

# **Zombie Banks and Forbearance Lending: Causes, Effects, and Policy Measures**

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## Chapter I

# Introduction

Zombie banks are banks that are practically insolvent but continue to exist through hiding bad loans on their balance sheet. This can be achieved by rolling over bad loans instead of writing them off, a process known as forbearance lending, zombie lending or evergreening.

Zombie banks have received increased attention of late, not least because of the sovereign debt and banking crisis in Europe. This follows other banking crises in the US and Japan which have equally seen an increased number of bank failures, and where insolvent companies have been kept alive by banks.

This study aims to give a theoretical assessment of the phenomenon around zombie banks and forbearance lending. Although zombie banks are the focus of a wide public debate, the existing research has not been able to fully explain many aspects around zombie banks that have been observed, such as the several motives for forbearance lending, the impact of forbearance lending on the overall loan portfolio of zombie banks, or the right policy response in dealing with them. In light of this, we present three models that simulate the behavior of banks when rolling over bad loans. These models offer insights into the causes and effects of zombie banking, and also allow us to analyze the context of policy measures by the government and the central bank. To put the models into the right context, the study also provides a detailed overview of the theoretical and empirical literature, as well as a case study of the practical experience with zombie banks and forbearance lending in Japan and Europe.

The study applies microeconomic bank models that focus on a representative bank and its behavior under different parameters. The models use a limited time horizon, i.e. two or three periods and incorporate the strategic choice between writing off bad loans or forbearance lending. Banks are able to start forbearance lending because of asymmetric information between the bank manager on the one hand, and the regulator or the creditors on the other hand, as the true value of loans is only known to the bank manager. All papers explicitly model the asset and the liability side of bank activity. This includes aspects such as refinancing costs and bank solvency on the liability side, but also the returns on assets of other parts of the overall loan portfolio, apart from the bad loans. Through this holistic approach, we can gain more insights into the causes and effects of zombie banking than by just highlighting one aspect of bank activity, as both sides of the balance sheet are interconnected with each other.

Before we start, it is worthwhile to give a few clarifying remarks on the terminology used in this study. As already mentioned, there are several terms that are used in the

literature to describe the action of rolling over bad loans by banks, i.e. evergreening, zombie lending or forbearance lending. Early in the literature, this behavior was also often referred to in a wider context as soft budget constraints. For the sake of this study, we will use the term forbearance lending. For forbearance lending to occur, the recipient of the loan –the “zombie borrower”- must be unable to pay back the loan principal in full, which would usually lead to a default, and a bad loan on the bank’s balance sheet. The bank then postpones the payback date of the loan, thus rolling over the bad loan.

Moreover, we will refer to insolvent banks that still remain active as zombie banks. Zombie banks survive by applying forbearance lending, as they hide the true extent of losses of their balance sheet. The two terms “zombie bank” and “forbearance lending” are thus strongly connected. However, they must not always go together: a zombie bank can also emerge if a bank has not valued its assets (e.g. its security portfolio) correctly, which would be similar but not entirely consistent with forbearance lending. At the same time, forbearance lending can theoretically also be exercised by a healthy bank. In reality, however, the two phenomena are strongly connected. For this reason, we use the term zombie banking when referring to the broader context involving both of them, i.e. a zombie bank applying forbearance lending.

The structure of the study is as follows: chapter II starts with an overview of several aspects around zombie banking. This covers the appearance of zombie banking over time and its coverage in the literature. It reviews the causes and consequences of zombie banking, and gives a detailed summary of the policy discussion around it. The chapter also serves as a background to the models presented afterwards and puts them in the right context. Afterwards, it summarizes the different empirical approaches in identifying and quantifying zombie banking. It thus gives a comprehensive view on zombie banking from a theoretical perspective but also gives reference to empirical results and practical experiences in dealing with it.

In each of the following three chapters then, a model is developed that covers a specific aspect of zombie banking, giving us new insights that have not been covered in the literature so far. Chapter VI then looks at the experience with zombie banks in Japan and more recently in Europe as a case study. Finally, chapter VII concludes.

The following will give a summary of the main points that are covered in the three models in chapters III to V. Chapter II puts the results for each model also in a wider context to the existing literature.

The model in chapter III evaluates the incentives for banks to start forbearance lending. While earlier papers have mostly highlighted the possibility for banks to either



recover parts of sunk costs through the supply of additional loans or to gamble for resurrection, this model shows that forbearance lending can also take place in cases where no additional capital is required, and even if recovery values do not improve. Moreover, the model introduces the funding side of the bank into its business activity, which has been neglected so far.

The main proposition is that the lending behavior on the asset side can be triggered through funding concerns on the liability side, as the banks' creditors adjust their credit charges to the perceived solvency of the bank. Due to the informational advantage banks have over their creditors on the quality of the loan book, an extension of bad loans can improve the declared bank performance and deceive bank creditors, resulting in lower funding costs, and higher bank solvency and profitability on a short term basis. Additionally, forbearance lending can help banks to extract excessive profits to pay out dividends to shareholders, if solvency allows.

Chapter IV builds on the insights of the model in chapter III and also incorporates interventions by the government or the central bank. It presents a scenario where insolvent banks roll over bad loans because they seek to avoid a default and can improve their equity capitalization with profits from ongoing business. There is thus a clear link between forbearance lending and zombie banks. Additionally, in line with the previous model these zombie banks can receive cheaper refinancing conditions if they do not disclose bad loans that harm their reported profits, improving their solvency even further. Despite triggering deteriorating asset values, rolling over bad loans has a healing effect for zombie banks.

For the regulator, this means that tolerating forbearance lending is one way of avoiding a bank default during a banking crisis if, for whatever reason, it is decided to rescue insolvent banks. Additionally, it is even possible to support banks in this behavior by lowering their refinancing conditions further through guaranteed debt or a low interest rate policy. Zombie banks that have been revitalized and eventually become solvent will then automatically write-off their bad loans.

Stimulating forbearance lending through guaranteed debt or a low interest rate policy is thus an alternative option to reinstating bank solvency through equity injections or asset transfers. While it brings with it damaging effects to the economy, it can be a more advantageous option for the government under certain conditions than the other two. This is because it can be implemented at little or no direct costs and with a high degree of effectiveness without the danger of a misuse of funds.

Compared to the previous two models, Chapter V switches the perspective of the bank activity and focusses on the lending business. It offers a formal model that explains the

notion that the existence of zombie banks leads to a crowding out of healthy firms by unprofitable ones. As zombie banks roll over bad loans to survive, the lending channel of zombie banks is impaired by the "roadblock" of bad debt in its books. This cuts off firms' access to new loans, whereby the most vulnerable ones are affected the most.

There are three potential policy measures to address this issue, which have mixed effects:

i.) A debt-financed recapitalization through the government turns the zombie bank into a healthy one, but has no positive effect on bank lending, as the bad loans are replaced with government debt in the bank books.

ii.) A zero interest rate policy (ZIRP) leaves the zombie bank unchanged, but improves bank lending, as it reduces the refinancing costs and thus widens the lending channel.

iii.) A debt-financed stimulus by the government to increase loan demand does not address the bank directly, but can lead to improved bank lending. Due to the trade-off between higher loan demand and a crowding out of loans via increased government debt, the net effect depends on the scale of the autonomous loan demand. A successful stimulus then leads to a holding of government bonds in the bank book.

Following the theoretical models, chapter VI provides a case study of zombie banking in Japan during the 1990s/early 2000s and in Europe during the recent sovereign debt and banking crisis. As we will see, the magnitude and course of the banking crisis for both cases is similar. Although the nature of affected banks is different, the policy response in both cases is a mix of limited state intervention via the government and a very expansionary monetary policy by the central bank. The case study then incorporates the lessons and insights from the theoretical models in chapters III to V into the analysis, showing the link between theory and practice.

The models of this study have been presented in various seminars, workshops and conferences, and have thus benefitted from helpful comments by the participants:

The model in chapter III was presented at the Doctoral Seminar in Economics in Leipzig, the annual meeting of the Verein fuer Socialpolitik in Goettingen and the annual meeting of the Nationaloekonomische Gesellschaft in Vienna, all in 2012.

The model in chapter IV was presented at the Doctoral Seminar at the University of Hamburg with Ingrid Groessl and Ulrich Fritsche, and the "Conference on Banking, Finance, Money and Institutions: The Post Crisis Era" at the University of Surrey, Guildford, co-organized by the University of Surrey and Fordham University, both in 2013.

The model in chapter V was presented (in different versions) at the Doctoral Seminar in Economics in Leipzig, "3. Workshop Banken und Finanzmaerkte" at the University of Augsburg, co-organized by the University of Augsburg and University of Magdeburg

(financial support for accommodation and travel expenses is gratefully acknowledged), and the "XXII International Conference on Money, Banking and Finance", hosted by CASMEF - Arcelli Center for Monetary and Financial Studies, at LUISS Guido Carli University in Rome, all in 2013.

## Chapter II

# Zombie Banks and Forbearance Lending: An Overview

This chapter will give an overview on the key aspects of zombie banks and forbearance lending. The purpose of this overview is to give an appropriate background to the topic of this study, which facilitates to put the three chapters that follow in the right context. It also serves to show the key contributions in the literature so far, and to identify its gaps that this study aims to fill. As the models in the following chapters are theoretical in nature, there will be a more detailed review of theoretical papers in the literature.

The plain reason why forbearance lending can occur in the first place is that the information about the quality of the loan book is solely accessible by the bank manager. An external auditor, regulator, debtholder or shareholder may have a general idea about the extent of bad loans in the economy in general and may suspect certain loans to be of low value in a particular bank, but there is no safeguard to the information asymmetry in this respect. Indeed, the fact that forbearance lending is a recurring economic phenomenon over time and across countries confirms that this information asymmetry has not been resolved so far.

Zombie banks use forbearance lending to survive. In simple terms, a zombie bank is a bank with bad loans on its balance sheet that would be insolvent if it had to recognize the true extent of losses from its bad loans. This is because it does not have sufficient equity to digest the write-off of these loans. By rolling over bad loans through forbearance lending, the bank stays alive as a zombie bank.

Although there is consensus that zombie banking has emerged in various forms over time, it is difficult to assess the true scale of it. This is because by nature, banks hide the true extent of bad loans to conceal their state of solvency. This also makes it difficult to classify which bank is a zombie bank and which is just a healthy bank but with bad loans. We will later deal with this difficulty and present some of the estimates and methodologies to approach this.

The structure of this chapter is as follows: the first section describes how and where zombie banking was first observed and documented in the literature. The second section then provides a review of the causes and banks' motivation behind it. An assessment of the effects to the borrower and the bank, but also to the wider economy follows in the third section. Section four gives a summary of the policy discussion. Section five then serves as the link to the rest of this study by showing the connection between the own

research and the literature.

# 1 Documentation of zombie banking

## 1.1 Emergence of zombie banking in historical context

### 1.1.1 The soft budget constraints literature

The first stream of literature that has incorporated aspects of zombie banking is the one about soft budget constraints (SBC).<sup>1</sup> The SBC concept has been first introduced by Kornai (1979) in the context of socialist and transitional economies. To quote from Kornai, Maskin and Roland (2003):

Although state-owned enterprises were vested with a moral and financial interest in maximizing their profits, the chronic loss-makers among them were not allowed to fail. They were always bailed out with financial subsidies or other instruments. Firms could count on surviving even after chronic losses, and this expectation left its mark on their behavior.

The main feature of the SBC is that an organization has a supporting institution that covers all or parts of its deficits. The organization can be a (state-owned) enterprise, while the supporting institution can be a government, a state agency or also a (state-owned) bank. The organization thus faces soft budget constraints, as it does not have to act within its normal constraints, such as liquidity, solvency or debt.

There are several means by which an organization can receive assistance from the supporting institutions. Kornai, Maskin and Roland (2003) categorize them in three groups: fiscal means, e.g. via subsidies or tax concessions; indirect support, e.g. by easing competition for the organization through administrative restrictions on competitors; and finally credit. It is easy to see how the SBC concept can be applied to forbearance lending. The organization, in this case the zombie borrower, would usually be constrained in its activities by the repayment of the bank loan. However, as the supporting institution, i.e. the bank extends the bad loan, the organization is allowed to continue its operation and the constraint becomes soft.

There are many reasons why soft budget constraints are tolerated or built up by the supporting institution. Kornai, Maskin and Roland (2003) identify the potential motives of the supporting institutions for the SBC syndrome as political motivations (such as

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<sup>1</sup>Kornai, Maskin and Roland (2003) give a comprehensive overview on the related literature, both theoretical and empirical, as well as on the forms and motivations behind the SBC syndrome.

avoiding unemployment), paternalism, reputational incentives to prevent financial failure, economic spillover effects, or corruption. As such, the overall motives for SBC are connected with general issues specific to transitional and socialist economies and less to commercial bank activity. While the concept of soft budget constraints has thus incorporated aspects of forbearance lending by banks, in the socialist and transitional economies banks were often in state hands, meaning that they did not operate to maximize profits but rather acted in line with general government objectives. Hence, the evidence of forbearance lending by state-owned bank as part of SBC literature shows that banks may have been used by governments as the channel for SBC, rather than being the ones who initiated it for their own benefit. For these reasons, the insights into the motivation for forbearance lending by these banks within the SBC literature are not always transferrable to commercial banks which seek to maximize profits. Nonetheless, there are several aspects around forbearance lending from the SBC literature that can also be applied to commercial bank, as they are economically reasonable, which we will highlight in section 2 of this chapter.

Apart from the contribution of the SBC literature that explains forbearance lending by banks to firms, the SBC framework has also been applied to bank bailouts, where the bank is the organization and the supporting institution is the state. Indeed, this approach models soft budget constraints on two levels: first, between the state and the bank, and then again between the bank and the borrower. We will refer to these studies later in this chapter.

### 1.1.2 **Zombie banks in Japan**

The financial and banking crisis in Japan in the late 1990s and early 2000s has attracted much research interest on the specific subject of forbearance lending by commercial banks. Indeed, Japan is the most thoroughly studied and analyzed case in the literature in this respect, and stimulated many studies into the causes and consequences of zombie banking.<sup>2</sup> Although some of the early contributions in this literature exist only in Japanese, their results have been taken over and incorporated in the English literature, as mentioned e.g. in Inaba et al. (2005) and Caballero, Hoshi and Kashyap (2008). Nonetheless, there are a few relevant contributions that are available in Japanese only, which will be referred to later in this study.

The reason why zombie banking in Japan has attracted so much interest is because Japan is the first well documented case of zombie banking in a developed economy. Com-

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<sup>2</sup>Inaba et al. (2005) give an overview of the experience of Japan with non-performing loans in relation to the performance of the Japanese economy, where they also present theoretical and empirical studies.

pared to the cases in the SBC literature that provided evidence mostly for transitional and socialist economies, at the outbreak of the crisis in Japan in the early 1990s it was one of the largest and most developed economies in the world. The affected banks were private commercial banks acting in a market economy and not state-owned institutions following government objectives. This showed that forbearance lending was also in the interest of the banks themselves.

Sekine, Kobayashi and Saita (2003) give empirical evidence that forbearance lending took place in Japan during the 1990s after the bubble burst, particularly for firms in the construction and real estate industries that had earlier experienced a surge in loans during the bubble economy of the 1980s. Forbearance lending occurred despite a decline in the interest rate spread, and thus limited profitability. This lowered the profitability of firms in those industries where forbearance lending was most common, as the debt level of these firms was high and return on assets was repressed.

Japan has also been the example where it is clearly established that there is a link between zombie borrowers and zombie banks. Peek and Rosengren (2005) note that Japanese banks engaged in forbearance lending between 1993 and 1999 to avoid write-offs, where the probability of forbearance lending increased with a lower level of capitalization of the bank. According to their estimated probability, in 1999 "sick" manufacturing firms were more likely to receive increased loans than "healthy" firms. Their so called "evergreening hypothesis" is that by keeping the loan current, the bank's balance sheet looks better, since the bank is not required to report such problem loans among its non-performing loans.

Finally, Japan also constitutes an interesting case with regard to the policy measures against zombie banking. The Japanese central bank has shifted to a zero interest rate policy, while the government has applied a wide range of measures, including equity injections, blanket guarantees, and asset transfers through bad banks.<sup>3</sup> The effects and effectiveness of these measures, also in respect to forbearance lending, have been the subject of debate, with the aim to apply the lessons learnt to subsequent crises, such as the recent sovereign debt crisis in Europe.

### 1.1.3 Financial crisis in the US

The (current) financial crisis that broke out in 2008 left banks in the US with high losses and weak capitalizations, leading to large-scale government interventions, including recapitalizations and asset transfer programs. It also triggered a low interest rate policy

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<sup>3</sup>A detailed account of the course of events around the financial crisis including the policy measures is provided by Nakaso (2001), Kanaya and Woo (2000) and Kawai (2005). Vollmer and Bebenroth (2012) also give an overview of the policy reaction by the central bank.

by the central bank. With these features, this environment has been a natural case for comparisons with the situation in Japan.<sup>4</sup>

Indeed, a fragile banking system has been at the heart of the crisis in the US. However, the characteristics of the issues are less reminiscent of the forbearance lending phenomenon observed in Japan. Losses arouse mainly from the correction of the mark-to-market positions in securities portfolios, as illiquid securities such as collateralized debt obligations (CDOs) and asset-backed securities (ABS) lost in market value in a downward spiral. Only to a small extent did losses originate from bad loans to companies that were rolled over. A much bigger concern were the refinancing operations, as a drop in trust led to a liquidity crunch in the interbank lending market. In this period, the effects of signals on the bank's health were crucial. Arguably, in such an environment banks became unwilling to recognize the true extent of losses on their portfolios in fear of a punishment in refinancing operations, resulting in a different kind of zombie bank than observed in Japan.

A sign of how important the appearance of banks to the public was for their business operations can be seen by the reluctance to accept any kind of official support. Banks were unwilling to accept liquidity provisions by the Central Bank, as it may have revealed that the bank was in a weak state, even if the bank was in fact healthy. This is reported by one of the Fed Governors (as cited in Federal Reserve Bank of Richmond 2011):<sup>5</sup>

When uncertainty about the health of individual institutions or the industry as a whole increases, stigma intensifies as the market tries to identify the weaker players. The dilemma facing the Fed is that when discount window borrowing is most needed to keep credit flowing, it is most stigmatized.

Accepting official support by the Fed was thus seen as a revelation for bad bank health, and banks then preferred not to accept it all. The parallels to forbearance lending are that in both cases, banks preferred not to disclose any information about their bad health and avoid transparency. As the market does not know anymore which banks are healthy and which are zombies, the refinancing conditions for all banks deteriorate. Zombie banks thus have repercussions on the activity of healthy banks as well. As we will see later, this is a point that is addressed in one of the models in the study at hand.

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<sup>4</sup>See e.g. Brunnermeier (2009) for a summary of the events in the US. Kashyap and Hoshi (2010) provide a comparison of the situation and policy measures in Japan and the US.

<sup>5</sup>See also Corbett and Mitchell (2000) and Ennis and Weinberg (2010) for an assessment of the stigma and signaling effect of accepting external support.



#### 1.1.4 Sovereign debt and banking crisis in Europe

The recent sovereign debt and banking crisis in Europe shares many similarities to the situation in Japan, as outlined by Schnabl (2013).<sup>6</sup> The causes and extent of the crisis are very complex, as they also include (among others) fiscal solvency issues and the design of the European Monetary Union. Nonetheless, zombie banks are one of the key areas of concern and have sparked a large public debate. Financial Times (2013a), e.g. mentions the increasing number of companies that barely survive only to pay interest on their debt, without generating any additional returns to pay back the principal or generate profits. Gros (2013) highlights the high number of banks without a viable and sustainable business model, and warns about the economic costs of keeping zombie banks alive due to misallocation of credit or risky deposits for retail customers that are unaware of the problem. As we will see shortly in the next section, there are various studies with estimates that many European banks are currently undercapitalized and have hidden losses on their balance sheets; other studies confirm that there are companies that survive by delaying the repayment of loans which is tolerated by banks, a clear sign of zombie banking.

The symptom of the crisis common with Japan is that in the peripheral countries, particularly in Spain and Ireland, banks have been suffering under a high burden of non-performing loans since the outbreak of the crisis. This follows a long period of credit booms, mainly in the real estate sector of the economy. Equally, the true extent of the losses is unknown as zombie banks are suspected to be hiding them via forbearance lending.

One big difference to Japan is that the costs of recapitalization have been too high for some countries to handle on their own. As the governments decided to intervene in the financial sector on a large scale, the burden has become too heavy to allow for sustainable state finances, urging the Irish and Spanish government to seek a (partial) bailout from the Troika themselves. This has made clear the interlink between the banking and the sovereign sector, as pointed out in Acharya et al. (2011).

The events thus raise the question on the right policy measures to be taken by the governments and the central bank as a response to zombie banks. While equity injections can recapitalize the banks, they come at a price for the government. The zero interest rate policy (ZIRP) by the ECB, on the other hand, has also been seen by some as a catalyzer for the crisis, as it facilitates the proliferation of harmful zombie banks.<sup>7</sup> At the same time, it serves as a helpful lifeline for banks, also in light of the high costs for government

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<sup>6</sup>See Vollmer (2013), Lane (2012) and Shambaugh (2012) for a detailed account of the crisis.

<sup>7</sup>See for example Eijffinger and Hoogduin (2012), Kraemer (2012), and the German newspaper Frankfurter Allgemeine Zeitung (2012, 2013).

interventions.<sup>8</sup> The debate on zombie banks and the right policy response thus continues.

To summarize, zombie banking has been observed and documented in several forms over the last decades. From the broad definition of soft budget constraints to the evaluation of concrete policy proposals in response to zombie banks and forbearance lending, the literature has been able to incorporate the experience from many countries, thus allowing for deep insights into the subject. The relevance of the topic is underlined by the ongoing discussion in Europe about the right measures to tackle the problems of zombie banks as part of the sovereign debt and banking crisis. Chapter VI will provide more information on the practical issues around zombie banking in a case study of Japan and Europe.

## 1.2 Identifying zombie banking

As we have seen, the appearance of forbearance lending and zombie banks, particularly during times of financial stress or crisis, is a recurring phenomenon. While it is documented that it has indeed occurred in various forms over time, a more difficult task is to quantify the magnitude of the problem.

This is because for once, forbearance lending by nature serves to hide the extent of bad loans on a bank balance sheet. Additionally, this then also complicates the categorization of a bank as a healthy or zombie bank. Since the definition of the zombie bank we use here is a bank with insufficient equity to digest the write-off of its bad loans, not knowing the real volume of bad loans poses difficulties.

In light of this, the following will summarize the attempts that have been applied so far in identifying zombie banking in one way or another. We will look at three overall approaches: ex-post estimates of historical data, estimates based on bank related data, and estimates based on firm (or borrower) related data.

### 1.2.1 Historical data

The most straightforward way of identifying a zombie bank and quantifying the true extent of forbearance lending for a single case is to look for banks that revise their historical balance sheet or earnings performance downwards. This can either happen during a liquidation process or after a bank has received state support. In hindsight then, it is possible to determine what the true value of the bank loans have been and for how long the bank has survived as a zombie bank. The case study in chapter VI highlights the example of a Spanish bank that accepted state assistance, after which it revised the

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<sup>8</sup>See also Rawdanowicz, Bouis and Watanabe (2013) on this subject.

earnings statement for the year preceding the bailout from a profit of a few million Euro into a loss of several billions due to a revaluation of its assets.

Transforming this approach to an entire economy, it would theoretically be possible to add up all write-downs that have happened during this kind of historical performance revision. However, this would just capture those cases of known forbearance lending where the zombie banks ultimately fail, and not those zombie banks who "come back to life" after an upturn in economic activity. It thus paints an incomplete picture.

Another approach is to add up all the bank losses during a certain period. As will be presented in the case study in chapter VI, the IMF (2008) gives an estimate of the total losses incurred by Japanese banks during the banking crisis in the 1990s as 750bn USD, for example. However, this does not separate between regular losses and those by zombie banks, so it cannot specify the magnitude of zombie banking itself.

A better approach is to quantify the extent of state assistance in the banking sector, as estimated e.g. by IMF (2011) for the early stages of the financial crisis in Europe, where the financial assistance accumulated to around 5% of GDP on average for selected countries. While this makes clear the extent of required support for the zombie banks, it does not cover additional hidden losses in bank balance sheets, and is thus also incomplete. Moreover, it cannot separate between losses that were hidden in the balance sheet until the acceptance of state assistance and losses that emerged due to a shock to the economy.

There is thus no case of precise estimates for the scale of forbearance lending or zombie banking on an aggregate basis, based on historical data.

### **1.2.2 Estimates based on bank-related data**

Another way to approach the issue is to estimate the total volume of bad loans in an economy. Comparing this to the official bank balance sheet data would reveal the extent of hidden losses for banks. Going one step further, it would then be possible to compare these hidden losses with the existing bank capital, to identify those banks with a shortfall that survive as zombie banks.

As for the first step, there are once again several approaches to estimate the total amount of bad loans. One is to base it on the reported number of non-performing loans in bank balance sheets and extrapolate this to a wider measure, as done e.g. by PwC (2013) for the case of Europe. They estimate the total amount of non-performing loans to be around 1.1trn EUR in Europe, as we will also see in the case study in chapter VI.

Another approach is to scrutinize each banks' balance sheet in a bottom-up approach and run an outside estimate as to the true value of the assets. The value for each single bank would then have to be added up for all banks to determine the total amount of

assets that have been subject to forbearance lending.

Once the true value of bank assets has been assessed, this can be compared to the capitalization of a bank to determine which banks have a capital shortfall. Those banks that do would then be identified as zombie banks. The problem here is to choose the right level of capitalization that qualifies as solvent, and acts as a dividing line between a healthy and a zombie bank.

In the case of Europe, there are three studies that estimate the total amount of capital shortfall and thus the extent of zombie banking. However, all studies only examine a limited numbers of banks, as it would be too complex to assess each single bank in Europe. S&P (2013) estimates that for the 50 largest banks in Europe alone, the capital shortfall (and thus the extent of zombie banking) is 110 billion Euro. For their estimate they make an outside assessment of the assets on the balance sheet according to their own metrics, and compare it with the equity capital, again normalized by their own definition. The capital shortfall is then the amount "that individual banks would need to increase in order to achieve a neutral ratings impact in [the] capital and earnings assessments".

Another approach is chosen by Schoenmaker and Peek (2014), who look at the 30 largest banks in Europe. They take bank balance sheets as they are, but compare this to the market capitalization for each bank. This assumes that the market capitalization includes the market view on the true value of the capital, including all potential write-offs. They then assume either a 3% or 5% threshold ratio of market capitalization over total assets for each bank to determine the capital shortage for all of the 30 banks. This comes to 84 billion and 365 billion EUR for the 3% and 5% threshold, respectively. In a third estimate, they simulate a financial crisis and calculate what the capital shortfall would then be for a 3% ratio, which comes to 241 billion Euro.

The last paper is by Acharya and Steffen (2014), who run a stress-test for 124 banks in the Euro-area that are subject to the supervision by the ECB from 2014 onwards. It is important to highlight that the main focus of their paper is to estimate the capital shortfall for the banks in a stress scenario, similar to what was done by Schoenmaker and Peek (2014) in their last estimate. By nature, such an approach does not capture how undercapitalized the banks currently are, i.e. what the extent of zombie banking is, but rather how much capital they would need if another financial crisis broke out. However, their study also provides an estimate for an unstressed capital shortfall. The reference point for this is the book value of equity. Compared to S&P (2013) who utilized their own capital estimates and Schoenmaker and Peek (2014) who referred to market capitalization as a proxy for the fair equity value, Acharya and Steffen (2014) thus use the book value of capital as the key indicator. However, due to diverging definitions of book capital, the authors use four different measures for it and compare these numbers with

four relevant leverage thresholds. These measures include pure balance sheet positions in their accounting statements (such as shareholders' equity, tangible and intangible assets, or derivative liabilities) as well as regulatory reporting items such as risk-weighted assets. With this approach, the calculated shortfall on an unstressed basis is between 7.5bn EUR and 66.8bn EUR. Hence, the estimate is much lower on an unstressed basis compared to the other two studies.

The differing estimates show that there is no clear definition and consensus as to the degree of zombie banking. Even using bank related data, it is difficult to quantify the extent of zombie banking and identify zombie banks. This is even more relevant for smaller institutions for which there is even less data available, compared to the largest banks.

### **1.2.3 Estimates based on firm related data**

Instead of looking at bank related data, the flipside would be to look at the borrowers that receive financing from banks to get an indication on the extent of zombie banking. Indeed, this perspective also allows for an estimate of the effect of zombie banking on an economy, which will be elaborated in more detail in section 3 of this chapter.

The SBC literature has picked up many different approaches and indicators for soft bank credit as listed in Kornai, Maskin and Roland (2003), such as unusual debt/equity ratios or cash flows by firms, or loan repayment data. Indeed, there have been numerous studies that examine the extent of soft bank credit in China, Hungary, Romania and many other socialist and transitional economies using these indicators. For the reasons mentioned above, however, the extent of forbearance lending documented here are not representative of matured market economies, as these soft budget constraints may have emerged for non-economical motives.

Nonetheless, some of these approaches have been applied in similar ways to the case of Japan. Sekine, Kobayashi and Saita (2003) approach this problem by looking at firms with a continuously high debt to equity ratio, which indicates that the firm keeps on receiving new financing by a bank. In another step, they check the profitability of such a firm, and see whether an additional bank loan actually lowered the profitability. If both cases apply, they conclude that firm benefitted from forbearance lending. As mentioned earlier, they conclude that forbearance lending did indeed take place in Japan, with negative effects for companies amid higher debt levels and lower profitability.

Caballero, Hoshi and Kashyap (2008) use a different approach and identify zombie firms by focussing on the interest payments of publicly listed companies. They set up an artificial benchmark interest rate, which they assume to be the lowest possible rate

for a healthy borrower. For this, they consider different types of financing products (e.g. commercial paper, convertible bonds, bank loans), and for each product search for the lowest possible rate, either by looking at the prime bank loan rate published with the Bank of Japan, or the lowest coupon issued in five years time. They then look at the publicly available information about the financing structure of listed companies, and normalize their interest payments by accounting for these different financing products. Now that the interest payments are comparable to the artificial benchmark interest rate, they categorize those firms as zombies whose interest payments are lower than this benchmark rate. The intuition behind it is that banks keep these zombie firms alive, and thus offer a subsidized credit interest rate. With this approach they find that in the early 2000s, 30% of the publicly listed companies that represent 15% of the total assets in six key industries are zombie firms, a number that is considerably higher than before the bubble burst.

Finally, a direct way of identifying forbearance lending is presented by Papworth (2013). He refers to a survey with companies in the UK where respondents claim that they are "just paying interest on debts (and not the debt itself)", which matches the characteristics of zombie firms we discussed so far. Other companies with similar characteristics that are in danger of becoming zombie firms include respondents which are "unable to repay debts if small increases in interest rates [happen]" or "struggling to pay debts when they fall due". Finally, there are also firms which are "having to negotiate payment terms with creditors". The last statement, however, would be a sign that the lending bank is able to recognize a write-off in the loan value, which would rule it out as a zombie bank. According to this survey, there are more than 100,000 zombie firms in a narrow sense as of the first statement, and around 200,000 firms which are in danger of becoming zombie firms in the future as a respondent of the second or third statement.

In summary, there are several approaches to identify zombie banking, but due to the nature of hidden losses there is no conclusive measure or evidence that can quantify the true extent in an economy.

## 2 Causes and motivation behind forbearance lending

It was already mentioned that within the SBC literature, it has been identified that the potential motives of the supporting institutions for the SBC syndrome could be as varying as political motivations or corruption, which would typically be less applicable to a commercial bank.<sup>9</sup> The last motive cited by the authors, however, relates to the fact that

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<sup>9</sup>However, Hamao, Kutsuna and Peek (2012) hint to the fact that in the case of Japan, forbearance lending may have also been the result of government pressure on banks "to avoid a massive increase

the supporting institution "may be induced by its own best business interests to extent more credit or invest more capital in a troubled organization". Indeed, the literature has identified many causes for forbearance lending, all of which are economically reasonable.

The following section will cluster the arguments around three main aspects of bank activity: the asset side of the balance sheet, i.e. the lending activity of the bank, the liability side of the balance sheet, i.e. the relationships to shareholders and debtholders, and aspects around the bank manager.

## 2.1 Asset-side driven forbearance lending

For asset-driven forbearance lending to happen, the bank must get some kind of return or benefit from its loan counterparts in exchange for rolling over bad loans.

One of the most intuitive approaches to explain forbearance lending is that banks can improve their recovery value of bad loans if they give borrowers more time and capital to improve the returns on their projects, identified by Dewatripont and Maskin (1995) and Berglöf and Roland (1995) as part of the SBC literature. Their models follow the same basic framework and are based on a lending relationship of a bank to an entrepreneur that requires one unit of capital in  $t=0$ . After one period, the bank learns whether the entrepreneur is able to repay the loan or not. In case of the latter, the recovery value of the loan is low (or actually zero). In  $t=1$ , the bank has to decide whether it will lend the entrepreneur one additional unit of capital. Banks can then only choose whether to refinance the entrepreneur with an additional unit of capital or write-off the loan. If the bank decides to lend the additional unit of capital, the recovery value would be below the costs of the two units of capital together, but still above the one unit that would be completely lost in case of a termination of the loan. Due to the sunk costs from the original loan and the higher recovery value connected to the additional unit of capital, banks decide to engage in forbearance lending.

Berglöf and Roland (1997) use a similar framework, but extend the model by one more period. Banks decide between forbearance lending or terminating the project after the first period, but also have to take into account the alternative to invest the additional unit in a new project. They also incorporate the feature that the decision of banks after the first period has repercussions on the behavior of entrepreneurs in the second period. If the entrepreneur knows that the bank benefits from forbearance lending, he lowers its efforts in the next period. The model then shows that the quality of new loan projects determines whether the bank terminates the loan relationship or starts

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in unemployment, [and] pressure from the government and the Tokyo Stock Exchange to avoid the embarrassment of large numbers of listed-firm failures“.

forbearance lending: if the quality of these alternative projects is high, the bank can convincingly threaten to terminate the old loan, which will improve the performance of the borrower. On the other hand, if the quality of alternative projects is low, the bank has to lend the additional unit of capital to old loan engagements, leading to a credit crunch for new loans.

While these models offer a clear reason for banks to continue relationships with failed counterparts, they also assume that these firms require one additional unit of capital after the first period. However, there are also cases where banks simply roll over bad loans without supplying additional capital, and where this concept can therefore not apply.

In an empirical study, Revankar and Yoshino (2008) refer to competitive pressure among banks for another reason to maintain excessive loans, as happened during the 1990s in Japan, even after the bubble burst. While not providing explicit links to forbearance lending itself, they find that the banks' loan volume was driven by the rivals' loan supply in the previous period (also referred to as "Yokonarabi"). The interpretation is that banks were competing with each other to supply loans to companies, even failed ones. There was thus an interconnectedness among rival banks in their decision for loan supply, which have led to aggressive loan expansion, although the economic environment was cooling down. This has gone so far that banks acted even beyond the scope of profit maximization. Arguably, banks did not cut off loan relationship to defend market share with existing clients, but also in anticipation (or hope) of a recovery in the borrowers' performance.

Peek and Rosengren (2005) offer another Japan-specific angle to the discussion, as they find that forbearance lending was more likely to take place for firms that belonged to the same *keiretsu*, i.e. conglomerate as the bank. This underlines the role of connectedness between bank and borrower in the decision for rolling over bad loans.

Hamao, Kutsuna and Peek (2012) go one step further and find that in contrast to large, listed firms that benefitted from forbearance lending, smaller, non-listed firms were more likely to go bankrupt. Banks thus seemed to prefer those firms for forbearance lending to which they also had a stronger connection. In a phenomenon they call Too-Connected-To-Fail, they find that firms with a higher concentration of share ownership by the main bank led to higher chances of obtaining loans, even if the firm had negative returns. Hence, the degree of the ownership connection between the bank and the loan counterpart also seems to have played a role in the decision of banks to roll over bad loans. Apart from reputational and political reasons, in case of an ownership by the bank in the company this can simply be because the failure of the firm has repercussions both on the loan relationship but also on the value of the holding by the bank.



This finding comes against the background that Japanese banks often have cross-ownerships with companies in the same group, as described e.g. by Scher (2001). As he points out, in the 1980s and early 1990s, around 20% of outstanding shares in a sample of firms were subject to cross-shareholdings by banks and firms. In such instances, the bank takes on a special role within a conglomerate as a main bank. He goes on to provide statistics that the twelve large Japanese banks had cross-shareholdings of between 130 and almost 670 corporations. While this finding is specific to Japan, arguably it should also be relevant for other countries where banks have large and numerous cross-shareholdings.<sup>10</sup>

A similar behavior is confirmed in a formal setting by Kobayashi and Osano (2011), who model the existence of other *non-main* banks next to the main bank in the loan relationship with the company. If the other non-main banks are involved in a specific loan commitment next to the main bank, the threat of their withdrawal enforces more discipline on the main bank, thus pressing it to be more efficient in liquidating distressed loans. This decision depends on the relation between the share of other banks in the overall loan commitment and the liquidation value of the firm. The higher the share of outside banks in the loan contract, the more the main bank would have to refinance in case of a withdrawal of the other banks. The main bank would then have to fund this gap itself or via new funds in the market. Hence, the higher the share of outside banks, the higher the threat on the main bank, leading to a more efficient outcome. In other words, a higher share of financing by the main bank reduces its efforts and makes it more likely that the bank continues distressed loans instead of liquidating them, leading to forbearance lending.

Forbearance lending can thus also happen if the relationship between bank and borrower goes beyond just a simple loan relationship, and a write-off has repercussions elsewhere.

Another contribution to the discussion around forbearance lending in Japan is offered by Seshimo and Yamazaki (2004 and 2007, chapter 11, both only in Japanese). They put the phenomenon in a context to the legal framework for corporate bankruptcies in Japan. Their main proposition is that the Japanese bankruptcy law allows for a violation of the so-called "absolute priority rule", i.e. in case of a corporate bankruptcy, the payout to bank creditors according to seniority can be called off during the bankruptcy proceedings. Banks that are junior creditors would benefit from this approach as they would not be treated junior in case of a bankruptcy. Those banks that are senior creditors, on the other hand, would then be worse off if a bankruptcy of one of their counterparts occurs. This

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<sup>10</sup>For instance, Onetti and Pisoni (2009) show the cross-shareholdings of banks and corporates in Germany, although they do not make a connection to zombie banking in this case.

gives firms the incentive to seek funds from junior creditors in case of financial stress when it cannot obtain further funding from senior creditor sources.

As negotiations between junior and senior creditors are costly and senior creditors cannot incentivize (or only at too much cost) the firm to reject junior creditors, senior creditors engage in forbearance lending to avoid a bankruptcy and the disadvantageous status during the proceedings. In a second step, the authors go on to conclude that banks will ultimately lend less to new projects to avoid this kind of forbearance lending, which results in a credit crunch for new project. Empirical evidence of this approach is given in Yamazaki et al. (2008, available in Japanese only), where they find that banks did engage in this form of forbearance lending, but cannot find clear links to a subsequent credit crunch.

This approach of a connection to the legal system is interesting specifically on a case-by-case basis with reference to the respective law environment, although the true impact of this aspect for other countries may be rather limited. After all, for the model framework by Seshimo and Yamazaki to be applicable to other countries, the absolute priority rule among bank creditors must be violated in a bankruptcy proceeding. It is true that there are general deviations from the absolute priority rule in many countries. Djankov et al. (2008) find that "deviations from absolute priority occur in 33 percent of high-income countries, 50 percent of upper-middle income countries, and 74 percent of lower-middle-income countries. They occur in no Nordic countries, 25 percent of English legal origin countries, 52 percent of German legal origin countries, and 74 percent of French legal origin countries." However, these are cases where the absolute priority rule is violated among several types of stakeholders over secured creditors, i.e. where there is a preferred payment of workers, suppliers, tax authorities or shareholders, before creditors are served. The deviation from absolute priority within the group of bank creditors is a special situation that would have to be assessed on a case-by-case basis, and cannot be seen as a general cause for zombie banking in all countries.

## 2.2 Liability-side driven forbearance lending

In contrast to the asset-side driven forbearance lending, the common feature of liability-side driven forbearance lending is that the main motivation behind it is to serve shareholders, e.g. through dividend payments, or to improve the bank's perceived solvency.

A widely attributed motivation to forbearance lending is for weakly capitalized banks to "gamble for resurrection", as modeled in Aghion, Bolton and Fries (1999), Bruche and Llobet (2011), and van Wijnbergen and Homar (2013). Indeed, this behavior combines elements related to both the asset and the liability side of the bank, and provides a strong

link between forbearance lending and zombie banks.

A gamble for resurrection happens if there is the chance for banks that the recovery value of their bad loans improves, even if on average the expected recovery value deteriorates. While a healthy bank would refrain from this kind of activity, a zombie bank embraces the potential upside. This is because a deterioration of the recovery value would not put the zombie bank in a more negative position, as it was insolvent beforehand anyway. Hence, a bank that would expect to be insolvent by foreclosing bad loans has nothing to lose from a gamble of this sort. This was already recognized by Kane (1993):

Limited liability gives zombie institutions the ability to reap potential gains from new investments while saddling the government surety with responsibility for losses. [...] a zombie's tenuous hold on life puts it in a no-lose situation: Head it wins, tails taxpayers and healthy competitors underwrite its loss. This transforms zombie institutions into risk-loving monsters that may aptly be said to "prey" on financial markets and on the profit margin of otherwise viable competitors.

In Aghion, Bolton and Fries (1999), this gamble for resurrection is part of the framework in which the bank manager and the regulator face asymmetric information about the extent of bad loans on the bank's balance sheet. These bad loans can take on several forms of recovery value after one period, which includes a deterioration but also an improvement. The bank manager then has to report to the regulator the extent of the bad loans, which is used by him as a decision for recapitalizations or a closure of the bank. Depending on the closure policy of the regulator, i.e. to liquidate or give additional equity capital, the bank manager then has incentives to over- or understate the extent of the bad loans. In case of an understatement of bad loans, the bank manager "gambles" on the fact that the bad loans could recover.

In Bruche and Llobet (2011), the bank similarly faces bad loans in its portfolio, where their return after rolling them over follows a certain distribution, which includes a potential improvement of the recovery value, but also a potential deterioration. In their model, any returns from loans must be used to pay back debt after one period. When deciding about the amount of bad loans that are disclosed, those banks with a high share of bad loans revert to forbearance lending, as a disclosure would not allow them to pay back the debt in full. Hence, they hope for a higher return on these bad loans that allows the payback of debt after one period.

Van Wijnbergen and Homar (2013), use a similar framework, but they include expectations by the depositors about the return of the portfolio. Under full information, depositors know the amount of bad loans on the bank balance sheet. Rolling over bad

loans can lead to a higher return, but on average leads to lower expected recovery values. Due to the expectation of the depositor and the demanded deposit rate, the bank has to liquidate bad loans in order to generate the necessary expected returns to pay back the depositors. However, under asymmetric information, the depositor now no longer knows the extent of bad loans on the balance sheet. The action of the bank then depends on the expectations of the depositors: if they expect the bank to be solvent, the bank continues operations but no longer has an incentive to liquidate bad loans, and thus opts for forbearance lending. If depositors, however, expect the bank to be insolvent, the bank does not receive financing and has to be liquidated.

A series of paper that highlights how forbearance lending can be triggered mostly by excessive payouts to shareholders is that by Niinimäki (2007, 2012a, 2012b). In his models, a bank can improve its short term profitability by not writing off bad loans through forbearance lending, which allows it to pay out excessive dividends to shareholders as profits are overstated amid hidden loan losses. This can go as far as constituting a Ponzi scheme, where the bank continues to replace old loans with new ones, and in the meantime serves shareholders with dividend payments, as shown in Niinimäki (2012a).

In his models, banks have assets which differ in the timing of their payoff, where quick assets pay a return after one period whereas slow assets only after two. Rolling over a bad loan can thus also be interpreted as a slow asset, even if in reality it was a quick one. The bank can decide whether to monitor borrowers or not, which is costly but influences the return in a positive way. Hence, there are benefits from not monitoring, as it increases the profit margin. Additionally, bad assets can also potentially recover in Niinimäki (2012b), allowing for a gamble for resurrection in a similar fashion as in the other papers above.

Forbearance lending is then mainly due to a moral hazard problem. This can either occur *ex-ante*, i.e. the bank is unwilling to monitor and “pay the consequence” for the bad loans it receives, or *ex-post*, i.e. it gambles for resurrection after the discovery of bad loans. The uneven loss-sharing between regulator and bank manager allows the latter to extract excessive profits and pay them out to shareholders as dividends.

A final explanation for liability-side driven forbearance lending is the reputation of banks in front of its creditors. It was already mentioned that Peek and Rosengren (2005) coined the “evergreening hypothesis” that banks engage in forbearance lending to cover loan losses in the case of Japan. They find a strong link to the regulatory requirements of capital ratios, where banks with capital close to the minimum requirements are more likely to engage in forbearance lending. This behavior can thus be seen as a response by banks to appear officially solvent to the regulator.

Indeed, the importance of the perceived bank health in relation to the public has been evident both in the case of Japan and also the US financial crisis. In case of the former, Nakaso (2001) mentions how banks were initially unwilling to accept state assistance:

Banks were generally reluctant to be singled out as a weak bank requiring capital injection. Thus, all major banks collectively applied for capital injection in order to avoid the risk of being singled out as a weak bank.

Meanwhile, for the case of the US it was already mentioned that there was a strong stigma connected to accepting liquidity measures. Hence, another reason for resorting to forbearance lending is to facilitate disguising true bank health, and consequently improving the appearance of the bank to the public and potential counterparties. As we will see, the role of forbearance lending in allowing banks access to more favorable funding conditions through deceiving counterparties about their true health is one of the focus areas of this study.

Section 4.1 of this chapter will also provide a more detailed account of regulatory policy as a cause for forbearance lending.

### **2.3 Bank manager's private benefit**

A final approach to explain forbearance lending has been to assume that bank managers have a private benefit by staying in power, as suggested by Aghion, Bolton and Fries (1999) and Mitchell (2001) as part of the SBC literature. The plain reason is that the benefit of bank managers, most notably the compensation but potentially also any dissipation of bank assets or other private benefits, are linked to the continuation of bank activity. If the bank is insolvent and liquidated, the bank manager would lose his benefits.

Both models consider a private benefit function for the bank manager for every period he stays in operation. In Aghion, Bolton and Fries (1999), it was already mentioned that the bank manager can gamble for resurrection and thus has a motivation to roll over bad loans and be entitled to additional benefits. In this case, the interests of the bank manager and those of the shareholders are aligned.

Mitchell (2001) offers a slightly different framework for explaining forbearance lending. In her model, there is asymmetric information not only between the bank and the regulator about the extent of bad loans, but there is also another level of asymmetric information between the bank and the borrower. In a two period model, banks learn after one period whether a borrower represents a good or a bad loan. However, at this stage the bank does not know the recovery value of the loan yet. It then faces two choices: either starting bankruptcy procedures for the borrower, which is costly, or rolling over the bad loan

and learning the recovery value later. In case of forbearance lending, recovery values cannot improve, so there is no way for the bank to gamble for resurrection. Instead, the borrower's manager has the chance to dissipate assets from the firm in case of forbearance lending, which lowers the recovery value even further. Choosing bankruptcy proceeding for the borrower, on the other hand, gives the bank information about the recovery value, but it also reveals to the regulator that the loan is a bad loan. In such an instance, the bank can choose forbearance lending to hide bad loans from the regulator, but it implies a deterioration of the bank performance. Bank managers then choose forbearance lending, whenever the choice for bankruptcy proceedings would reveal that the bank itself was insolvent, and thus the bank operation would be terminated. This is because the bank manager would not get his private benefit in such a case.

The model by Mitchell (2001) implies that the interests of the bank manager to be engaged in forbearance lending can be ambiguous in relation to the shareholders: if the bank performance is expected to deteriorate through forbearance lending, it is against the interest of the shareholder but in favor of the payoff for the manager to roll over bad loans. However, as can be seen in the case of the gamble for resurrection, the interests of the shareholder and the bank manager can also often be aligned if there is the change that the recovery value improves again.

In summary, there are a number of reasons why a bank decides to roll over bad loans. In reality, forbearance lending is often a combination of several of these factors. Which one of those is the main driver then depends on the economic (and sometimes legal) environment and can also be bank and country-specific.

### **3 Effects and consequences of zombie banking**

The many observances of zombie banking over time have naturally also provided insights into what kind of effects it can bring about. We can split up the identified effects into those that take place immediately on a micro-level, e.g. changes in the behavior of the zombie borrower, and the more far-reaching consequences on a macro-level, e.g. on productivity across industries. Many of the insights on the micro level come from theoretical models, whereas most of the macro-analysis has been done empirically. Generally speaking, the effects of zombie banking are predominantly negative.

### 3.1 Effects on microlevel

The identified effects on a microlevel can again be divided into those on the behavior of the borrower on the one hand, and the consequences for the bank business on the other.

It is not surprising that companies react to the fact that a bank changes its strict repayment guidelines to an existing contract and softens its stance. After all, the company is told to pay back the loan amount at the start of the contract by the bank, but gets away with not fulfilling its obligation ex-post. The negative effects on the behavior of the zombie borrower have been well summarized already in the SBC literature, as can be seen in Kornai, Maskin and Roland (2003):

Perhaps the most important [distortion] is the attenuation of managerial effort to maximize profits, or, when there is no profit motive, to reduce costs. There is also a weakening of the drive to innovate and develop new technologies and products. Finally, rather than wooing customers, sellers concentrate more on winning the favor of potential [supporting] organizations. [...] All these effects reduce the efficiency of organizations affected by the SBC.

Mitchell (2001) points out that this effect comes about for two reasons: first, there is asymmetric information between banks and the borrowers, and banks do not have sufficient access themselves to the real recovery values of companies without bankruptcy procedures. Second, even if banks had knowledge about it, they could not incentivize the borrower to change its behavior as the threat with bankruptcy is not credible, because they would themselves be liquidated. The firm thus gets away with a deterioration of its efforts or performance.

Zombie banking also has effects on the bank lending business, i.e. the overall loan volume, the loan interest rate or what kind of projects are financed by the bank. There are three model types that take on aspects of lending behavior by zombie banks, although there is no conclusive agreement whether banks reduce or increase lending, and what kind of borrower benefits from this.

The first approach to look at bank lending by zombie banks is their motivation to gamble for resurrection, as modeled in Aghion, Bolton and Fries (1999), Bruche and Llobet (2011), and van Wijnbergen and Homar (2013). As mentioned, under this framework banks extend bad loans to unprofitable firms in hope of an improvement in their recovery values. This leads to the situation that zombie firms crowd out profitable ones, as zombie firms are kept alive and there are less funds available for healthy ones. Bruche and Llobet (2011) show that banks also assume higher risks as they hope to survive through a higher return on their loans in the future.

Another string of models that look at the lending behavior of a zombie bank is by Niinimäki (2007, 2012a, 2012b). As it was mentioned already, forbearance lending allows the bank manager to reduce its monitoring efforts, which leads to higher profitability on the short term. A constant extension of bad loans by refinancing old loans with new engagement can then lead to a Ponzi game. Arguably, forbearance lending can thus go on indefinitely.

In this context, in Niinimäki (2007) it is shown that the bank can increase its balance sheet after it has discovered the bad loans. The bank then expands its spectrum of loan counterparts to receive additional interest income that covers up the losses from bad loans. In contrast to the approach for a gamble for resurrection, the bank lending volume, including that to new loan counterparts is now increased, which runs counter the intuition of the crowding out effect that was just described above.

The last model that looks at the effect on lending conditions by a bank that is exercising forbearance lending, is the paper by Berglöf and Roland (1997). As the bank has the sunk costs from its original loan engagement, it faces the situation of either writing off the first unit, or giving another unit and at least recover parts of both. The model shows that by keeping alive these kinds of unprofitable projects, the bank has less funds for financing new ones, which leads to a credit crunch for new projects. While the model thus explains why unprofitable firms survive, it does not allow for an analysis as to which firms receive financing, and what the lending conditions are.

In light of this inconclusive view on the effect of bank lending, the study at hand will provide another approach to explaining the lending behavior by zombie banks, which will focus on the lending conditions, i.e. the loan volume and the loan interest rate, as well as the counterparts for new loan business.

As already mentioned, there are only few positive aspects of forbearance lending and zombie banks identified in the literature. One of them includes Mitchell (2001) who accounts for the aspect that banks contain private information about their loan relationship, and that transferring or cancelling these loans takes away this information. Extending these loan relationships thus leaves this kind of information with the bank. We will later have a look at how policy measures can incorporate this feature.

### **3.2 Effects on macrolevel**

The distorting and damaging effects of forbearance lending that have been identified empirically on a macrolevel are in line with the findings from the microlevel. The most commonly used case study for empirical evidence is Japan.



As for the behavior of zombie firms, the lower productivity in sectors with forbearance lending is confirmed by numerous studies applied to Japan, including Sekine, Kobayashi and Saita (2003), Ahearne and Shinada (2005), Hoshi (2006), Caballero, Hoshi and Kashyap (2008), and Kwon, Narita and Narita (2009).

We have already alluded to the finding by Sekine, Kobayashi and Saita (2003) that for the case of Japan forbearance lending reduced firms' profitability due to the high levels of debt and repressed return on assets.

Ahearne and Shinada (2005) look at the productivity of Japanese companies in various industries. They find that productivity is much higher in traded goods sectors such as chemicals or electric components, and non-traded good sectors such as construction. They then look at the development of market shares within an industry. Typically, companies that are more productive increase the market share within their industry, implying that overall productivity goes up. However, they find that in sectors with weak productivity, the market share of unproductive firms actually increased.

In a second step, they connect this to the lending behavior by banks. They find that for the more productive traded goods sectors, bank lending declined sharply during the banking crisis, while lending to non-traded goods sectors actually increased, a clear sign of forbearance lending. Finally, they break down the industry on a firm-level and look at the lending behavior within an industry compared to each firm's market share. During the 1980s, i.e. in the run-up to the banking crisis, there is a correlation between bank lending and an increase in market share, meaning that banks increased lending to those companies that also increased their market share. In the 1990s, however, the pattern is less clear: for companies in non-traded sectors, lending increased with market share but the opposite was true for the traded sectors. Banks thus facilitated the increase in market share of unproductive firms via forbearance lending.

Hoshi (2006) looks at the characteristics of the zombie firms that were sustained by the banks through forbearance lending. In line with the studies above, he concludes that "zombie firms are found to be less profitable, more indebted, more dependent on their main banks, more likely to be found in non-manufacturing industries and more often located outside large metropolitan areas".

The fact that zombie firms survive and increase market share means that healthy firms are crowded out of the market. The study by Caballero, Hoshi and Kashyap (2008) already referred to above provides the most extensive evidence of the negative effects this has on other parts of the economy, using the example of Japan. They find that healthy firms reduced investment and employment growth with an increasing number of zombie firms in an industry. Moreover, the existence of zombie firms also implies that healthy firms not only have to be more productive to compete with zombie firms, but that

this productivity gap actually increases with the number of zombie firms in an industry. Overall, the existence of zombie firms leads to a decline in productivity in the economy.

In a subsequent step, this depressed productivity also has negative effects on job creation. As quoted in Rawdanowicz, Bouis and Watanabe (2013), “the rise of zombie firms was associated with falling levels of aggregate restructuring (job destruction and creation were smaller in industries with more zombies), while investment and employment growth for healthy firms was negatively related to the proportion of zombie firms in their industry.” Kwon, Narita and Narita (2009) estimate that through this inefficient labor reallocation process, 37% of the decline in productivity growth is attributable to forbearance lending.

Apart from these direct effects on the firms and the economy, we saw in the literature dealing with the microeconomic effects of zombie banking, that there can be several effects on the lending behavior by banks and their portfolio composition. Empirical results show some additional insights in this respect.

Peek and Rosengren (2005) show that Japanese firms were more likely to receive additional credit if they were in poor financial condition. However, as already mentioned, this only affected listed firms, while smaller, non-listed firms were not granted such a treatment by the banks, as found by Hamao, Kutsuna and Peek (2012). Hence, the effects of zombie banking seem to have been stronger for large firms than for smaller ones. This confirms that banks may have shifted their portfolios from healthy to poor counterparts, although smaller firms benefitted less from this behavior.

In contrast to this, Fukuda, Kasuya and Nakajima (2006) show that small and medium sized firms actually had better access to loans if the NPL ratio of banks was high. A possible explanation for this discrepancy is that banks maintained high loan volumes as they searched for new business to compensate for the bad loans, which would be in line with what was pointed out previously by Niinimäki (2007). Banks would then hold on to the bad loans from old engagements, but look for additional business as a compensation for the repressed returns in the bad loan portfolio.

It should be noted that Japan also offers some insights into positive side effects of zombie banking. Fukuda and Nakamura (2011) point out that in hindsight, the actual bankruptcy of zombie firms was rare, and instead most of them recovered during the first half of the 2000s as they reduced overcapacities in employment and assets. Forbearance lending thus helped these companies to survive and bought them time to regain health. This development was also supported by a more positive macroeconomic environment. However, debt relief was found to be one of the external support factors, indicating that banks had to realize at least some of the losses, even if the recovery value had improved.

## 4 Policy discussion

The extensive coverage of zombie banking in the literature naturally also includes a discussion on the right policy measures. In this section, we will look at various aspects in the interrelationship of bank behavior and policy measures: first, we summarize how zombie banking has been tolerated or consciously ignored by the regulator. We then summarize how zombie banking has actually been the result of certain policy interventions. Afterwards, we look at the question which measures would be the appropriate response to its appearance. For this, the suggested measures have to be put in a wider context, as the discussion of the right policy response is also associated with the literature around general interventions in the banking sector.

### 4.1 Zombie banking as tolerated by the regulator

Given that zombie banking has occurred so repeatedly over time and in some cases with quite obvious and observable signs, it may seem surprising that it is still possible for banks to hide the true extent of losses on the balance sheets. Indeed, there are several accounts and approaches in the literature that claim that regulators have knowingly ignored or tolerated forbearance lending. In the SBC literature, it was already alluded to the fact that state-owned banks acted according to the objectives of the government, and were often just used as a means of allowing soft budget constraints to struggling companies. However, even for commercial banks there have been accounts that regulators knowingly concealed the true value of bank assets.

Kane (1993) has been credited with first applying the term "zombies" to banks, in his reference to banks in the US savings and loan crisis during the 1980s. His main criticism is that US authorities knowingly accepted incorrect accounts about the true value of bank balance sheets. With a view to the Japanese banks in the 1990s, he warned about a repeat of the same mistake and recommended the avoidance of hidden losses in bank books.

Kane's main argument is that there is an incentive problem for regulators in carrying out their work. He presents a formal model that focusses on the utility of a bank regulator, which depends on the market value of banks on the one hand, but also on the private benefit of the regulator on the other. The market value of the bank can be influenced by deposit insurance, costly monitoring efforts and bank insolvency costs. The regulator now has two opposing interests: on the one hand, his job is ensure that the market value of banks is positive, which encourages him to detect weaknesses in banks' balance sheets. On the other hand, the utility of the regulator suffers from a bank failure, as the public perception of his job performance goes down as a consequence. For this reason,

the regulator has incentives to cover up bank failures and hope for the bank performance to improve in the future.

Apart from an individual incentive problem for the regulator, there are other reasons why zombie banks can be tolerated by the regulator. Some of the reasons for that could be that there is insufficient public support of a use of funds to bail out banks, while others may relate to the high externalities of a bank failure or the limits to available funds from the government. Nakaso (2001) confirms that in the early stages of the financial crisis in Japan, there was also a certain degree of conscious tolerance of the financial situation of the banks:

With hindsight, smaller vulnerable institutions were the first to be hit and it was only a matter of time before larger banks exhausted the buffer to absorb mounting pressure arising from NPLs. Evidence suggests that the Japanese authorities were aware, at least to some extent, of the potential danger, but a general lack of a sense of urgency and support for the use of public funds prevented the authorities from taking decisive actions at this point.

A report by Finpolconsult (2013) gives anecdotal but explicit evidence for regulatory forbearance in the cases of peripheral countries in Europe, particularly Spain. Although the arguments are based on case studies and not on empirical data, the study describes how the regulator tolerated forbearance lending by the Spanish savings banks, or *Cajas*, as a collapse of the banking system would have led to severe repercussions on regional economies:

Many [housing] developers were artificially kept afloat by "extend and pretend". [...] The Spanish regulator managed the forbearance with the clear intention to permit a "soft landing". [...] Contributing to recognition delay were the strong concentrations of risk as well as governance issues. The Cajas were not officially regulated until well into the crisis and [...] they were controlled by regional local governments with little other tax revenue than through selling or taxing land and real estate, transactions that the Cajas financed. Entire regional business models depended thus on the scale of loss recognition, and hopes were long harbored that a soft landing would be possible.

These examples underline the point that tolerating zombie banking can have other reasons than personal incentives as claimed by Kane (1993). In many cases, the regulator tries to buy time by not fully acknowledging the extent of losses. Indeed, the model in chapter IV will illustrate a framework where zombie bank can regain health over time and "come back to life".

## 4.2 Zombie banking as a response to policy measures

There is a large literature that shows that in several instances, zombie banking takes place partly or fully as the result of regulatory requirements or policy interventions. In these cases, a government or central bank policy triggers one of the causes discussed in section 2 of this chapter.

### 4.2.1 Capital requirements

As already mentioned earlier, capital requirements as part of bank regulation can play a key role in inducing forbearance lending. Watanabe (2010), in line with Peek and Rosengren (2005) find that for the case of Japan, banks were more likely to be engaged in forbearance lending if the capital ratio was close to the regulatory requirement. In other words, banks hid losses to avoid a recognition of insolvency and subsequently a closure of bank activity. Additionally, the situation was made worse if the regulator adopted a tough stance on the valuation of balance sheet positions.

He also finds that as a result of the capital requirements, banks changed the composition of the balance sheet, as they reduced the overall loan volume to increase the equity ratio, but at the same time had a higher concentration in bad loans. This result is confirmed by Fukuda, Kasuya and Nakajima (2006), who show that overall bank lending decreased with lower bank solvency, while it increased with higher NPLs.

The theoretical model of Niinimäki (2007) follows a similar kind of argument. Remember that in his model, the bank manager extracts excessive profits and pays them out as dividends to shareholders. He shows that for a given minimum equity ratio, banks can do one of two things to get a better capitalization (in relation to the loan volume): either shrink lending or improve the balance sheet by not reporting fully the extent of loan losses through forbearance lending. A bank with high bad loans that would usually not meet the equity threshold and be closed down, will then roll over bad loans *and* shrink lending to reach the regulatory minimum and pay out any excessive equity, because it knows that it will be closed down one period later after the true nature of the loans surface.

### 4.2.2 Bank closure policies

A topic closely related to capital requirements are bank closure policies. In effect, they determine what happens to a bank once it actually has less equity than required and reaches the state of insolvency. The bank can then either be closed or bailed out.

In the theoretical model by Aghion, Bolton and Fries (1999), the bank starts forbearance lending if the regulator applies a tough closure policy where banks are shut down, as

the bank manager has a private benefit from a continuation of bank activity. The same result is obtained in the model by Niinimäki (2012b).

However, in a theoretical model Berglöf and Roland (1995) show that the opposite can also occur: if the government follows a bank closure policy that is too soft, banks actually rely on the bailout by the government and follow soft budget constraints with their borrowers. The best policy would then be to make a bailout contingent on certain conditions, which we will turn to later again.

There is thus no clear-cut best practice with regard to bank closure policies, as forbearance lending can occur in both cases.

### 4.2.3 Zero interest rate policy

As already mentioned earlier, the appearance of zombie banks is often also linked to a central bank policy of low or zero interest rates. This is because such a policy reduces the refinancing costs and gives banks liquidity to survive, even if they may actually be insolvent. To allow their survival even under insolvency, these zombie banks engage in forbearance lending to hide the losses.

Schnabl (2013) outlines the parallels between Japan and the current situation in Europe, and describes the negative impact of a low or zero interest rate policy in combination with the proliferation of zombie banks. A ZIRP is often the consequence of a boom-bust cycle, as banks struggle in the aftermath of a lending boom when demand disappears. He also outlines how a ZIRP takes away benchmark comparison rates for banks, which lead to a distortion in investment projects. This can have two effects: one the one hand, banks may shift their portfolios from corporate loans to government debt, as the relative return of government debt compared to corporate loans increases. On the other hand, as argued in Hoffmann and Schnabl (2013), this can lead to the creation of another bubble as banks overinvest in risky projects. In this regard, a ZIRP can amplify the tendency of zombie banks to gamble for resurrection (as discussed earlier) and take on projects that are too risky. In a subsequent step, Hoffman and Schnabl (2013) argue that the credit boom leads to a bust, which again forces public policy to react with expansionary measures, resulting in a debt trap with continuously low interest rates and high debt levels.

The ZIRP is thus a policy that facilitates zombie banks to survive. Chapter IV will have a detailed look at how this mechanism works exactly in a formal model. Ultimately, the ZIRP may rather serve as an amplifier than the main trigger for zombie banking: the bank expects to have an advantage elsewhere by rolling over bad loans, e.g. increased profitability or a recovery of bad loans. This is also emphasized by Rawdanowicz, Bouis and Watanabe (2013):

Although policy affects the degree of forbearance mainly through banking regulations and supervision, monetary policy stimulus can also play a role in delaying the restructuring of banking sectors. To the extent that signs of ever-greening are already apparent, additional monetary policy stimulus may prolong and intensify these practices, adding to marginal costs.

However, a ZIRP can also give banks additional time to regain health and be revitalized again. The model in chapter IV will shed more light on this.

### **4.3 Policy intervention against zombie banking**

In light of the damaging effects of zombie banking that have been identified in section 3 of this chapter, there are many policy measures that have been advocated in the literature to contain it. Interestingly, they mostly relate to what has been called liability-side driven forbearance lending earlier in this chapter. The vast majority of the suggestions target the problems of bank solvency, gamble for resurrection, and private benefit of bank managers. There are only few policy measures dealing with asset-side driven forbearance lending. Another observation is that policy intervention is typically treated as an ex-post response to the existence of zombie banking, and less as an ex-ante prohibitory measure.

#### **4.3.1 Ex-ante prohibitory measures**

Strikingly, the few examples of policies targeted at asset-side driven forbearance lending are ex-ante prohibitory measures. An obvious recommendation here is to strengthen the quality of bank monitoring by the regulator, as suggested by Niinimäki (2007), as it will make it more costly for banks to hide losses through rolling over bad loans. Similarly, Berglöf and Roland (1995) and Niinimäki (2007) stress the importance of improving monitoring and screening efforts by the bank vis a vis the borrower, as it helps to avoid the build up of bad loans at all.

Capital requirements have been suggested as another ex-ante measure. However, we have just seen that they can also lead banks to start forbearance lending, as banks try to avoid a formal insolvency in front of the regulator. For this reason, Niinimäki (2007) recommends an equity requirement that is higher than a normal ratio, so as to avoid the incentivizing effect they have for border cases. He also proposes that the definition of equity capital is carefully chosen, e.g. by excluding interest receivables as they can lead to excessive dividends. In Niinimäki (2012b) he goes one step further and encourages the prohibition of dividends payments to shareholders in times of stress.

Berglof and Roland (1995) show another advantage of a high equity capitalization. In their model, this helps the bank in their stance towards borrowers, as it makes clear that banks are less vulnerable to the write-off of a bad loan and thus hardens the budget constraint.

Overall, the role of capital requirements for the existence of zombie banking is not clear-cut. While they may initially help to discourage it, once a banking crisis has occurred and bank capitalization is weak, they seem to have a rather stimulating effect for forbearance lending. For this reason, the majority of policy suggestions are ex-post measures reminiscent of crisis management tools.

### 4.3.2 Recapitalization via equity injection

The most widely proposed remedy against zombie banking are recapitalization policies. This is not surprising, as bank insolvency is often seen as the most common cause for forbearance lending, and recapitalizations have been studied in detail for tools against insolvent banks. Philippon and Schnabl (2013), for instance, establish in a theoretical model without specific relation to zombie banking that, in dealing with an undercapitalized bank, equity injections (against preferred stock plus warrants) are the most effective and cost-efficient tool compared to asset transfers and debt guarantees. This is because it gives governments the option to participate on an upside of bank activity, while it also discourages opportunistic exploitation by other banks.

Van Wijnbergen and Homar (2013) give empirical evidence as to the success of equity injections, as they investigate the effects of a government intervention in the financial sector during a recession on the length and severity of the crisis. They compare 65 systemic bank crises, and find that bank recapitalization policies shorten the recession by half, while liquidity support also has a positive effect, albeit on a lesser scale. Although the empirical study has no direct link to forbearance lending, the authors attribute the success of the intervention to the containment of zombie banking.

In a slightly different way of arguing, Diamond (2001) refers to the case of Japan and the fact that there are strong relationships between the bank and the borrower, reminiscent of the bank specific information on the loan mentioned by Mitchell (2001). He concludes that recapitalizations are helpful for banks as they would help to maintain this kind of information. If there was no support from the government, banks would be engaged in forbearance lending and the recovery value on the assets would fall, due to the loss of relationship-specific information. However, he emphasizes the necessity to make recapitalizations sufficiently large, as small injections actually increase the likelihood of forbearance lending. This point is also illustrated empirically by Giannetti and Simonov



(2013), who found that in the case of Japan, a first capital injection was not large enough and actually encouraged forbearance lending while only a second, larger recapitalization program was effective in discouraging it.

Other studies also underline the importance of the design of equity injections. Berglof and Roland (1995), Aghion, Bolton and Fries (1999) as well as Philippon and Schnabl (2013) recommend making equity injection contingent on certain conditions, such as increased monitoring efforts, the liquidation of bad loans or sufficient participation by banks in the economy. In an empirical study, Allen, Chakrabarty and Watanabe (2011) find that in the case of Japan, blanket capital injections for all banks in the economy did not lead to an aggregate increase in lending, while a tailored approach where a capital injection was targeted at banks close to the regulatory insolvency ratio had a positive result. Montgomery and Shimizutani (2009) confirm in a study of the same measures that the targeted approach led banks to write-off bad loans whereas the former was rather ineffective in that respect. However, as mentioned by Kashyap and Hoshi (2010), under the targeted approach banks were forced to increase lending to small and medium firms as a condition for the capital injection. Even then some banks cut back their lending and were thus ordered to increase the loan volume or be subject to fines, which led to many conflicts.

Another factor that influences the success of equity injections is the increase in government spending. This is also emphasized by Schnabl (2013), in reference to Polleit (2011):

The recapitalization cannot prevent a credit crunch, because credit to the private sector is crowded out by credit to the public sector. Because the governments have no liquidity buffers available, they have to raise the funds, which are needed for the recapitalization by issuing more government debt. The recapitalization of commercial banks allows banks to expand their credit volume, which will however be absorbed by an additional credit demand of the government sector.

This kind of crowding out of private sector lending by the government is also the focus of one of the models in the study at hand.

As we can see, blanket equity injections may not always be effective in combating forbearance lending. On the other hand, it was mentioned already that it reduces the stigma effect that was also cited by Nakaso (2001), and would thus make it easier for banks to participate. This is also one of the conclusions by Kashyap and Hoshi (2010), who see it crucial that any capitalization plan induces the participation by banks.

While equity injections have been proposed as a solution to zombie banking, it is clear that they do not always lead to the desirable result. The optimal design of equity injections are thus also one important factor in determining its success. However, the main problem is that banks can overstate the need for funds, as the regulator does not have information on the bad loans for each bank. This makes recapitalizations potentially very costly. For this reason, asset transfers have been highlighted as another tool to combat zombie banking.

### 4.3.3 Asset transfers

There are several theoretical models that highlight the benefits of asset transfers as a measure against zombie banking, e.g. Berglof and Roland (1995), Aghion, Bolton and Fries (1999), Mitchell (2001), and Bruche and Llobet (2011). The main mechanism behind them is that banks are given the opportunity to sell their bad loans to a state-owned asset management company (AMC), or bad bank. The benefits of asset transfers compared to recapitalizations, especially regarding the scale of interventions, come from the flexibility around design and pricing which give banks the right incentives to participate, but restrain them in exploiting government support.

Berglof and Roland (1995) show that the efficiency of an asset transfer depends on the volume and quality of the loan portfolio. If all bad loans are transferred, it is costly for the government as it reduces the incentives of the bank for hardening the budget constraints. The same effect happens if the quality of the loans is too poor.

Aghion, Bolton and Fries (1999) offer a more elaborated design and suggest a non-linear transfer price. This would serve to contain the incentive of overstating the amount of bad loans, and would make the scheme more efficient.

An even more sophisticated scheme is presented by Bruche and Llobet (2011), in which the bank has to pay an initial fee to participate, but then receives a subsidy for each loan that is transferred. The regulator then offers banks a range of these two-part tariffs, where a higher participation fee also implies a higher subsidy. Through this mechanism, they show that banks are incentivized to participate and give the true state of the bad loans while there are no further informational rents vis a vis the regulator.

While these models show advantages compared to a recapitalization policy, there are also some shortcomings. As already mentioned, Mitchell (2001) points out that a transfer of loans takes away valuable private information held by the bank about the borrower, which lowers the recovery value for the bad bank. The bad loan may thus be more valuable if it stays with the originating bank, as also suggested by Diamond (2001).

However, the biggest problem with asset transfers is their implementation. Although the design and pricing mechanism may work in a theoretical model, there seem to be difficulties in practice. After all, there are many additional aspects to asset transfers than just the transfer price. Mitchell (2001) mentions just a few:

These questions include whether the AMC [Asset Management Company] should be closed after it has finished handling the debt that has been transferred to it, whether the AMC receives good as well as bad assets, whether the AMC should be privately or publicly funded, and whether there should be one AMC as opposed to several, each being associated with a particular commercial bank. Countries that have established AMCs have in fact differed in the ways in which they have answered these questions.

At this stage, there are no empirical studies that assess the effectiveness of asset transfers against forbearance lending. However, there are some case studies that evaluate the general experience of countries which have applied asset transfers to reinstate bank solvency, namely Kashyap and Hoshi (2010) for the case of Japan and the US, and Calomiris, Klingebiel and Laeven (2005) for Sweden, Mexico, Indonesia and Korea. If these schemes were successful in reinstating bank solvency, they could be seen at least as a first step to also contain forbearance lending.

In all cases, asset transfers had different formats in relation to the pricing mechanism, but also regarding some of the points that were mentioned above. However, regardless of the design, the experience with asset transfers can be described as mixed at best. Kashyap and Hoshi (2010) conclude that in the cases of both Japan in the 1990s and the US in 2008, asset transfer programs were less successful and participation in the finally implemented schemes was limited. There were several reasons for this: the stigma that is connected to the participation of a government support scheme, restrictions for participants (e.g. on executive pay), the way bad banks deal with the bad loans once they are assumed, finding the right market price for the assets to be transferred, or the effect on the valuation of banks' liabilities. Calomiris, Klingebiel and Laeven (2005) paint an even more negative picture for some of the other countries where legal, regulatory and political institutions are even weaker and negotiations between banks and the regulator more difficult. Apart from similar reasons to the case of Japan and the US, they also mention problems of moral hazard and the information asymmetry between the banks and the regulators, and finally an incentive problem (such as corruption or political pressure) for the regulator to follow an efficient implementation.

Hence, asset transfers offer considerable advantages compared to recapitalization policies in theory, but in practice there are difficulties in the implementation which make

them a less promising tool.

### 4.3.4 Bank debt cancellation / restructuring

A last measure to combat zombie banking is to offer banks a cancellation or restructuring of their debt, as suggested by Mitchell (2001). This topic has received increased attention recently as a general crisis management tool, although with little focus specifically on forbearance lending. It may be surprising to suggest a measure that works on bank debt in order to address concerns on bank assets, but the logic would be to relieve banks of their liabilities to increase their solvency. Through this, banks would have more flexibility in working with their bad loans.

Despite this advantage, Mitchell (2001) shows that debt cancellation can have a negative effect on banks in dealing with bad loans, as it takes away the disciplinary measure of a threat of bankruptcy. Firms thus adjust their behavior to such a measure, through which the recovery value for bank can decrease.

Similar to asset transfers, the major problem of bank debt restructurings is the implementation. Philippon and Schnabl (2013) mention just a few:

We assume that the governments options are limited: it cannot simply renegotiate with bank debt holders because debt claims are structured to avoid renegotiation and because bank debt holders are highly dispersed. We further assume that the government prefers to avoid regular bankruptcy procedures, possibly because a large-scale restructuring of the financial sector would trigger runs on other financial institutions and impose large costs on the non-financial sector.

Another problem mentioned by Mitchell (2001) is the “credibility problem”, that banks anticipate a debt restructuring again in the future if it has occurred once, and adjust their behavior accordingly.

There is no empirical evidence on the efficiency of bank debt restructuring as a means against zombie banking. In fact, until recently it has rarely been applied as a measure at all. Mitchell (2001) point out that Bulgaria has been the only transitional economy thus far to cancel debt while Calomiris, Klingebiel and Laeven (2005) mention examples from the US in the 19th century and the 1930s where it was applied. Both cases do not relate to forbearance lending.

However, the debate about debt restructuring has received new momentum since the financial crisis 2008 in the US. In an idea going back to Bebchuk (1988) and Aghion, Hart and Moore (1992), debt-to-equity swaps have been proposed, initially e.g. by Zingales

(2008) as a general measure to deal with insolvent banks and later by Stiglitz (2009) as an explicit measure against zombie banking. In short, debt-to-equity swaps force a bank first to use all its equity to absorb losses. If losses exceed the equity, then the bank's liabilities are converted into equity according to their seniority, until all losses are absorbed. The new equity then allows the bank to continue operation.<sup>11</sup>

The recent efforts in Europe to reinstate bank solvency also make use of elements that are reminiscent of debt-to-equity swaps. For instance, the bail-out for Cyprus included a bank restructuring, while the principles of the bank resolution mechanism agreed by the EU in June 2013 include a participation of debtholders, either via a debt cancellation or debt-to-equity swap.<sup>12</sup>

As there are no documented experiences with bank restructuring in dealing with zombie banking itself, the efforts in Europe should bring new insights as to how effective they are in targeting forbearance lending.

#### **4.3.5 Government stimulus against zombie bank lending**

We have seen that zombie banking also leads to a distorted lending behavior and to a crowding out among firms, where unprofitable ones push profitable firms out of the market. There can thus be a credit crunch for healthy firms as zombie banks have less funds for healthy firms available. Apart from targeting the zombie bank itself to cure this negative effect, the government can also address the corporate sector directly to ensure an improved lending environment to firms. In this manner, the Japanese government has tried to revive the Japanese economy through many rounds of stimulus programs that have led to a large public debt, as mentioned in Schnabl (2013).

However, the accumulation of a large public debt also has to be financed with the issuance of government bonds. In the case of Japan, these bonds have been issued on a massive scale, which were increasingly placed with the banks. According to Yoshino and Mizoguchi (2013), Japanese banks have directed almost the entire additional inflow of funds they received between 2000 and 2006 to government bonds.<sup>13</sup> There is thus also a link between zombie banks and the holdings of government bonds. The increase in government spending then leads to a similar situation as the one under an equity injection

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<sup>11</sup>The general benefits and principles of debt-to-equity swaps are shown, for instance by Aghion, Hart and Moore (1992), Soares (2012) and Elsinger and Summer (2010).

<sup>12</sup>See Kopf (2013) and European Commission (2013a) on the details about the Cyprus programme and Eurogroup (2013) on the agreement on bank resolution.

<sup>13</sup>According to Yoshino and Mizoguchi (2013) the additional inflow of funds to banks (on top of the existing stock) between 2000 and 2006 was 25trn JPY, out of which 27trn JPY came from Japanese households, who thus overcompensated the outflow on another end. The banks used these funds for additional outflows of 22trn JPY, out of which 21.7 trn JPY was directed to government debt.

by the government, where the credit demand by the private sector is crowded out by the government.

Apart from the brief thoughts sketched out by Polleit (2011) that have been already alluded to, there is no study that links the appearance of zombie banks with increased government debt as a result of a stimulus. Acharya, Drechsler and Schnabl (2011) look into the interdependency of the public sector, banks and the corporate sector, and show the negative feedback loop between banks and sovereigns. The government has to bail out insolvent banks, which in turn affects its own creditworthiness. Banks, on the other hand, hold government bonds, whose value depreciates with lower creditworthiness of the government. Banks thus choose their portfolio between corporate loans and government bonds, and an increase in government spending has an effect on this portfolio choice. While this study shows the feedback loop between banks and sovereigns in case of an external shock, it focusses less on the effect on bank lending, and does not incorporate the existence of zombie banks that roll over bad loans. There is thus no modelling of a crowding out effect within the corporate sector so far, but it will be the focus of one of the models in this study at hand.

### **4.4 Risks of government interventions**

As we can see, there have been many suggestions to deal with zombie banking, and each measure has specific advantages and disadvantages, depending on the design and implementation. Taking a step back, it is clear that most of these measures bear some common risks that are found in any kind of intervention.

The first issue are reputational issues connected to a participation by banks. Many interventions have been ineffective as banks were unwilling to take part as they were afraid of a negative impact on their reputation.

Another question is the actual effectiveness of a measure, even if banks participate. As already mentioned, Montgomery and Shimizutani (2009) give evidence that in the case of Japan, the first round of new funds through equity injections did not necessary lead to higher write-offs of bad loans, as banks simply held extra cash. Such an outcome is even made worse if banks take advantage of the measures and abuse the funds by claiming more than they require, or at inappropriate prices.

This leads to the question as to what kind of costs are justified to intervene at all. While it has been shown that zombie banking does have negative consequences, it is less straightforward to assess whether high costs of intervention weigh up the benefits. In this respect, another important factor to consider is that there may be a limit to the resources of the government. We can assume that the government may only be able to dedicate a

certain level of resources to its interventionary policies, as otherwise its own solvency is affected. Acharya et al. (2011) give an evaluation of the link between sovereign solvency and the intervention in the banking sector in this respect. As was already mentioned, the cases of Cyprus, Spain and Ireland during the recent sovereign debt crisis have shown that bank insolvency can affect sovereign solvency directly and severely.

Moreover, the accumulation of a large government debt also leads to an issuance of government bonds, which have to be placed with banks and can have a negative effect on the availability of credit to the corporate sector.

Finally, any government intervention is connected to the discussion around moral hazard by banks. Berglof and Roland (1995) point out that a continuous bail out by governments affects the attitude of banks and leads to a “gamble-for-bailout”. Banks reduce their monitoring efforts and have soft budget constraints with their borrowers as they count on the government to bail them out. Finally, Philippon and Schnabl (2013) show that government intervention for one bank creates rents to all banks who benefit from reduced credit risk, in the sense of a free-rider problem.<sup>14</sup>

To summarize, we have seen that there is a wide range of policy measures that deal with zombie banking. However, no policy offers a clear solution to fight it without a shortcoming on another end. Most measures do not address zombie banking in isolation, but as part of a more general means to reinstate bank solvency. Hence, they are also related to the general pros and cons of a government intervention.

While it has been shown that zombie banking does have severe negative effects, the benefits of an intervention must be weighed against the costs and other (unintended) consequences. Worse, for some of the policies, it has been shown that they can actually stimulate zombie banking. The discussion about the right policy response to zombie banking thus remains inconclusive.

## 5 Own contributions in literature context

**Outline of each chapter** This study includes three theoretical models that complement the existing literature on several ends:

The first model in chapter III deals primarily with banks’ motivation for forbearance lending. It develops a model in which banks can either be healthy or toxic banks. Toxic banks hide their bad loans in order to improve their own appearance in front of bank creditors, which reduces their funding costs and improves their solvency. Using a two-

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<sup>14</sup>See e.g. Freixas and Rochet (2008), chapter 9.5 for further background on the issues around bank bailouts.

period framework, the model highlights the information asymmetry between the bank and its refinancing counterparties about the quality of the loan book. Banks with bad loans can take advantage of this information asymmetry to improve their own profitability and even solvency.

While the role of reputation has been highlighted before, the role of forbearance lending in influencing the refinancing costs has not been covered explicitly in the literature so far. Most of the reference to the importance of reputation for the operations of zombie banks has been anecdotal in nature, and only dealt with their willingness to accept government assistance. The paper is thus a contribution to the literature that deals with the causes for forbearance lending. However, it also shows that the existence of zombie banks can be harmful to healthy banks, as investors in bank debt are sceptical about the true nature of any bank's health, and demand higher premiums even for good banks that do not have bad loans due to the information asymmetry.

The paper also highlights the asymmetric information between the bank and the bank creditors. It thus emphasizes the importance of yet another layer of information asymmetry, apart from the two levels identified by Mitchell (2001), namely the one between the bank and the borrower, and the one between the bank and the regulator. With this, it is similar to the approach by van Wijnbergen and Homar (2013). However, their model is based on a gamble for resurrection, which is ruled out in this model. As we will see, even without this feature banks still have sufficient incentives for forbearance lending.

The second model shows under which conditions a bank can survive as a zombie bank. In the same spirit as the first model, banks can either be toxic banks or healthy banks. However, in this model a toxic bank can take on different levels of equity capital. Depending on the initial equity level, the toxic bank can then be one of three types: a "survivor bank" which holds sufficient equity to survive a write-off of bad loans, a "zombie bank" that is practically insolvent but remains alive by forbearance lending, or a "liquidation bank" which does not receive sufficient financing to continue its operation. Forbearance lending then gives zombie banks additional time to continue their operations and receive income, which can improve their solvency sufficiently for it to digest a write-off of bad loans afterwards.

The model builds on the insights of the first paper and shows how forbearance lending can have two purposes: first, as a means for banks to lower their refinancing costs, but also second, to buy time and rebuild solvency for banks. This is because zombie banks have additional income from new projects, not only from the bad loan portfolio.

These rather beneficial effects of forbearance lending can be supported by lowering the funding costs further, e.g. by monetary policy. Such a policy measure that looks



to revitalize zombie banks over time can be an alternative to a more direct intervention by the government via equity injections or asset transfers, which can become very costly. While the model is thus also a contribution to the literature around the motivation of banks for forbearance lending, it is also a contribution to the policy discussion.

The notion that zombie banks can regain health and "come back to life" has not received much attention so far. Niinimäki (2007) includes the opportunity for banks to increase their balance sheet and add new loan business to conceal the loan losses. However, the role of refinancing costs is neglected here, as he only assumes one uniform refinancing rate regardless of the bank action or type. The bank then only looks at the asset side to reach the necessary income to survive. The integrated approach of assets and liabilities is thus novel in this paper.

The third and last model relates to the consequences of zombie banking. Compared to the first two papers, which focus primarily on the causes of it, in this model it is shown how the lending behavior, i.e. the loan volume and the loan interest rate for firms, differ for a zombie bank and a healthy bank, and how this affects the borrowers.

As the focus of the model is on the effects of zombie banking, the framework for the existence of the zombie bank is more simple than in the other two models. It looks at one representative bank which is subject to an external shock, and the bank type is defined via the amount of equity it holds. Here, the bank can only be a zombie bank that does not have sufficient equity to write-off the bad loans, or a healthy bank that does. It is important to understand that the healthy bank in this model is also subject to bad loans but can digest the write-off (similar to the "survivor bank" in the second model), whereas in the first two models, the healthy bank is the one that does not even accumulate bad loans in the first place.

Again using a two-period setup, the bank then chooses the optimal lending volume in the second period. We will see that for a zombie bank, the bad loans turn out to be something of a "roadblock" that impairs the flow of funds from savers to borrowers. Zombie banks then have a lower volume of new loans, and also charge a higher interest rate to entrepreneurs, which leads to a lower total rent from private sector activity. With this approach, the model explains how zombie banks are damaging to the economy, and which kind of entrepreneurs are those that suffer the most. It thus addresses those aspects about the lending behavior by zombie banks that were not covered in the models by Berglöf and Roland (1997), Niinimäki (2007), and the models around the gamble for resurrection by Aghion, Bolton and Fries (1999), Bruche and Llobet (2011), and van Wijnbergen and Homar (2013), as mentioned above.

The government or central bank can interfere and try to repair the impaired lending

channel of the zombie bank. However, this affects the activity of the bank negatively elsewhere, leading to a trade-off of the effectiveness of each measure. More specifically, the model formalizes the intuition mentioned by Polleit (2011) and Schnabl (2013) that an equity injection increases the credit demand by the public sector, which crowds out private sector credit. With the focus on the right policy measures, the model thus also contributes to the policy discussion. It also offers an explanation to the increased level of government bond holdings by zombie banks in Japan, as pointed out by Yoshino and Mizoguchi (2013).

It should be noted that the modelling of the government bond rate in this model leads to an apparent contradiction compared to the first two papers: while in those models, the government bond rate corresponds to the risk-free rate and is thus lower than the bank refinancing rate, here it is actually higher, thus giving banks a positive return on holding government bonds. We may think of two potential explanations for this discrepancy: first, we can think of government debt as truly risk-free in the first two models, while we may think of risky government debt (due to dire public finances) in the third model. An alternative way of looking at this is that also in the third model, government debt is risk-free, but simply of longer maturities than bank refinancing (which is modelled to be for one period), leading to higher interest rates than bank refinancing.

After these theoretical models, the case study in chapter VI takes a detailed look at the experience with zombie banks in Japan and more recently in Europe with the results of the models in mind. After giving a background on the nature and course of the crises, including the policy reaction by the governments and the central banks, it applies the theoretical insights to the concrete cases of zombie banking in these regions. In both cases, reputational concerns in front of bank creditors led banks to hide the true extent of bad loans from the public via forbearance lending, as suggested in the first model. Moreover, the public policy response in both instances has been as modelled in chapter IV, namely a support of banks via improved refinancing conditions to give banks more time to improve their health. Finally, the existence of bad loans in bank balance sheets has been the reason for zombie banks to have more restrictive lending policies, particularly for more vulnerable borrowers, as modelled in chapter V. The case study highlights the similarities between the two regions in dealing with these issues and the challenges they face going forward.

**Common modeling approaches** All three papers use a microeconomic framework to analyze the respective topic, i.e. they look at one representative bank and how its behavior changes under different parameters. The models use a limited time horizon, i.e.

two or three period models, in order to focus on the date when the bank has to make the decision to either write-off bad loans or start forbearance lending. The bank manager is modelled to act in line with the shareholder to maximize the bank profit, and there are no private benefits for the bank manager. Due to asymmetric information between the bank manager on the one hand and the regulator or the bank's creditors on the other, only the bank manager knows the true loan quality and can start forbearance lending if it is in the interest of him and the shareholders.

Compared to the overall literature on the microeconomics of banking, the models do not put the focus on the borrower-lender relationship.<sup>15</sup> Apart from the fact that the bank extends the loan to the borrower in case of forbearance lending, elements such as monitoring efforts, renegotiations of loan contracts, debt enforcement, risk sharing, or incomplete contracts do not play a role here. The models, particularly the ones in chapter III and IV, do take up some of the approaches on bank risk-taking behavior used in the literature.<sup>16</sup> There is an element of moral hazard by bank managers as losses are not always fully born by the bank but passed on to creditors. This is due to limited liability by shareholders, as losses can exceed the equity of the bank. However, the models do not simulate allocation choices among assets with different risks, and also do not allow for a gambling for resurrection or private benefit of the bank manager by taking on excessive risks. Finally, the models focus on a representative bank maximizing its profits, without putting it in a competitive environment.<sup>17</sup> While the bank in chapter III and IV still takes the loan interest rate as given, the model in chapter V assumes a monopolistic environment where the bank can decide on the optimal lending conditions to maximize its profits. However, in all models the bank does act in a restricted environment in its refinancing means.

Apart from these features in the context of the literature on the microeconomics of banking, there are two commonly used approaches in all models of this study:

First, all papers explicitly model the asset and the liability side of bank activity. This includes aspects such as refinancing costs and bank solvency on the liability side, but also the returns on other parts of the overall loan portfolio, apart from the bad loans. Through this more holistic approach, we can gain deeper insights into the causes and effects of zombie banking than by just highlighting one aspect of bank activity. This is because both sides of the balance sheet are interconnected with each other. This approach also sheds new lights on some of the policy measures which have been discussed so far.

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<sup>15</sup>See e.g. chapter 4 in Freixas and Rochet (2008) for an overview on this strand of literature.

<sup>16</sup>See e.g. chapter 9 in Freixas and Rochet (2008) for an overview of models around bank risk-taking and regulation.

<sup>17</sup>See e.g. chapter 3 of Freixas and Rochet (2008) for the industrial organization approach to banking.

Second, in all models the recovery value of bad loans is assumed not to improve in case of forbearance lending. This is in contrast to most models, where a chance of an improved recovery value is often the trigger for banks to roll over bad loans. Most of the asset-side driven forbearance lending and a gamble for resurrection that were described earlier in this chapter would not work with this assumption. The study thus offers alternative insights into the causes and consequences of zombie banking that have not been dealt with before.

## Chapter III

# Forbearance Lending: Hiding Bad Loans to Deceive Banks' Creditors

## 1 Introduction

This model offers a theoretical framework for explaining the incentives of banks to start forbearance lending. A key component is that it introduces the funding side of the bank into its business activity, which has been neglected in most theoretical models so far. The main proposition is that the lending behavior on the asset side can be triggered through funding concerns on the liability side, as the banks' creditors adjust their credit charges to the perceived solvency of the bank. Such a behavior is particularly acute during a crisis, when "reputational" aspects about the perceived bank solvency are more crucial than in "normal times", as mentioned in chapter II.

Due to the informational advantage banks have over their creditors on the quality of the loan book, an extension of bad loans can improve the reported bank performance and deceive bank creditors, resulting in lower funding costs, and higher bank solvency and profitability on a short term basis. Additionally, forbearance lending can help banks to extract excessive profits to pay out dividends to shareholders, if solvency allows. Unlike in previous research, in the presented model forbearance lending can also take place in cases where no additional loans to borrowers are required, and even if recovery values do not improve but worsen.

### **Modelling approaches in theoretical literature on forbearance lending so far**

As mentioned in chapter II, there are several theoretical models that explain the motivation of banks for forbearance lending, although none has focussed on the aspect around perceived bank solvency yet. In the models as part of the soft budget constraint literature by Berglöf and Roland (1995) and Dewatripont and Maskin (1995), the bank decides to lend an additional unit of capital for an otherwise bad project, because the recovery value for such a case would be below the costs of the two units of capital together, but still above the one unit that would be completely lost in case of a termination of the loan. Due to the sunk costs from the original loan and the higher recovery value connected to the additional unit of capital, banks decide to engage in forbearance lending.

There are two features of their model that are explored more deeply in this paper

here: first, they assume that the entrepreneur needs one additional unit of capital in  $t=1$  on top of the initial loan in  $t=0$ . However, it is possible (or actually even more likely) that the firm does not need another unit of capital but simply more time to improve the recovery value of the first unit of capital it received. This could be e.g. because of changing economic environments. Moreover and more crucially, it is conceivable that the recovery value of the first unit of capital does not improve at all, irrespective of the fact whether another unit of capital is provided or not. In such a case, the framework used in the SBC literature would not work as laid out by the authors. These features are taken into account in the model structure presented later and represent one of the key contributions of this model. It poses an innovation as now, banks engage in forbearance lending even if there is no immediate gain on the asset side. Their motive for doing so are actually the benefits in other areas, namely the lower funding costs, improved solvency and/or the possibility to extract excess capital.

Second, it is notable that neither of the two papers mentioned above considers the source of additional capital the bank would use to lend, i.e. they assume that banks can easily obtain additional funding through new deposits. However, in case of limited endowment in a closed economy, this additional capital would have to be funded from somewhere, and creditors would have to be given incentives (i.e. high interest rates) to allocate their capital to new bank debt. The funding side, therefore, has not received sufficient attention so far; it will play a central role of the model framework of this paper.

Another widely attributed motivation to forbearance lending that has been elaborated on in chapter II is the “gamble for resurrection”. The key difference of the paper at hand is that a gamble for resurrection is not possible, as the recovery value cannot improve in case of forbearance lending. As a matter of fact, in this paper forbearance lending can only take place if the bank is solvent enough, and not in cases of high expected losses. Moreover, the second result of this paper is that forbearance lending is chosen to deceive creditors and improve the bank’s solvency, not to maximize the return under a limited liability as in their framework.

**(Missing) Link to funding side of bank activity** As already mentioned, given the substantial body of literature on both the SBC syndrome and forbearance lending, it is remarkable that there has not been a theoretical study that links the (forbearance) lending behavior of banks with their own funding operations. The motivation behind this paper, therefore, is to add the effect of the banks’ funding operations to the discussion on forbearance lending. It takes on some of the modelling approaches that have been reviewed in the forbearance lending literature above for the asset side, and combines it

with some aspects that were put forward by the literature on the behavior of banks' creditors. While the latter most commonly simulates situations of bank runs, it offers important insights into the funding side of banks that will be re-used here.

The approach chosen by Gorton (1985) comes closest to the features of bank debt simulated in the paper here: creditors make their investment decision in bank debt (in his case unsecured deposits) subject to the expected losses the bank makes, as all losses are absorbed by creditors. The second reference point for creditors is the yield of an alternative investment instrument. Creditors thus choose their portfolio allocation into bank debt depending on bank profitability and the yield of the alternative instrument, which is precisely the way the funding side is modelled in this paper at hand, too.

Finally, the article by Diamond and Rajan (2001) represents one of the few examples where the effect of bank creditors' behavior on lending activity is modeled, although in a different model environment. In their setup, banks can improve the performance of their lending counterparts (i.e. the firm) as they can credibly threaten to withdraw liquidity, and the incentive for firms to renegotiate their conditions are reduced. Interestingly, the implication of their article is that the funding side of the banks' balance sheets improves their asset side business, which is just contrary to the results of this paper.

**Chapter structure** The following section starts with a presentation of the model parameters. In section 3, the situation for a symmetric information case is explained. Here, both bank creditors and the bank manager have full knowledge about the loan book quality. For this analysis different scenarios are first presented and afterwards compared. In section 4, the paper introduces an informational asymmetry between bank creditors and the bank manager, and identifies differences to the symmetric information case. Section 5 discusses the results and assumptions, and section 6 concludes.

## 2 Model outline

### 2.1 Model set-up

**Features of bank finance** Banks provide loans  $L$  to entrepreneurs. They are refinanced through unsecured debt (called "credit"  $C$  here). This could be thought of as either unsecured bank bonds (as in the case of classical investment banks), interbank-lending or any other wholesale debt. For simplicity's sake, we assume that these credits are most junior second only to equity, and that there are no deposits in this model.<sup>18</sup>

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<sup>18</sup>One may think of the balance sheet of a classical investment bank that does not have deposits. The inclusion of deposits would actually not change the outcome but would unnecessarily complicate the

Equity represents an infinitesimal small share of the balance sheet. Any new equity in the form of profits  $\Pi$  will be paid out immediately as dividends  $\Omega$ .<sup>19</sup> Bank owners are subject to limited liability: losses on loans will thus be shared by creditors, while net profits (after paying interest to creditors) will be distributed to equity shareholders. We assume that the bank manager himself is the sole shareholder of the bank, aligning the incentives of the bank manager with those of the shareholders.

**Sequence of events** There are three dates ( $t=0, 1, 2$ ) and two time periods (between the dates). Loans will initially be paid out in  $t=0$  with the full capital base of the bank, i.e. with the bank debt they place with creditors and the infinitesimal small equity share. Loans have to be repaid in  $t=1$ , unless they are extended by the bank. If the loans are repaid in  $t=1$ , the bank can lend out the returned funds to new projects for another period, to be repaid in  $t=2$ . We will refer to these loans as "new" loans in  $t=1$ . If the loans from  $t=0$  are not repaid but extended by the bank in  $t=1$  for another period, we will refer to them as "old" loans. Hence, the overall loan portfolio in the period between  $t=1$  and  $t=2$  will consist of new and old, extended loans.

In  $t=1$ , banks discover whether they are either a healthy bank with probability  $1 - p$ , or a toxic bank with probability  $p$ , with  $0 < p < 1$ . A healthy bank (notated with  $h$  or  $H$ ) has a clean loan portfolio without bad loans. A toxic bank, however, has a share  $\alpha$  ( $0 < \alpha < 1$ ) of bad loans in its portfolio that have no recovery value. Toxic banks now have two options: they can either decide to write-off all bad loans to zero (what we will be calling the "write-off strategy", notated with  $w$ ). Or, they can apply forbearance lending, i.e. extend the bad loans for another period and just provide the remaining loan volume  $1 - \alpha$  to new projects ("forbearance lending (FBL) strategy", notated with  $f$  or  $F$ ).<sup>20</sup> Depending on which option they choose, the balance sheet and reported profit in  $t=1$  will be affected.

We assume that the bank type will have lasting effect for  $t=2$ : A healthy bank does not have bad loans in  $t=1$ , and will again not have bad loans in  $t=2$ . A toxic bank, on the other hand, faces the risk of having bad loans also in  $t=2$ . We can think of several reasons for this continuity, e.g. the low quality of risk management of the bank or its inferior business model compared to a healthy bank. Hence, once a bank has incurred

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balance sheet structure of banks. Deposit insurance would act as another "protective" layer until losses are shared by uninsured creditors and would simply raise the insolvency threshold that will be introduced later.

<sup>19</sup>We simulate a situation without regulatory requirements for capital ratios. See section 5.2. ("Separation of debt and equity investors") for a discussion on bank equity.

<sup>20</sup>Although the healthy bank is notated with  $h$  or  $H$ , we will refrain from using the indices  $t$  or  $T$  for the toxic bank and just stick to the strategic choices write off  $w$  or forbearance lending  $f$  or  $F$  for the toxic bank, to keep the indices simple.



bad loans it is in danger of facing bad loans again. The details of this will be explained shortly.

Creditors grant financing to the bank for one period at a time. In  $t=0$ , they "invest" their funds into the bank to be paid back in  $t=1$ , and receive an interest in return. After the bank has declared the profit in  $t=1$ , creditors can decide to extend the credits to the bank for one more period until  $t=2$  or withdraw them.

In  $t=2$ , no new projects will be available for financing. Any stock of bad loans will be written down to the residual value. Creditors and shareholders take the remaining equity and credits.

**Features of loans** In  $t=1$ , we assume that banks receive a fixed interest rate  $e$  on its entire loan portfolio for the past period, regardless of the bank type. Losses can only arise from the bad loan share  $\alpha$ , which appear with probability  $p$ . The banks that find the bad loans are then the toxic banks. For a toxic bank, the recovery value of the bad loans  $\alpha$  is zero. We will assume that the loss from the bad loans is higher than the interest income from loans, i.e.  $e < \alpha$ .

Put differently, this means that all entrepreneurs are able to make the interest payments, but that a share  $\alpha$  of them cannot pay back any of the principal loan amount. Some of the borrowers are thus only able to afford repayments to the bank in the amount of the interest, but not the debt itself. As mentioned, the bank can then either write off these loans, which would lead to a loss, or extend them, which would delay the loss recognition. The net return rate from the loans will be denoted as  $\epsilon$ , which represents the interest rate  $e$  minus any potential losses.

If the bad loans are extended for another period by the bank, we have the case of forbearance lending. The bank would then have a mixed portfolio of new and old, bad loans.

For the period between  $t=1$  and  $t=2$ , the performance of the loan portfolio depends on the bank type. As mentioned, a healthy bank will not have bad loans for this period and will again receive a fixed interest of rate  $e$  on its entire loan portfolio. All of the borrowers will be able to pay back both the principal loan amount and the interest in  $t=2$ . As mentioned, we may think of solid risk management practices or business strategy of the healthy bank as the reasons why it does not have bad loans in  $t=1$  and again not in  $t=2$ .

For a toxic bank, the situation is different. It encountered bad loans in  $t=1$  and may encounter bad loans again the period between  $t=1$  and  $t=2$ . Hence, there is again the probability  $1 - p$  that there are no new bad loans in between  $t=1$  and  $t=2$ . This would be the lucky case for the toxic bank. The overall return now depends on its strategic

choice in  $t=1$ : if the bank has written off all bad loans in  $t=1$ , it will receive the interest  $e$  on its entire loan portfolio, which are all new loans. However, if the bank has applied forbearance lending, it will only receive interest  $e$  on its new loans, while the bad loans  $\alpha$  yield no further return.

The toxic bank may also have bad luck and discover that there are new bad loans  $t=2$  as well. This happens again with probability  $p$ . In such a case, losses for the toxic bank arise not only from the write-off of the bad loans that were extended, but also from another, newly emerged set of bad loans. The bank will thus make a loss in  $t=2$ .

The volume of the newly emerged bad loans now depends on the bank action in  $t=1$ , i.e. whether it wrote-off the first share of bad loans or decided for forbearance lending: if the bank has written-off the bad loans in  $t=1$ , the new bad loans that appear between  $t=1$  and  $t=2$  will again make up a share  $\alpha$  of its loan portfolio. Remember that the loan portfolio consists only of new loans, as the bank wrote off all bad loans in  $t=1$ .

If the bank opted for forbearance lending in  $t=1$ , however, we now assume the newly emerged bad loans to make up a share  $\alpha$  of its *overall* loan portfolio  $L$ , not only from the new loans. The overall share of bad loans for the period between  $t=1$  and  $t=2$  is thus  $2\alpha$ : the bad loans extended in  $t=1$  and the newly emerged ones between  $t=1$  and  $t=2$ . This may be interpreted in a way that forbearance lending has contagious effects and actually deteriorates also the performance of any new lending portfolio.

Finally, in case the toxic bank has bad luck and is faced with new bad loans in  $t=2$ , we assume that regardless of the bank strategy choice in  $t=1$ , the bank will not receive income  $e$  on its loans anymore. This is because the bank has to finally recognize the losses in  $t=2$  and cannot count on forbearance lending for another period. We can think of this in a way that the bank has to finally make a cut and accept the default of the borrowers, which will take away incentives by the borrowers to make at least the interest payment.

The assumptions are chosen to allow for several factors:

First, we model the bank to receive interest income on its entire loan portfolio in  $t=1$  for the past period, even if some of the borrowers cannot pay back the principal. This is chosen so the bank can also make interest payments to its creditors, which would not be possible otherwise. This way, the bank can hide its true solvency state through forbearance lending, and continuously serves its debt by making interest payments. This would not work if there were no interest receivables from the bad loans.<sup>21</sup> For the period between  $t=1$  and  $t=2$ , we can relax this assumption because the bank cannot revert to forbearance lending again, and thus assume that there are no interest receivables in

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<sup>21</sup>Indeed, we have seen the evidence in chapter II that according to surveys, there are companies in the UK that are doing precisely that: "just paying interest on debts (and not the debt itself)".

the negative case, which facilitates solving the model. The results of the model are not affected by the omission of the interest receivables in  $t=2$ .<sup>22</sup>

Second, in case of forbearance lending, the share of new bad loans for the toxic bank in  $t=2$  is increased to  $2\alpha$  to simulate a contagious effect of the old bad loans on the productivity in other sectors, similar to the findings by Caballero, Hoshi and Kashyap (2008). This may be interpreted in a way that the existence of zombie firms also lowers the capacity of healthy borrowers to repay loans.

Third, modelling the recovery value this way implies that there is no chance of an improvement of bad loans in case of forbearance lending. This also means that a gamble for resurrection is not possible, as modelled by other papers. The chosen setup will serve the purpose of focussing solely on the effects on the funding activities of forbearance lending in this paper, and not on any other positive effect it may have.

**Creditors/bank debt investors** The paper will refer to creditors also as bank debt investors, as they are essentially investing in a bank debt instrument.

Creditors have an initial endowment of capital in  $t=0$  and can supply it to the bank as credits or invest their capital in a risk-free government bond at rate  $g$ . Each investment lasts for one period. When investing in bank debt, they get a fixed-rate interest payment at rate  $i$ , but they also have to take losses if the bank produces negative profits. The net return rate for the creditors thus consists of the interest rate  $i$  minus any potential losses, which will be called the yield  $y$ . On the risk-free instrument, they get a safe and constant return. The procedure is repeated in  $t=1$  for another period.

As mentioned in the introduction of this chapter, this approach is similar to the model by Gorton (1985), with the difference that in his case, the return of the risk-free instrument changes over time while here it is kept constant. The result of this small change is that now creditors will adjust the interest rate to compensate for potential losses, with the rate of the risk-free instrument serving as the benchmark. Put differently, in order to equalize the potential losses they have on their bank debt investment, they will demand a interest rate on their credits that is adjusted for potential losses. This potential loss-adjusted interest rate will be called "credit charge" or "credit rate" throughout the paper, and is one of the major innovations that is added to the forbearance lending discussion. The credit charge depends on the rate of the risk-free investment  $g$  plus potential losses, weighted by their relative probability  $p$ . As both loans and credits only last for one period, the credit charge  $i$  only reflects the potential losses for the upcoming period. In other words, in  $t=0$ , the credit charge  $i_1$  reflects potential losses for creditors in  $t=1$ , whereas

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<sup>22</sup>As a matter of fact, the beneficial effects of forbearance lending in this model would only be strengthened further if the toxic bank under back luck receives additional interest income in  $t=2$ .

the credit charge  $i_2$  that creditors demand in  $t=1$  reflect potential losses they may incur in  $t=2$ .

One important feature is that creditors are assumed to be risk-neutral, so they will be indifferent to a risk-free low return and a risky high return with potential losses, as long as the expected return is the same. We thus assume that banks can receive sufficient refinancing means from creditors to match the volume of the lending portfolio, as long as the expected return of bank debt is equal to that of the risk-free investment.

**Bank (in)solvency** The bank will only continue operations if it is profitable after taking into account the interest payments on its debt. If the expected profitability of the bank is negative, the bank will not receive funding and is insolvent. To be more precise, given the fixed return on assets (i.e. loans) and any credit charge, there is a crucial share of bad loans to break even profits. This crucial share will be called the "insolvency threshold"  $\bar{\alpha}$ . Hence, if the potential share of bad loans for the next period is higher than the insolvency threshold, the bank is insolvent.

If the bank is insolvent in  $t=1$ , the bank cannot distribute dividends for the past period, nor in  $t=2$ . It is thus in the interest of shareholders to avoid bankruptcy, as it would erase chances for a distribution of positive profits. While the expected share of bad loans is exogenous, the bank can influence the profitability of the bank by choosing to extend a bad loan or write it down. This will be the critical action for the bank for the rest of the paper.

With the introduction of the insolvency threshold and the credit charge, we have now created an environment where the bank cannot only look at the asset side when deciding about the bad loans, but also has to take its liability side into account. This setup is unique to this paper and allows for insights into the strategies of the bank in such a framework.

**Informational distribution and bank strategies** The model starts off in section 3 of this chapter with informational symmetry, i.e. equal information for the bank manager and creditors. In this case, banks and creditors know whether the bank has a share of bad loans in the portfolio or not, i.e. whether it is a toxic or healthy bank. Later in section 4 of this chapter, informational asymmetry is introduced. Here, only banks know whether they are healthy or toxic. Creditors only know the probability  $p$  for a toxic bank, and the extent of potential bad loans  $\alpha$ , but they cannot observe the actual bank type. Hence, creditors know the extent that bad loans can take on and also the likelihood. They thus have a general view on the economic environment the bank is in. However, they do not know whether the bank is a toxic or a healthy bank.

In both cases there are three different scenarios in  $t=1$ , depending on the bank type and the action the bank takes: the healthy bank on the one hand, and the write-off and FBL strategy for the toxic bank on the other. For  $t=2$ , there are five different profit outcomes: one for the healthy bank, and four for the toxic bank, depending on their strategic choice in  $t=1$  about forbearance lending or write-off, and whether they receive further bad loans or not in  $t=2$ .

Note that the toxic bank only decides once actively whether to write-off the bad loans or apply the FBL strategy, and this happens in  $t=1$ . After this, the bank cannot change the outcome anymore. For this reason, in  $t=1$  the toxic bank only looks at the expected outcomes for  $t=2$ , which are summarized in two different expected profits.

In the section with asymmetric information, toxic banks can use forbearance lending to deceive creditors, as they hide losses and make themselves appear as healthy banks. Section 4.1. and 4.2. will provide further details on this.

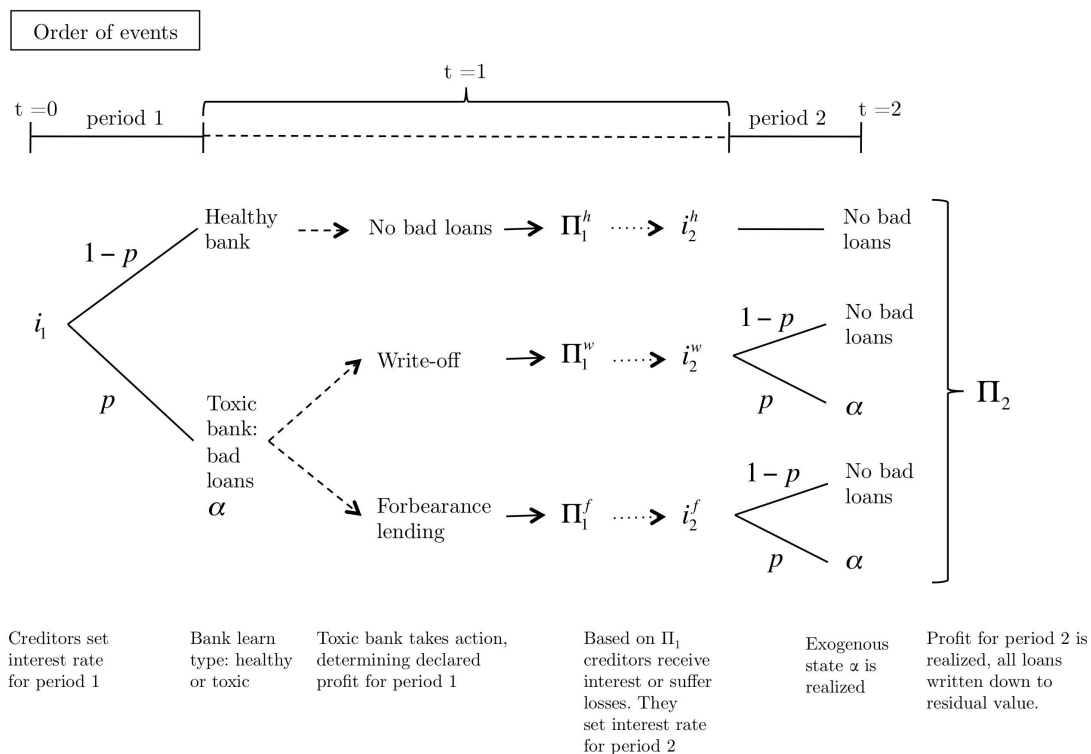
For the variables under asymmetric information, we will use the index in capital letters to separate them from variables under symmetric information, i.e. we use the index  $H$  for the healthy bank and  $F$  for the toxic bank applying forbearance lending under asymmetric information. As we will see, the values for the toxic bank writing off the bad loans will not change under asymmetric information, so we continue to use the index  $w$ .

**Graphical overview** Figure 1 offers an illustration of the process under symmetric information. As we see, the bank starts in  $t=0$  with the credit interest rate  $i_1$ , as determined by the creditors. It then discovers whether it is a healthy bank with probability  $p$  or a toxic one with probability  $1 - p$ . For a healthy bank, it does not have any bad loans, which leads to a profit of  $\Pi_1^h$  for the first period. The healthy bank will not have any new bad loans after  $t=1$  and can operate with refinancing costs at the rate of  $i_2^h$  which will determine the profit for  $t=2$ .

The toxic bank, on the other hand, discovers bad loans as share  $\alpha$  of its portfolio. In  $t=1$  it can now either write-off the bad loans, leading to a profit of  $\Pi_1^w$  for the first period, or decide for forbearance lending, which would lead to profit  $\Pi_1^f$ . Depending on the action, the credit charge for the period between  $t=1$  and  $t=2$  will be determined by creditors as  $i_2^w$  or  $i_2^f$ . Additionally, for  $t=2$ , the toxic bank can again discover a new bad loan share  $\alpha$  with probability  $p$ .

**Model drivers and solving procedure** We are going to approach the model as follows: in the section with symmetric information, we start with looking at the values in  $t=0$ , where we also introduce the concept of the insolvency threshold and the credit charge. In order to determine the insolvency threshold, we have to look at the expected

Figure 1: Order of events under symmetric information



profit, as the insolvency threshold is the crucial share of bad loans  $\alpha$  where bank profits are zero. The profits are also important to define the dividend and thus the payoff for the shareholders, which drives the decision of the bank manager. This is why we will have to go through the expected profits for all dates and bank types, both under symmetric and asymmetric information to solve the model.

As we will see, both the credit charge and the insolvency threshold depend on the probability  $p$  for having the bad loans  $\alpha$ , and the spread between the loan interest rate  $e$  and government bond rate  $g$ . The insolvency threshold  $\bar{\alpha}$  will be the key variable to determine the state of the solvency for the bank.

We then look at the healthy bank's values and choice in  $t=1$ . As the healthy bank does not have bad loans, the values are not important for the symmetric information case, but for the asymmetric information case later on.

The choices and values for the toxic bank are then analyzed next. Here, we first go through the details for the write-off case, and afterwards for the forbearance lending case to determine the credit charges and insolvency thresholds. The key difference is that writing off bad loans creates a loss, whereas forbearance lending allows to declare a profit, as it delays the write-off to a later period. Comparing these two, we can conclude which

choice the bank will take in  $t=1$ . As we will see, due to the symmetric information, the creditors will treat the bank more favorably if the bank decides to write-off the bad loans, leading to a higher insolvency threshold. This is because delaying the write-off under forbearance lending is economically inferior to an early write-off. However, the dividends are higher under forbearance lending, because the bank manager extracts excessive profits already after one period. Due to the limited liability, a higher write-off later on will not be borne by the shareholders, but by the creditors. Hence, in case the bad loans are low enough for the toxic bank to survive, the toxic bank can and will opt for forbearance lending.

In the section with asymmetric information, we then address the points that differ from the symmetric information case. Most importantly, bank creditors can only identify the bank as a toxic bank if a write-off is announced. However, if the toxic bank decides for forbearance lending, bank creditors do now know whether the bank is healthy or a toxic bank applying forbearance lending. Creditors will thus take a weighted approach for the credit charge, using the probability that it is a healthy bank and the probability that it is a toxic bank. This influences the insolvency threshold favorably for the toxic bank, compared to the write-off case. As the dividends become higher as well, the toxic bank will choose for forbearance lending. Under asymmetric information, forbearance lending is thus always more beneficial for the toxic bank than writing off bad loans.

Finally, we will take another look at the effects on the healthy bank under asymmetric information. As the healthy bank cannot distinguish itself from a toxic bank under forbearance lending anymore, it will have to accept a higher credit charge as well. Moreover, if the potential share of bad loans is too high, the risk of a loss for creditors is too high, leading to a situation where even the healthy bank does not receive funding.

## 2.2 Overview of model constituents

Creditors:

$i_t$ ... interest rate on bank debt for the period between  $t - 1$  and  $t$  ("credit charge")

$y_t$ ... net yield on credits after losses for the period between  $t - 1$  and  $t$

$C_t$ ... Credit volume (sum of unsecured funding) for the period between  $t - 1$  and  $t$

$g_t = g \forall t$ ... risk-free (government bond) interest rate

Banks:

$\alpha_t = \alpha \forall t$ ... share of bad loans, with  $0 < \alpha < 1$

$p_t = p \forall t$ ... probability of bad loans  $\alpha$ , with  $0 < p < 1$

$\bar{\alpha}_t$ ... insolvency threshold in  $t$

$e_t = e \forall t$  ... (fixed) interest on loan to entrepreneurs

$\epsilon_t$ ... net return on loans to entrepreneurs after loss in period between  $t - 1$  and  $t$

$L_t$ ... Loan volume in period between  $t - 1$  and  $t$

$\Pi_t = (1 + \epsilon_t) \times L_t - (1 + i_t) \times C_t$  ... Bank profit in  $t$

$\theta$ ...Discount factor

$\Omega_t$ ...Dividends to shareholders in  $t$

$\hat{\Pi}$  ... declared profits

$\tilde{\Pi}, \tilde{\epsilon}, \tilde{y}, \tilde{\Omega}$ .. expected values

$i^h, \Pi^h$ ... values for healthy bank under symmetric information

$i^w, \Pi^w$ ... values for toxic bank applying write-off under symmetric information

$i^f, \Pi^f$ ... values for toxic bank applying forbearance lending under symmetric information

$i^H, \Pi^H$ ... values for healthy bank under asymmetric information

$i^F, \Pi^F$ ... values for toxic bank applying FBL under asymmetric information

### 3 Symmetric information case

This chapter shows the behavior of banks in a scenario where creditors have full knowledge about the loan book quality.

#### 3.1 Bank activity and options

##### 3.1.1 $t=0$ : calculation of expected profit $\tilde{\Pi}_1$

**Banks'** return on their loan business for period 1 is:

$$L_1(1 + \epsilon_1) = \begin{cases} L_1(1 + e) & \text{with } 1 - p, \text{ and} \\ L_1(1 + e - \alpha) & \text{with } p. \end{cases}$$

Bank loan revenues thus depend on a (fixed) interest rate on the full loan volume minus losses on bad loans. The share of bad loans can either be high or low, with attached probability. The expected return on loans is then:

$$L_1(1 + \tilde{\epsilon}_1) = L_1[(1 - p)(1 + e) + p(1 + e - \alpha)].$$

**Creditors** receive yield on "credits" (funding volume  $C$ ):

$$C_1(1 + y_1) = \begin{cases} C_1(1 + i_1) & \text{with } 1 - p, \text{ and} \\ C_1(1 + i_1 + e - \alpha) & \text{with } p, \end{cases}$$



again depending on the share of bad loans, where the lower part includes the losses for creditors in case of bad loans. This means that they get their interest payment in case there is no bad loan share  $\alpha$ , but they will take the hit of the losses in case there is.

Loans to entrepreneurs can only be financed through credits:

$$L_1 = C_1.$$

**Net profit for banks** depends on loan yield and the interest rate on credits:

$$\Pi_1 = \begin{cases} (1 + e)L_1 - (1 + i_1)C_1 = (e - i_1)L_1 > 0 & \text{with } 1 - p, \text{ and} \\ (e - i_1 - \alpha)L_1 < 0 & \text{with } p. \end{cases}$$

**Credit charge  $i_1$  and insolvency threshold  $\vec{\alpha}$**  As the profitability depends on the margin between yield on loans and interests for credits, we can identify the critical share of bad loans to reach zero expected profits as:

$$\tilde{\Pi}_1 = (1 - p)(e - i_1)L_1 + p(e - i_1 - \alpha)L_1 = 0.$$

Solving this for  $\alpha$  yields:

$$\vec{\alpha}_1 = \frac{e - i_1}{p}. \quad (1)$$

We will refer to this from now on as the "insolvency threshold". As stated, for the bank to be operative in period 1 and to obtain financing from stakeholders, expected profit must be positive, i.e.  $\tilde{\Pi}_1 \geq 0$ . The profitability depends on the magnitude of bad loans and the interest rate for credits  $i$ . The potential bad loan share  $\alpha$  must thus be below this threshold:

$$\alpha \leq \vec{\alpha}_1.$$

The arrow over the variable  $\vec{\alpha}$  can be thought of as the "insolvency pointer", where any value above, i.e. to the right of it, implies insolvency.

In order to derive the specific  $\vec{\alpha}_1$  for this case, we will first have to establish the credit charge  $i$ . As we will see shortly,  $i$  again depends on the bad loan share  $\alpha$ . This implies that the insolvency threshold is determined by the exogenous parameters  $e$ ,  $g$ , and  $p$ .

For creditors, the expected yield on credits must be ultimately equal to the risk-free rate  $g$  for them to be indifferent between the two. Remember that creditors are risk neutral. Thus:

$$(1 + \tilde{y}_1) = (1 - p)(1 + i_1) + p(1 + i_1 + e - \alpha) = 1 + g.$$

If we solve this for  $i_1$ , we get the interest rate that banks will charge:

$$i_1 = g - p(e - \alpha). \quad (2)$$

We can see that this credit charge depends on the risk-free investment  $g$  plus potential losses from bank credits  $e - \alpha$ , weighted by its relative probability  $p$ .

Given this  $i_1$  and following equation  $\bar{\alpha}_1 = \frac{e-i_1}{p}$  the insolvency threshold can be derived as:<sup>23</sup>

$$\bar{\alpha}_1 = \frac{e(1+p) - g}{2p}.$$

**Lemma III.1** *For a bank to be operational, the potential bad loan share  $\alpha$  must be below the insolvency threshold  $\bar{\alpha}$  :*

$$\alpha \leq \bar{\alpha}_1 = \frac{e(1+p) - g}{2p}.$$

*Proof: obvious.*

For the rest of the paper, we assume this condition to be fulfilled.

Now that we have established the concepts of the insolvency threshold and the credit charge, we can have a deeper look at the bank activity for the healthy and toxic bank.

### 3.1.2 t=1: healthy bank

In this section, we will first have a look at the healthy bank. In figure 1, this represents the entire upper branch of the graph. Later, the same exercise is repeated for a toxic bank.

As already mentioned, a healthy bank will not have bad loans in period 2. The declared profit for period 1 represents the real profit, which is paid out as dividends  $\Omega_1^h$ :

$$\hat{\Pi}_1^h = \Pi_1^h = \Omega_1^h.$$

Remember that  $h$  denotes all variables for a healthy bank. The balance sheet is unchanged compared to t=0: equity in the amount of the profit  $\Pi_1$  is paid out and again infinitesimal small, whereas credits  $C_2^h$  and loan volume  $L_2^h$  are unchanged after the creditors have received their interest payment  $C_1 i_1$ . We thus have:

$$L_2^h = C_2^h = C_1 = L_1.$$

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<sup>23</sup>We can consider the following numbers as an example to illustrate the case more clearly:  $p = 20\%$ ,  $e = 10\%$  and  $g = 2\%$ , then the insolvency threshold  $\bar{\alpha}_1$  would be 25%.

As the bank will not have new bad loans in period 2, there is no risk of insolvency. Creditors are willing to accept the same interest rate as for risk-free government bonds:

$$i_2^h = g.$$

Profit for period 2 will be:

$$\Pi_2^h = (1 + e)L_1 - (1 + g)C_1 = (e - g)L_1.$$

There is obviously no way for the healthy bank to engage in forbearance lending, as it does not even have bad loans in its portfolio. The bank can carry out its operations without any impact from the toxic bank.

### 3.1.3 t=1: toxic bank

We now look at a situation for the toxic bank, which represents the lower branch of figure 1.

The bank made negative profits in period 1, as it did discover bad loans in its portfolio. As a toxic bank, the bank again faces the risk of bad loans for period 2. Naturally, credit charges will apply as beforehand.

The bank now has two choices: writing off the bad loans, or forbearance lending.

**Write-off (w) case** All variables for the write-off case are denoted with  $w$  here.

The bank reports all losses. Shareholders lose their infinitesimal small equity stake and recapitalize it, but creditors face a lower credit base due to the losses they have to absorb.

The loan and credit volume for period 2 are decreased by the losses in period 1:

$$C_2^w = L_2^w = L_1 + \Pi_1^w = L_1(1 + e - \alpha).$$

We see that the bank is now in a similar position as in  $t=0$ , only with a smaller balance sheet. The return is now:

$$L_2^w(1 + \epsilon_2^w) = \begin{cases} L_2^w(1 + e) & \text{with } 1 - p, \text{ and} \\ L_2^w(1 - \alpha) & \text{with } p. \end{cases}$$

As mentioned in the model outline, there is a small change in the profit function compared to period 1. With probability  $p$ , the bank faces losses of  $\alpha$  and no interest income  $e$ .

The profits for period 2 are then:

$$\Pi_2^w = \begin{cases} (e - i_2^w)L_2^w & \text{with } 1 - p, \text{ and} \\ (-i_2^w - \alpha)L_2^w & \text{with } p, \end{cases}$$

Creditors will again demand a credit rate for period 2, which is derived in the same way as in equation (2):<sup>24</sup>

$$i_2^w = g + p\alpha. \quad (3)$$

It follows in the same form of deriving equation (1) that the insolvency threshold is:

$$\bar{\alpha}_2^w = \frac{e(1-p) - g}{2p}.$$

Bank solvency thus depends on the expected bad loan share, as already stated in Lemma 1. It is easy to see that this insolvency threshold is lower than in period 1:

$$\bar{\alpha}_2^w = \frac{e(1-p) - g}{2p} < \bar{\alpha}_1 = \frac{e(1+p) - g}{2p}.$$

Bank solvency for a toxic bank under the write-off case is thus less favorable than in period 1.<sup>25</sup>

Due to the higher interest rates on credits (i.e.  $i_2^w > g$ ) and the lower loan volume (i.e.  $L_2^w < L_2^h$ ), expected profits are naturally lower than for a healthy bank:

$$\begin{aligned} \tilde{\Pi}_2^w &< \Pi_2^h, \text{ as} \\ [(1-p)e - i_2^w - p\alpha]L_2^w &= \tilde{\Pi}_2^w < \Pi_2^h = (e-g)L_2^h. \end{aligned}$$

To summarize the case of the write-off strategy for a toxic bank:

Creditors take the full hit of losses reported for period 1. The bank makes a fresh start, and creditors demand a credit charge again. Shareholders can naturally expect lower profits in period 2 than for a healthy bank. Solvency is also lower than in period 1.

**Forbearance lending (f) case** The bank hides the bad loans from period 1 in the FBL strategy and announces a profit. Cashflow has come in in the form of interest payments from entrepreneurs, and no write-downs are made. Shareholders thus receive the same dividend payment as with a clean bank. The announced profit and dividend for period 1

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<sup>24</sup>The credit charges and insolvency thresholds are also derived in detail in the appendix.

<sup>25</sup>If we use the same numerical example as above, the insolvency threshold would now be 15%, compared to 25% for  $\bar{\alpha}_1$ .

is:

$$\Omega_1^f = \hat{\Pi}_1^f = L_1(e - i_1). \quad (4)$$

Moreover, the bank has paid out interest to debtholders of  $C_1 i_1$ . We thus have the same balance sheet size as in the case of the clean bank, and as in period 1:

$$L_2^f = C_2^f = L_2^h = C_2^h = C_1 = L_1.$$

However, forbearance lending postpones the write-down of bad loans to  $t=2$  and makes bank activity in period 2 less profitable. The portfolio of the bank now contains two parts: new loans and the extended stock of bad loans from forbearance lending:

$$L_2^f = \underbrace{L_1(1 - \alpha)}_{\text{New loans}} + \underbrace{L_1\alpha}_{\text{Forbearance lending}}.$$

It is important to see that the new loan volume  $L_1(1 - \alpha)$  is smaller than for the write-off strategy, where the new loan volume is  $L_2^w = L_1(1 + e - \alpha)$ . This is because under forbearance lending, the bank has paid out dividends and interest expenses to debtholders.

Forbearance lending strongly affects the profitability in period 2. As mentioned in the model outline, we assume that with probability  $1 - p$ , the toxic bank is lucky and does not receive new bad loans. Here, interest income from entrepreneurs will come in, but only from the new loans, not on the forbearance lending part. Moreover, with probability  $p$  the bank is unlucky and finds new bad loans in relation to the entire loan volume  $L_1$ . This comes on top of the bad loans that were extended, making the overall bad loan share  $2\alpha$ . The bank is thus penalized for not having shrunk its balance sheet in  $t=1$ . We can interpret this as the lower loan quality of the overall loan book if there is a bad loan share of forbearance lending.

The overall return is now:

$$L_2^f(1 + \epsilon_2^f) = \begin{cases} L_1 + L_1(1 - \alpha)e - L_1\alpha & \text{with } 1 - p, \text{ and} \\ L_1 - L_1 2\alpha & \text{with } p. \end{cases}$$

As we can see, with probability  $1 - p$  the bank gets interest income on the new loan portfolio and only has to write-off the bad loans from period 1. With probability  $p$ , however, the bank does not get any interest income and additionally has to write-off the bad loans from period 1 and 2 together.

The profit is thus:

$$\Pi_2^f = \begin{cases} L_1[(1 - \alpha)e - \alpha - i_2^f] & \text{with } 1 - p, \text{ and} \\ L_1(-2\alpha - i_2^f) & \text{with } p. \end{cases}$$

The credit charge that will be demanded will then be:

$$i_2^f = g + 2p\alpha.$$

And, in the same way as before we can derive the insolvency threshold (see appendix for details):

$$\vec{\alpha}_2^f = \frac{e(1 - p) - g}{3p + 1 - ep + e}.$$

We are now in a position to compare the credit charge under the write-off  $i_2^w$  and the FBL case  $i_2^f$ .

**Lemma III.2** *Under symmetric information, the credit charge for FBL is higher than for the write-off strategy, i.e.*

$$i_2^f > i_2^w,$$

*and the insolvency threshold in period 2 is lower than in the write-off strategy:*

$$\vec{\alpha}_2^f < \vec{\alpha}_2^w.$$

*Proof: Appendix.*

To summarize, depending on the magnitude of the bad loans, the bank is less likely to survive under forbearance lending than under the write-off case due to a lower insolvency threshold.<sup>26</sup> However, if the bank can actually survive under forbearance lending, creditors do not get hit for losses reported for period 1, but expect high losses in period 2. They are compensated through a higher interest rate on credits. Shareholders can extract the same profit in  $t=1$  as under a healthy bank.

### 3.2 Choice for toxic bank in $t=1$

We can now compare the decision of the toxic bank in  $t=1$  whether to write-off the bad loans or choose forbearance lending. Shareholders have no downside in each scenario as they only lose their infinitesimal small equity investment. In order to evaluate their

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<sup>26</sup>Using the same numerical example as above, the threshold would now be  $\vec{\alpha}_2^f = 4\%$ , compared to the insolvency threshold under the write-off case  $\vec{\alpha}_2^w = 15\%$ .

preference, we must thus compare their upside potential, i.e. the overall profits received in each situation.

As for period 1, in the write-off strategy reported profits are negative, so the effect for shareholders is basically zero. They have to bear virtually no losses, only in form of their infinitesimal small equity stake. In the FBL strategy, on the other hand, they do receive a profit, which is the same as for a clean bank.

In period 2, however, chances for a profit are much higher with the write-off than with the FBL strategy. This is because due to the high credit charges in the FBL strategy, the bank is likely to be insolvent and non-operational for period 2. In such a case, shareholders do not get any return.

The solvency of the bank is thus a key factor, and we can distinguish 2 cases:

**Case a.** Bank is solvent only in the write-off case: The potential share of bad loans in period 2 is too high for the FBL strategy:

$$\vec{\alpha}_2^f < \alpha < \vec{\alpha}_2^w.$$

The shareholders naturally favor the write-off strategy.

**Case b.** Bank is solvent in both cases: The potential share of bad loans in period 2 is lower than the insolvency threshold in both cases, i.e.:

$$\alpha < \vec{\alpha}_2^f < \vec{\alpha}_2^w.$$

This is the more interesting case. Which choice would the bank make? For this to be answered, we have to compare the two overall dividends  $\Omega$  that shareholders expect in t=1:

$$\begin{aligned} \sum \Omega^w &= \max[0, \theta \tilde{\Pi}_2^w], \text{ and} \\ \sum \Omega^f &= \hat{\Pi}_1^f + \max[0, \theta \tilde{\Pi}_2^f]. \end{aligned}$$

As the crucial decision is made in t=1, the shareholders compare the actual payoff from the period between t=0 and t=1, and the expected payoff from the future, i.e. t=2. Future payoffs are discounted with  $\theta$ .

Remember again that  $\hat{\Pi}_1^w$  was negative, so it does not add any value to the shareholders, whereas  $\hat{\Pi}_1^f = L_1(e - i_1)$  is positive, as we see from equation (4). We then get:

**Proposition III.1** (*Symmetric information case*): *For a toxic bank, the decision between write-off and forbearance lending depends on the solvency of the bank. The bank will write-off the loans, if the bank is insolvent under forbearance lending, i.e.*

$$\bar{\alpha}_2^f < \alpha < \bar{\alpha}_2^w.$$

*However, if the bank is expected to "survive", i.e.*

$$\alpha < \bar{\alpha}_2^f < \bar{\alpha}_2^w,$$

*shareholders will prefer the forbearance lending case due to higher overall expected profits, i.e.*

$$\sum \Omega^w < \sum \Omega^f.$$

*Proof: Appendix.*

On first sight, it may be surprising that even if creditors have full information on the balance sheet quality, the bank would favor a situation that affects profitability negatively. Indeed, the write-off case would be the obvious choice as it delivers higher overall profitability. This is also the reason why the solvency situation is better here than under forbearance lending.

However, the bank here is driven by the interest of the shareholders. If the potential bad loan share  $\alpha$  is low enough, forbearance lending allows the bank to extract excessive equity before a potential insolvency. This is because shareholders have no downside, and instead all losses are shared by the debtholders. This result has also been identified by Niinimäki (2007) for one of the drivers for forbearance lending. In his model, a bank also engages in forbearance lending in order to delay the recognition of losses and collect interest receivables, which allows the bank to pay out dividends to its shareholders even if it may be in fact insolvent.<sup>27</sup>

### 3.3 Graphical illustration

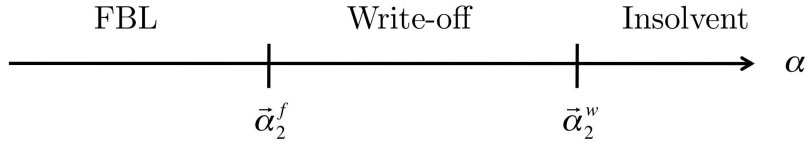
The result can be simply illustrated as in Figure 2. The chart shows the two insolvency thresholds for the toxic bank depending on its action,  $\bar{\alpha}_2^f$  for forbearance lending and  $\bar{\alpha}_2^w$  for the write-off case. The chart is only for illustrative purposes; the dimensions and distances between the thresholds do not reflect the actual values.

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<sup>27</sup>While the result is the same as in the paper at hand, in Niinimäki (2007), forbearance lending is modelled in the context of moral hazard. Rolling over bad loans allows the bank to reduce its monitoring costs, as it does not have to pay for the negative consequences. The effect of creditor behavior is not explicitly included in his model.



Figure 2: Bank action under symmetric information



The action of the toxic bank depends on the potential bad loan share  $\alpha$ . If  $\alpha$  is too high, i.e. right of  $\bar{\alpha}_2^w$ , the bank is insolvent as expected profitability would be negative. If  $\alpha$  is in between the two insolvency thresholds, we have the *case a.* as just described: the bank can only survive when writing-off the bad loans. However, if  $\alpha$  is sufficiently small, the bank prefers the forbearance lending case.

## 4 Asymmetric information case

We now look into a scenario where the creditors do not know the bank type. Nevertheless, they are assumed to know the loan rate  $e$  and share the same views on the probability  $p$  and the potential volume of bad loans  $\alpha$ , so they do have expectations on future profitability. For the probabilities of whether they are investing in a toxic or healthy bank in  $t=1$ , they have to rely on the reported profit in  $t=1$  by the bank.

As we will see, the introduction of asymmetric information has implications for both the toxic and the healthy bank.

### 4.1 Changes to bank activity and options

#### 4.1.1 Profit announcements and creditors' response

By announcing a certain profit, banks can influence creditors' view on the bank type, i.e. whether it is a healthy or toxic bank. Creditors, on the other hand, know the strategic options by banks and will therefore also adjust their views accordingly. Depending on the announced profit and the corresponding views by creditors, the credit charge they will demand will vary. There are three values for profits in period 1 that can be announced, for the healthy bank, for forbearance lending and for the write-off case. In order of their volume, they are:

$$\hat{\Pi}_1^w < 0 < \hat{\Pi}_1^f = \hat{\Pi}_1^h.$$

The following will outline the different choices by banks and the creditors' response to this.

$\hat{\Pi}_1 = \hat{\Pi}_1^w$  This case is straightforward. The bank announces a loss for period 1, which implies it is a toxic bank as it had to write off bad loans. Creditors will now know it is toxic and that there is the possibility again in period 2 that the bank will have bad loans. The debt investors will demand a credit charge  $i_2^w$ . The values remain the same as for the symmetric information case.

$\hat{\Pi}_1 = \hat{\Pi}_1^h = \hat{\Pi}_1^f$  In this case, there is a positive profit reported in  $t=1$ . Creditors will not know whether the bank is a healthy bank, or a toxic bank engaged in forbearance lending that is hiding the losses. They will weigh each scenario with its probability, i.e. probability of  $1-p$  that the bank is a healthy bank, and  $p$  that the bank is toxic. Creditors will thus respond with a new credit charge  $i_2^N$  (denoted with  $N$  for "new"), that takes these possible outcomes in mind, weighed by the probability. Intuitively, the new credit charge will then be higher than the risk-free rate  $g$ , but lower than the charge under symmetric information for forbearance lending, i.e.

$$g < i_2^N < i_2^f.$$

The specific  $i_2^N$  will be derived later. One result can already be pointed out: in an asymmetric information case, a healthy bank cannot convincingly signal to the creditors that it does not have bad loans, which would usually induce a low interest rate. Creditors will always suspect that banks have "misreported" true profits and will therefore penalize even healthy banks through a probability weighted estimate of the true state. At the same time, a toxic bank can benefit from lower refinancing means by misreporting its losses.

#### 4.1.2 Change in outcomes

We are now ready to compare the outcomes for banks when they are selecting their strategy, announcing a specific profit, paying the corresponding interest rate and earning the corresponding expected profit for period 2. The following table gives an overview of the outcomes.

<u>Bank</u>	<u>Strategy</u>	<u>Announced profits in t = 1</u>	<u>Credit charge</u>	<u>Exp. profit for creditors</u>	<u>(Exp.) profit for bank</u>
Healthy	–	$\hat{\Pi}_1^h$	$i_2^N$	$\tilde{\Pi}^N$	$\Pi_2^H$
Toxic	Write-off	$\hat{\Pi}_1^w$	$i_2^w$	$\tilde{\Pi}_2^w$	$\tilde{\Pi}_2^w$
Toxic	FBL	$\hat{\Pi}_1^f (= \hat{\Pi}_1^h)$	$i_2^N$	$\tilde{\Pi}^N$	$\tilde{\Pi}_2^F$

We can see that the expected profits are different for creditors and for the bank. For  $\hat{\Pi}_1^f = \hat{\Pi}_1^h$ , creditors expect the weighted profit  $\tilde{\Pi}^N$  and demand the credit charge  $i_2^N$ , whereas the bank expects a different profit. If it is a healthy bank, it knows the actual profit is going to be  $\Pi_2^H$ , because there is no chance of a bad loan. If it is a toxic bank, the expected profit is  $\tilde{\Pi}_2^F$ . In other words, the bank knows its state, whereas the creditors can only take a probability-weighted approach.

The difference in these expectations matters: the view of the creditor is important to determine the insolvency threshold, whereas the view of the bank is important for the ultimate decision between writing off the bad loans and forbearance lending.

Let's have a detailed look at the outcomes for each bank type.

## 4.2 Toxic bank

**Write-off strategy** Things will be unchanged to the symmetric information case.

**Forbearance lending** In order to derive the new credit charge  $i_2^N$ , we have to turn to the debt investors' point of view. For them, the return is:

$$L_2^N(1 + \epsilon_2^N) = \begin{cases} (1 + e)L_1 & \text{with } 1 - p, \\ L_1 + L_1(1 - \alpha)e - L_1\alpha & \text{with } p(1 - p), \text{ and} \\ L_1(1 - 2\alpha) & \text{with } p^2. \end{cases} \quad (5)$$

In case the potential losses  $\alpha$  are below the insolvency threshold, the first two scenarios would allow the creditors to be paid the full interest payment, and only the last scenario would mean a hit to their investment. The credit charge will thus be:

$$i_2^N = g + 2p^2\alpha.$$

This leads to the following result:

**Lemma III.3** *A toxic bank can lower its refinancing rate by applying forbearance lending from  $i_2^f$  to  $i_2^N$ , i.e.:*

$$g < i_2^N = g + 2p^2\alpha < i_2^f.$$

*Moreover, the insolvency threshold  $\bar{\alpha}_2^N$  will be lower than under the symmetric information case:*

$$\bar{\alpha}_2^f = \frac{e(1 - p) - g}{3p + 1 - ep + e} < \bar{\alpha}_2^N = \frac{e(1 - p^2) - g}{p(3p + 1 - ep + e)}.$$

*Proof: Appendix.*

In line with the intuitive result, the bank can lower its refinancing costs and improve its solvency state compared to the symmetric information case, where creditors actually knew it was a toxic bank.<sup>28</sup>

**Choice for toxic bank in t=1** When making the choice between forbearance lending or writing off the bad loans, the bank first has to consider its solvency. Comparing the refinancing rates and insolvency thresholds for both cases, we get

**Proposition III.2** (*Asymmetric information case*): *The bank has a better solvency state under forbearance lending, as the new insolvency threshold  $\vec{\alpha}_2^N$  is higher than for the write-off case  $\vec{\alpha}_2^w$ :*

$$\frac{e(1-p) - g}{2p} = \vec{\alpha}_2^w < \vec{\alpha}_2^N = \frac{e(1-p^2) - g}{p(3p + e - pe + 1)}.$$

Moreover, the bank has lower refinancing costs under forbearance lending compared to the write-off case if  $p$  is sufficiently small, i.e.

$$\begin{aligned} i^N &< i_2^w, \text{ if} \\ p &< \frac{1}{2}. \end{aligned}$$

*Proof: Appendix.*

We can now see that the bank manages to improve its solvency with forbearance lending not only compared to the symmetric information case, but also compared to the write-off scenario. With this, it has reversed the order compared to the symmetric information case, where solvency was more favorable when the bank was honest and wrote off the bad loans.

With this result, we can see that the bank will choose forbearance lending if the potential bad loan share is between the two thresholds, i.e.  $\vec{\alpha}_2^w < \alpha < \vec{\alpha}_2^N$ . Next, we have to look at the expected profits under both strategies to understand the bank action if the bank is solvent under both strategies.

**Comparing expected profits** We now compare the expected profits for the toxic bank from the point of view of the bank manager to determine its choice between write-off and forbearance lending in t=1. We look at the scenario where the bank is solvent under both

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<sup>28</sup>With the same numerical example as above, the new insolvency threshold is now  $\vec{\alpha}_2^N = 23\%$ . This is higher than the thresholds in the symmetric information case both under forbearance lending of  $\vec{\alpha}_2^f = 4\%$  and under the write-off case of  $\vec{\alpha}_2^w = 15\%$ .

a bad loan write-off and forbearance lending, i.e.

$$\alpha < \bar{\alpha}_2^w < \bar{\alpha}_2^N.$$

Remember that the expected profit for the toxic bank under forbearance lending  $\tilde{\Pi}_2^F$  is different from the profit expected by the creditors  $\tilde{\Pi}^N$ . As already mentioned, the expected profit for the write-off case  $\tilde{\Pi}_2^w$  remains the same. We thus have to compare the overall dividends under both strategies, which are:

$$\begin{aligned} \sum \Omega^w &= \max[0, \theta \tilde{\Pi}_2^w], \text{ and} \\ \sum \Omega^F &= \hat{\Pi}_1^f + \max[0, \theta \tilde{\Pi}_2^F]. \end{aligned}$$

We know from proposition III.1 in the symmetric information case that  $\hat{\Pi}_1^f > \theta \tilde{\Pi}_2^w$ , which remains unchanged for asymmetric information. Even if  $\tilde{\Pi}_2^F < 0$ , we know that shareholders will not have to suffer from losses due to their infinitesimal small share, as the dividend is the higher of 0 and  $\theta \tilde{\Pi}_2^F$ . For this reason, we get:

**Proposition III.3** (*Asymmetric information case*): *A toxic bank will always choose forbearance lending, as the overall expected profits and dividend payments are higher than under the write-off case, i.e.*

$$\sum \Omega^w < \sum \Omega^F.$$

*Proof: see above.*

This point confirms that even in case the bank would survive both the write-off and the forbearance lending scenario, it would always choose the latter due to higher overall expected dividends for the shareholder.

The bank thus strictly prefers forbearance lending over writing off bad loans under asymmetric information, irrespective of the volume of potential bad loans  $\alpha$ .

### 4.3 Healthy bank

For the healthy bank, the profit for period 2 under asymmetric information will be lower than under symmetric information. This is because the credit charge is now  $i^N$  and not the risk-free government bond rate  $g$ . Nonetheless, the bank makes profits of

$$0 < \Pi_2^H = (e - i^N)L_1 < \Pi_2^h = (e - g)L_1.$$

However, now even the healthy bank is constrained by the insolvency threshold  $\bar{\alpha}_2^N$ , even if it does not have any bad loans. We thus get

**Proposition III.4** (*Asymmetric information case*): *A healthy bank is only able to operate if the volume of potential bad loans for a toxic bank is below the insolvency threshold for a toxic bank applying forbearance lending, i.e.:*

$$\alpha < \vec{\alpha}_2^N.$$

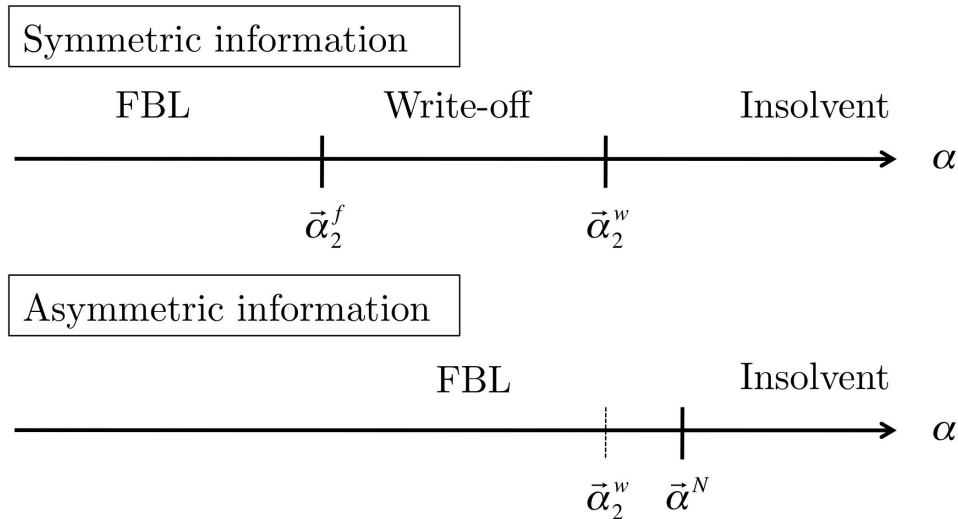
*Proof: see above.*

The actions of a toxic bank therefore also have contagious impacts on healthy banks, which can even lead to the inability of otherwise healthy banks to find financing in the market.

#### 4.4 Graphical illustration

The results can again be summarized graphically as in Figure 3. We compare the new

Figure 3: Bank action under symmetric and asymmetric information



insolvency thresholds under asymmetric information with those under symmetric information. Again, the chart is only for illustrative purposes; the dimensions and distances between the thresholds do not reflect the actual values.

We can see that the threshold for the write-off strategy  $\vec{\alpha}_2^w$  has not changed. However, the new threshold for forbearance lending  $\vec{\alpha}_2^N$  has moved to the right and is now even right of  $\vec{\alpha}_2^w$ . Even then, if  $\alpha$  is sufficiently large, the bank is insolvent and will not receive funding. For all other values, a toxic bank will prefer forbearance lending.

A healthy bank is now also subject to the insolvency threshold  $\vec{\alpha}_2^N$ , whereas it did receive financing under symmetric information for any sort of  $\alpha$ .

## 5 Discussion

### 5.1 Interpretation of results

Under the given model framework, we have seen that forbearance lending is something that lowers future profitability of banks. Therefore, it should be surprising on first sight that it is actually chosen. The reason that it actually does are two-fold: excessive profit extraction and creditor deceiving.

As for the first factor, excessive profit extraction, in this model shareholders (and thus implicitly bank managers) have (extremely) limited downside risk for profits. They might be interested in extracting all profits for period 1, even above the "real" profits of the bank, and worsen performance for period 2 if they have high preference for present value. In other words, forbearance lending is a way of excessive profit, or better, dividend squeezing by shareholders. This finding is in line with the result of Niinimäki (2007). However, creditors price in this lower future profitability through a higher credit charge. This increased cost of refinancing also implies that the solvency of the bank can be in danger. A prerequisite for the dividend squeezing is that the bank can survive these increased credit charges. Thus, forbearance lending in this sense only works if bank solvency allows.

On top of this and more importantly, forbearance lending can also work to deceive creditors about the profitability of the bank. This works if there is an informational asymmetry between creditors and bank managers about the true value of the portfolio. This asymmetry has two effects: first, creditors have to increase credit charges even for healthy banks, as there might be the possibility that the profits are "fake". Second, an actually bad bank could still get lower credit charges if the announced profit seems "realistic" and deceives creditors. This effect goes as far as that the insolvency threshold is actually higher for a forbearance lending case, or in other words, that the bank is more likely to receive funding at all, in case the creditors are deceived.

The model also showed the contagious effects from toxic banks to healthy banks. While healthy banks should usually be unaffected by the action of a toxic bank, if there is mistrust about the true financial state of a bank, even healthy banks can get hit and will find themselves unable to find financing means in the market.

The results underline the necessity for interventionary measures in a market where uncertainty about banks' health drives banks' lending operations. One implication would be to target all banks, regardless of the bank health, so as to also suppress the contagious effects to healthy banks. Another implication would be to alleviate bank refinancing means and thus take away the pressure to misreport profits. Finally, a situation where

banks continue to pay out dividends in times of stress, such as happened in Japan, should be reflected on with care.

## 5.2 Model parameters and scope for further research

Clearly, the results of the model are determined by the parameters that are assumed. What follows is a discussion of the influence of the main assumptions and other parameters of the model.

**Two- vs. multi-period model** The model setup has foreseen only two periods. This was mainly done for simplification reasons: the array of choices and combinations would greatly increase with a three or even multi-period model. Moreover, a multi-period model with a recursive structure and repeating games would probably require a different approach than the current two-scenario, two-strategy one. Forbearance lending could either be modeled as a "one-off" approach with a lasting effect in the following time periods, or also as a revolving share in the portfolio subject to external shocks, if one assumes that it can take place continuously and not only as a "one-off" strategy by the bank. Indeed, while such a setup would be clearly more complex than the one presented here, it would be able to analyze the more long-term benefits and risks inherent in such a strategy. It would also allow some empirical analysis if the right data is available.

Another issue that arises in a multi-period model is the extent as to which new projects given out in  $t=1$  could again be subject to forbearance lending. This was a factor that was considered by Berglöf and Roland (1997) for their three-period model. In their framework, loans given out to new projects in  $t=1$  run until  $t=3$  if there is forbearance lending in  $t=2$ . To put an end to an otherwise never-ending loop, they model that there are no new project the banks can invest into in  $t=2$ . While such an attempt takes care of the (unrealistic) approach that forbearance lending may only take place once as in the model presented here, it also brings about the issue that there are no new projects to invest into at some point, on top of making the entire model more complicated for the case here.

The other main consequence of the two-period approach is that the bank only has to live with the effects of forbearance lending for one period. In reality, the negative effect lasts much longer as it also narrows future business through a limitation of available cash. Thus, the incentive to engage in forbearance lending should be lowered due to these long-term factors.

**Risk preferences** As mentioned initially, risk preferences play an important role here. Particularly for creditors, the assumption of risk neutrality may not be overly convincing.



Indeed, while in the literature creditors are often actually assumed to be risk averse, in this model risk neutrality was again chosen for model simplification purposes. Without going through the entire exercise above again with risk averse creditors, let's consider briefly the main differences for such a scenario.

A risk averse creditor would avoid losses and has higher utility from lower variance of returns. His credit charge is therefore overall higher compared to the risk-free investment. Moreover, the charge would also additionally be comparatively higher for the FBL strategy in relation to the write-off one, due to the higher inherent risk. As a consequence, insolvency thresholds should also be lower overall, and additionally lower for the FBL strategies in comparison to the write-off one. Thus, bank solvency is a much bigger issue under risk-averse creditors. In case bank solvency holds, however, risk aversion on behalf of the creditors should not make any difference to the general results in the symmetric information case.

In the asymmetric information case, the same effects should have a bigger impact. Creditors associate a lower variance of future outcomes in period 2 with the write-off strategy. The benefits of the FBL strategy are now lower than with risk neutral creditors. This is intuitively easy to capture as the FBL strategy is simply riskier and a higher gamble on future profitability as the conservative write-off strategy.

To conclude, with risk-averse creditors the benefits of the bank for forbearance lending would be shrinking as solvency plays a bigger role, and the positive effect of forbearance lending would be lower compared to the conservative write-off strategy.

**Recovery value of bad loans in period 2** As laid out earlier, forbearance lending is modelled as an explicitly unprofitable behavior on the lending side, as the recovery value of bad loans remains unchanged and the profitability of the new lending portfolio is also negatively affected. The positive effect of forbearance lending on overall profitability can therefore just be explained by informational advantage of bank managers over creditors.

However, the effects of forbearance lending must not necessarily be that negative. One could think of a situation where the entrepreneur has one period of bad luck, e.g. a negative one-off event like a natural disaster, or an accounting error. He is unable to repay the principal after one period, but the recovery value could increase after one period if the loan is extended. In fact, it is conceivable that forbearance lending might actually be often used in reality with this kind of effect in mind, or at least with the hope of the bank (and the entrepreneur) for a higher recovery value in the future. This approach has also been used in the approach around gambling for resurrection and other parts of the literature.

Clearly, a more positive modelling of forbearance lending would make this instrument

more attractive to banks. The features chosen here reflect the main goal of this paper to identify the effects on the funding side.

**Relationship with entrepreneurs** One major restriction in the model here is that the loan rate  $e$  to the entrepreneur is fixed. How would the picture change if the bank is able to pass on some of the increased funding costs to the entrepreneur? When considering this point, it should also be mentioned that in this paper, there is no competition among banks for having the entrepreneurs as receivers of loans. If this was existent and there was an environment of perfect competition, the terms of the loan would be fixed again. Therefore, the question on as to which degree the bank can pass on increased costs to entrepreneurs is also a matter of industrial organization in the banking industry. Only if there is a slight degree of market power with banks would they be able to take advantage of this situation and charge higher interest rates from entrepreneurs if they have higher credit charges themselves. In this context, it might also be worthwhile exploring if and when all banks would experience higher funding costs, as compared to just single banks. While these are all questions beyond the framework presented in this paper, it would certainly be interesting to explore potential implications out of this subject for forbearance lending.

Another factor worth considering is the question as to how much the recovery value of bad loans can be influenced by certain pressure on the funding side. As mentioned in the beginning, Diamond and Rajan (2001) for example argue that pressure on the funding side of the banks induces discipline on the entrepreneur as the bank can credibly threaten to withdraw funds if the creditors do so. An application of their approach to this model with a flexible recovery value of bad loans may bring some additional interesting insights.

**Features of bank debt** When deriving the credit charge it has been assumed that creditors compare this investment to the risk-free rate. As already stated, this assumes that there is no competition among banks for creditor funding. In reality, creditors have a wide range of choices of bank debt investment opportunities, so the deciding factors for their investment portfolio are comparisons of risk-return assessments for several banks rather than just the benchmark risk-free rate (e.g. government bonds). For the purpose of this paper here, however, the interpretation of the interest rate as a credit charge, instead of a beauty contest for creditors' funds, serves the purpose.

It is also important to point out that the model assumes the existence of banks by definition, and also envisages no multi-period bank loans to entrepreneurs. This runs counter parts of the literature that explain the existence of banks themselves through their role as intermediaries to absorb liquidity shocks by creditors over time. Diamond and Dybvig (1983) e.g. have applied a two-period model with a two-period loan, and explain the

existence of banks as such that they offer one-period credits for investors who may change their preference for liquidity after one period. For this reason, investors are interested in channelling their funds through the bank instead of lending to the entrepreneur directly. If in their model there were no multi-period loans, the purpose of the bank itself would be in question. The same approach has been chosen e.g. by Gorton (1985) and Diamond and Rajan (2001). As there are no multi-period loans in this model here, what bank debt does not represent is a way for creditors to smooth liquidity shocks. Therefore, in this model the only purpose of the investment by creditors in bank debt is the re-investment gain and upside potential compared to the risk-free instrument.

**Infinitesimal small equity share** As mentioned in the beginning, one big assumption made here is that banks only have a very small equity share. In reality, there is a regulatory minimum capital ratio that banks have to comply with. On the other hand, we can look at the structure of bank balance sheets to see how they are funded. It is no secret that banks have massively leveraged their balance sheets off a small equity share. Admati et al. (2011) argue that some banks have an equity share of their balance sheet as low as 2-3%. Hence, it can be argued that the assumption of this model that debt investors must share most or all of the burden as equity is not sufficient to absorb all losses, is actually not too far away from economic reality.

As for modelling, an increased equity share could be introduced but would just shift thresholds up by the amount of equity that is there. Results would not materially change.

**State protection and bank bail-outs** Finally, the question arises if creditors are actually really facing potential losses in bank debt, if banks are permanently subject to bailouts by governments. See for example Brunnermeier (2009) for a recent overview and assessments of bank bailouts in the US during the financial crisis. If banks can never default and are always bailed out, it would imply that credit charges would not increase with higher perceived riskiness. However, facts clearly speak against this assumption as there is a wide difference in funding costs among banks. See for example Fabbro and Hack (2011) who show that there are considerable differences in bank financing costs between banks but also over time in Australia.

Nevertheless, there is an element of speculation particularly for big and systemically relevant banks that they would be bailed out in times of solvency issues. For the model here, this would simply imply that the credit charge would be lowered by this amount and that the insolvency threshold would rise. Otherwise, it would not make major differences for the other outcomes of this model.

## 6 Conclusion

This paper has reviewed the incentives for banks to engage in forbearance lending. While there has been a large literature, both theoretically and empirically, on this subject and also in relation to the soft budget constraint syndrome, there has not been a study that includes the effects of funding operations on the bank's lending activity.

This paper has presented a theoretical framework where the bank has to consider the costs of funding when choosing whether to extend bad loans or re-allocate funds to new projects. The bank has to take into account the informational advantage it has on the quality of the lending portfolio versus the creditors. Creditors, on the other hand, react with a higher credit charge for higher perceived risk. Depending on the announced profit of the bank, they assume corresponding expected profitability in future periods.

The main proposition has been that banks can hide bad loans and deceive creditors by avoiding a write-down and announcing a "healthy" profit. This can lower their funding costs and/or improve their solvency if they have bad loans in their portfolio. Moreover, banks can also use forbearance lending to excessively extract profits and pay out dividends if solvency allows.

In both cases, the action of the bank to roll over bad loans is triggered by the liability side of the balance sheet. Thus, in order to address problems of bank lending in an economy, it is also necessary to look at banks' refinancing means and their relationship to shareholders. The implications are more severe, the higher the mistrust is about the true state of bank health. The model has shown that there can even be a contagion to healthy banks who can end up unable to refinance themselves.

## 7 Appendix

### 7.1 Variables

$i_1, \vec{\alpha}_1$

$$\begin{aligned}\tilde{\Pi}_1 &= (1-p)(e-i_1)L_1 + p(e-i_1-\alpha)L_1 = 0 \\ \vec{\alpha}_1 &= \frac{e-i_1}{p}.\end{aligned}$$

$$\begin{aligned}(1+\tilde{y}_1) &= (1-p)(1+i_1) + p(1+i_1+e-\alpha) = 1+g \\ i_1 &= g-p(e-\alpha).\end{aligned}$$

$$\vec{\alpha}_1 = \frac{e(1+p)-g}{2p}.$$

$i_2^w, \vec{\alpha}_2^w$

$$\begin{aligned}(1+\tilde{y}_2^w) &= (1-p)(1+i_2^w) + p(1+i_2^w-\alpha) = 1+g \\ i_2^w &= g+p\alpha.\end{aligned}$$

$$\begin{aligned}\tilde{\Pi}_2^w &= L_2^w[(1-p)(1+e) + p(1-\alpha) - (1+i_2^w)] = 0 \\ \vec{\alpha}_2^w &= \frac{e(1-p)-g}{2p}.\end{aligned}$$

$i_2^f, \vec{\alpha}_2^f$

$$\begin{aligned}(1+\tilde{y}_2^f) &= (1-p)(1+i_2^f) + p(1+i_2^f-2\alpha) = 1+g \\ i_2^f &= g+2p\alpha.\end{aligned}$$

$$\begin{aligned}\tilde{\Pi}_2^f &= L_1[(1-p)(1-\alpha)(1+e) + p(1-2\alpha) - (1+i_2^f)] = 0 \\ (1-p)(1-\alpha)e - \alpha - p\alpha &= i_2^f \\ e - ep - e\alpha + ep\alpha - \alpha - p\alpha &= g + p2\alpha \\ \vec{\alpha}_2^f &= \frac{e(1-p)-g}{3p+1-ep+e}.\end{aligned}$$

## 7.2 Proof of Lemma III.2

We want to proof that:

$$\bar{\alpha}_2^f = \frac{e(1-p) - g}{3p + 1 - ep + e} < \bar{\alpha}_2^w = \frac{e(1-p) - g}{2p},$$

which can be simplified as:

$$\begin{aligned} 2p &< 3p + 1 - ep + e, \text{ or} \\ 0 &< 1 + p + e(1-p). \end{aligned}$$

Note that  $0 < \alpha < 1$ , so the lowest value for any insolvency threshold is 0, and there can be no negative thresholds. For this reason, we only have to consider positive values, i.e.  $\bar{\alpha}_2^f, \bar{\alpha}_2^w > 0$ .

As  $e > 0$ , and  $0 < p < 1$ , the inequation is valid. Q.E.D.

## 7.3 Proof of Proposition III.1

We have to prove that

$$\sum \Omega^w = \max[0, \theta \tilde{\Pi}_2^w] < \sum \Omega^f = \hat{\Pi}_1^f + \max[0, \theta \tilde{\Pi}_2^f].$$

We are looking at the case where  $\alpha < \bar{\alpha}_2^f$ . This means that the bank is expected to be solvent in period 2 and the expected profit is positive, i.e.  $\tilde{\Pi}_2^f > 0$ .

The inequation would thus also be valid for

$$\begin{aligned} \theta \tilde{\Pi}_2^w &< \hat{\Pi}_1^f, \text{ or} \\ \theta[(1-p)(e - i_1)L_2^w + p(e - \alpha)L_2^w] &< L_1(e - i_1). \end{aligned}$$

Remember that  $e - i_1 > 0$ , so we have a profitable margin for the bank to operate. The inequation can be re-written as

$$\theta(e - i_1)[(1-p)L_2^w - L_1] + \theta p(e - \alpha)L_2^w < 0.$$

We know that  $L_2^w = L_1(1 + e - \alpha) < L_1$ . As  $0 < p < 1$ , and  $e - \alpha < 0$ , both parts of the left hand side are negative.

Q.E.D.

## 7.4 Proof of Lemma III.3

It is straightforward to see that:

$$g < i_2^N = g + 2p^2\alpha < i_2^f = g + 2p\alpha.$$

Next, we derive the insolvency threshold  $\bar{\alpha}_2^N$ . From the point of view of the creditors, the expected profitability is:

$$\begin{aligned} \tilde{\Pi}^N &= L_1[(1-p)(1+e) + p(1-p)(1-\alpha)(1+e) + p^2(1-2\alpha) - (1+i^N)] = 0 \\ g + 2p^2\alpha &= (1-p^2)e - p(1-p)\alpha e - p\alpha - p^2\alpha \\ \bar{\alpha}_2^N &= \frac{e(1-p^2) - g}{p(3p+e-pe+1)}. \end{aligned}$$

Now, we can compare the insolvency thresholds for forbearance lending under full and asymmetric information. We want to show that

$$\bar{\alpha}_2^f = \frac{e(1-p) - g}{3p+1-ep+e} < \bar{\alpha}_2^N = \frac{e(1-p^2) - g}{p(3p+1-ep+e)}.$$

This can be written as

$$\begin{aligned} ep - ep^2 - gp &< e - ep^2 - g, \text{ or} \\ p &< 1. \end{aligned}$$

Q.E.D.

## 7.5 Proof of Proposition III.2

The first part of the proposition is straightforward:

$$\begin{aligned} i_2^N &= g + 2p^2\alpha < i_2^w = g + p\alpha, \text{ if} \\ p &< \frac{1}{2}. \end{aligned}$$

For the second part, we want to show that

$$\frac{e(1-p) - g}{2p} = \bar{\alpha}_2^w < \bar{\alpha}_2^N = \frac{e(1-p^2) - g}{p(3p+e-pe+1)}.$$

This inequation can be re-written as:

$$\begin{aligned} \frac{e - ep - g}{2} &< \frac{e - ep^2 - g}{1 + 3p + e - pe} \\ e - ep - g + 3ep - 3ep^2 - 3pg + e^2 - e^2p - eg - e^2p + p^2e^2 - egp &< 2e - 2ep^2 - 2g \\ [-e + 2ep - ep^2 + e^2 - 2e^2p + p^2e^2] + g[1 - e - ep - 3p] &< 0 \\ [-e(1 - e) + 2ep(1 - e) - ep^2(1 - e)] + g[1 - e - ep - 3p] &< 0 \\ [-e(1 - e)(p - 1)^2] + g[1 - e - ep - 3p] &< 0. \end{aligned}$$

We have two parts on the left hand side, both in brackets. The left part in brackets  $[-e(1 - e)(p - 1)^2]$  is negative, as  $0 < e < 1$ . We thus have to show that the term on the right  $g[1 - e - ep - 3p]$  is small to enough to confirm the inequation.

For this, we know that the maximum value for the risk-free government bond rate  $g$  can be the lending rate to entrepreneurs  $e$ , as otherwise there would be no margin for the bank to operate. If the inequation holds for the maximum  $g = e$ , then the inequation holds also for all other smaller values of  $g$ .

Assume then that  $g = e$  in maximum:

$$\begin{aligned} [-e(1 - e)(p - 1)^2] + e[1 - e(1 + p) - 3p] &< 0 \\ -p^2 + 2p - 1 + ep^2 - 2ep + e + 1 - e - ep - 3p &< 0 \\ -p^2(1 - e) - 3ep - p &< 0. \end{aligned}$$

Again, as  $0 < e < 1$  and  $0 < p < 1$ , the inequation is valid. Q.E.D.



## Chapter IV

# Stimulating Forbearance Lending to Revitalize Zombie Banks

## 1 Introduction

As shown in chapter II, there has been little research with focus on forbearance lending and the solvency of zombie banks, and how it can contribute to regulatory policy. This paper shows three results: first, forbearance lending can have a healing effect for banks. Second, if it is decided to rescue insolvent banks for whatever reason, it is an option for the regulator to tolerate forbearance lending and even stimulate it through guaranteed debt or a zero interest rate policy (ZIRP). Third, although forbearance lending has damaging effects to the economy, together with lower refinancing rates it can be a more advantageous option for the government under certain conditions than reinstating bank solvency through equity injections or asset transfers.

We model a scenario where banks are insolvent and consequently engage in forbearance lending to avoid a default, as they can improve their equity capitalization with profits from ongoing business. Additionally, in line with the model in chapter III they can receive cheaper refinancing conditions if they do not disclose their bad loans which harm reported profits, improving their solvency even further. This is a different motive for forbearance lending compared to other papers that explain it by higher recovery values of loans, private benefits of bank managers, or a gamble for resurrection. That sort of behavior is ruled out in this paper as recovery values of bad loans are modelled to worsen in case of forbearance lending, and there are no private benefits for bank managers. Consequently, the approach of this paper implies that by becoming "zombies", banks can regain solvency over time to digest even an increased write-down of bad loans.

Upon the appearance of such zombies, the regulator has to decide how to respond *ex post* to their existence, as it is too late to take *ex ante* preventive measures. We have seen in chapter II that regulators have in the past consciously tolerated the existence of zombie banks, with the hope for a recovery over time. Some of the reasons for that could be that there is insufficient public support of a use of funds to bail out banks, others may relate to the high externalities of a bank failure, or it could be due to the limits to available funds from the government. Therefore, if the regulator wishes to rescue insolvent banks for whatever reason, he can tolerate forbearance lending and thus save these zombie

banks from being liquidated. On top of this, through the offering of guaranteed debt or a lowering of interest rates by the central bank, banks can be supported in improving their solvency further by allowing even lower refinancing costs. This increases the number of banks that can survive by becoming zombie banks and at the same time, helps to revitalize these zombie banks more quickly.

The regulator can alternatively decide to rescue banks by reinstating bank solvency through equity injections or offering asset transfers. However, this is connected with direct costs to the government, which can be critical if the solvency of the sovereign itself is under threat. Moreover, it may also lead to an overuse of these facilities, or to a different use than the write-off of the bad loans. Guaranteed debt, on the other hand, can revitalize banks with no or little costs, depending on the equity level of banks and the number of periods for which the guarantees are available. However, as a consequence of such a policy the regulator has to accept the negative effects of forbearance lending to the economy.

This paper mainly provides a positive description of the motives for forbearance lending, and how it can serve as a tool for the regulator in times of crisis. It also includes a small section that qualitatively evaluates the advantages of forbearance lending from a regulatory point of view, also in comparison with other measures. However, the main purpose is to highlight features of forbearance lending that have received little or no attention. The aim of the paper is not to have a detailed normative analysis on whether banks should be rescued or not, and whether in this context forbearance lending should be discouraged due to its damaging effects. Nonetheless, the beneficial effects of forbearance lending as pointed out in this paper may help to shed a new light on these questions in the future.

### **Tolerating and stimulating forbearance lending as a regulatory policy option**

As shown in chapter II, there is an extensive literature on the question whether in times of crisis, banks should generally be rescued, and what kind of bank recapitalization measures should be taken. For the matter of this paper, we simply assume that the regulator wishes banks to survive, for whatever reason. In such a case, the envisaged forms of government intervention include equity injections, asset transfers of bad loans (e.g. to a bad bank) or debt guarantees, be it through an explicit guarantee on the debt stock or a direct liquidity injection by the central bank.

This paper proposes that tolerating forbearance lending can be seen as an additional policy option to the ones mentioned above, because it allows insolvent banks to continue their activity. Additionally, debt guarantees or a low interest rate policy can work together with forbearance lending as the refinancing costs will go down further, thus underpinning the "healing" effects of forbearance lending and allowing more banks to survive. Due

to the nature of the guarantees, they can be implemented at no or little direct costs to the government. On the other hand, they naturally imply that the damaging effects of forbearance lending to the economy prevail.

Tolerating or even stimulating forbearance lending can thus be a policy that is recommendable if the solvency of the government is under threat, the damaging effects of forbearance lending to the economy are low, or if the other two policies asset transfer and equity injections are ineffective.

**Model outline and paper structure** The paper is structured as follows: we first start off in section 2 with a simple model of a representative bank with bad loans in its loan portfolio. At this stage, we assume that both creditors and the bank know about the extent of bad loans in the portfolio of the bank, i.e. there is no information asymmetry. Here we lay out the basic intuition of the healing effect of forbearance lending which allows insolvent banks to temporarily become zombies and "come back to life" later. In a next step, we extend the base model and introduce an information asymmetry among bank creditors and the bank manager. Now the creditors do not know anymore whether the bank is a toxic or a healthy bank, which leads to varying debt servicing costs. Now, forbearance lending has a second function, namely to lower the refinancing costs, which allows even more banks to survive and become zombies.

In section 3, we then include the option of guaranteed funding and see how this affects the behavior and composition of banks. We briefly compare debt guarantees and forbearance lending with equity injections and asset transfers, with a focus on the direct costs of the different options to intervene. Results and assumptions of the model are discussed in section 4; section 5 concludes.

## 2 The model

### 2.1 Model setup

The bank is a representative bank in an economy with other banks. The bank has legacy activities with equity  $E_0$ , credits (or interbank loans)  $C_0$  as financing means, and a loan volume  $L_0$  on the asset side. For simplicity's sake, we assume there are no deposits in this setup, as it would only complicate the model.<sup>29</sup> All or parts of the equity is owned by the bank manager, aligning his incentives with those of the shareholders. We will assume

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<sup>29</sup>Alternatively, we could simply assume that the interest rate on deposits is zero, which would lead to the same result.

that the entire asset side of the balance sheet are loans, so we will refer to the credits and equities as a share of the balance sheet, with  $c = \frac{C_0}{L_0}$  and  $\varepsilon = \frac{E_0}{L_0}$ .

There are 3 dates,  $t=0, 1, 2$ , and two periods in between the dates. The first period between  $t=0$  and  $t=1$  is a legacy period of past activities that originated in  $t=0$ . We will keep the bank activity in the legacy period simple, as the focus is on the actions going forward. The bank receives an interest rate  $e_0$  on its loans and has to pay an interest rate  $i_0$  on its credits for the legacy period.

Loans are given out for one period at a time. Hence, in  $t=1$ , the borrowers of loans have to pay back the loan principal and the interest. The bank can then lend out that volume for another period. For the period between  $t=1$  and  $t=2$ , the bank then receives a fixed interest income from entrepreneurs  $e$  on the loan portfolio. Note that to keep notations simple, the variables for the period between  $t=1$  and  $t=2$  will not be indexed.

In  $t=1$ , the bank now discovers a bad loan burden  $\alpha$  (with  $0 < \alpha < 1$ ) in its legacy loan portfolio  $L_0$ . In other words, the bank discovers it is a toxic bank. The base case of the model assumes symmetric information between creditors and the bank manager about these bad loans, i.e. both know whether the bank has bad loans or not. The extension will then loosen this assumption and introduce asymmetric information on the bad loans. For that part, creditors don't know anymore whether the bank has bad loans or not. The extension will also introduce another bank type, namely a healthy bank, that does not have bad loans from the legacy period. In the base case, however, we will assume that the bank discovers the bad loans from the legacy period by default. This can be because of an external shock, for instance.

The bad loans carry a recovery value of  $(1 - \beta)$ . This means that the borrowers are able to pay back parts, but not all of the loan amount.  $\beta$  is the write-off ratio of the bad loans, i.e. the ratio of the value of the loan to be written off over the loan amount, and defined as  $0 < \beta < 1$ . Hence, the inverse case of  $(1 - \beta)$  corresponds to the recovery value of each loan.<sup>30</sup>

The bank now has to make a strategic decision in  $t=1$  about these bad loans. It can either write down the bad loan burden to  $L_0\alpha(1 - \beta)$  and re-invest the recovery value in new projects. Alternatively, it can start forbearance lending, i.e. it extends the bad loans and delays the repayment to  $t=2$ . Throughout the paper, we will denote variables that depend on this strategic choice with  $f$  or  $F$  for "forbearance lending" ( $f$  for values under symmetric information and  $F$  under asymmetric information) and  $w$  for

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<sup>30</sup>In bank practice,  $\beta$  would be the equivalent to the loss given default, or LGD. The introduction of this beta contrasts to the models in chapter III and V, where the recovery value of bad loans is modelled at zero. The purpose of this is to highlight the healing effects of forbearance lending even in a scenario where banks can recover and reinvest parts of the bad loan under the write-off case.

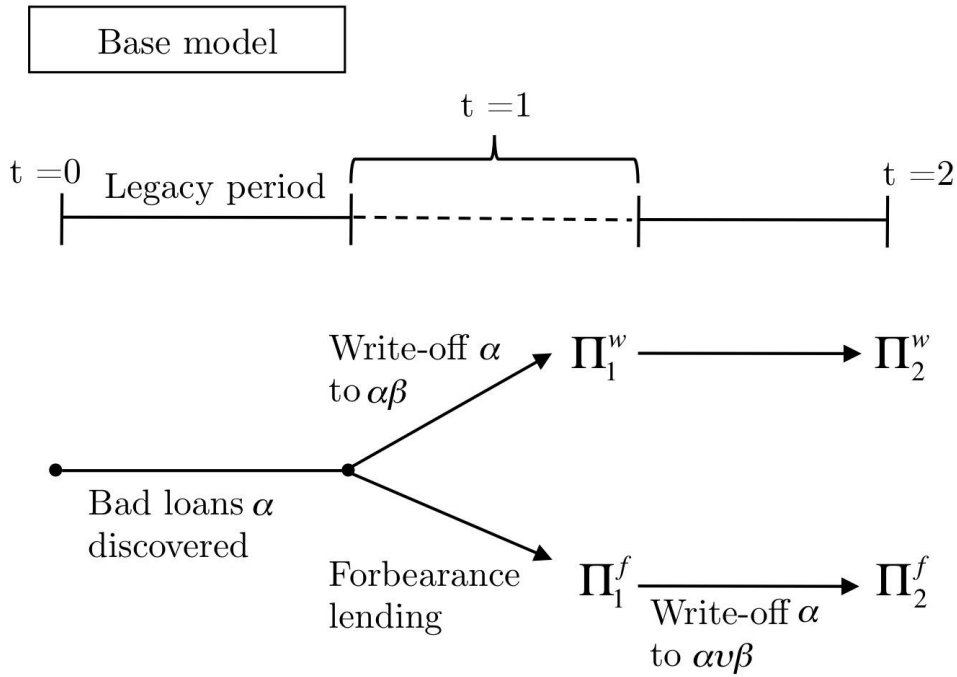
"write-off" (the values under the write-off case will remain the same under symmetric and asymmetric information). The profit in  $t=1$  in case of a write-off is  $\Pi_1^w$ , whereas the profit for forbearance lending is  $\Pi_1^f$  or  $\Pi_1^F$ .

If the bank is engaged in forbearance lending, the loans are not repaid in  $t=1$  but extended to  $t=2$ . The recovery value of the bad loans in  $t=2$  falls to  $L_0\alpha(1 - \beta v)$  with  $v > 1$ . In other words, the recovery value is worse in case of forbearance lending compared to the situation in  $t=1$ . Moreover, it will only receive interest income  $e$  on the "healthy" part  $(1 - \alpha)L_0$  of the portfolio, not on the bad loans that were extended.

On the other hand, if the bank writes off the bad loans in  $t=1$  and reinvests the recovery value, it receives interest income on the full new loan volume  $(1 - \alpha\beta)L_0$ , as there are no loans that were extended.

With this in mind, depending on the choice the bank makes in  $t=1$ , the profits in  $t=2$  are denoted as  $\Pi_2^w$  and  $\Pi_2^f$  or  $\Pi_2^F$ , respectively.

See the chart "Base model" for an overview of the sequence of events:



The creditors have an exposure of  $C_0$  to the bank in  $t=0$ . The bank cannot receive financing in  $t=1$  from new sources, and it has to renew the existing credits  $C_0$  for another period. We assume that the renewal of credits happens without a repayment of funds

in between periods. In other words, the cash remains with the bank unless the creditors explicitly do not want to continue their engagement. This will serve to focus on solvency aspects of the bank and not on liquidity aspects. With this setup, an actual default happens at the time the bank has to pay back the creditors, not at the time it is economically insolvent. Consequently, unless there is an actual default in  $t=1$ , all credits are paid back in  $t=2$ , with losses first absorbed by equity and any remaining losses to be shared by creditors.

The creditors of the bank receive an exogenously given interest rate of  $i_0$  on their exposure for the legacy period and  $i$  for the period between  $t=1$  and  $t=2$ , which pays a premium over the risk-free government bond rate  $g$ .<sup>31</sup> Initially, in the base case of the model we assume that there is no information asymmetry among creditors and the bank about the quality of bank assets. Bank creditors will thus know that the bank carries bad loans in its portfolio. At a later stage, when we introduce the clean bank into the model, there will be an information asymmetry between the bank and the creditors. The creditors will then be unable to distinguish a toxic bank with bad loans from a healthy bank.

If the equity position is positive in  $t=2$ , the bank pays out all remaining equity as dividends. So long, any announced profits in  $t=1$  and  $t=2$  will form part of an increased equity stock.

In case a bank does not receive any further funding from creditors in  $t=1$ , it is wound up. In this case, all loans are written down to the recovery value and remaining funds are paid back to creditors.

**Model variables**  $i_0, e_0$ ... interest rate on credits and loans from the legacy period

$i, e$ ... interest rate on credits and loans in the active bank period between  $t=1$  and  $t=2$

$g_t = g \forall t$ ... risk-free, government guaranteed interest rate

$\alpha_t = \alpha \forall t$ ... share of bad loans in loan portfolio

$\beta_t = \beta \forall t$ ... write-off ratio of each bad loan

$v_t = v \forall t$ ... deterioration of recovery value in case of forbearance lending

$L_0$ ... loan volume (equals balance sheet size) in  $t=0$

$E_t$ ... equity in  $t$

$C_0$ ... bank debt ("credits") in  $t=0$

$\varepsilon = \frac{E_0}{L_0}$ ... equity ratio as part of balance sheet

$(1 - \varepsilon) = \frac{C_0}{L_0}$ ... bank debt as part of balance sheet

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<sup>31</sup>This is in contrast to the model in chapter III, where the interest rate was determined endogenously in the model. For deriving the key results of the model here, it is sufficient to assume that creditors are satisfied with a rate that pays a premium over the risk-free government bond rate  $g$ .

$\Pi_t$ ... profit in  $t$

$\delta$ ... Discount factor

$\varepsilon^I$ ...insolvency threshold

$\varepsilon^L$ ...liquidation threshold under symmetric information

$\varepsilon^{L'}$ ...liquidation threshold under asymmetric information

$\varepsilon_G^L$ ...liquidation threshold under guaranteed debt

$\varepsilon_G^R$ ...revitalization threshold under guaranteed debt

$X$ ...volume of equity injection

$A$ ...volume of asset transfers

$E^w, \Pi^w$ ... values for toxic bank applying write-off under symmetric information

$E^f, \Pi^f$ ... values for toxic bank applying forbearance lending under symmetric information

$E^H, \Pi^H$ ... values for healthy bank under asymmetric information

$E^F, \Pi^F$ ... values for toxic bank applying FBL under asymmetric information

**Model drivers and solving procedure** As already mentioned, we will approach the model by first looking at a single representative bank that discovers bad loans  $\alpha$  from the legacy period by default. Depending on the equity  $E_0$  that the bank has, it is either solvent when there is sufficient equity to digest the write-off of the bad loans, or it is insolvent, if the equity is insufficient. The bank can then either write-off the bad loan, which leads to a loss, or decide for forbearance lending. Forbearance lending allows to delay the write-off and thus a continuation of bank activity, even if the bank is in fact insolvent. This is the simple creation of zombie banks in our model.<sup>32</sup> The crucial level of equity to determine whether the bank is solvent or not will be called the insolvency threshold  $\varepsilon^I$ . The ratio refers to the necessary equity  $E_0$  the bank needs in relation to the balance sheet size  $L_0$  to be solvent.

In the base case of the model, we assume that there is symmetric information between the zombie bank and the creditors, meaning that the creditors actually know that there is a bad loan which has to be written off at some point. For the next period, the bank continues its operations, which includes income from new lending activity, and potentially income from the reinvested recovery value  $\alpha(1 - \beta)$ . The key finding here is that forbearance lending by a zombie bank can be tolerated by creditors even if they know about this

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<sup>32</sup>The explicit modelling of equity is thus also a major change to the model in chapter III, where we assumed equity to be infinitesimal small. For this reason, the model in chapter III did not simulate the existence of zombie banks.

practice, as the income from new business may be enough to offset the increased write-offs of the bad loan  $v\beta$ . In this sense, the additional period of bank activity helps the zombie bank to be "revitalized", i.e. it overcompensates the higher write-off with profits from ongoing business. Creditors can increase their payout under this option. Hence, the survival of zombie banks is not the result of deceived creditors, but by the ability of the bank to build up profits. As we will see, the key driver here is the equity of the bank. Not only does the equity serve to absorb losses, but it also defines the leverage of the bank with debt, which in turn determines the debt servicing costs for any additional period of bank activity. If the equity is too low, even a zombie bank cannot survive, as the costs of continuing business are too high to promise creditors a higher payoff. Hence, apart from the insolvency threshold  $\varepsilon^I$  there is another crucial equity threshold, and banks with equity below this threshold are not able to survive even with forbearance lending. Those banks will be called liquidation banks, and the crucial share of equity will be called the liquidation threshold  $\varepsilon^L$ .

We then expand the model and integrate two features: first, we will introduce a second bank type, namely a healthy bank, into our model. This healthy bank does not have bad loans in its legacy period, unlike the toxic bank we dealt with in the base case. Second, there will be an information asymmetry between the bank manager and the creditors. Now, only the bank manager knows whether the bank is a zombie bank or a healthy bank, whereas the creditors cannot see it. Hence, in the same spirit as in the model in chapter III, the zombie bank can deceive creditors and receive a lower refinancing rate  $i^N$  ( $N$  for "new"). As we have explored the feature of lower refinancing rates through forbearance lending in detail in chapter III, we will apply it here as an exogenous assumption to facilitate the model. With this, we will see that forbearance lending serves two purposes that are interconnected: on the one hand, it gives zombie banks time to improve their solvency. On the other, it reduces the refinancing costs, which in turn improves bank solvency further. Due to the asymmetric information, the number of banks that can survive as zombie banks is thus higher than under symmetric information. This means that the liquidation threshold  $\varepsilon^L$  goes down.

Next, we will make a final extension model and introduce a third period. This is done to simulate how a zombie bank would act after it has survived one period and has to decide about the treatment of the bad loans again at a later stage. If the bank has generated equity from the profit of the ongoing business by then, it can decide to write-off the bad loans, instead of choosing forbearance lending one more time. Hence, the zombie bank can come back to life.

From the regulator's point of view, this outcome may just be what is desired. A bank that is initially insolvent survives as a zombie bank and regains health over time. The



regulator would thus not have to intervene via an equity injection or asset transfer that both require public funds. At the same time, he can still avoid negative externalities from a bank failure. To promote this even further, the regulator can reduce the refinancing costs by a low interest policy or debt guarantees. In terms of the model, this will lower the liquidation threshold even further, allowing more banks to survive.

## 2.2 Base case with symmetric information

The base case deals with a bank that finds bad loans in its legacy loan book by nature. There is symmetric information between the bank manager and creditors on the bad loans, i.e. both parties know about their existence and the volume.

### 2.2.1 Profits and insolvency threshold

We will start off by looking at the situation in  $t=1$ , i.e. at the end of the legacy period. As mentioned, the bank discovers a bad loan share  $\alpha$  in its portfolio.

The profit for the bank in  $t=1$  will be either

$$\Pi_1^w = (e_0 - \alpha\beta)L_0 - i_0C_0,$$

if it writes down and reinvests the recovery value, or

$$\Pi_1^f = e_0L_0 - i_0C_0,$$

if it decides to engage in forbearance lending, i.e. it is not writing down the bad loans.

As we can see, the only difference between the two is the recognition of the losses through the bad loans  $\alpha\beta$ . For simplification reasons, we assume for the legacy period that  $e_0L_0 = i_0C_0$ , so that there are zero profits in the base case for the legacy activities.<sup>33</sup> Thus, the bank continues with zero profit or losses in case of forbearance lending (i.e.  $\Pi_1^f = 0$ ), or makes a loss if it writes down the bad debt burden (i.e.  $\Pi_1^w = -\alpha\beta L_0$ ).<sup>34</sup>

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<sup>33</sup>Remember that the balance sheet structure is  $L_0 = C_0 + E_0$ , but the interest bearing elements that are relevant for the profit are only the loan  $L_0$  and the credits  $C_0$ . It thus follows that  $e_0 \neq i_0$ . The holders of equity  $E_0$  would in theory be entitled to dividends if there were positive profits, but that is not the case here.

<sup>34</sup>In line with the model in chapter III, this assumes that borrowers are able to repay the interest on the loan, but will default on parts of the loan principal.

The equity at the end of  $t=1$  will be

$$\begin{aligned} E_1^w &= E_0 + \Pi_1^w = E_0 - \alpha\beta L_0, \text{ for the write-off, and} \\ E_1^f &= E_0 + \Pi_1^f = E_0, \text{ for forbearance lending, with} \\ E_1^w &< E_1^f. \end{aligned}$$

Remember that the equity ratio  $\varepsilon$  represents the equity  $E_0$  from the legacy period over the balance sheet size  $L_0$ . We can then already make the first distinction here. If the toxic bank has a lower equity level than the so-called "insolvency threshold"

$$\varepsilon^I := \alpha\beta$$

it will normally be unable to operate, as the recovered value on the loan plus the equity would not be enough to pay back the interest to creditors. A bank with an equity below the insolvency threshold is thus insolvent.

However, the bank may be able to continue its business by starting forbearance lending. A major prerequisite for this is that the creditors are willing to renew their credits with the bank as well. If the creditors tolerate the continuation of activity by an insolvent bank, it is called a zombie bank. If the creditors do not accept that, the insolvent bank has to be liquidated, and will be called a liquidation bank.

Hence, we can further categorize such an insolvent bank into two groups: "zombie banks" that continue operation under insolvency and "liquidation banks" that will be liquidated after one period. Liquidation banks would thus not be able to conduct further business for  $t=2$ .

A toxic bank with an equity above the insolvency threshold will be referred to as "survivor bank", as it can survive even with the bad loans.

### 2.2.2 Zombie banks and liquidation banks

We can quickly sketch out the rationale for a bank to be engaged in forbearance lending.

The profit for the bank that is engaged in forbearance lending for  $t=2$  will be

$$\Pi_2^f = [e(1 - \alpha) - \alpha v\beta]L_0 - iC_0.$$

It will have running profits from interest income  $e$ , but only on the clean part of the portfolio  $(1 - \alpha)$ . On the bad loan share  $\alpha$  it faces a higher write-down in the next period  $v\beta$ .

As we outlined above, if the bank's equity is below the insolvency threshold, it is

practically insolvent in  $t=1$ , as it cannot pay back the creditors in full. The bank can theoretically survive by forbearance lending, becoming a zombie bank. However, the bank can only pursue this strategy if the creditors are willing to extend their credits for one more period. Creditors, in turn, will only approve of the strategy if their payback is increased in  $t=2$  compared to a liquidation scenario, in which they will have to suffer immediate losses in  $t=1$ . As creditors are comparing two different points in time, we have to adjust this through a discount factor  $\delta$ . For simplicity's sake, we assume that any discount rate is zero (or the discount factor is  $\delta = 1$  as we will see shortly).<sup>35</sup>

The mechanics now work as follows. As just said, when the zombie bank is engaged in forbearance lending, it will only get interest return  $e(1 - \alpha)$  on the new loans in its portfolio (not on the forbearance lending part  $\alpha$ ). On the liabilities side, the bank has to pay the interest rate  $i$  on the credits, which make up  $(1 - \varepsilon)$  of the balance sheet. We can see that the extra income from the loan activity  $e(1 - \alpha)$  minus the interest charges on its debt of  $i(1 - \varepsilon)$  have the potential to offset the additional write-down  $\alpha v \beta$  of the bad loan portfolio. If this extra benefit increases the equity to a level higher than before, then the strategy is feasible not only for the shareholder, but also from the creditor's point of view.<sup>36</sup> In other words, the strategy pays off if:

$$\delta \left[ \underbrace{e(1 - \alpha)}_{\text{Running revenues}} - \underbrace{\alpha v \beta}_{\text{increased write-off}} - \underbrace{i(1 - \varepsilon)}_{\text{interest charge}} \right] > \underbrace{-\alpha \beta}_{\text{initial write-off}}, \text{ with } \delta = 1.$$

The left hand side of the inequation represent the benefits from continuing bank business for another period, while the right hand side represent the payoffs of an immediate write-off. As two different points in time are compared, the future revenues are discounted with  $\delta$ .

As we can see, an important component are the debt servicing costs for another period  $i(1 - \varepsilon)$ . Here, the equity ratio  $\varepsilon$  plays a role in two ways: on the hand, it is important because it represents the ability to absorb losses. The higher the equity ratio, the higher naturally the ability to digest losses. On the other hand, it also determines the debt level of the balance sheet on which the bank has to pay interests. The lower the equity, the higher the interest costs every period for the bank.

The crucial equity level that determines this can then be called the liquidation thresh-

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<sup>35</sup>In essence, the introduction of  $\delta$  allows to compare the payoffs for creditors in two different dates. See the discussion in section 4 of this paper for a consideration of alternative values of  $\delta$ .

<sup>36</sup>Technically, the shareholder has no further advantage from this strategy, as all gains will be directed to the debtholder and his position will be unchanged. We assume, however, that both the bank manager and the shareholder prefer a continuity case against an insolvency case. This could also be more explicitly modelled by introducing bankruptcy procedure costs.

old:

$$\varepsilon^L := 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{i}.$$

Banks with equity above the liquidation threshold can survive as zombie banks. Otherwise, the bank is a liquidation bank, and cannot even survive under forbearance lending. The rationale is that due to the low capitalization, the debt ratio of the balance sheet is very high. While another period also brings additional revenues, it also implies additional debt servicing costs. Creditors cannot improve their position by waiting one more period.<sup>37</sup>

As we can see, the crucial equity level depends also on the write-down ratio. More specifically, the additional write-down factor  $v$  must be lower than the crucial level  $v^*$ , where:

$$v^* = 1 + \frac{e(1 - \alpha) - i(1 - \varepsilon)}{\alpha\beta}.$$

The highest possible deterioration is again a function of the margin between lending and funding business.<sup>38</sup> However, this also means that there are limits to this type of forbearance lending; if the recovery value deteriorates too much or the margin is not big enough, this concept does not work.

We have herewith defined a very simple framework for explaining forbearance lending. It is important to note that even in light of worsening recovery values, it is sensible for the bank's shareholders, as well as the creditors (!) to allow the bank to be engaged in forbearance lending, although on a pure mark-to-market basis in  $t=1$ , the bank will be insolvent. We will refer to this type of behavior as solvency-driven forbearance lending.

**Proposition IV.1** *For a bank that does not have sufficient equity to absorb losses from a write-down, forbearance lending is a suitable strategy for all stakeholders if the profits from the running business can cover the deterioration in recovery values, i.e. the equity level is above the liquidation threshold  $\varepsilon^L$ , with*

$$\varepsilon^L = 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{i},$$

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<sup>37</sup>To put some exemplary numbers to these variables, with an interest rate  $e = 10\%$ , an initial write-off ratio of  $\beta = 40\%$ , a bad loan share in the portfolio of  $\alpha = 30\%$ , an interest rate of  $i = 6.5\%$  and a deterioration of the recovery value of  $10\%$ , i.e.  $v = 1.1$ , this means that the insolvency ratio  $\varepsilon^I$  is  $12\%$ , whereas the liquidation threshold  $\varepsilon^L$  is  $10.8\%$ .

<sup>38</sup>To show how this can change with a bigger margin, if the interest rate drops to  $i = 5\%$ , and we assume a debt share of the balance sheet of  $(1 - \varepsilon) = 90\%$ , this means that  $v$  can deteriorate to as much as  $20\%$ .

and the deterioration of the recovery value is below the crucial level  $v^*$  with

$$v^* = 1 + \frac{e(1 - \alpha) - i(1 - \varepsilon)}{\alpha\beta}.$$

Such a strategy can help the bank to increase its equity capital and ensure continuing business activity, while it reduces losses for debtholders.

*Proof:* see above.

We now look at the question whether even solvent banks with equity above  $\varepsilon^L$  prefer forbearance lending, or whether this is limited to zombie banks only. We will refer to these banks as "survivor" banks, as they are able to survive the bad loans in their book.

### 2.2.3 Behavior of survivor bank with equity above $\varepsilon^I$

We have seen that the bank can also have an equity above the insolvency threshold  $\varepsilon^I$ , to which we refer as a survivor bank. The survivor bank can afford to write-off the bad loans, but naturally it also has the choice to start forbearance lending, even if it is not necessary under solvency aspects. In the following, we will briefly look into this choice.

The profit for period 2 for the bank under the write-off strategy is

$$\Pi_2^w = e(1 - \alpha\beta)L_0 - iC_0.$$

On the other hand, if the bank was to engage in forbearance lending, its profit would be:

$$\Pi_2^f = [e(1 - \alpha) - \alpha v\beta]L_0 - iC_0.$$

Comparing both options, we get

**Proposition IV.2 :** *Under symmetric information and if solvency allows, a survivor bank faced with the choice between forbearance lending and the write-off strategy will always choose the latter, as the overall equity in  $t=2$  including profits is higher, i.e.:*

$$E_2^w > E_2^f.$$

*Proof:* Appendix.

The rationale is that there is a double benefit from the immediate write-down: first, the bank can reinvest the recovery value and gets positive return on it. Second, the write-down is lower in  $t=1$  than after one period.

## 2.3 Extension with healthy and toxic banks under asymmetric information

So far, we assumed that the representative bank always had a bad loan share by nature. We now assume that the bank can either be a healthy or a toxic bank, where a healthy bank has a clean loan book without bad loans. Remember that values for the bank under forbearance lending are now indexed with  $F$  instead of  $f$ , whereas the values under write-off will stay the same, as we will see shortly.

In  $t=1$ , the bank learns whether it is a healthy or toxic bank. If it is a healthy one, the profit for the healthy bank in  $t=1$  will be

$$\Pi_1^H = e_0 L_0 - i_0 C_0.$$

The equity at the end of  $t=1$  will be

$$E_1^H = E_0 + \Pi_1^H = E_0.$$

In  $t=1$ , the profit for the next period is:

$$\Pi_2^H = e L_0 - g C_0,$$

as the healthy bank will not have a bad loan share, so it will always make profits. We assume, therefore, that the bank can refinance itself at the risk-free government bond rate  $g$  which is lower than  $i$ , while they are both exogenously given. Intuitively, we may think of the higher interest rate for a toxic bank  $i$  as a compensation for the possibility that debtholders face losses.

This implies that again  $e > g$ , so that a healthy bank has a positive margin. Therefore, a healthy bank does not need any equity to be solvent, as it can build up equity out of its running operations.

### 2.3.1 Weighted credit premiums under asymmetric information

We will now outline how the base model described above changes under asymmetric information. Remember that now, creditors will not know whether the bank is a healthy bank or toxic bank, i.e. whether it has a bad loan share  $\alpha$  or not. However, they are aware that banks can pretend to be a healthy bank (through announcing  $\Pi_1^F = \Pi_1^H$ ), even if they are actually toxic banks.

In this scenario, creditors will demand the rate  $i$  for the period between  $t=1$  and  $t=2$  given an announced profit of  $\Pi_1^w$ , as like before they know the bank is a toxic bank that

has just written down the bad loan. However, for an announced profit of  $\Pi_1^F = \Pi_1^H$  under forbearance lending, they will not know whether the bank is a healthy or toxic bank that just hides the losses. For that reason, we assume that they will demand a new intermediate rate  $i^N$ , with  $e > i > i^N > g$ .

Note that this rate  $i^N$  will be applied to both a healthy and a toxic bank under forbearance lending then, as there is no certainty for the creditors that the bank can be a healthy one.

Although  $i^N$  is exogenously given, its value is defined to lie in between  $i$  and  $g$ . In essence, the new intermediate rate  $i^N$  is lower than the rate  $i$  for the toxic bank, as it offers creditors the possibility that the bank is actually a healthy one, and thus induces no losses. Compared to  $g$ , it is a premium for not knowing exactly whether it is really a healthy bank.<sup>39</sup>

### 2.3.2 Effects of asymmetric information on the choice between FBL and write-offs

We have seen in proposition IV.2 that under symmetric information, the bank will always choose to write-off the bad loans as long as solvency allows. However, as we have seen, under asymmetric information forbearance lending brings the bank a second advantage, namely lower funding costs. This also has an effect on the choice for a solvent survivor bank between forbearance lending and write-offs, where it will choose the former if the overall equity in  $t=2$  is higher again, so (see appendix for details):

$$E_2^w > E_2^F, \text{ if} \tag{6}$$

$$\alpha\beta\left(\frac{e}{\beta} + v - e - 1\right) > (i - i^N)(1 - \varepsilon).$$

On the left hand side, we have the benefits of the write-off strategy, and the right hand side represent the lower funding costs for the bank. While in most cases the left hand side should be bigger, in case there is large gap in funding costs for a healthy and a toxic bank, and for a generally low share of bad loans, even a survivor bank (i.e. a toxic, but solvent bank) may choose to opt for forbearance lending. Apart from the function to "buy time" and increase the equity buffer, forbearance lending now has a second function, namely to reduce the debt servicing costs. This has been described more in detail in chapter III. We

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<sup>39</sup>The exact value of  $i^N$  is not relevant for the purpose of this paper, and it is sufficient to define that it is in the range between  $i$  and  $g$ . The advantage of using such an exogenous rate  $i^N$  is that we do not have to explicitly model what exactly the likelihood is to have a toxic or clean bank. This has already been done in chapter III with the model that explicitly derives interest rate charges for banks with different levels of bad debt. Incorporating this feature into this model would complicate it unnecessarily, while we can derive the same results with the setup as modeled.

will refer to this as funding-driven forbearance lending.<sup>40</sup>

### 2.3.3 Effects of asymmetric information on the composition of banks

Under these reduced funding costs, the liquidation threshold goes down for a toxic bank due to lower interest costs. Instead of the former liquidation threshold under symmetric information:

$$\varepsilon^L = 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{i},$$

we will now have a new threshold with  $i^N$ :

$$\varepsilon^{L'} := 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{i^N}.$$

It is easy to see that  $\varepsilon^L > \varepsilon^{L'}$ , as  $i > i^N$ . This means that now there are more banks that can survive with forbearance lending, as the perceived creditworthiness is improved. We here have a combination of the funding-driven and the solvency-driven forbearance lending.<sup>41</sup>

**Proposition IV.3** *The number of zombie banks increases under asymmetric information, where the new liquidation threshold is:*

$$\varepsilon^{L'} = 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{i^N}.$$

*Proof: see above.*

Note that a healthy bank would not need a minimum level of equity, as even with refinancing costs of  $i^N$ , it does not have any write-downs and gets profits from the margin  $e - i^N$ .

### 2.3.4 Overview of bank types

We can now summarize the different bank types we have identified. Please see the chart "Categorization of banks by equity" below for an overview of the categorization of banks according to their equity.

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<sup>40</sup>If we use the exemplary numbers of above where we have an interest rate for a toxic bank of  $i = 6.5\%$ , then we can assume a weighted interest rate of  $i^N = 6\%$ . Under these circumstances, the benefits of forbearance lending are too small to justify a funding-driven forbearance lending for the survivor bank. Assuming an equity ratio of  $\varepsilon = 12\%$ , the benefits on the funding side (right hand side) are 0.0044 balance sheet units, whereas the benefits of the increased return is 0.03 balance sheet units.

<sup>41</sup>Again, to use the exemplary numbers of above ( $e = 10\%$ ,  $\alpha = 30\%$ ,  $\beta = 40\%$ ,  $v = 1.1$ ,  $i^N = 6\%$ ), this would correspond to a new liquidation threshold of 3.3%. This is significantly lower than the original threshold  $\varepsilon^L$  of 10.8%.



The graph shows the types of banks according to their equity ratio. The higher up on the graph, the higher the equity ratio. In the first column on the left, we can see the values of the numerical example as a reference. The thresholds then represent the key threshold that define the bank type.

The column "Bank type (SI)" shows that under symmetric information (SI), the bank is either a survivor bank if it has an equity ratio which is higher than the insolvency threshold  $\varepsilon^I$ , a zombie bank if it has equity below that but more than the liquidation threshold  $\varepsilon^L$ , or a liquidation bank for all equity below  $\varepsilon^L$ .

In the next column "Bank type (AI)" we see that if we introduce asymmetric information (AI), the liquidation threshold goes down to  $\varepsilon^{L'}$  due to the lower financing costs for zombies. The number of banks that can survive as zombies would thus increase compared to the symmetric information case.

The final column shows the driver for forbearance lending (FBL). For the survivor banks, the driver for forbearance lending, if at all, is to improve the funding costs only. For zombie banks under symmetric information, forbearance lending serves only to keep them alive. Hence, it is chosen for solvency reasons. In the asymmetric information case, forbearance lending serves a dual purpose to improve both solvency and funding.

### 3 Regulator's view

As mentioned in the beginning, in case of a financial crisis and the appearance of insolvent banks, the regulator has to decide how to deal with the banks as a crisis manager. He first has to decide whether to let banks fail or whether he wants to rescue banks. Afterwards, once he decides for the latter, he has to decide on how to intervene.

It can be seen from the analysis so far that tolerating forbearance lending is one policy option: all liquidation banks will be liquidated while the zombie banks survive. By not intervening, some of the insolvent banks will thus be saved without external help, and even weaker capitalized banks will disappear.

However, the regulator can also actively intervene and influence the number of banks that survive in the economy. The following will examine this case further. For this, we will consider the effect of reduced refinancing costs on the composition of banks. This can be brought about by debt guarantees by the government or a low interest policy by the central bank. As we will see, reduced refinancing costs are favorable for banks that are engaged in forbearance lending, as the costs of operating one more period go down. This lowers the liquidation threshold. Hence, if the regulator wishes banks to survive for whatever reason (e.g. because of large externalities of bank failures), this policy promotes

Categorization of banks by equity

<u>Numerical example</u>	<u>Threshold</u>	Bank type (SI)	Bank type (AI)	FBL driver
12%	Insolvency $\epsilon^I$	Survivor	Survivor	Funding
10.8%	Liquidation (SI) $\epsilon^L$	Zombie	Zombie	Solvency
3.3%	Liquidation (AI) $\epsilon^{L,1}$	Liquidation		Funding + Solvency
			Liquidation	

SI = Symmetric Information, AI = Asymmetric Information, FBL = Forbearance lending

insolvent banks to start forbearance lending and hence continue operations. Some banks that may be liquidation banks without policy intervention can turn into zombie banks and survive.

Afterwards we will compare this policy with other measures that directly address the insolvency problem of banks, namely equity injections and asset transfers. As we will see, these policies are costly for the government and also run the risk of misuse by banks, e.g. if they overstate the required assistance. As already mentioned, this paper does not offer a normative analysis of rescue mechanism, but this quick comparison highlights that compared to these large scale intervention, tolerating or even stimulating forbearance lending via reduced refinancing costs can be an alternative for the regulator.

### 3.1 Reduced refinancing costs

We now introduce reduced funding costs into the model we had so far. We simply assume that the government offers this instrument to assist the banking system. Although in reality there are differences between liquidity provisions or a low interest rate policy by the central bank, as well as government guaranteed funding, for simplicity reasons we assume they have the same effect, namely funding at the risk-free rate and continuation of bank activities with debt from either guaranteed debtholders or from the central bank.<sup>42</sup> While certainly exaggerated, we assume that all debt would be covered by these policy measures, so that the funding costs go down significantly to the financing rate of a healthy bank  $g$ . As mentioned, we assume that risk-free funding at the government level  $g$  is cheaper than the normal funding rate  $i$ , i.e.  $i > i^N > g$ .

As the refinancing rate has gone down, the immediate impact of the guarantee is that the liquidation threshold will move further down. The new liquidation threshold under guaranteed debt will be denoted with  $\varepsilon_G^L$ , with  $G$  for guaranteed debt.

**Proposition IV.4** *Through measures that reduce the refinancing costs such as guaranteed debt or liquidity provisions, the number of zombie banks increases further, as the new liquidation threshold will be lowered to:*

$$\varepsilon_G^L := 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{g},$$

with

$$\varepsilon_G^L < \varepsilon^{L'} = 1 - \frac{e(1 - \alpha) - \alpha\beta(v - 1)}{i^N}.$$

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<sup>42</sup>Nakaso (2001) actually provides an example where the Bank of Japan directly provided risk capital into a financial institution during the banking crisis.

*Proof: obvious, as  $g < i^N$ .*

This means that the numbers of zombies increases compared to a situation without government intervention. Put differently, the number of banks in the economy that would otherwise be liquidated is lower, as the government intervention has saved them.

For banks below this new threshold, even these reduced funding rates cannot induce a positive profit, so that the situation actually deteriorates after one period. The regulator can thus only interfere with banks that have equity above this threshold.<sup>43</sup>

### 3.2 Extension by one period - additional healing effects of guaranteed debt

We can now make the last extension of the model. So far, we have worked with a model of two periods and three dates ( $t=0,1,2$ ). Here, the bank could only make the decision once in  $t=1$  whether to engage in forbearance lending or not. For the purpose of studying the effects of guaranteed debt, we will extend the model by one more period. Now, there is another moment in  $t=2$  where the bank can decide whether to engage in forbearance lending or not.

The model extension now allows to take into account the scenario that the bank is forced in  $t=1$  to engage in forbearance lending as a zombie bank, and has then accumulated sufficient capital in  $t=2$  to digest the write-off. In other words, the bank is only temporarily a zombie bank, but is "revitalized" after one period and could operate as a solvent bank again.

This means that the bank who chooses to write-off the bad loans in  $t=1$  receives clean profits for the next two periods, whereas in case of forbearance lending in  $t=1$ , the bank can decide again in  $t=2$  whether to write-off the bad loans then or not. Please see the chart "Extended model" below for an overview of events now.<sup>44</sup>

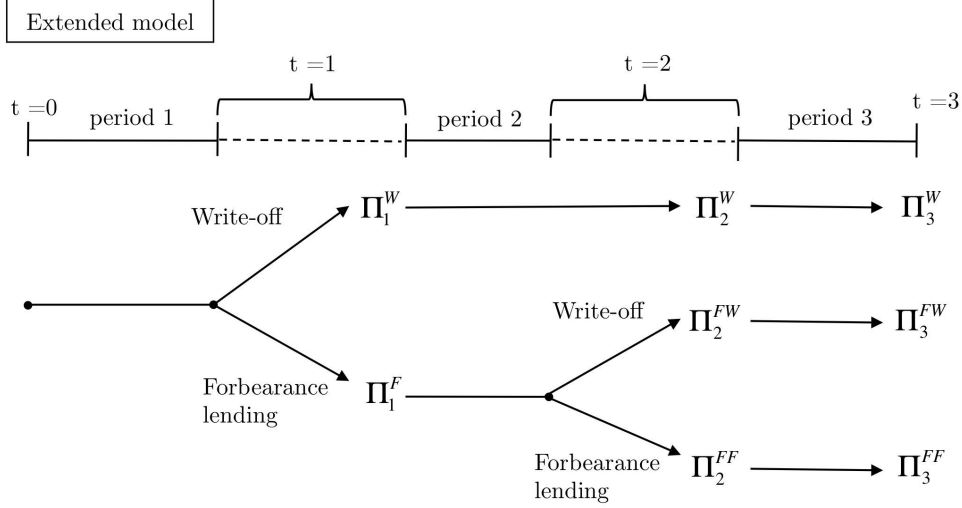
#### 3.2.1 Decision on forbearance lending in $t=2$

Going back to the base model without guaranteed debt, in  $t=2$  the bank faces the decision again, whether to continue forbearance lending or write-off the now increased bad debt.

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<sup>43</sup>For our exemplary numbers, the guaranteed funding ratio is low enough to allow all banks (even with 0% equity) to survive, although this does not always have to be the case.

<sup>44</sup>Theoretically, we can extend the model by multiple periods, as long as the bank keeps on receiving funds from creditors. For such a case, the insolvency threshold  $\varepsilon^I$  in  $t=1$  (with index)  $\varepsilon_1^I = \alpha\beta$  would increase to  $\varepsilon_2^I = \alpha\beta v$ , and  $\varepsilon_n^I = \alpha\beta v^{n-1}$ , where  $\varepsilon_{\max}^I = \alpha$ . In reality, however, many parameters would not remain the same for a multi-period model, e.g. the assumption that there will be no more bad loans out of new projects after  $t=1$  is unrealistic. For the purpose of the analysis, we will include only one more period.



The equity at  $t=2$  for a bank that engaged in forbearance lending in period 1 is:<sup>45</sup>

$$E_2^F = E_0 + [e(1 - \alpha) - \alpha v \beta] L_0 - i^N C_0,$$

and is subject to the refinancing costs  $i^N$ , as it cannot use the guaranteed debt yet. It will be able to write-down the bad loans  $\alpha \beta v$ , if the equity level is high enough to digest it, i.e. if the equity  $E_2^F$  is above zero.

For banks above this threshold, it can be shown that the payoffs through the write-off strategy are usually higher than under forbearance lending, so banks decide to write off their bad debt. See the appendix ("three period extension") for details.

We now look at the effects of introducing reduced debt refinancing costs. For zombie banks, while reduced funding costs improve the profitability of the bank for the next period, they cannot influence the solvency of the bank in  $t=1$ . Remember that the threshold for insolvency is  $\varepsilon^I = \alpha \beta$ , so independent of  $i$ .

However, the measure can be beneficial to induce the bank to write-off the bad loans after one period in  $t=2$ . With guaranteed debt the bank can thus reach the solvency threshold in  $t=2$  through a reduced funding rate. The equity  $E_{2,G}^F$  in  $t=2$  with reduced deb refinancing costs is now going to be:

$$E_{2,G}^F = E_0 + [e(1 - \alpha) - \alpha v \beta] L_0 - g C_0.$$

Comparing this equity with reduced debt refinancing costs  $E_{2,G}^F$  with the equity with-

<sup>45</sup>Remember that  $E_0 = E_1^F$ .

out government intervention  $E_2^F$ , it is straightforward to see that  $E_{2,G}^F > E_2^F$ , as  $i^N > g$  per definition.

Via backward induction, we can now also define a new threshold, which determines which zombie banks can become solvent banks in  $t=2$  under guaranteed debt. We will call this the revitalization threshold  $\varepsilon_G^R$ , with  $R$  for revitalization:<sup>46</sup>

**Proposition IV.5** *With reduced debt refinancing costs, the healing effect of forbearance lending is accelerated compared to a situation with regular funding costs. Zombie banks are revitalized and become solvent banks if they have equity above the threshold*

$$\varepsilon_G^R := \frac{\alpha v \beta + g - e(1 - \alpha)}{1 + g}.$$

*Proof: Appendix.*

To summarize the effects of reduced funding costs, the number of zombie banks will increase due to the lower liquidation threshold. At the same time, some of the zombie banks will stop their forbearance lending activity after one period in  $t=2$  and write off their bad debt. Guaranteed debt helps to accelerate this process.

### 3.3 Comparison with other measures of government intervention

As mentioned in the introduction, this paper does not aim to provide a detailed normative analysis of which form of intervention the government should follow. However, we can quickly compare the combination of forbearance lending and reduced funding costs with an equity injection and an asset transfer under the setup of this paper on a descriptive and qualitative basis.

One big difference is that equity injections and asset transfers have an immediate effect on bank solvency, while reduced funding costs and forbearance lending are effective only after one period. This means that equity injections and asset transfers can lead the bank to write-off all bad loans immediately and thus stop forbearance lending. The damaging effects of forbearance lending to the economy as pointed out in the literature can thus be avoided.

However, we have already seen in the introduction that there are disadvantageous points attached to these policies as well. One is the overuse and misuse of funds. As already described in the beginning, the main problem is that the regulator does not have

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<sup>46</sup>Using the numerical example from above and assuming a guaranteed rate of  $g = 4\%$ , this threshold would be  $\varepsilon^R = 9.8\%$ .

information on the level of bad assets for each bank. This means that it is not known how much funds each bank needs. Offering recapitalization measures or asset transfers can therefore simply result in a situation where the bank overuses these facilities. This point will also be reflected in the estimate of direct costs later.

Moreover, the bank can simply use the funds for other purposes, e.g. lending to new projects instead of writing off the bad loans. Again, the regulator cannot force the banks to write-off the bad debt, as it does not know how much each bank has in its balance sheet. It is thus not clear how effective these recapitalization policies are, whereas guaranteed debt successfully and immediately lowers the funding costs and, hence, improves the solvency.

Apart from the misuse of funds, the other, more problematic point are the direct costs to the government that come with such policies. This is especially the case if the government suffers under solvency problems itself, as pointed out in the introduction. The following will describe this point more in detail.

### 3.3.1 Direct costs of equity injection

In our model, any extra unconditional capital transfer  $X$  is beneficial to the bank. This is because it comes at zero direct funding cost to the bank, but brings in interest income of  $Xe$ . This raises the danger that banks overstate their capital needs and apply for too much capital. If the capital injections are done unconditionally, the regulator would thus be able to contain forbearance lending by all banks, but would also have to capitalize banks infinitely, way beyond the necessary equity for the losses. This is thus not a workable option.

One measure to reduce incentives to misreport the necessary equity is for the government to acquire a share of the bank and thus reducing future payouts for the other shareholders, similarly to what is suggested by Philippon and Schnabl (2013). As any equity level below  $\varepsilon^I$  would not make the bank immediately profitable, banks would at least apply for funds that bring them to  $\varepsilon^I$ . The payout  $P$  for a shareholder (and therefore also the bank manager) with extra government funds  $X$  after one period would be

$$P = \frac{E_0}{E_0 + X} (e[L_0(1 - \alpha\beta) + X] - iC_0),$$

where the increase in payout  $P$  subject to an increase in  $X$  is:

$$\frac{\partial P}{\partial X} = \frac{E_0^2 e - e(L(1 - \alpha\beta)) + iC_0}{(E_0 + X)^2}.$$

Hence, while a higher equity injection also has beneficial effects on profits, it also increases the share that is distributed to the government and away from the bank manager. To be more intuitive, if the government injects so much equity that the original equity of the bank manager only makes up an infinitesimal small share, the bank manager cannot benefit from higher profits of the bank.

Therefore, from the point of view of the shareholder (and thus the bank manager), the optimal transfer  $X$  is where the equity is brought at the margin above the zero-profit threshold  $\varepsilon^I$ . Any extra transfer beyond this reduces the payout for the shareholder again.

In our model, this means that the regulator recapitalizes the bank with a transfer of  $X = L_0(\varepsilon^I - \varepsilon)$ .

If we go one step further, we can apply this concept to a continuum of  $n$  banks ( $j = 1, 2, \dots, n$ ) in the economy that all have their respective equity level  $\varepsilon_j$  and insolvency threshold  $\varepsilon_j^I$ . For a regulator to act as a crisis manager then, if we assume that all banks apply for the minimum capital amount to get to solvency, the government would have to recapitalize all zombie and liquidation banks with the full shortfall to the insolvency threshold.

More formally, if there are  $n$  zombie and liquidation banks ( $j = 1, 2, \dots, n$ ) in the economy with their respective lending volume  $L_{0,j}$  equity level  $\varepsilon_j$  and insolvency threshold  $\varepsilon_j^I$ , the total sum of transfers would be:

$$\sum_{j=1}^n X_j = \sum_{j=1}^n L_{0,j}(\varepsilon_j^I - \varepsilon_j).$$

This implies that *all* zombie and liquidation banks in the economy are recapitalized in full up to solvency, a measure that would be very costly for any government to digest, especially during a time with high volumes of bad loans in the economy. Technically, the government would be entitled to receive dividends to reduce the initial losses after one or several periods, but the necessary initial funds needed to recapitalize all banks may already go beyond the capabilities of the government.

### 3.3.2 Direct costs of asset transfers

Asset transfers work very similarly to equity injections in this model. This is because by assumption, asset values cannot improve. At the same time, zombie banks are in the "comfortable" situation that they improve their financial position by continuing their regular business activity. They would thus have to be given incentives to participate in such a scheme that improve their situation beyond the forbearance lending case.

With this in mind, the regulator has two options: he can buy the bad assets at the



recovery value  $(1 - \beta)\alpha L_0$  or at the face value  $\alpha L_0$ . The former is difficult to execute, as the regulator does not know the true value. Even if it succeeds in receiving the recovery value (through a design proposed, e.g. by Bruche and Llobet 2011), the bank would then have to write-off the loan in its books, just like it would have to do without an asset transfer. While this is feasible for survivor banks who can bear the write-off, it is not workable for zombie banks, as they are actually insolvent. There is thus no incentive for the bank to participate in this kind of scheme.<sup>47</sup>

The other option is that the regulator assumes the assets at the face value, which implies that the government will make a loss of  $\beta\alpha L_0$ . This option is equal to a capital injection as it constitutes an indirect recapitalization. The difference is, however, that in this case the regulator is not entitled to future profits as dividends. Moreover, given that the regulator does not know the real recovery value of the assets, naturally all banks would transfer all their toxic assets to the regulator, including the survivor banks that would usually be able digest a write-off on their own without external help. Such a framework would increase the costs substantially compared to an equity injection.

More formally then, in an economy with  $k$  banks ( $q = 1, 2, \dots, k$ ), of which there are  $n$  zombie and liquidation banks ( $j = 1, 2, \dots, n$ ), i.e.  $k > n$ , with a lending volume each of  $L_{0,q}$  and an insolvency threshold (i.e. a write-off need) of  $\varepsilon_q^I$ , the cost for the regulator for an asset transfer scheme that contains forbearance lending is

$$\sum_{q=1}^k A_q = \sum_{q=1}^k \varepsilon_q^I L_{0,q}.$$

This will transfer all bad assets to the regulator at the face value.

We can easily see that the costs for the asset transfer are higher than for the equity injection, i.e.  $\Sigma A > \Sigma X$ , as  $k > n$ , and here the respective equity  $\varepsilon_q$  is not taken into account, as all bad loans are transferred.

In the framework of this paper, therefore, the effectiveness of asset transfers depends on their design. However, in any case they are either not sufficiently incentivizing banks to participate, or it would constitute a very high costs for the regulator.

**Proposition IV.6** *In an economy with  $k$  banks ( $q = 1, 2, \dots, k$ ), of which there are  $n$  zombie and liquidation banks ( $j = 1, 2, \dots, n$ ), i.e.  $k > n$ , a policy that saves banks and at the same time contains forbearance lending can only be achieved with high direct costs for an injection of extra equity*

$$\sum_{j=1}^n X_j = \sum_{j=1}^n L_{0,j}(\varepsilon_j^I - \varepsilon_j)$$

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<sup>47</sup>The main difference of this model to Bruche and Llobet (2011) is that here, banks' shareholders actually benefit from a normal continuation of forbearance lending, whereas in their framework, equity holders face a loss on average and do not have any benefits from other sources of income.

or an asset transfer

$$\sum_{q=1}^k A_q = \sum_{q=1}^k \varepsilon_q^I L_{0,q}.$$

*Proof: see above.*

This is in contrast to a policy that saves banks through reduced refinancing costs, which can be executed at little or no costs, although it does not contain forbearance lending.

### 3.4 Assessment of regulator's options

As long as the regulator does not know the asset quality of the bank, there is no measure to specifically target action only to certain types of banks. Once he offers a specific policy measure to banks, all types of banks will be addressed.

An equity injection or an asset transfer can contain forbearance lending, but only at a very high cost. Even if the government succeeds in designing equity injections in a way to capitalize banks to a minimum, new zombie banks are created from otherwise non-active liquidation banks. An asset transfer with upside potential for the government is not possible as asset values are not expected to increase. If it is designed as an indirect recapitalization, the costs are even higher than for an equity injection.

There is also the risk that banks misuse the measures offered by the government, thus making them ineffective.

The reduction of funding costs via the central bank or via debt guarantees by the government has the advantage that losses for the government are delayed until an actual default of the bank. At the same time, it helps improving the solvency of banks through lower funding costs, leading to a lower likelihood of a default. Banks that are solvent after one period actually stop rolling over loans as they are already receiving the lowest possible funding costs and they do not have any benefit from funding driven forbearance lending. Finally, reducing the funding costs lowers the liquidation threshold, but depending on the parameters, does not lead all liquidation banks to become active again, unlike an equity injection or an asset transfer.

Tolerating or even stimulating forbearance lending can thus be a policy that is recommendable if the solvency of the government is under threat, the damaging effects of forbearance lending to the economy are low, or if the other two policies asset transfer and equity injection are ineffective.

## 4 Discussion

### 4.1 Interpretation of results

The model has identified two functions of forbearance lending: on the one hand, it delays the moment of write-offs and can give banks the time to regain solvency. On top of this, it serves to disguise the nature of the bank as a toxic bank, improving its appearance before debt investors and thus its funding costs. These two functions, solvency and funding driven forbearance lending, can work alone or together to influence the bank's decision on how to deal with bad loans.

This feature offers the regulator an option to deal with insolvent banks, in case he wants them to continue their activity. On top of simply tolerating forbearance lending, guaranteed debt actually encourages banks to roll over their bad loans in the short term. Moreover, it does have the advantage that losses for the government are minimized, while over time it helps banks to regain solvency and stop forbearance lending. It is therefore a less radical and smoother policy than an asset transfer or an equity injection.

The regulator also has to take into account the beneficial and damaging effects of forbearance lending. It can intervene to discourage banks from this behavior. However, the main problem is that it does not know the extent of bad loans on each bank's balance sheet. There is thus a high risk that it saves some of the banks that would otherwise be liquidated, and that it also provides funds to banks that do not need them.

Some of the policy measures that were taken by regulators and central banks may therefore be seen in a different light. As mentioned above, there is evidence that forbearance lending has taken place in Japan. Through the zero-interest rate policy the central bank has lowered the refinancing costs for the banks and bought them time to regain solvency. As the capital to reinstate solvency for the entire financial sector through an asset transfer or comprehensive equity injection may not have been effective to induce banks to write-off bad loans, tolerating or even stimulating forbearance lending may have been another way to restore bank solvency, be it intentionally or not.

In light of the recent sovereign debt crisis and the weak financial sector in many countries, particularly Spain, the decision by the European Central Bank may also be seen from the same angle. Through offering short-term liquidity assistance and a zero interest rate policy, the ECB may also have been encouraging forbearance lending to improve the solvency of the banks.<sup>48</sup> We will have another look at this point in the case study in chapter VI.

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<sup>48</sup>See Eijffinger and Hoogduin (2012) for an account of the ECB measures and the link to zombie banks. According to their position, banks in Europe became "addicted" to the crisis measures by the ECB as restructuring and resolution was delayed, which led to a proliferation of zombie banks.

## 4.2 Model parameters and scope for further research

Some of the parameters of the model are kept simple for the sake of making it more straightforward. The following describes constraints and potential areas of further evaluation, that may bring additional insights.

**Bank activity** In this model, one of the key drivers for bank solvency is the profitability of the new loan portfolio. It is assumed that there are no new bad loans, and all new loans are profitable. The only source of bad loans is from the legacy activities. While this certainly oversimplifies reality, the key here is to assume that ongoing business is indeed profitable. This is also the assumption behind most other studies that highlight the damaging effect of bad loans, but the necessity to provide loans to new projects.

Moreover, refinancing costs for the bank are given exogenously (as  $i$  and  $i^N$ ). It may seem like a strong assumption that the bank can reduce the financing costs via forbearance lending. Additionally, in this model the refinancing costs are not correlated to the level of equity capitalization of a bank, which is not intuitive, as the volume of equity is usually one indicator for bank solvency. Chapter III has already offered an extensive evaluation on the effects of forbearance lending on refinancing costs. Integrating this concept endogenously into the model, instead of exogenously assuming it, may offer further insights into the interplay of equity capital and the incentives for banks to roll over bad loans. Arguably, the effects of a recapitalization by the government should be stronger, as refinancing costs go down and solvency improves quicker.

One assumption of the model is that the recovery value of bad loans does not improve when rolling over bad loans. This was done to show that banks are keen on forbearance lending, even if there is no obvious reason on the asset side of the bank's balance sheet. However, it is possible that bad assets can improve in their return. This would be just another reason for banks to be engaged in forbearance lending, as it further drives their profitability. While this may make asset transfers less costly for the government, it then raises the question whether these assets should actually not remain with the bank anyway. Bruche and Llobet (2011) offer a detailed assessment of asset transfers and forbearance lending in this respect.

**Time** As mentioned before, the base case of the model has two periods. Considering a multi-period extension of the current model has the constraints highlighted earlier; particularly the problem that there are no new bad loans and that refinancing costs do not change. An extension to a more realistic continuous period model would be interesting, as it would address the fact that banks need more than two periods to regain solvency.

It could also capture more precisely the costs and benefits of government measures.

In such a case, the model may also need to include a discount factor. In the current model, investors in bank debt are indifferent between future and present profits, as  $\delta$  is assumed to be 1. As they benefit from more solvent banks, they tolerate forbearance lending and want to avoid a bankruptcy. Changing the time preference of debt investors would imply that forbearance lending is less feasible for banks as debt investors are less willing to extend their debt. A lower preference for the future would thus imply higher insolvency thresholds.

**Industry structure** An interesting extension of the model would be to go from a view on one representative bank to an industry view. Forbearance lending could then have more impact on the emergence of new banks that would otherwise take over lending business from liquidation or zombie banks. It could also capture the effect on the overall loan supply.

Only if we include an interaction among banks that represents systemic risk from bank failures, the model would finally allow a comprehensive normative analysis of the optimal actions for the regulator.

**Normative analysis** Faced with the problem to resolve a crisis with insolvent banks *ex post* (as opposed to defining *ex ante* preventive measures), the decision of the government to tolerate or contain forbearance lending is a trade-off between bank insolvency and the damaging effects of forbearance lending. In this sense, the advantages and disadvantages of forbearance lending depend on the economic environment and the impact of each factor. Up to this point, there is no conclusive theoretical argument either strongly in favor or against forbearance lending. In an environment where, for example, the demand for new loans is low or the damaging effects of a bank insolvency are high, tolerating may well be an appropriate strategy. This would be an interesting topic for further research.

In the same spirit, it is difficult to empirically evaluate forbearance lending, as these beneficial effects cannot be quantified. While the harmful effects are clear and have been studied in detail, a final conclusion could only be made if it was possible to assess what would happen if a different policy was chosen. Such a study would have to include the effects of bank insolvency and potential shortage of credit supply, which so far has not been realized.

## 5 Conclusion

This study has developed a simple model that explains forbearance lending from a bank's solvency point of view. Rolling over bad loans can thus give zombie banks sufficient time to regain solvency through its running activities, and it can additionally improve the refinancing costs of the bank.

While the government may want to reduce this behavior in light of negative effects to the economy, it does not now know how many bad loans each bank has, since the volume of bad loans is private information only known to the bank. We have looked at the effects and potential costs of three measures to contain forbearance lending: equity capitalization, asset transfers and further reduction of funding costs. While the former two do successfully revitalize zombie banks, at the same time they bring back liquidation banks to the economy as well. This implies that the overall costs for the government are very high, particularly during a time of an economic crisis.

In such a setup, the reduction of funding costs can be less costly for the government, especially if they are stretched over a long period of time. With this measure, forbearance lending is actually promoted, but it does help banks to regain solvency quicker, due to even lower refinancing costs. Solvent banks will then automatically write-off their bad loans.

With these results in mind, the interpretation of policy action during the crisis in Japan and more recently in Europe may change. Faced with the options of allowing zombie banks to fail, recapitalizing them at an extreme cost to the government, or giving direct and indirect debt guarantees that buy the banks time but can have a harmful effect on the economy, the choice can shift towards the latter. While it is rather straightforward to point out the damage done by such a policy, it is still an open issue to analyze which outcomes an alternative policy would have had.

## 6 Appendix

### 6.1 Proof of proposition IV.2

We need to show that:

$$E_2^w > E_2^f.$$

This is fulfilled if

$$\begin{aligned} E_1^w + \Pi_2^w &> E_1^f + \Pi_2^f, \text{ or} \\ [e(1 - \alpha\beta) - \alpha\beta]L_0 - iC_0 &> [e(1 - \alpha) - \alpha v\beta]L_0 - iC_0, \text{ or} \\ v &> 1 + e - \frac{e}{\beta}. \end{aligned}$$

This holds, since we defined in the beginning that recovery values cannot deteriorate, i.e.  $v > 1$ , and  $e > 0$  and  $0 < \beta < 1$ .

Q.E.D.

### 6.2 Components of inequation (6)

The components for each side of the inequation

$$E_2^w > E_2^F$$

are made up of:

$$\begin{aligned} E_1^w + \Pi_2^w &> E_1^F + \Pi_2^F, \text{ or} \\ [e(1 - \alpha\beta) - \alpha\beta]L_0 - iC_0 &> [e(1 - \alpha) - \alpha v\beta]L_0 - i^N C_0, \text{ or} \\ \alpha\beta\left(\frac{e}{\beta} + v - e - 1\right) &> (i - i^N)(1 - \varepsilon). \end{aligned}$$

### 6.3 Three period extension

If the bank is in a position to decide in  $t=2$  whether it wants to apply the write-off or forbearance lending strategy, it simply has to compare the payoffs again. Note that in such a case, the bank reveals that it is a toxic bank, as it has bad loans to write-down. It will thus face higher refinancing costs  $i$ . The corresponding payoffs are

$$\begin{aligned} \Pi_3^{FW} &> \Pi_3^{FF}, \text{ if} \\ \alpha\beta v\left(\frac{e}{\beta} + v - \frac{e}{v} - 1\right) &> (i - i^N)(1 - \varepsilon). \end{aligned}$$

Remember that  $v > 1$ . It is thus more likely for the bank to write-off the bad loans, compared to a situation in  $t=1$  as in (6).<sup>49</sup>

The profits  $\Pi_3^{FW}$  and  $\Pi_3^{FF}$  in the equation above can be represented by:

$$\begin{aligned} \Pi_3^{FW} &> \Pi_3^{FF}, \text{ or} \\ &[e(1 - \alpha\beta v) - \alpha\beta v]L_0 - iC_0 + e([e(1 - \alpha) - \alpha v\beta]L_0 - i^N C_0) \\ &> [e(1 - \alpha) - \alpha v^2\beta]L_0 - i^N C_0 + e([e(1 - \alpha) - \alpha v\beta]L_0 - i^N C_0), \\ &\text{which then comes down to} \\ &\alpha\beta v\left(\frac{e}{\beta} + v - \frac{e}{v} - 1\right) > (i - i^N)(1 - \varepsilon). \end{aligned}$$

## 6.4 Proof of proposition IV.5

The full elements that make up the liquidity threshold with debt guarantees in equation is:

$$\begin{aligned} E_0 + [e(1 - \alpha)]L_0 - gC_0 &= \alpha v\beta L_0, \text{ or} \\ \varepsilon(1 + g) &= \alpha v\beta + g - e(1 - \alpha), \text{ or} \\ \varepsilon_G^R &= \frac{\alpha v\beta + g - e(1 - \alpha)}{1 + g}. \end{aligned}$$

Q.E.D.

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<sup>49</sup>Using our numerical example and assuming an equity ratio of  $\varepsilon = 12\%$ , the funding advantage is 0.0044 balance sheet units compared to the improved return of 0.0342 balance sheet units, which is higher than before.



## Chapter V

# The Impaired Lending Channel of Zombie Banks: Effects and Countermeasures

## 1 Introduction

To summarize the key insights from chapter II for this model, one conclusive evidence from the experience in Japan from the 1990s is that the existence of zombie banks has triggered a crowding out of healthy firms through zombie firms, as the banks continuously extended bad loans and kept their unprofitable counterparties alive.<sup>50</sup> Small firms have suffered disproportionately more than large firms in their lack of access to credit.<sup>51</sup> Another observation is that efforts by the Japanese government to induce higher lending by banks to the corporate sector via restoring bank health through equity injections has not been successful in many instances, or only when it was forced upon the banks as a condition for the injection.<sup>52</sup> At the same time, the Japanese government has tried to revive the Japanese economy through many rounds of stimulus programs that have led to the issuance of government bonds on a massive scale, which were increasingly placed with the banks. According to Yoshino and Mizoguchi (2013), Japanese banks have directed almost the entire additional inflow of funds they received between 2000 and 2006 to government bonds.<sup>53</sup>

This paper offers a theoretical model that explains how the existence of zombie banks leads to a crowding out of healthy firms by unprofitable ones. A zombie bank rolls over bad loans to survive, as a write-off of bad loans would lead to an insolvency of the bank itself. These extended bad loans have to be refinanced by the bank and thus increase the funding costs for any new loans. The lending channel of banks from depositors or other savers to corporate borrowers is thus impaired by the "roadblock" of bad debt in its

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<sup>50</sup>See Sekine, Kobayashi and Saita (2003), Ahearne and Shinada (2005), Peek and Rosengren (2005), Hoshi (2006), Caballero, Hoshi and Kashyap (2008), and Kwon, Narita and Narita (2009).

<sup>51</sup>See Hamao, Kutsuna and Peek (2012).

<sup>52</sup>See Giannetti and Simonov (2013), Kashyap and Hoshi (2010) and Montgomery and Shimizutani (2009).

<sup>53</sup>The additional inflow of funds to banks (on top of the existing stock) between 2000 and 2006 was 25trn JPY, out of which 27trn JPY came from Japanese households, who thus overcompensated the outflow on another end. The banks used these funds for additional outflows of 22trn JPY, out of which 21.7 trn JPY was directed to government debt.

books. The increased costs for new loans by the bank then lower the scope of potential loan counterparts for the bank, as the bank chooses a higher loan rate to compensate for the higher refinancing costs. Since entrepreneurs have to have a certain productivity to afford higher loan rates, this cuts off firms' access to new loans, whereby the most vulnerable ones that can only afford to pay low loan interest rates are affected the most. The effect is that the bank reduces its lending volume to new projects, where only the most productive entrepreneurs receive financing.

It is in the public interest to repair this lending channel, as they want to increase the flow of funds to the corporate sector, particularly to the more vulnerable firms.<sup>54</sup> For this reason, this paper looks at three policy measures to address this issue: a recapitalization of the zombie bank via an equity injection by the government, a zero-interest rate policy (ZIRP) by the central bank, and a government stimulus that increases the loan demand of the corporate sector by offering a deficit financed transfer of funds, e.g. via a tax break for earnings taxes.

For any government intervention, however, the resulting budget deficit has to be financed with the issuance of government bonds. These bonds, in turn, have to be placed with the bank as an intermediary to the savers, as the government does not have direct access to depositors. Hence, the bonds are an competing asset to the corporate loans, which reduces the availability of funds for bank lending. The three policy measures then bring about mixed effects:

i.) A debt-financed recapitalization through the government turns the zombie bank into a healthy one, but has no positive effect on bank lending, as the bad loans are simply replaced with government debt in the bank books.

ii.) A ZIRP does not turn the zombie bank into a healthy one, but improves bank lending, as it reduces the refinancing costs and thus widens the lending channel.

iii.) A debt-financed stimulus by the government does not address the bank, and thus also does not improve its solvency. Instead, it increases the loan demand, as it allows some firms to afford interest payments that they would otherwise not be able to handle. On the other hand, it also leads to new government debt that has to be placed with the bank. Due to the trade-off between higher loan demand and a crowding out of loans via increased government debt, the net effect depends on the scale of the autonomous loan

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<sup>54</sup>Examples of policies by the government and the central bank that are aimed at promoting lending activity can be found in many countries. In the UK, the Funding for Lending Scheme by the Bank of England and the government was introduced in 2012 as a measure to stimulate lending to households and companies, as mentioned by King (2012). In Japan, recapitalizations of banks in the 1990s took place with a precondition to extend lending to SMEs, as mentioned in Montgomery and Shimizutani (2009). In Europe, the introduction of the OMT (Outright Monetary Transactions) by the ECB in 2012 was justified with impaired monetary transmission and reduced lending by banks in peripheral countries, as mentioned in ECB (2012).

demand. In case the stimulus is successful, the bank ends up with a split of assets into bad loans, new loans and government bonds.

**Model approach** The model looks at a representative bank and its lending conditions to entrepreneurs, namely the volume of loans and the loan interest rate. The bank refinances itself with deposits, where a higher volume of deposits is connected to a higher interest rate. This can be because of distance costs to reach the depositor or because of competition for deposits.

On the lending side, the bank offers those loan conditions that maximize its profit. For this, we assume that the loan interest rate determines the loan volume in an inverse relationship, i.e. a lower loan interest rate leads to a higher loan volume. The bank has market power on the lending side and can choose the loan volume that allows it to maximize the profit. The discussion in section 4 of this paper offers possible reasons for the market power in lending, e.g. switching costs or location.<sup>55</sup>

The bank thus acts in a restricted environment on the refinancing side but has market power on the lending activity, with the objective to maximize its profits. In contrast to this, the objective of the social planner (which represents the view of the government and the central bank for simplicity's sake) is to maximize the rents of entrepreneurs by having a high loan volume and a low loan interest rate.

The model assumes an exogenous shock to the bank activity by introducing a share of bad loans to the bank loan portfolio. Whereas a healthy bank can survive a write-off of the bad loans, a zombie bank does not have sufficient equity to digest a loss coming from the write-off. Hence, the latter survives by forbearance lending, i.e. extending the bad loans for another period. These bad loans then affect the lending activity in the next period. As the bad loans remain in the book with only limited return, they make the refinancing for the bank more expensive. This limits the lending activity of the bank and cuts loans to entrepreneurs.

The bank acts within the margin given by exogenous factors, which are the size of bad loans in its books after an external shock, the scale of loan demand, and the costs for its operations, which include the deposit rate by the central bank, the marginal costs for any additional funds, and the regulatory costs for any corporate loan exposure. A policy intervention changes some of these parameters, and thus also changes the lending

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<sup>55</sup>This assumption differs to the model framework in chapter III and IV, where the bank was a "price taker" for the loan interest rate and could not influence the rate itself. Moreover, the assumption of having depositors is different to the models in chapter III and IV, where the bank was mainly reliant on wholesale funding. This distinction is important as the model in this chapter here focusses on the lending activity, whereas the previous two models had a focus on bank solvency and funding. Credit charges or default probabilities on bank debt are thus not relevant in this model here.

behavior by the bank.

The main function of the bank is to act as an intermediary channel between the savers (in this case the depositors) and the borrowers, namely the entrepreneurs, for the distribution of funds for new loans. However, the bank also has to act as an intermediary for government bonds. The key focus of the model is how the appearance of bad loans and government bonds impair the lending channel of the bank, and how this affects the supply of loans to entrepreneurs.

With this framework, the model offers a comparison of several states, namely the lending conditions of the bank as a healthy bank or as a zombie bank, and with and without a policy intervention. These comparative statics allow an assessment of the impact on the corporate sector under each state, and thus bring insights into the effectiveness of the policy measures. The analysis also gives an explanation of how exactly the crowding out effect brought about by zombie banks works, and which entrepreneurs are affected. The model shows that while public policy intervention can be helpful in addressing certain aspects of bank lending that facilitate the flow of funds to the corporate sector, they also bring about other negative side effects, which can overcompensate the positive ones by the interventionary policy.

**Drivers of interventionary policies** A recapitalization of the zombie bank via equity injection and a government stimulus lead to the creation of government debt. As the government cannot place the government bonds directly with households, it has to sell them to the bank.<sup>56</sup> The bank, on the other hand, sets up its asset split into corporate loans and government bonds in a way that maximizes its profit. In order to place the government bonds that arise from any intervention, the government accepts the bond rate that is necessary to place the corresponding volume with the bank. The placement with the bank is facilitated via an exemption from regulatory costs for the holdings of government bonds, unlike the loans to the corporate sector which incur additional costs for the bank. Since the holdings of government bonds also has to be refinanced, it increases the costs for any loan commitment. Thus, government bonds lead to a crowding out of new corporate loans, in a similar way to the effect of bad loans in the bank book.<sup>57</sup> While an equity injection removes the roadblock of bad loans, it replaces it with government bonds. This increases the bank profitability and solvency, but does not improve bank

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<sup>56</sup>In reality, government bonds are also placed with other intermediating financial institutions, such as insurance companies or mutual funds, which are not modelled here. In any case, the existence of such other institutional investors in this model would lead to the same result, namely that the savings of households are directed to government debt instead of the corporate sector.

<sup>57</sup>This form of crowding out via increased government debt is reminiscent of the "textbook" crowding out as lined out by Spencer and Yohe (1970) and Carlson and Spencer (1975).

lending.

A deficit-financed stimulus to the corporate sector, on the other hand, also leads to the creation of government debt, but the net effect can be positive as the demand for loans is increased. While the bank then has two competing assets in its books next to the corporate loans, namely the bad loans and the government bonds, the positive effects can outweigh the negative ones, if the initial loan demand base is low enough to make the intervention effective.

A ZIRP takes on yet another aspect of bank activity, namely the refinancing costs. While it leaves the roadblock of bad loans on the books, it lowers the base for the funding costs, which allows the bank to lower its lending rate to entrepreneurs, leading to a higher lending volume. It also does not lead to the creation of government bonds. Whether it can fully restore bank lending to the point that would be existent under a healthy bank depends on the central bank rate before the ZIRP, and also the marginal refinancing costs created by the bad loans.

Ultimately, it is not straightforward to induce lending conditions that would exist under a healthy bank, once a negative shock to the economy has led to the existence of zombie banks in the economy.

**Literature on monetary transmission** Apart from the contribution to the literature around zombie banks as laid out in chapter II, the focus of this paper also relates to the literature around the monetary transmission mechanism. As described e.g. in Freixas and Rochet (2008), chapter 5, and Gambacorta and Marques-Ivanez (2011), there has been a shift in the view on the role of banks in monetary policy transmission over the past decades. While the traditional view has been that banks merely act as a multiplier for money creation, recent research has shifted to the "credit view", which highlights the role of banks as intermediaries for lending activities via the credit channel. The credit channel works in two ways: first, the broad channel (also referred to as the "balance sheet channel") represents the varying creditworthiness of households and firms throughout business cycles that influences bank lending, as the value of loan collateral fluctuates and creates loss potential for the bank. The second channel, the "narrow" or "lending channel", relates to the interplay of assets and liabilities for banks themselves. If monetary policy tightens, for instance, the bank has to reduce lending as it faces increases costs of refinancing. In line with this, Gambacorta and Marques-Ivanez (2011) expand the scope of the credit channel further and provide empirical evidence that through the financial crisis in 2007-2011, banks with weaker capital ratios or a high dependence on market financing reduced lending.

The findings of the paper at hand support the importance of the credit channel. It

shows how forbearance lending by zombie banks leads to an impairment of the lending channel through bad loans on the bank book. As a result, zombie banks reduce their lending activity.

**Chapter structure** The paper is structured as follows: section 2 provides an outline of the basic model. After explaining the setup of the model, the lending conditions under a zombie bank and a healthy bank are evaluated and compared. In the following section, we look at the policy options for the government or central bank. More specifically, the effects of a bank recapitalization by an equity injection, a zero interest rate policy, and a government stimulus are explained and compared. This also includes a comparison to the situation under a zombie bank without intervention. Section 4 then discusses the results of this paper, with a view on the existing literature on the resulting policy implications. Section 5 concludes.

## 2 The model

### 2.1 Model setup

There are two periods in the model: a legacy period of past activities, and one "active" period of bank activity going forward. While the bank cannot change the legacy activities, it can set the parameters for the bank in the "active" period. Unless specified otherwise, all variables in this model will thus refer to the active bank period.

The legacy activities of the bank consist of a loan portfolio with entrepreneurs on the asset side, and a given amount of equity as well as credits as financing means (which can be deposits, bonds or interbank loans) on the liability side. All or part of the equity is owned by the respective bank manager, aligning his incentives with those of the shareholders. We will assume that the entire asset side of the balance sheet are loans. Moreover, the loan volume of the legacy period is set to 1, so that it serves as a reference unit for balance sheet size. Each loan is given out for one period, unless it is extended by the bank.

At the end of the legacy period, the bank discovers an exogenously given bad loan burden  $\alpha$  with  $0 < \alpha < 1$  in its legacy loan portfolio. These bad loans come from entrepreneurs who are not able to pay back their loans. We assume that the payback value is zero, i.e. there is no recovery value at all from these loans.<sup>58</sup> The bank now has two choices: an immediate write-off of the bad loans, or forbearance lending.

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<sup>58</sup>This is in line with the model in chapter III, but unlike the model in chapter IV, where we had a recovery value of  $0 < \beta < 1$ . As we do not focus on solvency issues in this model here but on the lending activity, we can keep the recovery value at zero, i.e. we use the case with the highest impact of bad loans for the bank.

For the immediate write-off choice, the bank terminates the lending relationship at the end of the legacy period. On the balance sheet, it would thus have to write off the bad loan share  $\alpha$  to zero, resulting in losses of this magnitude  $\alpha$ . It then collects the reimbursement of the rest of the loans  $1 - \alpha$  and lends it out in the active bank period again.

Alternatively, the bank starts forbearance lending. This means that it continues the lending relationship with the "bad" entrepreneurs for one more period without writing it off yet. In the next period, however, the entrepreneurs are not able to meet the full interest payment, and can still not pay back the loan principal. The bank will then write-off the bad loans  $\alpha$  to zero after this period. Compared to the immediate write-off choice, this simply delays the recognition of losses for one period.

It is obvious that the immediate write-off choice is more beneficial to the bank. Hence, a bank will always choose to write-off bad loans if it is able to. However, this can only be pursued if there is sufficient equity on the bank balance sheet to digest the initial write-off at the end of the legacy period.

The model now assumes that the bank can be one of two types, either a healthy bank or a zombie bank. These bank types share the same values for the legacy period, but the only difference between the two types is the equity level. We assume that a healthy bank has sufficient equity to write-off the equity, while a zombie bank does not. Thus, a zombie bank can only survive by pursuing forbearance lending.

For the rest of the paper, we will denote all variables for the zombie bank with  $Z$  and for the healthy bank with  $H$ .<sup>59</sup>

We will now have a closer look at the parameters for the active bank period.

**Bank activity: loan demand and interest rates** The bank provides loans to entrepreneurs. There are  $j = 1, 2, \dots, \frac{m}{v_l}$  entrepreneurs that are available as counterparts for the bank. Entrepreneurs have a project from which they gain a certain project return rate  $m_j$ . However, they require a unit of loans  $l_j$  to realize the project that is the same for all entrepreneurs, i.e.  $l_j = l \forall j$ . They pay an interest rate  $e$  on the loan. We assume that there is a decreasing project return rate  $m_j$  for each additional entrepreneur in the economy, because of differing productivity among entrepreneurs.<sup>60</sup> Only entrepreneurs with

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<sup>59</sup>The notation thus differs from the other two models in chapters III and IV. As already outlined in section 5 of chapter II, this also reflects that the healthy bank in this paper here is more reminiscent of the "survivor bank" in chapter IV, i.e. a bank with bad loans, but sufficient equity to digest an immediate write-off.

<sup>60</sup>Alternatively, if we assume a homogenous productivity across entrepreneurs, we can think of the decreasing income as a result of distance costs, as the bank has to reach out to entrepreneurs with an increasing distance for every additional loan counterpart.

an income of  $m_j > e$  can survive and pay back the loan to the bank. The last entrepreneur that can afford the loan will be referred to as entrepreneur  $j_0$ . Hence, while there are  $j = 1, 2, \dots, \frac{m}{vl}$  entrepreneurs in the economy, only  $j = 1, 2, \dots, j_0$  entrepreneurs receive financing, with  $j_0 < \frac{m}{vl}$ .

We can aggregate the total demand for loans by lining up all entrepreneurs by the decreasing project return, with the highest project return denoted as  $m$ . For the bank, the aggregate of all single loans  $l$  makes up the overall loan book  $L$ , with  $L = \sum_{j=1}^{j_0} l_j$ . From the point of view of the bank, we get the aggregate demand for loans of the shape:

$$e = m - vL,$$

where  $L$  denotes the volume of realized projects and  $m$  the maximal individual income rate, and thus the upper bound for the loan demand curve.  $v$  represents the downward slope of the curve, showing how steep the fall in the project return rate is for each additional entrepreneur (for lack of a better expression, we may think of  $v$  to stand for vaporizing marginal productivity). Parameters  $m$  and  $v$  are exogenously given, and can be interpreted as the scale for the loan demand range. As  $m$  is the maximum interest rate, we have  $e \in [0, m]$ . Moreover, the lending volume is limited to the loan demand range, i.e.  $L \in [0, \frac{m}{v}]$ .<sup>61</sup>

The bank thus receives a fixed interest income rate  $e$  from entrepreneurs on the new loan portfolio. The bank then chooses the volume of the new loan portfolio to maximize profits, which will be denoted as  $L^*$ . The corresponding interest rate is denoted as  $e^*$ . Hence, while the variables  $m, v$  and  $l$  are exogenously given, the parameters to maximize bank profit  $e^*$  and  $L^*$  are endogenous to the model.

Remember that the loan volume in the legacy period was set to 1 as a reference. The loan volume to maximize bank profits  $L^*$  in the active bank period thus compares to the legacy period. However, in case the bank rolls over the bad loans  $\alpha$  from the legacy period, these loans naturally form part of the loan portfolio in the second period. The total loan volume for a bank that is engaged in forbearance lending is thus  $\alpha + L^*$ .

As for the return of these bad loans in the second period, we assume that the loan counterparts (i.e. these "zombie firms") cannot make the full interest payment and only pay back a rate of  $r + c$ , which is the equivalent of the central bank refinancing rate plus the regulatory costs, as we will see later. This return is lower than the loan interest rate

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<sup>61</sup>Note that the loan demand range specifies the maximum lending volume  $\frac{m}{v}$ , whereas the number of entrepreneurs  $\frac{m}{vl}$  depends on the loan unit  $l$  of each loan. E.g., if we assume a maximum lending volume of  $\frac{m}{v} = 2$  and a loan unit  $l$  of 0.01, the number of entrepreneurs would be 200.



$e^*$  that maximized bank profits, i.e.  $e^* > r + c$ .<sup>62</sup> Remember that zombie firms are not able to pay back the loan principal volume, which implies that they not only default on the loan volume but even on parts of the interest payment in the active loan period. The return for a bank with forbearance lending is thus  $\alpha(r + c) + eL$ , whereas a bank without bad loans gets interest income of  $eL$ .

There are no new bad loans arising from the loans in the active bank period.

**Refinancing activity** To finance the loans, the bank takes on refinancing means which equal the loan portfolio  $L$ , or in case of forbearance lending  $\alpha + L$ . This could be any kind of external finance: deposits, interbank financing or bond issuances, but for the sake of this model we may think of them as deposits. We assume that the bank is able to collect the volume that is necessary for the loan volume  $L$ , but at an increasing cost. This is because depositors are dispersed around the bank, and the bank has to pay a higher rate to cover the distance costs for every additional depositor.<sup>63</sup>

Depositors do not know whether the bank is healthy or a zombie, and will demand the same rate regardless of the bank type. Deposits from the legacy period are extended for one period until the end of the active bank period, unless the balance sheet is smaller, in which case they are paid out. For the active bank period, the interest rate  $i$  on the refinancing volume then has the function:

$$i(L) = r + c + vL,$$

where  $c$  is the central bank rate,  $r$  the regulatory costs for any loan exposure, and  $v$  the rate at which the refinancing costs increase for every additional unit. All three variables are exogenously given. The central bank sets the lower floor for the level at which depositors are willing to offer funds. The regulatory costs  $r$  represent the costs the bank has to bear for loans to the entrepreneurial sector. It serves to have an additional cost for banks to give loans to the private sector, while the holdings of government bonds is not subject to additional charges. This can be because of additional administrative or reporting work, or regulatory provisioning for private sector loans while government bonds are considered risk-free.<sup>64</sup> Note that the shape of the marginal refinancing costs  $v$  equal the inverse shape of the loan demand curve. If we interpret this as distance costs, the bank has to cover

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<sup>62</sup>The important aspect about the return on the bad loans  $\alpha$  is that it is less than the interest rate  $e^*$  from healthy entrepreneurs. While any value for this return could serve the purpose of this model, the return of  $r + c$  was chosen to facilitate the algebra in the model.

<sup>63</sup>This approach for the marginal costs of funding is also chosen in the model by Vollmer and Wiese (2013), with reference to Ali and Greenbaum (1977).

<sup>64</sup>This is in line with the Basel regulation accords, which treat government bonds as risk free and give them a preferential treatment compared to bank loans, as mentioned e.g. by Hannoun (2011).

the same distance to reach out to new entrepreneurs and depositors.<sup>65</sup>

The refinancing costs for the bank remain the same regardless of the bank type, i.e. whether it is healthy or a zombie. This is because, as we will see shortly, the bank is expected to either survive, or be liquidated. If it is expected to survive, depositors will receive their interest payment after one period. If it is expected to be liquidated, the bank does not receive financing. The refinancing counterparties thus do not have to expect losses which would lead to an extra risk premium.

**Profits and equity** We will denote profits for the legacy period with  $\hat{\pi}$ , and with  $\pi$  for the active bank period.  $\Pi$  stands for the combined profits of both periods, i.e.  $\Pi_x = \hat{\pi}_x + \pi_x$ , with  $x = \{Z, H\}$ .  $\Pi^*$  represents the maximum bank profit. The agents in this model have no time preference, i.e. at the end of the legacy period, the discount factor of profits for the active bank period is zero.

For simplification reasons, we assume for the legacy period that interest income equals payments on external finance, so that there are zero profits. However, the bank makes a loss if it writes down the bad debt burden. The profit for the legacy period in  $t=1$  would then either be  $\hat{\pi}_H = -\alpha$  for the healthy bank that writes off the bad loans, or  $\hat{\pi}_Z = 0$  for the zombie bank that pursues forbearance lending, i.e. not writing down the bad loans. This means that  $\Pi_Z = \pi_Z$ . We saw above that the zombie bank cannot write-off the bad loans, as it does not have sufficient equity. Finally, there is also the possibility that the healthy bank starts forbearance lending, in which case it would also have a profit of zero for the legacy period. We will denote this with  $\Pi_{H,F}$ , with  $\hat{\pi}_{H,F} = 0$ . As we will see later, the bank will not choose this option due to the inferiority to the write-off case.

We have already established that the equity level differs for the healthy and the zombie bank. More specifically, we assume that the legacy equity is  $\alpha$  for the healthy bank and 0 for the zombie bank.<sup>66</sup> That means that at the beginning of the active bank period, both bank types have an equity level of zero, after the healthy bank has used the legacy equity to write off the bad loans. The bank thus has a very simple balance sheet for the second period, with loans on the asset side, and refinancing means on the liability side.

It should be noted that a zombie bank will cease operations and will be liquidated at the end of the legacy period, if it cannot make any positive profit for the next period. This is because there is no interest by either the bank manager/shareholder, nor the creditors

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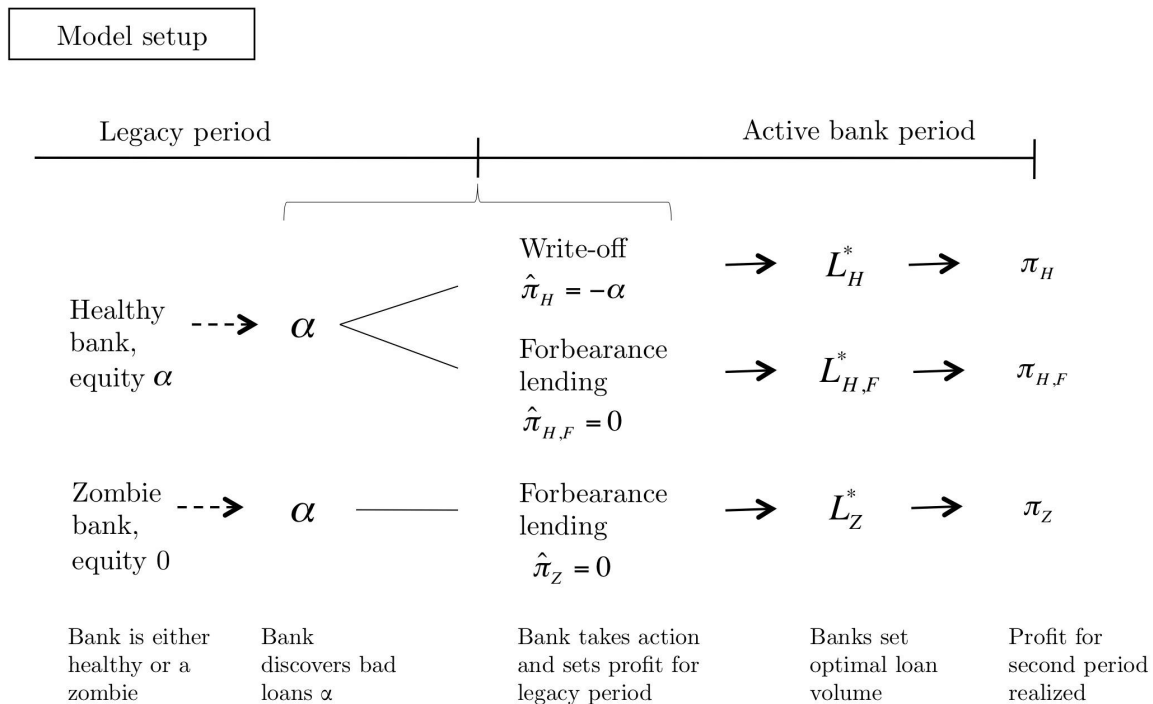
<sup>65</sup>A different slope of the loan demand curve and the refinancing costs would have no impact on model results, because it would apply to both a healthy and a zombie bank. Assuming the same rate lowers the number of variables in the model and also serves to facilitate it without changing the model outcome.

<sup>66</sup>For the zombie bank, we actually assume that the equity level is infinitesimal small and owned by the bank manager, so as to still align his interests with that of "shareholders", even though the value of the holdings is zero.

that the bank continues operation. As we will see later, the profits are subject to the bad loan share  $\alpha$ , so we can define a liquidation threshold  $\check{\alpha}_{Liq}$  with  $\Pi_Z^* = 0$ . For the time being, we assume that the bank is able to operate and continues with its activities in the second period. A healthy bank is not under threat of being liquidated because it has enough equity to digest a write-off even if it is engaged in forbearance lending.

Please see figure 4 for an overview of the model setup. The figure shows the two periods of the model, the legacy and the active bank period. In the legacy period, the bank discovers the bad loan share  $\alpha$  due to an external shock. Depending then on the equity volume of the bank, it is either a healthy or a zombie bank. If it is a healthy bank, as shown in the upper branch of the graph it can write-off the bad loan after the legacy period, or it can start forbearance lending. The zombie bank, on the other hand, can only start forbearance lending. This will determine the declared profit for the legacy period. For the active bank period, the bank sets the optimal loan volume, leading to the profit for the second period.

Figure 4:



**Summary of model variables:**

Exogenous variables:

$m_j$ ...project return for each entrepreneur

$l_j = \mathcal{N}j$ ...size of loan unit for each entrepreneur

$j_0$ ...last entrepreneur to realize project

$m$ ...maximum interest rate, indicator for scale of loan demand

$v$ ... indicator for shape of loan supply and demand curve / marginal distance costs

$c$ ... central bank rate

$r$ ...regulatory costs for loan exposure

$\alpha$ ... share of bad loans in portfolio from legacy period

Endogenous variables:

$e$ ... interest rate on loans to entrepreneurs

$i$ ...interest rate on refinancing means

$L$ ... loan volume

$e^*$ ...loan interest rate to maximize bank profit

$L^*$ ... loan volume to maximize bank profit

$\hat{\pi}$ ...bank profit for the legacy period

$\pi$ ...bank profit for the active bank period

$\Pi$ ...combined profits for both periods

$\Pi^*$ ...maximum bank profit for both periods

$\tilde{\alpha}_{Liq}$ ...liquidation threshold

$\phi_j$ ...rent from activity of entrepreneur  $j$

$\Phi$ ...aggregated rent for economy

$B$ ...government bond holdings by the bank

$G$ ...government bonds to be issued by the government

$g$ ...interest rate on government bonds

$B^*$ ...government bond holdings to maximize bank profit

$g^*$ ...interest rate on government bond to place all bonds with the bank

$Z$ ... index for zombie bank

$H$ ...index for healthy bank writing off the bad loans after the legacy period

$H, F$ ...index for healthy bank engaged in forbearance lending

$\eta$ ...index for equity injection

$\zeta$ ...index for zero interest rate policy (ZIRP)

$\sigma$ ...index for stimulus

## 2.2 Rents from private sector activity

As mentioned, each entrepreneur can invest in projects and receives a return  $m_j$ . For this to happen, the entrepreneur has to receive a loan from the bank to finance the project. The loan from the bank will have the same interest rate  $e^*$  for all entrepreneurs, which corresponds to the optimal loan interest rate from the point of view of the bank. The entrepreneur uses the return  $m_j$  to pay the interest payment on the loan that is necessary to finance the project. If the project return rate  $m_j$  is higher than the interest payment rate  $e^*$ , then the entrepreneur creates a unit of rent  $\phi_j$  for the economy. In formal terms, each entrepreneur  $j$  contributes to total rent in the economy if there is a surplus of individual income rate  $m_j$  over the external interest expense rate  $e^*$  on the project unit  $l$ :

$$\phi_j = (m_j - e^*)l.$$

This also implies that the lending conditions of the bank influences the rent that is created by its counterparts. Remember that the return rate  $m_j$  is different for each entrepreneur. Only those entrepreneur with a return rate  $m_j > e^*$  can afford the loan, and only  $j = 1, 2, \dots, j_0$  entrepreneurs receive financing, with  $j_0 < \frac{m}{v}$ .

The loan portfolio  $L^*$  of the bank is the sum of the loan units  $l$  for each single entrepreneur at the interest rate of  $e^*$ . For the entire loan portfolio of the bank then, the total rent for the economy  $\Phi$  is the sum of all the individual surpluses from entrepreneurs  $j = 1, 2, \dots, j_0$ , that receive financing:

$$\Phi = \sum_{j=1}^{j_0} \phi_j = l \sum_{j=1}^{j_0} (m_j - e^*).$$

We can now go back to the shape of the loan demand curve

$$e = m - vL,$$

where  $m$  represents the maximum project return rate for the "most productive" entrepreneur. On this curve, the entrepreneurs are "lined up" in decreasing values of  $m_j$  from the most productive to the least productive. The bank will choose the optimal interest rate  $e^*$  and lending volume  $L^*$  to maximize its profits. This determines the scope of entrepreneurs that receive financing, from the most productive up to entrepreneur  $j_0$ . Then

the total rent that is created from the bank activity follows the function:<sup>67</sup>

$$\Phi = \int_0^{L^*} (m - vL)dL - e^*L^*.$$

In other words, through giving out new loans of  $L^*$ , the bank allows the corresponding number of projects to happen. The first part of the equation represents the overall return on these projects. However, the entrepreneurs also have to pay the interest rate  $e^*$  on these projects, which has to be subtracted from the overall rent. The remainder is the rent to the economy created by the loan counterparts of the bank. It should be noted that the bank does not work to maximize this rent, but rather to maximize its own profit. The rent is therefore a "side-effect" by the bank activity.

For the bad loans  $\alpha$ , it was already mentioned that they give a return of  $c + r$ , which is lower than  $e$ . Zombie firms thus do not contribute to the rents from the private sector.

In this model, it is the objective of public policy to maximize the rent from private sector activity, and to determine whether an intervention is helpful or not. When referring to the public policy, we include any public policy representative, e.g. the central bank or the government, which we will simply refer to as the "social planner". While a social planner may usually also have to keep in mind other factors such as bank stability and government finances, for this paper we focus solely on the lending activity of the bank.

In simple terms, a higher rent  $\Phi$  can be reached by a higher lending volume, or by a lower loan interest rate for a given loan volume. As we will see, a zombie bank will have a different loan portfolio due to the bad loans, which also influences the rents from private sector activity.

In the following, we will see how the parameters are set for the healthy and the zombie bank, and what the effects are.

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<sup>67</sup>Compared to the notation above that expresses  $\Phi$  as the sum of all individual rents by each entrepreneur, this notation expresses  $\Phi$  as the area under the distribution curve that "lines up" entrepreneurs by decreasing productivity.

## 2.3 Healthy bank

### 2.3.1 Parameters of bank activity

We start off with the profit function of healthy bank for the active period:<sup>68</sup>

$$\begin{aligned}\pi_H(L) &= eL_H - iL_H, \text{ or} \\ &(m - vL_H)L_H - (c + r + vL_H)L_H.\end{aligned}$$

As we can see, the profit function depends on the loan demand curve, and the refinancing costs, which are both subject to the loan volume. There are no bad loans, as there were written-off at the end of the legacy period. All loans on the balance sheet are thus new loans. The bank now maximizes its profit by setting the optimal lending volume

$$L_H^* = \frac{m - c - r}{4v}.$$

Intuitively, the optimal lending volume increases with a higher loan demand in the economy (a higher  $m$ ), lower refinancing costs  $c + r$ , and a flatter shape of the curve, or lower distance costs  $v$ , depending on the interpretation of  $v$ . For this optimal lending volume  $L_H^*$ , the corresponding interest rate is:

$$e_H^* = m - v \frac{m - c - r}{4v} = \frac{3m + c + r}{4}.$$

With these parameters, the profit for the bank is:

$$\pi_H^* = \frac{(m - c - r)^2}{8v}.$$

Keep in mind that this profit comes for the operations in the second period, i.e. the active bank period, after it has written off the bad loans  $\alpha$  at the end of the legacy period. The overall profit for the healthy bank is thus the sum of both periods:

$$\Pi_H^* = \hat{\pi}_H + \pi_H^* = \frac{(m - c - r)^2}{8v} - \alpha.$$

**Choice between forbearance lending and write-off** We have mentioned in the beginning that the healthy bank has two choices in dealing with bad loans, i.e. writing them off or forbearance lending. A zombie bank cannot write-off the bad loans, as it would otherwise be insolvent. The healthy bank would only start forbearance lending, if

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<sup>68</sup>The detailed calculations for the parameters such as lending volume, profit and rent can be found in the appendix.

this is more profitable. Remember that the healthy bank has an equity of  $\alpha$ . If it does not write off the bad loans after the legacy period, it does not have to refinance the bad loan share  $\alpha$  in the second period, but only the new loans  $L$ .

Comparing the profit for a healthy bank that writes off the bad loans  $\Pi_H^*$  with the profit for a bank that is engaged in forbearance lending  $\Pi_{H,F}^*$ , we get:

**Lemma V.1** *A healthy bank will always write-off bad loans, as the profits are higher than under forbearance lending, i.e.:*

$$\Pi_H^* = \frac{(m - c - r)^2}{8v} - \alpha > \Pi_{H,F}^* = \frac{(m - c - r)^2}{8v} - \alpha(1 + c).$$

*Forbearance lending is only chosen by a zombie bank.*

*Proof: Appendix.*

### 2.3.2 Rent from private sector activity

Applying the rent function mentioned in the previous section, the rent that arises from the activity of the healthy bank is (see appendix for details):

$$\begin{aligned} \Phi_H &= \int_0^{L_H^*} (m - vL)dL - e_H^* L_H^* \\ &= \frac{(m - c - r)^2}{32v}. \end{aligned}$$

The rent is thus subject to the same variables as the lending volume, and equally increases with a higher loan demand in the economy (a higher  $m$ ), lower refinancing costs  $c + r$ , and a flatter shape of the curve  $v$ .

## 2.4 Zombie bank

### 2.4.1 Parameters of bank activity

Next, we take a look at the profit function of the zombie bank. Remember that now, the bank still holds the bad loans  $\alpha$  from the legacy period in its books, and any new loans  $L$  come on top of the bad loans. The bank also has to refinance the bad loans  $\alpha$ , and cover the capital costs for it. The profit function is thus:

$$\pi_Z(L) = \Pi_Z(L) = (c + r)\alpha + (m - vL_Z)L_Z - [c + r + v(L_Z + \alpha)](L_Z + \alpha) - \alpha.$$



Compared to the healthy bank, the bad loans  $\alpha$  only bring a return of  $c + r$  (as mentioned in the model setup), which is not enough to cover the refinancing costs. The bank has to find funding for both the new loans and the bad loans  $\alpha + L$ . Finally, the bank writes off the bad loans  $\alpha$  at the end of this period. As there were no losses in the legacy period, i.e.  $\hat{\pi}_Z = 0$ , the profit for the bank period equals the overall profit, i.e.  $\pi_Z(L) = \Pi_Z(L)$ .

As the bank maximizes the profit, the optimal volume for new loans is (see appendix for details):

$$L_Z^* = \frac{m - 2v\alpha - c - r}{4v}.$$

Compared to the lending volume of a healthy bank, the loan volume is reduced by  $\frac{\alpha}{2}$ . Remember that the overall loan volume is now the sum of the old loans  $\alpha$  and the new loans  $L_Z^*$ , so the overall loan volume is:

$$L_Z^* + \alpha = \frac{m + 2v\alpha - c - r}{4v}.$$

It is easy to see that the zombie bank initially has a bigger balance sheet overall compared to a healthy bank, until it writes off the bad loans at the end of the period. The optimal lending volume corresponds to a loan interest rate to entrepreneurs of:

$$e_Z^* = m - v \frac{m - 2v\alpha - c - r}{4v} = \frac{3m + 2v\alpha + c + r}{4},$$

and a profit of:

$$\Pi_Z^* = \frac{(m - 2v\alpha - c - r)^2}{8v} - \alpha(1 + v\alpha).$$

This optimal profit has implications for the ability of the bank to stay in operations.

**Liquidation threshold for zombie bank** While a zombie bank can use forbearance lending to stay alive, it can only receive financing for an additional period if the profits are sufficient to build up the equity that digest the subsequent write-off of the bad loans.

The optimal profit  $\Pi_Z^*$  now allows us to define the liquidation threshold  $\check{\alpha}_{LiQ}(\Pi_Z^* = 0)$ , where profits are zero:

**Lemma V.2** *A zombie bank is able to survive if its bad loan share  $\alpha$  is below the liquidation threshold  $\check{\alpha}_{LiQ}(\Pi_Z^* = 0)$ :*

$$\alpha < \check{\alpha}_{LiQ} := \frac{(m - c - r)^2}{4v(1 + m - c - r)}.$$

*It will always survive for  $m > 2(r + v) + 2\sqrt{v(1 + v)}$ .*

*Proof: Appendix.*

As long as the loan demand  $m$  is sufficiently large or the bad loans  $\alpha$  sufficiently low, the bank can continue operations and receives funding. However, if the margins are too low to receive sufficient profits that compensate the write-off, then the bank has to seize operations. Forbearance lending thus also has its limits as a means to keep insolvent banks alive.

### 2.4.2 Rent from private sector activity

With the lending volume for the zombie bank of  $L_Z^*$ , the corresponding total rent from entrepreneurial activity is (see appendix for details):

$$\begin{aligned}\Phi_Z &= \int_0^{L_Z^*} (m - vL)dL - e_Z^* L_Z^* \\ &= \frac{(m - 2v\alpha - c - r)^2}{32v}.\end{aligned}$$

Again, the total rent is subject to the same variables as the optimal lending volume  $L_Z^*$ , namely the loan demand  $m$ , the refinancing costs  $r$ , the shape of the loan demand and refinancing curve  $v$ , and the impact of the bad loans  $\alpha$ . Comparing the total rent to that under a healthy bank, we get:

**Proposition V.1** *A bank creates higher rents from private sector activity as a healthy bank than as a zombie bank, i.e.*

$$\Phi_H = \frac{(m - c - r)^2}{32v} > \Phi_Z = \frac{(m - 2v\alpha - c - r)^2}{32v}.$$

*A healthy bank has a higher volume of new loans at lower interest rates, i.e.*

$$\begin{aligned}L_H^* &= \frac{m - c - r}{4v} > L_Z^* = \frac{m - 2v\alpha - c - r}{4v}, \text{ and} \\ e_H^* &= \frac{3m + c + r}{4} < e_Z^* = \frac{3m + 2v\alpha + c + r}{4}.\end{aligned}$$

*However, the overall loan book of the bank is larger as a zombie bank than as a healthy bank:*

$$\alpha + L_Z^* > L_H^*.$$

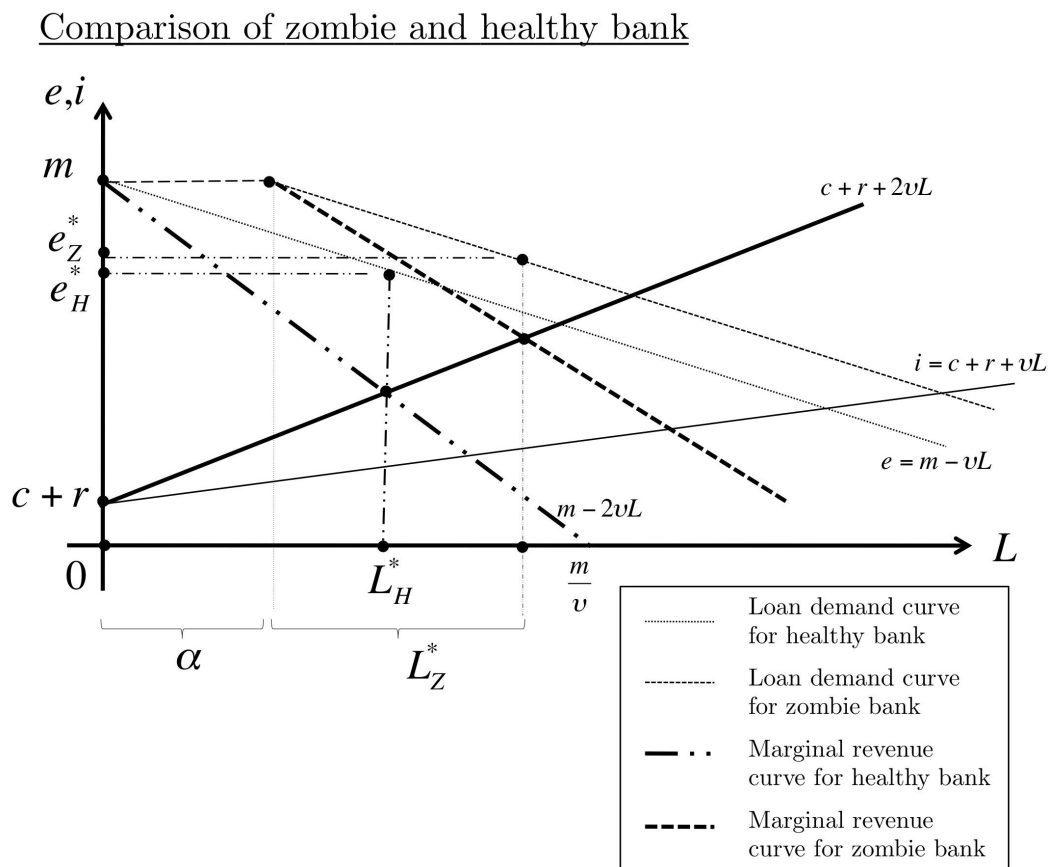
*Proof: Appendix.*

This result confirms that a zombie bank not only generates lower profits than a healthy bank, but also leads to lower rent from its loan counterparts. This is because there are

less new projects that are financed, and those that do receive funding have to pay a higher interest rate.

Graphically, this can be illustrated as in figure 5.

Figure 5:



The graph shows the loan volume on the x-axis and the interest rate on the y-axis. Point  $m$  on the y-axis is the starting point for the loan demand curve  $e = m - vL$  for the healthy bank. Point  $c + r$  is the starting point for the refinancing cost curve  $i = c + r + vL$ . The healthy bank chooses the optimal lending volume  $L_H^*$  where the marginal cost  $c + r + 2vL$  equals the marginal revenue  $m - 2vL$ , leading to the loan interest rate  $e_H^*$ .

The zombie bank, on the other hand, has to keep the bad loans  $\alpha$  in the book. The loan demand curve for new loans thus starts with a shift to the right, compared to the healthy bank. This also shifts the marginal revenue curve to the right, whereas the curve for the refinancing curve remains unchanged. As we can see, the overall lending  $\alpha + L_Z^*$  is larger than for the healthy bank  $L_H^*$ , but the volume of new loans  $L_Z^*$  is smaller. We also

see that the loan interest rate for the zombie bank  $e_Z^*$  is higher than for the healthy bank  $e_H^*$ . The activity of the zombie bank has thus led to a crowding out of the entrepreneurs on the curve between the points  $e_Z^*$  and  $e_H^*$ .

The explanation for this phenomenon is that a zombie bank has to keep the bad loans in its books in order to survive. These bad loans impair the function of a bank as an intermediary that channels funds from depositors to the corporate sector. While under a healthy bank, the funds flow freely through the bank, under a zombie bank the bad loans act as something of a roadblock that stops the flows. The bank thus has to get new funds at a more expensive rate, which results in less availability of funds to entrepreneurs.

It is thus those entrepreneurs with lower productivity that are cut off from access to loans. The crowding out among companies happens via the bank lending channel, as unprofitable firms stay alive as banks roll over bad loans, but smaller companies that need new financing are left out. The extent of this crowding out is a function of the size of the bad loans  $\alpha$ .

This result is in line with the findings in Japan that zombie lending leads to a crowding out among companies. Unprofitable firms survive, as old loan relationships are rolled over by the bank. At the same time, this comes to the expense of new ones that are cut off from funding.

This also explains the phenomenon that large companies seem to have benefitted from forbearance lending in Japan, as they kept on receiving new funds. At the same time, smaller companies could benefit less from that, as they found themselves on the right end of the curve.

In the following, we will have a look at the options for the social planner in repairing this lending channel.

### **3 Countermeasures and policy options**

We have seen that a zombie bank leads to a lower total rent from private sector activity than a healthy bank due to an impaired lending channel. In theory, it should thus be a straightforward conclusion that the zombie bank should be "revitalized" to improve the situation, or that the lending decision by the bank should be influenced in some other way.

We are now going to examine three different policy measures that can be applied in making an impact on the bank lending channel. These measures are an equity injection financed with the issuance of government bonds, a zero interest rate policy by the central

bank, and a stimulus by the government to increase the loan demand, also financed with the issuance of government bonds. It should be emphasized again that the focus of this paper is on the effects on the bank lending channel, not on bank solvency, sound government finances or other side effects from these policy measures. While these aspects are also important for the decision about the right policy intervention, for the sake of this paper we will only look at the effect on the rents from private sector activity.

The issuance of government bonds has repercussions on bank activity. We assume that these bonds cannot be placed directly with depositors, but rather via an intermediary, i.e. the bank.<sup>69</sup> As a matter of fact, we will assume that banks are the only intermediary that buys government bonds. We will thus not include the existence of insurance companies or asset management companies in this model. While this is certainly not in line with economic reality, the explicit modelling would not change the outcomes of the model. This is because the key consequence of government debt is that its holdings by banks increases their refinancing costs for any additional loan business. Modelling other intermediaries would have the same result, because banks would then have to reach out to savers that are farther away, which would increase their refinancing costs in the same way.

Hence, in this model we will assume that these government bonds are a competing asset for banks to direct its funds to, next to the loans to private companies. The government can also benefit from lower financing rates than these corporate loans, as the holdings of government bonds is not subject to regulatory costs. We will see later how exactly the mechanics work here.

As we will see, the three policy tools address different aspect of the bank lending channel. Speaking in illustrative terms, an equity injection removes the roadblock, i.e. the bad loans, to clear the intermediary channel of banks for the flow of funds from savers to entrepreneurs. It converts a zombie bank into a healthy bank, by giving it enough equity to digest a write-off of bad loans. However, the government debt has to be placed with the bank so that it creates another obstacle in place of the bad loans.

A zero interest rate policy (ZIRP), on the other hand, cannot remove the bad loans, and therefore leaves the zombie bank in the same state. Instead, it addresses the refinancing costs of the bank, thus facilitating the access to funds. This in turn, induces an increase in lending. Therefore, a zombie bank can be stimulated to increase its lending even without removing the roadblock of the bad loans.

A stimulus for the entrepreneurial sector is an alternative way for the government to influence bank lending, as it addresses the demand curve for new loans. Again, it does not turn the zombie bank into a healthy bank, but by increasing the loan demand, the

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<sup>69</sup>Indeed, even in the case of Japan, the share of government bonds held directly by households is only 5%, as mentioned by Yoshino and Mizoguchi (2013).

bank finds more counterparties for its loans at the same interest rate. However, such a stimulus has to be financed somehow, and the new government bonds lead to a partial crowding out of the new demand that is created. The success of such a measure depends on the economic environment.

**Modelling of government bond placement** Before we look at the measures in detail, the following will quickly sketch out how the placement of government bonds with the bank is modeled here.

The first step is to determine the amount of government bonds that will be issued for a measure. This amount will be referred to as government bonds  $G$ . In the case of a recapitalization, it is equal to the bad loan share  $\alpha$ , whereas for the stimulus, it depends on the scale of the intervention. In any case, the amount of government bonds is independent of the lending volume  $L$ .

The bonds have then to be placed with the bank. From the point of the bank, it can now split up its assets into two components: loans to entrepreneurs  $L$  or holdings in government bonds, which we will refer to as  $B$ . For the bank, government bonds and loans are substitutes on the balance sheet. With an increasing balance sheet, the refinancing costs increase. Hence, it has to choose the right split of optimal government bond holdings  $B^*$  and loans  $L^*$  that maximize its profits. While the overall amount of government bonds  $G$  is independent of  $L$ , this is not the case for the holdings of the government bond by the bank  $B$ .

One advantage of holding government bonds is that there are no regulatory costs  $r$  connected to their holdings, unlike loan exposure. The bank will thus compare the return on the optimal loan volume with the cost-adjusted return on government bonds.

The government, on the other hand, cannot force the bank to buy government bonds, so it has to offer an interest rate that incentivizes it via an appropriate government bond rate  $g$ . In other words, the government has to offer the optimal government bond rate  $g^*$  that it can place all its bonds with the bank, i.e.  $G = B^*$ . This means that for a higher return on the lending portfolio, for instance, it would also have to adjust the government bond rate accordingly.

We will now go through these measures step by step to see what the effects are on bank lending.

### 3.1 Equity injection

We will now look at the effects of a recapitalization of the zombie bank through an equity injection. As mentioned in the introduction, the common policy suggestion by many

economists is to apply this measure to contain forbearance lending.

All variables will be denoted with  $\eta$ . The required equity injection equals the bad loan share  $\alpha$ . The zombie bank now turns into a healthy bank and writes off the bad loan  $\alpha$  at the end of the legacy period. The profit for the bank in the legacy period is thus  $\hat{\pi}_\eta = 0$ , while the burden to the government is the new government debt  $G_\eta = \alpha$ . Thus, the government has expenditures of  $\alpha$ , which it covers with the issuance of government bonds  $G_\eta$ . After the active bank period, the bank pays back the government the equity  $\alpha$  with the profits it generates.

As mentioned, we assume that the government has to place these government bonds with the bank, as it cannot directly sell government bonds to depositors. When the bank buys these bonds, we assume that the holdings are not subject to the regulatory costs  $r$ , unlike the loans to entrepreneurs, because government bonds are treated as risk-free by the regulator. Thus, the government bonds are an attractive asset for the use of funds for the bank.

As the government has to place its debt with the bank, it will accept the rate  $g_\eta$  by the bank that corresponds to the placement of the full volume of government bonds  $G_\eta$ .

To see how this works, let's have a look at the new profit function of the bank after the equity injection of  $\alpha$ :

$$\Pi_\eta(B, L) = g_\eta B_\eta + (m - vL_\eta)L_\eta - [c + v(B_\eta + L_\eta)](B_\eta + L_\eta) - rL_\eta - \alpha.$$

The profit of the bank is now a function of the interest receivables on the government debt holdings  $g_\eta B_\eta$  plus the income from the loan to entrepreneurs, minus the costs to refinance the total volume of bonds and loans. Moreover, the bank also has to pay the regulatory costs  $r$  on the loan volume  $L_\eta$ , but not on the bond holdings  $B_\eta$ . The bank still has to write-off the bad loan share  $\alpha$  after the equity injection. Note that so far, the holdings of the bonds  $B_\eta$  is independent from the government debt  $G_\eta$ .

The bank now chooses the optimal lending volume  $L_\eta^*$ , which leads to the function of:<sup>70</sup>

$$L_\eta^* = \frac{m - c - r - 2vB_\eta}{4v}.$$

At the same time, it chooses the optimal volume of government bonds holdings  $B^*$ , which leads to the function of:

$$B_\eta^* = \frac{g_\eta - r - 2vL}{2v}.$$

Here we can see that these two functions are interdependent. The bank has to split up its balance sheet between the two components. As the two functions are interdependent,

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<sup>70</sup>See the appendix for a detailed calculation of all variables following below.

we can solve for the optimal portfolio split, which is

$$\begin{aligned} L_\eta^* &= \frac{m - r - g_\eta}{2v}, \text{ and} \\ B_\eta^* &= \frac{2g_\eta - m}{2v}. \end{aligned}$$

In the next step, we turn to the government. As mentioned, the government now has to place debt in the amount of the equity injection, so that  $B_\eta^* = G_\eta = \alpha$ . It therefore has to offer an interest rate  $g_\eta^*$  that incentivizes the bank to buy all government bonds up to the volume of  $G_\eta = \alpha$ .

Hence, substituting  $B_\eta^*$  with  $\alpha$  in the last equation, we get the government bond rate that induces the bank to hold all of the government bonds of this volume:

$$g_\eta^* = \frac{2v\alpha + m}{2}.$$

The government thus has to pay the interest rate of  $g_\eta^*$  on its debt  $G_\eta = \alpha$ , which leads to overall costs of

$$G_\eta g_\eta^* = \alpha \frac{2v\alpha + m}{2}$$

for the government.

Now that we have defined the holdings of government bonds, we can work out the optimal lending volume. As the optimal lending volume  $L_\eta^*$  is a function of  $g$ , when applying this government rate  $g_\eta^*$ , the optimal lending volume and the interest rate come down to:

$$\begin{aligned} L_\eta^* &= L_Z^* = \frac{m - c - r - 2v\alpha}{4v}, \text{ and} \\ e_\eta^* &= e_Z^* = \frac{3m + 2v\alpha + c + r}{4}. \end{aligned}$$

We have now worked out the lending conditions under an equity injection. If we consider the rent from these lending conditions, we can see the following result of the government intervention:

**Proposition V.2** *A bank recapitalization via an equity injection financed by government debt leads to the same rents from private sector activity as under a zombie bank, i.e.:*

$$\Phi_\eta = \Phi_Z = \frac{(m - c - r - 2v\alpha)^2}{32v}.$$

*Proof: Appendix.*



To reiterate, a bank that was previously a zombie and that receives an equity injection does not choose the same lending volume as a healthy bank. The reason for this is that the new government bonds have replaced the bad loans in the portfolio of the bank. These bonds stand in direct competition to the loans, and as the government has to place them with the bank, it takes away the funds from the entrepreneurs.

This result does not mean that an equity injection is a useless tool as such. A direct result of the equity injection is that the profitability of the bank increases. If we solve the profit function for the optimal profit, we get:

$$\Pi_{\eta}^*(B = \alpha, L^*) = \frac{(m - c - r - 2v\alpha)^2}{8v} - \frac{\alpha(2 + c + r - m)}{2}.$$

While the first part of the RHS of the equation is the same as for the zombie bank, the second part that represents the costs of the bad loan share  $\alpha$  are changed. Comparing this to the profit under a zombie bank, we get:

**Lemma V.3** *A bank recapitalization leads to a higher bank profitability than for a zombie bank without intervention, i.e.:*

$$\Pi_{\eta}^*(B^* = \alpha, L^*) > \Pi_Z^*.$$

*However, it leads to debt servicing costs for the government of*

$$G_{\eta}g_{\eta}^* = \alpha \frac{2v\alpha + m}{2}.$$

*Proof: Appendix.*

This implies that an equity injection may be a suitable tool for addressing bank solvency concerns and potential externalities from bank failures (which goes beyond the scope of this paper), but is not effective in leading to an increase of lending to the private sector.

### 3.2 Zero interest rate policy (ZIRP)

Next, we will look at the effects of a zero interest rate policy by the central bank. As we saw initially, the refinancing costs of the bank are subject to the central bank rate  $c$ , the regulatory costs  $r$  on loans to entrepreneurs, plus the marginal costs for receiving additional funds.

Under a ZIRP, the central bank rate goes down from  $c$  to zero. We will assume that the bank cannot operate under negative equity, hence the zombie bank can still not write-off its bad loans at the end of the legacy period. However, it will write off the bad loans after the period with the profits generated from its lending activity.

Therefore, a ZIRP does not turn the zombie bank into a healthy bank, but facilitates its access to funding.

Note that the regulatory costs for loans  $r$  remain unchanged.

We will denote all variables with  $\zeta$ .

The profit function for the bank now changes to:

$$\Pi_{\zeta}(L) = (c + r)\alpha + (m - vL_{\zeta})L_{\zeta} - [r + v(L_{\zeta} + \alpha)](L_{\zeta} + \alpha) - \alpha.$$

Unlike the case of the equity injection, the bank keeps the bad loans  $\alpha$  in the book, and receives the minimum income of  $c + r$  on these bad loans. Moreover, we can see that the starting point for the refinancing costs are now  $r$  instead of  $c + r$  that we had previously, because the central bank rate  $c$  is zero. Compared to the equity injection case, there are no government bond holdings  $B$  for the bank here.

Optimizing this function leads to the optimal lending volume and interest rate of:<sup>71</sup>

$$\begin{aligned} L_{\zeta}^* &= \frac{m - 2v\alpha - r}{4v}, \text{ and} \\ e_{\zeta}^* &= \frac{3m + 2v\alpha + r}{4}. \end{aligned}$$

Comparing this to the zombie bank and the healthy bank before any intervention, we get:

**Proposition V.3** *A zero interest policy leads to a higher total rent from private sector activity due to a higher volume of new loans and a lower loan interest rate compared to a zombie bank without intervention, i.e.*

$$\begin{aligned} \Phi_{\zeta} &= \frac{(m - 2v\alpha - r)^2}{32v} > \Phi_Z = \frac{(m - 2v\alpha - c - r)^2}{32v}, \text{ as} \\ L_{\zeta}^* &= \frac{m - 2v\alpha - r}{4v} > L_Z^* = \frac{m - 2v\alpha - c - r}{4v}, \text{ and} \\ e_{\zeta}^* &= \frac{3m + 2v\alpha + r}{4} < e_Z^* = \frac{3m + 2v\alpha + c + r}{4}. \end{aligned}$$

Moreover, a ZIRP can lead to the same or even higher lending volume and total rent from

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<sup>71</sup>The detailed explanations to derive the values can be found in the appendix.

*private sector activity compared to a healthy bank, i.e.*

$$\begin{aligned}\Phi_{\zeta} &\geq \Phi_H, \text{ if} \\ 2v\alpha &\leq c.\end{aligned}$$

*Proof: Appendix.*

Let's consider each part of this result step by step. The first result is that a ZIRP improves the lending activity of the zombie bank, although the bad loans are still in the books. This is because the lending activity is also subject to the refinancing costs, and a ZIRP facilitates the access to funds. Speaking in illustrative terms again, although the roadblock of the bad loans are still existent, a ZIRP widens the inflowing channel of funds to the bank, which also leads to a higher outflow.

The next result is that the magnitude of this improvement depends on the economic parameters. A ZIRP can increase the lending volume even to a stage that is the same as under a healthy bank. However, we now have two opposing effects on the lending activity: on the one hand, we have the "burden" of the bad loans in increasing the refinancing costs, which is the volume of bad loans  $\alpha$  times the marginal costs for additional funds  $2v$ . On the other hand, we have the positive effect of lower refinancing costs of  $c$ . A ZIRP can lead to the same rents as under a healthy bank if the latter effect compensates for the former one.

We have now looked at two policies that have addressed the bank directly, either via its equity or via its refinancing activities. Next, we will examine a policy that affects the loan counterparts of the bank.

### **3.3 Debt-financed government stimulus for loan demand**

We have previously seen that the use of government funds for an equity injection may be beneficial in addressing bank solvency concerns, but does not have a direct positive effect on bank lending. If the focus of the government is on improving the economic activity of the private corporate sector, as it is assumed here, it can interfere also by addressing the entrepreneurs directly. For this, it can create a stimulus that does not trigger any direct government spending (such as infrastructure projects), but that improves the financial conditions of entrepreneurs, e.g. by offering tax breaks. This forces the government to issue additional government debt, which again have to be absorbed by the bank. Such a policy then implies a higher demand for loans from entrepreneurs, while the government issues new bonds to finance this, in the sense of a "deficit without spending".

Such a policy would leave the zombie bank unchanged, i.e. it will not remove the bad loans and turn the bank into a healthy bank. Nonetheless, it represents an alternative way for the government to interfere in improving the lending activity of the bank.

For this model here, we assume that such a stimulus shifts the loan demand curve upwards. We will denote all variables with  $\sigma$ . The initial loan demand curve of

$$e = m - vL$$

is now shifted upwards by the stimulating effect  $s$  across the curve, leading to the new curve of

$$e_\sigma = m + s - vL_\sigma.$$

Remember that under the initial loan demand curve, the range of entrepreneurs was  $\frac{m}{v}$ .<sup>72</sup> We assume that the stimulus addresses each entrepreneur across this range but does not add any new entrepreneurs, so that the loan range remains  $L \in [0, \frac{m}{v}]$ . Hence, the stimulus shifts the existing curve upwards by  $s$ . The volume of the stimulus is thus the range of the stimulus  $\frac{m}{v}$  times the stimulus  $s$  itself, i.e.

$$G_\sigma = s \frac{m}{v}.$$

The government thus has to issue government bonds of  $G_\sigma = s \frac{m}{v}$  to finance the deficit.

We assume that the stimulus does not reach those zombie firms with bad loans, e.g. by imposing a tax break on earnings taxes, so that only the demand for new loans is reached.

With this new loan demand curve, the profit function for the bank is now:

$$\Pi_\sigma(B, L) = (c+r)\alpha + g_\sigma B_\sigma + (m+s-vL_\sigma)L_\sigma - [c+v(B_\sigma+L_\sigma+\alpha)](B_\sigma+L_\sigma+\alpha) - r(L_\sigma+\alpha) - \alpha.$$

The bad loans  $\alpha$  are still in the book with the return of  $c + r$ , and the bank has two additional revenue sources, namely the government bond holdings  $B_\sigma$  and the loans to entrepreneurs  $L_\sigma$  with the new demand curve  $m + s - vL_\sigma$ . It has to refinance all three assets, however, only the bad loans  $\alpha$  and the loans to entrepreneurs  $L$  are subject to additional regulatory costs  $r$ . The bad loans  $\alpha$  have to be written off at the end of the period.

Compared to the two previous cases of government intervention, the bank now has the full range of assets to invest in: on the one hand, it carries the bad loans  $\alpha$ , which also

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<sup>72</sup>In the model outline we defined that the range of entrepreneurs refers to the scope of the loan demand curve. This is different to the actual number of entrepreneurs, which is  $\frac{m}{vl}$ , as it depends on the unit of loan for each entrepreneur.

exist under the ZIRP but not the equity injection. It receives the return  $c + r$  on them, but also has to refinance them and incur regulatory charges  $r$ . On the other hand, it can also invest in government bonds, which was the case under the equity injection, but not the ZIRP. For this, it receives the income  $g_\sigma$ , but also has to refinance these holdings. Finally, here it has a different loan demand curve due to the stimulus by the government  $s$ .

Optimizing this for the bond holdings and the new loans in the same manner as we did for the equity injection above, we get the optimal lending and bond holdings to maximize profit:<sup>73</sup>

$$\begin{aligned} L_\sigma^* &= \frac{m + s - r - g_\sigma}{2v}, \text{ and} \\ B_\sigma^* &= \frac{2g_\sigma - 2v\alpha - m - s}{2v}. \end{aligned}$$

The government now has to place all of its bonds with the bank to have  $B_\sigma^* = G_\sigma$ , thus again accepting the rate  $g_\sigma^*$  that is demanded by the bank for the corresponding volume. As  $G_\sigma = s\frac{m}{v}$ , we get the government bond rate of

$$g_\sigma^* = \frac{m + 2v\alpha + s(1 + 2m)}{2}.$$

This, in turn, leads to the optimal lending volume and loan interest rate of

$$\begin{aligned} L_\sigma^* &= \frac{m - c - r - 2v\alpha + s - 2sm}{4v}, \text{ and} \\ e_\sigma^* &= \frac{3m + 3s + c + r + 2v\alpha + 2sm}{4}. \end{aligned}$$

Comparing this to the zombie bank without intervention, we get:

**Proposition V.4** *A deficit-financed government stimulus that improves the loan demand by  $s$  can lead to a higher total rent from private sector activity, if the initial loan demand base is sufficiently low, i.e.*

$$\begin{aligned} \Phi_\sigma &> \Phi_Z, \text{ if} \\ m &< \frac{1}{2}. \end{aligned}$$

*Proof: Appendix.*

The way a government stimulus works is as follows: on the one hand, it shifts up the demand curve, which naturally leads to a higher loan volume compared to a zombie bank

<sup>73</sup>See the detailed explanations to derive the optimum values in the appendix.

for any given rate. However, the government has to finance the resulting government deficit, and for this it has to issue new government bonds. These bonds, in turn, have to be placed with the bank and thus crowd out parts of the loans to entrepreneurs. The net effect of these two opposing forces can be seen in the difference between the loan functions for the zombie bank with and without stimulus, i.e.  $L_\sigma^*$  and  $L_Z^*$ , where the difference is  $s - 2sm$ . Here,  $s$  represents the positive impact from the stimulus, whereas  $2ms$  represents the additional refinancing costs for the bond holdings. Ultimately, the success of the stimulus depends on the initial loan demand  $m$ . If this is initially low, the impact of  $s$  is high, whereas if this is high already, then even an additional stimulus cannot make much impact. It is thus not a matter of how large  $s$  is, but how large the initial demand base is, because a higher  $s$  will also automatically lead to a higher government debt, which again brings crowding out effects with it.

It was mentioned that the focus of this paper is the bank lending activity. Nonetheless, it should be kept in mind that a government stimulus also leads to debt servicing costs for the government. If we assume that a stimulus is effective, i.e.  $m < \frac{1}{2}$ , then we can weigh the resulting government debt costs  $g_\sigma^* G_\sigma$ , against the resulting positive difference in rents for the zombie bank with and without intervention, denoted with  $\Delta\Phi_{\sigma,Z}$ . We then get

**Proposition V.5** *A successful government stimulus has the ratio of debt servicing costs over the positive effect on rents of:*

$$\frac{g_\sigma^* G_\sigma}{\Delta\Phi_{\sigma,Z}} = \frac{m}{2v} \frac{s(1+2m) + m + 2v\alpha}{s(1+4m^2) - (2+4m)(m+c+r+2v\alpha)}.$$

*Proof: Appendix.*

The extent of the government stimulus has to take into account the effects on bank lending, but naturally also the additional burden on government finances. As the focus of this paper is on bank lending, it does not incorporate a measure for the sustainability of government debt. The point here is that depending on the parameters, the ratio between the increased burden of government debt and the positive effect on bank lending changes with the size of the stimulus  $s$ , but also with the economic environment represented by the loan demand  $m$ , the shape of the demand and refinancing cost curve  $v$ , and the refinancing costs  $c + r$ . There is thus a natural limit to the effectiveness of the stimulus.

A case study of a stimulus volume that leads to the same lending conditions as under a healthy bank, i.e.  $L_\sigma^* = L_H^*$  can be found in the appendix.

### 3.4 Summary of policy measures

We have looked at three different policy measures to influence the lending conditions of a bank to the corporate sector: a recapitalization via equity injection, a zero interest rate policy (ZIRP), and a government stimulus to increase loan demand.

The table below summarizes the three measures in its approach, effectiveness, and result.

	<b>Equity injection</b>	<b>ZIRP</b>	<b>Stimulus</b>
Approach	Remove bad loans $\alpha$	Facilitate refinancing	Increase loan demand
Turns zombie into healthy bank?	Yes	No	No
Comparison with zombie bank	$\Phi_\eta = \Phi_Z$	$\Phi_\zeta > \Phi_Z$	$\Phi_\sigma > \Phi_Z$ , if $m < \frac{1}{2}$
Can healthy bank lending be restored?	No	Yes, if $2v\alpha \leq c$	Yes, if $m < \frac{1}{2}$
Government debt	$G_\eta = \alpha$	None	$G_\sigma = s \frac{m}{v}$
Government debt rate	$g_\eta^* = \frac{2v\alpha+m}{2}$	None	$g_\sigma^* = \frac{m+2v\alpha+s(1+2m)}{2}$

All three measures have a different approach in improving bank lending. An equity injection removes the roadblock of bad loans, which caused the impaired lending channel in the first place. It is thus also the only measure that turns the zombie bank into a healthy one. However, it cannot restore the bank lending to that of a healthy bank, due to the crowding out of loans by new government debt.

A ZIRP facilitates refinancing operations by putting the central bank rate  $c$  to zero. While it does not turn the zombie bank into a healthy one, it is successful in improving the rents from private sector activity. Another advantage is that it does not create government debt. Whether it can fully lead to the same lending conditions as those of a healthy bank depends on how high the initial central bank rate was before the ZIRP, and how this compares to the marginal refinancing costs of the bad loans  $\alpha$ .

Finally, a stimulus does not address the bank directly, but rather increases the loan

demand, e.g. through offering tax breaks. It leaves the zombie bank unchanged, and its success depends on the initial loan demand environment  $m$ . The size of the stimulus is not crucial for its success, as the stimulus also leads to new government debt which crowds out private loan demand. The scale of the intervention is also limited by increasing costs of government debt, and ultimately depends on the sustainability of government finances.

## 4 Discussion

### 4.1 Paper results in perspective

It was mentioned in the introduction that the discussion about zombie banks is centred around their damaging effects to the economy, and the necessity to recapitalize them, while a ZIRP is viewed as dangerous by keeping zombie banks alive.

On the damaging effects of zombie banks, we have seen that this effect comes from the impaired lending channel of banks due to the existence of bad loans in their books. Thus, even if there is no chance for a gamble for resurrection, a zombie bank can lead to a crowding out of healthy firms by unprofitable ones. Due to the increased refinancing costs, the bank offers higher lending rates and cuts the loan volume, which is why smaller firms would suffer more from a lack of access to funds, while large, productive firms can still survive and receive new loans from a zombie bank.

The model has also shown that the overall loan book, including the bad loans, is larger for a zombie bank compared to a healthy bank, which would also be in line with some of the findings in the literature that zombie firms do not necessarily lead to a credit crunch overall. Instead, it is only the new projects that suffer as they are cut off from funds.

On the necessity to recapitalize zombie banks, the debate often negates the consequences of state interference. An extra spending element for the government will naturally lead to repercussions elsewhere in the economy, as the government accumulates debt that has to be financed somehow, reminiscent of the "classical" crowding out phenomenon in the economy. This could also explain why equity injections have not had clear success in stimulating new lending in the case of Japan, where banks have accumulated large portions of government bonds during and after the crisis. Indeed, in the most recent recapitalization efforts of banks in Greece and Spain during the European sovereign debt and banking crisis, banks were actually recapitalized with bonds by public sector institutions, and not with cash. Instead of the indirect replacement of bad loans with government bonds as modelled here, there was thus an immediate change in assets from the write-off of bad loans to the holdings of government bonds, which is a very clear



illustration of the crowding out effect.

It must be emphasized again that the effectiveness of equity injections was viewed here in the context of improved bank lending conditions. It is clear that the recapitalization turns the zombie bank into a healthy one, which has positive effects elsewhere, e.g. if there is a threat to bank stability overall, or if there are high externalities of bank failures. Such factors, however, were not the focus of this paper here.

On the effects of a ZIRP, it is true that it helps zombie banks to stay alive and thus does not heal the impaired lending channel. However, a key feature is that through the ZIRP, zombie banks have easier access to funds and can channel these flows to the corporate sector. Due to the higher lending volume and lower lending rates, this is an immediately positive contribution to the economy, as borrowers have access to more favorable funding conditions.

To be clear, a ZIRP is not really an alternative to an equity injection. Rather, they are measures by different actors in the economy (i.e. the central bank and the government, respectively), and both have been applied simultaneously in the past as a response to zombie banks, e.g. in Japan. However, if we want to isolate and compare the effects of each policy, then we have seen that a ZIRP leads to more positive effects than an equity injection by the government.

Finally, if the government does want to interact in the economy to increase the lending conditions, it can do so by stimulating additional loan demand, e.g. by cutting taxes. Indeed, after the mixed experiences with the bank recapitalizations, the Japanese government has accumulated a massive public debt, which has led to holdings of government bonds by banks on a large scale. Whether the real effect on the lending conditions are positive depends on the autonomous loan demand before the intervention. Arguably, in the case of Japan the loan demand was very low, as the corporate sector turned into net savers and not borrowers for new funds, as mentioned by Yoshino and Mizoguchi (2013). Whether the intervention by the government has improved the lending conditions or whether the crowding out effect of government debt has prevailed is unclear. In case a stimulus is successful, the extent as to how large this stimulus should be depends on the sustainability of government finances. As mentioned in their paper, this can even lead to enormous debt stocks, which make the direction of new flows to the corporate sector difficult in light of the large holdings of government bonds by banks.

## 4.2 Model parameters and scope for further research

The results of the model naturally depend on the chosen framework. The following will discuss its main assumptions and components, with a view on potential areas for further research.

### 4.2.1 Basic model framework

The loan demand in the paper is subject to the loan interest rate, where lower interest rates imply higher loan demand. This assumption of the inverse relationship between loan volume and loan interest rate has been commonly applied and goes back to the loanable funds model by Robertson (1934). Another component of the model is the fact that the bank generates profits, and thus has a certain degree of market power. For a given refinancing rate and loan demand curve, banks determine to their own benefit which lending volume and interest rate they charge to their loan counterparts. They set the optimal volume and loan interest rate to maximize profits. This is in line with the Monti-Klein model of a monopolistic bank, and the same approach is also chosen elsewhere in the literature, e.g. by Kashyap, Rajan and Stein (2002).<sup>74</sup> This kind of market power for the bank can have several sources. In a review of the related empirical literature, Degryse and Ongena (2008) put them into four categories: market structure, switching costs, location and regulation. Market concentration (or rather the lack of it), in particular, results in spreads between refinancing and loan rates for the bank, and thus positive profits. Location can play a similar role, as close borrowers (in terms of physical distance, but also with regard to borders) pay a higher loan rate.<sup>75</sup> Indeed, only recently a large European bank stated publicly that it expects to have positive earnings even in bad times, indicating that it has sufficient market power to always make profits.<sup>76</sup>

In this context, it would be imaginable to put the model in a competitive environment where the zombie bank coexists with other banks. Right now, the bank faces increasing refinancing costs for higher volumes, which can be interpreted as distance costs, but also as costs in the competition for new funds. An extension of the model to also have competition in lending could then also incorporate any possible impact such competition could have on the profit margin, or the loan demand curve.

Due to the limitation of a two-period model (or actually only one active period), the model does not incorporate any feedback effects from the extension of bad loans on behalf of the loan counterparts. It is imaginable that the rolling over of bad loans weakens the

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<sup>74</sup>See e.g. chapter 3 in Freixas and Rochet (2008) for an outline of the Monti-Klein model.

<sup>75</sup>Another overview on the drivers behind market power including a theoretical background is provided in VanHoose (2010).

<sup>76</sup>See Financial Times (2013b).

position of the bank in its relation with new counterparts, leading to lower discipline and lower productivity overall. Firms could then gamble on the fact that the bank has to extent bad loans, as otherwise it would be insolvent. An extension for this feature may give additional insights into the effects of zombie banks on the corporate sector.

As already mentioned, a crucial feature of the model is that there is no improvement in recovery values of bad loans. This excludes a gamble for resurrection by the bank, that has often been identified in the literature as the main reason for zombie banks to roll over bad loans. However, in reality the performance of bad loans is related to the economic environment. In a period of economic growth, this could lead to another positive aspect of zombie banks that have not been accounted for in this model.

#### **4.2.2 Modelling of countermeasures**

While the government in this model is connected to the bank through the issuance of government bonds and via an equity injection, there is no explicit modelling of the government sector as such. Arguably, for the equity injection, the bank can pay back the equity that was received to the government after one period, leading to government debt costs for only one period. However, in case of a stimulus, the model does not take into account how the debt is paid back in the future. An extension of the model for more periods could include the effects of a tax rise of the same volume, leading to a lower demand.

In reality, however, governments do have a debt stock outstanding, and the discussion about the sustainability of public finances makes up an entire research branch on its own. The model also does not take into account the effects of increased incentives for the government to indebt itself for an increased demand by the banks for the bonds. Indeed, a formal modelling of all three sectors, i.e. the private sector, banks and the state, as done e.g. by Acharya, Drechsler and Schnabl (2011), could also incorporate the interaction between banks and the government, and the effects of higher interest payments for the government. Building such a wider model framework would be an interesting field for further research.

As the focus of this paper is solely on the effects on bank lending and not on government debt, the model has reduced the government activity to this impact on the loan demand. The important insight from this paper is that a government intervention must have an impact elsewhere in the economy that also influences bank lending.

Finally, the placement of government bonds in this paper is modelled to occur solely with the bank. As mentioned earlier, in reality the government also sells its bonds to other intermediaries, such as insurance companies or asset managers, and to a small extent also

directly to households. With the setting here, the government bond rate is determined by the bank. As the bank is monopolistic in its lending behavior and the government bonds compete with the return on lending, the government is forced to pay a high rate to place its bonds with the bank. A model with other forms of placement would change this result. While this would lower the profitability of bank activity under a government intervention and may lower the costs for the government, it does not change the main outcome of the model, namely that government intervention crowds out lending. This is because in a model with further placement possibilities for government bonds, depositors would direct their funds away from bank deposits and towards these other intermediaries, or directly to the government. The bank would then face higher refinancing costs, which are also the main driver for lower loan supply in the current model. Hence, a more complicated model would not change the model results and drivers.

The other difficult policy to fully incorporate is the ZIRP, as there are many indirect effects to the economy, as pointed out in the literature, e.g. in Schnabl (2013). The first and most direct effect is the one modelled here, namely that the refinancing rates of banks go down. This is also the only effect incorporated in the paper. The many other potential consequences, e.g. inflation or the creation of an asset bubble elsewhere, are not taken into account and would go beyond the scope of this paper. Thus, it is probably premature to attribute only positive effects to the ZIRP, as shown in this paper. A more thorough reflection of the many aspects of a ZIRP and their influence on bank lending would be a further useful contribution to the literature.

Moreover, we have only considered a ZIRP as the only policy measure by the central bank. However, there are also additional "weapons" within a central bank's arsenal of measures, which can be briefly sketched out here:

Negative interest rates (NIRP) can be incorporated very easily into the model by assuming a negative  $c$ . The effect of such a measure would be the same as a ZIRP, only with a stronger impact. Hence, if a ZIRP is not effective enough a central bank could go even further and lower interest rates to a negative territory. While a NIRP is in theory possible, in practice there has only been one example of a negative interest rate. Indeed, in Denmark the deposit rate was lowered to minus 0.1% in July 2012.

Another option for the central bank would be to purchase all or parts of the government bonds during a debt financed equity injection or stimulus. The immediate effect would also be beneficial to bank lending, as the bonds would not be absorbed by the bank balance sheet, and thus free up capacity for additional lending activities. Indeed, there have been several instances in the past where central banks have purchased government bonds, as recently as the Bank of Japan and the Federal Reserve Bank (see also the case study in

chapter VI on this). While such measure can be beneficial to the effect of bank lending, it can have other repercussions as laid out e.g. in Rawdanowicz, Bouis and Watanabe (2013), such as inflation, distortions to the incentive of the government to indebt itself, and others. However, for the purpose of this analysis such a measure would certainly have a positive effect on bank lending.

A final and recently popular measure of the central bank is a policy of forward guidance to keep rates low for a longer period of time, as advocated and exercised e.g. by the ECB, the Fed and the Bank of England.<sup>77</sup> In practice, this serves to lower not only the short-term interest rates but also longer term ones. For the model framework here this measure is difficult to incorporate, as we only have a two period model. However, as the main purpose of this measure is to keep interest rates low, the effect is comparable to that of a ZIRP or even NIRP. Hence, this is another policy tool that addresses the bank funding activity and should thus stimulate the lending volume to the entrepreneurial sector.

## 5 Conclusion

This paper has provided a formal analysis of the activity of zombie banks, also in comparison to healthy banks, and how they lead to a crowding out of profitable firms by unprofitable ones. Additionally, it has conducted an analysis of the effects coming from a government intervention via an equity injection, the effects of a zero interest rate policy, and of an government stimulus to increase loan demand. Such a comparative study has been missing in the literature so far.

The paper has shown why zombie banks are a particular threat to less productive firms that seek funds to finance new projects. While it is thus desirable to clean the banks of their bad loans, the paper has also shown that there is no easy way out of such a situation.

Government interventions, especially on a larger scale, may make the banking sector more healthy or increase loan demand but could have severe repercussions on bank lending if they lead to an increase in government debt, and subsequently to a rise in competing assets to corporate loans. Ultimately, the government debt that is created has to be absorbed by the households, via the banks as intermediaries. As many countries in Europe, but also Japan are already suffering from a high level of public debt, equity injections have to be considered with caution.

The ZIRP, on the other hand, may just give the banks the additional breathing space to receive easier access to financing. This should lead to more favorable lending conditions for corporate borrowers, i.e. higher lending volumes and lower loan rates. This approach

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<sup>77</sup>See e.g. Woodford (2012) and Bank of England (2013) on the details of forward guidance.

does not lead to an immediate resolution to the existence of zombie banks, and may well result in a longer period of readjustment as seen in Japan. It naturally also has other potential negative side effects such as increased inflation, that have not been covered in this paper. However, the effects could be more beneficial than under a large scale bank recapitalization or a stimulus by the government.

## 6 Appendix

### 6.1 Base model

#### 6.1.1 Healthy bank parameters

$$\begin{aligned}\Pi^H(L) &= (m - vL_H)L_H - (c + r + vL_H)L_H - \alpha. \\ \frac{\partial \Pi^H}{\partial L} &= -vL_H + m - vL_H - c - r - vL_H - vL_H = 0, \\ L_H^* &= \frac{m - c - r}{4v}.\end{aligned}$$

$$e_H^* = m - vL_H^* = \frac{3m + c + r}{4}.$$

$$\begin{aligned}\Pi_H^* &= (m - vL_H^*)L_H^* - (c + r + vL_H^*)L_H^* - \alpha \\ &= L_H^*[(m - c - r) - 2vL_H^*] - \alpha \\ &= \frac{(m - c - r)^2}{8v} - \alpha.\end{aligned}$$

#### 6.1.2 Zombie bank parameters

$$\begin{aligned}\Pi_Z(L) &= (c + r)\alpha + (m - vL_Z)L_Z - [c + r + v(L_Z + \alpha)](L_Z + \alpha) - \alpha. \\ \frac{\partial \Pi_Z}{\partial L} &= -vL_Z + m - vL_Z - (vL_Z + v\alpha + c + r + vL_Z + v\alpha) = 0, \\ L_Z^* &= \frac{m - 2v\alpha - c - r}{4v}.\end{aligned}$$

$$e_Z^* = m - vL_Z^* = \frac{3m + 2v\alpha + c + r}{4}.$$

$$\begin{aligned}\Pi_Z^* &= (m - vL_Z^*)L_Z^* - [c + r + v(L_Z^* + \alpha)](L_Z^* + \alpha) - \alpha + (c + r)\alpha \\ &= L_Z^*[(m - 2v\alpha - c - r) - 2vL_Z^*] - \alpha(1 + v\alpha) \\ &= \frac{m - 2v\alpha - c - r}{4v}[(m - 2v\alpha - c - r) - 2v\frac{m - 2v\alpha - c - r}{4v}] - \alpha(1 + v\alpha) \\ &= \frac{(m - 2v\alpha - c - r)^2}{8v} - \alpha(1 + v\alpha).\end{aligned}$$

#### 6.1.3 Lemma V.1: write-off vs. forbearance lending for healthy bank:

We want to show that the profit under a write-off of bad loans  $\Pi_H^*$  is higher than under forbearance lending  $\Pi_{H,F}^*$ . For this, we first have to derive the maximum bank profit. We

start off by deriving the optimal lending conditions. The bank profit for the healthy bank under forbearance lending is:

$$\Pi_{H,F}(L) = (c+r)\alpha + (m - vL_{H,F})L_{H,F} - (c+r + vL_{H,F})L_{H,F} - \alpha r - \alpha.$$

We can see that the first element includes the return on the bad loans  $(c+r)\alpha$ , in the same way as for the zombie bank. The lending return is also the same. For the refinancing, the healthy bank does not have to refinance the bad loans due to the equity  $\alpha$ . Hence, the refinancing costs  $(c+r + vL_{H,F})L_{H,F}$  are the same as for the healthy bank that writes off bad loans. However, the healthy bank still has to bear regulatory costs on the bad loans  $\alpha$ , which is reflected in  $\alpha r$ . Afterwards, it has to write-off the bad loans  $\alpha$  as well. With this profit function, the optimal loan volume is

$$\begin{aligned} \frac{\partial \Pi_{H,F}}{\partial L} &= -vL_{H,F} + m - vL_{H,F} - (vL_{H,F} + c + r + vL_{H,F}) = 0, \\ L_{H,F}^* &= \frac{m - c - r}{4v}. \end{aligned}$$

This leads to the following maximum profit:

$$\begin{aligned} \Pi_{H,F}^* &= (m - vL_{H,F}^*)L_{H,F}^* - (c + r + vL_{H,F}^*)L_{H,F}^* - \alpha r - \alpha + (c + r)\alpha \\ &= L_{H,F}^*[(m - c - r) - 2vL_{H,F}^*] - \alpha + c\alpha \\ &= \frac{m - c - r}{4v}[(m - c - r) - 2v\frac{m - c - r}{4v}] - \alpha(1 + c) \\ &= \frac{(m - c - r)^2}{8v} - \alpha(1 + c). \end{aligned}$$

We can now compare the two maximum profits for the bank:

$$\Pi_H^* = \frac{(m - c - r)^2}{8v} - \alpha > \Pi_{H,F}^* = \frac{(m - c - r)^2}{8v} - \alpha(1 + c).$$

Q.E.D.



### 6.1.4 Lemma V.2: Liquidation threshold

The liquidation threshold is where profits are zero:

$$\begin{aligned}\Pi_Z^* &= \frac{(m - 2v\alpha - c - r)^2}{4v} - \alpha(1 + v\alpha) = 0, \\ 4v\alpha(1 + v\alpha) &= (m^2 - 4vm\alpha + 4v^2\alpha^2) - 2(m - 2v\alpha)(c + r) + (c + r)^2, \\ \alpha 4v(1 + m - c - r) &= m^2 - 2m(c + r) + (c + r)^2, \\ \check{\alpha}_Z^{Liq} &= \frac{(m - c - r)^2}{4v(1 + m - c - r)}.\end{aligned}$$

As  $0 \leq \alpha \leq 1$ , the bank always survives, if  $\check{\alpha}_Z^{Liq} > 1$ :

$$\begin{aligned}4v + 4vm - 4v(c + r) &= m^2 - 2m(c + r) + (c + r)^2 \\ m^2 - 2m(c + r + 2v) - 4v + (c + r)^2 + 4v(c + r) &= 0 \\ c + r + 2v \pm \sqrt{(c + r + 2v)^2 + 4v - (c + r)^2 - 4v(c + r)} &= m \\ m &= c + r + 2v \pm 2\sqrt{v(1 + v)}\end{aligned}$$

As the bank must have a positive margin, i.e.  $m > c + r$ , only the positive solution  $c + r + 2v + 2\sqrt{v(1 + v)}$  is valid. The bank thus always survives for  $c + r + 2v + 2\sqrt{v(1 + v)}$ .

Q.E.D.

### 6.1.5 Proposition V.1: comparison of utilities:

The general function of the rents from private sector activity is:

$$\Phi = \int_{L=0}^{L^*} (m - vL)dL - e^*L^*.$$

For the healthy bank, this leads to a total rent of:

$$\begin{aligned}\Phi_H &= mL_H^* - \frac{v}{2}L_H^{*2} - e_H^*L_H^* \\ &= L_H^*(m - e_H^* - \frac{v}{2}L_H^*) \\ &= \frac{m - c - r}{4v}(m - \frac{3m + c + r}{4} - \frac{v}{2}\frac{m - c - r}{4v}) \\ &= \frac{m - c - r}{4v}(\frac{m - c - r}{8}) \\ &= \frac{(m - c - r)^2}{32v}.\end{aligned}$$

Likewise, the total rent under a zombie bank is:

$$\begin{aligned}\Phi_Z &= mL_Z^* - \frac{v}{2}L_Z^{*2} - e_Z^*L_Z^* \\ &= L_Z^*(m - e_Z^* - \frac{v}{2}L_Z^*) \\ &= \frac{(m - 2v\alpha - c - r)^2}{32v}.\end{aligned}$$

It is obvious that

$$\Phi_H = \frac{(m - c - r)^2}{32v} > \Phi_Z = \frac{(m - 2v\alpha - c - r)^2}{32v}.$$

Q.E.D.

## 6.2 Countermeasures and policy options

### 6.2.1 Parameters under equity injection

The government injects equity of the amount of bad loans  $\alpha$  into the bank, leading to an issuance of government bonds  $B$  of the same volume.

All of this debt has to be placed with the bank, so the government responds to the rate set by bank to buy this debt of volume  $\alpha$ .

The new profit function of the bank is:

$$\Pi_\eta(B, L) = g_\eta B_\eta + (m - vL_\eta)L_\eta - [r + v(B_\eta + L_\eta)](B_\eta + L_\eta) - rL_\eta - \alpha,$$

and maximizing this over  $L$  and  $B$  leads to

$$\begin{aligned}\frac{\partial \Pi_H}{\partial L} &= m - vL_\eta - vL_\eta - c - r - vB_\eta - vL_\eta - vB_\eta - vL_\eta = 0, \\ L_\eta^* &= \frac{m - c - r - 2vB_\eta}{4v}, \\ \frac{\partial \Pi_H}{\partial B_\eta} &= g_\eta - r - vB_\eta - vL - vB_\eta - vL = 0, \\ B_\eta^* &= \frac{g_\eta - r - 2vL}{2v}, \\ L_\eta^* &= \frac{m - c - r - g_\eta + r + 2vL}{4v} = \frac{m - r - g_\eta}{2v}, \\ B_\eta^* &= \frac{g_\eta - r - m + r + g_\eta}{2v}.\end{aligned}$$

The bonds to be placed now equal the bad loan share  $\alpha$ , i.e.  $G_\eta = \alpha$ , giving us the necessary government rate to place bonds of volume  $\alpha$  :

$$\begin{aligned}\alpha &= \frac{g - m + g_\eta}{2v}, \\ 2v\alpha &= 2g_\eta - m, \\ g_\eta^* &= \frac{2v\alpha + m}{2}.\end{aligned}$$

The optimal loan volume that was a result of the government bond rate  $g_\eta^*$  can now also be determined:

$$\begin{aligned}L_\eta^* &= \frac{m - r - \frac{2v\alpha + m}{2}}{2v} = \frac{2m - c - r - 2v\alpha - m}{4v} \\ &= \frac{m - c - r - 2v\alpha}{4v}.\end{aligned}$$

And this gives us the loan rate:

$$e_\eta^* = m - v \frac{m - c - r - 2v\alpha}{4v} = \frac{3m + c + r + 2v\alpha}{4}.$$

We can see that:

$$L_\eta^* = L_Z^* = \frac{m - c - r - 2v\alpha}{4v}.$$

Total government expenditures would be:

$$G_\eta g_\eta^* = \alpha \frac{2v\alpha + m}{2}.$$

**Proposition V.2:** Given the loan volume

$$L_\eta^* = L_Z^* = \frac{m - c - r - 2v\alpha}{4v},$$

the total rent from private sector activity after an equity injection is

$$\begin{aligned}\Phi_\eta &= mL_\eta^* - \frac{v}{2}L_\eta^{*2} - e_\eta^*L_\eta^* \\ &= L_\eta^*(m - e_\eta^* - \frac{v}{2}L_\eta^*) \\ &= \frac{(m - 2v\alpha - c - r)^2}{32v},\end{aligned}$$

which is the same total rent as for the zombie bank  $\Phi_Z$ .

Q.E.D.

**Lemma V.3:** We want to show that an equity injection improves the profitability. The new optimal profit is:

$$\begin{aligned}
 \Pi_{\eta}^*(B = \alpha, L) &= g_{\eta}^* \alpha + (m - vL_{\eta}^*)L_{\eta}^* - [r + v(\alpha + L_{\eta}^*)](\alpha + L_{\eta}^*) - rL_{\eta}^* - \alpha \\
 &= L_{\eta}^*(m - c - r - 2v\alpha - 2vL_{\eta}^*) - \alpha(1 + r + v\alpha - g_{\eta}^*) \\
 &= \frac{m - c - r - 2v\alpha}{4v} (m - c - r - 2v\alpha - 2v \frac{m - c - r - 2v\alpha}{4v}) - \alpha(1 + r + v\alpha - \frac{2v\alpha + m}{2}) \\
 &= \frac{(m - c - r - 2v\alpha)^2}{8v} - \alpha(\frac{2 + c + r + 2v\alpha - 2v\alpha - m}{2}) \\
 &= \frac{(m - c - r - 2v\alpha)^2}{8v} - \frac{\alpha(2 + c + r - m)}{2}.
 \end{aligned}$$

Comparing this with the profit under a zombie bank gives us:

$$\begin{aligned}
 \Pi_{\eta}^* &> \Pi_Z^*, \text{ if} \\
 -\frac{\alpha(2 + c + r - m)}{2} &> -\alpha(1 + v\alpha), \\
 -2 - c - r + m &> -2 - 2v\alpha, \\
 m + 2v\alpha &> (c + r).
 \end{aligned}$$

As  $m > (c + r)$  to create a positive margin for bank activity and  $\alpha, v > 0$ , the LHS of the inequation is bigger than the RHS. Q.E.D.

### 6.2.2 ZIRP parameters

A ZIRP lowers the central bank rate from  $c$  to zero. Note that the regulatory costs  $r$  for any loan exposure stays. The new function is thus:

$$\Pi_{\zeta}(L) = (c + r)\alpha + (m - vL_{\zeta})L_{\zeta} - [r + v(L_{\zeta} + \alpha)](L_{\zeta} + \alpha) - \alpha,$$

and optimizing this over  $L$  leads to:

$$\begin{aligned}
 \frac{\partial \Pi_{\zeta}}{\partial L} &= -vL_{\zeta} + m - vL_{\zeta} - (r + vL_{\zeta} + v\alpha + vL_{\zeta} + v\alpha) = 0, \\
 &= m - r - 2v\alpha - 4vL_{\zeta}, \\
 L_{\zeta}^* &= \frac{m - 2v\alpha - r}{4v}.
 \end{aligned}$$

The corresponding interest rate is:

$$e_{\zeta}^* = m - vL_{\zeta}^* = \frac{3m + r + 2v\alpha}{4}.$$

**Proposition V.3:** The total rent for the zombie bank under a ZIRP is:

$$\begin{aligned} \Phi_{\zeta} &= mL_{\zeta}^* - \frac{v}{2}L_{\zeta}^{*2} - e_{\zeta}^*L_{\zeta}^* \\ &= L_{\zeta}^*(m - e_{\zeta}^* - \frac{v}{2}L_{\zeta}^*) \\ &= \frac{(m - 2v\alpha - r)^2}{32v}. \end{aligned}$$

It is easy to see that the total rent is higher than under a zombie bank without intervention:

$$\Phi_{\zeta} > \Phi_Z = \frac{(m - 2v\alpha - c - r)^2}{32v}.$$

Next, we want to see whether the effect of a ZIRP can fully lead to the "healthy" lending volume. For this we can compare the lending volumes under a ZIRP and a healthy bank:

$$\begin{aligned} L_H^* &= \frac{m - c - r}{4v} > L_{\zeta}^* = \frac{m - 2v\alpha - r}{4v}, \text{ if} \\ 2v\alpha &> c. \end{aligned}$$

Q.E.D.

### 6.2.3 Government stimulus parameters

We will look at a stimulus that moves the old demand curve

$$e = m - vL$$

upwards by the stimulus effect  $s$  to create the new curve:

$$e_{\sigma} = m + s - vL.$$

The new profit function is:

$$\Pi_{\sigma}(B, L) = \alpha(c+r) + g_{\sigma}B_{\sigma} + (m+s-vL_{\sigma})L_{\sigma} - [c+v(B_{\sigma}+L_{\sigma}+\alpha)](B_{\sigma}+L_{\sigma}+\alpha) - r(L_{\sigma}+\alpha) - \alpha,$$

and maximizing over  $L$  and  $B$  leads to:

$$\begin{aligned} \frac{\partial \Pi_\sigma}{\partial L_\sigma} &= m + s - vL_\sigma - vL_\sigma - c - r - vB_\sigma - vL_\sigma - vB_\sigma - vL_\sigma - 2v\alpha = 0, \\ L_\sigma^* &= \frac{m + s - c - r - 2v\alpha - 2vB_\sigma}{4v}. \\ \frac{\partial \Pi_\sigma}{\partial B_\sigma} &= g_\sigma - r - vB_\sigma - vL_\sigma - vB_\sigma - vL_\sigma - 2v\alpha = 0, \\ B_\sigma^* &= \frac{g_\sigma - r - 2v\alpha - 2vL_\sigma}{2v}. \\ L_\sigma^* &= \frac{m + s - c - r - 2v\alpha - g_\sigma + r + 2vL + 2v\alpha}{4v} = \frac{m + s - r - g_\sigma}{2v}. \\ B_\sigma^* &= \frac{g_\sigma - r - 2v\alpha - m - s + r + g_\sigma}{2v}. \end{aligned}$$

Due to the range of entrepreneurs  $\frac{m}{v}$ , the overall costs of the intervention are:

$$G_\sigma = s \frac{m}{v},$$

and as the government has to place all of the bonds with the bank, i.e.  $B_\sigma^* = G_\sigma$ , this leads to the government bond rate of:

$$\begin{aligned} \frac{s}{v} \frac{m}{v} &= \frac{g_\sigma - 2v\alpha - m - s + g_\sigma}{2v}, \\ 2ms &= 2g_\sigma - 2v\alpha - m - s, \\ g_\sigma^* &= \frac{2ms + m + s + 2v\alpha}{2}. \end{aligned}$$

This, in turn leads to the optimal lending volume of

$$\begin{aligned} L_\sigma^* &= \frac{m + s - r - \frac{2ms + m + s + 2v\alpha}{2}}{2v} \\ &= \frac{m - c - r - 2v\alpha + s - 2sm}{4v}. \end{aligned}$$

The corresponding interest rate is:

$$e_\sigma^* = m + s - vL_\sigma^* = \frac{3m + 3s + c + r + 2v\alpha + 2sm}{4}.$$

**Proposition V.4:** The total rent from private sector activity for the zombie bank under a stimulus is:

$$\begin{aligned}\Phi_\sigma &= (m+s)L_\sigma^* - \frac{v}{2}L_\sigma^{*2} - e_\sigma^*L_\sigma^* \\ &= L_\sigma^*(m - e_\sigma^* - \frac{v}{2}L_\sigma^*) \\ &= \frac{(m - 2v\alpha - c - r + s - 2sm)^2}{32v}.\end{aligned}$$

Comparing this with the rents under a zombie bank without intervention gives us:

$$\begin{aligned}\Phi_\sigma &= \frac{(m - 2v\alpha - c - r + s - 2sm)^2}{32v} > \Phi_Z = \frac{(m - 2v\alpha - c - r)^2}{32v}, \text{ if} \\ s - 2sm &> 0, \\ m &< \frac{1}{2}.\end{aligned}$$

Q.E.D.

**Proposition V.5:** The costs of government debt under a stimulus are:

$$\begin{aligned}g_\sigma^*G_\sigma &= s \frac{m}{v} \frac{m + 2v\alpha + s(1 + 2m)}{2} \\ &= s \frac{m^2 + m2v\alpha + s(m + 2m^2)}{2v} \\ &= s \frac{m^2 + m2v\alpha}{2v} + s^2 \frac{m + 2m^2}{2v}.\end{aligned}$$

If we assume the success of a stimulus, i.e.  $m < \frac{1}{2}$ , then the total rent is higher with the stimulus than without it:

$$\Phi_\sigma = \frac{(m - c - r - 2v\alpha + s - 2sm)^2}{32v} > \Phi_Z = \frac{(m - c - r - 2v\alpha)^2}{32v},$$

and the difference in rents of the situation with and without stimulus is:

$$\begin{aligned}\Delta\Phi_{\sigma,Z} &= (s - 2sm)^2 + 2(s - 2sm)(m - c - r - 2v\alpha) \\ &= s^2 - 4sm + 4s^2m^2 + 2sm - 4sr - 4sv\alpha - 4sm^2 - 8srm - 8sv\alpha m \\ &= s^2(1 + 4m^2) - s(2m + 4r + 4v\alpha + 4m^2 + 8rm + 8v\alpha m) \\ &= s^2(1 + 4m^2) - s(2 + 4m)(m + c + r + 2v\alpha).\end{aligned}$$

This leads to the ratio of expenses over rents of:

$$\begin{aligned} \frac{g_{\sigma}^* B_{\sigma}}{\Delta \Phi_{\sigma, Z}} &= \frac{s \frac{m^2 + m2v\alpha}{2v} + s^2 \frac{m + 2m^2}{2v}}{s^2(1 + 4m^2) - s(2 + 4m)(m + c + r + 2v\alpha)} \\ &= \frac{m}{2v} \frac{s(1 + 2m) + m + 2v\alpha}{s(1 + 4m^2) - (2 + 4m)(m + c + r + 2v\alpha)}. \end{aligned}$$

Q.E.D.

**Case study: stimulus to restore healthy bank lending** If we assume that a stimulus is successful, we can determine the stimulus volume to restore the lending conditions under a healthy bank:

$$\begin{aligned} L_{\sigma}^* &= L_H^*, \\ \frac{m - c - r - 2v\alpha + s - 2sm}{4v} &= \frac{m - c - r}{4v}, \\ s(1 - 2m) &= 2v\alpha, \\ s_{\sigma, H} &= \frac{2v\alpha}{1 - 2m}. \end{aligned}$$

The stimulus is thus a function of the damaging effect of the bad loans  $2v\alpha$  that is has to be compensated, plus the negative effects of the government debt created by the stimulus  $1 - 2m$ .

For this stimulus volume the corresponding new government debt is:

$$\begin{aligned} G_{\sigma}(s) &= \frac{2v\alpha}{1 - 2m} = \frac{m}{v} \frac{2v\alpha}{1 - 2m} \\ &= \frac{2m\alpha}{1 - 2m}, \end{aligned}$$

and the bond rate for this specific case this is:

$$\begin{aligned} g_{\sigma}^*(s) &= \frac{2v\alpha}{1 - 2m} = \frac{m + 2v\alpha}{2} + \frac{1 + 2m}{2} \frac{2m\alpha}{1 - 2m} \\ &= \frac{m + 2v\alpha}{2} + \frac{(1 + 2m)m\alpha}{1 - 2m}. \end{aligned}$$



The overall debt servicing costs are then:

$$\begin{aligned}
 g_\sigma^* G_\sigma(s) &= \frac{2v\alpha}{1-2m} = \frac{2v\alpha}{1-2m} \frac{m^2 + m2v\alpha}{2v} + \left( \frac{2v\alpha}{1-2m} \right)^2 \frac{m + 2m^2}{2v} \\
 &= \frac{(\alpha m^2 + m2v\alpha^2)(1-2m) + 2v\alpha^2 m + 4v\alpha^2 m^2}{(1-2m)^2} \\
 &= \frac{\alpha m^2 + m2v\alpha^2 - 2\alpha m^3 - 4m^2 v\alpha^2 + 2v\alpha^2 m + 4v\alpha^2 m^2}{(1-2m)^2} \\
 &= \frac{\alpha m^2 + 4vm\alpha^2 - 2\alpha m^3}{(1-2m)^2} \\
 &= \alpha m \frac{m(1-2m) + 4v\alpha}{(1-2m)^2}.
 \end{aligned}$$

This then leads to the ratio of expenses over rents of:

$$\begin{aligned}
 \frac{g_\sigma^* G_\sigma}{\Delta \Phi_{\sigma,Z}} (L_\sigma^* = L_H^*) &= \frac{m}{2v} \frac{\frac{2v\alpha}{1-2m} (1+2m) + m + 2v\alpha}{\frac{2v\alpha}{1-2m} (1+4m^2) - (2+4m)(m+c+r+2v\alpha)} \\
 &= \frac{m}{2v} \frac{2v\alpha (1+2m) + (m+2v\alpha)(1-2m)}{2v \frac{2v\alpha}{1-2m} (1+4m^2) - 2(1+2m)(m+c+r+2v\alpha)(1-2m)} \\
 &= \frac{m}{4v} \frac{2v\alpha + 4v\alpha m + m + 2v\alpha - 2m^2 - 4vm\alpha}{v\alpha(1+4m^2) - (1-4m^2)(m+c+r+2v\alpha)} \\
 &= \frac{m}{4v} \frac{m - 2m^2 + 4v\alpha}{v\alpha + 4v\alpha m^2 - m - c - r - 2v\alpha + 4m^2(m+c+r) + 8v\alpha m^2} \\
 &= \frac{m}{4v} \frac{m - 2m^2 + 4v\alpha}{(4m^2 - 1)(m+c+r) + v\alpha(12m^2 - 1)}.
 \end{aligned}$$

## Chapter VI

# A Case Study of Zombie Banks in Japan and Europe

This chapter serves as a case study on the experience with zombie banks in Japan during the 1990s and in Europe during the recent sovereign debt and banking crisis. The aim of this chapter is to show what kind of zombie banks have emerged, and how governments and central banks have responded to it. The benefit of such a comparative approach is that it helps to highlight differences but also common features of these zombie banks and policy measures in dealing with them. This contributes to a better understanding of the situation and gives insights into the success and effects of the policy measures. As the European banking crisis continues, a look at the Japanese experience simply helps to evaluate the current policy options better. Finally, the chapter also serves to apply the insights from the theoretical models of this study and include them in the discussion.

The chapter is split in two parts: the first section starts with a description of the features of the zombie banks in Europe and Japan, and then looks at the policy measures in both cases. As we will see, while the nature of the zombie banks is quite different in both regions, the policy response has been remarkably similar. Afterwards, we will also look at the consolidation of the banking industry and the disappearance of banks throughout the crisis for both Japan and Europe. This is important, as it also tells us something about which zombie banks have not survived, and for what reason.

The second section of this chapter is devoted to an evaluation of the situation with the insights of the theoretical models of this study in mind. It looks at the cause and motivation for forbearance lending by the zombie banks, the effects on lending and banking activity, and the policy response. Chapter II of this study has already highlighted many findings in this respect in great detail, particularly for the case of Japan. The main focus of this section is thus a discussion of the situation in Europe.

There are numerous papers that have focussed on the Japanese banking crisis, the European sovereign debt and banking crisis, as well as on the policy measures by the governments and the central bank. There have also been many comparative studies in this respect. We will refer to the relevant studies later. However, the aim of this section is not to restate those findings in detail, but to build on their insights for the focus on zombie banks here. Particularly in the descriptive section, there will thus mostly be just a reference to these works for the interested reader, and we take out only the key information for this paper here.

# 1 Zombie banks and policy measures in Japan and Europe

## 1.1 Emergence and nature of zombie banks

### 1.1.1 Scale of losses and bad loans

The experience with zombie banks in Japan and in Europe shares many similarities. In both cases, the scale of the crisis is significant. While it is difficult to pin down a number to this (or believe any estimate that tries to do so), just as a ballpoint figure, the IMF (2008) estimates the banking crisis in Japan in the 1990s to have incurred bank losses of about 750bn USD, or around 15% of GDP (converted to 2007 real USD numbers). Compared to this, PwC (2013) has recently estimated the scale of non-performing loans in Europe to be around 1.1trn EUR across the EU, which equates around 9% of the GDP in the EU.<sup>78</sup> This number refers to the remaining non-performing loans on bank balance sheets and excludes the many write-offs that have already taken place in Europe, showing that the crisis in Europe is still acute and ongoing. As a measure for the write-offs that have already taken place, the IMF (2011) estimates that support to the financial sector in several economies in Europe plus the US by early 2011 have equalled to around 5% of GDP on average. This includes the US with contributions of around 3%, so the average for just the EU countries should be higher. Moreover, we can assume that the overall amount of write-offs is larger than the support from governments, as the latter is likely to have covered only the shortfall. The average contributions from governments of more than 5% of GDP thus have to be seen as a lower bound of what would have to be added to the remaining amount of bad loans. The outstanding NPLs and the losses that have already been incurred then together come to a number that is comparable to the estimate for Japan of bank losses of around 15% of GDP.

Although it is not straightforward to compare these numbers directly, the key point is that the problem of bank losses and NPLs is substantial in both cases, Japan and Europe.

The table below shows the breakdown by the top six countries in Europe where banks

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<sup>78</sup>The 1.1trn EUR includes 19 large EU countries without the three Baltic states, Luxembourg, Malta, Cyprus, Slovenia and Bulgaria. The GDP used as a reference is for all of the EU, using the Eurostat estimate for 2012. The headline number of 1.2trn EUR used by PwC in the press also includes non-EU countries such as Russia, Ukraine and Turkey.

have the highest estimated volume of bad loans.

<b>Non-Performing Loans by Country (bn EUR)</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>
Germany	142	204	192	179	179
UK	88	155	172	172	164
Spain	66	97	111	136	167
Ireland	15	88	109	119	135
Italy	42	59	78	107	125
France	51	77	133	133	125
<b>Total</b>	<b>404</b>	<b>680</b>	<b>795</b>	<b>846</b>	<b>895</b>

Source: PwC (2013)

These countries make up around 80% of the overall bad loans in the EU. It should be noted that Germany and the UK banks are both estimated to have more than 160bn EUR in NPLs on their balance sheets and represent the countries with the highest volumes of bad loans in the past years. The other countries in the top six are Spain, Italy, Ireland and France.

We can also see that the estimated number of bad loans has been exploding and has more than doubled since 2008, which we will revert to shortly.

Another estimate for the extent of undercapitalization among European banks is provided by Standard and Poor's (2013). They estimate the capital shortfall "as the capital necessary to improve minimum RAC [risk-adjusted capital] ratios to levels at which "capital and earnings" would be a neutral rating factor." In other words, they compare the existing capital levels of banks to theoretical levels that would be required for the risk positions of each bank, as calculated by Standard and Poor's. This already includes unrecognized or underprovisioned losses in banks' official balance sheets, as the study applies Standard and Poor's methodology to assess risk factors. For the 50 biggest European banks alone, the estimated shortfall amounts to 110bn EURs. This is the equivalent of 60% of the global capital shortfall among banks, which is estimated at 185bn EUR. This once more highlights the severity of zombie banking in Europe.

Of these 110bn EUR, 64% consist of banks from the peripheral countries Greece, Ireland, Portugal, Italy and Spain. The other 36% are banks from other Western European countries. Hence, while banks in the periphery suffer most by undercapitalization, banks in other European countries are also affected.

As also mentioned in section II, another approach for estimating the capital shortfall in Europe is chosen by Shoenmaker and Peek (2014), who look at the 30 largest banks

in Europe. Assuming a 3% and a 5% threshold ratio of market capitalization over total assets for each bank to determine the capital shortage for all of the 30 banks, they estimate the total shortfall to be 84 billion and 365 billion EUR, respectively. In another estimate that simulates another financial crisis and thus a stress scenario, the capital shortfall is calculated to be 241 billion Euro for a 3% threshold ratio. Finally, Acharya and Steffen (2014) run a stress-test for the 124 banks in the Euro-area that are subject to the supervision by the ECB from 2014 onwards. The calculated shortfall on an unstressed basis is between 7.5bn EUR and 66.8bn EUR, applying different definitions of book value of capital, based on pure balance sheet positions in their accounting statements (such as shareholders' equity, tangible and intangible assets, or derivative liabilities) as well as regulatory reporting items such as risk-weighted assets.

### **1.1.2 Nature of zombie banks**

Although the size of the crisis may be similar in Japan and Europe, the nature of the zombie banks in both cases is different.

In Japan, Kawai (2005) shows that the banking crisis followed a rapid credit expansion to the domestic corporate sector during the 1980s, particularly to the real estate and construction industries. The banking crisis started after the burst of the bubble in real estate and stock prices. The losses on bank balance sheet were thus mostly domestic in nature, and the result of bad loans from the property bubble.

In Europe, the nature of the zombie banks is not as easy to define. Roughly speaking, we can identify three different stages and types of zombie banks since the start of the banking crisis in 2007: first, banks affected by the US subprime crisis in 2007 and the liquidity crisis in 2008, mostly in Western and Northern European countries. Second, zombie banks with mostly domestic exposure, often from a credit boom in real estate markets, in peripheral countries such as Ireland or Spain. And third, the rise of pan-European zombie banks due to cross-border exposures and high government bond holdings.

The first wave of European zombie banks came into existence as a consequence of the US subprime crisis in 2007 and the subsequent financial crisis and global recession until 2009. As mentioned in Jackson (2009), and Dietrich and Vollmer (2012) for the case of Germany, banks were in trouble due to the exposure to structured products, mostly also related to the US, liquidity shortages due to limited access to the short term funding and the interbank lending market, and finally due to large exposures to countries in Central and Eastern Europe, which faced an economic downturn. Most of the affected banks were situated in Western and Northern Europe, i.e. Germany, Netherlands, the UK, and France. Governments across Europe then reacted with massive interventions

in the financial sector and economic stimulus programmes, which we already alluded to above and will have a more detailed look at later. While many banks faced high losses, the intervention by the governments and the subsequent easing of the refinancing situation for European banks repaired the cause for the turmoil of this first stage of banks. Although the liquidity crisis calmed down, banks were left wounded and governments faced an increased level of government debt as a consequence. This paved the ground for the increased vulnerability at a later stage, which will be described shortly.

It should be noted that the banks that were affected during this stage are different in kind to the Japanese zombie banks. Often, their problems were not solvency but liquidity issues, although the line here is blurry. Moreover, much of the losses arose from the write-down in value of structured securities, often linked to the US subprime crisis, and not from traditional loan business. Some of the traditional concepts of rolling over bad loans thus do not apply here. Nonetheless, the incentive to hide losses via an artificial valuation can be equally applied here.

The second group of zombie banks are those in several "peripheral" countries in Europe that had experienced a credit boom in the run-up to the crisis until 2007. Lane (2012) shows that in Greece, Spain and Ireland, the domestic credit volume to the private sector more than doubled between 1998 and 2007, and it grew around 75% in Portugal and Italy. This is in contrast to Germany, where the credit volume actually decreased during the same period.

Ireland and Spain, in particular experienced a real estate boom similar to that of Japan in the 1980s. The burst of the bubble then led to a large volume of bad loans on the balance sheet of banks. The resulting zombie banks are thus similar in nature to those in Japan, as they have bad loans from the domestic property bubble on their balance sheets. As Shambaugh (2012) explains, this situation deteriorated, as the economy in these peripheral countries went into recession, sometimes resulting in a heavy contraction of economic output, leading to an even higher volume of bad loans. This explains the strong surge in NPLs mentioned in the PwC study (2013) that we saw above.

As we will see later, these zombie banks in the peripheral countries have been increasingly dependent on measures by the ECB, including direct liquidity provisions, but also indirect financing mechanism by the TARGET system.

The third group of zombie banks are more difficult to specify, as they are rooted in the structure of the Eurozone and are also linked to the previous two groups. Two factors come into play here: first, the exposure by banks in "core" countries such as Germany to borrowers in peripheral countries, due to the continuous imbalances in current and

capital accounts across the Eurozone for many years. And second, the increasing holdings of government debt by banks across all of the European banks.

As mentioned in Schnabl (2013), Stein (2011), and Higgins and Clitgaard (2011), the build up of the credit boom in peripheral countries was accompanied by capital inflows from core countries in Europe such as France, Germany and the UK. Banks in these "core" countries were thus equally exposed to the bad loans from these countries as the domestic ones. Stein (2011), for instance, shows that in 2010 French and German investors held more than 900 and 700bn EUR, respectively, in government and bank debt from Greece, Ireland, Italy, Spain and Portugal. This also explains the high volume of non-performing loans for banks in Germany and the UK in the PwC study (2013). These exposures add to the already vulnerable situation of banks due to the structured securities and the liquidity crisis, putting also banks in these core countries in turmoil.

Meanwhile, governments have increased their debt levels since the beginning of the crisis (to which we will turn later), with banks directing an increasing share of their balance sheet to government bond holdings. As Financial Times (2013c) reports and we will cover more in depth later, the holdings of government bonds by European banks has been increasing to reach ever higher levels since the beginning of the crisis. As some of the sovereigns are now themselves under threat of a default, there is a strong feedback loop and interconnectedness between the sovereigns and the banks, something also described in Acharya, Drechsler and Schnabl (2011).

This leaves the nature of the zombie banks in Europe as a complex and heterogenous group of banks. The lines between the three groups of banks that were outlined are blurry. By now, it may be safe to say that most banks have some form of risky assets on their balance sheet, be it leftovers from the US subprime crisis or structured securities, exposure to peripheral countries, or government debt. While banks in the periphery are more domestically oriented, banks from core countries are exposed to various countries due to their cross-country holdings.

The relation between sovereign and banks is stronger for domestic banks in the peripheral countries, however. Alter and Beyer (2013) look at the spillover effects from sovereigns to banks, where they measure the effect of rise in sovereign credit-default swaps (CDS) on bank CDS for domestic banks and banks from other countries. While banks from other countries also react to an increase in riskiness, domestic banks react worse. They find, for instance, that in H1 2012, a rise of 100 basis points (bps) in the Spanish CDS lead to an increase in German bank CDS by 34 bps compared to Spanish banks by 51bps. They also find an increase in spillover effect since 2011.

To summarize, Japan's zombie banks during the 1990s all had similar exposures and

problems, while the zombie banks in Europe are more heterogenous and complex. What is clear, however, is that it is a European wide issue, although the nature of the zombie bank is slightly different between the core and the periphery.

## 1.2 Patterns of government intervention

While the nature of zombie banks is different for the case of Japan and Europe, there is a similar pattern in the means of government intervention. This can be characterized as follows:

First, the government intervenes in the financial sector at an early stage of the crisis with ad-hoc measures to ease the escalation of the crisis. These crisis mechanism tools include foremost equity injections, but also government guarantees and nationalizations of banks. In both cases, these tools have helped to ease the initial panic sentiment, but have not been successful in reinstating healthy and sustainably solvent banks.

Second, the central bank, i.e. the Bank of Japan (BoJ) and the European Central Bank (ECB), facilitates the refinancing situation of banks, both through a low or zero interest rate policy (ZIRP) and the offerings of additional liquidity measures. This allows zombie banks to survive more easily. However, this has also led to an increase in the balance sheet of both central banks over time. The ECB has gone one step further and supported the capital flow across countries via its TARGET2 system.

Third, the governments increase their debt level at a quick pace. This is the result of three things: first, stimulus programs to revive the economy; second, the costs for intervention in the financial sector, and third, a sluggish economy or recession which leads to an increase in expenditures and a decrease in tax income. This results in increased holdings of government debt by zombie banks.

### 1.2.1 Government intervention in the financial sector

**Japan** It was already alluded to in chapter II that the Japanese government intervened via equity injections at an early stage of the crisis. The government also intervened by nationalization of some banks, setting up of a Bad Bank for troubled loans, and government guarantees. A more detailed account of the intervention can be found in Kawai (2005), Nakaso (2001), Fujii and Kawai (2010) and Kashyap and Hoshi (2010). As already mentioned, these interventions were found to be unsuccessful in reinstating healthy bank activity for several reasons: first, the participation by banks was low. Second, it did not lead to an increase in lending, at least not on an ongoing basis. Finally and also as a consequence, it still left many banks undercapitalized compared to the burden of bad loans.



It did, however, calm down fears of a market panic or a bank run at the peak of the crisis in 1997 to 1998. These measures can thus be interpreted as a short-term crisis resolution tool, but not as a long-term solution to the underlying causes of the crisis.

**Europe** In Europe, the first phase of the financial crisis from 2007-2009 also saw a quick response by governments. Petrovic and Tutsch (2009) provide a very detailed account for each measure of the government in all of the EU states, which again include equity injections, government guarantees and (partial) nationalizations of banks. As already mentioned, the IMF (2011) estimates that on average, around 5% of GDP (or more without the US) were spent on interventions in the financial sector. However, the case of Ireland also illustrates that these interventions in some countries have put severe stress on governments: here, the intervention made up around 38% of GDP, which ultimately led to a bailout program by the EU and the IMF, as also recounted by Shambaugh (2012).

While the interventions across countries have thus been significant in size, they have still not led to a total resolution of the crisis. Instead, they helped easing the liquidity crisis and the initial wave of write-offs mostly related to structured securities, but they still left a high volume of bad loans on bank balance sheets. This has a high degree of similarity to the situation in Japan.

**Further bank restructuring measures in peripheral countries** Apart from the early crisis resolution measures that took place in virtually all European countries, some of the peripheral countries continue their efforts for a recapitalization and restructuring of their banking sector, as described in Lane (2012), Shambaugh (2012) and Vollmer (2013). These measures are targeted at the second group of zombie banks mentioned above, namely domestic banks with bad loans mostly resulting from real estate markets and the sluggish economy. This has included Greece, Spain, and Cyprus. However, the interventions in these countries contributed to solvency problems of governments and took place as part of a bailout or support program for the government by the EU and the IMF. The interventions thus exacerbated the crisis even further. Due to the strong linkages between the governments and the banks, future efforts for bank recapitalizations or restructurings are included in the discussion around the Banking Union, as explained e.g. in Goyal et al. (2013). We will revert to this topic later on again.

For now, it is important to sketch out how the bank recapitalization has worked for the cases of Spain and Greece, because it has important implications for the evaluation of the situation later. First, the Eurozone states set up a central bailout fund guaranteed by the governments: the European Financial Stability Facility (EFSF) on a temporary basis, and its permanent successor, the European Stability Mechanism (ESM), as explained in

Vollmer (2013). The EFSF then issued bonds which were absorbed by local bailout funds in Greece and Spain. These bonds, in turn, were used as a means to recapitalize the banks instead of cash payments, as mentioned in the report by Daiwa Capital Markets (2012) for Spain, and by Reuters (2012a) for Greece. The banks could then use these EFSF bonds with the ECB as collateral for liquidity measures.

Effectively, the zombie banks were thus recapitalized with quasi-government bonds. While this has helped them in improving their solvency, it has increased their balance sheet with holdings of quasi-governments bonds, which has implications elsewhere as we will see later.

### 1.2.2 Measures by the Central Banks

There have been many studies that compare the actions by the BoJ and the ECB already, including Schnabl (2013), Vollmer and Bebenroth (2012), and Fawly and Neely (2013). Ueda (2012) also compares to the Japanese experience to the US, while Shambaugh (2012) includes a description of the actions of the ECB during the crisis.

Without going in too much detail on their findings, the key feature for both Japan and Europe is that the central banks have responded with expansionary ordinary monetary policy and additional unconventional measures during the crisis. This has allowed zombie banks to overcome liquidity constraints, and lowered their debt service burden.

**Japan** In Japan, the interest rate was already set to 0.5% by 1994, so even before the outbreak of the banking crisis in 1997. The rate has been held low and near zero up to this day. The bank was also engaged in asset purchases (including short term paper, equities, corporate bonds, asset backed securities and at some stage also government bonds), and even an early form of forward guidance. Banks were given additional liquidity provisions with terms of up to 12 months. All in all, the package facilitated the access to refinancing means for Japanese banks significantly.

**Europe** Likewise, the ECB has lowered the interest rate gradually up to a level of 0.25% in 2013. Some of the unconventional measures included the Securities Markets Programme (SMP) where the ECB bought government bonds of peripheral countries; the Covered Bond programme, where covered bonds were accepted used as collateral against cash; the three year Longer Term Refinancing Operations (LTRO), where banks received liquidity provisions with three years maturity; and the Outright Monetary Transactions (OMT), where the ECB announced its readiness to purchase short term government bonds of EU support programme countries on an unlimited scale.

As with Japan, these measures have facilitated the access by banks to cheap refinancing means, and also increased the balance sheet of the ECB. The high participation by banks across the Eurozone, not only in peripheral countries, in measures such as the 3y LTROs shows that any stigma that may have been connected to accepting these measures by any potential zombie bank, were outweighed by the need of a large number of banks to accept them.

One additional "measure" (or rather operating instrument) by the ECB that has been the cause for most of the growth in its balance sheet is the TARGET2 interbank payment and settlement system, which has also been the subject of a wide public debate that should not be restated here. See Sinn and Wolmershaeuser (2012) and ECB (2011) for some of the discussion. What is important here is that the TARGET2 system has ensured that banks in peripheral countries have been able to have access to refinancing means, mostly against collateral such as domestic government bonds. This system thus replaced the traditional ties and capital flows in between European banks across borders with a clearing via the ECB. As we will see later, this is an important indicator for the role of reputation about bank health for the behavior of zombie banks.

### 1.2.3 Increased government debt

Governments in both Europe and Japan have reacted to the crisis not only with intervention in the financial sector, but also with a stimulus to the economy. This has led to increased levels of government debt. Additionally, these stimulus measures are only one of three reasons for a general increase in government debt, next to the spending for the financial sector intervention and the general increase in debt accompanied by a lack of growth, or in these cases, prolonged recessions.

**Japan** Starting with the situation in Japan, Nanto (2009) and Yoshino and Mizoguchi (2010) show that Japan put in place several stimulus packages on a grand scale to revive the economy in the 1990s. According to Nanto (2009), the government rolled out nine stimulus programs throughout the 1990s, each with a considerable size. While it is difficult to assess how much of the spending was attributable to each package, the combined stimulus size ranges somewhere between 6% and 17% of GDP.

On top of this, the government had to shoulder the costs from the intervention in the financial sector. Nanto (2009) shows that by 2007, the overall volume of financial assistance was nearly 400bn USD, so more than half of the volume of all bank losses of around 750m USD as estimated by the IMF (2008) that was cited at the beginning of this chapter. Of this, by 2007, i.e. ten years after the start of the banking crisis, less than

200bn USD had been recovered by the Japanese government from the financial sector.

Finally, the burden of slow or receding growth put additional stress on the government budget. Although the share of debt servicing costs on the overall deficit decreased throughout the banking crisis for Japan since 1995 due to falling interest rates, the public debt continued to grow, showing that the increase in debt was not due to high debt rollover costs, but rather due to the divergence of tax revenues and government expenditures.

As a consequence, Japanese public debt surged from still 65% of GDP in 1995 to 106% in 2000, and then to 141% in 2003. By then, the banking crisis went into a recovery stage between 2002 and 2005 and is thought to have been over by March 2005 when the government announced that the NPL ratio dropped below a manageable level, as mentioned in Fujii and Kawai (2010). Nonetheless, the public debt has still been increasing and reached 235% of GDP in 2012, as shown in Schnabl (2013).

Naturally, such an increase in public debt also has to be placed with investors somehow. In Japan, banks have increasingly spent their funds on the purchase of government bonds. To reiterate the facts mentioned in chapter II already, according to Yoshino and Mizoguchi (2013), with the increase in public debt, Japanese banks directed almost all of their additional capital inflows to an increase in government bond holdings. The share of banks as holders of government debt (including the Japanese Postbank) has reached 45%. If we look at the bank side, Japanese government bond holdings by now make up around 43% of bank balance sheets.<sup>79</sup>

Japanese zombie banks have thus not only benefitted from capital transfers from the government as part of the interventionary policies, but, in turn, they have also substantially increased their exposure to the government by a higher holding of public debt, that by now makes up almost half of the overall bank assets in the economy.

**Europe** The situation in Europe has many similarities in this respect. First, governments have responded in 2008 with large stimulus programs to revive the economy. As Jackson (2009) shows, most European countries implemented a stimulus package between 2008 and 2010 which mostly consisted of tax breaks on the one hand and spending measures on the other. While some peripheral and EU support program countries also actually lowered their spending, other countries such as Spain and Luxembourg implemented stimulus programs with the size of around 6% of GDP.

It was already described that on top of these stimulus packages, the interventions in the financial sector increased the public debt even further. While this was around 5%

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<sup>79</sup>According to Reuters (2013), total holdings of Japanese government bonds by domestic banks was 96 trillion JPY as of end August 2013. This compares to total assets in the Japanese banking sector of 224 trillion JPY in Japan as of November 2013, according to the BoJ website.

on average, it led to such high costs for countries such as Ireland and Spain that they required an EU/IMF support program to bear the costs.

Shambaugh (2012) finally describes how the lack of growth has put additional burden on public finances and led to an increase of debt.

As a result, the average public debt level across the EU has grown from 59% of GDP in 2007 to 85% in 2012 according to Eurostat (2013), i.e. an increase of around 45%. While this is already a large increase across the EU, the situation in the peripheral countries has seen an even sharper increase in debt such as Spain, where the debt grew from 36% to 86%, Ireland (25% to 117%), Portugal (68% to 124%), or Italy (100% to 124%).

It was already mentioned that government bond holdings as a share of European banks' balance sheet has been steadily increasing. While the situation is not as severe as in Japan, Financial Times (2013c) reports that by end August 2013, around 6% of bank balance sheets in the EU was devoted to government bonds. This number is higher in peripheral countries such as Italy (10%), Spain (10%) and Portugal (8%). Moreover, the numbers are rising quickly, as the increase since beginning of 2012, i.e. in less than two years, has been 47% in Italy, 51% in Spain, and even 65% in Portugal.

What makes the situation even more peculiar is that the recent bank recapitalization programs in Spain and Greece have actually used quasi-government bonds instead of cash payments to reinstate bank health, as was already mentioned above. Hence, the situation in Europe is still not at the stage of Japan, but the increase in both government debt and the holdings of bonds by banks is following a similarly rapid pace.

### **1.3 Consolidation in the banking industry**

The last part of the descriptive section of this chapter is devoted to the consolidation of bank activities in both Japan and Europe. We will look at how the number of banks have changed throughout the crisis, and how and which banks have been active in merger and acquisition (M&A) activities. This offers us insights into those banks that have disappeared from the market, and is in contrast to those banks that have been addressed previously, which are still in operation.

To summarize the findings of this section, Japan has seen a radical reorganization of its banking industry throughout the banking crisis. The number of banks and the nature of the remaining institutions has changed markedly compared to the start of the crisis. This shows that many zombie banks and/or "liquidation" banks (banks not profitable enough to even survive by forbearance lending) have either disappeared or been merged into healthier organizations.

In contrast to this, Europe has only seen a consolidation in the banking industry in the

early stages of the financial crisis. With the exception of Spain, however, there has been little to no M&A activity thereafter. What is more striking is that the reorganizations that have taken place are mostly domestic in nature, and there have been no cross-border consolidation efforts in Europe. This indicates that many zombie banks still exist.

**Japan** As mentioned in Kawai (2005) and Hosono, Sakai and Tsuru (2009), the banking landscape in Japan before the crisis can be categorized in three tiers: first, large city banks, which operate across Japan and also internationally and often form part of conglomerates such as Mitsubishi or Mitsui; second, regional banks, which are more active on a regional or prefectural level; and third, cooperative banks, which are smaller and more specialized institutions on a local level. As for the number of banks, there has been a substantial decrease in banking institutions since the burst of the bubble in the early 1990s until 2005, after the numbers were more or less stable during the 1980s. From 1980 to 2005, the number of city banks went down from 13 to 7, the regional banks from 71 to 48 and the cooperative banks from 462 to 301. Hosono, Sakai and Tsuru (2009) find that bank mergers took place when bank health was weak, and that a merger increased the efficiency of the bank. There were two general types of mergers: either a healthy bank took over an unhealthy one, or two unhealthy ones were merged into one institute to prevent a bank failure and be stabilized by the government.

Kawai (2005) also stresses the scale of mergers among the largest city and regional banks in Japan during this time, creating some of the biggest banks in the world. As *The Economist* (2000) describes, the pressure on the banks to merge their activities is highlighted by the fact that even rival banks from different conglomerate groups (or *keiretsu*) consolidated their activities, something that would have been unthinkable beforehand.

As we will describe more in detail later, these are signs that banks that were not profitable enough to survive even under the expansionary monetary policy, something that has been called "liquidation banks" in chapters IV and V, seized operations and were taken over by more healthy banks.

**Europe** In contrast to this, the situation in Europe has seen a very slow, or almost non-existent pace of consolidation in the banking sector, at least in the more recent stage of the crisis.

At the start of the crisis, particularly in 2007-2009, there was a certain degree of M&A activity. In Germany, for instance, some of the banks in the public Landesbanken sector, as well as some of the large commercial banks merged their activities, while some other banks were put in the process of liquidation, as Dietrich and Vollmer (2012) describe.

The ECB (2013) also highlights that 2007 saw the sale of ABN Amro to an international consortium of bidders, as well as a large merger in Italy between Sanpaolo IMI and Banca Intesa. However, the value of M&A transactions afterwards has decreased sharply and has been on a downward trend each year. More significantly, there has been no large cross-border merger in 2012 and 2013. The total number of banks in the EU has been on a declining trend since 2008, but also on a very slow pace, from something around 8300 to just under 8000. This is a much slower trend than during the crisis in Japan. As for the reasons, ECB (2013) cites "more conservative expansion strategies, the uncertainties related to economic prospects, vulnerabilities in the banking sector and the efforts to strengthen capital positions and focus on risks".

It should be noted that the only exception from this trend in Europe is Spain. The Spanish banking sector has been rigorously transformed in the past years, as outlined by IMF (2012). With assistance from the government, since 2008 "the number of institutions has declined from 45 to 11, [...] the number of branches has been reduced by 17 percent and the number of employees by 14.3 percent." However, it must be emphasized that this process has been taking place solely among domestic institutions.

Thus, there is no sign of a consolidation process among European institutions, where solvent banks and zombie or liquidation banks from weaker countries merge their activities. Given the nature of the zombie banks across Europe as explained above, this is a strong indicator that many of the zombie banks still survive.

## **2 Zombie banks in research context**

After we have had a look at the special features of the crises in Japan and Europe, we can now evaluate the situation of zombie banks with the insights from the theoretical models in chapters III to V in mind. This section has three parts: first, we will compare the motivation and cause by zombie banks to have been engaged in forbearance lending between the cases for Japan and Europe. Next, we will look at the effects of the existence of these zombie banks. Finally, we will discuss the current policy measures and outlook for the zombie banks in Europe.

### **2.1 Motivation for forbearance lending**

Chapter II had a detailed look at the reasons and motivations by banks for being engaged in forbearance lending. To summarize, this can be driven by factors related to the asset side of the business, e.g. an improvement in the loan recovery value, competitive pressure among banks, or peculiarities in the legal system that influence the payoff from bankruptcy

proceedings for loan counterparts. It can also be triggered by factors related to the liability side of the business, e.g. the limited liability of shareholders which can induce a gamble for resurrection, or the desire to pay out excessive dividends to shareholders. Finally, the private benefit of the bank manager can also have an influence in the decision how banks deal with bad loans.

The models in chapter III and IV have added two further aspects to this: on the one hand, the reputation about bank health was shown to be of relevance, where forbearance lending could help to improve it, or at least to deceive bank creditors about the true nature of bank health. Moreover, we saw that forbearance lending could give zombie banks extra time to regain health from business other than the bad loans, allowing them to "come back to life" again.

**Japan** The motivation for forbearance lending by Japanese banks is a mix of all factors mentioned above. Chapter II has presented empirical evidence for some of these aspects to be attributable to their behavior, particularly regarding asset side driven forbearance lending. The connections that some of the Japanese banks had to their loan counterparts via share ownership or affiliation to a conglomerate, the peculiarity of the Japanese legal system, and the hope for an improvement of asset prices were all found to be significant. There is thus also the strong likelihood that there was an element of a gamble for resurrection of Japanese banks, particularly the weakly capitalized ones.

Reputation about bank health as a driver for forbearance lending as presented in the model in chapter III also seems to have played a role, as can be seen by the reluctance of Japanese banks to accept state assistance. Moreover, Nakaso (2001) recounts how during the peak of the crisis in 1997-98 the behavior by banks was driven by reputational risks about their health. Banks were vulnerable in their financing structures, as they relied heavily on wholesale funding compared to retail funds, the maturities of wholesale funds were often very short (i.e. 60% overnight), and banks were reluctant to liquidate loan assets. Citing the example of three large banks that eventually failed, he observes a change in funding patterns in four steps. In step 1, risk premiums for banks increase as risk-sensitive investors and large depositors become more reluctant to fund these banks. Step 2, the funding maturities become shorter as wholesale investors avoid long-term deposits. Step 3, retail investors join wholesale depositors and withdraw their funds. Step 4, the banks stop operations on their own and seek refuge under the public safety net.

It is likely that many banks tried to avoid this fate by hiding losses and trying to appear healthy in front of the public, as stipulated in the model in chapter III.



The model in chapter IV proposes that unhealthy banks can survive as a zombie bank if the activities outside of the bad loan business give them enough income to build up equity which allows them to write-off the bad loans later. However, the model also highlights that unhealthy banks cannot survive even with forbearance lending if the burden from bad loans is too high and the debt servicing costs put additional pressure on their finances. These banks were classified as liquidation banks, and the crucial level of solvency between the zombie banks and liquidation banks was defined as the liquidation threshold.

As we have seen, these dynamics are confirmed for the case of Japan, where the number of banks decreased substantially, and many unhealthy banks were taken over by healthy banks. This is an indicator that despite the actions by the central bank to lower the refinancing costs and thus the liquidation threshold, some banks still could not generate sustainable income from their activities and had to be liquidated or acquired by other banks.

The gradual easing of the banking crisis in the years 2002-2005 then allowed banks to reduce the burden of non-performing loans, as described in Fujii and Kawai (2010). Moreover, as emphasized by Fukuda and Nakamura (2011), the zombie firms in Japan also gradually recovered since the first half of the 2000s. Often, this was also accompanied by debt restructurings and reorganizations with the help of the banks. Hence, this confirms that Japanese banks took on their bad loans step by step and cleaned their balance sheet gradually by writing down and restructuring their exposures. Japanese zombie banks then recovered over time and "came back to life", at least regarding the old bad loan exposure. The increased holdings of government debt will be addressed again later.

**Europe** Compared to Japan, there have been little to no empirical studies that formally confirm causes for forbearance lending by European banks. However, the sheer amount of bad loans outstanding confirms that there are still many zombie banks who survive by rolling over their bad loans. A striking example of how these zombie banks hide their losses is the Spanish bank Bankia. As mentioned by Reuters (2012b), it initially announced a profit of 41mn EURs for the financial year of 2011, but later revised this to a loss of 3.3bn EUR following a bailout by the government and a revision of its loan book. One year afterwards, it then reported a loss of 21.2bn EURs for the year 2012, mostly due to old loan exposures as reported by Bloomberg (2013a). In other words, a profit of a few millions can quickly turn into losses of billions of EURs, only by re-evaluating the quality of the loan book.

Similarly to Japan, it is difficult to break down the motivation of these banks for forbearance lending to just one factor. However, some of the factors behind asset side driven forbearance lending seem less applicable than in the case of Japan, as features such

as the legal system or the high connectivity among a bank and its loan counterparts, e.g. through cross-shareholdings, are special characteristics of Japan.<sup>80</sup> On the other hand, reputational reasons and the hope to regain solvency seem to play a large role again, just as in Japan.

As for the role of reputation about bank health, a report by McKinsey (2013) highlights that the funding situation for European banks has deteriorated markedly since 2007. Longer dated wholesale funding has fallen by half between 2007 and 2012, while the average maturity of these funding means has decreased from 10 to 7 years. The reputation of banks in front of bank creditors has thus gained in importance, as the volume of available funds has gone down.

The report also highlights that the refinancing constraints have spread from wholesale funding to retail deposits, again bearing resemblance to the situation in Japan. Moreover, there is a clear distinction among country lines by now in the refinancing rates of banks. There is a large gap between some of the "core" country deposit rates such as Germany of around 1% and that of peripheral countries such as Spain of around 3%. Investors in bank debt thus do not separate among individual institutions anymore, but cluster banks among their country of origin, as they presumably have similar characteristics, although they are subject to the same monetary policy.

Hence, this phenomenon is reminiscent of one of the results of the model in chapter III. Here, the model showed that the ability of toxic banks to hide bad loans also has effects on the refinancing conditions of healthy banks. This is because due to the asymmetric information about the true state of bank health, creditors also suspect healthy banks to be toxic. Hence, applied to the situation in Europe, bank investors simply assume that banks from specific countries are subject to similar exposures, so they treat all of them in the same manner, even if some of those may actually be healthy. Healthy banks are thus suffering from the intransparency by weaker banks.

This situation has become so severe that by now, banks in peripheral countries are only able to refinance themselves via the ECB. As international capital flows in between European countries have decreased since the start of the financial crisis, the ECB is refinancing entire national financial systems via the TARGET2 system, as already outlined above and also pointed out in the McKinsey (2013) report. This can also be seen in the funding gap between loan volumes and available deposits across Europe. According to the report, the overall funding gap is around 1.2trn EURs for banks across the Eurozone, which has been more or less stable over time. However, there are remarkable differences among countries: while banks in the Netherlands, Finland, Germany and Slovakia have a

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<sup>80</sup>See e.g. Allen and Gale (2000) for special features of the Japanese financial system.

funding surplus, the funding gap of banks from Greece, Ireland, Italy, Spain and France make up 99% of the overall funding gap in Europe.<sup>81</sup> Normalized by the volume of total bank assets in each country, the countries with the largest funding gaps are Greece, Slovenia, Ireland and Estonia, each with a funding gap of 10% of total assets or more.

To conclude, while the role of reputation and the asymmetric information about true bank health has already been a key driver for forbearance lending in Japan, it plays an even bigger role in Europe.

As for the role of forbearance lending to buy time in the hope to regain solvency, we have seen that banks in Japan cleaned their balance sheets over time, while weaker liquidation banks were taken over by healthy ones and disappeared, in line with the results from the model in chapter IV.

Such a process is not in sight in Europe. As for the bad loans on bank balance sheets, we have already seen that PwC (2013) estimates the number to have doubled in the past years. Instead of a cleaning up, banks seem to accumulate an increasing number of bad loans, also triggered by the ongoing recession in many European countries.

Moreover, there is also no process of consolidation among banks in sight. The fact that the number of banks has been going down only slowly, as mentioned earlier, shows that the liquidation threshold (as defined in the model in chapter IV) is very low. The measures by the ECB thus support zombie banks to a much higher degree than was the case in Japan. Many liquidation banks that would have stopped operations or merged with another bank are thus able to survive as zombie banks due to the support by the ECB. However, according to the ECB study (2013) as of now there is no active drive in sight that could change the situation. As we will see later, the current discussions to create a banking union could finally trigger some form of consolidation in Europe.

## 2.2 Effects of zombie banking

The extent of the damages by zombie banks to the economy in Japan as identified in the literature have already been referred to and documented in chapter II of this study. In summary, zombie banks keep unprofitable firms alive and lead to a crowding out of healthy firms. They also lead to a decrease in productivity and a reduction in employment.

The model in chapter V of this study has offered an additional explanation why zombie banks hurt most for less productive, vulnerable firms in search for new financing for their projects, as also found in empirical studies for the case of Japan. This is because zombie banks hold on to their bad loans, and in consequence they face increased refinancing costs

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<sup>81</sup> Adding up the funding gap for all countries leads to a number of higher than 100%, as there are also four countries with a funding surplus that reduce the overall number again.

and thus charge borrowers a higher level of interest. This, in turn, hurts those companies that cannot afford these higher rates.

The situation in Europe confirms this effect. As a report by the European Commission (2013b) points out, there is a divergence in loan interest rates among banks from the periphery and the core. While bank loan rates to corporate borrowers in Germany were decreasing to around 2% in 2012, the rate was around 3-4% in Italy, Spain and Ireland and even around 6% for Portuguese banks. While parts of this can also be explained with the increased funding costs that were mentioned above, the report also highlights that the divergence goes beyond just the difference in refinancing costs. Instead, they cite the following observation:

Greater variation in loan portfolio quality appears to be one of the structural determinants of the recent divergence in bank lending rates. The four countries whose banking sectors exhibited the highest share of non-performing loans (NPLs) in 2012H1 (Cyprus, Italy, Portugal and Spain), were also among those with the highest composite [...] lending rate to the non-financial private sector [...]. At the same time, the cross-country variation in the share of NPLs has increased across the euro area since 2008. This might have contributed to the growing divergence in lending rates, as banks facing the prospect of relatively larger losses on their loan portfolios increased interest margins on new lending.

This is precisely in line with the model in chapter V, as zombie banks increase their lending rates and cut the volume of new credit. These findings are also confirmed by Illes and Lombardi (2013) who investigate the pass-through mechanism of monetary policy via banks to corporate loans for the US and selected countries in Europe between 2002 and 2013. In their study, they decompose the spread of lending rates over central bank rates into three components, namely interbank lending risk, credit risk of bank relative to that of the respective government, and the credit risk from corporate lending. They find that the low interest rates by the central bank is passed on for the case of banks in Germany, whereas for peripheral countries such as Spain and Italy there is a substantial corporate credit risk component added on top, making the loan rates much higher.

A report by the International Institute of Finance (IIF) and Bain & Company (2013) also confirms that small and medium enterprises (SMEs) have been hit by restrictive lending from banks, similar to the situation in Japan and as predicted in the model.

Finally, as for the zombie firms that keep on being refinanced by banks, Papworth (2013) estimates "over 200,000 UK businesses are now either struggling to pay their debts or having to negotiate with their creditors, while 108,000 businesses are only able to service interest on its debt but not the debt itself". This can also be observed by the unusually

low corporate insolvency rate, which for the fiscal year ending Q1 2013 was only 0.7%, compared to an average of 1.2% in the 25 years beforehand, despite the struggles of the UK economy. Similar anecdotal evidence is also provided by Financial Times (2013a).

While there are no empirical studies that confirm the effect of zombie banks on the lending activity in Europe on a macro level, the facts support the model in chapter V and the experience from Japan. Hence, the existence of zombie banks puts additional stress on the economy and makes a recovery more difficult.

### 2.3 Policy measures

As highlighted in the model in chapter V, while it is easy to recognize that zombie banks are harmful to the economy, a successful policy intervention is less straightforward, as it has repercussions elsewhere. This is also clear from the summary of policy measures in chapter II, where the advantages and disadvantages of each policy tool was discussed.

Naturally, the success of any policy measure depends on the objectives. While the model in chapter V has focussed on the lending behavior by banks, the model in chapter IV has looked at policy measures with a view to reinstate bank solvency. The direct costs of any intervention also have to be taken into account. The ultimate mix of policy intervention thus has to weigh these trade-offs and should be the result of such a consideration of preferences. Moreover, as the situation changes over time, the policy mix can also change accordingly.

The following will give an assessment of the interventions for both the case of Japan and Europe in the context of the two models in chapters IV and V.

**Japan** It was already mentioned that the course of the Japanese banking crisis followed a slow and gradual healing approach after an initial quick intervention in the beginning. The public intervention by the government helped to ease the panic sentiment at the peak of the crisis in 1997-98, but was not sufficient to completely free banks of their bad loans. The policy by the central bank, on the other hand, helped banks to lower their refinancing costs and make their business more profitable, which allowed them to regain solvency over time. As already mentioned, however, even under such a monetary policy, banking consolidation took place and liquidation banks disappeared. The intervention by the central bank was thus not as supportive of banks as the ECB. Nonetheless, as modelled in chapter V, lower refinancing costs should in theory also have lead to a higher lending volume by banks.

Apart from these actions by the central bank, the government increased its public debt significantly and placed the bonds with banks. This was done in an effort to stimulate

the economy with increased spending, as modelled in chapter V.

This policy mix thus tolerated the negative effects of zombie banking and sought a gradual improvement in bank solvency over time, similar to the model in chapter IV. Zombie banks benefitted from a positive profit margin on the holdings of government debt. This allowed them to restructure their debt and clean their balance sheets, as already mentioned earlier. Due to the parallel consolidation that took place, the healing process can be seen as successful, as the banking crisis was announced to be over by the government in 2005.

As for the effect on bank lending, the policy approach was to tolerate the existence of zombie banks and stimulate lending in other ways. Put differently, these policy measures allowed banks to roll over bad loans with zombie firms, but aimed to increase additional loan business apart from these zombie firms. However, despite the combined efforts of the central bank and the government, lending to the corporate sector did not increase. Instead, as mentioned in Yoshino and Mizoguchi (2013), the corporate sector turned into a net saver and thus a supplier of capital to the financial system and not the demand for it.

The slowdown in corporate lending was compensated by the banks with the increased holdings of government bonds. This is in line with the model in chapter V. If we were to follow the arguments of this model, the crowding out effect of increased government debt was bigger than the stimulating effect on the economy.

However, the true reasons for this development are more complex. As Schnabl (2013) mentions, the slowdown in corporate lending can either be attributed to the supply side of capital, i.e. the role of banks, but also to the capital demand side, i.e. the corporate sector. There are various ways of how to look at this question. On the capital demand side, the corporate sector faced severe overcapacities, and firms worked to deleverage. Arguably, in such a balance-sheet recession as highlighted in Koo (2011), firms do not seek any additional capital and it is thus natural for loan demand to drop. According to his arguments, the government then successfully stepped in to fill the financing and output gap, and avoided an even longer and deeper recession.

On the other hand, if we look at the capital supply side, authors such as Ishikawa and Tsutsui (2006) stress that banks were constrained due to factors such as an undercapitalization, increased regulation, or indeed the burden of bad loans.

No matter what the ultimate reason is, the measures did have the effect that banks have ended up with an increase in government bond holdings and are now dependent on loose monetary policy. Strikingly, the government debt has continued to grow even after the banking crisis was announced to be resolved. Partly, this may also be attributable to

the global financial crisis that emerged in 2007, just shortly after the Japanese banking system recovered, which prompted the Japanese government to stimulate the economy further and which put renewed strain on the banks.

The real challenge, as laid out in Schnabl (2013) for the Japanese approach in dealing with the banking crisis is how to roll back the policies after the zombie banks have recovered. This is because both banks and the government are dependent on low interest rates, and they are also dependent on each other.

To address this problem, after two decades of economic malaise and increasing public debt levels, the government and the central bank have started a new initiative dubbed "Abenomics" in late 2012. Without going in to detail about the policies here,<sup>82</sup> in summary it is a radical attempt to promote growth and bring the economy back to inflation while managing public debt on a sustainable level. The measures include expansionary monetary policy, even to a higher degree than in the past, supported by fiscal expansion and a stimulation of private investment. In an ideal scenario, private demand for capital would succeed public demand, which reduces the banks' dependency on the government. Government finances would improve in light of higher nominal and real tax revenues and less expenditures due to a growing and inflating economy. If the measures fail, however, the risks of a renewed crisis due to unsustainable public debt levels are high.

Although the current state of the Japanese economy is not purely the result of the banking crisis and the policy response to zombie banks, these measures set the tone for the period after the banking crisis was thought to be over. As the situation coincided with the global financial crisis and recession, it now requires a risky initiative to get out of the vicious cycle. This highlights that any policy reaction to the emergence of zombie banks also has long repercussions even after the crisis is over.

**Europe** The financial crisis in Europe is still ongoing, although it seems that it has passed its (preliminary) peak of the crisis in mid 2012 since the announcement of the OMT program by the ECB, as mentioned e.g. in the report by the European Commission (2013b). So far, the policy reaction in dealing with zombie banks has been remarkably similar to Japan, as already referred to above.

The policies aim at a gradual improvement and a return to healthy banks over time. After an initial push across Europe to reinstate bank health in 2007-2009, the banks were then offered cheaper access to refinancing means via the ECB. This is similar to the experience in Japan, and again follows the model in chapter IV.

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<sup>82</sup>See, e.g. the briefing note by Manulife Asset Management (2013) or Arslanalp and Lam (2013) for details.

The limits to radical recapitalizations have been that some governments were thrown into turmoil themselves due to the high costs to recapitalize the banking sector. We will come back to this point later again.

It has already been mentioned, that the ECB has gone beyond the actions of the BoJ in supporting bank funding. The build-up of the TARGET2 positions within the network of central banks, in particular, suggests that the ECB provides indirect financing to a large degree of entire banking systems. While this has helped to stabilize the situation, it has also had the effect that many insolvent banks that would actually be liquidated otherwise survive as zombie banks. However, as already pointed out by Gros (2013), many of these banks do not have a sustainable business themselves, and only survive due to the liquidity measures by the ECB. Hence, a consolidation in the banking industry is necessary to accelerate the healing process in Europe. So far, the only country with efforts into this direction is Spain, even though it suffers under similar restrictions as other countries in the solvency of the government to efficiently promote this process.

As for bank lending, the approach again resembles the situation in Japan, where bad loans are tolerated on bank books, but additional lending should be stimulated apart from this. Indeed, the main reason why the ECB has implemented the OMT program in 2012 is because it saw the monetary transmission policy as impaired, and could thus not control the flow of funds within the financial sector and to the loan demand side anymore, as pointed out in a speech by ECB board member Coeure (2013). This monetary policy, that would allow the purchase of government bonds in secondary markets, was thus explicitly tailored to stimulating bank lending to the corporate sector.

However, as we have just seen even in light of an improved access to funding, banks have not substantially improved their lending rates. This is because they keep the "road-block" of bad loans on their book, as shown in the model in chapter V. Additionally, banks hold increasing amounts of government bonds in their books. We thus again have the trade-off between increased demand for loans due to increased government stimulus, but also a crowding effect due to the government bonds on bank books. This is even more extreme in the cases of the Spanish and Greek bailout where (quasi-)government bonds of the EFSF were used as a recapitalization measure. While such a policy has positive solvency effects on the banks, the effect on bank lending should be negligible.

It should be said, however, that the expansion of government debt is not as striking as in the case of Japan. While banks have also shifted their portfolios from private loans towards government bonds, levels are not as extreme as in the case of Japan. This is also because government debt levels across Europe, albeit on a rapid increase, are still relatively low compared to Japan during and especially after the crisis.



In summary, the current policy mix in Europe tries to seek a gradual improvement in bank health over time while containing an explosion of government debt. Negative effects of zombie banking are tolerated in the hope of a gradual recovery. There are ongoing efforts to reorganize the banking sector, but so far only a singular basis. This lack of consolidation is also due to the extraordinary policy measures by the ECB.

The situation is set to change with the implementation of the banking union in Europe. The banking union, as summarized e.g. by Goyal et al. (2013) is an ambitious and complex project with many elements that run parallel to each other, both in the political negotiations about its design but also in the implementation. In short, it aims to integrate banks in the Eurozone under a single supervisory and crisis resolution framework. The project has three pillars: the single supervisory mechanism (SSM) at the ECB, a single resolution mechanism (SRM), and a deposit insurance scheme with a real backstop. As of April 2014, both the SSM and the SRM are approved and in the process of being set up. The compromise probably combines national and supranational elements, with the SRM and SSM in charge of only the largest banks in Europe and a network of national authorities in charge of smaller, domestic banks, as reported by Financial Times (2013d, 2014).

One key element of the banking union that has been agreed upon is that a recapitalization of banks may happen through the funds of the ESM, but only after a debt restructuring has taken place that distributes losses to shareholders, wholesale debt owners and large depositors, as explained in chapter II.

For the purpose of our analysis, the banking union would change the situation as follows:

As for bank solvency, the banking union should break the link between sovereigns and banks. Governments of countries do not have to increase their debt burden with funds for bank recapitalizations, as bank resolution or recapitalization is integrated in the European framework. So far, the burden of bank failures was born to a large degree by the government, as holders of bank debt had to suffer little to no losses so far in light of limited bank failures, as also pointed out by Duebel (2012).

This resolution mechanism also lowers the necessity by the ECB to keep liquidation banks alive. Monetary policy could be relaxed, as orderly bank restructurings can take place. As a consequence, a consolidation of bank activity should take place, similar to Japan.

More questionable is how the role of reputation about bank health could change under a banking union. As mentioned, as of now the mistrust by bank investors about true bank

health has led to a high dependency on central bank liquidity. With a banking union, the situation can change in two opposing directions:

On the one hand, once it is clearly identified which banks are toxic and which banks are healthy, investors in bank debt should have more confidence in the information about each institution. This should facilitate banks' access to wholesale funding and allow a receding of the reliance on central bank liquidity, including the TARGET2 balances.

On the other hand, the burden sharing arrangement that would see a participation of bank creditors (or "bail-in") raises the risk for investors in bank debt and should make debt more costly, in line with the model in chapter II. This would put more pressure on the ECB and its liquidity measures. For this reason, the ECB is officially calling for a limitation of the burden sharing agreement, as reported by Bloomberg (2013b).

As for bank lending, the banking union should help removing the pressure of bad loans on the bank portfolio when seeking new loan activities. The ultimate effect depends on the mix of burden sharing in restoring bank health. If banks face increased funding costs due to the higher risk by investors, it would also lead to a lower loan volume and higher interest rates, as shown in the model in chapter V. If too much of the burden falls on the public sector, e.g. the ESM, then it leads to higher public debt, which in turn again leads to higher holdings of bonds by banks. The path to restoring bank health is thus delicate and not straightforward.

In summary, the banking union brings the opportunity for a careful treatment of zombie banks that could allow the ECB to roll back their liquidity measures, induce bank lending and restore bank health. However, it also bears risks, as the three factors of bank solvency, bank lending and bank reputation that were addressed in the theoretical models of this study are affected in sometimes opposing directions. As obvious as it is, the details of the design and implementation of the banking union are thus crucial in determining the final outcome.

### **3 Conclusion**

This chapter has provided a comparative case study of zombie banks in Japan during the banking crisis in the late 1990s/early 2000s, and in Europe during the recent sovereign debt and financial crisis. After a description and evaluation of the nature of zombie banks and the policy response to their appearance, the second part has applied the insights from the theoretical models to assess the situation.

As we could see, although zombie banks were different in their nature in Japan and Europe, the policy response was similar, as it included a mix of initial government in-

tervention in the financial sector, an accommodating policy by the central bank and increased government debt levels. A key difference was then found in the consolidation of the banking sector, as Japan witnessed a radical reorganization of its banking sector while in Europe, many unprofitable banks are still in operations.

In the analytical section, we then saw that the motivation and effects of zombie banks and forbearance lending were also similar, although with slight differences. The role of reputation about bank health is more pronounced in Europe, as banks from peripheral countries struggle to access wholesale funding. The negative effects of bad loans on the lending behavior by zombie banks, on the other hand, seems to be remarkably similar between Japan and Europe.

The analysis of the policy measures showed that any treatment of zombie banks is difficult. The policy mix in Europe so far is reminiscent of the approach of Japan to promote a gradual bank recovery while tolerating negative effects of zombie banks.

Finally, we saw that any policy response has long-term effects. Even in Japan, the aftermath of the banking crisis can be felt up to this day, as the current Abenomics policy is aiming to fight its legacy of high government debt, deflation, and a dependency of banks and the government on low interest rates. In Europe, the advent of the banking union may change the course of events and prevent a repeat of the Japanese experience. Bank restructuring may be carried out on a European-wide level with an involvement of bank creditors, and the link of banks and sovereigns could be cut.

In both cases, it remains to be seen how the policies are ultimately implemented and what their effects are going to be.

## Chapter VII

# Concluding Remarks

This study has provided a detailed assessment of zombie banking, which has been the subject of increased debate and research. Most conclusions about how best to deal with them have come from past experiences in other countries, most notably Japan. The literature, both theoretical and empirical, has identified several negative consequences of zombie banking. Indeed, zombie banks have been associated with being one of the causes for the two decades of economic stagnation in Japan. A quick fix for zombie banks has been advocated as a lesson for any further banking crisis, including the recent European sovereign debt and banking crisis.

However, we have also seen that it is not straightforward to deal with these zombie banks. There has not been the one efficient and effective tool in dealing with them, as each policy options comes with advantages and disadvantages when applied to the banks. Moreover, the costs of an intervention can also be unsustainable for the government, as seen in some instances in Europe. Finally, there is a general question about the appropriateness of government intervention in the banking sector.

In short, while there are clear damages from zombie banks in the economy, there is no clear answer as to how best to deal with them.

This study has presented three model frameworks to assess the motives and consequences of zombie banking, also in the context of potential policy measures. The models have incorporated different aspects of forbearance lending compared to other models, as they looked at bank activity in a more wider spectrum, including lending and funding operations, and also bank activity apart from the bad loan portfolio. With this approach, there have been the following key findings into the aspects of zombie banking:

First, forbearance lending can allow banks to reduce their funding costs and improve their solvency by disguising their true health in front of refinancing counterparties. However, the existence of zombie banks has repercussions on healthy banks, as refinancing counterparts get suspicious about the true state of bank health, which penalizes healthy banks.

Second, forbearance lending can give zombie banks time to regain strength and “come back to life” again, as they benefit from lower refinancing costs while they continue the healthy part of their portfolio. However, while zombie banks may be able to be revitalized, a key condition is that their healthy part of the business is profitable enough to sustain the negative impact of the bad loans. Thus, while zombie banking can buy time, not

all insolvent banks can equally "come back to life" after surviving as a zombie bank. A consolidation of bank activity and a reduction in the number of banks may therefore be a consequence, as has also been the case in Japan or more recently in Spain.

Third, zombie banks restrict lending to entrepreneurs compared to healthy banks, because the bad loans in their books act as a roadblock in the bank lending channel. This increases their refinancing costs and, in turn, increases the loan rates by the bank. A policy intervention is not straightforward, as any relief on one end has negative repercussions elsewhere. Measures by the government also lead to a higher holdings of government bonds by the bank. The success of an intervention depends on the economic environment, such as the loan demand in the economy.

The study then looked at the example of Japan and Europe as a case study in their experience with zombie banks. This included an application of the insights from the theoretical models. While the nature of zombie banks was found to be different, the policy mix was surprisingly similar. Japan chose an approach of a gradual recovery, tolerating the negative effects of zombie banking in order to reinstate bank health. Europe has been on a similar path, although the policy is even more accommodative for zombie banks than in Japan. Both regions have started new initiatives in their effort to clean up zombie banks and their legacy, and the lessons from these measures should soon offer renewed insights into the treatment of zombie banking.

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# Curriculum Vitae

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## Education / Academics

2010-2014 Doctoral student, Institute for Theoretical Economics – Monetary Economics, Faculty of Economics, University of Leipzig, Germany;  
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2008-2009 *Fernlehrgang Geschichte im Zeitspiegel* (Distance study course German history), Studiengemeinschaft Darmstadt, Germany

2004-2007 *Diplom-Volkswirtschaftslehre* (broadly equals M.Sc. in Economics) at Ludwig-Maximilians University (LMU) Munich, Germany

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2005-2006 Student research assistant, Seminar for International Economics, LMU Munich, Germany

2002-2004 *Diplom-Vorprüfung Betriebswirtschaftslehre* (undergraduate studies), University of Passau, Germany

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1989-2001 German Junior and Senior High School, Cologne, Germany  
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## Non-academic professional experience

Since 07/2014 Group Treasury – Capital Management, Deutsche Bank AG, Frankfurt, Germany

2010-06/2014 Debt Capital Markets – Bond Origination Public Sector, Commerzbank AG, London, UK

2007-2010 Group Development & Strategy – M&A, Commerzbank AG; Frankfurt, Germany

## Publications

### Articles in non-refereed journals:

“Die Auswirkungen der formellen Wirtschaftsintegration in Ostasien auf die Direktinvestitionen japanischer Unternehmen“ (Effects of formal economic integration in East Asia on Japanese foreign direct investment), *Japan Analysen Prognosen*, 199, 2007



”Activities for E-Democracy in Mie Prefecture, Japan: Comment“, with Yukiko Hamatani, *Regional Development Dialogue*, 27(2), 2006, p. 112-114

#### **Contributions to conference volumes:**

“Ein Vergleich der 2007/2008 US Subprime Finanzkrise mit der Finanzkrise durch die Vermögens- und Immobilienblase Japans 1987-1990: Verlauf, Ursachen und Auswirkungen“ (A comparison of the 2007/2008 US subprime financial crisis with the financial crisis caused by the asset bubble in Japan 1987-1990: course, causes and effects), *Veröffentlichungen des Japanisch-Deutschen Zentrum Berlins*, 58, 2009, p. 206-212

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“Doitsu to Nihon ni okeru Gakusei Seikatsu: Shunyu, Shishutsu to Daigaku Seido to no Kanren“ (Student life in Germany and Japan: income, expenses, and connections to the university system), *Jahresblätter für japanische und deutsche Forschung in Japan*, 1, 2006, p. 59-64

#### **Translation:**

Imakubo, S., „Die Auswirkungen von Globalisierung und Wirtschaftsintegration in Ost- und Südostasien auf den japanischen Arbeitsmarkt“ (Effects of globalization and economic integration in East and South East Asia on the Japanese labour market), in: *Neupositionierung regionaler Führungskräfte: Japan und Deutschland (Re-positioning regional powers: Japan and Germany)*, Klenner, W. & H. Watanabe (Hrsg.), Peter Lang, 2009, p. 97-142

#### **Conferences/seminars/workshops/summer schools:**

XXII International Conference on Money, Banking and Finance, CASMEF - Arcelli Center for Monetary and Financial Studies, LUISS Guido Carli University Rome, Italy, 2013

3<sup>rd</sup> Workshop “Banken und Finanzmärkte” (Banks and Financial Markets), co-organized by University of Augsburg and University of Magdeburg, Germany, 2013

Conference on Banking, Finance, Money and Institutions: The Post Crisis Era, co-organized by University of Surrey and Fordham University, UK, 2013

Doctoral Research Seminar, University of Hamburg, Germany, 2013

Verein für Socialpolitik Annual Congress, Göttingen, Germany, 2012

Annual Meeting of the Austrian Economic Association, Vienna, Austria, 2012

Doctoral Seminar in Economics, University of Leipzig, Germany, 2012 and 2013

Barcelona Banking Summer School, Barcelona Graduate School of Economics, Spain, 2010

1<sup>st</sup>-3<sup>rd</sup> German-Japanese-Korean Grant Recipients’ Seminar, Japanese-German Center Berlin, Germany, 2007-2009

Comparative Economic Policy System Seminar, Kyoto University, Japan, 2007

14<sup>th</sup> DAAD Tomonokai Japanese-German Forum, Yamanaka-Ko, Japan, 2006

**Grants/Programs:**

- 2008 Career Training Programme, InWEnt gGmbH (now Gesellschaft für Internationale Zusammenarbeit GmbH, GIZ) and CDS International
- 2007 Short-term scholarships for internships in international organizations/  
German missions abroad, German Academic Exchange Service (DAAD)
- 2006-2007 One-year scholarship for students, German Academic Exchange Service (DAAD)

**Internships/volunteering:**

- 2008-2009 Transparency International Germany, Frankfurt, Germany: Deputy Head of Regional Group Frankfurt/Rhein-Main, anti-corruption advocacy
- Winter 2007 United Nations Centre for Regional Development, Nagoya, Japan: intern, research department, Human Security unit
- Summer 2005 Transparency International Mexico, Mexico-City, Mexico: intern, special projects unit
- Spring 2004 Fundación Proyecto Ecológico Chiriboga, Quito, Ecuador: volunteer, reforestation, teaching in elementary school
- Summer 2002 Denko Agency, Nagoya, Japan: intern, advertisement
- Summer 2001 Object Magazine, Sydney, Australia: intern, editorial staff

# Selbständigkeitserklärung

Hiermit erkläre ich, die vorliegende Dissertation selbständig und ohne unzulässige fremde Hilfe angefertigt zu haben. Ich habe keine anderen als die angeführten Quellen und Hilfsmittel benutzt und sämtliche Textstellen, die wörtlich oder sinngemäß aus veröffentlichten oder unveröffentlichten Schriften entnommen wurden, und alle Angaben, die auf mündlichen Auskünften beruhen, als solche kenntlich gemacht. Ebenfalls sind alle von anderen Personen bereitgestellten Materialien oder erbrachten Dienstleistungen als solche gekennzeichnet.

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D. Willmann

(Unterschrift)

## **Bibliographische Beschreibung**

Willam, Daniel

Zombie Banks and Forbearance Lending:  
Causes, Effects and Policy Measures

Universität Leipzig, Dissertation  
205 S., 139 Lit.

Referat:

Zombie banks are banks that are practically insolvent but continue to exist through hiding bad loans on their balance sheet. This can be achieved by rolling over bad loans instead of writing them off, a process known as forbearance lending, zombie lending or evergreening.

Zombie banks have received increased attention of late, not least because of the sovereign debt and banking crisis in Europe. This follows other banking crises in the US and Japan which have equally seen an increased number of bank failures, and where insolvent companies have been kept alive by banks.

This study aims to give a theoretical assessment of the phenomenon around zombie banks and forbearance lending. Although zombie banks are the focus of a wide public debate, the existing research has not been able to fully explain many aspects around them, such as the several motives for forbearance lending, the impact of forbearance lending on the overall portfolio of zombie banks, or the right policy response in dealing with them. In light of this, we present three models that simulate the behavior of banks when rolling over bad loans. These models offer insights into the causes and effects of zombie banking, and also allow us to analyze the context of policy measures by the government and the central bank. To put the models into the right context, the study also provides a detailed overview of the theoretical and empirical literature as well as the practical experience with zombie banks and forbearance lending in Japan and Europe.