some or all of the assets, rights and liabilities of one or more institutions under resolution or a bridge institution."

the usage of this tool is that the sale should happen on commercial terms so that it does not violate European Union state aid guidelines (Article 38 paragraph 2, Bank Resolution and Recovery Directive, 2014). Furthermore, the objective of the sale is to maximize, as much as possible, the price.

Both these goals are accomplished through a sale process that is as transparent and non-discriminatory as possible. Taking into account that macroeconomical circumstances could make a complete inventarisation of potential purchasers irresponsible due to the increased risk of loss of confidence in financial markets, deviations from the norm are allowed to an extent. Furthermore, incentivizing purchasers or assisting them in other ways such as by providing guarantees is allowed to be considered if the resolution authority believes such measures to be beneficial to achieving a prompt transaction (World Bank, 2017).

3.4 Case studies of deposit guarantee scheme difficulties

In this section several cases where a bank or banking sector experienced difficulty will be examined. Throughout history deposit insurance schemes have been remarkably reliable with only three identified cases where losses were imposed on insured deposits[26]; Argentina in 1989 and 2001 and Iceland in 2008 (Demirgüç-Kunt et al., 2014). These three cases will be analyzed to determine what caused the distress and to approximate losses to depositors under the country's Deposit Guarantee Scheme. The Swedish banking crisis in 1991-1992 will also be analyzed as will the more recent crisis in Cyprus of 2012-2013.

3.4.1 Argentina 1989

Following decentralization of the Argentinian banking sector through liberalized interest rates on most deposits and loans, lowered reserve requirements and lowered barriers to entry in the early 1980s, foreign capital flowed in to the Argentinian economy freely due to the fact that foreign loans were relatively cheap compared to domestic ones. Furthermore, Argentina at the time had an explicit deposit insurance program that incentivized over-lending and risk-taking (Welch, 1991). When in 1980 it became apparent that inflation in Argentina did not converge as expected

[26] Arguably Cyprus is a fourth case, more on this in Section 2.4.5.

and exchange rates became progressively overvalued, capital inflow turned to capital flight owing to expectations of a devaluation of Argentinian pesos (Diaz-Alejandro, 1985; Welch, 1991).

Private sector firms that had expanded using cheap foreign debt during the debt expansion were confronted with deteriorating financial positions due to their lack of access to refinancing, causing bankruptcies to spike in 1980 and 1981 (Rudolph, 1985). This in turn led to a large increase in non-performing loans, causing the largest commercial bank in Argentina to default in March 1980 (Tybout, 1986). The expected devaluation occurred in 1981, which combined with the large portfolio of bad loans would have seen the Argentinian economy deteriorate even further leading the government to institute an exchange insurance program and to issue dollar denominated government bonds called "BONEX" (Bonos Externos – External bonds) which effectively transformed private dollar denominated debts into public dollar denominated debts. These BONEX later played a large role in the first failure of a deposit insurance scheme.

Throughout the 1980's inflation remained high in Argentina despite many attempts at price stabilization. These attempts at price stabilization culminated in a large devaluation of the currency (the Austral) in 1987. This attempt was costly but unsuccessful and was followed by the "Spring Plan" in 1988 which consisted of another devaluation combined with a multiple exchange rate system that allowed the central bank to earn a profit by purchasing foreign currency at the official exchange rate and reselling this currency through non-official channels. This naturally led to an overvalued Austral whose value could only be maintained through high real interest rates. High real interest rates proved to be insufficient and the Austral was further devalued. With the resignation of the government's economic team faith in the financial system was lost and hyperinflation occurred (Welch, 1991). It was in this economic climate that the dollar-denominated BONEX had to be refinanced in 1989 which the government found itself unable to do.

To refinance this dollar-denominated bond the government turned to the banking sector and instituted a forced exchange of all fixed-term deposits of over 1 million Australs (approximately \$500[27]) while deposit insurance at the time was 100% up to approximately \$60,000 (Miller, 1993).

[27] The World Bank states the official rate on December 10 was 1010 Australs per dollar and that the Austral depreciated another 50% against the dollar over New Year's weekend (Beckerman, 1992).

Given that the BONEX bonds depositors received in exchange for their fixed-term deposits traded at approximately 22% of their par value in financial markets (Miller, 1993) this forced exchange comprised a large confiscation of private assets. Estimates are that approximately 60% of the monetary base was confiscated in this way (Beckerman, 1992), with a total value converted of approximately $3.5 billion[28] (World Bank, 1994). This massive decrease in liquidity and in private asset holdings coupled with a general loss of the remaining faith in the financial system and government in Argentina lead to very high real interest rates, a drop in GDP of about 4.6% within a year and a withdrawal of about 75% of the total deposits in the banking system (Welch, 1991).

A long-term consequence of this failure to honor the deposit insurance was a general loss of faith in the banking sector in Argentina. Even today the Argentinian financial sector is very small compared to comparable countries and is mostly focused on transactions rather than on saving and lending (IMF, 2016).

3.4.2 Argentina 2001

The 2001 Argentine crisis is similar to the one in 1989 in more than one sense. Argentina's currency (the peso) was once again overvalued and pegged to the dollar, the country was in a recession and the government had trouble servicing its debt. When capital inflows to Argentina slowed and capital outflows increased, the cost of capital once again increased. Negative economic forecasts combined with increasing interest rates raised questions about the viability of the peso-dollar peg. In 2000 and 2001, Argentina attempted to reverse the situation by focusing on growth and by assuring markets that there was no risk of a government default. An IMF bailout package in December 2000 of $40 billion was partially intended to help allay fears.

Despite these attempts, doubts about the viability of the currency peg remained. In April 2001 the peg was already no longer in place for trade transactions and fears that the peg could also be removed for financial transactions were therefore not unfounded. Argentina's Minister of Economy further unnerved investors by rejecting limits on the abilities of the central bank,

[28] Unfortunately, no data is available regarding the amount of depositors that were affected by this measure and it is therefore not possible to say what the average loss per depositor was.

allowing the central bank to inject liquidity without limits thus dismantling the money-issuance rule that the peg was founded upon (De la Torre, Yeyati, & Schmukler, 2003).

Through all this, no decision regarding debt restructuring was taken. Since the government was unable to repay creditors, they called on Argentina's financial system to help. This was accomplished by placing $2 billion in bonds with Argentinian banks while changing regulations so that these bonds could be used by banks to meet up to 18% of their liquidity requirements. While this worked as a short-term solution, it increased linkage between the financial system and public finances while not addressing the root of the problem. As it became apparent that banks did not have sufficient dollars to cover all deposits, a bank run started on the entire banking sector (De la Torre et al., 2003; Kiguel, 2016).

In response, the government implemented the "corralito", a "little fence" which was intended to stop the outflow of deposits. This fencing allowed depositors to transfer funds within the banking system, but not to withdraw cash except for in small amounts (De la Torre et al., 2003). This shortage of cash led to considerable social unrest, especially due to the fact that the informal economy mostly ran on cash and was unable to continue functioning normally. This led to riots, further aggravated when the IMF announced it would cut off its support to Argentina. Argentina's president resigned and the new president announced Argentine's default on $93 billion of its sovereign debt. Several presidents later the fixed exchange rate was changed to 1.4 pesos per dollar and later to fully floating, depreciating the peso considerably (Van de Wiel, 2013). The majority of bank deposits were dollar-denominated, which were forcibly converted at a rate of 1.4 pesos per dollar, considerably below the prevailing market rate (De la Torre et al., 2003) of 3.86 pesos per dollar in June 2002 (Halac & Schmukler, 2003).

Worsening the unfairness of this decision was the fact that those hit hardest by this forced conversion were relatively small deposit holders as large and foreign depositors had managed to not only convert their pesos to dollars at the favorable rate but had managed to take their dollars out of the system prior to the capital controls and forced conversion[29]. Furthermore, the deposit

[29] To illustrate: Between December 2000 and November 2001 small depositors (<$5000) decreased their total peso deposits by 11.3% and increased their dollar deposits by 16.9% while large depositors decreased their peso and

guarantee fund that was supposed to safeguard these small depositors up to 30,000 pesos or dollars (Peria & Schmukler, 2001) was quickly depleted when the bank run began due to the fact that there were no restrictions on the use of this liquidity by banks (Halac & Schmukler, 2003). Total losses are hard to quantify due to a lack of data on accounts, it is however possible to offer an estimate of approximately ARS$15 billion (Table 1) corresponding to approximately US$3.9 billion in total depositor losses that should have been covered under the Deposit Guarantee Scheme. Based on each account belonging to a different depositor this corresponds to losses of approximately $US4200 losses per depositor, a very large loss given that GDP per capita was approximately $US2600 in 2002 (World Bank, 2018a).

Table 1
Forcibly Converted Dollar Deposit Accounts in Argentina in 2001.

Deposit range	Average value	Percentage of total deposits	Total value of deposits (US)	Total value of deposits after conversion (ARS)	Actual total value (ARS)	Total lost value under Deposit Guarantee Scheme (ARS)
$0-$5,000	$2,500	48%	$1,121	$1,569	$4,327	$2,757
$5,000-$20,000	$12,500	31%	$3,619	$5,067	$13,971	$8,904
$20,000-$100,000	$60,000	19%	$10,648	$14,908	$41,102	$3,274
$100,000-$500,000	$300,000	2%	$5,604	$7,846	$21,633	-

Note: Total values in millions. US$ converted to ARS$ at a rate of 1 US$ = 3.9 ARS$. Total lost under Deposit Guarantee Scheme defined as the amount lost by depositors that should have been covered under the Deposit Guarantee Scheme (up to US$30,000). Source: Halac and Schmukler (2003).

There are several key reasons that explain why Argentina was unable to honor its deposit guarantee. A primary reason is lack of faith in the promise by the government to safeguard deposits. Given the relatively recent failure of the deposit insurance scheme in 1989 it can be assumed that faith in the deposit guarantee scheme was already lower than it was in other countries. The decision to call upon banks' dollar liquidity to fund public debt payments further aggravated the situation twofold. The first negative consequence of this decision was a decrease in depositor confidence that banks could honor their dollar commitments causing depositors to start withdrawing cash, thus starting a bank run. A secondary negative consequence of this decision

dollar deposits by 49.4% and 23% respectively. Foreign residents decreased their deposits the most, 94.5% and 62.2% for peso and dollar deposits respectively (Halac & Schmukler, 2003).

was the increased linkage between the private financial system and public finances. Henceforth, a deteriorating position of public finances had far larger repercussions on banks' balance sheets. Uncertainty regarding the exchange rate further exacerbated concerns for both domestic and international depositors leading to an accelerated outflow, specifically from large depositors that therefore had a larger impact on liquidity. The absence of a credible lender of last resort for dollar deposits meant that this combination of factors made a guarantee on dollar deposits a hollow promise.

3.4.3 Iceland 2008

Iceland is of special interest due to the fact that it is a lot closer to the Netherlands both geographically and in the sense that the Netherlands was a party in the failure of the Icelandic Deposit Guarantee Scheme. Furthermore, as Iceland was and is a member of the European Economic Area it was at the time of the failure subject to many of the same rules that EU member states are.

The Icelandic crisis is similar to the Argentinian crises in certain aspects but differs in important other aspects. The primary similarity is that the financial sector in Iceland was deregulated not too long before problems started, in 2001. Following this deregulation, the three Icelandic banks took on large amounts of foreign debt (Jackson, R., 2008) estimated at €50 billion in September 2008 (Central Bank of Iceland, 2008a), compared to a GDP of €9.9 billion[30]. Large amounts of wholesale funding were also attracted, with less than 30% of loans backed by deposits in early 2006 (The Economist, 2008b).

A second similarity is that the Icelandic banking sector did not have a credible lender of last resort. Through rapid growth after the deregulation of 2001 the Icelandic banking sector grew to approximately 9-11 times the size of the economy (BBC, 2009; The Economist, 2008a; Iceland Chamber of Commerce, 2017). At the end of September 2008 when the crisis hit, the total (both domestic and foreign) official reserves of the Central Bank of Iceland were €2.41 billion (Central

[30] The OECD lists Iceland's GDP at 13,560 million US dollars in 2008 (OECD, 2018a), converted at a rate of 1 USD = 0.7337 EUR taking the exchange rate of July 2nd (Pound Sterling Live, 2018)

Bank of Iceland, 2008b), while short-term international debt of the Icelandic banks was €2.25 billion (Central Bank of Iceland, 2008a), both denominated in krónur. On top of this krónur-denominated international debt Icelandic banks also held approximately €5.6 billion[31] (The Guardian, 2013) in retail deposits in the UK and another €1.6 billion[32] in retail deposits in the Netherlands (NOS, 2008). Due to its insufficient reserves and due to the fact that a large percentage of the debt was in foreign currency, the Central Bank of Iceland could not act as a lender of last resort.

An important difference between Iceland and Argentina is how the government prioritized between foreign and domestic depositors. Whereas, as seen in Section 3.4.2, in Argentina the small, domestic depositors suffered far more than larger and foreign depositors, Iceland opted to prioritise domestic depositors leading to both the official failure of their deposit guarantee[33] and to political and legal proceedings initiated by the Netherlands and the UK (Giebels, 2014; Marshall & Martin, 2008). In 2013 the EFTA Court ruled Iceland had not breached any obligations by discriminating against foreign depositors given that there were attenuating circumstances, these being that the collapse of the banking sector was an "enormous event". The court was of the opinion that Directive 94/19/EC did not oblige the Icelandic government to guarantee the Icelandic guarantee fund's liabilities, and that therefore no promises had been broken. The Directive 94/19/EC was later amended to clarify that member states were obliged to ensure payments due under the deposit guarantee scheme were paid by the country's deposit guarantee fund (Waibel, 2013).

A second difference in the case of Iceland is that in the end Iceland opted to nationalize the majority of their banking sector[34]. The default of the banking sector cost foreign creditors €47 billion, after which the banks were recapitalized by the Icelandic government to the tune of 23% of GDP

[31] Converted at 1 GBP to 200.87 ISK at October 6th 2008 (Central Bank of Iceland, 2018)
[32] Converted at 1 EUR to 155.34 ISK at October 6th 2008 (Central Bank of Iceland, 2018)
[33] Following Directive 94/19/EC, Article 4 (European Parliament and the Council, 1994): "Deposit-guarantee schemes introduced and officially recognized in a Member State . . . shall cover the depositors at branches set up by credit institutions in other Member States." Deposits in the Netherlands and in the UK were therefore explicitly covered by the Icelandic Deposit Guarantee Scheme but this obligation was not honored.
[34] It has to be noted that in Iceland's case "entire banking sector" means four banks.

(Benediktsdottir, Danielsson, & Zoega, 2011), approximately €2.3 billion[35]. While the Icelandic government did not honor its deposit guarantee promise for Dutch and British savers, these savers nonetheless did not lose any funds as the Dutch and British government opted to activate their national deposit guarantee schemes to reimburse depositors (De Nederlandsche Bank, 2008a; FSCS, 2008).

3.4.4 Sweden 1991-1992

The banking crisis in Sweden displays similarities to the cases studied previously in the sense that a cause of the crisis was deregulation. In the 1980's Sweden followed a global trend in deregulation based on the idea that politicians are presumed to be self-interested maximizers that could thus be influenced by market parties (Peltzman, Levine, & Noll, 1989). This lead to the "removal of interest rate controls on deposit accounts in 1978, of liquidity quotas in 1983, of interest rate controls on loans and limits on SEK lending in 1985, and of currency controls in 1989" (Engwall, 1997). A sole increase in regulatory standards was an increase in the non-interest bearing cash reserve requirements for banks from 1% to 3% in 1989 (Englund, 1999).

The removal of limits on lending led to large increases in the volume of lending. Between 1985 and 1989 the credit volume of Swedish banks grew at an annual rate of 17% and total lending grew from 80% of GNP in 1985 to 140% in 1990 (Engwall, 1997). Much of this increased lending and thus borrowing was channeled into the real estate market which saw office real estate prices increase by 352% in real terms between 1980 and 1989. After this prolonged price increase, office real estate prices declined by 66% between 1990 and 1993. A similar bubble and burst can be seen in the Stockholm real estate markets, where prices increased by 780% from 1980 to 1990 and then fell by 60% from 1990 to 1993 (Jaffee, 1994). Stock markets exhibit a similar trend in the same period (Englund, 1999).

The decline in real estate markets and stock markets led to increasing credit losses for financial institutions. Increasing real interest rates led to further difficulties causing non-bank financial

[35] The OECD lists Iceland's GDP at 13560 million US dollars in 2008 (OECD, 2018a), converted at a rate of 1 USD = 0.7337 EUR taking the exchange rate of July 2nd (Pound Sterling Live, 2018)

companies to be unable to roll over their debt which had previously been financed through company investment certificates that were backed by banks. Unable to refinance using these company investment certificates, non-bank financial companies resorted to borrowing from banks directly to shore up funding (Englund, 1999). This led to increased exposure of banks to financial companies. Engwall (1997) finds that only 10% of bank losses could be attributed to household customers, and that corporate losses were concentrated in loans to non-bank financial companies that were largely associated with the building industry.

At the time, Sweden had no formal deposit insurance scheme (Englund, 1999) meaning that when losses started becoming apparent the rational decision for deposit holders was to withdraw their funds from banks that were in trouble. Fearing a bank run the Swedish government injected capital into the banks that were no longer fulfilling their capital requirements (Ingves & Lind, 1997). When this turned out to be insufficient given that Gota Bank, despite receiving a capital injection from its private sector owners, defaulted on September 9th, 1992, the Swedish government announced it would guarantee all of Gota Bank's obligations other than equity therefore including all deposits but also all other bank debt (Englund, 1999). On September 23rd this guarantee was extended to all other Swedish banks (Ingves & Lind, 1997), providing a blanket guarantee.

Sweden was relatively ahead of its time in its treatment of shareholders. While public money to the tune of 71 billion SEK, approximately $US13.8 billion or 4.9% of GDP[36], was used to save the country's financial system, only 3.1 billion SEK went to the old bank owners[37]. Shareholders were forced to take losses first prior to the government bail-out (Englund, 1999). Furthermore, the principle of bad banks was used by transferring portfolios of non-performing loans from troubled banks to a 100% government owned entity (Ingves & Lind, 1997). New management was found for this asset management vehicle that was given substantial independence by the government and was tasked with winding down distressed assets with a view to maximising value in the long term.

[36] Converted at $US1 = 5.13 SEK, using exchange rate of September 2nd, 1992 (Central Bank of Russia, 2018) and GDP of $US280 billion (World Bank, 2018d).

[37] Arguably the blanket guarantee on deposits preserved a large amount of shareholder value at some expected cost to the Swedish government owing to the liability arising from this guarantee.

Combined with the revenue realized from the sale of these assets the final government bill was lowered to 35 billion SEK, down from 71 billion SEK (Englund, 1999).

While the Deposit Guarantee Scheme, in this case in the sense of blanket insurance, was effective at avoiding a bank run, having a Deposit Guarantee Scheme prior to the crisis would not necessarily have made a large difference in the case of Sweden. This crisis was not caused by a bank run, rather the bank run would have been a result of the crisis.

3.4.5 Cyprus 2012-2013

Cyprus is a special case in the sense that this was not only a situation in which the Deposit Guarantee Scheme came very close to failing as a write-down (a "haircut") of insured deposits was considered but also in the sense that this is the only case where insured euro deposits were not repaid in the full sense of the word.

Similar to Iceland, Cyprus had a banking sector that was many times larger than its GDP. Prior to the introduction of the euro to Cyprus in January 2008 its banking sector was already relatively large at 340% of GDP at the end of 2005, this increased in size rapidly following the euro's introduction to reach 688% of GDP at the end of the second quarter of 2010 (Bank of Cyprus, 2016). As a result of the financial crisis leading to large decreases in tourism and shipping income, sectors that were some of the largest contributors to GDP (IMF, 2011), unemployment rose. Coupled with a decrease in commercial property values that had been propped up by highly leveraged mortgages (IMF, 2011; Royal Institution of Chartered Surveyors, 2018) this led to a sharp increase in non-performing loans (see Figure 3) and thus increased pressure on the banking system.

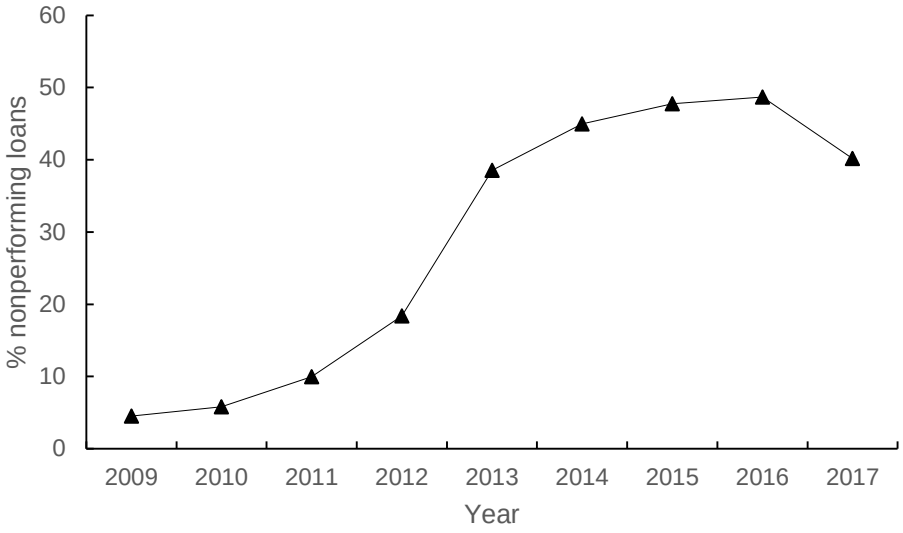

Figure 3. Share of non-performing loans Cyprus 2009 to 2017 (World Bank, 2018b).

The Greek government-debt crisis further increased problems due to the fact that Cypriot banks had a high exposure to Greek sovereign bonds and were therefore highly impacted by the haircut imposed on these bonds, suffering a write-down of approximately €4.5 to €5 billion[38] (The Economist, 2013). Given that the Cypriot banks' Greek debt holdings were public information at this point due to the July 2011 stress test performed by the European Banking Authority (European Banking Authority, 2011) markets were well aware of the difficulty Cypriot banks were in leading to further liquidity problems. Funding needed to recapitalize the Cypriot banks was estimated to be approximately €17 billion (Demirgüç-Kunt, 2013), almost equal to Cyprus' GDP of €18 billion (European Central Bank, 2018b).

These combined factors of deteriorating bank balance sheets and a government that could not credibly serve as a backstop in case of further deterioration led Cyprus to request a bailout from "the Troika" consisting of the IMF, European Commission and the ECB in 2012 (Washington Post, 2013a). The original plan for the bailout was a source of major controversy given that bank deposits guaranteed under the Deposit Guarantee Scheme (up to €100,000) would be haircut by 6.75%, while larger deposits would be haircut by 9.9% (Sibert, A., 2013). While this proposal was

[38] Another source states €3.5 billion (Washington Post, 2013a).

put forward by Cyprus' president Nicos Anastasiades, it had the backing of the Troika and led to a bank run by small depositors. The proposal was quickly amended to exempt the first €20,000 in deposits, however despite this change the proposal was rejected by the Cypriot government (Washington Post, 2013a). Aside from the short term damage done by causing a bank run, this proposal had large repercussions for Europe as a whole given that this haircut would be a violation of the sanctity of small deposits. While short term damage in terms of costs and euro devaluation was small, the long term costs were potentially large as small depositors in other troubled countries such as Greece, Spain, Italy and Portugal would in case of future banking crises be more likely to withdraw funds rather than trust in the Deposit Guarantee Scheme of their country (Washington Post, 2013b).

Cyprus' president and the Troika eventually changed the proposal so that small depositors would be unaffected and large depositors would foot the entire bill that was to be paid by depositors, after which Eurogroup president Jeroen Dijsselbloem stated this should be seen as a blueprint for future crises (Financial Times, 2013b). Through this agreement reached by this proposal Cyprus was able to acquire funds to recapitalize their banks. While this bail-in was controversial it proved to indeed be a blueprint in the sense that the BRRD includes, as a final layer of creditors, the same large depositors that were haircut in the case of Cyprus.

The Cypriot banking crisis was remarkable in more than one aspect. The funds needed to save the banks were equal to almost 100% of GDP meaning this was a case of extreme stress on the Deposit Guarantee Scheme. The crisis also showed that even writing down shareholders and debtholders might not be enough to save banks and that a write-down of large depositors was a possibility. Furthermore, despite all this, small depositors came out relatively unharmed and the Deposit Guarantee Scheme was arguably upheld. An additional interesting element of this crisis is the choice made by the Cypriot government to selectively default on government debt (Fitch Ratings, 2018; Moody's, 2013; Standard and Poor's, 2013) while ensuring all small deposits (<€100,000) were safeguarded. While there have been many more sovereign defaults (Reinhart & Rogoff, 2011) than failures of Deposit Guarantee Schemes over the years, Cyprus is a remarkable case in that there was such a clear trade-off between the two.

The Cypriot banking crisis was also remarkable in the sense that during the period of the banking crisis capital controls were imposed. These capital controls (starting with a monthly cap of €5,000

on bank transfers and a cap of €3,000 on moving cash out of the country (Financial Times, 2013a)) were imposed on the country as a whole for approximately 2 years. While this does not officially constitute a failure of the Deposit Guarantee Scheme it does come very close to it. The premise of the Deposit Guarantee Scheme in the EU is that small (<€100,000) deposits are guaranteed to an absolute, euro-denominated amount. While this promise was upheld in Cyprus with no deposits under €100,000 being haircut, the capital controls instituted could be seen as a failure of the Cypriot Deposit Guarantee Scheme as small deposits were (temporarily) worth less than €100,000 due to implicit exchange rate fluctuations.

While the euro functions as a common currency, it does not matter whether euros are kept in a Dutch checking account or in a Cypriot checking account, especially when this checking accounts hold <€100,000 in funds. However, during the period of these capital controls, a Cypriot euro was not equal to a non-Cypriot euro as there would be a preference towards non-Cypriot banks given that this money could be freely moved throughout the entire European Union and could be spent or invested without issue. It therefore no longer held true during this period that Cyprus used the same euros as other euro countries as these capital controls effectively devaluated Cypriot euros vis-à-vis all other euros.

Cyprus' capital controls were not extremely strict and therefore the devaluation was, most likely, limited. If an entity however had a €100,000 deposit at the time of bank distress of these Cypriot banks, the repayment would have been to a Cypriot bank account rather than a non-Cypriot bank account which would mean the effective value of your deposit would have decreased, meaning the Deposit Guarantee Scheme arguably failed in this instance.

3.5 Case study of the opinion on Deposit Guarantee Scheme of Dutch political parties

This section analyzes the opinion of the six largest (corresponding to 128 out of 150 seats or 85.3% of all seats) Dutch political parties in the House of Representatives regarding the Dutch Deposit Guarantee Scheme. A focal point is whether the parties believe the government should act as a backstop in case depositors' funds cannot be saved using only private sector funding. Viewpoints of parties are analyzed in descending order by the number of seats attained in the latest Dutch general election of 2017 (Kiesraad, 2017).

The largest party in the past Dutch general election was the VVD (People's party for Freedom and Democracy), obtaining 33 seats out of a possible 150 (22%). In their most recent general election programme, the VVD stated they "are of the opinion that the bail-in rule should be strictly adhered to prior to a financial institution, or European member state, being able to call upon collective European funds such as the European Stability Mechanism (ESM) and the Single Resolution Fund (SRF)"[39] (VVD, 2016). No specific mention is made of the Dutch government providing a backstop. In the VVD's election programme for the European Parliament a more specific viewpoint is given:

"Concerning the resolution of non-viable banks it is just that in the first place the shareholders and debtholders, and not only the taxpayer, contribute when a financial institution is in distress"[40] (VVD, 2014).

Combining the VVD's election programme for the Dutch general election and for the European Parliament it is clear that the VVD is of the opinion that the onus is on shareholders and creditors to save failing banks, but that, subsequent to this bail-in, contribution of Dutch or European public funds would also be a possibility if necessary.

The second largest party in the latest general election was the PVV (Party for Freedom), obtaining 20 seats corresponding to 13.3% of seats. Given that the PVV's Dutch election and European Parliament programme are short at a length of only one page, it is not surprising that no mention is made of the Deposit Guarantee Scheme (PVV, 2014; PVV, 2016). Taking into account opinions stated outside of election programmes, the PVV is known to have approved of the change from ex-post to ex-ante funding (Tweede Kamer, 2011; Tweede Kamer, 2013) and it is known that the PVV was against the possibility of Deposit Guarantee Funds borrowing from other EU member states' funds (Tweede Kamer, 2011). Given that this is not a clear opinion on the role of the Deposit Guarantee Scheme in a failure large enough that the normal measures are inadequate, it is not

[39] "De zogenaamde bail-in regel die dit mogelijk maakt, moet scherp worden toegepast voordat een financiële instelling of een euroland een beroep kan doen op collectieve Europese middelen zoals het Europese Noodfonds (ESM) en het Europese Resolutiefonds(SRF)."

[40] "Bij de afwikkeling van niet-levensvatbare banken is het rechtvaardig dat in de eerste plaats de aandeel- en obligatiehouders, en niet slechts de belastingbetaler, meebetalen wanneer een financiële instelling in de problemen komt."

possible to say what the opinion of the PVV is regarding a government backstop to the Deposit Guarantee Scheme.

The third largest party in the last general election was the CDA (Christian Democratic Appeal), obtaining 19 seats corresponding to 12.7% of seats. Similar to the PVV the CDA's Dutch general election programme makes no mention of the Deposit Guarantee Scheme (CDA, 2016). The European Parliament election programme mentions that "the savings of depositors in Europe under €100,000 should be safeguarded at all times. There can be no doubt about that[41]" (CDA, 2014). The European Parliament election programme statement can be seen as an implicit approval of a government backstop, due to the phrasing "at all times" implying a government role if necessary. Further statements relating to the Deposit Guarantee Scheme cannot be found in parliamentary debates. It is not possible to say what the exact opinion of the CDA is regarding a government backstop, though their European Parliament election programme statement could be construed to mean that the CDA is of the opinion that it is an option.

D66 (Democrats 66) obtained exactly the same amount of seats as the CDA at 19, corresponding to 12.7% of seats. D66 makes mention of the Deposit Guarantee Scheme in their election programme, however only in the sense that they approve of a European Deposit Guarantee Scheme (D66, 2016). D66's European Parliament election programme repeats this message (D66, 2014a). The party website provides additional information, stating that the costs of bank default should be borne by shareholders and other creditors rather than by the government. Additionally, the website mentions that "measures should be taken to prevent banks from taking unacceptable risks (the results of which) will fall on the public and the government" (D66, 2018). It therefore appears to be the case that while D66 believes governments should not be involved in bearing the costs for bank defaults, the door is left open for government intervention if needed. This is further confirmed by the vision on the banking sector published by D66 (2014b) stating that "it is possible that for some systemically important banks a write-down of creditors alone is not sufficient to revitalize the bank. In that case public money needs to be available in the next years to recapitalize these

[41] "Het spaargeld van spaarders onder de 100.000 euro moet in heel Europa te allen tijde veilig zijn. Daar mag geen twijfel over bestaan."

banks. If banks need to be bailed out using taxpayers' money, the banks' home country should bear the costs.[42]" This statement can be seen as a clear desire to protect small depositors through a government backstop if necessary.

The fifth largest party in the last election was Groenlinks (The Green Left), obtaining 14 seats corresponding to 9.3% of all seats. In Groenlinks' election programme the Deposit Guarantee Scheme is not mentioned explicitly, however mention is made of increasing bank buffers so that risks can no longer be shifted to taxpayers (GroenLinks, 2016). Groenlinks' European Parliament election programme makes mention of being in favor of bailing in creditors, a fund for bank resolution and of using the European Stability Mechanism as a public backstop (GroenLinks, 2014). Furthermore, the election programme states business banks should be separated from retail banks and that business banks would never be eligible for a bailout using taxpayers' money, implying retail banks would be eligible. It therefore appears that Groenlinks' is in favor of a government backstop under certain conditions.

Finally, the sixth largest party in the last general election was the Partij van de Arbeid (Labor Party, "PvdA") obtaining 9 seats corresponding to 6% of all seats. Their Dutch election program states that the Partij van de Arbeid "wishes to complete the European banking union by introducing a European Deposit Guarantee Scheme so that governments will not be tempted to save failing banks[43]" (PvdA, 2016). The PvdA's European Parliament election programme states that the PvdA wishes to avoid using public funds being used for risks taken by private companies. It further states that "in a banking union, it is no longer the government and taxpayer that pay for a failing bank but first and foremost the shareholders and debtholders[44]" (PvdA, 2014). This is further elaborated by stating investors should take part in paying for the costs of an impending default by a bank

[42] "Het is mogelijk dat voor sommige systeemrelevante banken het afstempelen van obligaties alleen niet genoeg is om weer gezond te worden. Dan moet er de komende jaren toch overheidsgeld beschikbaar zijn om die banken te herkapitaliseren. Als banken gered moeten worden met belastinggeld, dan draait in eerste instantie het thuisland voor deze kosten op."

[43] "We willen de bankenunie vervolmaken door de invoering van een door banken zelf gefinanciering Europees Depositogarantiestelsel (DGS), zodat overheden onder druk van spaarders niet in de verleiding komen falende banken alsnog te redden."

[44] "In een Bankenunie betalen niet langer de overheid en de belastingbetaler voor een omvallende bank, maar eerst en vooral de aandeel- en obligatiehouders."

through a European Resolution Authority where the contribution of the private sector comes first. It is unclear whether this means a resolution authority that is primarily funded by bail-in with a government backstop if needed and the opinion of the PvdA regarding a government backstop is therefore, in both cases, vaguely phrased. No other opinions are given in parliamentary debates or memoranda. Given the vague phrasing conclusions regarding the PvdA's opinion regarding a government backstop cannot be drawn.

Summarizing, out of the six largest parties representing 128 out of 150 seats corresponding to 85.3% of all seats, three parties (VVD, D66 and Groenlinks) representing 66 seats (44%) are clear on their desire for a government backstop to save banks if needed, while one party (CDA) implies a government backstop is an option and two parties (PVV, PvdA) do not offer a clear opinion. The latter three parties have been contacted to obtain a clear opinion, however no response has been received. Given the fact that parties corresponding to 44% of seats in the House of Representatives appear to publicly support a government backstop, coupled with other parties not offering a clear opinion and not necessarily rejecting a government backstop, it appears likely that in case banks are unable to acquire sufficient funds through bail-in or liquidation, the Deposit Guarantee Fund and through an additional ex-post contribution, the government will provide additional financing.

4. Model used to determine probability of bank default

To determine the adequacy of the Dutch Deposit Guarantee Scheme it must first be established which Dutch banks are most likely to fail. To this end a paper by Betz et al. (2014) is used. Betz et al. (2014) take into account not only outright defaults but also other vulnerable states that signal distress for their sample period of 2000Q1 to 2013Q2, leading to a more representative sample of bank distress than other methods. Combined with a broad range of indicators this allows them to create a model that has relatively high predictive power in terms of predicting bank distress. The model by Betz et al. (2014) is therefore an ideal starting point to determine which Dutch banks are most likely to fail. Given that the model used is integral to the conclusions of this paper, an overview of the parts of the paper by Betz et al. (2014) relevant to this paper is offered here.

4.1 Data on distress events

The paper by Betz et al. (2014) improves on previous models by combining bank-specific, macro-financial and banking sector indicators with a novel dataset of bank distress events that includes not only defaults, liquidations and bankruptcies, but also distressed mergers and state interventions. Including these events increases the available bank distress events leading to a larger dataset available for analysis.

Data on bankruptcies, liquidations and defaults is used to capture direct bank failures. A bank is defined to be bankrupt if its net worth falls below the level required by the capital requirements of the country in which the bank resides, while a bank is defined to be liquidated if a bank is sold under liquidation proceedings. Finally, a bank is defined to be in default in either of two cases: (i) the bank failed to pay interest or repay principal on one or more financial obligations beyond any grace period specified by the terms of the obligation or (ii) the bank completed a debt exchange in which one or more financial obligations are repurchased or replaced by other instruments leading to a lower total value. Using this method 13 distress events are found, the majority of which are defaults.

Furthermore, data on state interventions is used by Betz et al. (2014) as another proxy for a bank being in a state of distress given that state interventions imply a bank is no longer able to continue functioning without outside support. A state intervention is defined as a bank either receiving a capital injection by the state or taking part in a government-funded asset relief programme, thereby

focusing on asset-side assistance. Using this approach Betz et al. (2014) find 153 distress events as proxied by state interventions, signifying that these distress events are far more common than outright defaults at 13 in the dataset.

Mergers in distress are used by Betz et al. (2014) as a proxy for distress events that are solved by the private sector. Merged entities are defined to be in distress if (i) a parent entity is on the receiving end of state support within a year of the merger or (ii) a merged entity has a negative capital and reserve coverage of nonperforming loans (González-Hermosillo, 1999) within a year after the merger. These two distress rules are only applied to merged entities, rather than to all entities, to ensure only banks that are forced to merge due to distress are captured. Based on these definitions, 35 merger in distress events are found.

Using these three approaches to proxy for bank distress a total of 194 unique bank distress events are found by Betz et al. (2014) after 7 events are removed due to appearing in more than one category. Vulnerable states, or pre-distress events, are defined as the 8 quarters leading up to the distress event and a binary pre-distress variable is therefore set to 1 in these pre-distress quarters and at 0 for all other quarters.

4.2 Data on vulnerability indicators

The paper by Betz et al. (2014) utilizes three categories of indicators to predict a bank's probability of distress: (i) bank-specific indicators, (ii) banking sector indicators and (iii) macro-financial indicators.

Bank-specific indicators are used as in the CAMELS rating system (Flannery, 1998; González-Hermosillo, 1999; Poghosyan & Čihák, 2009) where CAMELS stands for Capital adequacy, Asset quality, Management quality, Earnings, Liquidity and Sensitivity to market risk. A full overview of the indicators used by Betz et al. (2014) and their transformations to proxy the CAMELS model is supplied in Table A2.

The second group of indicators used by Betz et al. (2014) are country-specific banking sector indicators. These indicators proxy for imbalances at the level of a country's banking system rather than imbalances at individual banks' level and are often used as early-warning indicators for banking crises (Borio & Lowe, 2002; Demirgüç-Kunt & Detragiache, 1998; (Demirguc-Kunt & Detragiache, 2000; Hahm, Shin, & Shin, 2013; Kaminsky, Lizondo, & Reinhart, 1998). Betz et al.

(2014) use these indicators in the following ways: total assets to GDP and growth in non-core liabilities proxy for economic booms and rapid increases in bank balance sheets; leverage of the banking sector is proxied by debt-to-equity and loans-to-deposits ratios; level of securitization is proxied by debt securities to liabilities; while property booms are proxied by the ratio of mortgages to loans.

The final group of indicators used by Betz et al. (2014) are country-specific macro-financial indicators to proxy for both macro-economic imbalances and conjunctural variation in asset prices and business cycles. Data is obtained on private sector credit flow, government debt and country's international investment position. Furthermore, asset prices (each country's leading stock market indicator price and housing prices) and business cycle indicators (real quarterly GDP growth and CPI inflation) are used to proxy conjunctural variation. A full overview of the summary statistics of the variables used by Betz et al. (2014) is provided in Table A3.

Betz et al. (2014) then perform a mean comparison test (t-test) to determine whether these indicators significantly discriminate between non-distress and distress events, the full results of which can be found in Table A4. The t-test results indicate that most variables are good indicators (19 out of 27 or 70%).

4.3 Methodology of evaluation of model signals

As the paper focuses on detecting states of distress for banks, the indicator used by Betz et al. (2014) to signal possible distress is a binary variable that takes the value of one when the model predicts a vulnerable state for a bank in a specified forecast horizon and takes a value of zero otherwise. As the model does not result in a binary outcome but rather in a continuous probability outcome the probability *p* is transformed into a binary prediction variable P_j that takes a value of one to signify a pre-crisis period if P_j exceeds a certain set threshold $\lambda \in [0,1]$ and is set at zero otherwise.

4.4 Methodology of estimation and prediction of probability of default

Logit analysis is used by Betz et al. (2014), rather than probit analysis, given that logit's assumptions of relatively fat-tailed distributions correspond better to the frequency of banking crises and to bank distress events. Betz et al. (2014) opt to use a pooled logit model due to their objective to capture a wide variety of vulnerable states and due to the relatively small number of

crises in the observed countries. Furthermore, pooled logit models are what has typically been preferred in literature (Davis & Karim, 2008; Kumar, Moorthy, & Perraudin, 2003) due to its outperformance relative to more sophisticated models (Fuertes & Kalotychou, 2007). Country-specific effects are taken into account by Betz et al. (2014) to a certain extent given that country-level indicators are used as indicators in the model. The dependent variable is defined as a number of quarters leading up to the distress event, where the benchmark case uses the eight quarters leading up to the event. The early-warning model created in this way is a recursive logit model where at each quarter *t* a prediction is made using an estimation sample that grows in an increasing-window fashion.

This prediction is made by estimating a model for each quarter *t* using all available data up to quarter $t - 1$ and evaluating the outcomes of the model for the in-sample period to determine the optimal threshold $\lambda \in [0,1]$ that optimizes usefulness of the model, where maximum usefulness is when λ minimizes type I and type II errors[45] for a certain set relative preference. Using the threshold $\lambda \in [0,1]$ value, the binary prediction variable of each bank in quarter *t* (therefore out of sample) is determined, after which these steps are repeated for quarter $t + 1$ recursively.

Fratzscher (2006) argues that in an early warning system such as the model developed by Betz et al. (2014) post-crisis and crisis bias needs to be addressed. This possible bias is due to the fact that comparing both tranquil periods in which independent variables are at normal levels and post-crisis or recovery periods in which variables behave differently to crisis periods, without differentiating between tranquil periods and post-crisis periods, means the model might be predicting a post-crisis period rather than the crisis period itself. Betz et al. (2014) account for this by excluding periods in which a bank distress event occurs and the four following quarters from their independent variables.

[45] A type I error is a rejection of a null hypothesis that is true (a false positive) whereas a type II error is a failure to reject a false null hypothesis (a false negative).

4.5 Results of Betz et al. (2014)

Using the methodology detailed in the previous section Betz et al. (2014) use their estimation sample of 2001Q1 to 2011Q2 to create a benchmark model containing indicators drawn from the three groups as listed in Section 4.2, being bank-level indicators, country-specific banking sector indicators and country-level macro-financial indicators. Using this data two benchmark models are created that are optimized taking into account a preference to use a wide range of potential vulnerabilities and data availability, excluding variables where their inclusion would result in a large decrease of available banks and observations especially where their exclusion does not decrease predictive usefulness of the model. The benchmark+ (model 2) illustrates this tradeoff. The coefficients Betz et al. (2014) thus arrive at are detailed in Table 2.

Table 2
Logit Estimates on Bank Distress and their Predictive Performance (Betz et al., 2014).

	Estimates	(1) Benchmark		(2) Benchmark +	
Bank-specific indicators	Intercept	-3.46 ***		-3.26 ***	
	Capital Ratio	-0.76 ***		-1.37 ***	
	Tier 1 Ratio			-5.91	
	Impaired Assets			0.14 .	
	Reserves to impaired assets	-0.19		-0.15	
	ROA	0.12 *		0.56 ***	
	Loan Loss Provisions	0.09 .		0.18 .	
	Cost to Income	0.09		0.22 *	
	ROE	-0.06		-0.28	
	Net Interest Margin			0.23	
	Interest expenses to liabilities	0.14 ***		0.50 **	
	Deposits to funding	0.01		-0.33 *	
	Net short term borrowing	0.18 **		0.48	
	Share of trading income	-0.14		-0.27 .	
Country-specific banking sector indicators	Total assets to GDP	0.71 ***		1.71 ***	
	Non-core liabilities	0.32 ***		0.28 ***	
	Debt to equity	0.30 ***		0.37 ***	
	Loans to deposits	0.14		0.05	
	Debt securities to liabilities	-0.22 *		-0.19 *	
	Mortgages to loans	0.03		0.21 *	
Country-specific macro-financial indicators	Real GDP	-0.10 .		-0.06	
	Inflation	0.06		0.15 **	
	Stock Prices	0.02		-0.05	
	House Prices	-0.38 ***		-0.28 **	
	Long-term government bond yield	0.04		0.12	
	International Investment position to GDP	-0.50 ***		-0.48 ***	
	Government debt to GDP	0.50 ***		0.43 ***	
	Private sector credit flow to GDP	0.36 ***		0.23 ***	
	R2[a]	0.27		0.24	
	No. of banks	298		238	
	No. of observations	8340		6088	
	Predictive performance	$U_a(\mu)$	$U_r(\mu)$	$U_a(\mu)$	$U_r(\mu)$
Usefulness for a policymaker	$\mu = 0.6$	0.01	12%	0.01	14%
	$\mu = 0.7$	0.01	16%	0.02	22%
	$\mu = 0.8$	0.03	31%	0.03	29%
	μ **= 0.9**	**0.04**	**42%**	**0.03**	**40%**
$P(I_j\ (h)=1)$[c]		0.06		0.07	

Note: Reproduced from Betz et al. (2014). For standardized coefficients, the explanatory variables have been transformed to have zero mean and unit variance. Significance codes: "***", 0.001, "**", 0.01, "*", 0.05, ".", 0.10.
[a] R2 refers to the Nagelkerke's pseudo R-squared.
[b] The usefulness for a policymaker is computed with absolute and relative usefulness $U_a(\mu)$ and $U_r(\mu)$ as described in section 4.1 of Betz et al. (2014).
[c] $P(I_j\ (h)=1)$ refers to the unconditional probability of pre-distress events.

Table A5 depicts the predictive power of the three different indicator groups. The benchmark model used in this paper is the model with both the highest R2 at 0.27 and the highest usefulness to a policymaker at every preference level. Using only one group of indicators, the banking sector group has the highest R2 at 0.15, while the macrofinancial indicators offers an R2 of 0.12 and basing the model solely on bank-specific indicators results in an R2 of 0.10.

An interesting finding by Betz et al. (2014) is that augmenting the usefulness measure by incorporating bank-specific weights, where larger banks thus have an increased influence, decreases model performance in terms of usefulness to a policymaker that wants to use the model to predict banking crises. This illustrates that the model is better at predicting distress in small banks than in large banks, possibly owing to the fact that distress in large banks is caused by more complex factors than in small banks.

5. Data

To determine the adequacy of the Dutch Deposit Guarantee Scheme it is first determined which Dutch banks are most likely to go into distress using the benchmark model developed by Betz et al. (2014), subsequent to which scenarios are used in which percentiles of the banks most likely to default are assumed to go into distress. The loss given default for these distressed banks is calculated based on levels of asset losses as used in Carmassi et al. (2018) after which the loss absorption capacities of the banks in distress will be analyzed to determine whether bail-in of securities is sufficient to absorb the losses imposed by this stress. If bail-in of securities is insufficient, the Deposit Guarantee Scheme absorbs losses.

5.1 Data on probability of default

To determine the probability of default for Dutch banks, the benchmark model as developed by Betz et al. (2014) as detailed in Section 4.5 is used which uses data on bank-specific indicators, country-specific banking sector indicators and data on country-specific macro-financial indicators to determine the likelihood a bank will go into distress in the next eight quarters. Data for Dutch banks is obtained from Bloomberg for 2003Q1 to 2018Q1 for bank-specific indicators such as each banks' respective capital ratio, return on assets and deposits to funding. For a full overview, see Table 2. Additionally, data is obtained for country-specific banking sector indicators and country-specific macro-financial indicators. As is the case in Betz et al. (2014), this data is then used to reconstruct the data available to investors at a given point in time by applying the appropriate publication lags. Bank balance sheet and house price indicators are lagged by two quarters, while investment position to GDP, government debt to GDP and private sector credit flow to GDP indicators are lagged by six quarters. Banking sector indicators and all other macro-financial indicators are lagged by one quarter. Where possible quarterly data is used, where quarterly data is not available annual figures have been adjusted to a quarterly basis and used for the four quarters subsequent to publication.

Given that basing the analysis solely on Bloomberg data would limit the analysis severely, bank balance sheet data is supplemented by using data obtained from Orbis Bankfocus, DNB and banks' annual reports. Care has been taken to ensure figures are reported on the same basis across data sources. For a full overview of summary statistics see Table A6 while a comparison of summary statistics found in Betz et al. (2014) and in this paper is offered in Table 3.

Table 3
Comparison of Summary Statistics between this Paper and Betz et al. (2014)

		Comparison paper			Current paper		
	Variable	*Obs.*	*Mean*	*Std. dev.*	*Obs.*	*Mean*	*Std. dev.*
Bank specific indicators	Capital Ratio	19585	0.07	0.04	1175	0.08	0.07
	Tier 1 Ratio	11397	0.10	0.04	1038	0.19	0.14
	Impaired Assets	12474	0.02	0.03	639	0.02	0.03
	Reserves to impaired assets	12146	1.53	2.39	729	1.37	4.70
	ROA	19761	0.01	0.01	1116	0.01	0.01
	Loan Loss Provisions	16292	0.01	0.01	544	0.00	0.01
	Cost to Income	19283	2.84	6.44	622	0.69	0.23
	ROE	19504	0.07	0.14	1058	0.06	0.14
	Net Interest Margin	16768	0.02	0.01	999	0.02	0.02
	Interest expenses to liabilities	18984	0.03	0.02	702	0.01	0.01
	Deposits to funding	18508	0.55	0.24	941	0.49	0.26
	Net short term borrowing	19121	0.08	0.19	841	0.01	0.1
	Share of trading income	18928	0.26	0.83	490	0.75	5.9
Country-specific banking sector indicators	Total assets to GDP	25552	12.2	12.2	61	13.57	1.15
	Non-core liabilities	25507	0.00	0.01	61	0.00	0.00
	Debt to equity	25568	14.4	4.25	61	20.47	2.47
	Loans to deposits	25568	2.39	0.74	61	0.97	0.07
	Debt securities to liabilities	25568	0.18	0.09	61	0.12	0.02
	Mortgages to loans	25428	0.17	0.07	61	0.40	0.03
Country-specific macro-financial indicators	Real GDP	26279	0.00	0.01	61	0.00	0.01
	Inflation	26383	0.01	0.01	61	0.02	0.01
	Stock Prices	26261	0.01	0.12	61	0.01	0.09
	House Prices	25617	0.01	0.03	61	0.00	0.01
	Long-term government bond yield	25933	0.04	0.02	61	0.03	0.01
	International Investment position to GDP	26383	-0.2	0.32	61	0.17	0.26
	Government debt to GDP	26383	0.72	0.28	61	0.56	0.08
	Private sector credit flow to GDP	26383	0.09	0.09	61	0.08	0.04

Note: Observations defined as one observation per quarter per bank for the current paper. Data is obtained on 30 banks for 61 quarters meaning a potential 1830 observations. Country-specific banking sector indicators and country-specific macro-financial indicators are available for each quarter and are the same for all banks in the sample, therefore this is defined as one observation per quarter in the current paper. Betz et al. (2014) count each observation for the country-specific banking sector and country-specific macro-financial indicators per bank, meaning for the current paper the observations for these indicators using the method by Betz et al. (2014) would be 1830 rather than 61. Data in Betz et al. (2014) is collected for the period 2000Q1 to 2013Q2 whereas data for this paper is collected for 2003Q1 to 2018Q1.

5.1.1 Bank specific indicators

Comparing the data on the probability of distress of Dutch banks to the data as obtained by Betz et al. (2014) it is clear that while the number of observations is markedly lower due to the smaller number of banks analyzed the mean values are similar (with some exceptions). Cost to income shows a large discrepancy (mean value of 2.84 vs 0.69) which could be explained by this paper covering a different time period. As Figure 4 shows this explanation does not seem plausible given that the cost-to-income variable does not show a downward trend and in fact changes relatively little through the period observed.

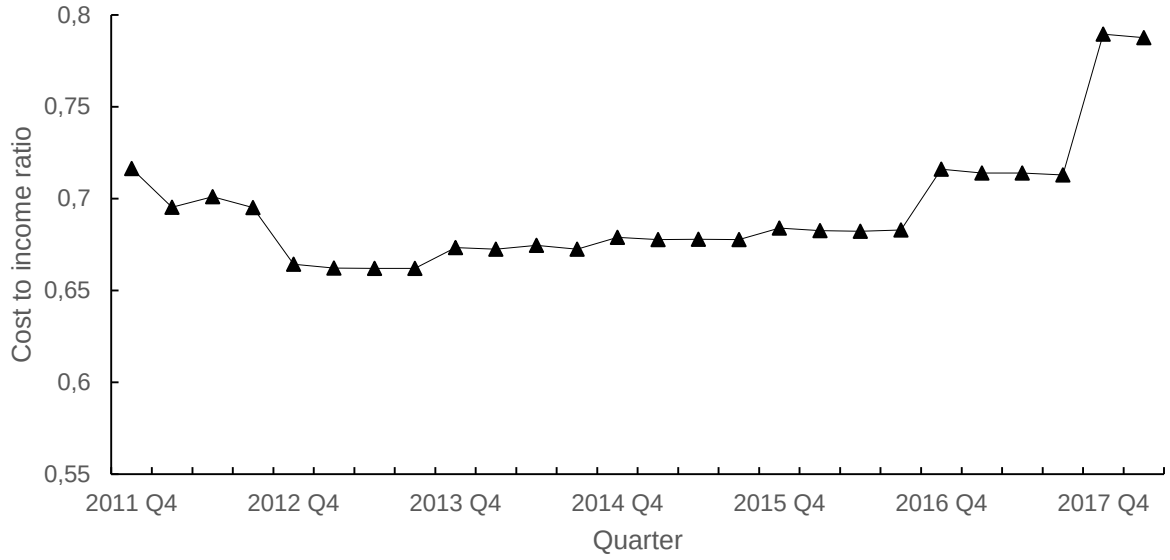

Figure 4. Cost to income ratio 2011Q4 to 2018Q1.

Large differences also appear in the net short term borrowing and share of trading income indicators. Net short term borrowing during the time that overlaps with the period covered by Betz et al. (2014) is even lower than the mean for the total period (-0.02 vs 0.01) and has risen considerably since (see Figure 5).

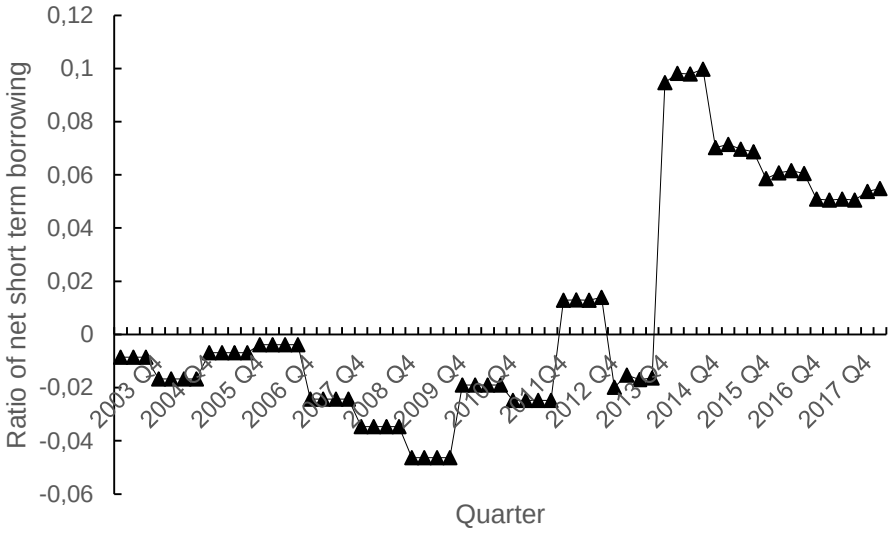

Figure 5. Net short term borrowing 2003Q1 to 2018Q1.

It therefore appears that Dutch banks have a combination of less short-term borrowing combined with more cash relative to total liabilities. The share of trading income for Dutch banks on the other hand is markedly higher than that of the bank sample in Betz et al. (2014) at 0.75 versus 0.26. While there seems to be no clear trend in the share of trading income (see Figure B4) there is a large difference between individual banks with regards to this indicator, with two banks having such large outliers that this influences the mean considerably. The bank with the highest share of trading income is RBS N.V. Given that RBS N.V. mostly focuses on financial instruments transactions (RBS Holdings N.V., 2018) this is not surprising. Aegon Bank's trading income is also relatively high which is harder to explain given that Aegon Bank is far more diversified. No explanation is offered in the annual report as to the cause of this high value (AEGON Bank N.V., 2012) (AEGON Bank N.V., 2013). Removing RBS N.V., which could be justified given that this is not a bank in the traditional sense, reduces the mean value from 0.75 to 0.31 which is more in line with Betz et al. (2014). Figure 6 provides an overview of the share of trading income for Dutch banks, where RBS N.V.'s outlier of 61 and Aegon Bank's outlier of 22 are not shown.

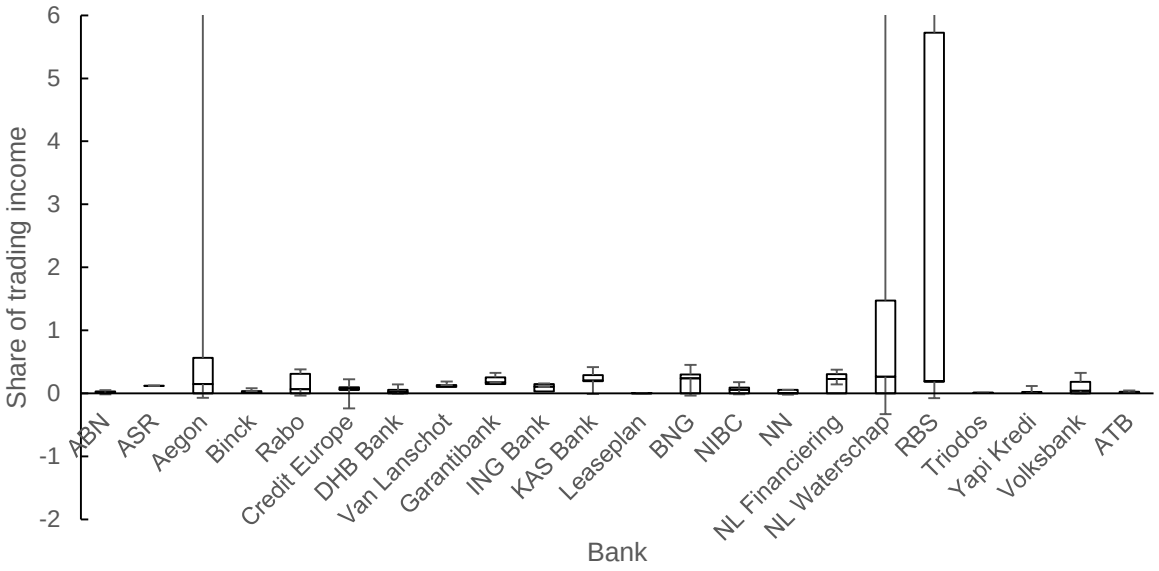

Figure 6. Box plot of share of trading income per bank.

5.1.2 Country-specific banking sector indicators

In terms of country-specific banking sector indicators the Netherlands exhibits some differences from the average values found for the countries analyzed by Betz et al. (2014). The higher mean score for debt to equity reflects the higher-than-average leverage used by Dutch banks, though as can be seen in Figure 7 the leverage of Dutch banks has decreased steadily over the past few years due to increasingly rigorous capital buffer requirements (De Nederlandsche Bank, 2014).

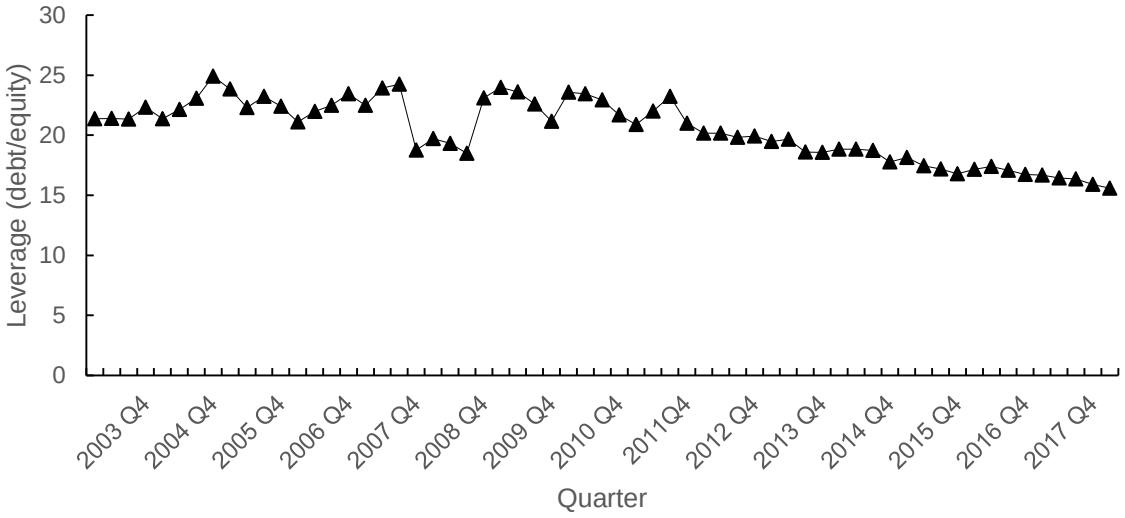

Figure 7. Ratio of debt to equity, average for all banks over the period 2003Q1 to 2018Q1.

Interestingly, this higher leverage is not reflected in the loans-to-deposits ratio. While the comparison paper finds an average value of 2.39 the value found for the Netherlands is 0.97. The Dutch value on this variable has been relatively consistent over the time period observed. This could partly, though not fully, be explained by the relatively high level of bank deposits in the Netherlands relative to other EU member countries (see Table 4).

Table 4.
Level of Bank Deposits Relative to GDP.

	2005-01-01	2010-01-01	2015-01-01
Netherlands	87%	97%	101%
Germany	63%	73%	80%
Euro Area	64%	79%	80%

Note: Source: The World Bank (2018c).

A final country-specific banking sector indicator where the Netherlands markedly differs from the EU sample picked by Betz et al. (2014) is in terms of the mortgages to loans indicator. The Netherlands has a mean value of 0.40[46] for this indicator, compared to 0.17 for the comparison sample. This is unsurprising given that the Netherlands has one of the highest mortgage debt to GDP ratios in the world (De Nederlandsche Bank, 2016).

5.1.3 Country-specific macro-financial indicators

While the values for country-specific macro-financial indicators found for the Netherlands are similar to those found by Betz et al. (2014) the international investment position to GDP ratio differs substantially. Not only is the value found for the Netherlands relatively high, as Figure 8 shows it has also been steadily increasing and the Netherlands is currently one of the biggest credit nations (Obrzut, 2018). As can be seen in Table 2 this indicator influences the probability of bank distress negatively quite strongly in the benchmark model used in this paper.

[46] The mean value found would be even higher if we were to use non-ECB MFI statistics. While the ECB finds total lending for house purchase of €471 billion in June 2017 (European Central Bank, 2018d) the Dutch Bureau for Statistics offers a value of €760 billion in June 2017. Given that Betz et al. (2014) use ECB MFI statistics this paper uses ECB data as well.

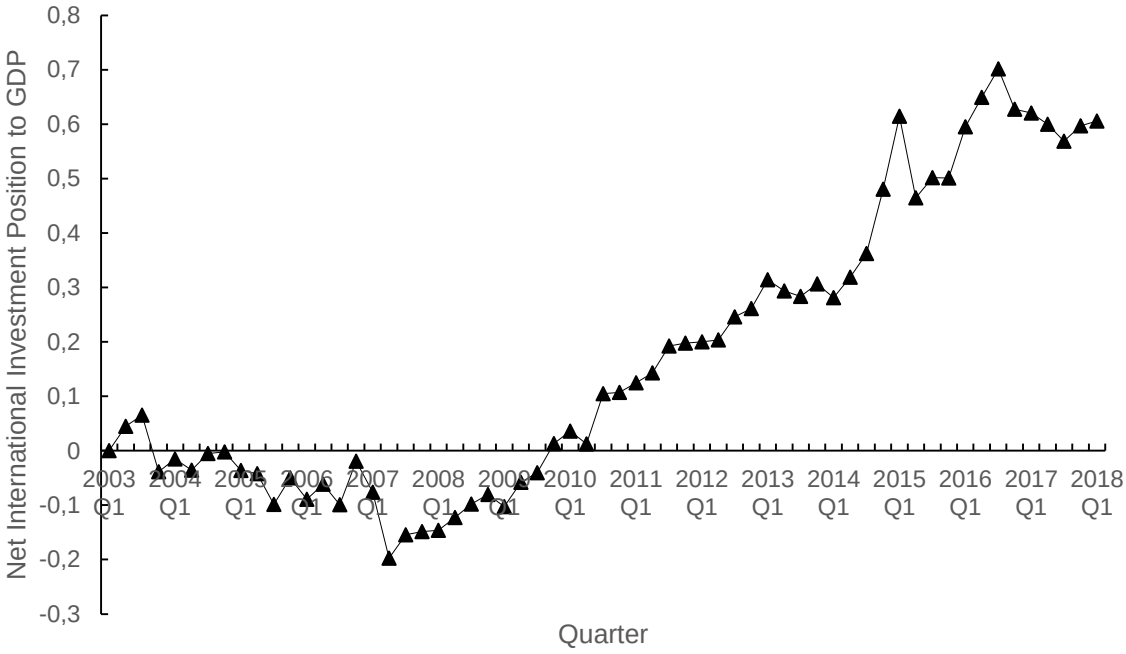

Figure 8. Net International Investment Position to GDP.

5.2 Data on loss given default

As stated previously the loss given default calculation is based on the paper by Carmassi et al. (2018). They use a combination of the methodology detailed in Betz et al. (2014) and the methodology used in an internal ECB working paper to calculate the probability of default. Following this calculation they estimate loss given default assuming scenarios of different magnitude. These different scenarios consist of asset losses of 5% to 25% in resolution and asset losses of 7.5% to 37.5% in insolvency. To establish whether banks are able to deal with the stress exerted by a defined level of loss in terms of assets, data on total assets is gathered from Bloomberg and supplemented with data from Orbis Bankfocus. For an overview on average loss given default for each Dutch bank, see Table A7.

5.3 Data on loss absorption capacities

After determining the loss given default the ability of each distressed bank to absorb these losses will be analyzed. To do so, banks' absorption layers, as delineated in Section 3.2 and graphically represented in Figure B1, are calculated for each bank in each quarter. Data regarding the layers to be written down is obtained using Orbis Bankfocus for all banks for the period 2003Q1 to

2018Q1 for all quarters where data is available. Data is available for 27 out of 30 banks in Orbis Bankfocus for 2013Q4 to 2017Q4, while data for 2011Q4 to 2017Q4 and 2012Q4 to 2017Q4 is available for respectively 22 and 24 banks.

5.3.1 Equity

The primary layer that is written down is the equity layer. Shareholders equity is calculated using Orbis Bankfocus data where shareholders equity consists of: (i) common equity: par value + capital surplus; (ii) valuation gains/losses on available for sale securities; (iii) valuation gains/losses on property; (iv) cash flow hedging reserves; (v) foreign exchange revaluation reserves; (vi) other reserves; (vii) treasury/own shares and (viii) retained earnings.

5.3.2 Subordinated liabilities

As shown in Figure B1, the secondary layer to be written down is the layer consisting of subordinated liabilities. The value taken for subordinated liabilities is the sum of total subordinated liabilities on balance sheet plus undated subordinated liabilities.

5.3.3 Other liabilities

The third layer to be written down, as shown in Figure B1, consists of all other unsecured liabilities, large corporate deposits (>€100,000) and derivatives. Data regarding corporate deposits is unfortunately unavailable given that customer deposits are not split between retail deposits and corporate deposits.

Given that data on corporate deposits is unavailable this layer consists of all other unsecured debt and derivatives. All other unsecured debt consists of the balance sheet items of (i) short-term funding and debt securities; (ii) long term borrowings; (iii) financial liabilities at fair value; (iv) repurchase agreements (repos) and (v) trading liabilities. The value for derivatives is set equal to the balance sheet item of derivative financial instruments.

5.3.4 Deposits

The final layer that is available to be written down is the layer of large deposits. Unfortunately, data regarding deposits is not split up between covered deposits (<€100,000) and large deposits (>€100,000) making it impossible to accurately distinguish between deposits that could be written down and deposits that are secured and could thus not be used for write-down purposes.

While deposits therefore consist of (i) demand deposits; (ii) savings deposits; (iii) time deposits and (iv) other customer deposits, this does not accurately reflect the size of this layer. For calculation purposes assumptions are therefore made. Covered deposits are assumed to be 40% of total deposits, based on total covered deposits being €390 billion in 2009 (Minister van Financiën, 2012) on a total of €979 billion in deposits (European Central Bank, 2018a), and being €486 billion in 2017 (Tweede Kamer, 2018) on a total of €1175 billion in deposits (European Central Bank, 2018a). This means covered deposits were respectively 39.8% and 41.4% in 2009 and 2017, this paper therefore assumes covered deposits are, on average, 40% of total deposits and large deposits available for write-down purposes therefore are 60%. Given that the distribution of covered deposits between banks is unlikely to be equal and that capital flight could lead to lower deposits available for bail-in, a conservative estimate is used where it is assumed that rather than 60% of deposits being available in bail-in scenarios, only 30% of deposits are available for bail-in, representing half the average large deposits. Capital flight in a recent case of bank distress in Cyprus has been relatively low (2.2% the month prior to the rescue (Bloomberg, 2013)), therefore the estimate used in this paper can be seen as a very conservative estimate. Scenarios are later evaluated where large deposits are not bailed in, which is a more conservative scenario than one where they are bailed in but should lead to more accurate findings.

6. Methodology

6.1 Determining likelihood of distress

The analysis to determine to what level of stress the Deposit Guarantee Scheme would be able to pay out depositors starts by determining the stress level at which the Deposit Guarantee Scheme would be forced to pay out depositors in the first place. To determine this level, and to be able to estimate the level at which the Deposit Guarantee Scheme would no longer be able to sufficiently pay out depositors, it is first needed to determine which banks are most likely to default. For this estimation findings of Betz et al. (2014) as detailed in Chapter 4 are used. In their analysis they find that a combination of bank-specific indicators, country-specific banking-sector indicators and country-specific macro-financial indicators allows them to derive an estimated probability of a bank experiencing a distress event in the next eight months ($R^2 = 0.27$). A full breakdown of the indicators and their coefficients is provided in Table A8.

By using the indicators and coefficients found in the benchmark model developed by Betz et al. (2014) combined with the values for these indicators for all Dutch banks, the probability of distress for these Dutch is estimated on a quarterly basis from 2012Q2 to 2018Q1. Subsequently, banks are ranked according to their probability of default, where the bank most likely to experience a distress event in the next eight quarters in each given quarter is denoted by 1 and the bank least likely to experience a distress event is denoted by n, where n is the number of banks data is available on in that given quarter.

6.2 Computing loss given default

Following the determination of what banks have the highest likelihood of going into distress for each quarter, the loss given default is calculated for these banks. As stated previously the loss given default calculation is based on the paper by Carmassi et al. (2018). To determine whether a European Deposit Insurance Scheme would be sufficient in case of a large crisis, they stress banks by assessing banks' loss given default assuming scenarios of different magnitude. The scenarios used by Carmassi et al. (2018) are severe. Estimated average losses for banks in distress over the period between 2007 and 2010 were 2.5% of liabilities, and losses plus recapitalization for these banks averaged 6% of total liabilities, while globally systemically important banks reported losses averaging 2-4% and losses plus recapitalization between 3.9% and 6.1% (Carmassi et al., 2018).

The range used by Carmassi et al. (2018) imposes higher losses, ranging from 5% to 25% in a resolution scenario and 7.5% to 37.5% in an insolvency scenario. Given that the aim of their paper is to test the sufficiency of a European Deposit Insurance Scheme in a large crisis, the lower end of these ranges is already a very stressful scenario given that 5% losses is on the upper range of the values observes in the last financial crisis. Furthermore, an upper range of 10% of the banks most likely to default is used in combination with 25% asset losses imposed, while during the previous crisis the number of banks affected was smaller and only one bank experienced asset losses of over 8% (Carmassi et al., 2018). As this paper aims to establish to what extent the Deposit Guarantee Scheme is able to cope with bank distress it is assumed a higher distress level than that observed in the last crisis is needed, the high range established by Carmassi et al. (2018) therefore is a good starting point.

The loss given default for each bank in Carmassi et al. (2018) is assumed to be higher for banks that are liquidated than for banks that are resolved, where banks that are liquidated are assumed to have 50% higher losses owing to the complexity, cost and length of insolvency proceedings. To determine whether a bank is resolved or deemed to be insolvent a combination of balance sheet size and number of checking accounts is used by Carmassi et al. (2018). Banks that have a balance sheet size of over €20 billion at the time of bank failure go into resolution, as do banks that have over 40,000 checking accounts. Banks that do not meet one of these criteria go into insolvency proceedings. Due to a lack of data in terms of both checking accounts and covered deposits, which is the proxy Carmassi et al. (2018) used in their paper[47], an estimation is made in this paper to proxy for covered deposits. Given that covered deposits consist of, on average, approximately 40% of total deposits[48], banks in this paper are deemed to go into resolution if 40% of total deposits is equal to or exceeds €4 billion. This can be seen as a conservative estimate, since it is unlikely that

[47] Carmassi et al. (2018) opted to, due to a lack of data availability on checking accounts, use a conservative estimate where €4 billion in covered deposits proxied for 40,000 checking accounts, based on covered deposits being perfectly spread over as little checking accounts as possible.
[48] See Section 5.3.4.

€4 billion in deposits corresponds to 40,000 checking accounts as this would mean each account would hold exactly the amount that is covered under the Deposit Guarantee Scheme[49].

6.3 Applying stress to the Dutch banking sector

Following the determination of the loss given default for each bank for five different scenarios, where the scenarios are 5% to 25% asset losses in bail-in scenarios and 7.5% to 37.5% asset losses in insolvency proceedings, and the ranking of banks according to their probability of default, two different scenarios are used to model different levels of stress put on the Dutch banking sector. Following the methodology of Carmassi et al. (2018) a crisis simulation is used in which the 3% or 10% riskiest banks fail simultaneously, corresponding to the 97th percentile and 90th percentile riskiest banks.

While the 3% riskiest banks and 10% riskiest banks in Carmassi et al. (2018) correspond to respectively 51 banks and 167 banks failing, this paper has a smaller sample given that it focuses solely on the Dutch banking sector. The Dutch banking sector is highly concentrated which could potentially lead to distorted outcomes if only small banks that have a negligible impact when going into distress are placed into distress in the simulation. If the model used to determine probability of default results in a scenario where there is a clear skew towards small banks, as defined by banks that go into insolvency proceedings, separate scenarios will be checked where the large banks with the highest probability of default are substituted for smaller banks.

6.4 Assessing banks' loss-absorption capacity

For each bank that goes into distress the loss-absorption capacity is used to determine to what extent the bank would be able to repay depositors out of their own funds. To model each banks' loss-absorption capacity different tranches of creditors are called upon sequentially to determine the layers in the hierarchy that would have to contribute in a bail-in scenario. This means that the write-down occurs conforming to the creditor hierarchy as illustrated in Figure B1, where equity is written down first, followed by subordinated debt, followed by the layer consisting of other unsecured liabilities, corporate deposits (>€100,000) and derivatives. Given that data regarding

[49] Data regarding the actual average amount in a checking account in the Netherlands was not available.

large corporate deposits is unavailable corporate deposits are disregarded. If the previous layer proves insufficient, retail and SME deposits (>€100,000) are used[50] as a final available layer for write-down purposes (also known as a haircut of deposits).

Using this methodology, different scenarios in terms of the extent of write-down can be illustrated thereby making it possible to see to what layer creditors would have been written down based on different stress scenarios in the quarters analyzed. Furthermore, both scenarios including a haircut on large deposits and without a haircut on large deposits will be explored where a haircut on deposits consists of a write-down of large deposits to the extent needed to absorb asset losses.

Subsequent to determining to what level the Dutch Deposit Guarantee Scheme would be stressed using the methodology of Carmassi et al. (2018), increased pressure is placed upon the Dutch Deposit Guarantee Scheme to determine at what percentage of banks defaulting or what level of asset write-downs the Deposit Guarantee Scheme is no longer able to safeguard depositors. A scenario is evaluated in which solely the ex-ante and ex-post contributions of banks are used, while a scenario in which the Dutch government provides a backstop is also explored.

[50] Retail and SME deposits (>€100,000) are estimated to be 60% of total deposits, see also Section 5.3.4.

7. Results

7.1 Probability of distress for Dutch banks

Using the data obtained for Dutch banks, the model by Betz et al. (2014) as detailed in Section 4.5 is used to determine the probability of distress for all Dutch banks on a quarterly basis. Summary statistics per bank are reported in Table A9. The quarterly probability of default for Dutch banks (Figure 9) reveals some interesting results. The first noticeable aspect of the graph is that while up to 2013Q1 the average probability of distress for Dutch banks appears to be increasing, afterwards it appears to decline. A second noticeable aspect is that while there is variation in the probability of distress for Dutch banks, this variation is limited.

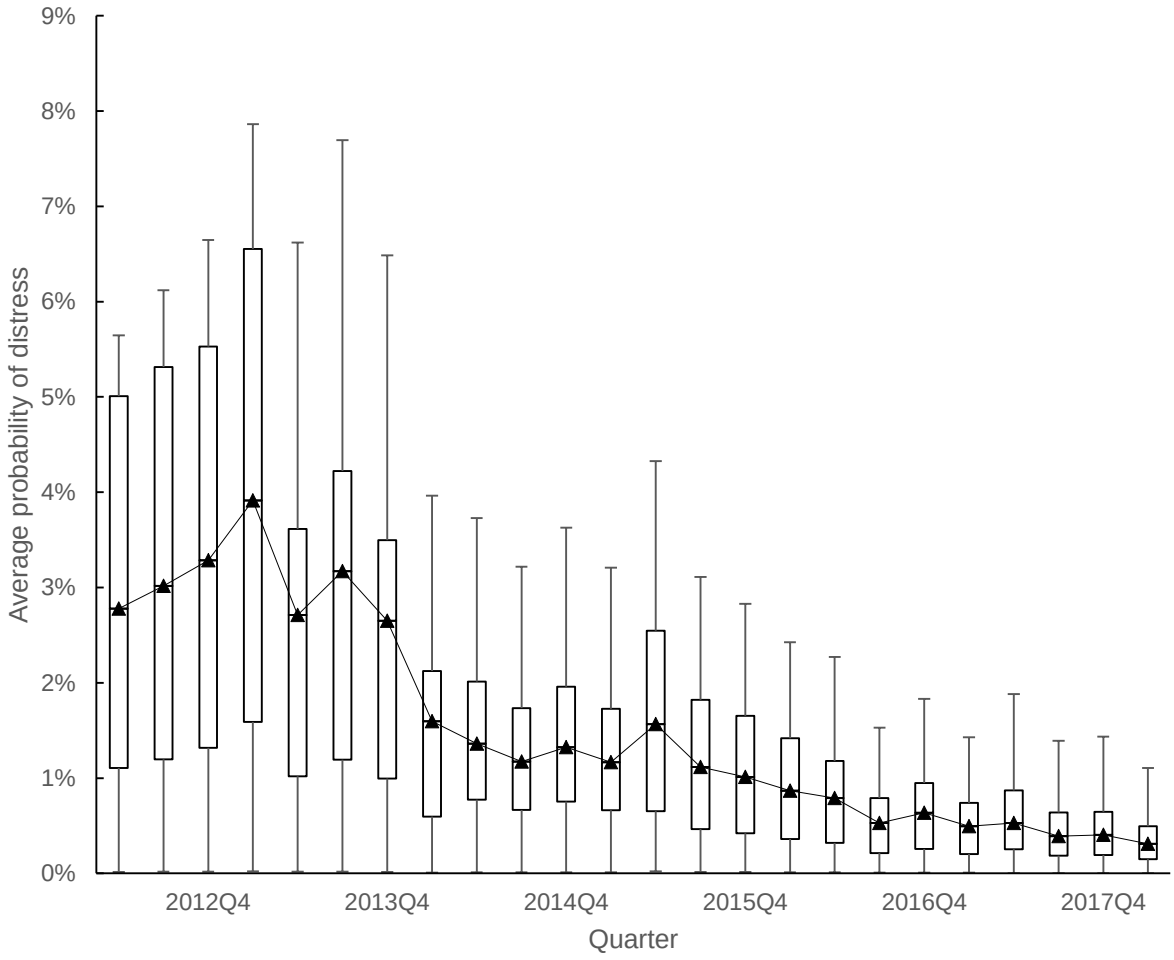

Figure 9. Probability of distress for all Dutch banks on a quarterly basis, 2012Q2 to 2018Q1.

The results regarding the banks most likely to go into distress are surprising at first sight. The bank that is the bank most likely to experience distress in the most quarters (most likely in 16 out of 24 quarters observed, second most likely in an additional 4) is the Nederlandse Waterschapsbank (NWB Bank). The bank second most likely to experience distress in many of these quarters is the Bank Nederlandse Gemeenten (Dutch Municipal Bank, BNG). Both of these outcomes are unexpected given that BNG and NWB Bank are respectively listed as fifth and sixth on the 2017 global world's safest banks list (Global Finance, 2017) a position they held in 2016 and 2015 as well. The primary reason for this mismatch is that while both banks have a relatively low capital ratio leading to a higher probability of distress in the model used, they are both government-related entities[51] that primarily issue loans to government-related entities which have a very low risk profile. As the Betz et al. (2014) model used does not take into account risk-weighting of assets, the fact that the loans issued by these two banks are extremely safe is not taken into account leading to the apparent mismatch. Due to this mismatch BNG and NWB Bank are not taken into account in the rest of the results regarding the ranking of the banks most likely to default.

Unfortunately, unavailability of data means it is only possible to calculate the probability of default for banks in the period 2012Q2 – 2018Q1 using this model. Because of this limitation it is hard to judge whether this model would have predicted ING Bank needing a capital injection in 2008 (Rijksoverheid, 2014), the recapitalization of Aegon NV and SNS Reaal in 2008 (Rijksoverheid, 2008a; Rijksoverheid, 2008b) and the nationalization of Fortis Bank in 2008 (Rijksoverheid, 2018).

An event that does fall within the period analyzed in this paper is the nationalization of SNS REAAL (Volksbank). This happened in February 2013, which means that in the eight quarters leading up to 2013Q1 SNS REAAL should have a relatively high probability of experiencing distress. As Figure 10 shows, the probability of default of SNS REAAL was indeed relatively high in the quarters leading up to 2013Q1, and peaked in 2013Q1 at a probability of 7.73% which is the second highest absolute probability in the entire sample across all quarters observed. In terms of

[51] The Dutch state owns 50% of BNG while the other 50% is owned by municipalities, provinces and a water board (water authority). The NWB Bank is a Local Government Funding Agency and as such is owned by the Dutch water boards and provinces.

relative probability of default SNS REAAL is the second most likely bank to default between 2012Q2 and 2013Q1[52] and is the bank most likely to default the two following years.

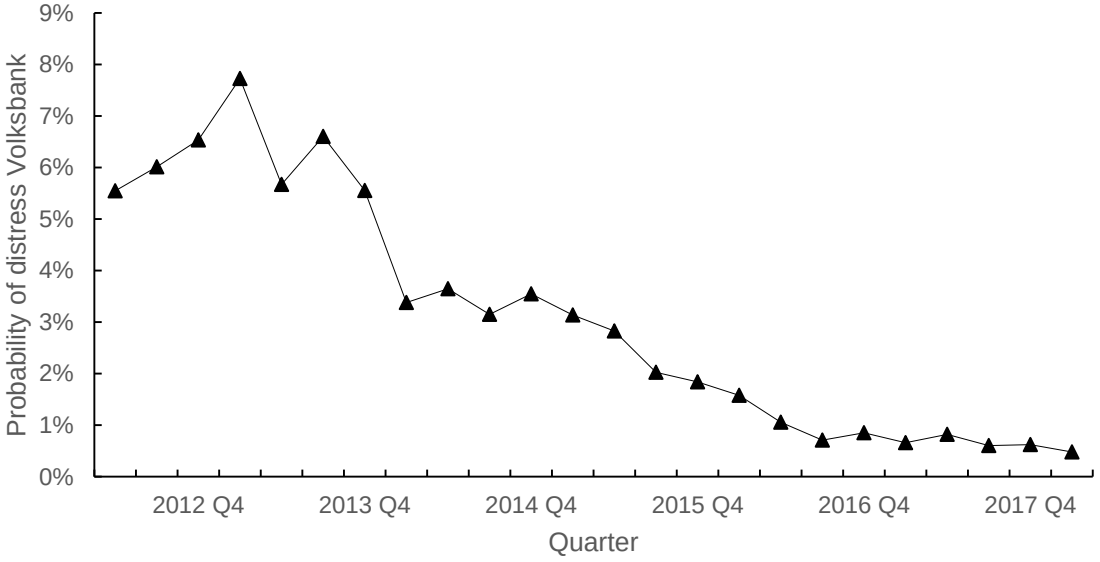

Figure 10. Probability of distress for Volksbank from 2012Q1 to 2018Q1.

A notable result in general is the relatively low probability of default for Dutch banks over the period observed. While the unconditional probability of pre-distress events found in Betz et al. (2014) for the model used is 6%, the average probability of a pre-distress event found for Dutch banks is 1.3%. A possible explanation for this is that while the period analyzed by Betz et al. (2014) was a period where banking crises occurred, the period observed in this paper was a relatively tranquil period. As Figure 9 illustrates the probability of default has been decreasing over time and it could be possible that during the period prior to the period observed in this paper the probability of default for Dutch banks was higher.

Ranking the banks in terms of their probability of default for each quarter reveals some further interesting details. While the majority of banks have a relatively steady rank, Amsterdam Trade Bank goes from being the bank 10th most likely to experience a distress event in the next 8 quarters (out of 23) in 2016Q1 to the bank most likely to experience a distress event in the next 8 quarters

[52] Achmea Bank is the bank most likely to default during this period.

(out of 24) in 2016Q2. While the average probability of failure decreased from 0.75% to 0.67% in this period, Amsterdam Trade Bank's increased from 0.95% to 1.69% (see Figure 11). This broader period was a time with some unusual occurrences for Amsterdam Trade Bank, such as being in talks with Dutch authorities with respect to past unusual transactions in 2015 (Amsterdam Trade Bank N.V., 2016), being named in a large money laundering scheme that occurred from 2010 to 2014 (together with Dutch banks ING, ABN Amro and Rabobank) (Harding, Hopkins, & Barr, 2017), and having large investments in Russia and Ukraine while conflict flared up in those regions in 2014-2015. The latter forced Amsterdam Trade Bank to reserve large sums for impaired loans and forced Alfa Bank, Amsterdam Trade Bank's parent company, to inject capital to increase equity five times in 2015 and 2016 (Bökkerink, 2017). Although Amsterdam Trade Bank did not go into distress while the model predicted the likelihood of failure was relatively high, the fact that capital injections from a parent company were needed means the relatively high ranking in terms of probability of experiencing distress for Amsterdam Trade Bank could be accurate.

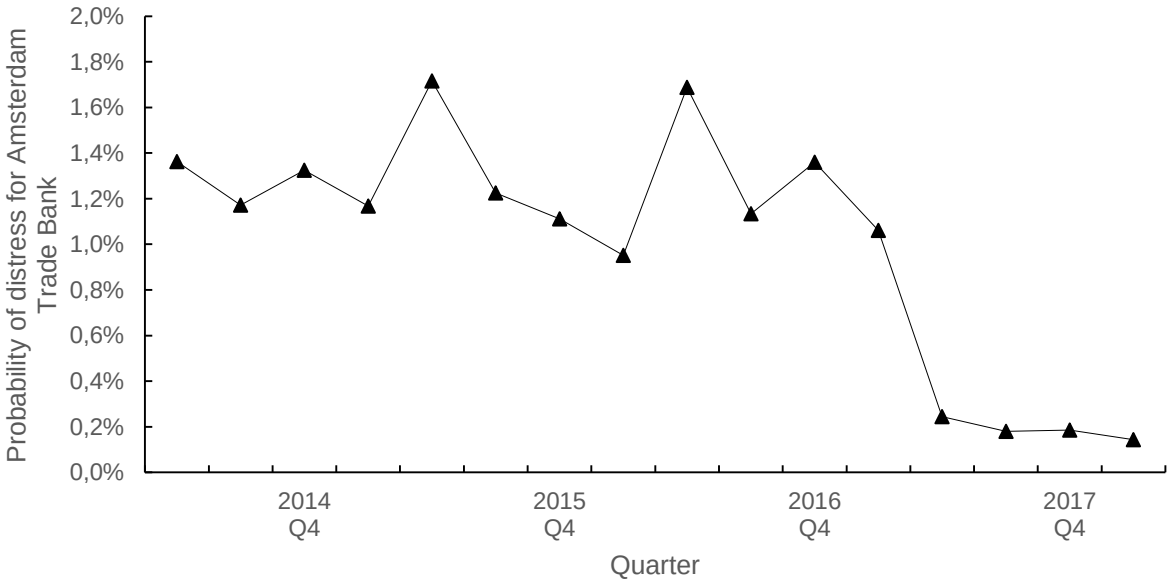

Figure 11. Probability of distress for Amsterdam Trade Bank from 2014Q2 to 2018Q1.

Sorting the banks by probability of distress for each quarter (see Table A10) reveals that there is some variation in terms of the bank most likely to experience distress in each quarter, with 4 different banks being the most likely to experience distress over the period observed. Additionally, a mix between small, medium size and large banks is represented in the upper percentiles. A

complete overview of the banks that are included in the probability of distress calculations for each quarter is provided in Table A11.

7.2 Comparing outcomes of the benchmark model used to different models

As this paper has insufficient data to be able to state how the model would have performed in the years of the financial crisis, different models from the paper by Carmassi et al. (2018) are used to illustrate whether the bank failures around the years 2007 and 2008 could have been predicted. Given the lack of bank-specific indicator data prior to 2012Q2 combined with the availability of data on country-specific banking-sector indicators and country-specific macro-financial indicators, the models used in Carmassi et al. (2018) using either only country-specific banking-sector indicators or country-specific macro-financial indicators are used and compared to outcomes produced by the baseline model as used in this paper. As can be seen in Figure B5, while the benchmark model used and the macro-financial indicator model appear to be correlated, which is confirmed by Table 5, and offer similar values, the banking sector indicator offers a far higher value, with probability of default ranging from approximately 40% to 70%. Removing the indicator for mortgages to loans, which has a relatively high value as seen in Table 3, shows that a major reason that the banking sector model has higher values is due to the high ratio of mortgages to loans in the Netherlands.

Table 5
Correlation Coefficients (Pearson) Between the Banking Sector Model, Macro-financial Model and Benchmark Model as in Table A5.

	1	2	3
1. Banking sector model			
2. Macro-financial model	0.12		
3. Benchmark model	0.13	0.97 ***	

Note: *** denotes a level of significance of <0.001.

Given that the correlation between the benchmark model and the macro-financial model is high, the benchmark model is regressed on the macro-financial model using a simple linear regression to estimate values for the benchmark model for the period in which data on bank-specific indicators is unavailable (2003Q1 to 2012Q1) in Table 6.

Table 6
Simple Linear Regression for Predicting Outcomes of the Benchmark Model Based on the Macrofinancial Model (N = 24)

Predictor	B	SE(B)	β	*t*	Sig. (p)
Macro-financial model	0.46	0.02	0.97	20.49	0.000

Note: $R^2 = .95$

Using this simple model, values for the benchmark model for the period 2003Q1 to 2012Q1 are predicted. Graphing these values shows a peak for the predicted benchmark model around 2008-2009 (see Figure 12). This peak takes place in 2009Q2, signifying that this model predicted a relatively high probability of bank distress in the next eight months in 2009Q2. Given that at this point the worst bank distress had already taken place (Kickert, 2012) this prediction would not have been valuable as it predicted distress after the worst distress had already taken place. It could be argued that at this point banks were still relatively vulnerable leading to a high probability of bank distress, and that the increase in predicted probability of bank distress from 2008Q1 to 2008Q2 from 1.98% to 2.84% in the predicted benchmark model would have been valuable in signaling a negative development. Furthermore, it appears to be the case that the probability of bank distress as predicted by both the macro-financial indicator model and the benchmark model trends downward starting at the end of 2012.

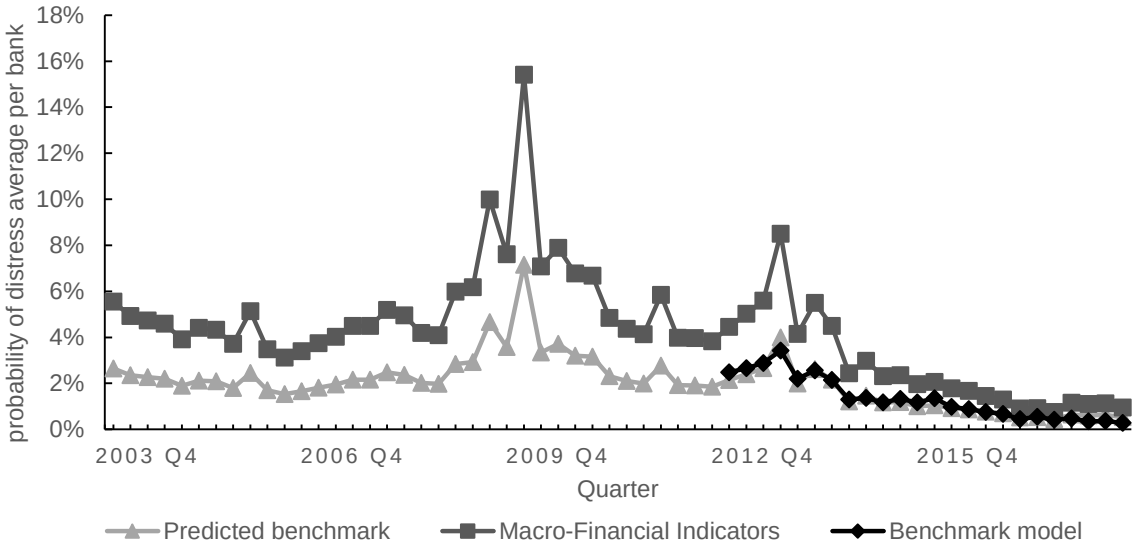

Figure 12. Average probability of bank distress in next eight months as predicted by the benchmark mode, the macro-financial model and the benchmark model as obtained from regression on the macro-financial model.

7.3 Loss absorption capacity over time

It is to be expected that due to measures taken since the financial crisis banks have become safer and that therefore probability of default for the banking sector as a whole has decreased. As Figure 12 exhibits, this is reflected in the model given that there appears to be a downward trend. An increase in loss absorption capacity could increase the resiliency of the Dutch banking sector. As can be seen in Figure 13 the equity to assets ratio has been increasing steadily, meaning that even if the probability of default had stayed equal over the period observed banks are nonetheless better able to absorb shocks using their first layer of bail-in securities compared to previous years.

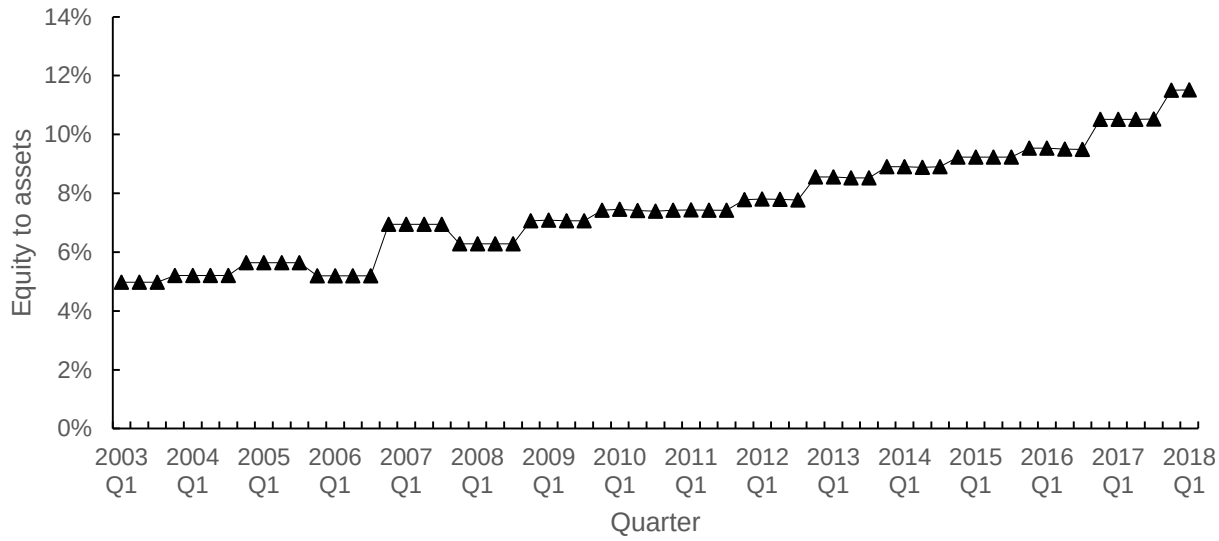

Figure 13. Equity to assets ratio, average of all banks from 2003Q1 to 2018Q1.

Analyzing the Tier 1 capital ratio offers a clearer picture as can be seen in Figure 14, where there appears to be a decrease in ratios leading up to the financial crisis in 2007-2008 and subsequent to the financial crisis a clear increase is apparent.

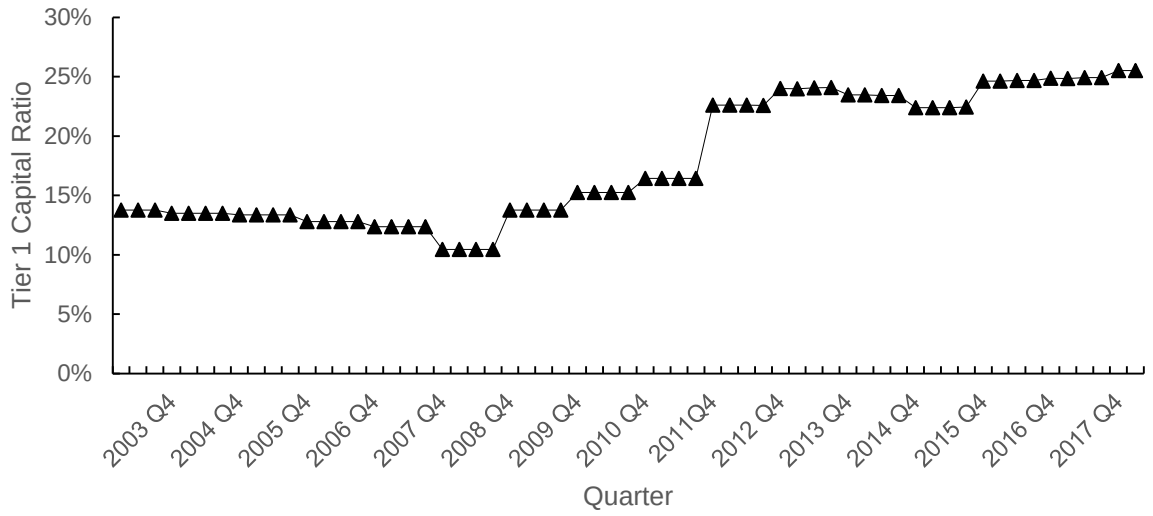

Figure 14. Tier 1 Capital ratio, average of all banks from 2003Q1 to 2018Q1.

7.4 Loss given default

Having determined the probability of default for each of the banks in the dataset a second computation is done to determine loss given default for each of the banks in each quarter. As explained in Chapter 6 loss given default is calculated based on the banks' balance sheet size and total deposits, which proxies for whether a bank would go into resolution or liquidation. For average loss given default per bank in the sample, see Table 7. Over the period of 2012Q2 to 2018Q1, 29% of banks going into distress go into resolution proceedings while 71% would go into insolvency proceedings.

Table 7.
Average Loss Given Default Based on 5% to 25% Asset Losses in Resolution and 7.5% to 37.5% Asset Losses in Insolvency Proceedings.

Bank	5% asset write-down	Average bank equity	Percentage of equity written down in 5% scenario
ABN	€ 20,304	€ 16,429	124%
ASR	€ 90	€ 64	140%
Achmea	€ 1,175	€ 662	178%
Aegon	€ 720	€ 406	177%
Allianz	€ 30	€ 35	86%
Anadolu	€ 44	€ 80	55%
Binck	€ 255	€ 426	60%
Rabobank	€ 34,177	€ 39,988	85%
Credit Europe	€ 669	€ 767	87%
DHB Bank	€ 136	€ 230	59%
Van Lanschot	€ 1,048	€ 1,261	83%
Garantibank	€ 353	€ 508	69%
Hof Hoorneman	€ 10	€ 21	47%
ING Bank	€ 43,349	€ 38,759	112%
KAS Bank	€ 334	€ 205	163%
Leaseplan	€ 1,407	€ 2,775	51%
MUFG	€ 594	€ 569	104%
BNG	€ 7,239	€ 3,386	214%
NIBC	€ 1,199	€ 1,889	63%
Nationale Nederlanden	€ 725	€ 510	142%
NL Financiering	€ 531	€ 2,241	24%
NL Waterschap	€ 4,171	€ 1,350	309%
RBS	€ 2,072	€ 3,010	69%
Triodos	€ 541	€ 723	75%
Yapi Kredi	€ 135	€ 296	46%
Volksbank	€ 3,495	€ 2,757	127%
ATB	€ 217	€ 216	100%

Note: Amounts in millions. Losses in insolvency proceedings assumed to be 50% higher as per Section 6.2. Percentage of equity is asset writedown as a percentage of total equity. Writedowns and corresponding percentages for 10% to 25% (15% to 37.5%) scenarios are arrived at by multiplying the values in columns 2 and 4.

Table 7 again illustrates the large size differences between banks in the sample. While a default of one of the smaller banks such as Hof Hoorneman Bankiers would lead to a loss given default for

this bank of only €10 million to €50 million, for ING Bank this would entail losses of €43 billion to €216 billion.

7.5 Loss absorption capacity at 3% failure rate

Following loss given default calculations, loss absorption capacities for the different relevant layers are calculated as detailed in Section 5.3 and used to determine whether the banks that are most likely to default in this model require the Deposit Guarantee Scheme to pay out depositors. Following Carmassi et al. (2018) the 3% of banks most likely to go into distress (average probability of distress 3.3%) are placed into distress for each of the quarters. Given that the dataset consists of 17 to 24 banks (see Table A11), this means that only the bank that is most likely to default is placed into distress. The assets of the bank placed in distress in each quarter represent an average of 1.4% of total assets of the banks in the sample. Table 8 summarizes the results of the extent of write-down in case of a 5% to 25% loss of asset value in bail-in and 7.5% to 37.5% asset value loss in liquidation proceedings, where liquidation proceedings are assumed to have 50% higher asset losses than a bail-in scenario. In this 3% failure rate scenario, 50% of the distressed banks would go into resolution proceedings and 50% would go into insolvency proceedings.

Table 8
Extent of Write-down in Different Scenarios Assuming a 3% Failure Rate.

Quarter analyzed	5% asset write-down	10% asset write-down	15% asset write-down	20% asset write-down	25% asset write-down	Total remaining with haircut in 25% scenario (mln)	Total remaining without haircut in 25% scenario (mln)	Defaulting bank
2018 Q1	200%	219%	239%	258%	277%	€0	€0	Nationale Nederlanden
2017 Q4	200%	219%	239%	258%	277%	€0	€0	Nationale Nederlanden
2017 Q3	201%	220%	238%	257%	275%	€0	€0	Nationale Nederlanden
2017 Q2	201%	220%	238%	257%	275%	€0	€0	Nationale Nederlanden
2017 Q1	68%	300%	335%	370%	400%	€13	€292	Amsterdam Trade Bank
2016 Q4	68%	300%	335%	370%	400%	€13	€292	Amsterdam Trade Bank
2016 Q3	177%	325%	353%	382%	400%	€53	€581	Amsterdam Trade Bank
2016 Q2	177%	325%	353%	382%	400%	€53	€581	Amsterdam Trade Bank
2016 Q1	205%	219%	233%	248%	262%	€0	€0	Achmea Bank
2015 Q4	205%	219%	233%	248%	262%	€0	€0	Achmea Bank
2015 Q3	206%	220%	234%	248%	262%	€0	€0	Achmea Bank
2015 Q2	206%	220%	234%	248%	262%	€0	€0	Achmea Bank
2015 Q1	203%	225%	248%	271%	294%	€0	€0	Volksbank
2014 Q4	203%	225%	248%	271%	294%	€0	€0	Volksbank
2014 Q3	206%	225%	245%	264%	283%	€0	€0	Volksbank
2014 Q2	206%	225%	245%	264%	283%	€0	€0	Volksbank
2014 Q1	206%	225%	245%	264%	283%	€0	€0	Volksbank
2013 Q4	206%	225%	245%	264%	283%	€0	€0	Volksbank
2013 Q3	207%	223%	239%	254%	270%	€0	€0	Volksbank
2013 Q2	207%	223%	239%	254%	270%	€0	€0	Volksbank
2013 Q1	206%	219%	231%	243%	255%	€0	€0	Achmea Bank
2012 Q4	206%	219%	231%	243%	255%	€0	€0	Achmea Bank
2012 Q3	205%	216%	226%	237%	247%	€0	€0	Achmea Bank
2012 Q2	205%	216%	226%	237%	247%	€0	€0	Achmea Bank

Note: In this table the different layers that can be written down are represented. The first layer to be written down is the equity layer, meaning that a write-down of 0-100% consists of merely an equity write-down. A write-down of 100-200% consists of a write-down of equity and, additionally, a write-down of subordinated liabilities. A write-down of 200-300% consists of a write-down of the previous, plus a write-down of all other liabilities save deposits and liabilities that fall outside the scope of bail-in and liquidation proceedings (such as tax, wage and pension liabilities). Finally, a write-down of 300-400% means that 30% of deposits, based on the earlier calculation as shown in Section 5.3.4, will also be written down. A write-down of 400% therefore means that every class that can be bailed in has been bailed in while a write-down of 350% means 30% of deposits suffer a write-down of 50%. The total remaining sum is the sum that cannot be absorbed by the banks' creditors based on a 25% asset devaluation and would have to be absorbed by the Deposit Guarantee Scheme. For reference: the limit of the Deposit Guarantee Scheme using the combined ex-ante funds and an ex-post contribution is €3.8 billion.

As Table 8 depicts, a loss of 5% (7.5% in insolvency proceedings) of assets does not lead to notable problems. In only four quarters losses are imposed on the Deposit Guarantee Scheme, both in cases where a haircut on depositors is imposed and in cases where instead all depositors are protected fully. These four quarters are the quarters in which Amsterdam Trade Bank is the bank most likely to default and is thus the bank being analyzed (see Table A10). A notable aspect in Table 8 is that in quarters where a bank other than Amsterdam Trade Bank defaults, the first two layers (equity and subordinated liabilities) are completely written down even in a scenario with only 5% asset losses imposed and the third layer is called upon. On the other hand, in quarters where Amsterdam Trade Bank has the highest probability of distress, a 5% asset loss is absorbed by the first two layers, however if larger losses are imposed Amsterdam Trade Bank is, unlike other banks, unable to sufficiently absorb these losses through their third layer of other liabilities and derivatives. Instead, losses are imposed either on large depositors[53] (>€100,000) or on the Deposit Guarantee Scheme in all scenarios where asset losses are larger than 10%. This is caused by Amsterdam Trade Bank having average equity of €216 million and average subordinated liabilities of €84 million, but only an average of €3 million in other liabilities available for bail-in meaning their third layer is very small.

A 25% reduction in asset value for Amsterdam Trade Bank would therefore mean the Deposit Guarantee Scheme is activated since, even if the bank were to be fully liquidated and large deposits would be haircut, this would leave a sum to be absorbed. Based on the assumptions made regarding the sum of large deposits that could be haircut this would be a relatively small sum that would have to be contributed by the Deposit Guarantee Scheme, the maximum sum being €53 million in 2016Q2 and 2016Q3. Assuming this would happen in 2018, this could be covered by the ex-ante contributions to the Deposit Guarantee Fund up to this point, totaling approximately €1.37 billion (see Figure 2 in Section 3.1). If, however, a decision is made to not impose a haircut on deposits, the situation is different. Based on a 25% asset value loss and no haircut on deposits, the maximum sum that remains to be covered by the Deposit Guarantee Scheme is €581 million. While this is insufficient to empty the Deposit Guarantee Fund up to this point, it is nonetheless a sizeable sum.

[53] Large depositors are assumed to represent 30% of total deposits, see Section 5.3.4.

The quarters where large banks are the most likely banks to go into distress do not lead to problems for the Deposit Guarantee Scheme. This is explained by these banks having sufficient creditors in their third layer that could be bailed in and therefore, even without a haircut on large depositors, there is no need for the Deposit Guarantee Scheme to intervene.

7.6 Loss absorption capacity at 10% failure rate

Given that a 25% loss in asset values in the 3% of Dutch banks most likely to fail was not sufficient to stress the Deposit Guarantee Scheme a 10% failure rate is now evaluated. A 10% failure rate, based on the number of banks in the dataset being 17 to 24 and on rounding up means that in each quarter the 3 banks most likely to default are placed into distress (average probability of default 2.91%). Where 10% of banks, rounded up, corresponds to two banks defaulting, three banks are placed in distress to mirror the threefold increase that going from 3% to 10% accomplishes in Carmassi et al. (2018). The assets of the banks placed in distress in each quarter represent an average of 26% of total assets of the banks in the sample. In this 10% failure rate scenario, 56% of the distressed banks would go into resolution proceedings while 44% would go into insolvency proceedings.

The full results are shown in Table 9. This table shows that for some quarters the different layers are written down less than in the 3% banks defaulting scenario (for a side by side comparison, see Table A12). The reason for this is that while for some quarters the bank that is most likely to default has a high level of write-down on creditors, the banks that are second and third most likely to default have a higher loss absorption capacity in their layers meaning the extent of write-down on creditors is less for these banks, leading to a lower average write-down. This is not the case for the total remaining sum to be absorbed both with and without deposit drawdown, given that this value can by definition not be lower when more banks are added as this is the remaining sum to be absorbed by the Deposit Guarantee Scheme.

Table 9
Extent of Write-down in Different Scenarios Assuming a 10% Failure Rate.

Quarter analyzed	5% asset write-down	10% asset write-down	15% asset write-down	20% asset write-down	25% asset write-down	Total remaining with haircut in 25% scenario (mln)	Total remaining with haircut in 25% scenario (mln)
2018 Q1	212%	238%	263%	289%	316%	€79	€1,947
2017 Q4	212%	238%	263%	289%	316%	€79	€1,947
2017 Q3	213%	240%	267%	294%	320%	€67	€2,111
2017 Q2	213%	240%	267%	294%	320%	€67	€2,111
2017 Q1	97%	213%	234%	255%	277%	€13	€1,921
2016 Q4	97%	213%	234%	255%	277%	€13	€1,921
2016 Q3	155%	220%	242%	265%	287%	€53	€1,388
2016 Q2	155%	220%	242%	265%	287%	€53	€1,388
2016 Q1	151%	220%	243%	266%	288%	€0	€2,748
2015 Q4	127%	214%	235%	255%	274%	€0	€2,748
2015 Q3	153%	215%	232%	249%	266%	€0	€0
2015 Q2	164%	215%	232%	250%	267%	€0	€0
2015 Q1	128%	213%	231%	248%	266%	€0	€0
2014 Q4	128%	213%	231%	248%	266%	€0	€0
2014 Q3	151%	215%	233%	251%	269%	€0	€0
2014 Q2	180%	216%	233%	249%	266%	€0	€0
2014 Q1	151%	215%	233%	251%	269%	€0	€0
2013 Q4	151%	215%	233%	251%	269%	€0	€0
2013 Q3	171%	213%	228%	242%	256%	€0	€0
2013 Q2	176%	214%	228%	243%	257%	€0	€0
2013 Q1	139%	213%	230%	247%	263%	€0	€0
2012 Q4	139%	213%	230%	247%	263%	€0	€0
2012 Q3	204%	216%	229%	242%	254%	€0	€0
2012 Q2	204%	216%	229%	242%	254%	€0	€0

Note: In this table the different layers that can be written down are represented. The first layer to be written down is the equity layer, meaning that a write-down of 0-100% consists of merely an equity write-down. A write-down of 100-200% consists of a write-down of equity and, additionally, a write-down of subordinated liabilities. A write-down of 200-300% consists of a write-down of the previous, plus a write-down of all other liabilities save deposits and liabilities that fall outside the scope of bail-in and liquidation proceedings (such as tax, wage and pension liabilities). Finally, a write-down of 300-400% means that 30% of deposits, based on the earlier calculation as shown in Section 5.3.4, will also be written down. A write-down of 400% therefore means that every class that can be bailed in has been bailed in while a write-down of 350% means 30% of deposits suffer a write-down of 50%. The total remaining sum is the sum that cannot be absorbed by the banks' creditors based on a 25% asset devaluation and would have to be absorbed by the Deposit Guarantee Scheme. Write-down percentages are shown as a weighted average based on total assets per bank. For reference: the limit of the Deposit Guarantee Scheme using the combined ex-ante funds and an ex-post contribution is €3.8 billion.

A side-by-side comparison between the scenarios where 3% of banks go into distress and where 10% of banks go into distress for both a scenario where a haircut is employed and a scenario without a haircut is provided in Table A12. The total remaining sum to be written down both with and without a large deposit write-down is, in some quarters, very similar or exactly the same. In case a haircut is employed, the remaining sum to be contributed by the Deposit Guarantee Fund is equal in 20 quarters and is higher in the scenario where 10% of banks default in only 4 quarters. The scenario where a haircut is not employed shows larger differences in terms of the sums required from the Deposit Guarantee Fund. This can be explained as rather than one bank needing to call upon the Deposit Guarantee Fund there are now two or three banks in each quarter that might have sufficient losses to require the Deposit Guarantee Fund to contribute.

As shown in Table A12, even in the worst-case scenario tested for, where 10% of the banks most likely to default go into distress and experience a 25% asset write-down while not performing a haircut on large deposits, the damage to the Deposit Guarantee Scheme is limited to a maximum of €2.75 billion. While this exceeds the current sum of funds in the Deposit Guarantee Fund (approximately €1.37 billion) the Deposit Guarantee Fund could call upon extra funds through an ex-post contribution, leading to a total of €3.8 billion. A scenario where 10% of the banks most likely to go into distress experience a 25% asset write-down, even without performing a haircut on large depositors and thus guaranteeing all deposits, would therefore not stress the Deposit Guarantee Scheme excessively.

7.7 Necessary stress level for Deposit Guarantee Scheme failure

To determine the level of stress that would be required for the Deposit Guarantee Scheme to be unable to pay out depositors sufficiently assumptions have to be made. Based on the current size of the fund and the possible ex-post contributions approximately €3.8 billion could be paid out by the Deposit Guarantee Scheme prior to having to resort to non-banking sector funding. Given that it is possible to either base the stress required to reach this level based on deposits being haircut or deposits not being haircut, combined with the lack of availability on corporate deposits and exact covered deposits, it is opted to calculate the stress needed to reach this sum without invoking a haircut on large deposits. It is therefore assumed that large deposits either will not be haircut and

are fully guaranteed, equal to covered deposits, or that the defaulting banks do not have any large deposits meaning their total deposits consist of only covered deposits[54].

Furthermore, there are two primary methods in which it is possible to increase the amount of stress placed on the banks and therefore on the Deposit Guarantee Scheme. The first method is to increase the number of banks being hit by the asset write-down. The percentage of banks defaulting is therefore increased from 10% by steps of 5%. At 15% and at 20% the remaining write-down without haircut of deposits is still insufficient to exceed the limit of the Deposit Guarantee Scheme, as can be seen in Table 10.

By increasing the percentage of banks defaulting to 25%, corresponding to 5 or 6 banks going into distress for each quarter, a value is arrived at of €5.5 billion in 2018Q1 and values of €4.1 to €4.6 billion in 2015Q2 to 2016Q1. This €4.1 to €5.5 billion is the sum that cannot be absorbed by the banks' creditors and would therefore need to be covered by the Deposit Guarantee Scheme. Given that the Deposit Guarantee scheme can cover a maximum amount of €3.8 billion a default of the 25% of banks most likely to default combined with an asset write-down of 25% leads to losses larger than can be absorbed by banks' balance sheets plus the Deposit Guarantee Scheme. The full results are listed in Table 10. 25% of banks going into distress corresponds to an average probability of default of 2.54% and represents an average of 56.9% of total assets of the banks in the sample. In this 25% failure rate scenario, 51% of the distressed banks would go into resolution proceedings and 49% would go into insolvency proceedings.

[54] This is a very conservative assumption as a haircut on large depositors adds a large amount of loss-absorption capacity, however given that accurate data regarding the amount of secured and unsecured deposits is unavailable this assumption allows for a more accurate answer.

Table 10
Placing Increasing Stress on the Deposit Guarantee Scheme Through a Higher Percentage of Defaulting Banks.

Quarter	3% banks defaulting	10% banks defaulting	15% banks defaulting	20% banks defaulting	25% banks defaulting
2018 Q1	€0	€1,947	€1,947	€1,947	€5,501
2017 Q4	€0	€1,947	€1,947	€1,947	€1,947
2017 Q3	€0	€2,111	€2,111	€2,111	€2,111
2017 Q2	€0	€2,111	€2,111	€2,111	€2,111
2017 Q1	€292	€1,921	€1,921	€2,403	€2,403
2016 Q4	€292	€1,921	€1,921	€2,403	€2,403
2016 Q3	€581	€1,388	€2,396	€2,806	€2,806
2016 Q2	€581	€1,388	€2,396	€2,806	€2,806
2016 Q1	€0	€2,748	€2,748	€3,555	€4,563
2015 Q4	€0	€2,748	€2,748	€3,555	€4,563
2015 Q3	€0	€0	€0	€2,561	€4,129
2015 Q2	€0	€0	€0	€2,561	€4,129
2015 Q1	€0	€0	€0	€2,561	€2,561
2014 Q4	€0	€0	€0	€2,561	€2,561
2014 Q3	€0	€0	€0	€2,659	€2,659
2014 Q2	€0	€0	€0	€2,659	€2,659
2014 Q1	€0	€0	€0	€2,659	€3,471
2013 Q4	€0	€0	€0	€2,659	€3,471
2013 Q3	€0	€0	€0	€0	€1,411
2013 Q2	€0	€0	€0	€0	€1,411
2013 Q1	€0	€0	€0	€0	€1,344
2012 Q4	€0	€0	€0	€0	€1,344
2012 Q3	€0	€0	€0	€0	€1,624
2012 Q2	€0	€0	€0	€0	€1,624

Note: All amounts listed in millions. All numbers listed based on a 25% asset write-down and no haircut of depositors. Numbers are the total sum that the defaulting bank or banks are unable to absorb through their bail-inable securities and that therefore need to be covered by the Deposit Guarantee Scheme. For reference: the limit of the Deposit Guarantee Scheme using the combined ex-ante funds and an ex-post contribution is €3.8 billion.

The bank that causes the increase from €2.75 billion in the 10% scenario to €5.5 billion in the 25% scenario in 2018Q1 is the Volksbank, which is a large bank that is unable to fully offset a 25% asset loss through its creditors and therefore its default, without a haircut on large deposits being employed, leads to the Deposit Guarantee Scheme being called upon. Given that the Volksbank is currently owned by the Dutch state the probability that a capital injection would occur rather than a write-down of creditors occurring could be large, that is however beyond the scope of this paper. Furthermore, the Deposit Guarantee Fund plus an ex-post contribution are also insufficient in this

scenario in the period of 2015Q2 to 2016Q1. This is caused by Nationale Nederlanden, a medium-sized bank that, while being better able to absorb losses through its creditors than the other defaulting banks in those quarters, causes the sum required from the Deposit Guarantee Fund to increase beyond its maximum. In this scenario, where 25% of the banks most likely to go into distress fail, six banks would be going into distress at the same time. While six banks going into distress appears to be an extreme scenario, during the 2008 financial crisis exactly this many banks participated in government guarantees for medium-term unsecured debt, though this guarantee scheme was needed because of liquidity problems rather than an outright devaluation of assets (Kellermann, 2009).

A second method that can be used to determine the necessary stress level to fully use the available funds of the Deposit Guarantee Scheme is to increase the level of asset loss. The maximum asset devaluation percentage used by Carmassi et al. (2018) is 25%, which has also been used in this paper. By increasing this percentage, pressure on the Deposit Guarantee Scheme can be further increased. It appears that a 25% asset loss coupled with 10% of the most likely to fail banks going into distress is close to the limit of the Deposit Guarantee Scheme, given that increasing the percentage asset devaluation to 30% overshoots the goal of a €3.8 billion leftover sum. A percentage asset devaluation of 26.68% is the exact percentage asset devaluation arrived at that is necessary to require a contribution by the Deposit Guarantee Fund of €3.8 billion (see Table 11). At this point a devaluation of 26.68% is employed combined with 10% of the most likely to fail banks defaulting, which is relatively extreme given average losses during the 2007-2010 period were 2.5% of total liabilities and even taking into account recapitalization averaged only 6%. In the outcome of this specific model three Dutch banks would be subjected to losses of 26.68% which, while lower than the maximum value found in Europe during the 2007 to 2010 period of 46.4% is nonetheless a highly unlikely situation given that during the previous financial crisis only one bank reported losses higher than 8% of total assets (Carmassi et al., 2018).

Table 11
Asset Devaluation and Corresponding Total Remaining Gap Without Deposit Haircut at 10% of Banks Defaulting.

Quarter	5% asset devaluation	10% asset devaluation	15% asset devaluation	20% asset devaluation	25% asset devaluation	27% asset devaluation	30% asset devaluation
2018 Q1	€43	€176	€308	€789	€1,947	€2,337	€3,106
2017 Q4	€43	€176	€308	€789	€1,947	€2,337	€3,106
2017 Q3	€34	€146	€258	€1,087	€2,111	€2,454	€3,134
2017 Q2	€34	€146	€258	€1,087	€2,111	€2,454	€3,134
2017 Q1	€0	€1	€98	€912	€1,921	€2,259	€2,929
2016 Q4	€0	€1	€98	€912	€1,921	€2,259	€2,929
2016 Q3	€0	€130	€280	€460	€1,388	€1,699	€22,155
2016 Q2	€0	€130	€280	€460	€1,388	€1,699	€22,155
2016 Q1	€0	€0	€0	€0	€2,748	€3,801	€25,722
2015 Q4	€0	€0	€0	€0	€2,748	€3,801	€5,882
2015 Q3	€0	€0	€0	€0	€0	€177	€2,440
2015 Q2	€0	€0	€0	€0	€0	€177	€2,440
2015 Q1	€0	€0	€0	€0	€0	€177	€2,440
2014 Q4	€0	€0	€0	€0	€0	€177	€2,440
2014 Q3	€0	€0	€0	€0	€0	€0	€547
2014 Q2	€0	€0	€0	€0	€0	€0	€547
2014 Q1	€0	€0	€0	€0	€0	€0	€547
2013 Q4	€0	€0	€0	€0	€0	€0	€547
2013 Q3	€0	€0	€0	€0	€0	€0	€0
2013 Q2	€0	€0	€0	€0	€0	€0	€0
2013 Q1	€0	€0	€0	€0	€0	€0	€0
2012 Q4	€0	€0	€0	€0	€0	€0	€0
2012 Q3	€0	€0	€0	€0	€0	€0	€0
2012 Q2	€0	€0	€0	€0	€0	€0	€0

Note: All amounts listed in millions. Amounts listed are the remaining sums that the defaulting bank or banks are unable to absorb through their bail-inable securities and that therefore need to be covered by the Deposit Guarantee Scheme. Losses in insolvency proceedings assumed to be 50% higher as per Section 6.2.For reference: the limit of the Deposit Guarantee Scheme using the combined ex-ante funds and an ex-post contribution is €3.8 billion.

7.8 Necessary stress including a government backstop

While the previous analyses focused on the level of stress necessary to require a sum from the Deposit Guarantee Fund that was larger than the current ex-ante funds plus the maximum possible ex-post contribution, during previous crises the government has provided funds that effectively

extended the limit of the Deposit Guarantee Scheme[55]. Given that during the previous crisis government injections, guarantees and asset relief programs contributed approximately €168 billion or 26.24% of GDP at the time, a scenario is produced where, despite bail-in of all eligible liabilities aside from deposits, the sum that falls on the Deposit Guarantee Scheme is large enough to fully use up all ex-ante contributions, ex-post contributions and is large enough to exceed the funds contributed by the Dutch government during the previous crisis. This is a highly unrealistic scenario as the stress exerted on the system for this to occur will most likely be so extreme that the probability of such a level of stress occurring is very small.

As in Section 7.7, it is possible to either base the stress required to reach this level based on deposits being haircut or deposits not being haircut. Given the lack of availability on corporate deposits and exact covered deposits, it is opted to calculate the stress needed to reach this sum without invoking a haircut on large deposits. It is therefore assumed that large deposits either will not be haircut and are fully guaranteed, equal to covered deposits, or that the defaulting banks do not have any large deposits thus their total deposits consists of only covered deposits[56].

Taking a combination of the values for loss given default and percentage of banks defaulting found previously in Section 7.7 of 25% of banks defaulting and a 26.68% loss given default leads to a necessary contribution by the Deposit Guarantee Scheme of €6.2 billion which is insufficient to reach the amount of funds contributed the Dutch government during the last crisis of €168 billion (see Table 12). Further increasing the percentage of banks defaulting and the percentage loss given default results in a final value of 40% of the most at-risk banks defaulting, combined with a loss given default of 39.57% in case of resolution, to exceed the sum contributed by the state during the previous crisis, leading to a sum required to be absorbed by the Deposit Guarantee Scheme of slightly over €168 billion in 2016Q3. For intermediate steps taken and the final result see Table 12. At this point the assets of the banks placed in distress in each quarter represent an average of 85% of total assets of the banks in the sample. In this 40% failure rate scenario, 48% of the

[55] See also footnote 18.
[56] See Section 5.3.4 on assumptions made regarding large depositors.

distressed banks would go into resolution proceedings and 52% would go into insolvency proceedings.

Table 12
Placing the Deposit Guarantee Scheme under Extreme Stress.

Quarter	26.68% LGD 25% defaulting	30% LGD 25% defaulting	30% LGD 30% defaulting	35% LGD 30% defaulting	35% LGD 40% defaulting	39.57% LGD 40% defaulting	40% LGD 40% defaulting
2018 Q1	€6,914	€26,004	€26,004	€82,088	€83,847	€151,615	€160,105
2017 Q4	€2,337	€19,405	€26,004	€80,799	€82,558	€150,141	€158,614
2017 Q3	€2,454	€3,134	€9,267	€50,957	€52,861	€115,302	€121,230
2017 Q2	€2,454	€3,134	€9,267	€50,756	€52,660	€114,931	€120,842
2017 Q1	€2,779	€3,523	€9,657	€56,592	€58,272	€121,237	€127,214
2016 Q4	€2,779	€3,523	€9,657	€49,159	€50,839	€112,477	€118,354
2016 Q3	€3,452	€24,569	€30,451	€96,057	€97,606	€168,007	€174,709
2016 Q2	€3,452	€24,569	€30,451	€94,106	€95,655	€165,777	€172,452
2016 Q1	€6,180	€29,216	€30,962	€93,438	€94,319	€164,266	€170,925
2015 Q4	€6,180	€29,216	€30,962	€91,101	€91,982	€161,575	€168,200
2015 Q3	€4,762	€7,927	€9,552	€14,733	€16,424	€69,699	€75,607
2015 Q2	€4,762	€7,927	€9,552	€14,733	€16,424	€69,854	€75,752
2015 Q1	€2,966	€5,679	€7,861	€16,852	€21,295	€82,059	€88,105
2014 Q4	€2,966	€5,679	€7,861	€12,684	€17,128	€62,492	€68,318
2014 Q3	€2,863	€3,814	€5,783	€19,699	€23,677	€79,306	€84,936
2014 Q2	€2,863	€3,814	€5,783	€19,699	€23,677	€77,347	€82,950
2014 Q1	€3,771	€4,910	€5,293	€18,731	€21,079	€72,073	€77,607
2013 Q4	€3,771	€4,910	€5,293	€18,731	€21,079	€65,206	€70,661
2013 Q3	€1,604	€1,985	€3,720	€5,007	€5,419	€40,175	€44,209
2013 Q2	€1,604	€1,985	€3,720	€5,007	€5,419	€40,175	€44,209
2013 Q1	€1,475	€1,734	€1,734	€2,448	€4,855	€39,660	€43,721
2012 Q4	€1,475	€1,734	€1,734	€2,448	€4,855	€39,660	€43,698
2012 Q3	€1,759	€2,025	€2,025	€16,269	€16,269	€60,560	€64,728
2012 Q2	€1,759	€2,025	€2,025	€16,269	€16,269	€60,560	€64,728

Note: LGD = Loss Given Default. All amounts listed in millions. The Deposit Guarantee Scheme is placed under extreme stress so as to arrive at a value where the Deposit Guarantee Scheme and government backstop are no longer able to absorb losses. The amounts displayed are the remaining sums that the defaulting bank or banks are unable to absorb through their bail-inable securities and that therefore need to be covered by the Deposit Guarantee Scheme. For reference: the government backstop is set to a maximum of €168 billion.

Table A13 presents an overview of the asset write-down necessary per quarter to reach the limit of the government backstop of €168 billion, based on the 40% of banks most likely to go into distress defaulting. Table A13 shows that the degree of write-down necessary to reach the limit

has decreased over the period studied. Offsetting this is a decrease in the probability of default for the 40% of banks that would be defaulting. The lower degree of asset write-down needed is explained by shifts in the different layers that could be bailed in, combined with the layers used for this analysis. While the first, second and fourth layers in the bail-in hierarchy, representing equity, subordinated liabilities and large deposits, have increased as a percentage of total bail-inable instruments, the third layer of other liabilities has decreased. Given that this analysis is based on a non-haircut scenario where the fourth layer is not bailed in, it is logical that a shift to relatively more fourth layer funding results in a lower asset write-down needed in this model.

A scenario where 40% of banks default, combined with a loss given default of 39.57%, appears to be unrealistic despite the fact that the Dutch government had to provide financing up to the amount that is tested for in this scenario in the previous crisis. The reason that this can nevertheless be seen as unrealistic nowadays, and yet happened during the previous crisis, is that during the previous crisis shareholders and debtholders were not bailed in to the extent that they are bailed in in this model. In this scenario the contribution by the government to the Deposit Guarantee Scheme would be indistinguishable from a direct contribution to the resolution of distressed banks, given that as described in Section 3.1 the Dutch central bank can choose to utilize the Deposit Guarantee Scheme to assist in resolution proceedings rather than as a means to pay out depositors directly.

Total losses in terms of assets in the aforementioned scenario amount to an average of €800 billion in asset losses (32.6% of total banking sector assets), of which an average of €685 billion (86%) is accounted for through bail-in measures. As a comparison, during the crisis years of 2007-2008 the largest decrease in assets on a monthly basis was €141 billion between November 2008 and December 2008 (European Central Bank, 2018e).

If a scenario were to occur in which the Dutch government had to provide financing exceeding the amount of €168 billion used for calculations in this paper, it is nonetheless probable that small depositors would still be covered up to the limits of the Deposit Guarantee Scheme. While government bonds have been defaulted on frequently, deposit guarantee schemes have only failed three times over their history. The Cyprus crisis illustrated this more directly given that Cyprus

defaulted on its sovereign bonds while honoring its promise under the Deposit Guarantee Scheme.[57]

[57] See Section 3.4.5.

8. Conclusion

This paper presents an estimation of the adequacy of the Dutch Deposit Guarantee Scheme, simulating a high level of stress on the Dutch banking sector for the period 2012Q2 to 2018Q1 on a quarterly basis to determine to what level the Deposit Guarantee Scheme would be adequate. A scenario of 3% of the most likely to fail banks going into distress, combined with 5% to 25% of asset losses in resolution and 7.5% to 37.5% asset losses in insolvency proceedings, stresses the Deposit Guarantee Scheme in a limited way, with amounts of up to €581 million required from the Deposit Guarantee Fund to ensure no losses to depositors both small and large, while including a haircut of large deposits means the Deposit Guarantee Fund needs to contribute approximately €53 million.

An increased stress level, many times more severe than the stress level experienced in the recent financial crisis, where 10% of the most likely to fail banks default combined with 25% asset losses in resolution and 37.5% asset losses in insolvency proceedings leads to an increase in stress for the Deposit Guarantee Scheme vis-à-vis the 3% scenario with the Deposit Guarantee Fund needing to disburse approximately €2.7 billion in case no deposits are written down and €79 million in case a levy is placed on large depositors.

To reach the limits of the Deposit Guarantee Scheme without taking into account government support, either a scenario using a default rate of 25% of the most likely to default banks combined with an asset devaluation of 25% is needed or a scenario where 10% of the most likely to default banks go into distress combined with an asset devaluation of 26.68%. Given that the Deposit Guarantee Scheme is backed by the Dutch government a far more extreme scenario is utilized to determine the level of stress where the government backstop, assumed to be equal to the government backstop in the previous crisis, is insufficient to bail out all depositors. This is found to occur at a 40% failure rate of banks combined with a 39.56% asset devaluation, corresponding to 34.05% of total Dutch banking sector assets being wiped out.

Answering the question “How safe are deposits under the Dutch Deposit Guarantee Scheme?”, it can be said that deposits under the Dutch Deposit Guarantee Scheme are extremely safe. Although scenarios where 3% to 10% of banks fail and 25% to 37.5% of assets are written down, corresponding to stress levels far more severe than experienced historically in Europe including in the recent financial crisis, would lead to severe stress for the Dutch banking sector and would

activate the Dutch Deposit Guarantee Scheme, the sums required would not be larger than what is possible for the Deposit Guarantee Fund to pay out through the ex-ante funded contributions and an ex-post contribution. Furthermore, if scenarios were to occur that increase stress placed upon the Dutch Deposit Guarantee Scheme yet further the government backstop is sufficient up to scenarios that are extremely unlikely. As the Cyprus crisis has shown, the government backstop could extend further than the limit used in this paper and even extend beyond the limit where the government is able to pay holders of sovereign bonds, further increasing resilience. This means it can be stated that deposits covered under the Dutch Deposit Guarantee Scheme have a risk level that, through the combination of guarantees by banks, the Dutch Deposit Guarantee Scheme and the government backstop, is lower than that of Dutch sovereign bonds and the risk level is therefore extremely low.

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Appendix A: Tables

Table A1.

Overview Deposit Guarantee Schemes of OECD Countries, Edited from Deposit Insurance Around the World (Demirgüc-Kunt, Kane, & Laeven, 2015)

	Coverage including Government guarantees (US$)							
Country	2003	2010	2013	type (1=legally separate; 2=other)	Ex-ante fund (yes=1; no=0)	Increase in deposit protection since 2008: increase in statutory DIS coverage (1=yes; 0=no)	Government guarantees on bank assets since 2008 (1=yes; 0=no)	Significant nationalizations of banks since 2008 (1=yes; 0=no)
Australia	n.a.	Unlimited	221,625.00	2	0	0	0	0
Austria	22,727.00	133,333.00	137,830.00	1	0	1	1	1
Belgium	22,727.00	133,333.00	137,830.00	1	1	1	1	1
Canada	42,857.00	97,087.00	93,985.00	1	1	0	0	0
Chile	2,643.00	4,542.00	4,710.00	2	0	1	0	0
Czech Republic	28,409.00	133,333.00	137,830.00	1	1	1	0	0
Denmark	45,524.00	133,333.00	137,830.00	1	1	1	0	1
Estonia	7,263.00	133,333.00	137,830.00	1	1	1	0	0
Finland	28,409.00	133,333.00	137,830.00	1	1	1	0	0
France	79,545.00	133,333.00	137,830.00	1	1	1	1	0
Germany	22,727.00	133,333.00	137,830.00	1	1	1	1	1
Greece	22,727.00	133,333.00	137,830.00	1	1	1	0	1
Hungary	13,374.00	133,333.00	137,830.00	1	1	1	0	0
Iceland	27,259.00	28,019.00	28,789.00	1	1	1	0	1
Ireland	22,727.00	133,333.00	137,830.00	2	1	1	1	1
Italy	117,376.00	133,333.00	137,830.00	1	0	1	0	0
Japan	86,259.00	113,921.00	94,967.00	1	1	0	0	0
Korea, Rep.	41,960.00	43,250.00	47,366.00	1	1	1	0	0
Latvia	5,227.00	133,333.00	137,830.00	2	1	1	0	1
Luxembourg	22,727.00	133,333.00	137,830.00	1	0	1	0	1
Mexico	2,984,865.00	146,515.00	154,876.00	1	1	1	0	0
Netherlands	**22,727.00**	**133,333.00**	**137,830.00**	**2**	**0**	**1**	**1**	**1**
Norway	282,486.00	331,126.00	327,172.00	1	1	0	0	0
Poland	25,568.00	133,333.00	137,830.00	1	1	1	0	0
Portugal	28,409.00	133,333.00	137,830.00	1	1	1	0	0
Slovak Republic	22,727.00	Unlimited	137,830.00	1	1	1	0	0
Slovenia	21,023.00	133,333.00	137,830.00	2	0	1	0	0
Spain	22,727.00	133,333.00	137,830.00	1	1	1	0	1
Sweden	30,902.00	133,333.00	137,830.00	2	1	1	0	0
Switzerland	22,222.00	96,154.00	112,170.00	1	0	1	1	0
Turkey	33,333.00	33,333.00	46,473.00	1	1	0	0	0
United Kingdom	51,967.00	130,769.00	139,978.00	1	0	1	1	1
United States	100,000.00	250,000.00	250,000.00	1	1	1	1	1

Note: Dollar amounts for euro countries correspond to €100,000.

Table A2

Indicators, Definitions, Transformations and Data Sources as used in Betz et al. (2014) *and this paper.*

		Variable	Definition and transformation	Source in Betz et al. (2014)	Source in this paper
Bank specific indicators	C	Capital Ratio	Total equity / Total Assets	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		Tier 1 Ratio	Tier 1 Capital Ratio	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
	A	Impaired Assets	Non-Performing Assets / Total Assets	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		Reserves to impaired assets	Reserves for Loan Losses / Non Performing Assets	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		ROA	Return on Assets	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		Loan Loss Provisions	Provisions for Loan Losses / Total Average Loans	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
	M	Cost to Income	Operating Costs / Operating Income	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
	E	ROE	Return on Equity	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		Net Interest Margin	Net Interest Margin	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
	L	Interest expenses to liabilities	Interest Expenses / Total Liabilities	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		Deposits to funding	Deposits / Funding	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
		Net short term borrowing	Short-term borrowing - Cash / Total Liabilities	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
	S	Share of trading income	Trading Income / Operating Income	Bloomberg	Bloomberg, Orbis Bankfocus, DNB
Country-specific banking sector indicators		Total assets to GDP	Total Assets / GDP	ECB MFI Statistics	ECB MFI Statistics
		Non-core liabilities	Growth Rate of (Total Liabilities - Capital and Reserves - Deposits)	ECB MFI Statistics	ECB MFI Statistics
		Debt to equity	(Total Liabilities - Capital and Reserves) / Capital and Reserves	ECB MFI Statistics	ECB MFI Statistics

	Loans to deposits	Total Loans / Deposits	ECB MFI Statistics	ECB MFI Statistics
	Debt securities to liabilities	Debt Securities to Liabilities	ECB MFI Statistics	ECB MFI Statistics
	Mortgages to loans	Mortgages to Total Loans	ECB MFI Statistics	ECB MFI Statistics
Country-specific macro-financial indicators	Real GDP	Growth Rate of real GDP	Eurostat	Eurostat
	Inflation	Growth rate of the HICP index	Eurostat	OECD
	Stock Prices	Growth rate of the stock price index	Bloomberg	Bloomberg
	House Prices	Growth rate of the house price index	ECB MFI Statistics	ECB MFI Statistics
	Long-term government bond yield	10-year government bond yield	Bloomberg	Bloomberg
	International Investment position to GDP	Net International Investment Position as a % of GDP	MIP	Eurostat
	Government debt to GDP	General Government Debt as a % of GDP	MIP	Eurostat
	Private sector credit flow to GDP	Private sector credit flow as a % of GDP	MIP	Eurostat

Note: Growth rates are quarterly growth rates. Bank balance sheet and house price indicators are lagged by 2 quarters, while Investment position to GDP, Government debt to GDP and Private sector credit flow to GDP are lagged by 6 quarters. Banking sector indicators and all other macro-financial indicators are lagged by 1 quarter. Where possible, the same source has been used for this paper as the source used as in Betz et al. (2014).

Table A3

Summary Statistics of Data used in Betz et al. (2014).

	Variable	*Obs.*	*Min*	*Max*	*Mean*	*Std. dev.*	*Skew*	*Kurtosis*
Bank specific indicators	Capital Ratio	20432	0.00	0.40	0.07	0.04	2.20	8.05
	Tier 1 Ratio	11999	0.04	0.32	0.10	0.04	2.18	6.71
	Impaired Assets	13079	0.00	0.17	0.02	0.03	2.62	8.79
	Reserves to impaired assets	12735	0.02	19.19	1.52	2.38	5.61	36.78
	ROA	20608	-0.04	0.03	0.01	0.01	-1.15	8.48
	Loan Loss Provisions	17010	0.00	0.06	0.01	0.01	3.60	16.62
	Cost to Income	20122	-24.05	43.27	2.84	6.43	2.20	19.24
	ROE	20351	-0.86	0.44	0.07	0.14	-3.55	20.52
	Net Interest Margin	17501	0.00	0.06	0.02	0.01	0.85	1.42
	Interest expenses to liabilities	19793	0.00	0.10	0.03	0.02	1.85	5.06
	Deposits to funding	19321	0.00	0.98	0.55	0.24	-0.30	-0.58
	Net short term borrowing	19950	-0.41	0.72	0.08	0.19	0.73	1.77
	Share of trading income	19761	-3.60	4.74	0.26	0.84	0.89	13.18
Country-specific banking sector indicators	Total assets to GDP	26562	1.40	135.92	12.27	12.05	7.61	67.02
	Non-core liabilities	26517	-0.11	0.05	0.00	0.01	-0.16	8.03
	Debt to equity	26578	3.87	38.70	14.38	4.23	0.60	-0.34
	Loans to deposits	26578	1.00	7.41	2.39	0.75	1.73	5.79
	Debt securities to liabilities	26578	0.00	0.51	0.17	0.09	0.66	1.97
	Mortgages to loans	26438	0.01	0.41	0.17	0.07	0.65	0.16
Country-specific macro-financial indicators	Real GDP	27297	-0.13	0.08	0.00	0.01	-1.29	11.24
	Inflation	27401	-0.03	0.11	0.01	0.01	1.72	16.65
	Stock Prices	27279	-0.55	0.89	0.00	0.12	-0.16	1.14
	House Prices	26628	-0.40	1.59	0.01	0.03	8.01	275.70
	Long-term government bond yield	26919	0.01	0.34	0.04	0.02	6.57	81.79
	International Investment position to GDP	27401	-1.75	1.40	-0.19	0.33	-0.26	2.18
	Government debt to GDP	27401	0.04	1.71	0.71	0.28	0.34	-0.61
	Private sector credit flow to GDP	27401	-0.38	1.76	0.09	0.09	4.50	70.48

Note: Summary statistics reproduced from Betz et al. (2014). Statistics as derived from their full sample of 28,832 observations.

Table A4

Mean-comparison Test as Reproduced From Betz et al. (2014).

		C = 0			C = 1			Mean t-test	
	Variable	*Obs.*	*Mean*	*Std. dev.*	*Obs.*	*Mean*	*Std. dev.*	*t*	*Prob*
Bank specific indicators	Capital Ratio	19585	0.07	0.04	847	0.05	0.03	22.13	0.00
	Tier 1 Ratio	11397	0.10	0.04	602	0.08	0.02	20.64	0.00
	Impaired Assets	12474	0.02	0.03	605	0.03	0.03	1.61	0.11
	Reserves to impaired assets	12146	1.53	2.39	589	1.22	2.17	3.37	0.00
	ROA	19761	0.01	0.01	847	0.00	0.01	5.95	0.00
	Loan Loss Provisions	16292	0.01	0.01	718	0.01	0.01	4.42	0.00
	Cost to Income	19283	2.84	6.44	839	2.85	6.33	0.03	0.98
	ROE	19504	0.07	0.14	847	0.06	0.19	1.67	0.10
	Net Interest Margin	16768	0.02	0.01	733	0.02	0.01	1.27	0.20
	Interest expenses to liabilities	18984	0.03	0.02	809	0.04	0.02	9.62	0.00
	Deposits to funding	18508	0.55	0.24	813	0.55	0.23	0.12	0.90
	Net short term borrowing	19121	0.08	0.19	829	0.10	0.15	4.78	0.00
	Share of trading income	18928	0.26	0.83	833	0.29	1.02	0.71	0.48
Country-specific banking sector indicators	Total assets to GDP	25552	12.19	12.19	1010	14.40	7.37	9.06	0.00
	Non-core liabilities	25507	0.00	0.01	1010	0.00	0.01	3.75	0.00
	Debt to equity	25568	14.37	4.25	1010	14.83	3.92	3.66	0.00
	Loans to deposits	25568	2.39	0.74	1010	2.42	1.02	0.97	0.33
	Debt securities to liabilities	25568	0.18	0.09	1010	0.16	0.10	5.91	0.00
	Mortgages to loans	25428	0.17	0.07	1010	0.20	0.07	15.25	0.00
Country-specific macro-financial indicators	Real GDP	26279	0.00	0.01	1018	0.00	0.01	10.34	0.00
	Inflation	26383	0.01	0.01	1018	0.01	0.01	0.51	0.61
	Stock Prices	26261	0.01	0.12	1018	-0.03	0.13	7.20	0.00
	House Prices	25617	0.01	0.03	1011	0.00	0.03	12.89	0.00
	Long-term government bond yield	25933	0.04	0.02	986	0.05	0.02	3.37	0.00
	International Investment position to GDP	26383	-0.19	0.32	1018	-0.38	0.42	14.48	0.00
	Government debt to GDP	26383	0.72	0.28	1018	0.59	0.27	14.56	0.00
	Private sector credit flow to GDP	26383	0.09	0.09	1018	0.16	0.11	18.60	0.00

Note: Mean-comparison test reproduced from Betz et al. (2014). Statistics as derived from their full sample of 28,832 observations.

Table A5

Logit Estimates on Bank Distress and their Predictive Performance Using Different Models (Betz et al., 2014)

		(1)		(2)		(3)		(4)		(5)		(6)	
	Estimates	Benchmark		BS Model		BSI Model		MF Model		BS & BSI Model		BS & MF Model	
Bank-specific indicators	Intercept	-3.46 ***		-3.05 ***		-3.02 ***		-3.06 ***		-2.91 ***		-3.47 ***	
	Capital Ratio	-0.76 ***		-2.20 ***						-1.40 ***		-2.21 ***	
	Reserves to impaired assets	-0.19		-0.15						-0.15		-0.15	
	ROA	0.12 *		0.28 .						0.16		0.26 .	
	Loan Loss Provisions	0.09 .		0.36 ***						0.22 **		0.21 *	
	Cost to Income	0.09		0.18 *						0.26 **		0.14	
	ROE	-0.06		-2.29 *						-1.84 *		-1.67 .	
	Interest expenses to liabilities	0.14 ***		0.91 ***						0.82 ***		0.88 ***	
	Deposits to funding	0.01		0.38 ***						0.09		-0.01	
	Net short term borrowing	0.18 **		1.20 ***						0.68 **		1.03 ***	
	Share of trading income	-0.14		-0.20						-0.27 *		-0.15	
Country-specific banking sector indicators	Total assets to GDP	0.71 ***				1.53 ***				2.33 ***			
	Non-core liabilities	0.32 ***				0.22 ***				0.40 ***			
	Debt to equity	0.30 ***				0.49 ***				0.08			
	Loans to deposits	0.14				-0.21 **				-0.60 ***			
	Debt securities to liabilities	-0.22 *				-0.45 ***				-0.08			
	Mortgages to loans	0.03				0.40 ***				0.30 ***			
Country-specific macro-financial indicators	Real GDP	-0.10 .						-0.16 ***				-0.13 **	
	Inflation	0.06						0.10 *				0.10 *	
	Stock Prices	0.02						-0.04				-0.03	
	House Prices	-0.38 ***						-0.62 ***				-0.56 ***	
	Long-term government bond yield	0.04						0.19 *				0.10	
	International Investment position to GDP	-0.50 ***						-0.25 ***				-0.42 ***	
	Government debt to GDP	0.50 ***						-0.02				0.10 .	
	Private sector credit flow to GDP	0.36 ***						0.52 ***				0.50 ***	
	R2[a]	0.27		0.10		0.15		0.12		0.20		0.21	
	No. of banks	298		298		298		298		298		298	
	Predictive performance	$U_a(\mu)$	$U_r(\mu)$	$U_a(\mu)$	$U_r(\mu)$	$U_a(\mu)$	$U_r(\mu)$	$U_a(\mu)$	$U_r(\mu)$	$U_a(\mu)$	$U_r(\mu)$	$U_a(\mu)$	$U_r(\mu)$
Usefulness for a policymaker[b]	μ = 0.6	0.01	12%	0.00	0%	0.00	3%	0.00	0%	0.00	0%	0.00	1%
	μ = 0.7	0.01	16%	0.00	0%	0.00	4%	0.00	4%	0.00	5%	0.01	7%
	μ = 0.8	0.03	31%	0.01	5%	0.01	13%	0.01	14%	0.02	17%	0.02	24%
	μ **= 0.9**	**0.04**	**42%**	**0.02**	**19%**	**0.02**	**21%**	0.02	**22%**	0.03	**30%**	0.03	**36%**
$P(I_j\ (h)=1)$[c]		0.06		0.06		0.06		0.06		0.06		0.06	

Note: Reproduced from Betz et al. (2014). For standardized coefficients, the explanatory variables have been transformed to have zero mean and unit variance. Significance codes: "***", 0.001, "**", 0.01, "*", 0.05, ".", 0.10.

[a] R2 refers to the Nagelkerke's pseudo R-squared.

[b] The usefulness for a policymaker is computed with absolute and relative usefulness $U_a(\mu)$ and $U_r(\mu)$ as described in section 4.1 of Betz et al. (2014).

[c] $P(I_j\ (h)=1)$ refers to the unconditional probability of pre-distress events.

Table A6
Summary Statistics on Indicator Variables as used in this Paper.

	Variable	*Obs.*	*Min*	*Max*	*Mean*	*Std. dev.*	*Skew*	*Kurtosis*
Bank specific indicators	Capital Ratio	1175	0.00	0.47	0.08	0.07	2.19	5.95
	Tier 1 Ratio	1038	0.00	1.11	0.19	0.14	2.79	12.85
	Impaired Assets	639	0.00	0.26	0.02	0.03	5.76	37.48
	Reserves to impaired assets	729	0.02	39.00	1.37	4.70	6.61	43.45
	ROA	1116	-0.08	0.06	0.01	0.01	0.22	14.10
	Loan Loss Provisions	548	-0.32	7.53	0.16	0.68	9.50	99.79
	Cost to Income	622	0.31	3.68	0.69	0.23	7.03	84.94
	ROE	1058	-1.33	0.38	0.06	0.14	-4.53	35.53
	Net Interest Margin	999	-0.01	0.13	0.02	0.02	3.26	15.47
	Interest expenses to liabilities	702	0.00	0.03	0.01	0.01	1.95	4.28
	Deposits to funding	941	0.00	0.93	0.49	0.26	-0.44	-0.91
	Net short term borrowing	841	-0.54	0.22	0.01	0.10	-1.22	4.50
	Share of trading income	490	-1.50	61.33	0.75	5.90	9.26	90.22
Country-specific banking sector indicators	Total assets to GDP	61	11.13	15.59	13.57	1.15	-0.50	-0.56
	Non-core liabilities	61	-0.08	0.12	0.01	0.04	0.04	-0.09
	Debt to equity	61	16.35	24.91	20.47	2.47	-0.20	-1.19
	Loans to deposits	61	0.85	1.10	0.97	0.07	-0.30	-0.64
	Debt securities to liabilities	61	0.09	0.18	0.12	0.02	0.55	-0.69
	Mortgages to loans	61	0.35	0.45	0.40	0.03	0.29	-1.49
Country-specific macro-financial indicators	Real GDP	61	-0.04	0.02	0.00	0.01	-2.79	14.48
	Inflation	61	0.00	0.03	0.02	0.01	0.08	-0.47
	Stock Prices	61	-0.26	0.22	0.01	0.09	-0.84	1.32
	House Prices	61	-0.04	0.03	0.00	0.01	-1.02	1.05
	Long-term government bond yield	61	0.00	0.05	0.03	0.01	-0.47	-1.15
	International Investment position to GDP	61	-0.20	0.70	0.17	0.26	0.67	-0.81
	Government debt to GDP	61	0.43	0.68	0.56	0.08	-0.23	-1.18
	Private sector credit flow to GDP	61	0.01	0.14	0.08	0.04	-0.12	-1.16

Note: Observations defined as one observation per quarter per bank. Data is obtained on 30 banks for 61 quarters meaning a potential 1830 observations. Country-specific banking sector indicators and country-specific macro-financial indicators are available for each quarter and are the same for all banks in the sample, therefore this is defined as one observation per quarter.

Table A7
Average Loss Given Default Based on 5% to 25% Asset Losses.

Bank	5% losses	10% losses	15% losses	20% losses	25% losses
ABN Amro	€ 20,304	€ 40,608	€ 60,912	€ 81,217	€ 101,521
ASR Bank	€ 90	€ 180	€ 270	€ 361	€ 451
Achmea Bank	€ 1,175	€ 2,349	€ 3,524	€ 4,699	€ 5,874
Aegon Bank	€ 720	€ 1,439	€ 2,159	€ 2,878	€ 3,598
Allianz Asset Management	€ 30	€ 60	€ 90	€ 120	€ 151
Anadolu Bank	€ 44	€ 89	€ 133	€ 178	€ 222
BinckBank	€ 255	€ 510	€ 765	€ 1,020	€ 1,275
Rabobank	€ 34,177	€ 68,353	€ 102,530	€ 136,706	€ 170,883
Credit Europe	€ 669	€ 1,338	€ 2,007	€ 2,676	€ 3,345
DHB Bank	€ 136	€ 271	€ 407	€ 542	€ 678
Van Lanschot	€ 1,048	€ 2,096	€ 3,144	€ 4,192	€ 5,240
Garantibank	€ 353	€ 707	€ 1,060	€ 1,413	€ 1,767
Hof Hoorneman	€ 10	€ 20	€ 29	€ 39	€ 49
ING Bank	€ 43,349	€ 86,698	€ 130,047	€ 173,396	€ 216,745
KAS Bank	€ 334	€ 667	€ 1,001	€ 1,334	€ 1,668
Leaseplan	€ 1,407	€ 2,815	€ 4,222	€ 5,629	€ 7,037
MUFG Bank	€ 594	€ 1,189	€ 1,783	€ 2,377	€ 2,972
BNG	€ 7,239	€ 14,478	€ 21,717	€ 28,956	€ 36,195
NIBC Bank	€ 1,199	€ 2,398	€ 3,598	€ 4,797	€ 5,996
Nationale Nederlanden	€ 725	€ 1,449	€ 2,174	€ 2,899	€ 3,624
NL Financiering	€ 531	€ 1,063	€ 1,594	€ 2,125	€ 2,656
NL Waterschap	€ 4,171	€ 8,341	€ 12,512	€ 16,683	€ 20,853
RBS	€ 2,072	€ 4,143	€ 6,215	€ 8,287	€ 10,358
Triodos Bank	€ 541	€ 1,082	€ 1,623	€ 2,164	€ 2,705
Yapi Kredi Bank	€ 135	€ 270	€ 405	€ 540	€ 675
Volksbank	€ 3,495	€ 6,990	€ 10,485	€ 13,980	€ 17,475
Amsterdam Trade Bank	€ 217	€ 434	€ 650	€ 867	€ 1,084

Note: Amounts in millions. Losses in insolvency proceedings assumed to be 50% higher as per Section 5.2.

Table A8
Logit Estimates on Bank Distress and their Predictive Performance, as in Betz et al. (2014).

	Variable	Benchmark
Bank-specific indicators	Intercept	-3.46 ***
	Capital Ratio	-0.76 ***
	Tier 1 Ratio	
	Impaired Assets	
	Reserves to impaired assets	-0.19
	ROA	0.12 *
	Loan Loss Provisions	0.09 .
	Cost to Income	0.09
	ROE	-0.06
	Net Interest Margin	
	Interest expenses to liabilities	0.14 ***
	Deposits to funding	0.01
	Net short term borrowing	0.18 **
	Share of trading income	-0.14
Country-specific banking sector indicators	Total assets to GDP	0.71 ***
	Non-core liabilities	0.32 ***
	Debt to equity	0.30 ***
	Loans to deposits	0.14
	Debt securities to liabilities	-0.22 *
	Mortgages to loans	0.03
Country-specific macro-financial indicators	Real GDP	-0.10 .
	Inflation	0.06
	Stock Prices	0.02
	House Prices	-0.38 ***
	Long-term government bond yield	0.04
	International Investment position to GDP	-0.50 ***
	Government debt to GDP	0.50 ***
	Private sector credit flow to GDP	0.36 ***
	R2	0.27

*Note***:** For standardized coefficients, the explanatory variables have been transformed to have zero mean and unit variance.
Significance codes: '***', 0.001, '**', 0.01, '*', 0.05, '.', 0.10
R2 refers to the Nagelkerke's pseudo R-squared.

Table A9
Summary Statistics of Probability of Default per Dutch Bank.

	Observations	Min	Max	Mean	Std. Dev.	Kurt
All banks	540	0.00	0.08	0.01	0.01	3.79
ABN Amro	24	0.00	0.06	0.03	0.02	-0.38
Achmea Bank	24	0.01	0.08	0.03	0.02	-0.14
Aegon Bank	24	0.00	0.04	0.02	0.01	-0.57
Allianz Asset Management	16	0.00	0.02	0.01	0.00	-0.53
Anadolu Bank	16	0.00	0.01	0.00	0.00	-1.38
Amsterdam Trade Bank	16	0.00	0.02	0.01	0.01	-0.69
ASR Bank	20	0.01	0.03	0.01	0.01	-0.02
BinckBank	24	0.00	0.01	0.00	0.00	2.27
Credit Europe	24	0.00	0.04	0.01	0.01	-0.83
DHB Bank	24	0.00	0.02	0.01	0.00	0.54
Garantibank	24	0.00	0.02	0.01	0.01	-0.23
ING Bank	24	0.01	0.07	0.03	0.02	0.13
KAS Bank	24	0.00	0.06	0.02	0.02	0.17
Van Lanschot	8	0.00	0.01	0.00	0.00	0.46
Leaseplan Corporation N.V.	16	0.00	0.01	0.00	0.00	-1.32
MUFG Bank	16	0.00	0.01	0.01	0.00	-1.37
BNG	24	0.00	0.04	0.02	0.01	-0.94
NIBC Bank	24	0.00	0.04	0.01	0.01	0.34
Nationale Nederlanden	16	0.01	0.02	0.01	0.01	-0.27
Nederlandse Financierings-Maatschappij	24	0.00	0.00	0.00	0.00	-0.84
Nederlandse Waterschapsbank	24	0.01	0.08	0.03	0.02	-1.07
Rabobank	24	0.00	0.05	0.02	0.01	-0.31
RBS Bank (NatWest)	16	0.00	0.01	0.00	0.00	-0.51
Triodos Bank	24	0.00	0.02	0.01	0.00	-0.04
Yapi Kredi Bank	16	0.00	0.00	0.00	0.00	-1.38
Volksbank	24	0.00	0.08	0.03	0.02	-1.08

Note: The period observed is 2012Q2 to 2018Q1 on a quarterly basis, where the maximum amount of observations per bank is therefore 24.

Table A10

Ranking of Dutch Banks According to Probability of Default.

Quarter	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5	Rank 6
2018 Q1	Nationale Nederlanden	Aegon	ASR Bank	ING Bank	Achmea Bank	Volksbank
2017 Q4	Nationale Nederlanden	Aegon	ASR Bank	ING Bank	Achmea Bank	ABN Amro
2017 Q3	Nationale Nederlanden	Aegon	ASR Bank	ING Bank	ABN Amro	Achmea Bank
2017 Q2	Nationale Nederlanden	Aegon	ASR Bank	ING Bank	ABN Amro	Achmea Bank
2017 Q1	Amsterdam Trade Bank	Aegon	ING Bank	Nationale Nederlanden	ASR Bank	Achmea Bank
2016 Q4	Amsterdam Trade Bank	Aegon	ING Bank	Nationale Nederlanden	ASR Bank	Achmea Bank
2016 Q3	Amsterdam Trade Bank	Aegon	ING Bank	Nationale Nederlanden	ASR Bank	Achmea Bank
2016 Q2	Amsterdam Trade Bank	Aegon	ING Bank	Nationale Nederlanden	ASR Bank	Achmea Bank
2016 Q1	Achmea Bank	Volksbank	ING Bank	ABN Amro	Aegon	Nationale Nederlanden
2015 Q4	Achmea Bank	Volksbank	ABN Amro	ING Bank	Aegon	Nationale Nederlanden
2015 Q3	Achmea Bank	ABN Amro	Volksbank	ING Bank	Aegon	Nationale Nederlanden
2015 Q2	Achmea Bank	Volksbank	ABN Amro	ING Bank	Aegon	Nationale Nederlanden
2015 Q1	Volksbank	Achmea Bank	ING Bank	ABN Amro	Aegon	Rabobank
2014 Q4	Volksbank	Achmea Bank	ING Bank	ABN Amro	Aegon	Rabobank
2014 Q3	Volksbank	Achmea Bank	ING Bank	ABN Amro	Aegon	Rabobank
2014 Q2	Volksbank	Achmea Bank	ABN Amro	ING Bank	Aegon	Rabobank
2014 Q1	Volksbank	Achmea Bank	ING Bank	ABN Amro	Aegon	KAS Bank
2013 Q4	Volksbank	Achmea Bank	ING Bank	ABN Amro	Aegon	KAS Bank
2013 Q3	Volksbank	Achmea Bank	ABN Amro	ING Bank	Aegon	KAS Bank
2013 Q2	Volksbank	Achmea Bank	ABN Amro	ING Bank	Aegon	KAS Bank
2013 Q1	Achmea Bank	Volksbank	ING Bank	ABN Amro	KAS Bank	Rabobank
2012 Q4	Achmea Bank	Volksbank	ING Bank	ABN Amro	KAS Bank	Rabobank
2012 Q3	Achmea Bank	Volksbank	ABN Amro	ING Bank	KAS Bank	Rabobank
2012 Q2	Achmea Bank	Volksbank	ABN Amro	ING Bank	KAS Bank	Rabobank

Note: Banks ranked according to probability of distress as calculated using the benchmark model in Section 3.5, where 1 is the bank most likely to go into distress and 6 the bank 6th most likely to go into distress.

Table A11

Complete Overview of Banks in Sample per Quarter.

	Number of banks	Banks dropped
2018 Q1	24	
2017 Q4	24	
2017 Q3	24	
2017 Q2	24	
2017 Q1	24	
2016 Q4	24	
2016 Q3	24	
2016 Q2	24	
2016 Q1	24	
2015 Q4	24	
2015 Q3	24	
2015 Q2	24	
2015 Q1	24	
2014 Q4	24	
2014 Q3	24	
2014 Q2	24	
2014 Q1	24	
2013 Q4	24	
2013 Q3	19	Anadolu Bank, Leaseplan Bank, MUFG Bank, Nationale Nederlanden, Yapi Kredi Bank
2013 Q2	19	
2013 Q1	19	
2012 Q4	19	
2012 Q3	17	ASR Bank, Allianz Asset Management
2012 Q2	17	

Note: The complete list of banks: ABN AMRO Bank N.V., Achmea Bank N.V., Aegon Bank N.V., Allianz Nederland Asset Management B.V., Amsterdam Trade Bank N.V., Anadolubank Nederland N.V., ASR Bank N.V., BinckBank N.V., Coöperatieve Rabobank U.A., Credit Europe Bank N.V., de Volksbank N.V., Demir-Halk Bank (Nederland) N.V., Garantibank International N.V., ING Bank N.V., KAS BANK N.V., Leaseplan Corporation N.V., MUFG Bank (Europe) N.V., Nationale-Nederlanden Bank N.V., NatWest Markets N.V., Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden N.V., NIBC Bank N.V., Triodos Bank N.V., Van Lanschot N.V., Yapi Kredi Bank Nederland N.V.. Where the number of banks is listed as 24, all of the above banks are included. While data was available for N.V. Bank Nederlandse Gemeenten and Nederlandse Waterschapsbank N.V. these banks are not included in the rankings due to being public rather than private banks. Bank Ten Cate & Cie, Hof Hoorneman Bankiers N.V., Van der Hoop Bankiers and Indover were excluded from final models due to a lack of data availability. All other banks that possess a banking license but were not included were excluded either due to lack of data availability for the indicators used in the benchmark model by Betz et al. (2014).

Table A12.
Comparison of Deposit Guarantee Scheme Liability Between 3% and 10% banks Defaulting Scenarios.

	Total remaining with haircut in 25% scenario		Total remaining without haircut in 25% scenario	
Quarter	3% banks defaulting	10% banks defaulting	3% banks defaulting	10% banks defaulting
2018 Q1	€0	€79	€0	€1,947
2017 Q4	€0	€79	€0	€1,947
2017 Q3	€0	€67	€0	€2,111
2017 Q2	€0	€67	€0	€2,111
2017 Q1	€13	€13	€292	€1,921
2016 Q4	€13	€13	€292	€1,921
2016 Q3	€53	€53	€581	€1,388
2016 Q2	€53	€53	€581	€1,388
2016 Q1	€0	€0	€0	€2,748
2015 Q4	€0	€0	€0	€2,748
2015 Q3	€0	€0	€0	€0
2015 Q2	€0	€0	€0	€0
2015 Q1	€0	€0	€0	€0
2014 Q4	€0	€0	€0	€0
2014 Q3	€0	€0	€0	€0
2014 Q2	€0	€0	€0	€0
2014 Q1	€0	€0	€0	€0
2013 Q4	€0	€0	€0	€0
2013 Q3	€0	€0	€0	€0
2013 Q2	€0	€0	€0	€0
2013 Q1	€0	€0	€0	€0
2012 Q4	€0	€0	€0	€0
2012 Q3	€0	€0	€0	€0
2012 Q2	€0	€0	€0	€0

Note: Total remaining is the total sum that the defaulting bank or banks are unable to absorb through their bail-inable securities and that therefore needs to be covered by the Deposit Guarantee Scheme. All amounts listed in millions. For reference: the limit of the Deposit Guarantee Scheme using the combined ex-ante funds and an ex-post contribution is €3.8 billion.

Table A13

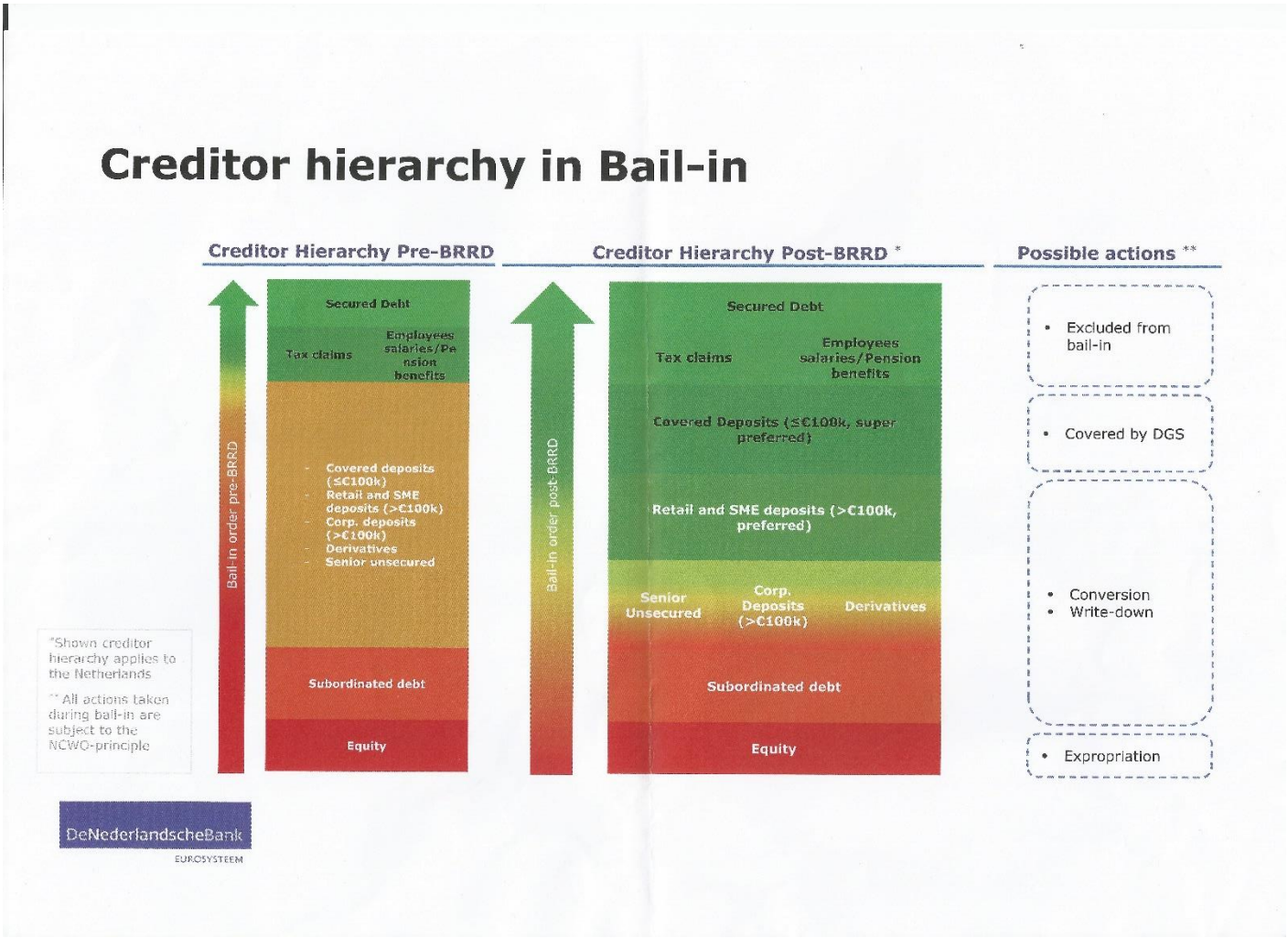
Necessary Write-down to Reach the Limit of Government Backstop per Quarter.

	Write-down % necessary (loss given default)	Average probability of default	% Assets of total banking sector	% Layer 1	% Layer 2	% Layer 3	% Layer 4
2018 Q1	40.40%	0.51%	85.0%	11.26%	4.27%	47.99%	36.48%
2017 Q4	40.48%	0.66%	85.0%	11.24%	4.27%	47.96%	36.53%
2017 Q3	43.16%	0.64%	84.6%	10.42%	4.18%	52.00%	33.40%
2017 Q2	43.18%	0.87%	84.6%	10.33%	4.18%	52.06%	33.43%
2017 Q1	42.85%	0.76%	84.7%	10.29%	4.19%	52.04%	33.48%
2016 Q4	43.32%	0.97%	84.5%	10.28%	4.20%	52.18%	33.34%
2016 Q3	39.57%	0.81%	85.9%	9.24%	3.63%	52.61%	34.53%
2016 Q2	39.72%	1.21%	85.8%	9.22%	3.63%	52.61%	34.54%
2016 Q1	39.82%	1.34%	85.8%	9.25%	3.64%	52.76%	34.35%
2015 Q4	39.99%	1.58%	85.8%	9.18%	3.63%	52.54%	34.66%
2015 Q3	46.73%	1.75%	84.7%	8.65%	3.26%	58.71%	29.38%
2015 Q2	46.73%	2.43%	84.7%	8.55%	3.26%	58.75%	29.44%
2015 Q1	45.69%	2.07%	85.1%	8.56%	3.29%	58.75%	29.40%
2014 Q4	47.36%	2.34%	84.7%	8.53%	3.30%	58.96%	29.20%
2014 Q3	46.24%	2.08%	85.4%	8.24%	2.84%	58.54%	30.38%
2014 Q2	46.42%	2.42%	85.4%	8.20%	2.85%	58.69%	30.25%
2014 Q1	46.86%	1.98%	86.0%	8.25%	2.85%	58.96%	29.94%
2013 Q4	47.27%	3.28%	85.9%	8.27%	2.87%	59.33%	29.53%
2013 Q3	49.75%	4.27%	84.1%	7.83%	2.70%	62.81%	26.66%
2013 Q2	49.48%	3.67%	84.2%	7.81%	2.70%	62.78%	26.71%
2013 Q1	49.09%	5.96%	85.3%	7.83%	2.70%	62.66%	26.80%
2012 Q4	49.73%	5.02%	85.2%	7.82%	2.72%	63.00%	26.46%
2012 Q3	48.21%	4.91%	83.8%	7.59%	2.48%	63.68%	26.25%
2012 Q2	48.47%	4.59%	83.8%	7.58%	2.49%	63.85%	26.09%

Note: This table displays the write-down % necessary to reach a remaining sum to be written down that needs to be absorbed by the Deposit Guarantee Scheme equal to the government backstop during the previous crisis of €168 billion. All calculations based on the 40% of banks most likely to go into distress defaulting at the same time. Average probability of default is calculated as the average probability of default of the 8 to 10 banks that default in this scenario in each quarter, while % assets of total banking sector corresponds to the ratio of the defaulting banks' assets to total banking sector assets in this paper's sample. % layer 1 to layer 4 signify the composition of the defaulting banks' securities, where layer 1 securities correspond to the equity tranche and layer 4 securities to the large deposits tranche as in Section 4.3.

Appendix B: Figures

Figure B1. Creditor Hierarchy pre-BRRD vs post-BRRD in Bail-in.



Source: DNB Masterclass on Resolution, 2018.

Figure B2. Graphical Overview of Dutch Deposit Guarantee Scheme.

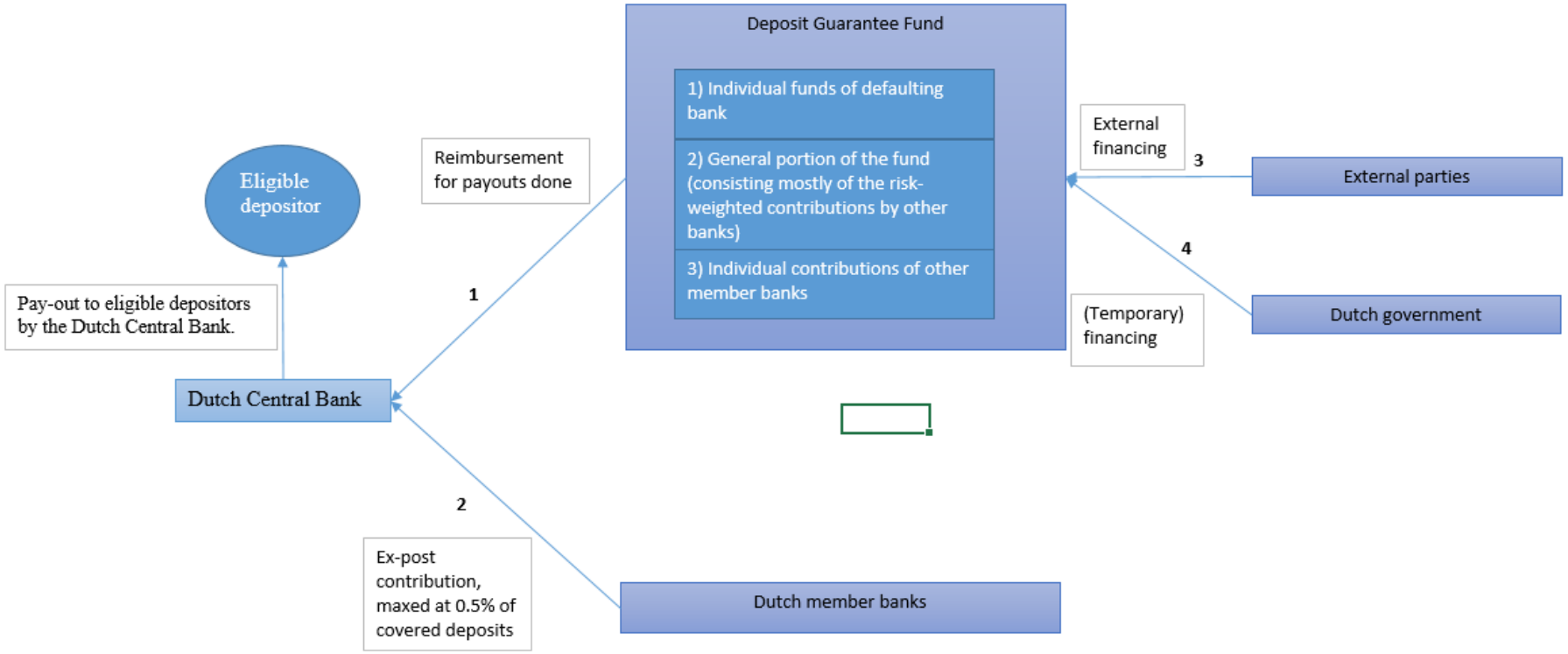


Figure B3. Alternative Options for Resolution, original by Price Waterhouse Coopers (Price Waterhouse Coopers, 2016)

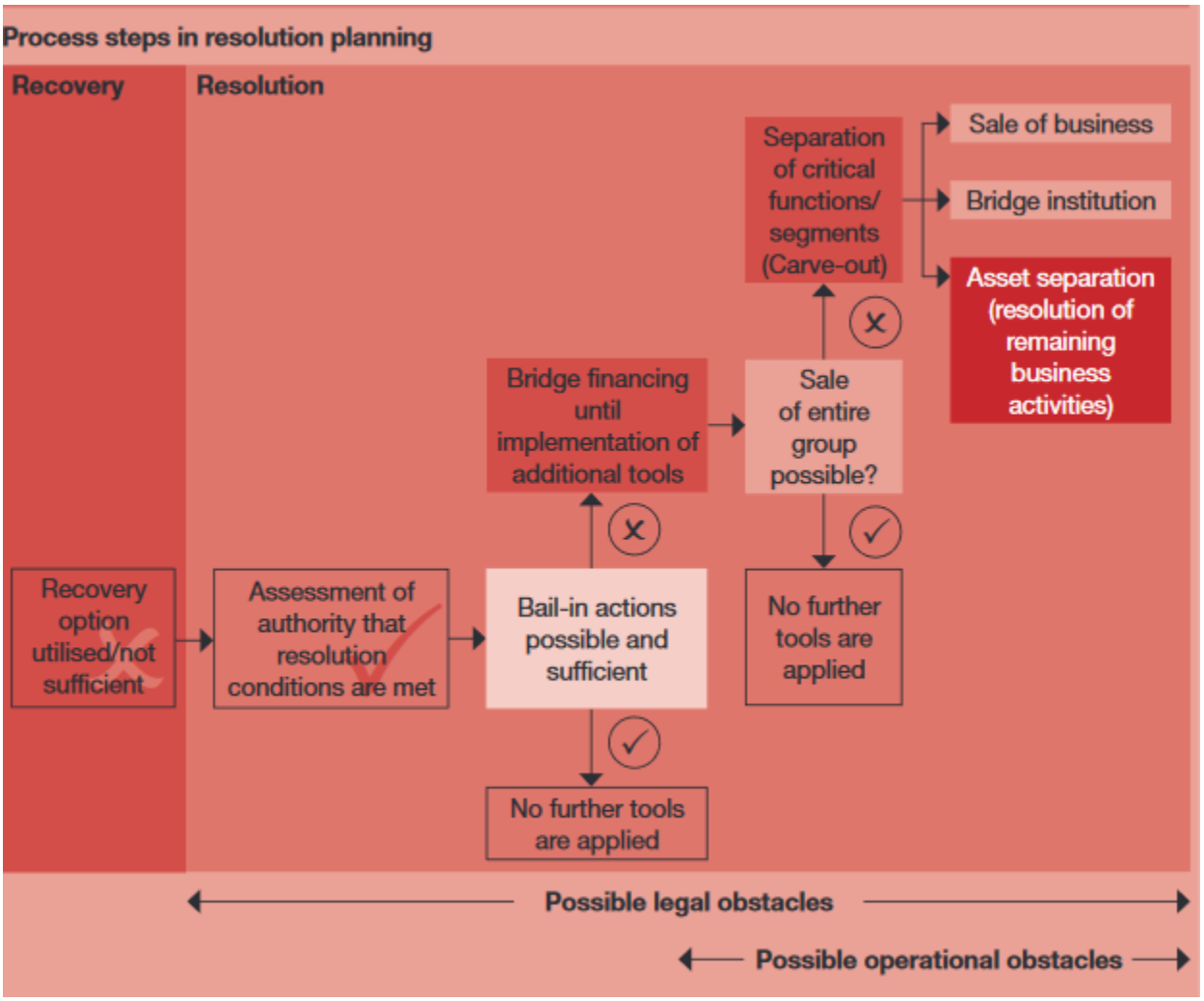


Figure B4. Share of trading income 2011Q4 to 2018Q1.

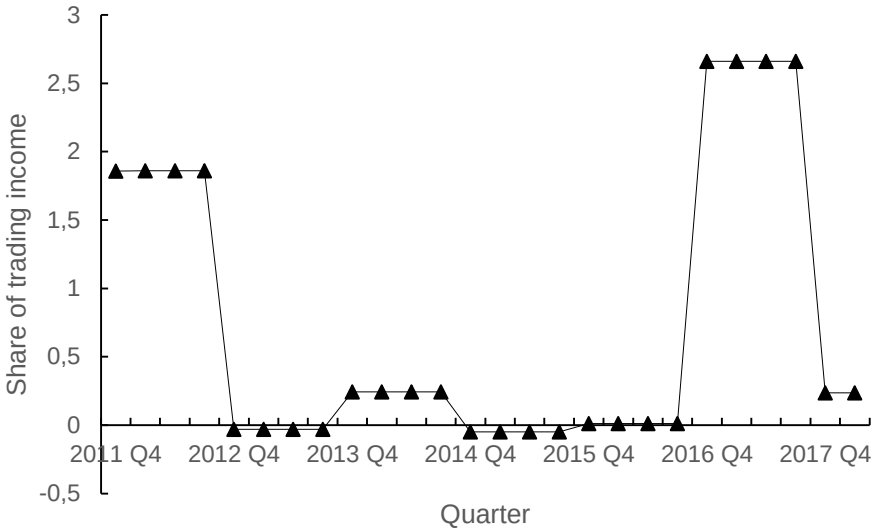


Figure B5. Comparison of benchmark model used to the banking sector indicator and macro-financial indicator models used by Betz et al. (2014).