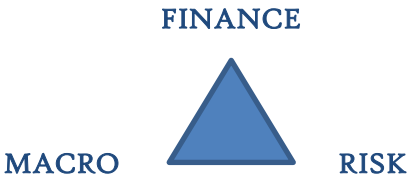

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On Zombie Banks and Recessions after Systemic Banking Crises: It Does Matter How Governments Intervene

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On Zombie Banks and Recessions after Systemic Banking Crises: It does matter how Governments intervene[1]

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Abstract: Systemic banking crises often continue into recessions with large output losses (Reinhart & Rogoff 2009a). In this paper we ask whether the way Governments intervene in the financial sector has an impact on the economy's subsequent performance. Our theoretical analysis focuses on bank incentives to manage bad loans. We show that interventions involving bank restructuring provide banks with incentives to restructure bad loans and free up resources for new economic activity. Other interventions lead banks to roll over bad loans, tying up resources in distressed firms. Our analysis suggests that zombie banks are a drag on economic recovery. We then analyze 65 systemic banking crises from the period 1980-2012, of which 25 are part of the recent global financial crisis, to answer the question: how effective are intervention measures from the macro perspective, in particular how do they affect recession duration? We find that bank restructuring, which includes bank recapitalizations, significantly reduces recession duration. The effect of liquidity support on the probability of recovery is positive but smaller. Blanket guarantees on bank liabilities and monetary policy do not have a significant effect.

Key words: Financial crises, intervention policies, zombie banks, economic recovery, bank restructuring, bank recapitalization

JEL codes: E44, E58, G21, G28

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1. Introduction

As early as 2009, Reinhart and Rogoff (2009a) pointed out that "recessions surrounding financial crises are usually long compared to normal recessions". Their research highlighted surprisingly large declines in output, slow recoveries and large and persistent negative effects on unemployment, public debt and fiscal deficits in the aftermath of banking crises. The subsequent experiences in the United States and particularly in Western Europe seem to lend further support to their findings. Governments intervene during financial crises, not just to preserve the key functions of the financial system, but often also to mitigate or reverse their macroeconomic impact. But does it matter how they intervene for their chances of macroeconomic success? In Europe distressed banks and fiscally strapped Governments continue to hold each other hostage, while financial recovery and banking sector independence from public support has been achieved much more quickly in the US than in Europe. In the light of this experience it is natural to ask whether the way Governments intervene in the financial sector has an impact on the economy's subsequent performance. In this paper we begin to answer that question: is the speed of recovery after a financial crisis dependent on the mode of intervention the Government chooses in response to that crisis?

The existing literature has documented that intervention measures have high fiscal costs (Honohan & Klingebiel 2003). Whether the measures are effective in achieving their macroeconomic objectives is less clear. Claessens et al. (2005) find that fiscal costs of banking crises depend on the quality of institutions, which also affects the output losses of crises, but they do not discuss the nature of the interventions taken. Laeven and Valencia (2011) provide suggestive microeconomic evidence that the mode of intervention does matter: they show that in times of banking crises firms more dependent on external finance grow faster when bank recapitalizations are done. We investigate how effective intervention measures are from a macro perspective: how do they affect recession duration? We find that bank restructuring, which includes bank recapitalizations, significantly reduces recession duration. The effect of liquidity support on the probability of recovery is positive but smaller. Blanket guarantees on bank liabilities and monetary policy do not have a significant effect on the speed of recovery.

In the theoretical analysis that provides the framework for our subsequent empirical analysis, we focus on a key difference between bank restructuring and the other policies mentioned, their differential impact on bank incentives for managing bad loans. Financial crises leave distressed banks with unexpectedly low capital ratios. We show that measures that fail to address the undercapitalization of banks provide these banks with incentives to just roll over bad loans and shift risks to depositors. Guarantees make depositors indifferent to the risks that are shifted their way. On the contrary, interventions that restore the capitalization of distressed banks provide them with incentives to restructure bad loans and free up resources for new economic activities. In that way zombie banks, banks that do not enforce discipline on distressed borrowers, form a drag on economic recovery.

We then analyze 65 systemic banking crises from the period 1980-2012, of which 25 are part of the recent global financial crisis. The main challenge in estimating the effect of intervention on recession duration is how to control for unobserved heterogeneity in crisis severity. The choice of policies is likely to depend on the extent of underlying problems in each banking crises. Some policies are more likely to be used in more severe crises than in mild crises. Having a panel dataset about intervention measures in each quarter of recessions, makes it possible to estimate the effect of policies on the probability of recovery that is independent of unobserved crisis severity. We use a grouped duration model with a specification

similar to Mundlak (1978), which enables estimation of fixed effects in a nonlinear model. The unobserved crisis severity is captured by the fixed effect component of each recession.

The estimation results show that bank restructuring measures, have a highly significant positive effect on the probability of recovery. Liquidity support also has a positive and significant effect but less strong than bank restructuring. The effects of blanket guarantees and monetary policy are insignificant in most specifications. The average recession duration is about 5 quarters both for crises where bank restructuring was not done and for crises where it was done. Computing the effect of bank restructuring on expected recession duration shows striking results.

We calculate the predicted recession duration separately for a typical crisis where bank restructuring was never done and a typical crisis where bank restructuring was done at some point. Crises where bank restructuring was done are on average much more severe than the crises where it was not done. The typical crisis where bank restructuring was never done is predicted to last 6 quarters. This is close to the average of observed actual duration of such crises. If bank restructuring was done, the duration would be only 2.7 quarters. The effect of bank restructuring is even larger for a typical crisis where bank restructuring has in fact taken place. The predicted recession duration with bank restructuring is 5 quarters. The counterfactual duration, how long such a recession would last if bank restructuring was not done, is 14 quarters. The empirical results confirm the predictions of the theoretical model. Bank restructuring measures, which restore incentives for prudent lending, greatly increase the probability of recovery from recessions following systemic banking crises.

The paper is organized as follows. Section 2 discusses the related literature. Section 3 presents the theoretical model, with which we demonstrate the effects of different intervention measures on the risk shifting incentives of banks and the consequences for their management of loans to borrowers in distress ("bad loans"). The empirical methodology is explained in Section 4 while Section 5 describes the data. Results are presented in Section 6. Robustness checks are in Section 7. Section 8 concludes.

2. Review of related literature

Our paper first of all builds on the empirical literature on financial crises. Reinhart and Rogoff (2009b) provide an extensive analysis of financial crises over history. Hoggarth et al. (2002) estimate average cumulative output losses of 24 banking crises during 1980-2000 to be in the range of 15-20% of annual GDP. Several authors focus, like we do, on the interaction between public policy and output losses after a crisis, but their emphasis is on fiscal costs, not on the nature of bank intervention, the key question addressed in this paper. Honohan & Klingebiel (2003) report that the fiscal costs of government intervention in 39 banking crises from the same period are on average 12.8%. Claessens et al. (2005) and Detragiache & Ho (2010) investigate the relationship between fiscal costs and output losses but find no support in favor of higher fiscal outlays. An issue in such analysis is endogeneity of policies to crisis severity. To address it Claessens et al. (2005) look at residual fiscal outlays above the amount predicted by proxies for quality of institutions. They find that higher residual fiscal costs are related to larger output losses. Detragiache and Ho (2010) use the type of political system as an instrument for policy choice. Their estimates show that fiscally costly policies are related to higher output losses and longer crisis duration.

Kane and Klingebiel (2004) suggest that governments are too eager to use containment policies, particularly guarantees on bank liabilities and liquidity support, in the first phase of crisis.

The *endogeneity of macro-policies* problem can sometimes be circumvented by switching to microdata. Kroszner et al. (2007) and Dell'Ariccia et al. (2008) investigate the growth of firms with higher dependence on external finance and find that such firms grow relatively slower in times of banking crises. Using the same approach, Laeven and Valencia (2011) find that bank restructuring measures have a positive effect on growth of financially dependent firms. Laeven and Valencia (2012b) show that blanket guarantees and bank restructuring are to a degree substitutes for subsequent liquidity support.

We use macrodata but because of the weak instruments problem plaguing 2SLS approaches, we use an alternative approach that enables us to estimate the effectiveness of different policies undistorted by any simultaneous but reverse dependence of policy choice on crisis severity. We capture crisis severity by including a recession specific fixed effect in our panel data setup. We use a grouped duration model with a specification similar to Mundlak (1978), and allow for correlation between crisis severity as measured by the FE constants and the choice of policy variables. Since we have a panel dataset about intervention measures in each quarter of recessions, this approach makes it possible to estimate the effect of policies on the probability of recovery that is independent of unobserved crisis severity.

Furthermore, we differentiate between bank restructuring, which improves banks' risk taking incentives, and other policies that only prevent bank failures. Improving bank incentives to manage loans is crucial. Japanese experience (Peek & Rosengren 2005; Caballero et al. 2008; Watanabe 2010) show that poorly capitalized banks tend to extend loans to insolvent firms. Because the inefficient firms then do not exit their industries, more productive firms do not prosper, or may delay entry. This can lead to a long stagnation. An example of successful restructuring where banks were incentivized to become agents of change in loss-making state owned enterprises is Poland (Wijnbergen 1997). Banks were recapitalized and prudential regulation was gradually put in place. Many banks negotiated a debt to equity conversion with struggling firms. The alternative option for insolvent firms to be transferred to a state agency was made unattractive both for banks and firm insiders. The restructuring program worked out well. The ultimate privatization proceeds from the sale of banks and restructured firms, and bank capitalization ratios at the end of restructuring, far exceeded initial expectations.

Secondly, our paper relates to theoretical literature on intervention in the presence of risk shifting or adverse selection in banking. In Diamond & Rajan (2011) banks with the greatest risk of becoming illiquid in future choose not to sell illiquid assets early, which would insure their survival but hold on to illiquid assets, gambling that the liquidity shock will not occur. Liquid buyers hoard liquidity in expectation of fire sales that take place when many illiquid banks need to sell their assets to repay their liabilities. Philippon and Schnabl (2012) analyze optimal intervention when banks underinvest because of debt overhang. The government cannot observe the value of banks' existing long term assets and new investment opportunities. The optimal form of intervention is bank recapitalization, any debt like instrument would only add to the overhang. To minimize costs of the program the equity injection should be in the form of preferred stock with warrants to make the offer unattractive for banks that would anyhow invest on their own. In contrast, Philippon and Skreta (2012) find that direct lending in the form of liquidity support or guarantees on bank liabilities is the optimal form of intervention when there is adverse selection in bank debt markets. One of their main assumptions is that banks can only raise debt by

pledging the combined income from existing assets and new investments. Because investors cannot discriminate between banks based on the quality of their existing assets, banks with high value of legacy assets prefer to pass up positive NPV investment opportunities over paying high interest rates on their debt. In a similar setting with adverse selection Tirole (2011) reaches another conclusion: the optimal form of intervention is asset purchases. This conclusion critically depends on the assumption that only revenues generated by new projects are pledgeable, and only partially so for standard agency reasons, so Banks can only finance the new investment if they sell existing assets.

A common feature of the theoretical papers discussed so far is that adverse selection rather than moral hazard is the key asymmetric information problem. Of course adverse selection is a major problem facing regulators having to intervene in notoriously opaque banks where the regulator cannot easily identify weak banks, and especially so when banks' participation in intervention programs is voluntary. Yet we want to focus on the relatively neglected moral hazard problem. For sharpness of results we assume the absence of any adverse selection problem by looking at a single bank facing the choice between two projects with different risk and return characteristics while asset allocation is not observable for creditors of the bank. The theoretical part of our paper is perhaps most closely related to a very early contribution to the literature on bank intervention, Berglof and Roland (1995). Their focus is entirely different from ours: the key issue in Berglof and Roland (1995) is the incentive banks have to game the regulator: they are interested in why so called soft budget constraints emerge. In our set up, we assume that regulators can fully commit to the intervention method and subsidy amount (if any) chosen. We focus on the impact of low capitalization and of different intervention approaches on bank incentives for managing existing assets: the bad loan problem and the macro consequences of so called zombie banks.

3. Model

The model is mostly intended to generate some insights to guide the empirical analysis. We show that bank recapitalization improves bank incentives for managing bad loans. A common form of risk shifting in banking crises is holding on to bad loans instead of liquidating them. A bad loan is a highly risky project with an expected payoff lower than its liquidation value. Yet, it is attractive for a weakly capitalized bank: due to limited liability the bank's shareholders capture the upside if the bad loans repays but shift the risk of losses to debtholders. On the aggregate level renewing bad loans results in lower output because inefficient firms are funded instead of productive new or expanding firms. In stable times, depositors correctly predict the proportion of bad loans that banks will realize. In equilibrium bank leverage is then such that banks have an incentive to liquidate bad loans. But in a banking crisis the ratio of bad loans turns out to be unexpectedly high. Banks that have been hit no longer have an incentive to liquidate bad loans. If depositors expect a bank to be insolvent in the final period, they withdraw early causing the liquidation of the bank. If the bank is liquidated, there are efficiency losses as together with bad also good loans are liquidated. The regulator can improve welfare if it prevents bank failures to limit the loss of welfare from liquidating good loans and restores incentives of banks to liquidate bad loans. Recapitalizing banks before they make a decision about bad loans fulfills both objectives. Providing liquidity support or guaranteeing bank liabilities, however, only prevents bank failures but does not change their incentives when managing bad loans.

Timeline of events

There are two time periods. The first one lasts from $t=0$ until $t=1$ and the second from $t=1$ till $t=2$. There are three types of agents: a bank, depositors and the regulator. The regulator is only active from $t=1$ on if there is a banking crisis.

- At $t=0$ the bank raises k of equity and $1-k$ of debt with maturity of one period. It makes 1 unit of loans to firms that invest into two-period projects.
- At $t=1$ the bank and the regulator observe the quality of bank loans. A proportion of loans $1-q$ is good; the remaining q are bad loans. Depositors may withdraw. If the bank cannot obtain funding it liquidates the loans as much as necessary to repay depositors. The liquidation value of both good and bad loans is $\lambda<1$ per unit of a loan. If the bank can secure funding for the second period, it makes a decision about the bad loans. It either rolls them over as if they were good loans or liquidates them and lends the proceeds to new firms.
- At $t=2$ the bank collects loan repayments. Good loans repay a cash flow R with certainty. Bad loans that were liquidated repay λR per unit of initial lending, with certainty. Bad loans that were not liquidated repay R with probability p and zero otherwise. Depositors are repaid. Bank shareholders get the residual.

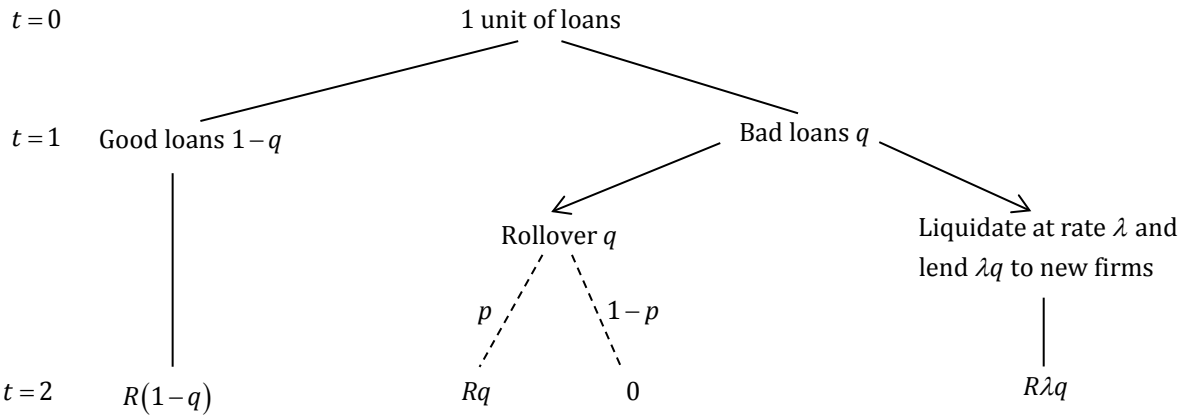

Figure 1: Loan characteristics

At $t=0$ the bank makes 1 unit of loans. At $t=1$ the bank and the regulator observe the quality of loans. A proportion of loans $1-q$ is good; the remaining q are bad loans. At $t=2$ good loans repay with certainty a cash flow R per unit of lending. If the bank rolls over the bad loans, they repay R with probability p and zero otherwise. If the bank liquidates bad loans it gets λ per unit of liquidated bad loans. The proceeds from liquidation are lent to new firms at a rate R.

Depositors

Depositors are risk neutral and in expectation require a return equal to the risk free rate, which is normalized to 1. At $t=0$ the bank raises $1-k$ of deposits, for which it promises to repay D at $t=2$ or $\sqrt{D}$ at $t=1$ if depositors withdraw early. If they withdraw at $t=1$, the bank tries to raise new debt in the amount of $\sqrt{D}$ to repay the existing depositors. In case it cannot repay the promised amount, the depositors get all cash flows the bank can collect. If the bank is insolvent at $t=1$ the depositors get λ

since the bank has to liquidate its entire loan portfolio. If the bank is insolvent at $t=2$, which can occur when bad loans did not perform well, the depositors get $R(1-q)$.

Bank

The bank pursues the interests of its shareholders. It is assumed that an incentive structure is in place that insures that the interests of bank managers do not diverge from those of bank shareholders. At $t=0$ bank shareholders pay in k of equity, on which they require an expected return strictly larger than the risk free rate. This gives them an incentive to lever up as much as possible. Bank shareholders are residual claimants on cash flows at $t=2$ and have limited liability. If the bank liquidates bad loans the payoff to bank shareholders is $R(1-q)+R\lambda q-D$.[2] If the bank rolls over bad loans, the payoff to bank shareholders is $R-D$ if the bad loans perform and zero if they do not.

Bad loans

Liquidating bad loans represents the use of the material adverse change clause, which gives a bank the right to call a loan when the probability of repayment deteriorates significantly. An alternative interpretation is that firms use the loans to fund projects with duration longer than the maturity of loans. Such loans need to be rolled over before the project is completed. Liquidation parameter λ is the price at which the assets of firms with bad loans can be sold to outside investors or can alternatively be interpreted as restructuring of bad loans where the bank immediately writes off $1-\lambda$ of the loan principal to increase the probability of repayment. It is socially optimal to liquidate bad loans. Leaving them as they are is risky and has a lower expected payoff than the payoff from liquidation (and new lending), which is certain.[3]

$$pR < R\lambda \tag{1}$$

For simplicity it is assumed that the bank extracts all value from the firms to which it lends. The total amount collected from lending is then equal to aggregate output. Despite the liquidation of bad loans being socially optimal, the bank may choose to roll them over if bank shareholders do not fully internalize the losses when bad loans fail. The bank chooses to liquidate bad loans if liquidation and subsequent lending to new firms brings a higher expected payoff to bank shareholders than does rolling over of bad loans.

$$\mathrm{E}\left[\max\left(R(1-q)+R\lambda q-D,0\right)\right] > \mathrm{E}\left[\max\left(R-D,0\right)\right] \tag{2}$$

Computing the expected payoffs gives the liquidation incentive constraint: [4]

$$R(1-q)+R\lambda q-D > p(R-D) \tag{3}$$

If the liquidation incentive constraint (3) is not satisfied, the bank chooses to roll over bad loans.

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[2] The payoff from liquidating bad loans is certain. Whenever the bank chooses to liquidate bad loans, this payoff has to be positive.

[3] The insights of the model would remain the same if good loans and new lending were risky but the variance of their repayment would be lower than the variance of bad loans that are rolled over.

[4] The incentive constraint only applies when debt obligations are sufficiently high that bank shareholders get zero in case bad loans fail.

Equilibrium in stable times

The lending rate R, the proportion of bad loans q, the liquidation value λ and the probability that bad loans repay p are public knowledge at $t=0$. The analysis focuses on the case where parameter values are such that banking is only viable if bad loans are liquidated in stable times. We therefore assume that if the bank holds on to bad loans the total expected return from lending is less than 1:

$$R\left(1-q\right)+Rpq<1<R\left(1-q\right)+R\lambda q \tag{4}$$

Thus depositors and bank shareholders can both earn at least the risk free rate only if bad loans are liquidated. Therefore in equilibrium bad loans have to be liquidated. If bad loans are liquidated, the loan repayments at $t=2$ are certain. Hence, with the risk free rate being equal to 1, the promised repayment to depositors is equal to their initial investment $D=1-k$. To insure that bad loans are liquidated, the incentive constraint (3) has to be satisfied. It can be expressed as a constraint on the bank capital ratio k.

$$k>1-\frac{R\left(1-p-q\left(1-\lambda\right)\right)}{1-p} \tag{5}$$

The only way for the bank to commit to liquidate bad loans is to have a sufficiently high capital ratio. Since bank shareholders prefer a return strictly larger than the risk free rate, they have an incentive to increase bank leverage as much as possible, so in equilibrium the incentive constraint is binding. The required capital ratio is increasing in the proportion of bad loans q and decreasing in the liquidation value λ.

Banking crisis

A banking crisis differs from stable times in that the proportion of bad loans turns out to be unexpectedly high. Neither the bank nor the depositors expect a shock to the amount of bad loans, so at $t=0$ their behavior is exactly the same as in stable times. But at $t=1$ the bank (and the regulator) observe that the proportion of bad loans is $q+\xi$, with $\xi>0$ being the shock. It still is socially optimal to liquidate bad loans and lend to new firms. But the incentive constraint is no longer satisfied for the new, higher proportion of bad loans. The new capital ratio k' that would satisfy the incentive constraint given the higher proportion of bad loans, is larger than the existing capital ratio k:

$$\begin{aligned} k' &= 1-\frac{R\left(1-p-\left(q+\xi\right)\left(1-\lambda\right)\right)}{1-p} \\ &= 1-\frac{R\left(1-p-q\left(1-\lambda\right)\right)}{1-p}+\frac{R\xi(1-\lambda)}{1-p} \\ &> k \end{aligned} \tag{6}$$

Depositors recognize that the bank has been hit but do not observe the size of the shock. They cannot coordinate their actions. If all existing depositors withdraw, potential new depositors are not willing to lend to the bank either. Because the depositors do not know the size of the shock, a new deposit contract at a different rate is not feasible.[5] If the bank cannot obtain new deposits, it liquidates its loan portfolio at

[5] This assumption rules out equilibria where the deposit rate is adjusted for risk or where the bank shrinks. Such equilibria are only possible if the shock is small enough that bank shareholders can earn a positive return after readjustment. This is explored in a separate paper.

a rate λ to repay the existing deposits. If λ is less than the amount of debt $1-k$, depositors are not fully repaid. Whether $\lambda<1-k$ depends on the equilibrium value of k; in what follows we will assume this to be the case.

The regulator, representing the central bank and the government, does observe the size of the shock. It cannot require the bank to liquidate bad loans but it can possibly improve total welfare by intervening the bank. Total welfare is defined as the sum of repayments to depositors, bank shareholders and the losses or gains realized by the regulator. In the absence of intervention, the entire bank is liquidated. The loans are then sold to outside investors. Depositors place the proceeds into riskless government securities. Total welfare is then equal to λ. This scenario implies efficiency losses because good loans are liquidated at a loss and because the proceeds from liquidation of loans are not lent on to new firms as the bank has gone out of business. Consider next two types of intervention, the first group directed at providing access to debt finance, and the second group focusing on recapitalization.

Deposit insurance, blanket guarantees and liquidity support

These measures prevent bank failures as the bank is able to obtain debt financing despite being insolvent. Because the incentive constraint is still not satisfied, the bank does not liquidate bad loans and gambles that they will succeed. Under deposit insurance or blanket guarantees on bank liabilities, the investors are willing to lend to the bank at the risk free rate because the regulator covers the difference between the value of bank assets $R\left(1-q-\xi\right)$ and the outstanding debt D in case bad loans fail. The expected loss of the regulator is $\left(1-p\right)\left(D-R\left(1-q-\xi\right)\right)$. By providing liquidity support the regulator effectively substitutes all of the bank's existing debt. The expected repayment of the bank is $pD+\left(1-p\right)\left(R\left(1-q-\xi\right)\right)$. The expected loss to the regulator is exactly the same as under deposit insurance. Providing liquidity support or guaranteeing bank liabilities is a better outcome than the failure of the bank if the total expected repayment of the good loans and the bad loans that are rolled over is larger than the liquidation value of the entire bank, which is the case if:

$$pR+\left(1-p\right)R\left(1-q-\xi\right)>\lambda \tag{7}$$

If the amount of bad loans $q+\xi$ is too high (the shock too large), (7) is not satisfied and then guarantees on bank liabilities and liquidity support are worse than letting the bank fail at $t=1$.

Bank recapitalization

Bank shareholders do not have an incentive to recapitalize the bank at $t=1$ after it has been hit by a shock; recapitalization would only benefit the depositors. The regulator, however, can improve total welfare by recapitalizing the bank before the bank makes the decision about the bad loans. If the regulator injects g of equity into the bank, the incentive constraint is again satisfied if g satisies:

$$k+g>1-\frac{R\left(1-p-q\left(1-\lambda\right)\right)}{1-p}+\frac{R\xi\left(1-\lambda\right)}{1-p} \tag{8}$$

The amount of recapitalization necessary is thus at least $g = \frac{R\xi(1-\lambda)}{1-p}$. It is used to repay part of the existing deposits. Deposits in the second period are then only $1-k-g$. When the incentives for liquidating bad loans are restored, the value of bank assets at $t=2$ is $R(1-q-\xi)+R\lambda(q+\xi)$. This outcome maximizes total welfare because no good loans are liquidated (as would happen in the case of bank failure) but bad loans are liquidated (unlike what happens under the other type of interventions). The regulator can recoup the costs of the equity injection at $t=2$. In terms of total welfare it does not matter whether the regulator recoups more or less than g at $t=2$.

In order for the recapitalization to be effective, three conditions need to be satisfied. First, the recapitalization has to be done before the bank makes the decision about bad loans. If it is done after the bank has already rolled over the bad loans, it has no beneficiary effect on incentives: ex post recapitalization only covers the losses from failed bad loans. Second, the recapitalization needs to be large enough. We assume that the regulator cannot take over the bank and thus cannot directly instruct the manager to liquidate bad loans. Therefore the recapitalization has to be high enough so that with $k+g$ of equity, liquidation of bad loans becomes in the interest of bank shareholders. Third, there should be a ban on dividend payouts. If existing bank shareholders could decide what to do with recapitalization funds they would prefer an immediate pay out and a continued gamble with the bad loans. To be successful, the recapitalization has to reduce leverage enough to shift incentives, so to be effective it should be accompanied by a ban on dividend payments.

4. Empirical methodology

The dataset about systemic banking crises is a panel where index i denotes a banking crisis and t refers to a particular quarter of a recession. For each crisis i the sample includes all time periods when the country was in a recession and the period when it recovered. The time index is $t=0$ in the first recession quarter and $t=T_i$ in the period of recovery. It indicates how many quarters has a recession already lasted before period t. The completed duration of the recession related to banking crisis i is T_i. For each observation in the sample recession indicator y_{it} indicates whether a country was in a recession or it has just recovered.

$$y_{it} = \begin{cases} 1 & \text{recession ends} \\ 0 & \text{recession is ongoing} \end{cases}$$

The hazard rate $\lambda(t, x_{it}, c_i)$ of a recession ending is the probability of recovery in quarter t of crisis i conditional on that the recession has not ended before and conditional on the values of explanatory variables x_{it}, which are proxies for policies used in systemic banking crises, and the unobserved heterogeneity c_i.[6]

$$\lambda(t, x_{it}, c_i) = \Pr(y_{it}=1 \mid y_{it-1}=0, \ldots, y_{i1}=0, x_{it}, c_i) = G(x_{it}\beta + \gamma_t + c_i) \quad (9)$$

[6] For additional discussion of modeling duration of a process see Appendix 1: Modeling duration of a process.

$G(\cdot)$ is a cumulative distribution function that maps the expression $x_{it}\beta+\gamma_t+c_i+e_{it}$ into a probability measure. $\gamma_t=\gamma(t)$ is a function of elapsed duration. The parameter of crisis severity c_i is constant over all periods of a crisis but varies over crises. Explanatory variables that are positively related to the hazard rate, increase the probability of recovery and reduce the expected duration.

The main challenge in estimation of the effects of policies on recession duration is the presence of unobserved heterogeneity. Parameters c_i account for the heterogeneity in unobserved crisis severity, which would in the absence of intervention determine recession duration. The crisis severity affects both the probability of recovery and the probability that a particular policy is used. Therefore it cannot be assumed that x_{it} are independent from c_i. To allow for correlation between x_{it} and c_i, we use the approach proposed by Mundlak (1978). If the unobserved heterogeneity is time-invariant, it is possible to separate out the effect of explanatory variables that is independent of c_i.

The observed dependent variable y_{it} is an indicator of the latent probability of recovery $y_{it}=\mathbf{1}\left[y_{it}^{*}>0\right]$, with $\mathbf{1}[....]$ an index function that equals 1 if $y_{it}^{*}>0$ and 0 otherwise.

$$y_{it}^{*}=x_{it}\beta+\gamma_t+c_i+e_{it} \tag{10}$$

To allow for correlation between time invariant unobserved heterogeneity and explanatory variables, unobserved heterogeneity is specified as a function of the average of values of explanatory variables per crisis i.

$$c_i=\psi+\bar{x}_i\delta+v_i \tag{11}$$

The error term v_i is normally distributed and independent from e_{it}. In this specification explanatory variables x_{it} do not include a constant. Combining (10) and (11), the latent variable equation can be written as

$$y_{it}^{*}=x_{it}\beta+\bar{x}_i\delta+\gamma_t+v_i+e_{it}. \tag{12}$$

In equation (12) the constant ψ from equation (11) is not included as a constant is already included in γ_t. A cubic function $\gamma_t=\gamma_0+\gamma_1 t+\gamma_2 t^2+\gamma_3 t^3$ is used to control for the effect of elapsed duration. This specification can be estimated with random effects logit or the complementary log-log procedure. The vector of coefficients β describes the effect of policies on recession duration extracted from the variation of policies over time. In a linear probability model, the estimates of β obtained with Mundlak's (1978) approach equal estimates obtained after performing a fixed effects transformation $x_{it}-\bar{x}_i$. However, this transformation cannot be performed on a nonlinear model, but the non-linear model with Mundlak's (1978) specification can be estimated directly using nonlinear estimation methods. The estimation also allows a test of whether correlation between explanatory variables and unobserved heterogeneity is in fact an issue. If the estimate of coefficient δ in (12) is not significant, the correlation between explanatory variables is not problematic and a specification without $\bar{x}_i$ as a regressor can be estimated.

The approach enables us to estimate the effects of policies on the probability of recovery independent of unobserved crisis severity and not affected by any potential impact of crisis severity on

choice of intervention mode. A potential weakness of the approach is that we assume the crisis indicator to be crisis specific but time independent, in line with the Mundlak (1978) specification. This means that no account is taken of the possibility that the crisis severity indicator changes during a specific crisis, with simultaneous impact on both expected duration of the corresponding recession and potential changes in policy intervention mode during that same recession.

Computing the expected recession duration from predicted probabilities of recovery

Based on the estimated parameters from equation (12) we can calculate predicted probabilities of recovery, which we then use to obtain expected recession durations. Bellow we provide equations for predicted probabilities for three estimation models that differ in terms of distributional assumption: the complementary log-log model, the logit model and the linear probability model. A desirable characteristic of the complementary log-log model is that it assumes that the underlying process (recession) is continuous but can only be observed at discrete points in time, while the logit and the linear probability model require the assumption that the duration process is discrete. An additional disadvantage of the linear probability model is that the predicted probabilities can lie out of the $\left[0,1\right]$ range.

The predicted probability of recovery in period t conditional on the recession not having ended in any of the previous quarters and conditional on x_{it} and c_i is given by the following equations for the complementary log-log (13), the logit (14) and the linear probability (15) model respectively:

$$\hat{P}\left(y_{it}=1\,|\,y_{it-1}=0,...,y_{i1}=0,x_{it},c_i\right)=1-\exp\left(-\exp\left(x_{it}\hat{\beta}+\overline{x}_i\hat{\delta}+\hat{\gamma}_t\right)\right) \tag{13}$$

$$\hat{P}\left(y_{it}=1\,|\,y_{it-1}=0,...,y_{i1}=0,x_{it},c_i\right)=\frac{\exp\left(x_{it}\hat{\beta}+\overline{x}_i\hat{\delta}+\hat{\gamma}_t\right)}{1+\exp\left(x_{it}\hat{\beta}+\overline{x}_i\hat{\delta}+\hat{\gamma}_t\right)} \tag{14}$$

$$\hat{P}\left(y_{it}=1\,|\,y_{it-1}=0,...,y_{i1}=0,x_{it},c_i\right)=x_{it}\hat{\beta}+\overline{x}_i\hat{\delta}+\hat{\gamma}_t \tag{15}$$

These probabilities are from here on referred to as conditional probabilities of recovery. In contrast, the term unconditional probability of recovery is used for the predicted probability of recovery that is conditioned only on the values of explanatory variables until then $X_{i\{1,...,t\}}$ and c_i but not on the recession not having ended before. The unconditional probability of recovery is the product of the probability of recovery conditional on recession lasting until t and the unconditional probability that the recession has not ended in the previous quarter.

$$P\left(y_{it}=1\,|\,X_{i\{1,...,t\}},c_i\right)=P\left(y_{it}=1\,|\,y_{it-1}=0,...,y_{i1}=0,x_{it},c_i\right)\cdot\left(1-P\left(y_{it-1}=1\,|\,X_{i\{1,...,t-1\}},c_i\right)\right) \tag{16}$$

The unconditional probability that the recession has not ended in the previous quarter can be expressed as the corresponding conditional probability of that quarter (conditional on the recession not having ended the quarter before) and the unconditional probability of no recovery a quarter before. This procedure can be repeated all the way back to the first quarter when the conditional probability of recovery is equal to the unconditional probability as there is no preceding quarter. This gives an expression for the unconditional probability of recovery in quarter t as a product of conditional probabilities of no recovery in all previous quarters.

$$P\left(y_{it}=1\mid X_{i\{1,\ldots,t\}},c_i\right)=P\left(y_{it}=1\mid y_{it-1}=0,\ldots,y_{i1}=0,x_{it},c_i\right)\cdot$$
$$\cdot\left(1-P\left(y_{it-1}=1\mid y_{it-2}=0,\ldots,y_{i1}=0,x_{it-1},c_i\right)\right)\cdot\ldots\cdot\left(1-P\left(y_{i1}=1\mid x_{i1},c_i\right)\right) \quad (17)$$

The expected recession duration $E\left[T_i\right]$ is the product of the predicted unconditional probabilities of recovery in any period and their respective durations, which range from $t=0$ up to $t=t_{MAX}$.

$$E\left[T_i\right]=\sum_{t=1}^{t_{MAX}}\left[t\cdot\hat{P}\left(y_{it}=1\mid x_{i\{1,\ldots,t\}},c_i\right)\right] \quad (18)$$

The limit t_{MAX} is set at a value where the numerically computed probability of recession lasting until then is equal to zero.

5. Data

The dataset covers 65 systemic banking crises from the period 1980-2012, of which 40 are from the period before 2007 and 25 belong to the recent global financial crisis. For each banking crisis the sample includes observations for the quarters, in which a country was in a recession, and the quarter when it recovered.[7] Table 1 below lists the crises from the period 1980-2007. Countries experiencing a systemic banking crisis during the global financial crisis are listed in Table 2.

Systemic banking crises that did not have a recession are included in the tables but cannot be analyzed with recession duration models. In total there are 11 such crises, 9 in the period before 2007 and 2 after. The list of systemic banking crises and their starting dates are from Laeven and Valencia (2012a). The starting date of a banking crisis is the quarter in which major distress in the banking sector was observed. Laeven and Valencia (2012a) define also the date when a crisis became systemic. For a banking crisis to be systemic two conditions have to be met. Firstly, there is major distress in the banking system such as bank runs, large losses of bank capital and bank liquidations. Secondly, there need to be significant policy interventions in response to the problems in the banking sector. This condition is met if at least 3 of the following measures were used:

- extensive liquidity support (claims of the central bank on deposit money banks larger than 5 percent of deposits and liabilities to nonresidents)
- gross bank restructuring costs at least 3 percent of GDP
- significant bank nationalizations
- significant guarantees on bank liabilities
- asset purchases amounting to at least 5 percent of GDP
- deposit freezes or bank holidays.

When both conditions are met a crisis is considered systemic. If just 2 types of measures from the list above were used, Laeven and Valencia (2012a) report it as a borderline case. All crises in the 1980-2007 period were systemic according to the above definition. In the recent global financial crisis 17 countries were classified as having a systemic banking crisis and 8 as borderline cases.

[7] An exception is Greece where the recession was still ongoing in 2012 Q2, which was the last available observation. For Greece the sample includes only recessionary quarters and no recovery quarter.

Table 1: Systemic banking crises in the period 1980-2007.

Country	Banking crisis start	Recession start	Systemic crisis date	Recession duration (quarters)	Bank restructuring time	Blanket guarantees time	Liquidity support	Monetary policy
Argentina	1980 Q1	1980 Q2	1980 Q2	11			0.3502	0.5042
Argentina	1989 Q4	1988 Q1	1989 Q4	10			2.6812	1.1842
Argentina	1995 Q1	1995 Q1	1995 Q1	3			0.6105	-0.0183
Argentina	2001 Q4	2001 Q2	2001 Q4	5			0.1042	0.0716
Bolivia	1994 Q4		1994 Q4					
Brazil	1990 Q1	1992 Q1	1990 Q1	4			0.0360	1.1258
Brazil	1994 Q4	1996 Q1	1994 Q4	4	-1		0.1944	0.1515
Bulgaria	1996 Q1	1996 Q1	1996 Q2	8	2		0.1149	0.4584
Chile	1981 Q4	1981 Q4	1983 Q1	5			0.1463	0.0323
Colombia	1982 Q3		1982 Q3					
Colombia	1998 Q2	1998 Q2	1998 Q2	5	4		0.0181	-0.0246
Cote d'Ivoire	1988 Q1	1990 Q1	1988 Q1	16			0.8600	0.0114
Croatia	1998 Q1	1998 Q4	1998 Q1	3	1		0.0231	0.0838
Czech Republic	1996 Q2	1997 Q1	1996 Q2	6	-1		0.0904	0.0236
Dominican Rep.	2003 Q2	2003 Q1	2003 Q2	4			0.3257	0.2109
Ecuador	1998 Q3	1998 Q3	1998 Q4	5	4	1	0.2544	-0.0174
Estonia	1992 Q4	1994 Q1	1992 Q4	5			0.0895	0.0440
Finland	1991 Q3	1990 Q2	1993 Q1	13	8	11	0.0606	
Ghana	1982 Q1	1981 Q1	1982 Q1	8			0.0011	0.1056
Indonesia	1997 Q4	1998 Q1	1997 Q4	2	4	0	0.1187	0.2115
Jamaica	1996 Q4	1997 Q3	1997 Q1	3	-2	-2	0.0037	0.1121
Japan	1997 Q4	1998 Q1	1997 Q4	2	0	-1	0.0131	0.0390
Korea	1997 Q3	1998 Q1	1997 Q4	2	0	-1	0.3078	-0.0222
Latvia	1995 Q2	1995 Q3	1995 Q2	7			0.0575	0.0361
Lithuania	1995 Q4		1995 Q4					
Malaysia	1997 Q3	1998 Q1	1998 Q1	3	0	0	0.0449	-0.1460
Mexico	1994 Q4	1995 Q1	1995 Q1	2	0	-5	0.2069	0.0597
Nicaragua	2000 Q3		2001 Q1					
Norway	1991 Q4		1991 Q4					
Paraguay	1995 Q2		1995 Q3					
Philippines	1997 Q3	1998 Q1	1998 Q1	4			0.0138	0.0374
Russia	1998 Q3		1999 Q1					
Sri Lanka	1989 Q1		1989 Q1					
Sweden	1991 Q3	1991 Q1	1992 Q3	9	9	6	0.0499	0.0458
Thailand	1997 Q3	1997 Q3	1997 Q4	5	1	0	0.0466	-0.0024
Turkey	2000 Q4	2001 Q1	2000 Q4	4	1	-1	0.1348	0.1074
Ukraine	1998 Q3	1993 Q1	1998 Q4	28			0.2586	0.3038
Uruguay	2002 Q1	1999 Q1	2002 Q2	16	14		0.1042	0.0109
Venezuela	1994 Q1	1994 Q1	1994 Q1	4	2		0.0147	0.1524
Vietnam	1997 Q4		1998 Q4					

BANKING CRISIS START is the quarter when major distress in the banking sector was observed. SYSTEMIC CRISIS DATE is the quarter when the conditions for a banking crisis to be classified as systemic were met. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECESSION DURATION is the duration in quarters of the recession that began at most 8 quarters after the start of a banking crisis or it began before it and was ongoing at the start of the banking crisis. BANK RESTRUCTURING TIME is the number of quarters a recession has already been ongoing when bank restructuring was done. A negative value means that bank restructuring was done before the recession started. If there was no bank restructuring, the value is missing. BLANKET GUARANTEES TIME is the number of quarters a recession has already been ongoing when blanket guarantees were put in place. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. MONETARY POLICY is the lagged quarterly growth rate in reserve money. For liquidity support and monetary policy average values per recession are reported.

Table 2: Systemic banking crises after 2007.

Country	Banking crisis start	Recession start	Systemic crisis date	Recession duration (quarters)	Bank restructuring time	Blanket guarantees time	Liquidity support	Monetary policy
Austria	2008 Q3	2008 Q3	2008 Q4	4	1	1	0.0884	0.0381
Belgium	2008 Q3	2008 Q3	2008 Q4	3	0	1	0.2473	0.0740
Denmark	2008 Q3	2008 Q3	2009 Q1	5	2	2	0.2940	0.0016
France	2008 Q3	2008 Q2		5		2	0.1022	0.0367
Germany	2008 Q3	2008 Q2	2009 Q4	4	3	2	0.1044	0.0651
Greece	2008 Q3	2008 Q2	2009 Q2	16	4	2	0.3008	0.0393
Hungary	2008 Q3	2008 Q3		6		1	0.0088	-0.0071
Iceland	2008 Q3	2008 Q3	2008 Q4	7	0	1	0.2237	0.1073
Ireland	2008 Q3	2008 Q1	2009 Q1	12	4	2	0.4833	0.0238
Italy	2008 Q3	2008 Q2		7		2	0.0285	0.0352
Kazakhstan	2008 Q3		2010 Q3					
Latvia	2008 Q3	2008 Q1	2008 Q4	9	2	3	0.0325	-0.0457
Luxembourg	2008 Q3	2008 Q3	2008 Q3	6	0	1	0.2346	0.0360
Mongolia	2008 Q3	2009 Q1	2009 Q4	4		-2	0.0921	0.0862
Netherlands	2008 Q3	2008 Q2	2008 Q4	5	1	2	0.0503	0.0367
Nigeria	2009 Q3		2011 Q4					
Portugal	2008 Q3	2008 Q1		5		3	0.0262	0.0558
Russia	2008 Q3	2008 Q4		2		0	0.2273	-0.0666
Slovenia	2008 Q3	2008 Q3		5		1	0.0488	0.0509
Spain	2008 Q3	2008 Q2	2011 Q2	7	16	2	0.0510	0.0352
Sweden	2008 Q3	2008 Q3		3		1	0.1328	0.3914
Switzerland	2008 Q3	2008 Q3		3			0.0281	0.2830
Ukraine	2008 Q3	2008 Q2	2009 Q2	4	5		0.0933	0.0457
United Kingdom	2007 Q3	2008 Q2	2008 Q4	5	1	2	0.0350	0.2147
United States	2007 Q4	2008 Q1	2008 Q4	6	2	3	0.0325	0.1248

For explanation see Table 1.

The Recession indicator

The recession indicator is the dependent variable in the duration models. It is equal to 0 if a country is in a recession in a given quarter and equal to 1 if it has just recovered from it. For countries that are not in a recession at the time of the banking crisis start, the start of the recession is defined as the first quarter with negative GDP growth after the start of the banking crisis. This quarter needs to be either part of a sequence of at least two consecutive negative growth quarters or if it is followed by a positive growth quarter, it should after that single quarter of positive growth be followed by a sequence of at least two negative growth quarters. A recession ends with two consecutive positive growth quarters that succeed a recession quarter.[8] The first of these two quarters is the recovery quarter in which the recession indicator has value 1. One positive growth quarter in a sequence of negative growth quarters is not considered a recovery. The recession period is composed of quarters with negative growth but may include few positive growth quarters within the sequence of negative growth quarters.[9] Such a definition is used as one positive growth quarter does not mean that a recession is really over. Applying this definition to

[8] An exception to the rule that two positive growth quarters mean a recession has ended, is made for Greece. The seasonally adjusted quarterly growth rates in third and fourth quarter of 2009 are positive. But because the recession has continued for many quarters afterwards these two positive quarters are considered part of the recession.

[9] Robustness checks are performed using a definition where only consecutive negative growth quarters are counted as a recession.

determine the start and end of the recent recession in the US gives the same dates as the ones announced by the National Bureau of Economic Research. NBER (2012) uses multiple indicators and judgment to define the date of a peak and a through. A recession is the period between a peak and a through. The recent recession in the US began with the peak in December 2007 and ended with the through in June 2009. In the first quarter of 2008 GDP growth was negative; in the second it was positive; then four quarters of negative growth followed. The recovery quarter was the third quarter of 2009. A recession is considered related to the banking crisis if it starts 8 quarters or less after the start of the banking crisis.[10]

Some countries are already in a recession in the quarter when the banking crisis starts. In these cases the negative growth quarters before the start of the banking crisis are counted as a part of the recession. If there is a positive growth quarter in the sequence of negative growth quarters before the start of the banking crisis, only the consecutive negative growth quarters that run up to the start of the banking crisis are counted as an existing recession. The pre-banking crisis period with alternating growth rates is not counted as a recession.[11] We use the GDP data from the International Financial Statistics database (IMF 2012a). For more details about the data see Appendix 2: Defining the start and end dates of recessions.

Bank restructuring

The bank restructuring variable is an indicator of whether major bank restructuring measures that include bank recapitalizations have been carried out in any of the quarters preceding the one for which the probability of recovery is analyzed. One quarter after bank restructuring was done and in all subsequent quarters of a crisis bank restructuring indicator has value 1. In the quarter in which it is done and all previous quarters it has value 0. The lag is used to allow at least one quarter time for bank restructuring to have an effect on the probability of recovery. For crises from 1980-2007 we construct the indicator values from the bank restructuring dates reported by Laeven and Valencia (2012b). We differ from their data in three cases where the restructuring date refers to measures that do not include bank recapitalizations. Table 11 in Appendix 3 lists the bank restructuring dates and the events, to which the dates refer.

For crises after 2007 our indicator values are based on information about dates and sizes of bank recapitalizations collected from various sources. In Table 12 in Appendix 3 we list for each country the quarter in which the first major bank restructuring in a crisis was done, and names of banks that received the largest amounts of recapitalization funds. Bank recapitalizations, which were relatively small relative to the GDP of a country, are not considered a major bank restructuring. The dates refer to the main bank restructuring that a country did in the banking crises. If there were first a few smaller recapitalizations and then a large one, the date is based on the large one. For the United Kingdom the nationalization of the Northern Rock in February 2008 is considered minor. The bank restructuring date refers to the recapitalization of the Royal Bank of Scotland Group and Lloyds Banking Group that were announced in

[10] Most recessions begin in the same quarter as the banking crisis started or earlier. Two recessions start in quarter 5 after the banking crisis start and two in quarter 8. All other begin at latest in quarter 3.

[11] Robustness checks are performed using a definition that counts also the pre-banking crisis period with negative growth quarters possibly interrupted by a positive quarter as a part of the recession.

October 2008. If there were two large recapitalizations, such as in Belgium (Fortis in September 2008 and Dexia in October 2011) the date is based on the first one.

Blanket guarantees

The indicator for blanket guarantees in quarter t is equal to 1 if blanket guarantees were in place in the preceding quarter. The lag is used in order to allow some time for the guarantees to have an effect on GDP growth. The variable values are based on the dates of introduction of blanket guarantees and dates of removal reported in (Laeven & Valencia 2012a). Appendix 4 reports these dates for the banking crises where blanket guarantees were used.

Liquidity support

Liquidity support is the ratio of claims of monetary authorities on deposit money banks to total deposits. The ratio is computed with end of quarter values and lagged one period. The data comes from the International Financial Statistics of the IMF (IMF 2012a). For details see Appendix 5: Data about liquidity support.

Monetary policy

The quarterly growth rate in reserve money is used as a proxy for monetary policy. In the regression analysis the growth rates are lagged one quarter. The source of data is the International Financial Statistics database (IMF 2012a). For details see Appendix 6: Data about monetary policy.

6. Results

The duration of recessions after systemic banking crises is analyzed with respect to four policies: bank restructuring measures, blanket guarantees on bank liabilities, liquidity support to banks and monetary policy. Table 3 reports the results of specification (12) estimated with a random effects complementary log-log procedure. The dependent variable is the recession indicator, having value 0 if a country is in a recession and value 1 if it has just recovered from a recession. The explanatory variables in the regressions are of three types. First, there the four policy variables. The estimated coefficients for the policy variables represent the effect of a policy on the hazard rate, which is the probability of recovery in a particular quarter conditional on that the recession has not ended before. A positive coefficient means that a higher value of explanatory variable increases the probability of recovery.

Second, there are averages of policy variables, averaged over all time periods of a particular recession. The purpose of these averages is to control for the fact that unobserved heterogeneity in crisis severity may be correlated to policy variables. If the estimated coefficients for averages of policy variables are statistically significant, the correlation between policy variables and unobserved heterogeneity is important. In this case estimating a specification without the averages of policy variables would result in biased estimates. Apart from that, the estimated coefficients of averages of policy variables do not have an interpretation. Third, a linear, quadratic and cubic term of elapsed duration are included to flexibly account for the possibility that the probability of recovery depends on how long a recession has already lasted.

Table 3: Estimation results of the effects of policy variables on the probability of recovery for the full sample of crises and the subsamples from the period 1980-2007 and after 2007.

Dependent variable: Recession indicator	Full sample (1)		1980-2007 crises (2)		Recent crisis (3)	
Bank restructuring	2.1962	***	2.3427	**	1.2781	
	(2.61)		(2.16)		(0.76)	
Blanket guarantees	-0.0787		-1.0430		1.3999	
	(-0.12)		(-0.90)		(0.94)	
Liquidity support	3.1820	**	5.6480	*	-3.4756	
	(2.19)		(1.95)		(-0.96)	
Monetary policy	-1.1474	*	-1.3667		-2.0488	
	(-1.67)		(-1.48)		(-1.45)	
Average of bank r. per crisis	-2.9404	**	-2.1086		-3.2018	
	(-2.34)		(-1.44)		(-1.27)	
Average of b. guar. per crisis	0.0865		2.2155		-4.5281	**
	(0.09)		(1.52)		(-1.99)	
Average of liq. supp. per crisis	-5.0643	***	-7.5321	**	3.5734	
	(-2.78)		(-2.23)		(0.83)	
Average of mon. pol. per crisis	1.4714		1.2722		6.5189	**
	(1.33)		(0.79)		(2.02)	
Duration	2.0321	***	2.4694	***	1.9262	*
	(3.64)		(3.02)		(1.74)	
Duration^2	-0.2566	***	-0.3295	***	-0.1691	
	(-3.21)		(-2.64)		(-1.09)	
Duration^3	0.0094	***	0.0132	**	0.0046	
	(2.90)		(2.54)		(0.70)	
Constant	-5.5728	***	-6.7267	***	-5.3973	**
	(-4.71)		(-3.94)		(-2.41)	
Observations	313		157		156	
Crises	49		26		23	
Log likelihood	-99.56		-44.70		-39.70	

RECESSION INDICATOR is the dependent variable having value 1 if a country has just recovered from a recession and 0 if it is in a recession in a particular quarter. A positive regression coefficient means that a higher value of the explanatory variable increases the probability of recovery. BANK RESTRUCTURING indicates whether bank restructuring has already been done. BLANKET GUARANTEES indicates whether blanket guarantees were present in the previous quarter. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. MONETARY POLICY is the lagged quarterly growth rate in reserve money. Averages of dependent variables are included to allow for correlation between unobserved heterogeneity and explanatory variables. DURATION is the number of quarters a recession has already been ongoing until the period for which the probability of recovery is estimated. The specifications are estimated using complementary log-log random effects procedure. In parentheses are z-values of the tests for significance of coefficients. Significance levels of 10%, 5%, and 1% are denoted by *, **, ***, respectively.

Table 3 reports the results estimated on three samples: the full sample of systemic banking crises from 1980 until 2012, and separately for the subsample of crises from the period 1980-2007 and the subsample from the recent crisis. The samples include crises in which the recession began up to 2 quarters before the start of the banking crisis or up to 8 after it. The start of the banking crisis is defined as the quarter when major distress in the banking sector was observed. Crises that did not have a recession or crises where the country was already in a recession for more than 2 quarters before the banking crises started, are not included. This cutoff is used to exclude recessions where the problems in the banking system are not an important determinant of the probability of recovery for a large part of recession duration. In Section 7 below, where we check the results for robustness, we present alternative specifications that also include crises with long recessions before the banking crises, and a specification based on a more conservative approach, with only the crises included where recessions had not started

before the banking distress was observed. These alternative specifications do not affect the results materially.

The estimated effects of bank restructuring and liquidity support on the probability of recovery are positive and significant for the full sample and the sample of 1980-2007 crises but not for the sample from the recent crisis alone. Blanket guarantees do not have a statistically significant effect. The estimated effect of expansive monetary policy is negative. Although only marginally significant, this effect of monetary policy seems to be in line with the prediction of Dell'Ariccia et al. (2012) who show that banks increase the riskiness of their assets in response to a reduction in real interest rates. A higher amount of lending induced by monetary expansion may not result in a faster recovery if banks respond by increasing leverage and allocating more assets to negative NPV but high variance projects.

The averages of policy variables are statistically significant for each policy in at least one sample. This confirms that policies are correlated to unobserved heterogeneity hence including their per crisis average values is necessary to obtain consistent estimates of the coefficients of interest. The time a recession has already been ongoing is clearly an important determinant of the probability that it ends now. All duration terms are highly significant in the estimation performed on the full sample. On the subsamples they have the same signs but lower significance levels, which should not come as a surprise given the smaller sample size. The linear term in the duration coefficient is positive, so the longer a recession has already lasted, the more likely it is to end in the current quarter. The quadratic term is negative, so the marginal effect of duration on exit probability decreases as crises last longer. In other words, recessions that have already lasted some time are likely to be long, so the probability of recovery is decreasing in the square of the duration (the marginal effect decreases linearly in crisis severity). But every recession ends at some point, so the effect of the cubic term is positive.

Among all policies the effect of bank restructuring is most significant. To evaluate its effect, we compute expected recession durations for two representative crises: a crisis representing the group of crises where bank restructuring was not done and a crisis representing the group where it was actually done. The reason for introducing two representative crises is that the two groups of crises differ in unobserved crisis severity. Banking crises where bank restructuring was done are much more severe than those where it was not done. From here on we use the expression *mild representative crisis* to refer to the representative crisis of the group where bank restructuring was not done and *severe representative crisis* to denote the representative crisis of the group where bank restructuring was done. Note that individual crises where bank restructuring was not done may be more severe than some crises where bank restructuring was done. On average, however, as shown in the following analysis crises where bank restructuring was never done were mild and those where it was done, were severe.

For both representative crises we compute the predicted recession duration if bank restructuring is done and if it is not done. One of the predictions should be close to the average of the realized recession durations for the group of crises to which the representative crisis refers. The other is the counterfactual, which would happen if a different decision had been taken regarding bank restructuring. The expected durations are computed using equations (13), (17) and (18). The inputs for conditional probabilities of recovery are the estimated coefficients from Table 3 and the values of explanatory variables of the two representative crises. The explanatory variable values of the severe (mild) representative crisis are simply the averages of explanatory variables of crises where bank restructuring was (was not) done. The only

explanatory variables of representative crises that are not averages and are not constant in all time periods of a representative crisis are the elapsed duration, which increases every quarter, and bank restructuring indicator. Bank restructuring indicator is equal to 0 in all recession quarters if the expected duration is computed for the case without bank restructuring. When we compute what the expected duration would be with bank restructuring, the value of the indicator is 0 in quarters $t=0$ and $t=1$, and equals 1 afterwards. This corresponds to the median time when bank restructuring was done in crises where it was carried out at some point. It is worth emphasizing that the explanatory variable average of bank restructuring (not to be confused with bank restructuring indicator), which in specification (12) captures the effect of bank restructuring correlated to unobserved crisis severity, is constant over all time periods. This enables us to analyze the effect of bank restructuring that is independent from crisis severity by changing the value of bank restructuring indicator, while keeping the component of bank restructuring correlated to crisis severity fixed. For the mild representative crisis the value of this component is equal to 0 in all time periods. For the severe representative crisis the value of the component is positive. For both the mild and the severe representative crises we compute the expected duration with bank restructuring indicator being equal to 0 or bank restructuring indicator turning to one at $t=2$. For some additional details and intermediate results in computing expected durations see Appendix 7: Computing expected durations.

Table 4: Expected recession durations for the mild representative crisis (representing the group of crises where bank restructuring was never done).

Mild representative crisis	Full sample (1)	1980-2007 crises (2)	Recent crisis (3)
Expected recession duration if no bank restructuring	5.98	7.80	5.26
Expected recession duration if bank restructuring	2.70	3.08	3.84
Difference in expected recession duration	3.28	4.72	1.42
Average observed recession duration	5.48	6.25	4.64

The expected durations are computed based on coefficients from Table 3. Average observed duration is the average of actual durations of recessions that are represented by the mild representative crisis.

Table 4 shows the expected durations for the mild representative crisis. The expected duration without bank restructuring is fairly close to the average observed recession duration of crises where bank restructuring was never done. For the full sample the average observed duration is 5.48 quarters and the predicted duration is 5.98 quarters. If bank restructuring was done, the expected duration of the representative crisis would be only 2.70 quarters, which is a reduction close to 50%. For the sample of crises in the period 1980-2007 the effect is even larger. For the recent crisis it is less pronounced.

Figure 2 depicts the predicted conditional probabilities of recovery for the mild representative crisis. The predicted probabilities are plotted from the beginning of the recession at $t=0$ until quarter $t=20$ when the predicted probability approaches 1. The predicted probability is initially very low. Then it increases. Later it falls and finally increases toward 1. The shape of the curve is such because of the effect of elapsed duration, which is modeled with a cubic function. This shape of the predicted probability is consistent with the observation that there are many short recession and some that last quite long but eventually end. Bank restructuring is done at $t=1$. At $t=2$ when it has an effect on the predicted

probability there is a huge jump in the probability of recovery. Until quarter $t=5$ the predicted probability almost reaches 1. If bank restructuring is not done it stays below 0.5 until $t=16$. As a consequence there is a substantial difference in expected duration with or without bank restructuring.

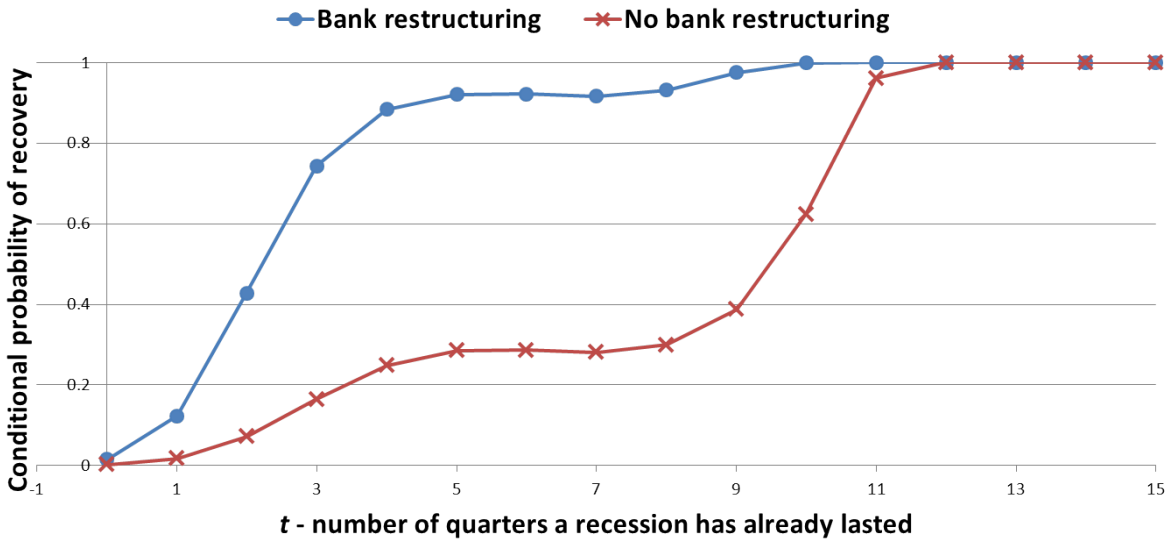

Figure 2: Predicted conditional probabilities with and without bank restructuring for the mild representative crisis (representing the group of crises where bank restructuring was never done).

Table 5 presents the expected durations for the severe representative crisis. The expected durations of the severe representative crisis are much longer than those of the mild representative crisis. This difference is due to the component of unobserved heterogeneity correlated to bank restructuring. The expected duration of the severe representative crisis is 5.00 quarters if bank restructuring is done. This is fairly close to the average realized recession duration for crises where bank restructuring was done (5.31 quarters). If bank restructuring was not done, the severe representative crisis would last 13.93 quarters, which is a large increase. The effect of bank restructuring on expected duration is large both on the full sample and the subsamples of the past and the recent crises.

Table 5: Expected recession durations for the severe representative crisis (representing the group of crises where bank restructuring was done).

	Full sample	1980-2007 crises	Recent crisis
Severe representative crisis	**(1)**	**(2)**	**(3)**
Expected recession duration if no bank restructuring	13.93	9.86	14.19
Expected recession duration if bank restructuring	5.00	3.55	8.03
Difference in expected recession duration	8.93	6.31	6.16
Average observed recession duration (quarters)	5.31	4.00	6.83

The expected durations are computed based on coefficients from Table 3. Average observed duration is the average of actual durations of recessions that are represented by the severe representative crisis.

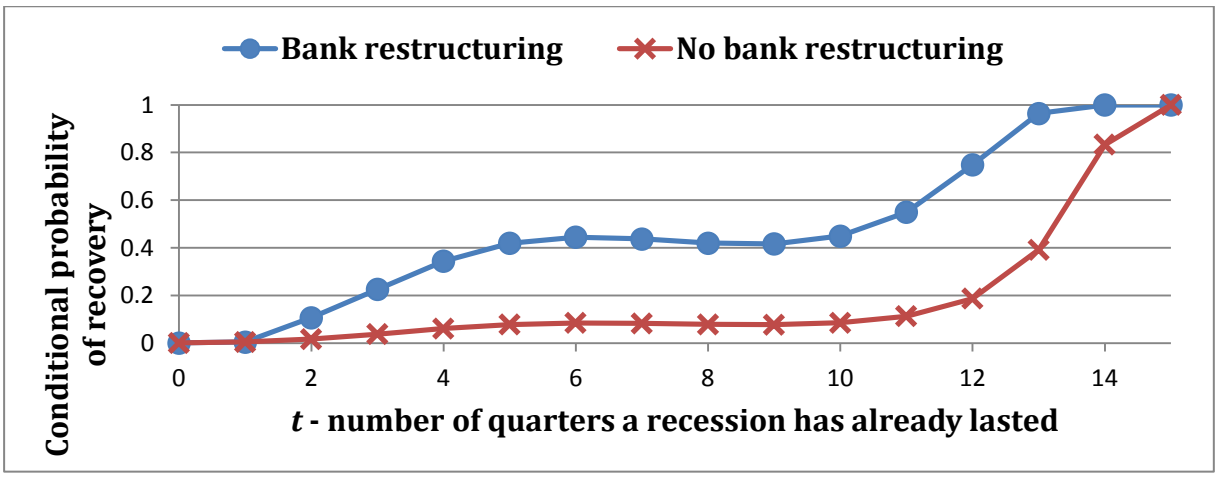

Figure 3: Predicted conditional probabilities with and without bank restructuring for the severe representative crisis (representing the group of crises where bank restructuring was done).

Figure 3 shows the predicted conditional probabilities of recovery of the severe representative crisis. When bank restructuring is done the predicted probability increases substantially from quarter $t = 2$ on. The shape of the curve is mainly affected by the duration dependence.

The effect of bank restructuring is striking. The difference it makes to the expected duration is substantial for both representative crises. In absolute terms the effect of bank restructuring is much larger for crises where it was actually done. This is not obvious from looking at the average realized duration in both groups of crises. It appears that recession duration is similar in both groups, 5.31 quarters in the group where it was done and 5.48 in the group where it was not. Only computing the expected durations, holding the level of unobserved crisis severity fixed, shows the magnitude of the effect of bank restructuring.

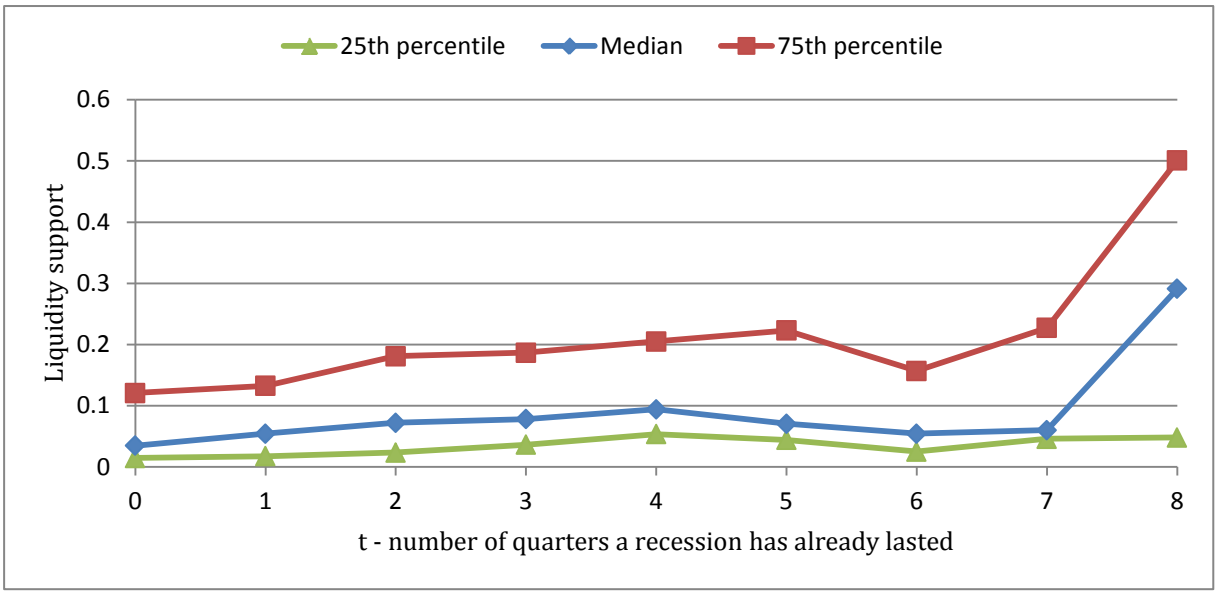

Figure 4: Liquidity support over time. The quartiles are reported for each time period of recessions up to $t = 8$ for the full sample of crises from Table 3.

Next, we analyze the effect of liquidity support on expected duration. Liquidity support is very high for some crises particularly when the recession has already lasted long. To determine the values of

liquidity support, at which to analyze its effect on expected duration, we plot the first quartile, the median and the third quartile of liquidity support measure for each time period up to $t = 8$ (Figure 4). The quartiles are computed for each t based on recessions with duration of at least t. In the bottom quartile liquidity support is always lower than 5% of total deposits with the exception of period $t = 4$. The median tends to be between 5% and 10% until the period $t = 8$. At the third quartile liquidity support is around 20% in most periods before it shoots up in the period $t = 8$ when only a few recessions remain. For $t > 8$ the values become higher but are not reported as the quantiles would be based only on very few crises.

Table 6: Expected recession durations for the mild and the severe representative crises.

	Liquidity support						
	0.00	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.50**
Mild representative crisis							
Expected recession duration if no bank restructuring	8.72	7.99	7.28	6.63	6.03	5.50	3.77
Expected recession duration if bank restructuring	3.22	3.08	2.95	2.82	2.71	2.61	2.19
Difference in expected recession duration	5.50	4.91	4.34	3.80	3.32	2.89	1.58
Severe representative crisis							
Expected recession duration if no bank restructuring	15.57	15.12	14.62	14.08	13.50	12.87	9.28
Expected recession duration if bank restructuring	6.67	6.08	5.56	5.11	4.72	4.39	3.33
Difference in expected recession duration	8.90	9.04	9.06	8.97	8.77	8.48	5.95

The expected durations are computed based on coefficients from Table 3 for the full sample of crises.

Table 6 reports the expected durations at different values of liquidity support computed for both representative crises, with and without bank restructuring. The possible values of liquidity support are chosen in order to cover the relevant range of observed liquidity support. The expected durations are computed assuming that the ratio of liquidity support is the same in all time periods of a recession. Liquidity support reduces the expected recession duration. A change in liquidity support from 5% to 20%, which roughly corresponds to the difference in liquidity support between the first and the third quartile of crises, reduces the expected duration of the mild representative crisis by almost 2 quarters. But if in this crisis bank restructuring was done, the effect of liquidity support would be a reduction of less than half a quarter because bank restructuring reduces recession duration for about 4 quarters for such a crisis. For the severe representative crisis increasing liquidity support from 5% to 20% reduces the expected duration approximately by 1.5 quarter regardless of whether bank restructuring is done or not. In the severe representative crisis bank restructuring reduces expected duration for about 8 quarters, substantially more than liquidity support.

The main difference between bank restructuring on one side and blanket guarantees and liquidity support on the other is that bank restructuring improves banks' portfolio management incentives while liquidity support and blanket guarantees only reduce the probability of bank failures. Guaranteeing bank liabilities and providing them with liquidity enables weak banks to continue operating. Such banks increasingly have incentives to take extreme risks and gamble for resurrection.

Table 7: Estimation of the effects of policies on the probability of recovery. A common indicator is used for extensive liquidity support and for blanket guarantees.

Dependent variable: Recession indicator	Full sample (1)		1980-2007 crises (2)		Recent crisis (3)
Bank restructuring	2.2262	***	2.6998	***	1.8563
	(2.75)		(2.71)		(1.14)
Ext. liq. support or b. guar.	0.4528		0.3602		0.7439
	(0.79)		(0.46)		(0.49)
Monetary policy	-0.8833		-0.5020		-1.6916
	(-1.15)		(-0.58)		(-1.24)
Average of bank r. per crisis	-2.9131	**	-2.1477		-3.8360
	(-2.42)		(-1.59)		(-1.50)
Average of ext. liq. supp. or b. guar. p.c.	-0.8397		-0.2708		-2.0386
	(-1.05)		(-0.27)		(-1.07)
Average of mon. pol. per crisis	1.0813		-0.2230		7.3040
	(1.01)		(-0.16)		(1.95)
Duration	1.8912	***	2.0275	***	2.1855
	(3.59)		(2.86)		(1.85)
Duration^2	-0.2434	***	-0.2683	**	-0.2177
	(-3.20)		(-2.53)		(-1.32)
Duration^3	0.0090	***	0.0104	**	0.0063
	(2.90)		(2.37)		(0.89)
Constant	-5.3187	***	-5.8958	***	-6.4920
	(-4.87)		(-4.05)		(-2.67)
Observations	313		157		156
Crises	49		26		23
Log likelihood	-103.42		-51.29		-41.97

RECESSION INDICATOR is the dependent variable having value 1 if a country has just recovered from a recession and 0 if it is in a recession in a particular quarter. A positive regression coefficient means that a higher value of the explanatory variable increases the probability of recovery. BANK RESTRUCTURING indicates whether bank restructuring has already been done. EXTENSIVE LIQUIDITY SUPPORT OR BLANKET GUARANTEES takes value 1 if either blanket guarantees were present or liquidity support was extensive. Liquidity support is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. It is considered extensive if it is 5 percentage points larger than in the quarter before the banking crisis started. MONETARY POLICY is the lagged quarterly growth rate in reserve money. Averages of dependent variables are included to allow for correlation between unobserved heterogeneity and explanatory variables. DURATION is the number of quarters a recession has already been ongoing until the period for which the probability of recovery is estimated. The specifications are estimated using complementary log-log random effects procedure. In parentheses are z-values of the tests for significance of coefficients. Significance levels of 10%, 5%, and 1% are denoted by *, **, ***, respectively.

To compare the effect of bank restructuring with the effect of liquidity support and blanket guarantees together, we construct a new indicator, which takes value 1 if either liquidity support is extensive or blanket guarantees are present in a particular quarter. Laeven and Valencia (2012a) consider liquidity support to be extensive if it exceeds 5% of total deposits. We define liquidity support as extensive if it is 5 percentage points higher than the level in the quarter before the banking crisis has started. For most crises using either of the definitions does not make a difference. For some crises liquidity support is already high in the quarter before a banking crisis starts; in these cases looking at the change is more appropriate. The indicator is lagged one quarter, which means that it indicates the presence of blanket guarantees or extensive liquidity support in the quarter before the one, for which the probability of recovery is analyzed. Blanket guarantees or extensive liquidity support are on average present in 53% of quarters in crises without bank restructuring and 65% of quarters in crises with bank restructuring. In Table 7, regression (12) is estimated on the same samples as in Table 3 but instead of the indicator for blanket guarantees and the continuous measure of liquidity support the common indicator is used. The effect of bank restructuring is again highly significant. The estimated coefficients for the indicator of blanket guarantees or extensive liquidity support are positive but are not significant.

Table 8: Expected recession durations for the mild and severe representative crises at different values of the indicator for blanket guarantees or extensive liquidity support.

	Blanket guarantees or extensive liquidity support		
	Never	**Sample average**	**Always**
Mild representative crisis	**0**	**0.6524**	**1**
Expected recession duration if no bank restructuring	6.81	5.87	5.19
Expected recession duration if bank restructuring	2.75	2.58	2.45
Difference in expected recession duration	4.07	3.30	2.74

	Blanket guarantees or extensive liquidity support		
	Never	**Sample average**	**Always**
Severe representative crisis	**0**	**0.5369**	**1**
Expected recession duration if no bank restructuring	15.17	14.22	13.66
Expected recession duration if bank restructuring	6.02	5.09	4.69
Difference in expected recession duration	9.14	9.13	8.97

The expected durations are computed based on coefficients from Table 7 for the full sample of crises.

Table 8 reports the expected duration for representative crises for three cases: if blanket guarantees or liquidity support are not present in any quarter, if at least one of them is present in all quarters and if their indicator has the average value in all quarters. For all of these cases expected recession duration is computed with and without bank restructuring for both representative crises. The presence of blanket guarantees or extensive liquidity support in all quarters reduces expected recession duration of the mild representative crisis by 1.6 quarters if bank restructuring is not done and by just 0.3 quarters if it is done. The duration of the severe representative crisis is reduced by 1.5 quarter if bank restructuring is not done and by 1.3 if it is done. Altogether, bank restructuring reduces recession duration much more than blanket guarantees or extensive liquidity support.

7. Robustness checks

The main result is that the effect of bank restructuring on the probability of recovery is positive and highly significant and that bank restructuring substantially reduces the expected duration of recessions. To assess the robustness of these findings, we report in this section on the estimation results using different estimation procedures, recession definitions and rules for including crises with long recessions that had started before there was distress in the banking sector. In all tables of the robustness checks, we report regression estimates and expected recession durations for both representative crises. The results of the robustness checks should be compared to the estimates in column (1) of Table 3 and the expected durations in Table 4 and Table 5. Tables with complete estimation results are listed in Appendix 8. Here we only summarize the results.

First, we check robustness with respect to a different assumption about the distribution of the error term in equation (12). We compare the estimates of the complementary log-log estimation with estimates of the logit and the linear probability model. The first two differ in the underlying assumption about the structure of the duration process (continuous for complementary log-log and discrete for logit) and the third one is an approximation that does not guarantee that the LHS variable remains in the $\left[0,1\right]$ interval and as such may produce irregular predictions that cannot be interpreted as hazard rates. The

signs of the significant coefficients of policies are the same under all three distributional assumptions. The significance levels and coefficient values of the logit estimation are close to the ones of the complementary log-log. The estimated coefficients of the linear probability model are less significant. Bank restructuring remains significant. The expected durations computed from the logit estimation are very close to the ones based on the complementary log-log estimates. The expected durations from the linear probability model are different because predicting the probabilities with a linear probability model is less precise. The probabilities outside of the $\left[0,1\right]$ interval need to be capped at the bounds. Estimation results are reported in Table 20 of Appendix 8.

Second, we run the estimations and compute recession durations using different rules for inclusion of recessions that started before the problems in the banking sector were observed, into the sample for estimation. In the main results in Table 3 we include recessions that started up to 2 quarters before the distress in the banking sector. In Table 21 in Appendix 8 we perform estimations with: (1) recessions that started in the same quarter as the banking crisis or after it, (2) recessions that started up to 4 quarters before the banking crisis, (3) all recessions but with their pre-banking crisis recession duration capped at 8 quarters. We also perform estimations without capping the pre-banking crisis recession duration but do not report them. Such estimates are biased toward a too large effect of policies used in banking crises. These recessions were not long because of the absence of policies but for other reasons. The estimated coefficients are similar regardless of the cutoff. The significance level and the size of the bank restructuring coefficients tend to increase with including more recessions. Also the expected durations are longer when recessions that began before the banking crisis start are included. These recessions tend to be longer than the ones that began after the banking crisis start.

Third, we use an alternative recession definition, under which it is not necessary that a recession includes two consecutive quarters with negative growth. A sequence of a negative, a positive and a negative growth quarter is also considered a recession with duration equal to 3 quarters. This rule is applied to recessions that started after the banking crisis and also to the part of recessions before the banking crisis. In Table 22 of Appendix 8 estimations using this definition and different cutoff rules are performed. The expected durations are close to those from Table 4 and Table 5. The effect of bank restructuring is significant except when all crises with recessions that started before the banking crisis start are excluded. Since this recession definition tends to count to many quarters as a recession a strict cutoff rule results in a small sample and an insignificant estimate for bank restructuring.

Fourth, we perform estimations with a definition of recession that counts only consecutive negative growth quarters as a part of recession. Again we use different cutoffs for including recessions that started before banking crises. The effect of bank restructuring remains positive and significant. The expected durations are shorter than in main results because the stricter rule on what counts as a part of a recession leads to shorter recession durations. Estimation results are reported in Table 23 of Appendix 8.

8. Conclusions

We show that it matters how Governments intervene in systemic banking crises. Bank restructuring measures that provide banks with incentives to liquidate or restructure bad loans, significantly accelerate the recovery from recessions related to banking crises. In contrast, blanket

guarantees and liquidity support only prevent bank failures. They enable zombie banks to hold on to bad loans, gambling that those loans will repay with some small probability. Sticking to bad loans is a value-destroying decision; bank shareholders opt for it because they can shift risk on debtholders or the Government. Ultimately such behavior of banks leads to lower aggregate output.

We analyze the effect of intervention measures on the duration of recessions after 65 systemic banking crises in the period 1980-2012. We estimate a duration model with recession specific fixed effects on a panel dataset. The main advantage of our approach is that it deals with the problem of endogeneity of policies. It allows for any type of correlation between time-invariant crisis severity and intervention measures. Our estimations confirm that controlling for crisis severity is crucial. We find a positive and highly significant effect of bank restructuring on the probability of recovery. The effect of liquidity support is also positive but less strong. Blanket guarantees and expansive monetary policy do not to have a significant effect.

The second advantage of our approach is that we can compute expected durations at different values of policy variables while keeping crisis severity constant. This shows dramatic results. Bank restructuring reduces expected recession duration by a half. On first sight, crises where bank restructuring was done and those where it was not, look similar; on average both types of crises lasted between 5 and 6 quarters. The difference in their severity and the scale of the effect of bank restructuring become obvious when we compute the counterfactual expected durations. A typical crisis where bank restructuring was not done would last only 2.7 quarters if restructuring had been done while a typical crisis where bank restructuring was done would go on for 14 quarters if it had not been done.

In the theoretical part of our paper we model the mechanism that explains the differential impact of bank recapitalization on bank incentives vs. all other interventions. A well-capitalized bank has an incentive to maximize the expected total payoff of a bad loan. A weakly capitalized bank, however, prefers to gamble on the highly unlikely repayment of the bad loan even though this is a negative NPV project. In stable times banks hold just enough capital to commit to take the right decision about bad loans else they could not raise debt. In a systemic banking crisis banks realize an unexpectedly high proportion of bad loans, which means their capital is no longer sufficient to incentivize them to optimally manage their portfolio. In such circumstances the regulator intervenes to prevent two types of inefficiencies: liquidation of good loans below their true value (triggered when depositors refuse to roll over) and continuation of bad loans, which destroys value. We show that timely and sufficient bank recapitalizations achieve both goals, while other types of intervention achieve only the first.

Thus we show that bank recapitalizations are the optimal intervention from an ex post perspective. An obvious extension to our model would be to argue in favor of higher capital requirements: holding more capital in stable times would reduce the need for intervention. Recapitalizations would not be necessary for low values of the shock to the proportion of bad loans. We leave questions about the interaction between ex ante incentives of intervention and maximization of ex post welfare for future research. It is equally tempting to speculate on the impact of our findings on the debate about the macroeconomic impact of stricter capital requirements. However it is likely that the manner in which capital requirements are met plays a role in that discussion; another topic for future research.

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Appendix 1: Modeling duration of a process

Duration is the length of time that a process lasts. Hazard rate measures the likelihood that the process will end now given that it has not ended before. Explanatory variables that increase the hazard rate reduce the expected duration. In a duration model where duration T_i is a continuous variable, the hazard rate is defined as the limit of the ratio between the probability that a process ends between time t and $t+h$ and the size of the interval h conditional on that it has not ended before t and conditional on explanatory variables x_{it}.

$$\lambda\left(t, x_{it}\right) = \lim_{h \downarrow 0} \frac{P\left(t \le T_i < t+h \mid T_i \ge t, x_{it}\right)}{h} \tag{19}$$

When the distribution of durations is discrete either because the process ends at discrete points in time or because the state of the process can only be observed discretely, the hazard rate is the probability that the process ends at time t conditional on that it has not ended before.

$$\lambda\left(t, x_{it}\right) = \Pr\left(T_i = t \mid T_i \ge t, x_{it}\right) = G\left(x_{it}\beta + \gamma_t\right) \tag{20}$$

The probability that the process ends depends on how long it has already lasted. Time dependence is modeled with γ_t, which can be a dummy for each time period or it is specified as a function of the elapsed duration $\gamma_t = \gamma\left(t\right)$. $G\left(\cdot\right)$ is a cumulative distribution function. If $G\left(\cdot\right)$ is the complementary log-log cumulative distribution function $G\left(z\right) = 1 - \exp\left(\exp\left(-z\right)\right)$, it can be assumed that the process is continuous but is only observed at discrete points in time. The model with complementary log-log distribution is a discrete time equivalent of the continuous time Cox (1972) model, which assumes that explanatory variables have a multiplicative effect on the hazard rate but does not impose any assumption on the basic form of the hazard rate $\lambda\left(u\right)$. In the Cox (1972) model continuous hazard rate is described as

$$\lambda\left(u, x_{it}\right) = \lambda\left(u\right)\exp\left(x_{it}\beta\right). \tag{21}$$

Integrating the continuous hazard rate between two points in time, gives the complementary log-log model.

$$\Pr\left(t \le T < t+1 \mid T \ge t, x_{it}\right) = 1 - \exp\left[-e^{x_{it}\beta}\int_t^{t+1}\lambda\left(u\right)du\right] = 1 - \exp\left(-e^{x_{it}\beta+\gamma_t}\right) = G\left(x_{it}\beta + \gamma_t\right) \tag{22}$$

where $\gamma_t = \ln\int_t^{t+1}\lambda\left(u\right)\,du$ and $G\left(r\right)$ is the complementary log-log cumulative distribution function $G\left(z\right) = 1 - \exp\left(-\exp\left(-z\right)\right)$.

The hazard rate in (20) can be expressed using y_{it} as the dependent variable, which is defined as an indicator of whether process i is still ongoing in period t.

$$y_{it} = \begin{cases} 1 & \text{process ends} \\ 0 & \text{process is ongoing} \end{cases}$$

With the indicator y_{it} the hazard rate (20) can be written as:

$$\lambda\left(t, x_{it}\right) = \Pr\left(y_{it} = 1 \mid y_{it-1} = 0, \ldots, y_{i1} = 0, x_{it}\right). \tag{23}$$

In the presence of unobserved heterogeneity c_i, which is the same in all periods of process i but varies over different processes, the hazard rate becomes:

$$\lambda\left(t, X_{i\{1,...,T\}}, c_i\right) = \Pr\left(y_{it} = 1 \mid y_{it-1} = 0, ..., y_{i1} = 0, X_{i\{1,...,T\}}, c_i\right). \tag{24}$$

In the general case with unobserved heterogeneity the hazard rate is conditioned on values of explanatory variables $X_{i\{1,...,T\}} = \left[x_{i1}, ..., x_{iT}\right]$ in all time periods. If x_{it} are strictly exogenous conditional on c_i, which means that x_{it} does not include lagged dependent variables and that future x_{it} do not depend on current or past values of the dependent variable, y_{it} can be conditioned only on current values of explanatory variables instead on values of $X_{i\{1,...,T\}}$ in all time periods.

$$\Pr\left(y_{it} = 1 \mid y_{it-1} = 0, ..., y_{i1} = 0, X_{i\{1,...,T\}}, c_i\right) = \Pr\left(y_{it} = 1 \mid y_{it-1} = 0, ..., y_{i1} = 0, x_{it}, c_i\right) = G\left(x_{it}\beta + \gamma_t + c_i\right) \tag{25}$$

A discrete duration model or a grouped duration model can be represented with a sequence of binary choice equations. A model of recession duration is a series of equations for the probability of recession ending in quarters $1,...,T$. The conditional density of $\left(y_{i1}, ..., y_{iT}\right)$ with unobserved heterogeneity is given by:

$$f\left(y_{i1}, ..., y_{iT} \mid X_{i\{1,...,T\}}, c_i, \beta, \gamma_t\right) = \prod_{t_i=1}^{T_i}\left[G\left(x_{it}\beta + \gamma_t + c_i\right)\right]^{y_{it}}\left[1 - G\left(x_{it}\beta + \gamma_t + c_i\right)\right]^{1-y_{it}}. \tag{26}$$

The first part of the expression is the probability that the process ends in period t, the second part is the probability that the process does not end in period t. Period T_i is the period when the process ends.

Appendix 2: Defining the start and end dates of recessions

Table 9 and Table 10 list recession start and recovery dates, the total recession duration, the duration of recession before banking crisis start and the source of GDP data for each crisis. The definitions of recession start and recovery dates are in the main text. Explanation about the data sources is below.

Table 9: Data about recessions for systemic banking crises in the period 1980-2007.

Country	Banking crisis start	Recession start	Recovery	Recession duration (quarters)	Duration of existing recession	Source of GDP data
Argentina	1980 Q1	1980 Q2	1983 Q1	11		IFS, Q_t/Q_{t-4}
Argentina	1989 Q4	1988 Q1	1990 Q3	10	7	IFS, Annual
Argentina	1995 Q1	1995 Q1	1995 Q4	3		IFS, s. adj. with X-12
Argentina	2001 Q4	2001 Q2	2002 Q3	5	2	IFS, s. adj. with X-12
Bolivia	1994 Q4					IFS, s. adj. with X-12
Brazil	1990 Q1	1992 Q1	1993 Q1	4		IFS, Annual
Brazil	1994 Q4	1996 Q1	1997 Q1	4		IFS, Annual
Bulgaria	1996 Q1	1996 Q1	1998 Q1	8		IFS, Annual
Chile	1981 Q4	1981 Q4	1983 Q1	5		IFS, s. adj. with X-12
Colombia	1982 Q3					IFS, Annual
Colombia	1998 Q2	1998 Q2	1999 Q3	5		IFS, s. adj. with X-12
Cote d'Ivoire	1988 Q1	1990 Q1	1994 Q1	16		IFS, Annual
Croatia	1998 Q1	1998 Q4	1999 Q3	3		IFS, s. adj. with X-12
Czech Republic	1996 Q2	1997 Q1	1998 Q3	6		IFS, s. adj. with X-12
Dominican Republic	2003 Q2	2003 Q1	2004 Q1	4	1	IFS, Annual
Ecuador	1998 Q3	1998 Q3	1999 Q4	5		IFS, s. adj. with X-12
Estonia	1992 Q4	1994 Q1	1995 Q2	5		IFS, s. adj. with X-12
Finland	1991 Q3	1990 Q2	1993 Q3	13	5	IFS, s. adj. with X-12
Ghana	1982 Q1	1981 Q1	1983 Q1	8	4	IFS, Annual
Indonesia	1997 Q4	1998 Q1	1998 Q3	2		IFS, s. adj. with X-12
Jamaica	1996 Q4	1997 Q3	1998 Q2	3		IFS, s. adj. with X-12
Japan	1997 Q4	1998 Q1	1998 Q3	2		IFS, s. adj.
Korea	1997 Q3	1998 Q1	1998 Q3	2		IFS, s. adj. with X-12
Latvia	1995 Q2	1995 Q3	1997 Q2	7		IFS, s. adj. with X-12
Lithuania	1995 Q4					IFS, s. adj. with X-12
Malaysia	1997 Q3	1998 Q1	1998 Q4	3		IFS, s. adj. with X-12
Mexico	1994 Q4	1995 Q1	1995 Q3	2		IFS, s. adj. with X-12
Nicaragua	2000 Q3					IFS, Annual
Norway	1991 Q4					IFS, s. adj. with X-12
Paraguay	1995 Q2					IFS, Annual
Philippines	1997 Q3	1998 Q1	1999 Q1	4		IFS, s. adj. with X-12
Russia	1998 Q3					IFS, s. adj. with X-12
Sri Lanka	1989 Q1					IFS, Annual
Sweden	1991 Q3	1991 Q1	1993 Q2	9	2	IFS, s. adj. with X-12
Thailand	1997 Q3	1997 Q3	1998 Q4	5		IFS, s. adj. with X-12
Turkey	2000 Q4	2001 Q1	2002 Q1	4		IFS, s. adj. with X-12
Ukraine	1998 Q3	1993 Q1	2000 Q1	28	22	WEO, Annual
Uruguay	2002 Q1	1999 Q1	2003 Q1	16	12	IFS, Annual
Venezuela	1994 Q1	1994 Q1	1995 Q1	4		IFS, Annual
Vietnam	1997 Q4					IFS, Annual

The list of banking crises and their starting dates are from Laeven and Valencia (2012a) dataset. BANKING CRISIS START is the quarter when major distress in the banking sector was observed. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECOVERY is the quarter when a country recovered from the recession. RECESSION DURATION is the duration in quarters of the recession that began at most 8 quarters after the start of a banking crisis or it began before it and was ongoing at the start of the banking crisis. DURATION OF EXISTING RECESSION reports how much of the recession duration refers to the period before the start of the banking crisis (only for crises where the recession began before the banking crisis).

Table 10: Data about recessions for systemic banking crises after 2007.

Country	Banking crisis start	Recession start	Recovery	Recession duration (quarters)	Duration of existing recession	Source of GDP data
Austria	2008 Q3	2008 Q3	2009 Q3	4		IFS, s. adj. with X-12
Belgium	2008 Q3	2008 Q3	2009 Q2	3		IFS, s. adj. with X-12
Denmark	2008 Q3	2008 Q3	2009 Q4	5		IFS, s. adj. with X-12
France	2008 Q3	2008 Q2	2009 Q3	5	1	IFS, s. adj.
Germany	2008 Q3	2008 Q2	2009 Q2	4	1	IFS, s. adj.
Greece	2008 Q3	2008 Q2		16	1	IFS, s. adj. with X-12
Hungary	2008 Q3	2008 Q3	2010 Q1	6		IFS, s. adj. with X-12
Iceland	2008 Q3	2008 Q3	2010 Q2	7		IFS, s. adj. with X-12
Ireland	2008 Q3	2008 Q1	2011 Q1	12	2	IFS, s. adj. with X-12
Italy	2008 Q3	2008 Q2	2010 Q1	7	1	IFS, s. adj.
Kazakhstan	2008 Q3					IFS, Annual
Latvia	2008 Q3	2008 Q1	2010 Q2	9	2	IFS, s. adj. with X-12
Luxembourg	2008 Q3	2008 Q3	2010 Q1	6		IFS, s. adj. with X-12
Mongolia	2008 Q3	2009 Q1	2010 Q1	4		IFS, s. adj. with X-12
Netherlands	2008 Q3	2008 Q2	2009 Q3	5	1	IFS, s. adj.
Nigeria	2009 Q3					WEO, Annual
Portugal	2008 Q3	2008 Q1	2009 Q2	5	2	IFS, s. adj. with X-12
Russia	2008 Q3	2008 Q4	2009 Q2	2		IFS, s. adj. with X-12
Slovenia	2008 Q3	2008 Q3	2009 Q4	5		IFS, s. adj. with X-12
Spain	2008 Q3	2008 Q2	2010 Q1	7	1	IFS, s. adj.
Sweden	2008 Q3	2008 Q3	2009 Q2	3		IFS, s. adj. with X-12
Switzerland	2008 Q3	2008 Q3	2009 Q2	3		IFS, s. adj.
Ukraine	2008 Q3	2008 Q2	2009 Q2	4	1	IFS, s. adj. with X-12
United Kingdom	2007 Q3	2008 Q2	2009 Q3	5		IFS, s. adj.
United States	2007 Q4	2008 Q1	2009 Q3	6		IFS, s. adj.

For explanation see Table 9.

We use the GDP data from the International Financial Statistics database (IMF 2012a). For 50 crises quarterly data is available; for 15 there is only annual data. We compute quarter on quarter growth rates from the GDP index with 2005 as the base year (IFS codes, IND2005 and IND2005SA). For a few countries GDP data in the IFS is already seasonally adjusted. For other countries we seasonally adjust the quarterly data with the X-12 ARIMA procedure provided by the US Census Bureau (2011). We use the plugin for Stata by Wang & Wu (2012) with the default settings for adjusting quarterly GDP data, described in their example. For countries for which quarterly GDP data is not available, we use annual data. In those cases we assume that a recession starts or ends in the first quarter of the year in which the change happened. For Ukraine and Nigeria GDP data is taken from the World Economic Outlook (IMF 2012b) as it is not available in the IFS for the required periods. For the banking crisis in Argentina starting in 1980 quarterly GDP data is available until 1980 Q4 but not afterwards. Recession start is based on quarterly growth rates over the same quarter of the previous year. Recession end is based on annual data.

Appendix 3: Bank restructuring dates

Table 11: Bank restructuring in systemic banking crises in the period 1980-2007.

Country	Banking crisis start	Recession start	Recovery	Bank restructuring	Description
Bolivia	1994 Q4			1995 Q3	
Brazil	1994 Q4	1996 Q1	1997 Q1	1995 Q4	Implementation of PROER
Bulgaria	1996 Q1	1996 Q1	1998 Q1	1996 Q3	Implementation of restructuring plan begins with placement in conservatorship of 9 banks
Colombia	1998 Q2	1998 Q2	1999 Q3	1999 Q2	FOGAFIN creates capitalization credit line
Croatia	1998 Q1	1998 Q4	1999 Q3	1999 Q1	Law grants new powers; used with Dubrovacka Banca
Czech Republic	1996 Q2	1997 Q1	1998 Q3	1996 Q4	Program started to sell non-performing loans
Ecuador	1998 Q3	1998 Q3	1999 Q4	1999 Q3	Release of international audits and actions against undercapitalized banks
Finland	1991 Q3	1990 Q2	1993 Q3	1992 Q2	GGF begins providing capital support
Indonesia	1997 Q4	1998 Q1	1998 Q3	1999 Q1	Bank recapitalization begins
Jamaica	1996 Q4	1997 Q3	1998 Q2	1997 Q1	FINSAC begins recapitalization plan
Japan	1997 Q4	1998 Q1	1998 Q3	1998 Q1	Strategy for bank recapitalization released
Korea	1997 Q3	1998 Q1	1998 Q3	1998 Q1	Bank recapitalization strategy begins, with funding approved at the National Assembly
Malaysia	1997 Q3	1998 Q1	1998 Q4	1998 Q1	Banking sector strengthening package is announced, including recapitalization
Mexico	1994 Q4	1995 Q1	1995 Q3	1995 Q1	Implementation of PROCAPTE
Norway	1991 Q4			1991 Q2	CGF begins injecting capital in large banks
Sweden	1991 Q3	1991 Q1	1993 Q2	1993 Q2	Government agency in charge of providing capital support to banks begins operations
Thailand	1997 Q3	1997 Q3	1998 Q4	1997 Q4	Special funds for bank restructuring approved
Turkey	2000 Q4	2001 Q1	2002 Q1	2001 Q2	Bank restructuring plan implemented, including recapitalization
Uruguay	2002 Q1	1999 Q1	2003 Q1	2002 Q3	Bank restructuring strategy begins after bank holiday
Venezuela	1994 Q1	1994 Q1	1995 Q1	1994 Q3	8 banks are intervened, closed, recapitalized or nationalized
Argentina	1980 Q1	1980 Q2	1983 Q1		no major bank restructuring
Argentina	1989 Q4	1988 Q1	1990 Q3		no major bank restructuring
Argentina	1995 Q1	1995 Q1	1995 Q4		no major bank restructuring
Argentina	2001 Q4	2001 Q2	2002 Q3		no major bank restructuring
Brazil	1990 Q1	1992 Q1	1993 Q1		no major bank restructuring
Chile	1981 Q4	1981 Q4	1983 Q1		no major bank restructuring
Colombia	1982 Q3				no major bank restructuring
Cote d'Ivoire	1988 Q1	1990 Q1	1994 Q1		no major bank restructuring
Dominican Republic	2003 Q2	2003 Q1	2004 Q1		no major bank restructuring
Estonia	1992 Q4	1994 Q1	1995 Q2		no major bank restructuring
Ghana	1982 Q1	1981 Q1	1983 Q1		no major bank restructuring
Latvia	1995 Q2	1995 Q3	1997 Q2		no major bank restructuring
Lithuania	1995 Q4				no major bank restructuring
Nicaragua	2000 Q3				no major bank restructuring
Paraguay	1995 Q2				no major bank restructuring
Philippines	1997 Q3	1998 Q1	1999 Q1		no major bank restructuring
Russia	1998 Q3				no major bank restructuring
Sri Lanka	1989 Q1				no major bank restructuring
Ukraine	1998 Q3	1993 Q1	2000 Q1		no major bank restructuring
Vietnam	1997 Q4				no major bank restructuring

The list of banking crises and their starting dates are from Laeven and Valencia (2012a) dataset. BANKING CRISIS START is the quarter when major distress in the banking sector was observed. SYSTEMIC CRISIS DATE is the quarter when the conditions for a banking crisis to be classified as systemic were met. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECOVERY is the quarter when a country recovered from the recession. BANK RESTRUCTURING DATE is the quarter in which the first major bank restructuring was carried out. The source of data is (Laeven & Valencia 2012b). DESCRIPTION provides some information about the restructuring program or the event to which bank restructuring date refers.

Laeven and Valencia (2012b) report also the crises in Argentina 1995, Philippines 1997 and Russia 1998 as having bank restructuring. In this paper these three crises are not considered as having bank restructuring as the gross amount spent on bank recapitalization during these crises was less than 0.5% of GDP as reported in Laeven and Valencia (2012a) dataset.

Table 12: Bank restructuring in systemic banking crises after 2007.

Country	Banking crisis start	Recession start	Recovery	Bank restructuring date	Description
Austria	2008 Q3	2008 Q3	2009 Q3	2008 Q4	Kommunalkredit Austria (November 2008), Hypo Group Alpe Adria (December 2008)
Belgium	2008 Q3	2008 Q3	2009 Q2	2008 Q3	Fortis (September 2008), Dexia (October 2011)
Denmark	2008 Q3	2008 Q3	2009 Q4	2009 Q1	Fionia (February 2009)
Germany	2008 Q3	2008 Q2	2009 Q2	2009 Q1	Hypo Real Estate, Commerzbank (January 2009)
Greece	2008 Q3	2008 Q2		2009 Q2	Agricultural Bank of Greece, National Bank of Greece, Aspis Bank, Geniki Bank, Millenium Bank, Proton Bank, Alpha Bank, Attica Bank, Piraeus Bank
Iceland	2008 Q3	2008 Q3	2010 Q2	2008 Q3	Glitnir, Landsbanki, Kaupthing, Staumur-Burdaras, SPRON, Icesave
Ireland	2008 Q3	2008 Q1	2011 Q1	2009 Q1	Allied Irish Bank, Bank of Ireland Group, announced February 11, 2009
Latvia	2008 Q3	2008 Q1	2010 Q2	2008 Q3	Parex (November 2008)
Luxembourg	2008 Q3	2008 Q3	2010 Q1	2008 Q3	Fortis (September 2008)
Netherlands	2008 Q3	2008 Q2	2009 Q3	2008 Q3	ING, ABN Amro, AEGON, SNS Reaal, October 2008
Nigeria	2009 Q3			2011 Q3	Afribank, Bank PHB, Springbank, August 2012
Spain	2008 Q3	2008 Q2	2010 Q1	2012 Q2	Bankia (May 2012)
Ukraine	2008 Q3	2008 Q2	2009 Q2	2009 Q3	Rodovid, Kyiv, Ukrgazbank, approved June 10, 2009
United Kingdom	2007 Q3	2008 Q2	2009 Q3	2008 Q3	Capital injections into RBS Group and Llyods Banking Group, announced October 8, 2008
United States	2007 Q4	2008 Q1	2009 Q3	2008 Q3	Capital injections under the TARP program, announced October 14, 2008
France	2008 Q3	2008 Q2	2009 Q3		no major bank restructuring
Hungary	2008 Q3	2008 Q3	2010 Q1		no major bank restructuring
Italy	2008 Q3	2008 Q2	2010 Q1		no major bank restructuring
Kazakhstan	2008 Q3				no major bank restructuring
Mongolia	2008 Q3	2009 Q1	2010 Q1		no major bank restructuring
Portugal	2008 Q3	2008 Q1	2009 Q2		no major bank restructuring
Russia	2008 Q3	2008 Q4	2009 Q2		no major bank restructuring
Slovenia	2008 Q3	2008 Q3	2009 Q4		no major bank restructuring
Sweden	2008 Q3	2008 Q3	2009 Q2		no major bank restructuring
Switzerland	2008 Q3	2008 Q3	2009 Q2		no major bank restructuring

The list of banking crises and their starting dates are from Laeven and Valencia (2012a) dataset. BANKING CRISIS START is the quarter when major distress in the banking sector was observed. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECOVERY is the quarter when a country recovered from the recession. BANK RESTRUCTURING DATE is the quarter in which the major bank recapitalizations were carried out. Under DESCRIPTION the most important bank recapitalizations of a crisis are listed. Crises without a date for bank restructuring had no or only minor bank recapitalizations that are not considered a major bank restructuring.

Appendix 4: Data about blanket guarantees

Table 13: Blanket guarantees in systemic banking crises.

Country	Banking crisis start	Recession start	Recovery	Blanket guarantees introduction	Blanket guarantees removal	Duration of blanket guarantees (in quarters)
Banking crises 1980-2007						
Ecuador	1998 Q3	1998 Q3	1999 Q4	1998 Q4	2002 Q1	13
Finland	1991 Q3	1990 Q2	1993 Q3	1993 Q1	1998 Q4	23
Indonesia	1997 Q4	1998 Q1	1998 Q3	1998 Q1	2005 Q3	30
Jamaica	1996 Q4	1997 Q3	1998 Q2	1997 Q1	1998 Q1	4
Japan	1997 Q4	1998 Q1	1998 Q3	1997 Q4	2005 Q2	30
Korea	1997 Q3	1998 Q1	1998 Q3	1997 Q4	2000 Q4	12
Malaysia	1997 Q3	1998 Q1	1998 Q4	1998 Q1	2005 Q3	30
Mexico	1994 Q4	1995 Q1	1995 Q3	1993 Q4	2003 Q1	37
Nicaragua	2000 Q3			2001 Q1	2002 Q3	6
Paraguay	1995 Q2			1995 Q3	1996 Q2	3
Sweden	1991 Q3	1991 Q1	1993 Q2	1992 Q3	1996 Q3	16
Thailand	1997 Q3	1997 Q3	1998 Q4	1997 Q3	2005 Q1	30
Turkey	2000 Q4	2001 Q1	2002 Q1	2000 Q4	2004 Q3	15
Banking crises after 2007						
Austria	2008 Q3	2008 Q3	2009 Q3	2008 Q4		
Belgium	2008 Q3	2008 Q3	2009 Q2	2008 Q4		
Denmark	2008 Q3	2008 Q3	2009 Q4	2009 Q1		
France	2008 Q3	2008 Q2	2009 Q3	2008 Q4		
Germany	2008 Q3	2008 Q2	2009 Q2	2008 Q4		
Greece	2008 Q3	2008 Q2		2008 Q4		
Hungary	2008 Q3	2008 Q3	2010 Q1	2008 Q4		
Iceland	2008 Q3	2008 Q3	2010 Q2	2008 Q4		
Ireland	2008 Q3	2008 Q1	2011 Q1	2008 Q3		
Italy	2008 Q3	2008 Q2	2010 Q1	2008 Q4		
Latvia	2008 Q3	2008 Q1	2010 Q2	2008 Q4		
Luxembourg	2008 Q3	2008 Q3	2010 Q1	2008 Q4		
Mongolia	2008 Q3	2009 Q1	2010 Q1	2008 Q3		
Netherlands	2008 Q3	2008 Q2	2009 Q3	2008 Q4		
Nigeria	2009 Q3			2009 Q4		
Portugal	2008 Q3	2008 Q1	2009 Q2	2008 Q4		
Russia	2008 Q3	2008 Q4	2009 Q2	2008 Q4		
Slovenia	2008 Q3	2008 Q3	2009 Q4	2008 Q4		
Spain	2008 Q3	2008 Q2	2010 Q1	2008 Q4		
Sweden	2008 Q3	2008 Q3	2009 Q2	2008 Q4		
United Kingdom	2007 Q3	2008 Q2	2009 Q3	2008 Q4		
United States	2007 Q4	2008 Q1	2009 Q3	2008 Q4		

The list of banking crises and all dates are from Laeven and Valencia (2012a) dataset. BANKING CRISIS START is the quarter when major distress in the banking sector was observed. SYSTEMIC CRISIS DATE is the quarter when the conditions for a banking crisis to be classified as systemic were met. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECOVERY is the quarter when a country recovered from the recession. Blanket guarantees INTRODUCTION is the quarter when blanket guarantees were introduced. If the date of their REMOVAL is known, the DURATION of the period with the blanket guarantees is computed.

Appendix 5: Data about liquidity support

Liquidity support is the ratio of claims of monetary authorities on deposit money banks to total deposits. The data is from the International Financial Statistics of the IMF. Depending on the time period the data is available under different items. For older periods the ratio is computed as claims of monetary authorities on other depository corporations (IFS code 12E__) divided by the sum of demand deposits at other depository corporations (IFS code 24__) and time, savings and foreign currency deposits at other depository corporations (IFS code 25___). For more recent crises the ratio is computed as claims of the central bank on other depository corporations (IFS code FASAD) divided by the sum of transferable deposits included in broad money (IFS code FOST) and other deposits included in broad money (IFS code FOSD).

For the United Kingdom the data is not available in the IFS therefore we use the data from the Bank of England (2012). The claims of Bank of England on other depository corporations are computed as the sum of long term reverse repos (item RPWB3J2), sterling standing facility assets (item RPWBL47) and short term sterling market operations (item RPWBL48) from the Banking department Assets of the Central Bank Balance Sheet (Bank of England 'Bank return'). The total deposits are computed as the sum of items: RPMTBFB, RPMTBFC, RPMTBFD, RPMTBFE, RPMTBFG, RPMTBFH, RPMTBFI, RPMTBFJ, RPMTBFK, RPMTBFL, RPMTBFM, RPMTFDG from Other bank's balance sheet.

For the Swedish crisis in 1991 the data about total deposits is not available after the last quarter of 1989. The data about the claims of the central bank on other depository corporations is available in the IFS. We use the value of deposits in 1989 Q4 as the denominator to compute the liquidity support ratio over the entire crisis period. The numerator changes every quarter. If the amount of deposits is reasonably stable using such an approximation is better than dropping the Swedish crisis from the sample.

For Jamaica the claims of the central bank on other depository corporations are reported to be 0 from 1995 Q2 to 2010 Q3. This suggests that there was no liquidity support in the crisis that started in 1996. Laeven and Valencia (2012a), however, report that the peak value of liquidity support in that crisis was 0.37%. Since 0.37% is very low, we use it as the value of liquidity support measure for Jamaica for the entire recession period.

Table 14: Liquidity support in systemic banking crises in the period 1980-2007.

Country	Banking crisis start	Recession start	Recovery	Liquidity support	Source of data about liquidity support
Argentina	1980 Q1	1980 Q2	1983 Q1	0.3502	IFS, items: 12E__, 24__, 25__
Argentina	1989 Q4	1988 Q1	1990 Q3	2.6812	IFS, items: 12E__, 24__, 25__
Argentina	1995 Q1	1995 Q1	1995 Q4	0.6105	IFS, items: 12E__, 24__, 25__
Argentina	2001 Q4	2001 Q2	2002 Q3	0.1042	IFS, items: 12E__, 24__, 25__
Bolivia	1994 Q4				IFS, items: 12E__, 24__, 25__
Brazil	1990 Q1	1992 Q1	1993 Q1	0.0360	IFS, items: 12E__, 24__, 25__
Brazil	1994 Q4	1996 Q1	1997 Q1	0.1944	IFS, items: 12E__, 24__, 25__
Bulgaria	1996 Q1	1996 Q1	1998 Q1	0.1149	IFS, items: FASAD, FOSD, FOST
Chile	1981 Q4	1981 Q4	1983 Q1	0.1463	IFS, items: 12E__, 24__, 25__
Colombia	1982 Q3				IFS, items: 12E__, 24__, 25__
Colombia	1998 Q2	1998 Q2	1999 Q3	0.0181	IFS, items: 12E__, 24__, 25__
Cote d'Ivoire	1988 Q1	1990 Q1	1994 Q1	0.8600	IFS, items: 12E__, 24__, 25__
Croatia	1998 Q1	1998 Q4	1999 Q3	0.0231	IFS, items: 12E__, 24__, 25__
Czech Republic	1996 Q2	1997 Q1	1998 Q3	0.0904	IFS, items: 12E__, 24__, 25__
Dominican Republic	2003 Q2	2003 Q1	2004 Q1	0.3257	IFS, items: FASAD, FOSD, FOST
Ecuador	1998 Q3	1998 Q3	1999 Q4	0.2544	IFS, items: 12E__, 24__, 25__
Estonia	1992 Q4	1994 Q1	1995 Q2	0.0895	IFS, items: 12E__, 24__, 25__
Finland	1991 Q3	1990 Q2	1993 Q3	0.0606	IFS, items: 12E__, 24__, 25__
Ghana	1982 Q1	1981 Q1	1983 Q1	0.0011	IFS, items: 12E__, 24__, 25__
Indonesia	1997 Q4	1998 Q1	1998 Q3	0.1187	IFS, items: 12E__, 24__, 25__
Jamaica	1996 Q4	1997 Q3	1998 Q2	0.0037	IFS, items: 12E__, 24__, 25__
Japan	1997 Q4	1998 Q1	1998 Q3	0.0131	IFS, items: 12E__, 24__, 25__
Korea	1997 Q3	1998 Q1	1998 Q3	0.3078	IFS, items: 12E__, 24__, 25__
Latvia	1995 Q2	1995 Q3	1997 Q2	0.0575	IFS, items: 12E__, 24__, 25__
Lithuania	1995 Q4				IFS, items: 12E__, 24__, 25__
Malaysia	1997 Q3	1998 Q1	1998 Q4	0.0449	IFS, items: 12E__, 24__, 25__
Mexico	1994 Q4	1995 Q1	1995 Q3	0.2069	IFS, items: 12E__, 24__, 25__
Nicaragua	2000 Q3				IFS, items: 12E__, 24__, 25__
Norway	1991 Q4				IFS, items: 12E__, 24__, 25__
Paraguay	1995 Q2				IFS, items: 12E__, 24__, 25__
Philippines	1997 Q3	1998 Q1	1999 Q1	0.0138	IFS, items: 12E__, 24__, 25__
Russia	1998 Q3				IFS, items: 12E__, 24__, 25__
Sri Lanka	1989 Q1				IFS, items: 12E__, 24__, 25__
Sweden	1991 Q3	1991 Q1	1993 Q2	0.0499	IFS, items: 12E__, 24__, 25__
Thailand	1997 Q3	1997 Q3	1998 Q4	0.0466	IFS, items: 12E__, 24__, 25__
Turkey	2000 Q4	2001 Q1	2002 Q1	0.1348	IFS, items: 12E__, 24__, 25__
Ukraine	1998 Q3	1993 Q1	2000 Q1	0.2586	IFS, items: 12E__, 24__, 25__
Uruguay	2002 Q1	1999 Q1	2003 Q1	0.1042	IFS, items: FASAD, FOSD, FOST
Venezuela	1994 Q1	1994 Q1	1995 Q1	0.0147	IFS, items: 12E__, 24__, 25__
Vietnam	1997 Q4				

The list of banking crises, starting dates and the dates when a banking crisis became systemic are from Laeven and Valencia (2012a) dataset. BANKING CRISIS START is the quarter when major distress in the banking sector was observed. SYSTEMIC CRISIS DATE is the quarter when the conditions for a banking crisis to be classified as systemic were met. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECOVERY is the quarter when a country recovered from the recession. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository institutions over the total deposits at other depository institutions. The reported values are averages over time for each recession. If a banking crisis did not have a recession no value is reported.

Table 15: Liquidity support in systemic banking crises after 2007.

Country	Banking crisis start	Recession start	Recovery	Liquidity support	Source of data about liquidity support
Austria	2008 Q3	2008 Q3	2009 Q3	0.0884	IFS, items: FASAD, FOSD, FOST
Belgium	2008 Q3	2008 Q3	2009 Q2	0.2473	IFS, items: FASAD, FOSD, FOST
Denmark	2008 Q3	2008 Q3	2009 Q4	0.2940	IFS, items: FASAD, FOSD, FOST
France	2008 Q3	2008 Q2	2009 Q3	0.1022	IFS, items: FASAD, FOSD, FOST
Germany	2008 Q3	2008 Q2	2009 Q2	0.1044	IFS, items: FASAD, FOSD, FOST
Greece	2008 Q3	2008 Q2		0.3008	IFS, items: FASAD, FOSD, FOST
Hungary	2008 Q3	2008 Q3	2010 Q1	0.0088	IFS, items: FASAD, FOSD, FOST
Iceland	2008 Q3	2008 Q3	2010 Q2	0.2237	IFS, items: FASAD, FOSD, FOST
Ireland	2008 Q3	2008 Q1	2011 Q1	0.4833	IFS, items: FASAD, FOSD, FOST
Italy	2008 Q3	2008 Q2	2010 Q1	0.0285	IFS, items: FASAD, FOSD, FOST
Kazakhstan	2008 Q3				IFS, items: FASAD, FOSD, FOST
Latvia	2008 Q3	2008 Q1	2010 Q2	0.0325	IFS, items: FASAD, FOSD, FOST
Luxembourg	2008 Q3	2008 Q3	2010 Q1	0.2346	IFS, items: FASAD, FOSD, FOST
Mongolia	2008 Q3	2009 Q1	2010 Q1	0.0921	IFS, items: FASAD, FOSD, FOST
Netherlands	2008 Q3	2008 Q2	2009 Q3	0.0503	IFS, items: FASAD, FOSD, FOST
Nigeria	2009 Q3				IFS, items: FASAD, FOSD, FOST
Portugal	2008 Q3	2008 Q1	2009 Q2	0.0262	IFS, items: FASAD, FOSD, FOST
Russia	2008 Q3	2008 Q4	2009 Q2	0.2273	IFS, items: FASAD, FOSD, FOST
Slovenia	2008 Q3	2008 Q3	2009 Q4	0.0488	IFS, items: FASAD, FOSD, FOST
Spain	2008 Q3	2008 Q2	2010 Q1	0.0510	IFS, items: FASAD, FOSD, FOST
Sweden	2008 Q3	2008 Q3	2009 Q2	0.1328	IFS, items: FASAD, FOSD, FOST
Switzerland	2008 Q3	2008 Q3	2009 Q2	0.0281	IFS, items: 12E__, 24__, 25__
Ukraine	2008 Q3	2008 Q2	2009 Q2	0.0933	IFS, items: FASAD, FOSD, FOST
United Kingdom	2007 Q3	2008 Q2	2009 Q3	0.0350	Bank of England
United States	2007 Q4	2008 Q1	2009 Q3	0.0325	IFS, items: FASAD, FOSD, FOST

For explanation see Table 14.

Appendix 6: Data about monetary policy

The proxy for monetary policy is the quarterly growth rate in reserve money. The source of data is the International Financial Statistics database (IMF 2012a).

Table 16: Monetary policy in systemic banking crises in the period 1980-2007.

Country	Banking crisis start	Recession start	Recovery	Monetary policy	Source of data about monetary policy
Argentina	1980 Q1	1980 Q2	1983 Q1	0.5042	IFS, item 14__
Argentina	1989 Q4	1988 Q1	1990 Q3	1.1842	IFS, item 14__
Argentina	1995 Q1	1995 Q1	1995 Q4	-0.0183	IFS, item 14__
Argentina	2001 Q4	2001 Q2	2002 Q3	0.0716	IFS, item 14__
Bolivia	1994 Q4				IFS, item 14__
Brazil	1990 Q1	1992 Q1	1993 Q1	1.1258	IFS, item 14__
Brazil	1994 Q4	1996 Q1	1997 Q1	0.1515	IFS, item 14__
Bulgaria	1996 Q1	1996 Q1	1998 Q1	0.4584	IFS, item FASMB
Chile	1981 Q4	1981 Q4	1983 Q1	0.0323	IFS, item 14__
Colombia	1982 Q3				IFS, item 14__
Colombia	1998 Q2	1998 Q2	1999 Q3	-0.0246	IFS, item 14__
Cote d'Ivoire	1988 Q1	1990 Q1	1994 Q1	0.0114	IFS, item 14__
Croatia	1998 Q1	1998 Q4	1999 Q3	0.0838	IFS, item 14__
Czech Republic	1996 Q2	1997 Q1	1998 Q3	0.0236	IFS, item 14__
Dominican Republic	2003 Q2	2003 Q1	2004 Q1	0.2109	IFS, item FASMB
Ecuador	1998 Q3	1998 Q3	1999 Q4	-0.0174	IFS, item 14__
Estonia	1992 Q4	1994 Q1	1995 Q2	0.0440	IFS, item 14__
Finland	1991 Q3	1990 Q2	1993 Q3		
Ghana	1982 Q1	1981 Q1	1983 Q1	0.1056	IFS, item 14__
Indonesia	1997 Q4	1998 Q1	1998 Q3	0.2115	IFS, item 14__
Jamaica	1996 Q4	1997 Q3	1998 Q2	0.1121	IFS, item 14__
Japan	1997 Q4	1998 Q1	1998 Q3	0.0390	IFS, item 14__
Korea	1997 Q3	1998 Q1	1998 Q3	-0.0222	IFS, item 14__
Latvia	1995 Q2	1995 Q3	1997 Q2	0.0361	IFS, item 14__
Lithuania	1995 Q4				IFS, item 14__
Malaysia	1997 Q3	1998 Q1	1998 Q4	-0.1460	IFS, item 14__
Mexico	1994 Q4	1995 Q1	1995 Q3	0.0597	IFS, item 14__
Nicaragua	2000 Q3				IFS, item 14__
Norway	1991 Q4				IFS, item 14__
Paraguay	1995 Q2				IFS, item 14__
Philippines	1997 Q3	1998 Q1	1999 Q1	0.0374	IFS, item 14__
Russia	1998 Q3				IFS, item 14__
Sri Lanka	1989 Q1				IFS, item 14__
Sweden	1991 Q3	1991 Q1	1993 Q2	0.0458	IFS, item 14__
Thailand	1997 Q3	1997 Q3	1998 Q4	-0.0024	IFS, item 14__
Turkey	2000 Q4	2001 Q1	2002 Q1	0.1074	IFS, item 14__
Ukraine	1998 Q3	1993 Q1	2000 Q1	0.3038	IFS, item 14__
Uruguay	2002 Q1	1999 Q1	2003 Q1	0.0109	IFS, item 14__
Venezuela	1994 Q1	1994 Q1	1995 Q1	0.1524	IFS, item 14__
Vietnam	1997 Q4				IFS, item 14__

The list of banking crises, starting dates and the dates when a banking crisis became systemic are from Laeven and Valencia (2012a) dataset. BANKING CRISIS START is the quarter when major distress in the banking sector was observed. RECESSION START is the quarter, in which the recession related to a particular banking crisis started. RECOVERY is the quarter when a country recovered from the recession. MONETARY POLICY is the lagged quarterly growth rate in reserve money. The reported values are averages over time for each recession. If a banking crisis did not have a recession no value is reported.

When available the item Monetary Base (IFS code FASMB) from the Central Bank Survey is used. For older time periods the item Reserve Money (IFS code 14__) from the Non-standardized Presentation in the Central Bank Survey is used. For Eurozone countries the data comes from European Central Bank Statistical Data Warehouse (ECB 2012), item Base money (sum of L010 & L021 & L022).

Table 17: Monetary policy in systemic banking crises after 2007.

Country	Banking crisis start	Recession start	Recovery	Monetary policy	Source of data about monetary policy
Austria	2008 Q3	2008 Q3	2009 Q3	0.0381	ECB: Base money
Belgium	2008 Q3	2008 Q3	2009 Q2	0.0740	ECB: Base money
Denmark	2008 Q3	2008 Q3	2009 Q4	0.0016	IFS, item FASMB
France	2008 Q3	2008 Q2	2009 Q3	0.0367	ECB: Base money
Germany	2008 Q3	2008 Q2	2009 Q2	0.0651	ECB: Base money
Greece	2008 Q3	2008 Q2		0.0393	ECB: Base money
Hungary	2008 Q3	2008 Q3	2010 Q1	-0.0071	IFS, item FASMB
Iceland	2008 Q3	2008 Q3	2010 Q2	0.1073	IFS, item FASMB
Ireland	2008 Q3	2008 Q1	2011 Q1	0.0238	ECB: Base money
Italy	2008 Q3	2008 Q2	2010 Q1	0.0352	ECB: Base money
Kazakhstan	2008 Q3				IFS, item FASMB
Latvia	2008 Q3	2008 Q1	2010 Q2	-0.0457	IFS, item FASMB
Luxembourg	2008 Q3	2008 Q3	2010 Q1	0.0360	ECB: Base money
Mongolia	2008 Q3	2009 Q1	2010 Q1	0.0862	IFS, item FASMB
Netherlands	2008 Q3	2008 Q2	2009 Q3	0.0367	ECB: Base money
Nigeria	2009 Q3				IFS, item FASMB
Portugal	2008 Q3	2008 Q1	2009 Q2	0.0558	ECB: Base money
Russia	2008 Q3	2008 Q4	2009 Q2	-0.0666	IFS, item FASMB
Slovenia	2008 Q3	2008 Q3	2009 Q4	0.0509	ECB: Base money
Spain	2008 Q3	2008 Q2	2010 Q1	0.0352	ECB: Base money
Sweden	2008 Q3	2008 Q3	2009 Q2	0.3914	IFS, item FASMB
Switzerland	2008 Q3	2008 Q3	2009 Q2	0.2830	IFS, item 14__
Ukraine	2008 Q3	2008 Q2	2009 Q2	0.0457	IFS, item FASMB
United Kingdom	2007 Q3	2008 Q2	2009 Q3	0.2147	IFS, item 14__
United States	2007 Q4	2008 Q1	2009 Q3	0.1248	IFS, item FASMB

For explanation see Table 16.

Appendix 7: Computing expected durations

We compute expected durations in three steps. We begin by computing predicted conditional probabilities of recovery using equation (13) for each of the possible durations. Then we calculate the unconditional probabilities of recovery with equation (17). And finally we compute the expected durations with equation (18). We set the limit up to which we compute predicted conditional probabilities at 100, which is well above the point where the unconditional probabilities of recessions lasting until then become negligibly low. At around 20 they fall below 10^{-20}. Table 18 presents the intermediate results for the mild representative crisis for the full sample. These results refer to expected durations reported in column (1) in Table 4. Table 19 reports the intermediate results for the severe representative crisis, relating to column (1) of Table 5.

Table 18: Predicted probabilities of recovery for the mild representative crisis (representing the group of crises where bank restructuring was never done).

	Conditional probability of recovery in quarter *t*		**Unconditional probability of recovery in quarter *t***		**Contribution to expected duration**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Duration	**No bank r.**	**Bank r.**	**No bank r.**	**Bank r.**	**No bank r.**	**Bank r.**
0	0.0027	0.0027	0.0027	0.0027	0	0
1	0.0160	0.0160	0.0159	0.0159	0.0159	0.0159
2	0.0590	0.4210	0.0579	0.4132	0.1158	0.8264
3	0.1424	0.7487	0.1315	0.4254	0.3945	1.2762
4	0.2405	0.9157	0.1905	0.1307	0.7619	0.5229
5	0.3087	0.9638	0.1857	0.0116	0.9285	0.0580
6	0.3249	0.9708	0.1351	0.0004	0.8106	0.0025
7	0.2958	0.9573	0.0830	0.0000	0.5812	0.0001
8	0.2425	0.9177	0.0479	5.0E-07	0.3835	0.0000
9	0.1865	0.8437	0.0279	3.8E-08	0.2513	0.0000
10	0.1413	0.7457	0.0172	5.2E-09	0.1721	5.2E-08
11	0.1113	0.6540	0.0116	1.2E-09	0.1281	1.3E-08
12	0.0966	0.5990	0.0090	3.7E-10	0.1078	4.4E-09
13	0.0977	0.6033	0.0082	1.5E-10	0.1067	1.9E-09
14	0.1213	0.6875	0.0092	6.7E-11	0.1287	9.4E-10
15	0.1927	0.8540	0.0128	2.6E-11	0.1924	3.9E-10
16	0.3890	0.9881	0.0209	4.4E-12	0.3345	7.1E-11
17	0.8115	1.0000	0.0267	5.3E-14	0.4531	0
18	0.9998	1	0.0062	1.6E-20	0.1115	0
19	1	1	9.4E-07	0	0	0
20	1	1	0	0	0	0
21	1	1	0	0	0	0
22	1	1	0	0	0	0
23	1	1	0	0	0	0
24	1	1	0	0	0	0
25	1	1	0	0	0	0
Sum			1.0000	1.0000	5.9781	2.7021

DURATION is the number of quarters a recession has already been ongoing until the quarter, for which the probability of recovery is predicted. CONDITIONAL probability of recovery is the predicted probability of recovery conditional on that the recession has not ended before. UNCONDITIONAL probability of recovery is the predicted probability that the recession does not end in any of the of the quarters before *t* and it ends in quarter *t*. CONTRIBUTION to expected duration is the product of *t* and the unconditional probability that *t* is the realized recession duration. Summing up the column contribution to expected duration gives the expected duration. In columns (1), (3) and (5) the predicted values are computed assuming that bank restructuring is not done. In columns (2), (4) and (6) the predicted values are computed assuming that bank restructuring is done in done quarter $t=1$ and has an effect on the probability of recovery from quarter $t=2$ on.

Table 19: Predicted probabilities of recovery for the severe representative crisis (representing the group of crises where bank restructuring was done).

	Conditional probability of recovery in quarter *t*		Unconditional probability of recovery in quarter *t*		Contribution to expected duration	
	(1)	(2)	(3)	(4)	(5)	(6)
Duration	No bank r.	Bank r.	No bank r.	Bank r.	No bank r.	Bank r.
0	0.0004	0.0004	0.0004	0.0004	0.0000	0.0000
1	0.0026	0.0026	0.0026	0.0026	0.0026	0.0026
2	0.0096	0.0831	0.0096	0.0096	0.0191	0.0191
3	0.0241	0.1968	0.0238	0.1943	0.0713	0.5830
4	0.0427	0.3246	0.0412	0.2574	0.1646	1.0297
5	0.0569	0.4094	0.0525	0.2193	0.2624	1.0967
6	0.0604	0.4291	0.0526	0.1357	0.3155	0.8144
7	0.0541	0.3936	0.0442	0.0711	0.3097	0.4977
8	0.0431	0.3271	0.0333	0.0358	0.2666	0.2866
9	0.0322	0.2550	0.0238	0.0188	0.2145	0.1692
10	0.0239	0.1953	0.0171	0.0107	0.1710	0.1072
11	0.0186	0.1550	0.0130	0.0068	0.1426	0.0753
12	0.0160	0.1350	0.0110	0.0050	0.1317	0.0605
13	0.0162	0.1364	0.0109	0.0044	0.1420	0.0573
14	0.0203	0.1685	0.0135	0.0047	0.1889	0.0658
15	0.0334	0.2631	0.0217	0.0061	0.3258	0.0915
16	0.0752	0.5048	0.0473	0.0086	0.7565	0.1380
17	0.2326	0.9075	0.1353	0.0077	2.2995	0.1305
18	0.7524	1.0000	0.3358	0.0008	6.0443	0.0141
19	1	1	0.1105	2.8E-09	2.1000	5.3E-08
20	1	1	6.0E-07	0	1.2E-05	0
21	1	1	0	0	0	0
22	1	1	0	0	0	0
23	1	1	0	0	0	0
24	1	1	0	0	0	0
25	1	1	0	0	0	0
Sum			1.0000	1.0000	13.9287	5.2392

For explanation see Table 18.

Appendix 8: Robustness checks

Table 20: Robustness check: comparing estimations with complementary log-log, logit and linear probability model with random effects.

Dependent variable: Recession indicator	Complementary log-log (1)		Logistic (2)		Linear probability (3)	
Bank restructuring	2.1962	***	2.3999	**	0.1199	*
	(2.61)		(2.33)		(1.87)	
Blanket guarantees	-0.0787		0.0057		0.0136	
	(-0.12)		(0.01)		(0.24)	
Liquidity support	3.1820	**	3.5900	**	0.2725	
	(2.19)		(2,00)		(1.05)	
Monetary policy	-1.1474	*	-1.3392	*	-0.1198	*
	(-1.67)		(-1.66)		(-1.72)	
Average of bank r. per crisis	-2.9404	**	-3.1051	**	-0.1438	**
	(-2.34)		(-2.09)		(-2.24)	
Average of b. guar. per crisis	0.0865		0.0338		-0.0021	
	(0.09)		(0.03)		(-0.03)	
Average of liq. supp. per crisis	-5.0643	***	-5.6182	***	-0.4890	*
	(-2.78)		(-2.61)		(-1.93)	
Average of mon. pol. per crisis	1.4714		1.6317		0.1177	
	(1.33)		(1.27)		(1.35)	
Duration	2.0321	***	2.3137	***	0.0978	***
	(3.64)		(3.60)		(3.13)	
Duration^2	-0.2566	***	-0.2970	***	-0.0097	
	(-3.21)		(-3.19)		(-1.36)	
Duration^3	0.0094	***	0.0110	***	0.0003	
	(2.90)		(2.89)		(0.74)	
Constant	-5.5728	***	-5.9760	***	0.0203	
	(-4.71)		(-4.43)		(0.63)	
Observations	313		313		313	
Crises	49		49		49	
Log likelihood	-99.56		-99.97			
Mild representative crisis						
Expected recession duration if no bank restructuring	5.98		6.08		5.25	
Expected recession duration if bank restructuring	2.70		2.84		3.89	
Difference in expected recession duration	3.28		3.24		1.36	
Severe representative crisis						
Expected recession duration if no bank restructuring	13.93		13.84		7.58	
Expected recession duration if bank restructuring	5.00		4.92		4.95	
Difference in expected recession duration	8.93		8.92		2.63	

The sample includes banking crises with recessions that began up to 8 quarters after the start of the banking crisis or up to 2 quarters before it in the period 1980-2012. RECESSION INDICATOR is the dependent variable having value 1 if a country has just recovered from a recession and 0 if it is in a recession in a particular quarter. A positive regression coefficient means that a higher value of the explanatory variable increases the probability of recovery. BANK RESTRUCTURING indicates whether bank restructuring has already been done. BLANKET GUARANTEES indicates whether blanket guarantees were present in the previous quarter. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. MONETARY POLICY is the lagged quarterly growth rate in reserve money. Averages of dependent variables are included to allow for correlation between unobserved heterogeneity and explanatory variables. DURATION is the number of quarters a recession has already been ongoing until the period for which the probability of recovery is estimated. In parentheses are z-values of the tests for significance of coefficients. Significance levels of 10%, 5%, and 1% are denoted by *, **, ***, respectively. Expected durations are computed for two types of representative crises using the estimates of each regression and explanatory variable values of representative crises being averages from the relevant sample.

Table 21: Robustness check: different cutoffs for including crises with existing recession into the estimation sample.

Dependent variable: Recession indicator	No existing recessions (1)		Existing rec. up to 4 quarters (2)		Existing rec. capped at 8 quarters (3)	
Bank restructuring	2.0624	**	2.2395	***	2.5152	***
	(2.26)		(2.65)		(3.39)	
Blanket guarantees	-1.1480		-0.0029		0.3163	
	(-1.37)		(0,00)		(0.46)	
Liquidity support	3.2754	*	3.0874	**	2.5273	*
	(1.93)		(2.13)		(1.86)	
Monetary policy	-1.0144		-1.0465		-0.9846	
	(-1.56)		(-1.63)		(-1.56)	
Average of bank r. per crisis	-2.4849	*	-2.9652	**	-3.4451	***
	(-1.94)		(-2.34)		(-2.97)	
Average of b. guar. per crisis	2.3231	**	0.1231		0.0352	
	(2,00)		(0.12)		(0.03)	
Average of liq. supp. per crisis	-5.6259	***	-4.8372	***	-2.9881	**
	(-2.74)		(-2.67)		(-2.02)	
Average of mon. pol. per crisis	0.8414		1.4668		2.1482	**
	(0.67)		(1.34)		(2.25)	
Duration	2.4320	***	1.9360	***	1.8044	***
	(3.31)		(3.55)		(3.75)	
Duration^2	-0.3048	***	-0.2422	***	-0.2324	***
	(-2.70)		(-3.10)		(-3.48)	
Duration^3	0.0118	**	0.0088	***	0.0087	***
	(2.52)		(2.78)		(3.24)	
Constant	-6.5335	***	-5.5286	***	-5.5827	***
	(-4.40)		(-4.77)		(-5.40)	
Observations	208		322		352	
Crises	36		50		53	
Log likelihood	-64.19		-103.08		-113.75	
Mild representative crisis						
Expected recession duration if no bank restructuring	5.76		6.12		6.30	
Expected recession duration if bank restructuring	3.02		2.69		2.46	
Difference in expected recession duration	2.74		3.43		3.84	
Severe representative crisis						
Expected recession duration if no bank restructuring	9.00		14.19		14.94	
Expected recession duration if bank restructuring	3.88		5.03		4.97	
Difference in expected recession duration	5.13		9.16		9.97	

The sample includes banking crises from 1980 until 2012. In column (1) only crises with recessions that started after or in the quarter when first signs of major distress were observed in the banking sector, are included. In column (2) crises with recession that started after the banking crisis start or up to 4 quarters before it, are included. In column (3) all crises with recessions are included. The duration of existing recessions is capped at 8 quarters (Recessions that started more than 8 quarters before the banking crisis are assumed to start exactly 8 quarters before it). RECESSION INDICATOR is the dependent variable having value 1 if a country has just recovered from a recession and 0 if it is in a recession in a particular quarter. A positive regression coefficient means that a higher value of the explanatory variable increases the probability of recovery. BANK RESTRUCTURING indicates whether bank restructuring has already been done. BLANKET GUARANTEES indicates whether blanket guarantees were present in the previous quarter. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. MONETARY POLICY is the lagged quarterly growth rate in reserve money. Averages of dependent variables are included to allow for correlation between unobserved heterogeneity and explanatory variables. DURATION is the number of quarters a recession has already been ongoing until the period for which the probability of recovery is estimated. The specifications are estimated using complementary log-log random effects procedure. In parentheses are z-values of the tests for significance of coefficients. Significance levels of 10%, 5%, and 1% are denoted by *, **, ***, respectively. Expected durations are computed for two types of representative crises using the estimates of each regression and explanatory variable values of representative crises being averages from the relevant sample.

Table 22: Robustness check: different definition of recession. A positive growth quarter preceded and succeeded by one negative growth quarter is considered a 3-quarter recession. It is not necessary to have two consecutive negative growth quarters.

Dependent variable: Recession indicator	No existing recessions (1)		Existing rec. up to 4 quarters (2)		Existing rec. capped at 8 quarters (3)	
Bank restructuring	1.6404		1.7892	**	1.9008	***
	(1.60)		(2.49)		(3.02)	
Blanket guarantees	-1.4996	*	-0.7022		0.1238	
	(-1.76)		(-1.09)		(0.20)	
Liquidity support	4.6466	**	3.4239	**	2.5747	**
	(2.20)		(2.17)		(2,00)	
Monetary policy	-1.0291		-1.0243	*	-0.8035	
	(-1.52)		(-1.86)		(-1.54)	
Average of bank r. per crisis	-1.3542		-2.0283	*	-2.2915	**
	(-1.01)		(-1.89)		(-2.29)	
Average of b. guar. per crisis	3.1223	**	1.2670		0.2745	
	(2.57)		(1.20)		(0.27)	
Average of liq. supp. per crisis	-7.3911	***	-5.3627	***	-2.8796	**
	(-2.94)		(-2.71)		(-2.05)	
Average of mon. pol. per crisis	0.3255		1.2723		1.8758	**
	(0.20)		(1.10)		(2,00)	
Duration	3.0949	***	2.2265	***	1.3357	***
	(3.34)		(3.43)		(3.91)	
Duration^2	-0.3953	***	-0.2717	***	-0.1442	***
	(-2.79)		(-2.95)		(-3.54)	
Duration^3	0.0153	***	0.0104	***	0.0042	***
	(2.64)		(2.79)		(3.07)	
Constant	-8.0873	***	-6.5490	***	-5.1498	***
	(-4.16)		(-4.63)		(-5.97)	
Observations	163		319		415	
Crises	28		49		56	
Log likelihood	-46.33		-98.33		-131.30	
Mild representative crisis						
Expected recession duration if no bank restructuring	6.66		6.15		7.39	
Expected recession duration if bank restructuring	3.74		3.36		3.06	
Difference in expected recession duration	2.92		2.78		4.33	
Severe representative crisis						
Expected recession duration if no bank restructuring	6.84		9.40		15.17	
Expected recession duration if bank restructuring	3.79		4.45		4.98	
Difference in expected recession duration	3.04		4.95		10.19	

The sample includes banking crises from 1980 until 2012. In column (1) only crises with recessions that started after or in the quarter when first signs of major distress were observed in the banking sector, are included. In column (2) crises with recession that started after the banking crisis start or up to 4 quarters before it, are included. In column (3) all crises with recessions are included. The duration of existing recessions is capped at 8 quarters (Recessions that started more than 8 quarters before the banking crisis are assumed to start exactly 8 quarters before it). RECESSION INDICATOR is the dependent variable having value 1 if a country has just recovered from a recession and 0 if it is in a recession in a particular quarter. A positive regression coefficient means that a higher value of the explanatory variable increases the probability of recovery. BANK RESTRUCTURING indicates whether bank restructuring has already been done. BLANKET GUARANTEES indicates whether blanket guarantees were present in the previous quarter. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. MONETARY POLICY is the lagged quarterly growth rate in reserve money. Averages of dependent variables are included to allow for correlation between unobserved heterogeneity and explanatory variables. DURATION is the number of quarters a recession has already been ongoing until the period for which the probability of recovery is estimated. The specifications are estimated using complementary log-log random effects procedure. In parentheses are z-values of the tests for significance of coefficients. Significance levels of 10%, 5%, and 1% are denoted by *, **, ***, respectively. Expected durations are computed for two types of representative crises using the estimates of each regression and explanatory variable values of representative crises being averages from the relevant sample.

Table 23: Robustness check: different definition of recession. Only consecutive negative growth quarters are counted as a part of a recession.

Dependent variable: Recession indicator	No existing recessions (1)		Existing rec. up to 4 quarters (2)		Existing rec. capped at 8 quarters (3)	
Bank restructuring	1.6566	*	1.8407	**	2.3780	**
	(1.94)		(2.50)		(2.30)	
Blanket guarantees	-1.0849		-0.5270		-0.7329	
	(-1.34)		(-0.85)		(-0.58)	
Liquidity support	3.7616	**	2.2682		2.5262	
	(2.15)		(1.50)		(1.33)	
Monetary policy	-0.9760		-1.0450		-1.0399	
	(-1.56)		(-1.53)		(-1.52)	
Average of bank r. per crisis	-2.1500	*	-2.3006	**	-2.5327	*
	(-1.74)		(-2.04)		(-1.92)	
Average of b. guar. per crisis	1.8097	*	1.1689		2.0887	
	(1.68)		(1.21)		(0.95)	
Average of liq. supp. per crisis	-5.8176	***	-4.4396	**	-3.2889	
	(-2.85)		(-2.20)		(-1.28)	
Average of mon. pol. per crisis	0.1819		1.3126		2.0854	
	(0.16)		(1.22)		(1.57)	
Duration	2.7983	***	2.1910	***	2.8013	
	(3.97)		(3.82)		(1.37)	
Duration^2	-0.4020	***	-0.3034	***	-0.3552	*
	(-3.33)		(-3.37)		(-1.74)	
Duration^3	0.0163	***	0.0124	***	0.0139	**
	(3.11)		(3.27)		(1.98)	
Constant	-5.8591	***	-5.4612	***	-7.6529	
	(-4.66)		(-5.03)		(-1.54)	
Observations	181		273		303	
Crises	36		50		53	
Log likelihood	-57.76		-91.62		-102.37	
Mild representative crisis						
Expected recession duration if no bank restructuring	4.80		5.27		4.97	
Expected recession duration if bank restructuring	2.73		2.72		2.71	
Difference in expected recession duration	2.07		2.55		2.26	
Severe representative crisis						
Expected recession duration if no bank restructuring	7.48		9.18		7.91	
Expected recession duration if bank restructuring	3.31		3.73		3.43	
Difference in expected recession duration	4.17		5.45		4.48	

The sample includes banking crises from 1980 until 2012. In column (1) only crises with recessions that started after or in the quarter when first signs of major distress were observed in the banking sector, are included. In column (2) crises with recession that started after the banking crisis start or up to 4 quarters before it are included. In column (3) all crises with recessions are included. The duration of existing recessions is capped at 8 quarters (Recessions that started more than 8 quarters before the banking crisis are assumed to start exactly 8 quarters before it). RECESSION INDICATOR is the dependent variable having value 1 if a country has just recovered from a recession and 0 if it is in a recession in a particular quarter. A positive regression coefficient means that a higher value of the explanatory variable increases the probability of recovery. BANK RESTRUCTURING indicates whether bank restructuring has already been done. BLANKET GUARANTEES indicates whether blanket guarantees were present in the previous quarter. LIQUIDITY SUPPORT is the lagged ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. MONETARY POLICY is the lagged quarterly growth rate in reserve money. Averages of dependent variables are included to allow for correlation between unobserved heterogeneity and explanatory variables. DURATION is the number of quarters a recession has already been ongoing until the period for which the probability of recovery is estimated. The specifications are estimated using complementary log-log random effects procedure. In parentheses are z-values of the tests for significance of coefficients. Significance levels of 10%, 5%, and 1% are denoted by *, **, ***, respectively. Expected durations are computed for two types of representative crises using the estimates of each regression and explanatory variable values of representative crises being averages from the relevant sample.