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Recessions after Systemic Banking Crises: Does it matter how Governments intervene?

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On Zombie Banks and Recessions after Systemic Banking Crises: Government Intervention Matters[1]

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Abstract: Systemic banking crises often continue into recessions with large output losses. 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 recapitalizations provide banks with incentives to restructure bad loans and free up resources for new economic activity. When the fundamental problem is undercapitalization of the banking sector, other interventions, such as guarantees on bank liabilities and liquidity support, lead banks to roll over bad loans, tying up resources in distressed firms: they become zombie banks and a drag on economic recovery. We then analyze 68 systemic banking crises from the period 1980-2013, of which 28 are part of the recent global financial crisis, and find that bank recapitalizations substantially reduce recession duration.

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

JEL codes: E44, E58, G21, G28

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[2] The title of the first version was "Recessions after Systemic Banking Crises: Does It Matter How Governments Intervene?"

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. Therefore it is no surprise that governments often 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 and 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 recapitalizations significantly reduce recession duration as do generic low interest rate policies. We find little or no support for the impact of bank specific guarantees or liquidity support on the expected recession duration.

In the theoretical analysis that provides the framework for our subsequent empirical analysis, we focus on a key difference between bank recapitalizations and the other bank interventions mentioned, their differential impact on bank incentives for managing bad loans. Financial crises leave distressed banks with unexpectedly low capital ratios. Measures that fail to address the undercapitalization of banks keep incentives in place (or even strengthen them) for these banks to just roll over bad loans and shift risks to depositors. Guarantees make depositors indifferent to the risks that are shifted their way increasing rather than reducing risk shifting and roll over incentives. In that way zombie banks, banks that do not enforce discipline on distressed borrowers, form a drag on economic recovery. 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.

We then analyze 68 systemic banking crises from the period 1980-2013, of which 28 are part of the recent global financial crisis using a discrete duration model on a panel dataset to estimate the effect of intervention on the probability of recovery from recession. Our approach enables us to take into account that intervention is endogenous to crisis severity. Governments are more likely to intervene in severe than in mild crises. We think about crisis severity as of a measure of the scale of problems in the banking sector, which would determine recession duration if there was no intervention. As such, crisis severity is not observable. Using a

particular policy in a banking crisis affects the probability of recovery and is at the same time informative about crisis severity. If a measure increases probability of recovery but it is more likely to be used in severe crises, it may appear that the measure is not effective unless the estimation controls for crisis severity. To control for crisis severity, we have to make two assumptions about its structure. First, we assume crisis severity has two components: a time-invariant component that is correlated with intervention and a time-varying component that is not correlated with intervention. The time-invariant component can be interpreted as the shock to banking sector that has caused the banking crisis. The time-varying component depends on how long the recession has already lasted. Second, we assume that the average value of intervention over the whole recession period is related to the time-invariant component of severity. Our identification is based on how the deviations of intervention from its average over the whole recession period affect the probability of recovery.

The estimation results show that bank recapitalizations, have a highly significant positive effect on the probability of recovery. We calculate the model-predicted recession duration separately for a typical crisis where bank recapitalizations were never done and a typical crisis where banks were recapitalized at some point. Crises with bank recapitalizations are on average much more severe than crises where recapitalizations were not used. The typical recession (from the sample of 2007-2013 crises) during which banks were recapitalized is predicted to last 6.3 quarters, but if banks were not recapitalized, the same recession would go on for 11 quarters. For less severe crises (where no recapitalizations took place), the recession is expected to last 5.6 quarters without bank recapitalizations but only 3.5 quarters if banks are recapitalized. Thus the empirical results confirm the predictions of the theoretical model. Bank recapitalizations, which restore incentives for prudent lending, greatly increase the probability of recovery from recessions related to 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 Sections 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 and 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 and 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 intervention 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 and Rosengren 2005; Caballero, Hoshi, and Kashyap 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 (Van 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 and 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. 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. The model is setup to demonstrate how bank

recapitalization improve incentives of a zombie bank and is not intended to compare the recapitalizations with liquidity support and guarantees on bank liabilities in general. In other settings, for example with sunspot runs or contagion, guarantees and liquidity support could be desirable.

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.

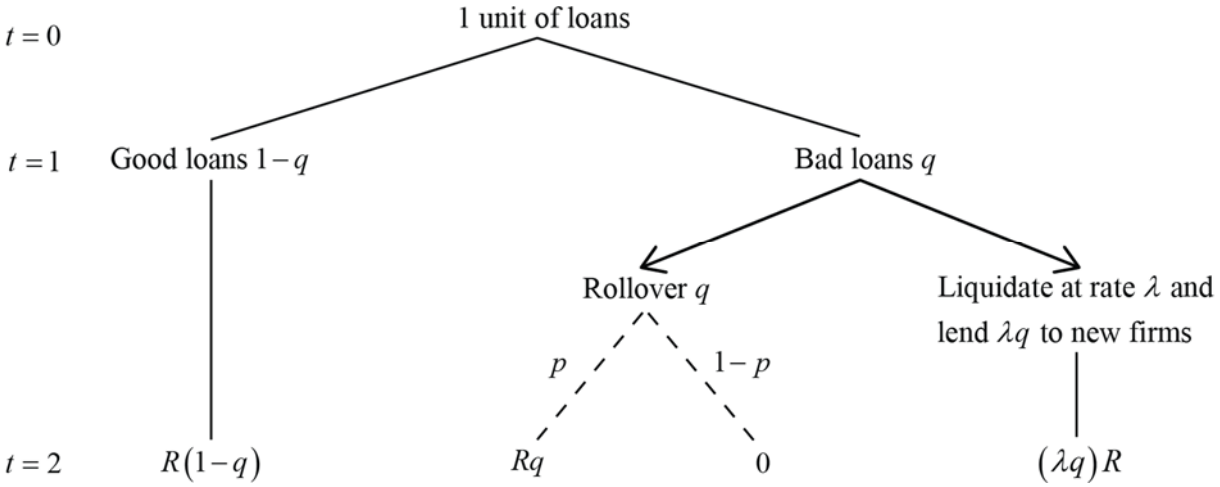

Figure 1: Loan characteristics

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 gross 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. Assuming a premium on bank equity is consistent with the existing literature (Hellmann, Murdock, and Stiglitz 2000; Repullo 2004; Dell'Ariccia and Marquez 2006; Allen, Carletti, and Marquez 2009). The higher required return 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 $R(1-q)+R\lambda q-D$.[3] 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.[4]

$$pR < R\lambda \qquad (1)$$

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 the 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

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

[4] 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.

higher expected payoff to bank shareholders than does rolling over of bad loans. This is the case if (with $R_{roll\ over}$ being the outcome of rolled-over bad loans):

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

Computing the expected payoffs gives the liquidation incentive constraint: [5]

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

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

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 require 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

Our focus is on ex-post intervention so we model a banking crisis as a zero-probability event as in Allen and Gale (2000). 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:

[5] The incentive constraint only "bites" when debt obligations are so high that bank shareholders get zero in case bad loans fail. Note that for simplicity we assume that liquidation proceeds that are lent out again receive R with certainty. Assuming that a fraction q of those loans is likely to fail again makes no material difference to any of the results.

$$k' = 1 - \frac{R\left(1-p-\left(q+\xi\right)\left(1-\lambda\right)\right)}{1-p}$$

$$= 1 - \frac{R\left(1-p-q\left(1-\lambda\right)\right)}{1-p} + \frac{R\xi(1-\lambda)}{1-p} \qquad (6)$$

$$> k$$

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.[6] If the bank cannot obtain new deposits, it liquidates its loan portfolio at 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:

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

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

[6] 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.

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 satisfies:

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

The amount of recapitalization necessary is thus at least $g=\frac{R\xi\left(1-\lambda\right)}{1-p}$. 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 $R\left(1-q-\xi\right)+R\lambda\left(q+\xi\right)$. 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

Our 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 a recession has 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 is in a recession or it has just recovered.

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

In regressions we estimate the effect of intervention on the probability of recovery, which is in the context of a duration model also called the hazard rate $\lambda(t, x_{it}, c_i)$. Explanatory variables that are positively related to the hazard rate, increase the probability of recovery and reduce the expected duration. The hazard rate is conditional on that the recession has not ended before quarter t, on the values of explanatory variables x_{it}, and the unobserved heterogeneity c_i.[7]

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

$G(\cdot)$ is a cumulative distribution function that maps the expression $x_{it}\beta + \gamma_t + c_i + e_{it}$ into a probability measure. Crisis severity has two components: a time-varying component $\gamma_t = \gamma(t)$, which is a function of elapsed duration and crisis-specific fixed effect c_i. The time-varying component captures the pattern that the probability of recovery follows over time independent of intervention. We expect it to be an increasing function of time (but not necessarily monotonically increasing). Intervention is likely to be correlated to crisis severity. We model this correlation by assuming that the component c_i of crisis severity is a function of the average values of intervention variables over the quarters of a recession.

$$c_i = \psi + \bar{x}_i \delta + v_i \tag{10}$$

Error term v_i is assumed to be normally distributed, δ is a vector of coefficients describing the relationship to average intervention and ψ is a constant. This specification can capture correlation between severity and intervention when a particular type of intervention is more likely to be used in severe than in mild crisis, when the quantity of intervention depends on the severity or when the timing of intervention depends on the severity. In all these cases the average value of intervention in a crisis is informative about crisis severity. Our identification is based on the part of variation in intervention that is not correlated to c_i, thus the variation in intervention over time within a recession. The assumption we make is that intervention is correlated to the component of crisis severity that is common to multiple quarters of a banking crisis (such as the undercapitalization of banks due to a shock to their asset values at the beginning of the crisis) and that it is not driven by variation of crisis severity over time.

We use the approach proposed by Mundlak (1978) to incorporate this form of crisis severity into the estimation equation. First we restate equation (9) using y_{it} as an indicator of the latent probability of recovery $y_{it} = 1[y_{it}^* > 0]$ in place of the hazard rate ($1[....]$ is an index function that equals 1 if $y_{it}^* > 0$ and 0 otherwise).

$$y_{it}^* = x_{it}\beta + \gamma_t + c_i + e_{it} \tag{11}$$

Then we combine it with equation (10), which describes the relationship between policies and crisis severity to obtain the estimation equation:

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

The constant ψ from equation (10) drops out as a constant is already included in γ_t for which we use a cubic function $\gamma_t = \gamma_0 + \gamma_1 t + \gamma_2 t^2 + \gamma_3 t^3$. Specification (12) can be estimated with nonlinear methods such as

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

complementary log-log or logit with random effects. The vector of coefficients β describes the effect of policies on recession duration. This specification also allows us to test whether correlation between explanatory variables and unobserved heterogeneity is in fact an issue. If the estimate of the coefficient vector 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.

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 outside the $\left[0,1\right]$ range. For those reasons we use the complementary log-log specification as our basic approach[8].

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:

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

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

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

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.

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

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

[8] In Appendix 5 (Table 14) we report estimates based on the other two probability models. It is clear from that table that using alternative probability models does not materially change any of the results.

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 68 systemic banking crises from the period 1980-2013, of which 40 are from the period before 2007 and 28 belong to the recent global financial crisis. For each banking crisis the panel includes the quarters in which a country was in a recession, and the quarter when it recovered.[9] We start with the list of 65 of systemic banking crises described by Laeven and Valencia (2012b). They consider a banking crisis to be systemic if two conditions are 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 (2012b) report it as a borderline case. All crises in the 1980-2006 period listed in their dataset 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. The starting date of a banking crisis is the quarter in which major distress in the banking sector was observed. The date when a crisis becomes systemic is the quarter when the above conditions are fulfilled.

[9] Exceptions are Cyprus and the second crisis in Greece where the recessions were still ongoing in 2013 Q3, which was the last available observation. For these two crises the sample includes only recessionary quarters and no recovery quarter.

Table 1: Systemic banking crises in the period 1980-2006.

Country	Crisis start	Systemic crisis date	Recession start	Recovery	Recession duration	Duration of existing recession	Bank restructuring date	Recap. end of recession	Recap. end of crisis
Argentina	1980 Mar	2000 Jan	1981 Q1	1983 Q1	8				
Argentina	1989 Dec	1989 Dec	1988 Q1	1990 Q3	10	7			
Argentina	1995 Jan	1995 Jan	1995 Q1	1995 Q4	3				
Argentina	2001 Nov	2001 Dec	2001 Q2	2002 Q2	4	2			
Bolivia	1994 Nov	1994 Nov							
Brazil	1990 Feb	1990 Feb	1990 Q1	1991 Q1	4				
Brazil	1994 Dec	1994 Dec	1995 Q2	1995 Q4	2				1.24
Bulgaria	1996 Jan	1996 Jun	1989 Q1	1998 Q1	36	28	1996 Q2	4.50	4.50
Chile	1981 Nov	1983 Mar	1981 Q4	1983 Q1	5				
Colombia	1982 Jul	1982 Jul							
Colombia	1998 Jun	1998 Jun	1998 Q3	1999 Q3	4			0.38	0.75
Cote d'Ivoire	1988	1988							
Croatia	1998 Mar	1998 Mar	1998 Q1	1999 Q3	6			2.40	8.37
Czech Republic	1996 Jun	1996 Jun	1996 Q4	1997 Q4	4				
Dominican Rep.	2003 Apr	2003 Apr	2003 Q1	2004 Q1	4	1			
Ecuador	1998 Aug	1998 Dec	1998 Q3	1999 Q4	5		1999 Q3	5.85	5.85
Estonia	1992 Nov	1992 Nov	1994 Q1	1995 Q2	5				
Finland	1991 Sep	1993 Feb	1990 Q2	1993 Q3	13	5	1992 Q4	2.89	3.46
Ghana	1982 Jan	1982 Jan	1982 Q1	1984 Q1	8				
Indonesia	1997 Nov	1997 Dec	1997 Q4	1999 Q3	7			20.10	58.14
Jamaica	1996 Dec	1997 Feb	1997 Q3	1998 Q2	3			1.51	1.51
Japan	1997 Nov	1997 Nov	1997 Q4	1998 Q3	3			0.15	0.75
Korea	1997 Aug	1997 Nov	1997 Q4	1998 Q3	3			0.87	3.33
Latvia	1995 Apr	1995 Apr							4.54
Lithuania	1995 Dec	1995 Dec							
Malaysia	1997 Jul	1998 Mar	1998 Q1	1999 Q1	4			0.58	1.18
Mexico	1994 Dec	1995 Jan	1995 Q1	1995 Q3	2			1.65	4.98
Nicaragua	2000 Aug	2001 Jan							
Norway[10]	1990 Dec	1991 Oct	1991 Q3	1993 Q1	6		1991 Q4	3.08	3.08
Paraguay	1995 May	1995 Jul							
Philippines	1997 Jul	1998 Mar	1997 Q3	1998 Q4	5				
Russia	1998 Aug	1999 Jan							
Sri Lanka	1989	1989							
Sweden	1991 Sep	1992 Sep	1991 Q1	1993 Q1	8	2	1992 Q2	3.26	5.31
Thailand	1997 Jul	1997 Oct	1997 Q3	1998 Q4	5		1998 Q3	4.17	5.30
Turkey	2000 Nov	2000 Dec	2000 Q4	2002 Q1	5				2.64
Ukraine	1998 Aug	1998 Dec	1998 Q1	1999 Q1	4	2			
Uruguay	2002 Jan	2002 Apr	1999 Q1	2003 Q1	16	12		0.33	0.38
Venezuela	1994 Jan	1994 Jan	1994 Q1	1995 Q1	4		1994 Q2	24.61	24.61
Vietnam	1997 Nov	1998 Oct							

CRISIS START is the date when major distress in the banking sector was observed. SYSTEMIC CRISIS DATE is the date when the conditions for a banking crisis to be classified as systemic were met. RECESSION DURATION is in quarters. DURATION OF EXISTING RECESSION tells how long a recession has already been ongoing at the time of the banking crisis start. BANK RESTRUCTURING DATE is the time when the main part of bank recapitalizations has been completed. RECAP. END OF RECESSION is the cumulative amount of bank recapitalizations at the end of the recession. RECAP. END OF CRISIS is the total amount of bank recapitalizations in a banking crisis (it includes also bank recapitalizations done after the recession has already ended). The recapitalization amounts are expressed in percent of total banking assets.

Using these criteria, we add 3 more crisis to the list: Cyprus starting in 2011 Q3, Greece 2010 Q2 and Spain 2011 Q3. Greece and Spain already experienced a banking crisis in 2008 Q3. The recessions immediately following the 2008 crisis had already ended by the time problems in the banking sector reemerged. We analyze the first and the second crises of these two countries separately as there were two recessions and multiple rounds of intervention measures during both recessions. Table 1 lists the systemic banking crises from the period 1980-2006. Countries that experienced a systemic banking crisis (or were classified as a borderline case) during the recent global financial crisis are listed in Table 2. Some banking crises were not followed by a recession. These crises are

[10] Laeven and Valencia (2012a) report October 1991 as the start of the banking crisis in Norway. This is the date when the crisis became systemic. We report December 1990 as the banking crisis start. At that time there was already significant distress in the banking sector.

included in the tables although they cannot be analyzed with recession duration models. In total there are 13 such crises, 11 in the period before 2007 and 2 after. Next we describe the variables used in the regression analysis.

Table 2: Systemic banking crises in the period 2007-2013.

Country	Crisis start	Systemic crisis date	Recession start	Recovery	Recession duration	Duration of existing recession	Bank restructuring date	Recap. end of recession	Recap. end of crisis
Austria	2008 Sep	2000 Jan	2008 Q3	2009 Q3	4		2009 Q2	1.10	1.46
Belgium	2008 Sep	2000 Jan	2008 Q3	2009 Q2	3		2008 Q4	2.81	4.27
Cyprus	2011 Jul	2013 Mar	2011 Q3		7		2013 Q1	17.86	17.86
Denmark	2008 Sep	2000 Jan	2008 Q3	2010 Q1	6		2009 Q2	1.22	1.34
France	2008 Sep		2008 Q2	2009 Q3	5	1		0.56	0.85
Germany	2008 Sep	2009 Oct	2008 Q2	2009 Q2	4	1	2009 Q1	0.81	1.35
Greece	2008 Sep	2009 May	2008 Q2	2009 Q2	4	1			1.27
Greece	2010 Apr	2012 May	2010 Q1		13	1	2012 Q2	6.86	6.86
Hungary	2008 Sep		2008 Q3	2009 Q4	5			0.15	0.15
Iceland	2008 Sep	2008 Oct	2008 Q3	2010 Q4	9		2009 Q4	11.13	11.13
Ireland	2008 Sep	2009 Jan	2008 Q1	2011 Q1	12	2	2010 Q4	9.52	14.30
Italy	2008 Sep		2008 Q2	2010 Q1	7	1		0.20	0.28
Kazakhstan	2008 Sep	2010 Sep							4.10
Latvia	2008 Sep	2000 Jan	2008 Q1	2009 Q4	7	2		2.01	6.67
Luxembourg	2008 Sep	2008 Sep	2008 Q2	2009 Q3	5	1	2008 Q4	0.92	0.95
Mongolia	2008 Sep	2009 Nov	2009 Q1	2010 Q1	4				2.49
Netherlands	2008 Sep	2008 Oct	2008 Q4	2009 Q3	3		2008 Q4	0.93	1.47
Nigeria	2009 Aug	2011 Oct							4.16
Portugal	2008 Sep		2008 Q1	2009 Q2	5	2			2.36
Russia	2008 Sep		2008 Q3	2009 Q3	4		2009 Q2	1.02	1.02
Slovenia	2008 Sep		2008 Q3	2009 Q3	4				1.95
Spain	2008 Sep	2011 Apr	2008 Q2	2010 Q1	7	1		0.06	0.36
Spain	2011 Sep	2012 Dec	2011 Q3	2013 Q3	8		2012 Q4	2.48	2.48
Sweden	2008 Sep		2008 Q1	2009 Q4	7	2			
Switzerland	2008 Sep		2008 Q4	2009 Q3	3			0.31	0.31
Ukraine	2008 Sep	2009 May	2008 Q2	2009 Q2	4	1		3.23	7.31
United Kingdom	2007 Sep	2008 Nov	2008 Q2	2009 Q4	6			0.53	0.97
United States	2007 Dec	2008 Oct	2008 Q1	2009 Q3	6		2008 Q4	1.35	1.36

For explanations of the different column headings 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 a sequence of positive and negative quarters where a positive quarter is always preceded and succeeded by a negative quarter and there are at least two consecutive negative quarters in that sequence. The recession needs to start at latest 6 quarters after the start of a banking crisis to be considered related to the banking crisis.[11] Two consecutive positive growth quarters mark the end of a recession. The first of these two quarters is the recovery quarter in which the recession indicator turns 1. The recession period is composed of quarters with negative growth but may include few positive growth quarters within the

[11] The recession in Cote d'Ivoire started 2 years after the start of the banking crisis. The primary reason of this recession was not the banking crisis therefore we do not include it into the sample. All other recessions started at latest 5 quarter after the banking crisis start.

sequence of negative growth quarters.[12] Such a definition is used as one positive growth quarter does not mean that a recession is really over. Applying this definition to 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.

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. The sources of GDP data are the World Economic Outlook and the International Financial Statistics databases (IMF 2013a; IMF 2013b). For more details about the data see Appendix 2: GDP data sources.

Bank recapitalizations

The variable bank recapitalizations measures the cumulative amount of recapitalizations in the banking sector since the start of the crisis. The amounts are weighed by total assets of the banking sector. Recapitalizations are assumed to have an effect on the probability of recovery from the first quarter after they have been implemented until the end of the recession. Some banks repay the capital injections they have received from the state before the recession ends. These banks typically raise equity from private investors to repay the state support. Our variable captures how much state intervention has increased bank capital since the beginning of the crisis.

There is a variety of measures that could be considered a recapitalization. We count as recapitalization injections of common equity, preferred stock, conditionally convertible bonds or any Tier 1 qualifying instrument by the state, a bank restructuring agency or other government agency. We do not consider injections of subordinated debt, qualifying as Tier 2 capital, a recapitalization. Conversion of subordinated debt or other bank liabilities into equity and liability management exercises are counted as recapitalization. Write-offs of bank liabilities in the process of bank restructuring where creditors do not get any security in exchange are not counted as recapitalization although they are sometimes referred to as the contribution of bondholders toward recapitalization. In purchase and assumption deals the state often compensates the acquiring bank for the difference between the value of assets and liabilities of the bank that is being taken over in the process of restructuring. This amount is not counted as recapitalization as it merely brings the net asset value of the restructured bank to zero. It benefits the creditors of the distressed bank that would otherwise suffer losses in the process of restructuring and does not increase capital of the acquirer. If the acquiring bank receives an equity injection on top of that, the equity injection is counted as recapitalization. Sometimes both the state and private

[12] In the robustness section we estimate the model using a definition where only consecutive negative growth quarters are counted as a recession, with similar results.

investors participate in bank equity issues. In those cases only the amount purchased by the state is counted as recapitalization.

We collect the data about bank recapitalizations from four types of sources: (i) IMF staff reports is our main source; (ii) European Commission decisions about state aid (EU member states need to request approval by the European Commission for measures that could constitute state aid. As a result bank recapitalizations in EU countries in the recent crisis are well described in the documents about state aid decisions.); and (iii) webpages of central banks, restructuring agencies and annual reports of intervened banks.

We need the total amount of recapitalizations in the banking sector in each quarter for all crises. Whenever possible we collect the recapitalization amounts at bank level. We document the amount of recapitalization, a description of the measure and the month or quarter when the measure was implemented. For the recent crises almost all data has this level of detail. If bank-level data is not available, we collect data about total amount of recapitalizations in each quarter of a recession. For some crises before 2007 IMF staff reports only include how much was spent on recapitalizations until a certain date. In such cases we use two rules how to allocate the amounts across the quarters. If the names of banks or the number of banks intervened in a particular quarter are reported but not the amounts per bank, we assume that each of the intervened bank received an equal amount. If only the date when a bank restructuring program was approved by the government and the total amount of recapitalizations at a later point in time are known, we assume that recapitalization amounts are evenly spread across quarters between the start of the restructuring program and the time at which the cumulative amount of recapitalizations is reported. Table 1 and Table 2 provide data about the amount of bank recapitalizations in banking crises. [13]

In some regressions we use an indicator for bank restructuring, which turns from 0 to 1 in the quarter after the following two conditions are satisfied:

- The cumulative recapitalizations since the start of the crisis exceed half of the amount of recapitalizations in the whole banking crisis (which includes recapitalizations after the recession has already ended).
- The cumulative recapitalizations exceed the threshold to be considered significant bank restructuring. This limit is 0.75% of total banking assets for 2007-2013 crises and 1.75% of total banking assets for 1980-2006 crises. It is 50% of the median total amount of recapitalizations in banking crises where there were some recapitalizations.

The first condition is to determine the time when the main part of bank restructuring has been implemented. The second is necessary not to treat crises with very little recapitalizations as having done a proper bank restructuring.

Guarantees on bank liabilities

We use an indicator for the presence of significant guarantees on bank liabilities other than deposits. The indicator takes value 1 if guarantees were present in the preceding quarter. The lag is used in order to allow some time for the guarantees to have an effect on GDP growth. We use the data of Laeven and Valencia (2012b)

[13] We plan to make the detailed data about bank recapitalizations publicly available. For now the data is available upon request.

about the introduction and removal dates of significant guarantees on bank liabilities and complement it with data from European Commission decisions about state aid. The indicator for guarantees on bank liabilities in quarter t is equal to 1 if the 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 and Valencia 2012a) and documents of the European Commission about state aid decisions where the guarantee schemes requested by member states are approved. Appendix 3 reports these dates for the banking crises where extensive guarantees on bank liabilities were used.

Liquidity support

The measure for liquidity support provided by central banks is the ratio of claims of monetary authorities on deposit money banks to total deposits. It tells how large is the support from the central bank compared to total deposits in the banking sector. The ratio is computed with end of quarter values and lagged one period. The data comes from the International Financial Statistics (IMF 2013b). For details see Appendix 4: Data about liquidity support, monetary policy and fiscal policy.

Monetary policy

We use two alternative variables to control for the effect of monetary policy on the probability of recovery. The preferred proxy is the decrease in real interest rates from quarter $t-2$ to $t-1$ when the probability of recovery in quarter t is analyzed. We use this measure for crises after 2007. In the analysis of crises before 2007 and of the full sample we employ the quarterly growth rate in reserve money as a proxy for monetary policy not to lose observations because interest rate data is not available for all pre-2007 crises. The source of data is the International Financial Statistics database (IMF 2013b). For details see Appendix 4: Data about liquidity support, monetary policy and fiscal policy.

Fiscal policy

We control for the effect of fiscal policy on the probability of recovery by using cyclically adjusted general government deficit in the analysis of crises after 2007. The source of data is World Economic Outlook Database (IMF 2013a). Cyclically adjusted fiscal data is not available for most of crises before 2007. We do not use non-adjusted deficit as it is endogenous to GDP growth. For details see Appendix 4: Data about liquidity support, monetary policy and fiscal policy.

6. Results

We estimate the effect of bank recapitalizations, guarantees on bank liabilities, liquidity support, monetary policy and fiscal policy on the probability of recovery from recessions related to banking crises. 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 are the variables representing policies used in banking crises. A positive estimated coefficient means that a higher value of the

explanatory variable increases the probability of recovery. Second, there are averages of intervention variables, averaged over all time periods of a recession to control for the correlation between crisis severity and intervention. 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 intervention variables on the probability of recovery for the full sample of crises and the subsamples from the period 1980-2006 and 2007-2013.

	Full sample 1980-2013	Past crises 1980-2006	Recent crises 2007-2013	Recent crises 2007-2013
Recession indicator	**(1)**	**(2)**	**(3)**	**(4)**
Bank recapitalizations	0.6637***	1.2636***	1.0449**	1.5126**
	(3.26)	(2.72)	(2.18)	(2.01)
Guarantees on bank liabilities	0.0133	-2.4110	0.3519	0.2769
	(0.02)	(-1.61)	(0.39)	(0.22)
Liquidity support	2.6676*	4.2064	-4.5830	-3.6067
	(1.76)	(1.47)	(-1.26)	(-0.80)
Growth of reserve money	-0.7330	-1.1811	-1.3611	
	(-1.56)	(-1.39)	(-1.21)	
Real interest rate reduction				0.2528*
				(1.89)
Fiscal deficit, cyclically adj.				0.2077
				(0.97)
Average of bank recapitalizations	-1.2208***	-2.0501***	-2.6339**	-3.2815**
	(-2.96)	(-2.63)	(-2.40)	(-1.97)
Average of guarantees on bank liab.	-0.2616	3.8550*	-2.2861	-2.3825
	(-0.29)	(1.94)	(-1.29)	(-1.19)
Average liquidity support	-3.1950	-2.1699	4.9049	2.3497
	(-1.46)	(-0.69)	(1.13)	(0.42)
Average reserve money growth	0.2569	0.1703	3.0066	
	(0.48)	(0.27)	(1.10)	
Average real interest rate reduction				-0.7642***
				(-2.90)
Average cyclically adj. fisc. def.				-0.2598
				(-0.97)
Duration	2.9566***	10.5926**	1.8332	1.5191
	(2.97)	(2.56)	(1.24)	(0.79)
Duration^2	-0.3936**	-2.1770**	-0.1576	-0.0479
	(-2.35)	(-2.46)	(-0.65)	(-0.14)
Duration^3	0.0147*	0.1419**	0.0034	-0.0044
	(1.76)	(2.39)	(0.28)	(-0.22)
Constant	-7.1750***	-17.5565***	-5.3922**	-5.1440
	(-3.96)	(-2.84)	(-1.97)	(-1.58)
Observations	317	147	170	170
Crises	51	26	25	25
Log likelihood	-89.7512	-37.4357	-39.5122	-35.8520

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 RECAPITALIZATIONS are the cumulative amount of recapitalizations since the start of the banking crises, weighted by total banking assets. GUARANTEES ON BANK LIABILITIES are an indicator variable for the presence of guarantees. LIQUIDITY SUPPORT is ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. GROWTH OF RESERVE MONEY and REAL INTEREST RATE REDUCTION are measures of monetary policy. CYCLICALLY ADJUSTED FISCAL DEFICIT is a measure of discretionary fiscal policy. All policy variables except for fiscal deficit are lagged one quarter. 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 2013, and separately for the subsample of past crises from the period 1980-2006 and the subsample of

recent crises. The samples include crises in which the recession began up to 2 quarters before the start of the banking crisis. 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. This does not affect the results materially.

The estimates of the effect of bank recapitalizations on the probability of recovery are positive and significant in all samples: bank recapitalizations significantly increase the probability of recovery. Guarantees on bank liabilities on the other hand do not have a significant effect, while liquidity support is marginally (at a 10% level) significant only in the full sample; in both subsamples separately it is insignificant. The estimates for growth of reserve money are negative and insignificant. We use growth in reserve money as a proxy of monetary policy in order to be able to perform the analysis on the maximum possible number of crises. However, when we substitute it with the reduction in real interest rates in column (4), the estimated effect is positive and significant, albeit only marginally so, at 10%. The effect of fiscal policy approximated by the cyclically adjusted fiscal deficit is not significant.

Coefficients of *averages* of bank recapitalizations, guarantees on bank liabilities and real interest rate reduction are statistically significant for 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. Time dependence seems to be stronger and more significant in past crises than in recent crises. The coefficient of the linear duration 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.[14]

In many crises, recapitalizations are done at multiple times but with the largest amounts typically concentrated in one quarter. To approximate this we rerun the regressions with an alternative definition of bank recapitalization: we replace the continuous recapitalization variable by the bank restructuring indicator which loosely speaking equals one when a significant bank recapitalization took place; for a more precise definition see Section 5. If there were only minor recapitalization the value of bank restructuring indicator is zero. Table 4 reports the results of the regressions of Table 3 but performed with the bank restructuring indicator instead of the continuous bank recapitalization variable.

[14] In column (4) of Table 3, both the quadratic and the cubic term are negative and all three duration terms are insignificant.

Table 4: Estimation results of the effects of intervention variables on the probability of recovery for the full sample of crises and the subsamples from the period 1980-2006 and 2007-2013. Bank restructuring indicator is used as a measure of bank recapitalizations.

	Full sample 1980-2013	Past crises 1980-2006	Recent crises 2007-2013	Recent crises 2007-2013
Recession indicator	**(1)**	**(2)**	**(3)**	**(4)**
Bank restructuring indicator	2.5108***	2.4613**	3.1409**	2.6437**
	(3.33)	(2.13)	(2.31)	(2.01)
Guarantees on bank liabilities	0.1880	-2.4368	0.9789	0.8003
	(0.37)	(-1.46)	(1.19)	(0.80)
Liquidity support	1.5768	2.7520	0.4888	0.0719
	(1.09)	(1.02)	(0.16)	(0.02)
Growth of reserve money	-0.6270	-1.0170	-1.3002	
	(-1.25)	(-1.21)	(-1.19)	
Real interest rate reduction				0.1525
				(1.60)
Fiscal deficit, cyclically adj.				0.1431
				(0.86)
Average of bank restructuring	-5.2089***	-4.9578**	-5.2014	-2.5858
	(-2.79)	(-2.00)	(-1.49)	(-0.74)
Average of guarantees on bank liab.	-0.7037	3.5793	-3.6670**	-2.3402
	(-0.85)	(1.64)	(-2.07)	(-1.35)
Average liquidity support	-2.6088	-1.3133	-3.8338	-7.5598
	(-1.25)	(-0.44)	(-0.79)	(-1.37)
Average reserve money growth	0.2661	0.0333	1.8759	
	(0.50)	(0.05)	(0.64)	
Average real interest rate reduction				-0.7108***
				(-2.88)
Average cyclically adj. fisc. def.				-0.2626
				(-1.30)
Duration	2.5049***	8.6194**	1.5378	2.2927
	(2.88)	(2.41)	(1.13)	(1.44)
Duration^2	-0.3177**	-1.7740**	-0.1267	-0.2011
	(-2.20)	(-2.25)	(-0.57)	(-0.82)
Duration^3	0.0118*	0.1184**	0.0031	0.0069
	(1.65)	(2.16)	(0.29)	(0.61)
Constant	-6.3985***	-14.5225***	-4.7048*	-6.8388**
	(-4.01)	(-2.79)	(-1.84)	(-2.12)
Observations	317	147	170	170
Crises	51	26	25	25
Log likelihood	-92.7037	-42.8870	-39.8077	-35.4818

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 is an indicator for significant bank recapitalizations.. GUARANTEES ON BANK LIABILITIES are an indicator variable for the presence of guarantees. LIQUIDITY SUPPORT is ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. GROWTH OF RESERVE MONEY and REAL INTEREST RATE REDUCTION are measures of monetary policy. CYCLICALLY ADJUSTED FISCAL DEFICIT is a measure of discretionary fiscal policy. All policy variables except for fiscal deficit are lagged one quarter. 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.

The basic results are again confirmed: bank recapitalizations are the only intervention that really matters. Even general liquidity support, as measured by the real interest rate variable, loses significance. Thus we can conclude with confidence that of all intervention policies, bank recapitalizations are the most significant ones. To investigate the size of their effect on recession duration, we compute expected recession durations for two representative crises: a crisis representing the group of crises where substantial recapitalizations were done and a crisis representing the group with no or very little recapitalizations. The reason for introducing two representative crises is that the two groups of crises differ in unobserved crisis severity. Banking crises where

banks were recapitalized tended to be much more severe than those where recapitalizations were not done. From here on we use the expression *severe representative crisis* to denote the representative crisis of the group with significant bank recapitalizations and *mild representative crisis* to refer to the representative crisis of the group with no bank or minor recapitalizations.

We compute expected recession duration with and without bank restructuring for both representative crises. The expected durations are computed using equations (13), (17) and (18). The inputs for conditional probabilities of recovery are the estimated coefficients from Table 4 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 recapitalizations were (were 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 which changes from 0 to 1 in the quarter after bank recapitalizations are done. The median time that the recession has already lasted when bank restructuring was done is 1 quarter in the past crises and 2 quarters in the recent crises. When computing the expected durations we assume that bank restructuring is done at $t = 2$ and has an effect on the probability of recovery from $t = 3$ onwards.

We emphasize that the explanatory variable average of bank restructuring (not to be confused with the bank restructuring indicator), is by definition constant over all time periods. This enables us to analyze the effect of bank restructuring independent from crisis severity by changing the value of the bank restructuring indicator while keeping the component 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.

Table 5: Expected and average observed recession durations for severe and mild crises.

	Full sample 1980-2013 (1)	**Past crises 1980-2006 (2)**	**Recent crises 2007-2013 (3)**	**Recent crises 2007-2013 (4)**
Severe crises				
Average actual duration	*6.18*	*5.60*	*6.42*	*6.42*
Expected duration if no bank restructuring	13.25	7.14	20.88	10.97
Expected duration if bank restructuring is done	4.54	3.77	5.89	6.34
Difference in expected duration	8.72	3.37	14.99	4.63
Mild crises				
Average actual duration	*4.74*	*4.43*	*5.23*	*5.23*
Expected duration if no bank restructuring	5.25	4.50	5.80	5.59
Expected duration if bank restructuring is done	3.03	2.98	3.10	3.53
Difference in expected duration	2.22	1.52	2.70	2.06

Severe crises are crises where bank restructuring is done at some point. Mild crises are crises where bank restructuring is never done. Average observed duration is the average recession duration of the group of crises to which a representative crisis refers. Expected recession durations are computed based on estimates from Table 4. The expected durations in each column correspond to estimates in the same column of Table 4 (i.e. the results reported in column (4) of Table 5 are based on the regression reported in column (4) of Table 4 etc.). Expected durations with bank restructuring are computed assuming that bank restructuring is done in the third recession quarter.

Table 5 reports the expected durations computed based on estimates from Table 4. Column (1) of Table 4 refers to column (1) of Table 5 etc. The size of the effect of bank restructuring becomes apparent when the expected recession durations are compared. For the sample of 2007-2013 crises in column (4) the expected duration of severe representative crisis with bank restructuring is fairly close to the average observed duration of

severe crises; similarly the average observed duration of mild crises is close to the expected recession duration of the mild representative crises if bank restructuring is not done. So our benchmarks seem well chosen. The counterfactual durations, however, are very different. The severe representative crisis would last 11 quarters instead of 6.3 quarters if bank restructuring would not have been done. The expected recession of the mild representative crisis is reduced from 5.6 to 3.5 quarters if bank restructuring is done. So on average bank restructuring reduces expected recession duration by about 40%.

Another way of translating the regression results into an understandable metric is a comparison of exit probabilities over time with and without recapitalizations. Once again we do this for severe and mild crises, as defined earlier. We plot the predicted conditional probabilities, the same that were used to compute expected durations for past crises in column (2) and for the recent crises in column (4) of Table 5. We present the graphs of subsamples separately because for the 2007-2013 the estimates with real interest rates and fiscal policy are preferable and even without using those measures pooling the two subsamples should not be done according to the likelihood ratio test. We test whether the null-hypothesis that the estimates on the full sample in column (1) of Table 3 (or Table 4) are not significantly different from the estimates on the subsamples in columns (2) and (3). The test statistic is $D = -2\ln L_{Full\ sample} + 2\ln L_{Past\ crises} + 2\ln L_{Recent\ crises}$. It has a chi-squared distribution with degrees of freedom equal to the number of constraints on coefficients. Pooling the two samples imposes a number of constraints equal to the number of explanatory variables. The P-value of the test with estimates from Table 3 is 0.0122 and with those from Table 4 it is 0.0667. Thus regressions should be run on the two subsamples separately.

In the plots below we show the predicted exit probabilities with and without intervention.

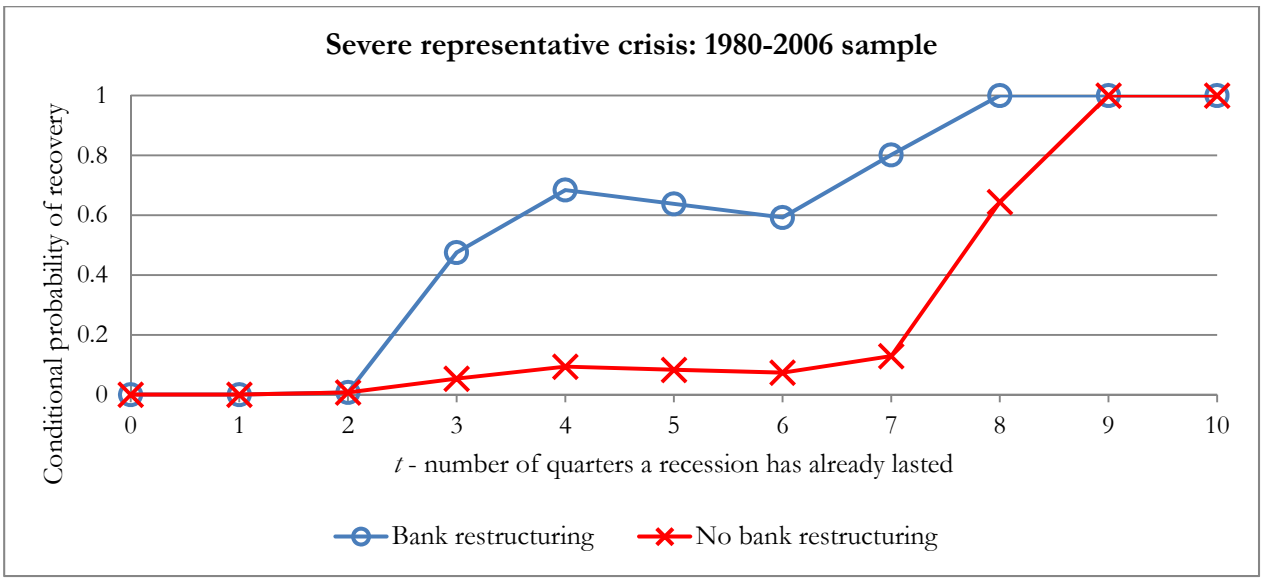

Figure 2: Predicted conditional probabilities of recovery for severe representative crisis of the 1980-2006 sample.

Initially, when a recession starts at $t = 0$, the predicted probability of recovery is obviously very low, then it gradually increases as time goes by. At some point the curve flattens or even slightly decreases (the 1980-2006 representative crises), but eventually it approaches 1: even without intervention, recessions eventually come to an end. The shape of the curve is due to time dependence, which is captured by the duration terms in regression

specification (12). We implement the bank recapitalization at $t=2$, which explains the jumps in the plots at $t=3$. In the absence of intervention the initial shock that caused the banking crisis and time dependence determines the time pattern of exit probabilities and the expected duration as becomes clear by comparing the no-intervention exit probabilities in the plots for the mild and the severe crisis respectively.

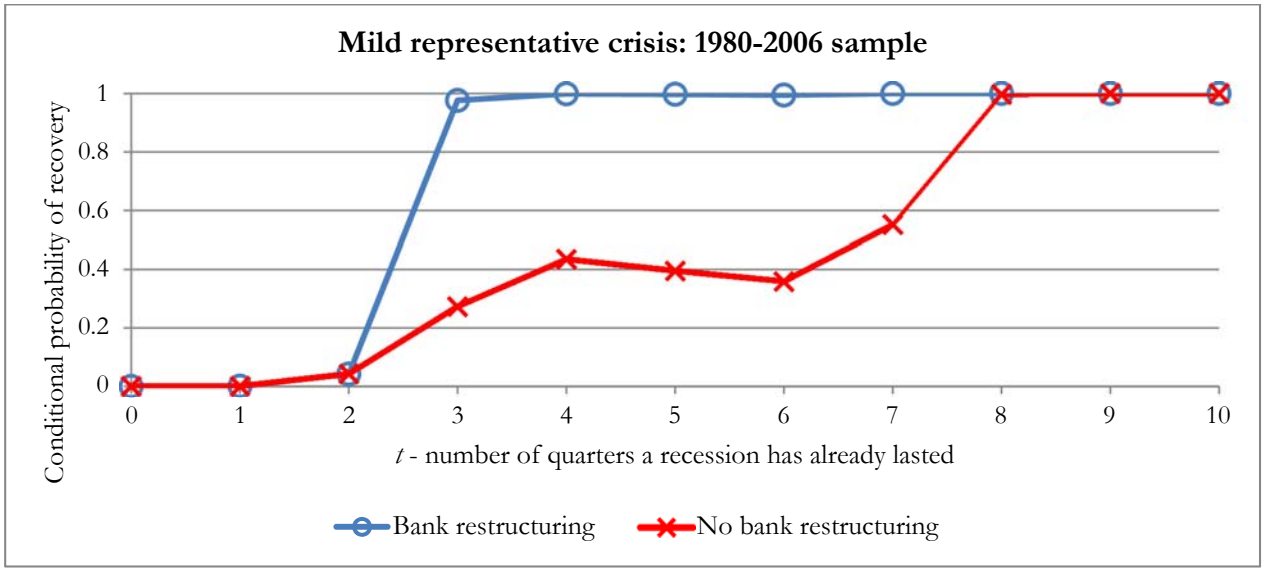

Figure 3: Predicted conditional probabilities of recovery for mild representative crisis of the 1980-2006 sample.

The absolute difference in the probability of recovery with bank restructuring and without bank restructuring is widening also after $t=3$ although then there is no change in policy anymore. The reason is that the change of bank restructuring indicator happens within the cumulative distribution function $G(\cdot)$ so the shift in probability is not linear.

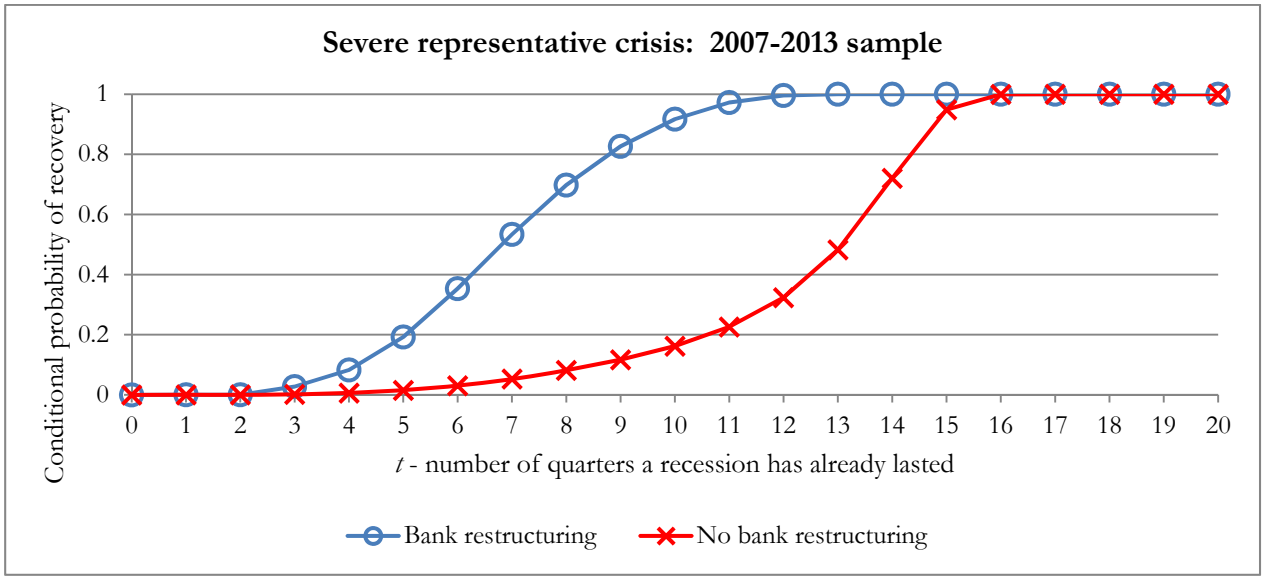

Figure 4: Predicted conditional probabilities of recovery for severe representative crisis, the 2007-2013 sample.

The exit probabilities derived from the estimates based on the more recent sub sample give qualitatively similar results: both for severe and mild crises, bank restructuring significantly reduces expected recession durations (Figures 4 and 5 below). The plots demonstrate our earlier results very clearly: bank recapitalizations increase the probability of recovery substantially.

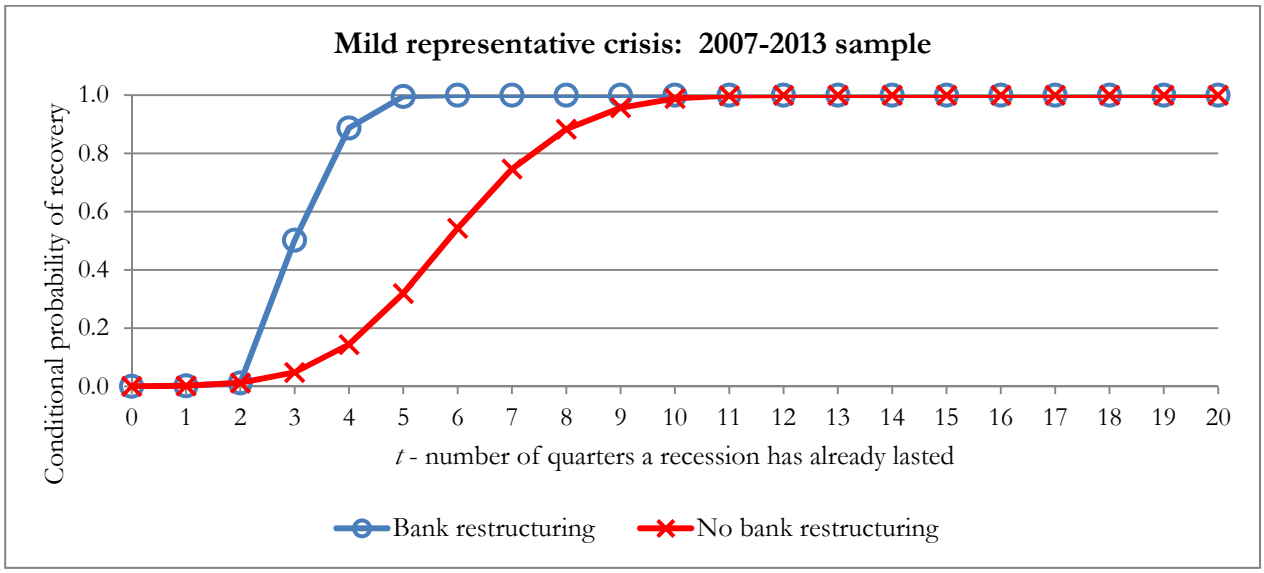

Figure 5: Predicted conditional probabilities of recovery for mild representative crisis of the 2007-2013 sample.

Finally, we investigate possible *interaction effects* between bank recapitalizations and other policies on the sample of recent crises. The results are reported in Table 6. When interactions terms are included individually, the interaction of guarantees on bank liabilities with bank recapitalizations and fiscal policy with bank recapitalizations are negative and significant. However, when all interaction terms are included simultaneously, their signs do not change but significance levels are much reduced, in fact no interaction term is significant in column (6) of Table 6. In all variants the basic impact of bank recapitalizations remains highly significant. The significance level of real interest rate reduction increases compared to the baseline regression.

Guarantees on bank liabilities were used in all but one crisis after 2007. They were almost always already in place when bank recapitalizations were done. The negative interaction coefficient suggests that guarantees have a more positive (although still insignificant) effect in the first phase of the crisis before bank recapitalizations are done but that their effect goes down once recapitalizations are implemented. Another way of interpreting the results is that providing guarantees have no positive impact in itself (its coefficient is insignificant) but that they undermine the impact of bank recaps: witness the negative interaction term.

The negative interaction term with fiscal policy is consistent with the predictions of Van der Kwaak and Van Wijnbergen (2013), who argue that fiscal stimuli in a weak bank capitalization environment are less effective than the same stimuli would have been if banks would have been better capitalized. Since bank recapitalizations are more likely when banks are more undercapitalized, the negative coefficient of the interaction term suggests that fiscal policy is less effective in a weak banks environment, in line with their theoretical results.

Table 6: Estimations with interaction terms between bank recapitalizations and other policies on the sample of 2007-2013 crises.

Recession indicator	Recent crises 2007-2013 (1)	Recent crises 2007-2013 (2)	Recent crises 2007-2013 (3)	Recent crises 2007-2013 (4)	Recent crises 2007-2013 (5)	Recent crises 2007-2013 (6)
Bank recapitalizations	1.5126**	3.2619***	1.8554**	1.4450**	3.0555***	4.3104***
	(2.01)	(2.68)	(2.10)	(2.03)	(2.67)	(2.58)
Guarantees on bank liabilities	0.2769	2.9221	0.0377	0.2640	0.3160	2.1610
	(0.22)	(1.48)	(0.03)	(0.20)	(0.24)	(0.94)
Guarantees * bank recap.		-1.7396*				-1.2486
		(-1.95)				(-1.22)
Liquidity support	-3.6067	-9.0823*	-2.0505	-4.3946	-2.9516	-3.5243
	(-0.80)	(-1.67)	(-0.43)	(-0.96)	(-0.73)	(-0.59)
Liquidity support * bank recap.			-1.0599			-0.6577
			(-0.90)			(-0.60)
Real interest rate reduction	0.2528*	0.4326**	0.2635**	0.4325**	0.4121**	0.6761***
	(1.89)	(2.44)	(2.07)	(2.36)	(2.54)	(2.68)
Real int. rate reduction * bank recap.				-0.0943		-0.0792
				(-1.48)		(-1.12)
Fiscal deficit, cyclically adj.	0.2077	0.1490	0.2368	0.2528	0.3454	0.2840
	(0.97)	(0.60)	(1.06)	(1.11)	(1.46)	(1.00)
Fiscal deficit, cycl. adj. * bank recap.					-0.1455**	-0.1066
					(-2.04)	(-1.07)
Average of bank recapitalizations	-3.2815**	-3.4216**	-4.0347**	-3.3727**	-4.1363***	-4.9512**
	(-1.97)	(-2.12)	(-2.06)	(-2.18)	(-2.63)	(-2.35)
Average of guarantees on bank liab.	-2.3825	-3.9103	-2.4671	-1.6997	-1.8643	-3.0673
	(-1.19)	(-1.58)	(-1.21)	(-0.79)	(-0.85)	(-1.08)
Average liquidity support	2.3497	4.2471	3.1108	2.9685	-3.0218	-0.5763
	(0.42)	(0.71)	(0.56)	(0.53)	(-0.46)	(-0.08)
Average real interest rate reduction	-0.7642***	-0.7404***	-0.8076***	-0.7302***	-0.8662***	-0.8682***
	(-2.90)	(-2.68)	(-2.93)	(-2.80)	(-3.09)	(-2.67)
Average cyclically adj. fisc. def.	-0.2598	-0.2403	-0.2686	-0.3118	-0.3919	-0.3261
	(-0.97)	(-0.76)	(-1.01)	(-1.10)	(-1.33)	(-0.96)
Duration	1.5191	0.9055	1.9354	1.2068	0.7594	0.0505
	(0.79)	(0.52)	(1.13)	(0.70)	(0.52)	(0.03)
Duration^2	-0.0479	-0.0258	-0.1686	-0.0140	0.0921	0.1435
	(-0.14)	(-0.08)	(-0.57)	(-0.05)	(0.35)	(0.54)
Duration^3	-0.0044	-0.0010	0.0058	-0.0045	-0.0119	-0.0102
	(-0.22)	(-0.06)	(0.35)	(-0.25)	(-0.84)	(-0.66)
Constant	-5.1440	-4.2767	-5.5431*	-4.7498	-4.1665	-3.4003
	(-1.58)	(-1.46)	(-1.77)	(-1.64)	(-1.64)	(-1.48)
Observations	170	170	170	170	170	170
Crises	25	25	25	25	25	25
Log likelihood	-35.8520	-33.6307	-35.5098	-34.6523	-33.6776	-31.9634

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 RECAPITALIZATIONS are the cumulative amount of recapitalizations since the start of the banking crises, weighted by total banking assets. GUARANTEES ON BANK LIABILITIES are an indicator variable for the presence of guarantees. LIQUIDITY SUPPORT is ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. GROWTH OF RESERVE MONEY and REAL INTEREST RATE REDUCTION are measures of monetary policy. CYCLICALLY ADJUSTED FISCAL DEFICIT is a measure of discretionary fiscal policy. All policy variables except for fiscal deficit are lagged one quarter. 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.

7. Robustness checks

In this section we perform several additional regressions to check the robustness of our results. Firstly, we include the squared term of bank recapitalizations into the regression specification to check whether each

additional amount of recapitalizations is equally beneficial. We find an insignificant positive effect of the squared term on the sample of past crises and a negative effect on the sample of recent crisis. The significance of this effect is, however, driven by one single crisis, Cyprus. The crisis in Cyprus is special in two respects. The recession was still ongoing at the time of our data collection (2013 Q3) and the amount of recapitalizations (17.86% of total banking assets) is an outlier in the 2007-2013 sample.[15] Similarly as Cyprus also the second Greek recession, which started in 2010 Q1 was not yet finished by 2013 Q3. Table 12 in the Appendix reports four regressions with which we investigate the negative effect of squared recapitalization. In column (1) Cyprus as well as all other crises in 2007-2013 period are included. The estimated effect of the squared term is negative and highly significant. In column (2) Cyprus is excluded. The effect of squared recapitalizations becomes insignificant. In column (3) also the second Greek recession is included, which does not make any difference compared to column (2). In column (4) we use forecast data for the second Greek recession (and do not include Cyprus). The forecasts from the World Economic Outlook database (IMF 2013a) predict that Greece will recover in 2014 Q1. In addition to that we assume that the values of policy variables will be the same in 2013 Q4 and 2014 Q1 as in 2013 Q3.[16] The estimation results in columns (2), (3) and (4) are very similar; the squared term of bank recapitalizations is always insignificant. Based on this results we conclude that the negative effect of squared recapitalizations is due to Cyprus. A possible interpretation for the negative effect could be that bank recapitalizations that are very large are large not because the government wanted to bring banks to a higher capitalization level than when recapitalizations are intermediate but because the recapitalizations were delayed for too long. The zombie banks are already deeply insolvent when they are recapitalized. In such circumstances it can be that each additional unit of recapitalization is not as effective as when the scale of problems in the banking sector is smaller. But because this result only depends on one crisis we do not include Cyprus and the squared recapitalizations in the main results in the previous section.

To check whether our results are robust with respect to the definition of recession duration we perform estimations on data where (A) a more lax and (B) a more strict rule is used to determine which quarters constitute a recession. Under the lax definition we do not require a recession to include two consecutive negative growth quarters. A sequence of a negative, a positive and a negative quarter is considered a 3- quarter recession. Under this definition also Bolivia experienced a recession. In addition to this change we include also recessions that started more than 2 quarters before the start of the banking crises. As these recessions were not related to a banking crisis when they started we only count 4 quarters before the start of the banking crisis and the quarters after the start of the banking crisis as their recession duration. This adds 2 more recessions to the sample.[17] Under the strict definition we only count consecutive negative quarters as recession and do not include recessions that started more than 2 quarter before the banking crisis. Compared to the main definition some recessions are shorter under this definition. They either start later or end sooner.

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[15] Compared to recapitalizations in 1980-2006 crises it is not that high. See Table 1 and Table 2 for details.

[16] Our data about policy variables runs until 2013 Q2 but because the values of policy variables are lagged in regression we in fact can use actual data until 2013 Q3 and only need to use assumptions for two quarters.

[17] Under this definition the recession in Bulgaria is assumed to start in 1995 Q1, and in Uruguay in 2002 Q1. Two other crises with long recessions before the start of the banking crisis, Argentina 1989 and Finland 1991 cannot be included as they have missing data for one of the policies.

Table 13 in the Appendix provides the estimation results with both recession definitions. The estimates in columns (1) and (4) on the full sample can be compared with column (1) of Table 3, columns (2) and (4) on the sample of past crises with column (2) of Table 3, and columns (3) and (6) on the sample of recent crises with column (4) in Table 3. The estimation results under both alternative definitions are very similar to the main results. The effect of bank recapitalizations and reduction in real interest rate are positive and significant. The estimated effect of liquidity support is positive under the lax definition of recession for the sample of past crises while it was insignificant in the main results and the negative effect of guarantees becomes significant under the strict recession definition on the past crises sample. Otherwise there are no important differences.

In the final robustness check we run the regression using different distribution functions for the duration model. Instead of complementary log-log random effects estimation we use (A) logit random effect estimation and (B) linear probability model with random effects in Table 14 in the Appendix. The estimates obtained with logit are very similar to our main results in Table 3. In the linear probability model the predicted probabilities can lie outside of the $[0,1]$ range but even then the effect of bank recapitalizations remains.

8. Conclusions

We show that 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, guarantees on bank liabilities 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 apparently 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 68 systemic banking crises in the period 1980-2013. We estimate a duration model with recession specific fixed effects on a panel dataset. Our approach takes into account that intervention in banking crises is endogenous to crisis severity. We use the fact that the average use of intervention over the crisis period is informative about crisis severity. The estimations confirm that controlling for crisis severity is crucial. We find a positive and highly significant effect of bank recapitalizations on the probability of recovery. The other policies directed at distressed banks, guarantees on bank liabilities and liquidity support, do not seem to contribute much to a faster recovery.

Our approach enables us to compute expected durations at different values of intervention variables while keeping crisis severity constant. Our empirical results very clearly show that bank recapitalizations substantially reduce expected recession duration. On first sight, crises where bank recapitalizations were done and those where they were not, look similar; on average both types of crises lasted about 5 quarters. But the difference in their severity and the scale of the effect of bank recapitalizations becomes obvious when we compute the counterfactual expected durations. A typical crisis where banks were not recapitalized would last only 3 quarters if recapitalizations would be carried out while the recession of a typical crisis where banks were recapitalized would be about twice as long if bank recapitalizations 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 from a macroeconomic point of view, bank recapitalizations are the best intervention. Bank recapitalization leads to substantially shorter periods of output loss than other ways of supporting banks in distress. Obviously, our findings argue in favor of higher capital requirements: holding more capital in stable times would reduce the need for intervention in bad times. Recapitalizations would not be necessary for sufficiently low values of the shock. 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}.

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

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.

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

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 $\gamma_t = \gamma(t)$. $G(\cdot)$ is a cumulative distribution function. If $G(\cdot)$ is the complementary log-log cumulative distribution function $G(z) = 1 - \exp(\exp(-z))$, 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 $\lambda(u)$. In the Cox (1972) model continuous hazard rate is described as

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

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

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

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

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:

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

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:

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

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.

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

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:

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

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: GDP data sources

We use GDP data from the World Economic Outlook (IMF 2013a) and the International Financial Statistics (IMF 2013b) databases to determine recession durations. Whenever available we use seasonally adjusted quarter-over-quarter GDP growth rates from the WEO (item NGDP_R_SA_PCHA). For crises for which these data is not available, we complement it with quarterly GDP from the IFS. We take GDP index with 2005 as the base year (item NGDP_R) and compute quarter-over-quarter growth rates which we then seasonally adjust using the X-12 ARIMA procedure provided by the U.S. Census Bureau (2011). We use the plugin for Stata by Wang and Wu (2012) with the default settings for adjusting quarterly GDP data, described in their example.

Table 7: Data about recessions related to systemic banking crises in the 1980-2006 period.

Country	Crisis start	Recession start	Recovery	Recession duration	Duration of existing recession	Source and frequency of GDP data
Argentina	1980 Mar	1981 Q1	1983 Q1	8		WEO, annual
Argentina	1989 Dec	1988 Q1	1990 Q3	10	7	WEO, annual
Argentina	1995 Jan	1995 Q1	1995 Q4	3		WEO, seasonally adjusted
Argentina	2001 Nov	2001 Q2	2002 Q2	4	2	WEO, seasonally adjusted
Bolivia	1994 Nov					IFS, s. adj. with X-12 ARIMA
Brazil	1990 Feb	1990 Q1	1991 Q1	4		WEO, annual
Brazil	1994 Dec	1995 Q2	1995 Q4	2		WEO, seasonally adjusted
Bulgaria	1996 Jan	1989 Q1	1998 Q1	36	28	WEO, annual
Chile	1981 Nov	1981 Q4	1983 Q1	5		IFS, s. adj. with X-12 ARIMA
Colombia	1982 Jul					WEO, annual
Colombia	1998 Jun	1998 Q3	1999 Q3	4		WEO, seasonally adjusted
Cote d'Ivoire	1988					WEO, annual
Croatia	1998 Mar	1998 Q1	1999 Q3	6		WEO, seasonally adjusted
Czech Republic	1996 Jun	1996 Q4	1997 Q4	4		WEO, seasonally adjusted
Dominican Rep.	2003 Apr	2003 Q1	2004 Q1	4	1	WEO, annual
Ecuador	1998 Aug	1998 Q3	1999 Q4	5		IFS, s. adj. with X-12 ARIMA
Estonia	1992 Nov	1994 Q1	1995 Q2	5		WEO, seasonally adjusted
Finland	1991 Sep	1990 Q2	1993 Q3	13	5	WEO, seasonally adjusted
Ghana	1982 Jan	1982 Q1	1984 Q1	8		WEO, annual
Indonesia	1997 Nov	1997 Q4	1999 Q3	7		WEO, seasonally adjusted
Jamaica	1996 Dec	1997 Q3	1998 Q2	3		IFS, s. adj. with X-12 ARIMA
Japan	1997 Nov	1997 Q4	1998 Q3	3		WEO, seasonally adjusted
Korea	1997 Aug	1997 Q4	1998 Q3	3		WEO, seasonally adjusted
Latvia	1995 Apr					WEO, seasonally adjusted
Lithuania	1995 Dec					WEO, seasonally adjusted
Malaysia	1997 Jul	1998 Q1	1999 Q1	4		WEO, seasonally adjusted
Mexico	1994 Dec	1995 Q1	1995 Q3	2		WEO, seasonally adjusted
Nicaragua	2000 Aug					WEO, annual
Norway	1990 Dec	1991 Q3	1993 Q1	6		IFS, s. adj. with X-12 ARIMA
Paraguay	1995 May					WEO, annual
Philippines	1997 Jul	1997 Q3	1998 Q4	5		WEO, seasonally adjusted
Russia	1998 Aug					WEO, seasonally adjusted
Sri Lanka	1989					WEO, annual
Sweden	1991 Sep	1991 Q1	1993 Q1	8	2	WEO, seasonally adjusted
Thailand	1997 Jul	1997 Q3	1998 Q4	5		WEO, seasonally adjusted
Turkey	2000 Nov	2000 Q4	2002 Q1	5		WEO, seasonally adjusted
Ukraine	1998 Aug	1998 Q1	1999 Q1	4	2	WEO, seasonally adjusted
Uruguay	2002 Jan	1999 Q1	2003 Q1	16	12	WEO, annual
Venezuela	1994 Jan	1994 Q1	1995 Q1	4		WEO, annual
Vietnam	1997 Nov					IFS, annual

CRISIS START is the date when major distress in the banking sector was observed. RECESSION DURATION is in quarters. DURATION OF EXISTING RECESSION tells how long a recession has already been ongoing at the time of the banking crisis start.

If quarterly data is available neither in the WEO nor in the IFS, we use annual GDP growth rates from the WEO (item NGDP_R) or the IFS (item NGDP_R). There are 16 crises for which only annual data is available. Of those 8 did not have a recession and 3 had already been in a recession for more than a year before the banking crises started. So only for 5 crises included in the regression analysis recession durations are based on annual GDP data.

Table 8: Data about recessions related to systemic banking crises in the 2007-2013 period.

Country	Crisis start	Recession start	Recovery	Recession duration	Duration of existing recession	Source and frequency of GDP data
Austria	2008 Sep	2008 Q3	2009 Q3	4		WEO, seasonally adjusted
Belgium	2008 Sep	2008 Q3	2009 Q2	3		WEO, seasonally adjusted
Cyprus	2011 Jul	2011 Q3		7		WEO, seasonally adjusted
Denmark	2008 Sep	2008 Q3	2010 Q1	6		WEO, seasonally adjusted
France	2008 Sep	2008 Q2	2009 Q3	5	1	WEO, seasonally adjusted
Germany	2008 Sep	2008 Q2	2009 Q2	4	1	WEO, seasonally adjusted
Greece	2008 Sep	2008 Q2	2009 Q2	4	1	WEO, seasonally adjusted
Greece	2010 Apr	2010 Q1		13	1	WEO, seasonally adjusted
Hungary	2008 Sep	2008 Q3	2009 Q4	5		WEO, seasonally adjusted
Iceland	2008 Sep	2008 Q3	2010 Q4	9		WEO, seasonally adjusted
Ireland	2008 Sep	2008 Q1	2011 Q1	12	2	WEO, seasonally adjusted
Italy	2008 Sep	2008 Q2	2010 Q1	7	1	WEO, seasonally adjusted
Kazakhstan	2008 Sep					WEO, annual
Latvia	2008 Sep	2008 Q1	2009 Q4	7	2	WEO, seasonally adjusted
Luxembourg	2008 Sep	2008 Q2	2009 Q3	5	1	WEO, seasonally adjusted
Mongolia	2008 Sep	2009 Q1	2010 Q1	4		IFS, s. adj. with X-12 ARIMA
Netherlands	2008 Sep	2008 Q4	2009 Q3	3		WEO, seasonally adjusted
Nigeria	2009 Aug					WEO, annual
Portugal	2008 Sep	2008 Q1	2009 Q2	5	2	WEO, seasonally adjusted
Russia	2008 Sep	2008 Q3	2009 Q3	4		WEO, seasonally adjusted
Slovenia	2008 Sep	2008 Q3	2009 Q3	4		WEO, seasonally adjusted
Spain	2008 Sep	2008 Q2	2010 Q1	7	1	WEO, seasonally adjusted
Spain[18]	2011 Sep	2011 Q3	2013 Q3	8		WEO, seasonally adjusted
Sweden	2008 Sep	2008 Q1	2009 Q4	7	2	WEO, seasonally adjusted
Switzerland	2008 Sep	2008 Q4	2009 Q3	3		WEO, seasonally adjusted
Ukraine	2008 Sep	2008 Q2	2009 Q2	4	1	WEO, seasonally adjusted
United Kingdom	2007 Sep	2008 Q2	2009 Q4	6		WEO, seasonally adjusted
United States	2007 Dec	2008 Q1	2009 Q3	6		WEO, seasonally adjusted

For explanation see Table 8.

[18] To determine the end of the Spanish recession that started in 2011 Q3 we rely on data by the Spanish central bank (Banco De España 2013), which announced that Spain has recovered from the recession in 2013 Q3.

Appendix 3: Data about guarantees on bank liabilities

Table 9 reports the introduction and end dates of significant guarantees on bank liabilities. The source of data for 1980-2006 crises is (Laeven and Valencia 2012a). For crises after 2007 the introduction dates are from (Laeven and Valencia 2012a); the end dates are collected from EU Commission State Aid cases and IMF Country Staff Reports. If the end date is not available we assume that the guarantees were still in place in the quarter when the recession ends. The table reports the sources for each crisis.

Table 9: Data about significant guarantees on bank liabilities.

Country	Crisis start	Guarantees introduction	Guarantees end date	Source
Ecuador	1998 Aug	1998 Dec	2002 Jan	Laeven and Valencia (2012a)
Finland	1991 Sep	1993 Feb	1998 Dec	Laeven and Valencia (2012a)
Indonesia	1997 Nov	1998 Jan	2005 Jul	Laeven and Valencia (2012a)
Jamaica	1996 Dec	1997 Feb	1998 Mar	Laeven and Valencia (2012a)
Japan	1997 Nov	1997 Nov	2005 Apr	Laeven and Valencia (2012a)
Korea	1997 Aug	1997 Nov	2000 Dec	Laeven and Valencia (2012a)
Malaysia	1997 Jul	1998 Jan	2005 Aug	Laeven and Valencia (2012a)
Mexico	1994 Dec	1993 Dec	2003 Jan	Laeven and Valencia (2012a)
Nicaragua	2000 Aug	2001 Jan	2002 Jul	Laeven and Valencia (2012a)
Paraguay	1995 May	1995 Jul	1996 Jun	Laeven and Valencia (2012a)
Sweden	1991 Sep	1992 Sep	1996 Jul	Laeven and Valencia (2012a)
Thailand	1997 Jul	1997 Aug	2005 Jan	Laeven and Valencia (2012a)
Turkey	2000 Nov	2000 Dec	2004 Jul	Laeven and Valencia (2012a)
Austria	2008 Sep	2008 Dec	2011 Jun	Laeven and Valencia (2012a); State Aid SA.32018 (2010/N)
Belgium	2008 Sep	2008 Oct	2012 May	Laeven and Valencia (2012a); State Aid SA.34925 (2012/C-2) (ex 2012/N-2)
Cyprus	2011 Jul	2012 Nov	2013 Dec	Laeven and Valencia (2012a); State Aid SA.36930 (2013/N)
Denmark	2008 Sep	2009 Feb	2010 Jun	Laeven and Valencia (2012a); State Aid N 20/2010
France	2008 Sep	2008 Oct	2012 May	Laeven and Valencia (2012a); State aid SA.34925 (2012/C-2) (ex 2012/N-2)
Germany	2008 Sep	2008 Oct	2013 Jun	Laeven and Valencia (2012a)
Greece	2008 Sep	2008 Oct	2013 Dec	Laeven and Valencia (2012a)
Hungary	2008 Sep	2009 Dec	2013 Jun	Laeven and Valencia (2012a); State aid SA.36088 (2013/N)
Iceland	2008 Sep	2008 Oct		Laeven and Valencia (2012a)
Ireland	2008 Sep	2008 Sep	2013 Jun	Laeven and Valencia (2012a); Official Journal of the EU, C81, Vol. 56, 20 March 2013
Italy	2008 Sep	2008 Nov	2012 Jun	Laeven and Valencia (2012a); State Aid SA.34344 (2012/N)
Latvia	2008 Sep	2008 Dec	2010 Dec	Laeven and Valencia (2012a); State Aid N 223/2010
Luxembourg	2008 Sep	2008 Oct	2012 May	Laeven and Valencia (2012a); SA.34925 (2012/C-2) (ex 2012/N-2)
Mongolia	2008 Sep	2008 Nov	2012 Nov	Laeven and Valencia (2012a); IMF Country Report No. 11/107
Netherlands	2008 Sep	2008 Oct	2010 Dec	Laeven and Valencia (2012a)
Nigeria	2009 Aug	2009 Oct	2011 Dec	Laeven and Valencia (2012a); IMF Country Report No. 13/146
Portugal	2008 Sep	2008 Oct		Laeven and Valencia (2012a)
Russia	2008 Sep	2008 Nov	2010 Dec	Laeven and Valencia (2012a); IMF Country Report No.11/294
Slovenia	2008 Sep	2008 Dec	2010 Dec	Laeven and Valencia (2012a); Official Journal of the EU, C298, Vol. 53, 4 November 2010
Spain	2008 Sep	2008 Oct	2012 Dec	Laeven and Valencia (2012a)
Spain	2011 Sep	2008 Oct	2012 Dec	Laeven and Valencia (2012a)
Sweden	2008 Sep	2008 Oct	2011 Jun	Laeven and Valencia (2012a)
United Kingdom	2007 Sep	2008 Oct	2012 Dec	Laeven and Valencia (2012a); State Aid SA.34908 (2012/N)
United States	2007 Dec	2008 Oct		Laeven and Valencia (2012a)

Only banking crises where there were significant guarantees on bank liabilities are listed in the table. CRISIS START is the date when major distress in the banking sector was observed. GUARANTEES INTRODUCTION is the date when significant guarantees on bank liabilities were introduced. GUARANTEES END DATE is the time when the guarantees expired.

Appendix 4: Data about liquidity support, monetary policy and fiscal policy

Liquidity support

Liquidity support is the ratio of central bank claims over total deposits. The source of data is the International Financial Statistics Database (IMF 2013b). Depending on the time period the data is available under different items. For more recent crises the relevant IFS items are: FASAD (Claims on other depository institutions), FOST (Transferable deposits included in broad money) and FOSD (Other deposits included in broad money). For time periods for which these items are not available, we use items: 12e_ (Claims on other depository corporations), 24_ (Demand deposits) and 25_ (Time, savings and foreign currency deposits).

For the United Kingdom these 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. In addition we make changes in the IFS data for Jamaica and Sweden. 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. For the Swedish crisis in 1991 the data about total deposits is not available after the last quarter of 1989 while the data about the claims of the central bank on other depository corporations is available. 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.

Monetary policy

For monetary policy we use two alternative measures: growth of reserve money and decrease in real interest rate. The source of data for both measures is the International Financial Statistics Database (IMF 2013b). Reserve money growth is computed using FASMB (Monetary base) or 14_ (Reserve money) depending on which is available. For Eurozone countries the data comes from the European Central Bank Statistical Data Warehouse (ECB 2013), item Base money (sum of L010 & L021 & L022).

To compute the real interest rates we use the Fisher equation:

$$1+i=(1+r)(1+\pi)$$
$$r=\frac{1+i}{1+\pi}-1 \qquad (27)$$

where r is the real interest rate, i the nominal rate and π the expected inflation rate. As the nominal interest rate we use several IFS items describing interest rates relevant for monetary policy: FIMM (Interest rates, money market rate), FPOLM (Interest rates, monetary policy related interest rate), FID (Interest rates, discount rate). The first of these that is non-missing is used as the nominal rate in a crisis. For all but two recessions after 2007 FIMM is used. In case of Eurozone countries sometimes country-specific FIMM is reported. If the country specific FIMM is not available, we use the FIMM of the Euro Area, which is also reported in the IFS. Inflation rates are always country-specific. Therefore the real interest rates differ across Eurozone members even if the nominal interest rate is the same. As the expected inflation rate we use PCPI (Consumer prices, all items) percent change over the corresponding quarter of the previous year. We only compute real interest rates if the relevant annual inflation rate is less than 50%.

Fiscal policy

As a measure of fiscal policy we use cyclically adjusted deficit of general government obtained from the item GGCB (General government cyclically adjusted primary balance, percent of potential in fiscal year GDP) from the WEO (IMF 2013a)[19].

Table 10 and Table 11 report the average values of liquidity support, reserve money growth, decrease in real interest rate and cyclically adjusted fiscal deficit for all recessions. The data sources used to construct variable values are reported for each crisis for variables where different sources or items are possible.

[19] Among the 2007-2013 crises that had a recession, fiscally adjusted deficit is not available only for Mongolia. In general we do not use non adjusted fiscal deficit data. In this case, however, we use the non-adjusted fiscal deficit in place of the adjusted for Mongolia in order not to lose observations of this crisis.

Table 10: Average values and sources for liquidity support, reserve money growth, real interest rates and fiscal deficit for 1980-2006 crises.

Country	Crisis start	Recession start	Liquidity support	Liq. source	Reserve money growth	Reserve money source	Real int. rate decrease	Real int. source	Fiscal deficit
Argentina	1980 Mar	1981 Q1	0.4403	IFS: 12e, 24_, 25_	0.6317	IFS: 14_			
Argentina	1989 Dec	1988 Q1	2.6812		1.1842	IFS: 14_			
Argentina	1995 Jan	1995 Q1	0.6105	IFS: 12e, 24_, 25_	-0.0183	IFS: 14_	-0.0797	IFS: FIMM	
Argentina	2001 Nov	2001 Q2	0.0674	IFS: 12e, 24_, 25_	0.0882	IFS: 14_	-3.6819	IFS: FIMM	8.4561
Bolivia	1994 Nov			IFS: 12e, 24_, 25_		IFS: 14_			
Brazil	1990 Feb	1990 Q1	0.0430	IFS: 12e, 24_, 25_	2.1974	IFS: 14_			
Brazil	1994 Dec	1995 Q2	0.1472	IFS: 12e, 24_, 25_	-0.0381	IFS: 14_			
Bulgaria	1996 Jan	1989 Q1	0.1493	IFS: FASAD, FOST, FOSD	0.2343	IFS: FASMB			
Chile	1981 Nov	1981 Q4	0.1463	IFS: 12e, 24_, 25_	0.0323	IFS: 14_			
Colombia	1982 Jul			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FID	
Colombia	1998 Jun	1998 Q3	0.0194	IFS: 12e, 24_, 25_	-0.0036	IFS: 14_	0.1080	IFS: FIMM	
Cote d'Ivoire	1988			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FIMM	
Croatia	1998 Mar	1998 Q1	0.0157	IFS: 12e, 24_, 25_	0.0491	IFS: 14_	-0.2494	IFS: FIMM	
Czech Republic	1996 Jun	1996 Q4	0.0910	IFS: 12e, 24_, 25_	0.0234	IFS: 14_	-0.4175	IFS: FIMM	4.0738
Dominican Rep.	2003 Apr	2003 Q1	0.3258	IFS: FASAD, FOST, FOSD	0.2109	IFS: FASMB	3.6209	IFS: FIMM	4.2045
Ecuador	1998 Aug	1998 Q3	0.2544	IFS: 12e, 24_, 25_	-0.0174	IFS: 14_			
Estonia	1992 Nov	1994 Q1	0.0895	IFS: 12e, 24_, 25_	0.0440	IFS: 14_			
Finland	1991 Sep	1990 Q2	0.0606	IFS: 12e, 24_, 25_			0.1276	IFS: FIMM	
Ghana	1982 Jan	1982 Q1	0.0008	IFS: 12e, 24_, 25_	0.0971	IFS: 14_			
Indonesia	1997 Nov	1997 Q4	0.1179	IFS: 12e, 24_, 25_	0.0955	IFS: 14_			
Jamaica	1996 Dec	1997 Q3	0.0037	IFS: 12e, 24_, 25_	0.1121	IFS: 14_			
Japan	1997 Nov	1997 Q4	0.0112	IFS: 12e, 24_, 25_	0.0245	IFS: 14_	-0.4148	IFS: FIMM	5.3195
Korea	1997 Aug	1997 Q4	0.2608	IFS: 12e, 24_, 25_	0.0018	IFS: 14_	-0.4574	IFS: FIMM	-2.2941
Latvia	1995 Apr			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FIMM	
Lithuania	1995 Dec			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FIMM	
Malaysia	1997 Jul	1998 Q1	0.0375	IFS: 12e, 24_, 25_	-0.1209	IFS: 14_	0.9733	IFS: FIMM	
Mexico	1994 Dec	1995 Q1	0.2069	IFS: 12e, 24_, 25_	0.0597	IFS: 14_	-4.4586	IFS: FIMM	
Nicaragua	2000 Aug			IFS: 12e, 24_, 25_		IFS: 14_			
Norway	1990 Dec	1991 Q3	0.1413	IFS: 12e, 24_, 25_	0.0229	IFS: 14_	-1.4448	IFS: FIMM	8.4824
Paraguay	1995 May			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FIMM	
Philippines	1997 Jul	1997 Q3	0.0123	IFS: 12e, 24_, 25_	0.0090	IFS: 14_	0.1269	IFS: FIMM	
Russia	1998 Aug			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FIMM	
Sri Lanka	1989			IFS: 12e, 24_, 25_		IFS: 14_		IFS: FIMM	
Sweden	1991 Sep	1991 Q1	0.0472		0.0498	IFS: 14_	-1.1439	IFS: FIMM	11.1926
Thailand	1997 Jul	1997 Q3	0.0466	IFS: 12e, 24_, 25_	-0.0024	IFS: 14_	0.8614	IFS: FIMM	4.3910
Turkey	2000 Nov	2000 Q4	0.1250	IFS: 12e, 24_, 25_	0.0956	IFS: 14_			13.2055
Ukraine	1998 Aug	1998 Q1	0.1772	IFS: 12e, 24_, 25_	0.0462	IFS: 14_	-4.9163	IFS: FIMM	
Uruguay	2002 Jan	1999 Q1	0.1045	IFS: FASAD, FOST, FOSD	0.0109	IFS: 14_	-1.7663	IFS: FIMM	
Venezuela	1994 Jan	1994 Q1	0.0147	IFS: 12e, 24_, 25_	0.1524	IFS: 14_			
Vietnam	1997 Nov					IFS: 14_		IFS: FPOLM	

CRISIS START is the date when major distress in the banking sector was observed. Average values (over the quarters of a recession) and data sources are reported for each policy variable. LIQUIDITY SUPPORT is a ratio. RESERVE MONEY GROWTH is reported as a ratio. REAL INTEREST RATE DECREASE and FISCAL DEFICIT are in percentage points.

Table 11: Average values and sources for liquidity support, reserve money growth, real interest rates and fiscal deficit for 2007-2013 crises.

Country	Crisis start	Recession start	Liquidity support	Liq. source	Reserve money growth	Reserve money source	Real int. rate decrease	Real int. source	Fiscal deficit
Austria	2008 Sep	2008 Q3	0.0884	IFS: FASAD, FOST, FOSD	0.0381	ECB	0.0270	IFS: FIMM, Eurozone	2.8660
Belgium	2008 Sep	2008 Q3	0.2473	IFS: FASAD, FOST, FOSD	0.0740	ECB	0.1627	IFS: FIMM, Eurozone	3.2937
Cyprus	2011 Jul	2011 Q3	0.2131	IFS: FASAD, FOST, FOSD	0.0486	ECB	-0.0630	IFS: FIMM, Eurozone	4.6249
Denmark	2008 Sep	2008 Q3	0.2729	IFS: FASAD, FOST, FOSD	0.0214	IFS: FASMB	0.2352	IFS: FIMM	0.3291
France	2008 Sep	2008 Q2	0.1022	IFS: FASAD, FOST, FOSD	0.0367	ECB	0.1104	IFS: FIMM, Eurozone	4.9118
Germany	2008 Sep	2008 Q2	0.1044	IFS: FASAD, FOST, FOSD	0.0651	ECB	0.0796	IFS: FIMM	1.2339
Greece	2008 Sep	2008 Q2	0.1066	IFS: FASAD, FOST, FOSD	0.0651	ECB	0.1639	IFS: FIMM, Eurozone	16.2124
Greece	2010 Apr	2010 Q1	0.5682	IFS: FASAD, FOST, FOSD	0.0255	ECB	-0.0168	IFS: FIMM, Eurozone	6.5400
Hungary	2008 Sep	2008 Q3	0.0103	IFS: FASAD, FOST, FOSD	-0.0091	IFS: FASMB	-0.2282	IFS: FID	3.7498
Iceland	2008 Sep	2008 Q3	0.1855	IFS: FASAD, FOST, FOSD	0.0562	IFS: FASMB	0.5002	IFS: FIMM	10.3545
Ireland	2008 Sep	2008 Q1	0.4833	IFS: FASAD, FOST, FOSD	0.0238	ECB	-0.0172	IFS: FIMM	8.6633
Italy	2008 Sep	2008 Q2	0.0284	IFS: FASAD, FOST, FOSD	0.0352	ECB	0.2781	IFS: FIMM	3.4923
Kazakhstan	2008 Sep			IFS: FASAD, FOST, FOSD		IFS: FASMB		IFS: FPOLM	
Latvia	2008 Sep	2008 Q1	0.0344	IFS: FASAD, FOST, FOSD	-0.0463	IFS: FASMB	-0.5596	IFS: FIMM	6.0966
Luxembourg	2008 Sep	2008 Q2	0.2684	IFS: FASAD, FOST, FOSD	0.0367	ECB	-0.0026	IFS: FIMM, Eurozone	-1.4214
Mongolia	2008 Sep	2009 Q1	0.0921	IFS: FASAD, FOST, FOSD	0.1409	IFS: FASMB	-5.0474	IFS: FPOLM	4.0597
Netherlands	2008 Sep	2008 Q4	0.0608	IFS: FASAD, FOST, FOSD	0.0435	ECB	0.6406	IFS: FIMM, Eurozone	3.8588
Nigeria	2009 Aug			IFS: FASAD, FOST, FOSD		IFS: FASMB		IFS: FID	
Portugal	2008 Sep	2008 Q1	0.0262	IFS: FASAD, FOST, FOSD	0.0558	ECB	0.0889	IFS: FIMM, Eurozone	5.9940
Russia	2008 Sep	2008 Q3	0.1798	IFS: FASAD, FOST, FOSD	0.0138	IFS: FASMB	-0.7280	IFS: FIMM	0.3483
Slovenia	2008 Sep	2008 Q3	0.0454	IFS: FASAD, FOST, FOSD	0.0381	ECB	-0.4864	IFS: FIMM	4.2376
Spain	2008 Sep	2008 Q2	0.0510	IFS: FASAD, FOST, FOSD	0.0352	ECB	-0.0263	IFS: FIMM	8.1408
Spain	2011 Sep	2011 Q3	0.1795	IFS: FASAD, FOST, FOSD	0.0333	ECB	-0.1332	IFS: FIMM	7.4921
Sweden	2008 Sep	2008 Q1	0.1168	IFS: FASAD, FOST, FOSD	0.2217	IFS: FASMB	-0.0091	IFS: FIMM	-0.5447
Switzerland	2008 Sep	2008 Q4	0.0230	IFS: 12e, 24_, 25_	0.2927	IFS: 14_	-0.4118	IFS: FIMM	-0.8654
Ukraine	2008 Sep	2008 Q2	0.0933	IFS: FASAD, FOST, FOSD	0.0457	IFS: FASMB	-4.4669	IFS: FIMM	3.1920
United Kingdom	2007 Sep	2008 Q2	0.0312	Bank of England	0.1873	IFS: 14_	0.6758	IFS: FIMM	8.7106
United States	2007 Dec	2008 Q1	0.0319	IFS: FASAD, FOST, FOSD	0.1248	IFS: FASMB	0.1863	IFS: FIMM	7.8305

For explanation see Table 10.

Appendix 5: Robustness checks

Table 12: Robustness checks to investigate what drives the negative effect of squared bank recapitalizations on the sample of 2007-2013 crises.

Recession indicator	Recent crises 2007-2013 Cyprus included (1)	Recent crises 2007-2013 Cyprus excluded (2)	Recent crises 2007-2013 Excl. Cyprus and Greece II (3)	Recent crises 2007-2013 Excl. Cyprus, forecasts for Greece II (4)
Bank recapitalizations	2.7863***	2.3598**	2.3303**	2.2671**
	(2.87)	(2.15)	(2.12)	(2.12)
Bank recapitalizations^2	-0.1308***	-0.0194	-0.0175	-0.0700
	(-2.67)	(-0.17)	(-0.15)	(-0.69)
Guarantees on bank liabilities	0.7316	1.0895	1.1171	0.5362
	(0.60)	(0.86)	(0.85)	(0.45)
Liquidity support	-6.3882	-5.1881	-5.0584	-6.7820
	(-1.39)	(-1.03)	(-0.99)	(-1.49)
Real interest rate reduction	0.3910***	0.3954**	0.3936**	0.3566**
	(2.80)	(2.53)	(2.51)	(2.55)
Fiscal deficit, cyclically adj.	0.2030	0.1583	0.1527	0.2223
	(0.93)	(0.71)	(0.69)	(1.04)
Average of bank recapitalizations	-2.5039	-2.0080	-1.9551	-1.8155
	(-1.27)	(-0.93)	(-0.91)	(-0.89)
Average of bank recapitalizations^2	-0.0099	-0.2372	-0.2408	-0.1065
	(-0.07)	(-0.87)	(-0.89)	(-0.46)
Average of guarantees on bank liab.	-1.1421	-2.0740	-2.1035	-1.1290
	(-0.58)	(-0.96)	(-0.94)	(-0.57)
Average liquidity support	-6.3063	-3.7751	-3.7686	-4.8961
	(-0.97)	(-0.56)	(-0.56)	(-0.72)
Average real interest rate reduction	-0.8028***	-0.8345***	-0.8305***	-0.7864***
	(-3.11)	(-3.13)	(-3.10)	(-3.05)
Average cyclically adj. fisc. def.	-0.4198	-0.3070	-0.2993	-0.4262
	(-1.42)	(-1.00)	(-0.97)	(-1.46)
Duration	1.8593	0.7180	0.7081	2.9799**
	(1.08)	(0.39)	(0.38)	(2.16)
Duration^2	-0.1533	0.1005	0.1023	-0.3339*
	(-0.53)	(0.28)	(0.29)	(-1.73)
Duration^3	0.0042	-0.0128	-0.0129	0.0125*
	(0.28)	(-0.59)	(-0.59)	(1.68)
Constant	-5.3914*	-4.2224	-4.2288	-7.3350**
	(-1.70)	(-1.48)	(-1.48)	(-2.37)
Observations	178	170	156	173
Crises	26	25	24	25
Log likelihood	-34.0987	-33.2302	-33.2013	-34.4881

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 RECAPITALIZATIONS are the cumulative amount of recapitalizations since the start of the banking crises, weighted by total banking assets. GUARANTEES ON BANK LIABILITIES are an indicator variable for the presence of guarantees. LIQUIDITY SUPPORT is ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. GROWTH OF RESERVE MONEY and REAL INTEREST RATE REDUCTION are measures of monetary policy. CYCLICALLY ADJUSTED FISCAL DEFICIT is a measure of discretionary fiscal policy. All policy variables except for fiscal deficit are lagged one quarter. 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 13: Robustness checks with a lax and strict definition of recession duration.

	Lax recession definition			Strict recession definition		
	Full sample 1980-2013	Past crises 1980-2007	Recent crises 2008-2013	Full sample 1980-2013	Past crises 1980-2007	Recent crises 2008-2013
Recession indicator	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Bank recapitalizations	0.4981***	0.5758**	1.5126**	1.4929***	10.4952***	1.5118*
	(3.01)	(2.19)	(2.01)	(3.41)	(2.83)	(1.79)
Guarantees on bank liabilities	0.2147	-0.7833	0.2769	0.0642	-9.5049**	1.1483
	(0.37)	(-0.55)	(0.22)	(0.10)	(-2.05)	(0.98)
Liquidity support	2.2820	4.1813**	-3.6067	1.3861	3.9983	-1.7372
	(1.54)	(2.09)	(-0.80)	(0.82)	(1.36)	(-0.36)
Growth of reserve money	-0.7008	-1.0296		-0.9572	-0.8084	
	(-1.44)	(-1.59)		(-1.33)	(-0.90)	
Real interest rate reduction			0.2528*			0.3013*
			(1.89)			(1.83)
Fiscal deficit, cyclically adj.			0.2077			0.1400
			(0.97)			(0.64)
Average of bank recapitalizations	-0.9101***	-0.9077**	-3.2815**	-2.4421***	-17.4654***	-1.5597
	(-2.79)	(-2.05)	(-1.97)	(-3.33)	(-2.83)	(-1.12)
Average of guarantees on bank liab.	-0.2221	2.0478	-2.3825	0.0612	13.2054**	-1.4321
	(-0.24)	(1.09)	(-1.19)	(0.06)	(2.15)	(-0.67)
Average liquidity support	-3.4466	-2.9527	2.3497	-1.5375	-3.6407	-1.0577
	(-1.50)	(-1.02)	(0.42)	(-0.66)	(-1.05)	(-0.16)
Average reserve money growth	0.3092	0.1960		0.1336	-0.0348	
	(0.58)	(0.29)		(0.26)	(-0.06)	
Average real interest rate reduction			-0.7642***			-0.5048
			(-2.90)			(-1.60)
Average cyclically adj. fisc. def.			-0.2598			-0.3113
			(-0.97)			(-1.08)
Duration	2.9867***	4.1362***	1.5191	10.6175***	14.7311***	12.6821**
	(3.37)	(2.91)	(0.79)	(3.65)	(2.73)	(2.02)
Duration^2	-0.4211***	-0.6572***	-0.0479	-2.1788***	-3.0337***	-2.3633*
	(-2.88)	(-2.65)	(-0.14)	(-3.50)	(-2.59)	(-1.86)
Duration^3	0.0174**	0.0311**	-0.0044	0.1405***	0.1954**	0.1453*
	(2.46)	(2.47)	(-0.22)	(3.35)	(2.48)	(1.78)
Constant	-7.1655***	-9.1529***	-5.1440	-16.9647***	-23.0266***	-22.2398**
	(-4.38)	(-3.66)	(-1.58)	(-3.93)	(-2.91)	(-2.18)
Observations	343	173	170	270	127	143
Crises	54	29	25	51	26	25
Log likelihood	-102.2606	-51.5714	-35.8520	-72.9453	-26.4058	-28.9011

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 RECAPITALIZATIONS are the cumulative amount of recapitalizations since the start of the banking crises, weighted by total banking assets. GUARANTEES ON BANK LIABILITIES are an indicator variable for the presence of guarantees. LIQUIDITY SUPPORT is ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. GROWTH OF RESERVE MONEY and REAL INTEREST RATE REDUCTION are measures of monetary policy. CYCLICALLY ADJUSTED FISCAL DEFICIT is a measure of discretionary fiscal policy. All policy variables except for fiscal deficit are lagged one quarter. 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 14: Robustness checks with different estimation procedures.

	Logit			Linear probability model		
	Full sample 1980-2013	Past crises 1980-2006	Recent crises 2007-2013	Full sample 1980-2013	Past crises 1980-2006	Recent crises 2007-2013
Recession indicator	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Bank recapitalizations	0.9217***	1.9362**	1.7692**	0.0213**	0.0205*	0.0080
	(3.30)	(2.50)	(1.98)	(2.36)	(1.94)	(0.37)
Guarantees on bank liabilities	0.1109	-4.3222	0.1584	0.0550	0.0106	0.0333
	(0.15)	(-1.60)	(0.11)	(0.87)	(0.08)	(0.40)
Liquidity support	3.5145*	5.4953	-4.2407	0.0838	0.2241	-0.4243
	(1.70)	(1.42)	(-0.72)	(0.43)	(0.81)	(-1.44)
Growth of reserve money	-1.0666	-1.6619		-0.0666	-0.0538	
	(-1.61)	(-1.44)		(-1.26)	(-0.84)	
Real interest rate reduction			0.2987*			0.0177
			(1.84)			(1.31)
Fiscal deficit, cyclically adj.			0.2570			0.0213
			(0.96)			(1.53)
Average of bank recapitalizations	-1.6008***	-3.1527**	-3.8238*	-0.0294**	-0.0188	-0.0273
	(-3.25)	(-2.44)	(-1.94)	(-2.36)	(-1.25)	(-0.82)
Average of guarantees on bank liab.	-0.3524	6.4750*	-2.6210	-0.1028	0.0676	-0.1448
	(-0.31)	(1.91)	(-1.16)	(-1.21)	(0.43)	(-0.97)
Average liquidity support	-4.1150	-3.1733	2.6633	-0.3186	-0.1544	-0.0247
	(-1.47)	(-0.78)	(0.34)	(-1.45)	(-0.45)	(-0.07)
Average reserve money growth	0.3374	0.2478		0.0660	0.0518	
	(0.52)	(0.33)		(0.78)	(0.54)	
Average real interest rate reduction			-0.8285***			-0.0352
			(-2.59)			(-1.41)
Average cyclically adj. fisc. def.			-0.3184			-0.0292*
			(-0.99)			(-1.80)
Duration	3.1358***	11.0233**	1.8056	0.0191	0.0018	0.0285
	(2.60)	(2.25)	(0.80)	(0.47)	(0.02)	(0.52)
Duration^2	-0.3940*	-2.2231**	-0.0679	0.0143	0.0251	0.0128
	(-1.90)	(-2.07)	(-0.16)	(1.54)	(0.81)	(1.09)
Duration^3	0.0129	0.1439**	-0.0043	-0.0012**	-0.0020	-0.0009
	(1.20)	(1.96)	(-0.18)	(-2.17)	(-0.72)	(-1.33)
Constant	-7.5508***	-18.4472**	-5.4396	0.0707	-0.0172	0.1237
	(-3.52)	(-2.57)	(-1.44)	(1.28)	(-0.20)	(1.36)
Observations	317	147	170	317	147	170
Crises	51	26	25	51	26	25
Log likelihood	-88.6471	-37.0105	-36.6919	.	.	.

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 RECAPITALIZATIONS are the cumulative amount of recapitalizations since the start of the banking crises, weighted by total banking assets. GUARANTEES ON BANK LIABILITIES are an indicator variable for the presence of guarantees. LIQUIDITY SUPPORT is ratio of central bank claims on other depository corporations divided by the total deposits at other depository corporations. GROWTH OF RESERVE MONEY and REAL INTEREST RATE REDUCTION are measures of monetary policy. CYCLICALLY ADJUSTED FISCAL DEFICIT is a measure of discretionary fiscal policy. All policy variables except for fiscal deficit are lagged one quarter. 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.