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# Determinants of the Allocation of Funds Under the Capital Purchase Program

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## Abstract

During 2008-09, as part of a wide-ranging rescue operation, the US Treasury poured capital infusions into a great many domestic financial institutions under the Capital Purchase Program (CPP), thus helping to avert a complete collapse of the US banking sector. In carrying out this effort, government regulators had to distinguish between those banks deserving of being bailed out and those that should be allowed to fail. The results of this study show that the CPP favored larger financial institutions whose potential failure represented higher degrees of systemic risk. This allocation of CPP funds was cost-effective from the point of view of taxpayers, as such banks reimbursed the government for their CPP bailouts sooner than expected. In contrast, smaller banks that were heavily into mortgage-backed securities, mortgages, and non-performing loans were less likely to be bailed out and, if they did receive CPP help, took longer to repurchase their shares from the Treasury. Several explanations of such allocation decisions are proposed in this paper, including adverse selection of the mortgage products kept on banks' books and the Treasury's approach to distinguishing between insolvent and temporarily illiquid institutions.

**JEL Codes:** E52, E58, G21

**Keywords:** Capital Purchase Program, bank recapitalization, systemic risk

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## 1. Introduction

The global financial crisis that began in the US in 2007 dealt a severe blow to the American economy as a whole. Financial institutions, corporations, and households all felt the strain, while government interventions across the world imposed heavy burdens on the taxpayers in their societies. These interventions included such measures as loan guarantee schemes for newly issued senior unsecured debt and bank recapitalizations. In the US, between October 2008 and December 2009, the US Treasury injected huge amounts of liquidity into 707 banks[1] in 48 states through the purchases of preferred equity stakes under the voluntary Capital Purchase Program (the CPP; for more details, see Acharya and Sundaram, 2009; Panetta *et al.*, 2009; King, 2009; Cooley and Philippon, 2009; Khatiwada, 2009).

The Federal Reserve and US Treasury had to develop criteria for deciding whether to bail out a given bank or allow it to go under. Many such judgments were made on a case-by-case basis during the height of the crisis, and the debate over the effectiveness of the entire rescue program for the country's commercial banks continues to this day. On the one hand, regulators were leery of entering into "moral hazard" territory (Dam and Koetter, 2011; Gale and Vives, 2002; Stiglitz, 2012); on the other hand, bank recapitalizations were obviously necessary to support solvent but illiquid banks and thus avert a catastrophic collapse of the entire financial system (Fender and Gyntelberg, 2008).

Compared with other types of government support, the purchase of preferred or common shares is often seen as one of the most efficient types of capital infusions (see Wilson and Wu, 2010). Another argument in favor of the CPP is that the program did not end up costing taxpayers much. Specifically, it spent only $204.9 billion of its $250 billion budget (more than a third of the total Troubled Asset Relief Program). The largest investment was $25 billion and the smallest was $301,000.

By April 30, 2013, the Treasury had recovered more than $222 billion of what it had disbursed through the CPP in the form of repayments, dividends, interest, and other income (according to the US Department of the Treasury website). (It should be noted that not all bank stakes taken up under the CPP at that time were held by the Treasury.) In March 2012, the Treasury started to wind down its remaining bank investments through public auctions. This process accelerated during the fall of 2012.

[1] Including more than 450 small and community banks and 22 certified community development financial institutions (CDFIs).

This paper focuses on the determinants of the liquidity provisions under the CPP. It first defines the factors that contributed to the final bailout allocation and to bailout repayments[2]. Based on that, it is possible to assess the effectiveness of the allocation of CPP funds according to the goals of the program and the realized risks for taxpayers.

The presented analysis rests on four main hypotheses. The first hypothesis is that the distribution of CPP funds and their repayments were geared to the perceived financial fragility of commercial banks just before the crisis. Regulators were expected to provide liquidity to more financially vulnerable banks as well as to those banks exposed to the so-called "tail risk" that materialized after a secular collapse in the housing market.

The second hypothesis is that the CPP was designed to minimize the spreading of the crisis. First, there was the risk of a drying up of credit availability due to the deterioration in the intermediary role of the banking sector. Second, there was significant counterparty risk, mostly from the side of LCFIs (Large Complex Financial Institutions), which proved to be "too big to fail" due to their size, complexity, interconnectedness, and other factors. Several indicators are used in this paper to identify systemically critical institutions: Marginal Expected Shortfall (MES) (Acharya *et al.*, 2010), $\Delta CoVaR$ (Adrian and Brunnermeier, 2011), bank size, and beta.

Another hypothesis underlying this study is that political contributions (including lobbying activities) and a bank's location could have caused a more generous distribution of CPP funds towards specific financial institutions. In this vein, Duchin and Sosyura (2012) find evidence of politically connected firms having priority in being funded.

A bank's excessive risk-taking before the crisis might be one more reason for its participation in the CPP. The higher the degree of risk taken by such an enterprise (indicated by the change in the bank's share value), the larger its losses should be during the crisis and thus the greater its need for CPP funds vis-à-vis other banks (Kibritcioglu, 2002).

The paper contributes to the literature on bailouts and on the effectiveness of liquidity provisions. The allocation of CPP funds is investigated and evaluated by analyzing bailout repayments over the four years following the disbursement of CPP funds (2009-12). In this regard, it is an important source of information on the realized risks of funding allocations. Methodologically, polytomous and duration models are applied to analyze capital injections under the CPP and their reimbursement.

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2 The bailout repayments under the CPP mean the repurchase of the Treasury's equity stake.

Not all banks were automatically eligible for the CPP. First, a bank had to request participation in the CPP by applying to the appropriate Federal banking agency (FBA). Second, the Treasury had to approve the bank's application. Then, the bank had 30 days from the date of that notification to accept the Treasury's terms and conditions and to submit investment agreements and related documentation. This being the case, if a particular bank was not bailed out, two distinct scenarios were possible to explain why.

First, that bank either did not apply for CPP funds in the first place or did not accept the Treasury's conditions after receiving preliminary approval, perhaps because of the availability of cheaper alternative financing or the absence of the need to recapitalize. Second, such a bank could have been refused CPP funds by the Treasury for two main reasons: (i) it was considered to be insolvent or (ii) its financial situation was deemed superior to those of other applicants (given that the amount to be disbursed under the CPP was limited). Of these, the first reason seems to be more realistic, as not all CPP funds were disbursed and most banks were suffering from liquidity shortages equally.

According to a report by the US Government Accountability Office (GAO, 2009), the Treasury had received over 1,300 CPP applications from regulators by June 12, 2009, while more than 220 applications had not yet been forwarded to the Treasury by bank regulators[3]. Further, approximately 400 financial institutions that had received preliminary approval had withdrawn their CPP applications by June 12, 2009 because of the uncertainty surrounding future program requirements. However, in this paper, no distinction is made between these two situations, as no data on individual bank applications are freely available. This limitation has been taken into account when interpreting the results.

The results of multinomial logit regression analysis confirm that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks. At the same time, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury than other banks. Thus, saving these banks helped avoid large external costs for the other sectors of the economy in the event of a total collapse of the banking sector, while taxpayers' money was returned in relatively short order. However, such an allocation of CPP funds might have contributed to the creation of moral hazard and triggered more future bailouts of large and "too interconnected" banks. In addition, while financially distressed banks (according to their Z-scores) were more likely to be bailed out, this was not the case for banks with

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[3] The deadline for applications by small banks was then extended until November 21, 2009.

portfolios overweighted with mortgage-backed securities (MBSs), mortgages, and non-performing loans.

There are several interpretations of these results, depending on whether a bank decided not to apply for CPP funds or the Treasury rejected the bank's application. A bank may have decided not to apply for CPP funds if the mortgages and MBSs on its books were of primary loan type. This means that banks preferred to leave high-quality loans on their balance sheets and to securitize and sell off less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles. However, if the Treasury decided not to bail out a commercial bank, it may have been due to its specializing in mortgage lending and MBSs rather than commercial lending.

Banks that specialized in commercial and industrial loans might have been viewed as more viable and temporarily illiquid through no fault of their own (the cause being deterioration of the interbank market), unlike their counterparts that had been wallowing in mortgage lending, which were now insolvent after engaging in predatory lending before the crisis. Moreover, the former group of banks had a higher probability of repaying CPP funds in full before July 2012.

The remainder of the paper is structured as follows. Section 2 presents the estimation methodology. Section 3 introduces the data and describes the dependent and explanatory variables. The empirical results for the polytomous and time-to-repayment regressions analyzing the factors that determined the disbursement of CPP funds and their repayments are presented in Section 4. Section 5 contains the conclusion.

## 2. Estimation Methodology

### 2.1 Multinomial (Polytomous) Logistic Regression

Multinomial logistic regression uses the maximum likelihood method to predict a categorical dependent variable that takes on more than two outcomes that have no natural ordering. The discrete dependent variable in that model represents a bank's progress in CPP funds repayment by July 31, 2012.

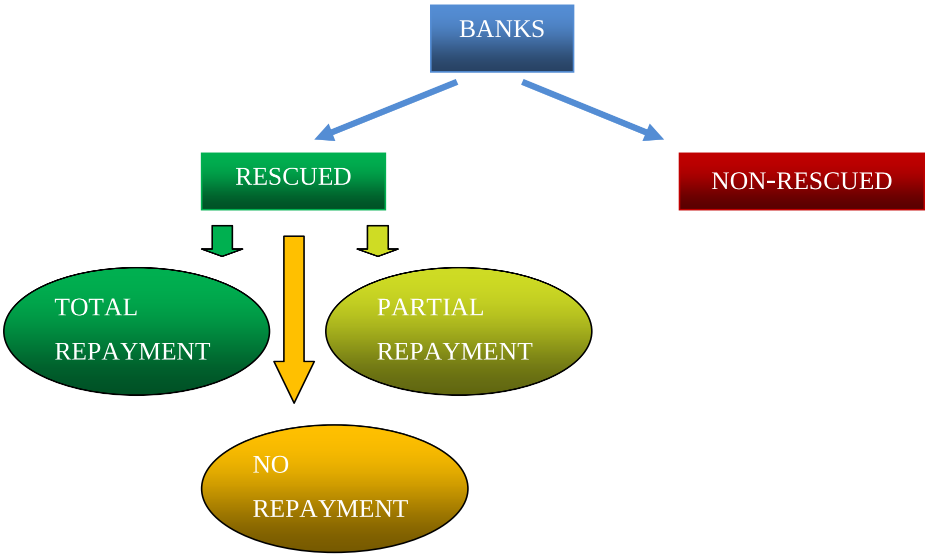
The set of coefficients for explanatory variables is estimated for each outcome: no bailout, $y = 0$; bailout and total repayment, $y = 1$; bailout and partial repayment, $y = 2$; bailout and no repayment, $y = 3$ (Figure 1).

The model requires setting the base outcome. The coefficients associated with that base outcome are zero. That is, when the setting outcome is "bailout and total repayment" ($y = 1$), the coefficients for the remaining outcomes measure the change relative to that base group.

## Duration analysis

Under the CPP, financial institutions received the funds in the period between October 2008 and December 2009, while the date of each bank's exit from the CPP depended on its ability to repurchase the Treasury's stake. The time until the bailout repayment is another measure quantifying the realized risks of funding allocations.

**Figure 1. Bailout and Repayment Decision**




A central component of the analysis in this section is the hazard rate, which is the probability of the CPP refund at time $t_i$, conditional on not having repaid the bailout before (or having survived to time $t_i$).

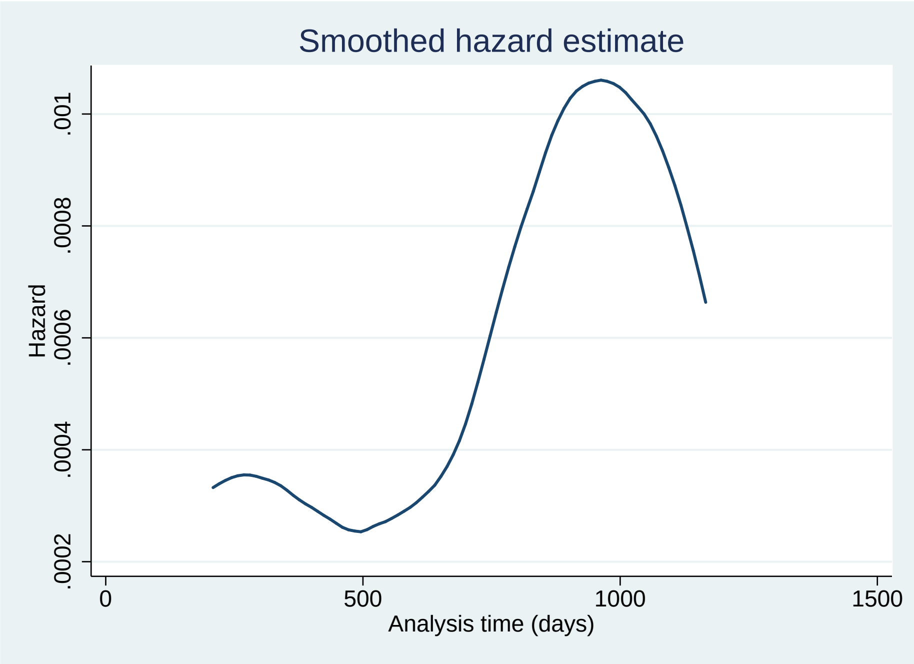
One of the issues of the duration analysis is to define the shape of the hazard rate. The Semiparametric Cox proportional-hazards model allows us to leave the baseline hazard $h_0(t)$ without particular parametrization, while the effects of the covariates are parametrized to alter the hazard function in a certain way:

$$h(t|x_j) = h_0(t)\exp(x_j\beta_x) \quad (1)$$

where $\beta_x$ are regression coefficients and are to be estimated from the data.

However, when a correct form of the $h_0(t)$ is chosen, the model could fit the data better and produce better results. Figure 2 presents smoothed estimates of the hazard function, which has a monotonically increasing shape until around 2.7 years after the bailout and then starts to decline. Thus, the plot suggests that there is an increased rate of repayment in the period between 1.5 and 2.8 years after the CPP funds disbursement, while this repayment hazard rate diminishes after 2.8 years following the bailout.

**Figure 2. Estimates of the Hazard (Probability of CPP Funds Repayment) Function**




Parametric models can be based, on the one hand, on the proportional-hazards assumption, and, on the other hand, on accelerated-failure-time (AFT) assumption. To capture the monotonically increasing shape of the hazard function (Figure 2), the Weibull distribution is chosen.

The declining shape of the hazard function at the end of distribution, however, suggests a possibility of a non-monotonic pattern-of-duration dependence. The log-logistic distribution is chosen from among other AFT models.

The choice between the parametric models is made using the Akaike Information Criterion (AIC) and log-likelihood. The AIC scores are compared between the parametric models. The lowest value of the AIC is found for the Weibull model of baseline hazard, even though Figure 2 suggests a greater resemblance to log-logistic and log-normal models. Log-logistic distribution of the hazard function is preferred to the log-normal one, according to the AIC criterion; anyway, it is commonly used when fitting data with censoring.

Thus, three duration models are finally fitted: the Cox proportional-hazards model (no specific parametrization), the Weibull proportional-hazards model (monotonically increasing hazard function), and the log-logistic model (non-monotonic unimodal hazard).

## 3. Data and Summary Statistics

### 3.1 Data Description

To construct the sample of firms, US domestically controlled commercial banks were selected from DataStream. These financial companies operated in the US market in US dollars and were still active in December 2008. After variables needed for estimation were selected, around 650 commercial banks were left in the sample.

The data on bailouts (promised amount, actual disbursed amount, date of entering the program) and bailout reimbursement (amount repaid, date of repayment) were obtained from the Treasury's Office of Financial Stability. The data on political contributions and lobbying expenditures of PACs (Political Action Committees) related to banks came from the website of the US Federal Election Commission.

The data from these three sources were merged. Bailouts under CPP were provided to domestically controlled banks, bank holding companies, savings associations, and savings and loan holding companies. Only actual disbursed amounts were considered as evidence of a bank bailout.

After outlier cleaning, 597 banks were left in the sample.

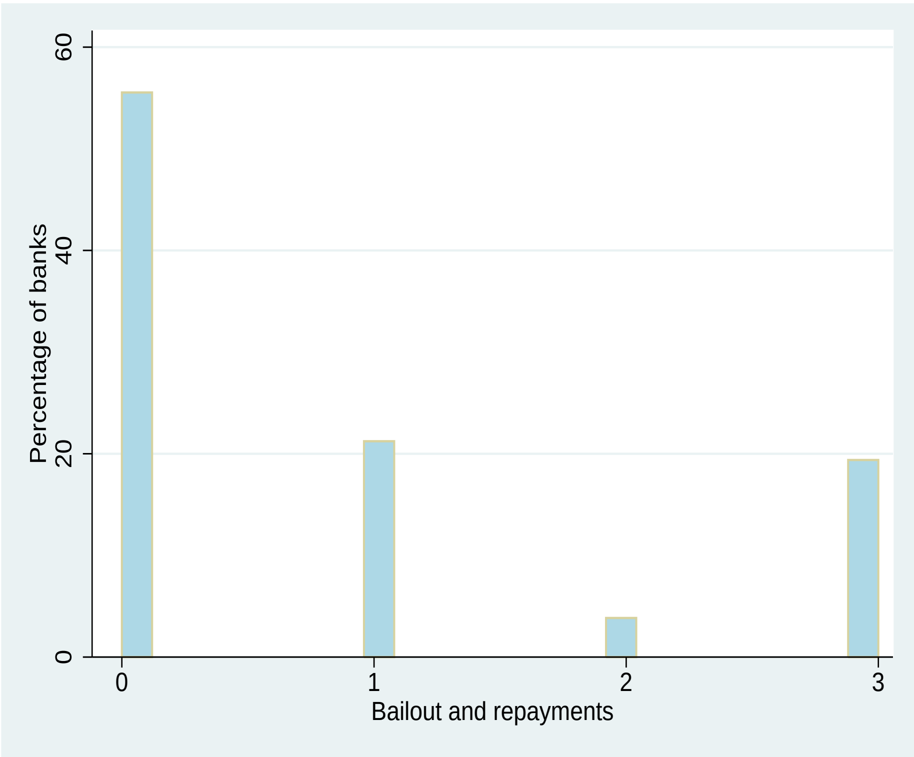
### 3.2 Dependent Variables

#### 3.2.1 CPP Funds Allocation and Repayment

This discrete dependent variable classifies the banks into four groups: banks that did not receive the CPP funds, $y = 0$; banks that received the CPP funds and reimbursed them totally, $y = 1$; banks that received the CPP funds and reimbursed them partly, $y = 2$; and banks that received the CPP funds but did not pay back anything, $y = 3$.

Slightly more than half of the represented banks did not receive the CPP funds in 2008-09 (Figure 3). Around 20% of the banks from the sample received the CPP funds and repaid them totally; another 20% of them received the CPP funds but did not pay back anything by July 31, 2012; and a small fraction of the banks (less than 5%) repaid the CPP funds partly (the majority of which repaid at least 50% of the total amount).

**Figure 3. Distribution of the Ordinal Variable on CPP Funds Allocation and Their Repayment by July 2012**




### 3.2.2 Time-to-Repayment

The time at risk or time until the event occurs (here the CPP funds repayment) is analyzed in this duration model.

Only bailed out banks were considered for the estimation. Thus, around half of the observations were left in the sample, around 280 banks. The analyzed period was limited to between the distribution of the CPP funds in 2008-09 and July 31, 2012. In that period, approximately half of these banks repaid the bailouts.

A bank was said to have repaid the CPP funds if it managed to repurchase the total amount of preferred shares from the Treasury by the end of the analyzed period (total refund). Time-to-repayment was counted in days.

The data and the repayment announcements suggested the first repayments would take place in March 2009, around half a year after the start of the CPP program. Starting from that period, the probability of CPP refunds increases with time (see Section 2.2 for details).

## 3.3 Bank Balance-Sheet Characteristics

Bank balance-sheet characteristics are financial-statement variables that define the "financial health" of a bank, or, in other words, determine the probability of the bank's default (Duchin and Sosyura, 2012; Ratnovski and Huang, 2009). Here indicators from the next three models were included: Altman's Z-score, KMV Moody's RiskCalc for US banks, and the BondScore (Credit Sights) model. Some indicators appeared to be highly correlated with each other and needed to be excluded from the final estimation.

The bailout dummy $BD_i$ is introduced in correlation tables, allowing us to make assumptions about the impact of explanatory variables on disbursement of CPP funds. The bailout dummy takes a value of one if the bank received the CPP funds, zero otherwise.

### 3.3.1 Altman's Z-score

Altman's bankruptcy model proposes a Z-score indicator for each firm, representing the level of distress of that firm. Five financial ratios are used to calculate that score (see details in Appendix A.1). A higher Z-score is interpreted as an indicator of a "safer" or, in other words, more financially healthy firm, while a lower Z-score indicates a high level of distress for that organization.

It is expected that safer financial firms would show they had suffered less from the capital shortage and had had a smaller probability of receiving the CPP funds.

### 3.3.2 Moody's KMV RiskCalc™ V3.1 US Banks

More recently, Moody's rating agency came out with its KMV RiskCalc V3.1 model for predicting probability of a bank's default. It comprises financial-statement variables and equity-market information on a bank's prospects and business risk.

As expected, default frequency measures as well as the formula for computing them are not available to the public, so the input variables of the Moody's model are plugged directly into the regressions (taking into account the probability of multicollinearity between indicators from different models). Each category is represented by at least one variable; descriptive statistics are provided in Table 1. The main variables are discussed below.

**Table 1. Summary of Dependent Variables and Balance-Sheet Characteristics from Altman's and Moody's Models For US Commercial Banks**

| Variable | Name | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Bailout dummy | $BD_i$ | 644 | 0.44 | 0.5 | 0 | 1 |
| Bailout and repayment categorical variable | $R_i$ | 644 | 0.87 | 1.16 | 0 | 3 |
| Time-to-repayment (in days) | $TR_i$ | 280 | 1004.22 | 355.34 | 89 | 1355 |
| Z-score, standardised | $Z$ | 597 | 0 | 1 | -2.92 | 4.27 |
| Moody's RiskCalc U.S. Banks | | | | | | |
| Total equity to total assets, winsorised at 2% level, standardised | $CS_1$ | 661 | 0 | 1 | -1.20 | 3.54 |
| Total deposits to total assets, winsorised at 1% level, standardised | $CS_2$ | 642 | 0 | 1 | -1.67 | 2.80 |
| Net revenues to total assets, winsorised at 1% level, standardised | $P_1$ | 654 | 0 | 1 | -2.25 | 3.68 |
| Cash flow per share, winsorised at 2% level, standardised | $P_2$ | 640 | 0 | 1 | -0.84 | 3.50 |
| Mortgage Real-Estate Loans to total loans ratio (in Percentage), standardised | $AC_1$ | 661 | 0 | 1 | -3.56 | 2.02 |
| Consumer and Industrial Loans to total loans ratio (in percentage), winsorised at 2% level, standardised | $AC_2$ | 653 | 0 | 1 | -1.22 | 3.21 |
| Treasury Securities to total assets ratio (in percentage), winsorised at 2% level, standardised | $Liq_1$ | 607 | 0 | 1 | -0.56 | 3.59 |
| Mortgage-Backed Securities to total assets ratio (in Percentage), winsorised at 2% level, standardised | $Liq_2$ | 641 | 0 | 1 | -1.04 | 3.36 |
| Non-performing loans to total loans ratio (in Percentage), winsorised at 2% level, standardised | $AQ$ | 661 | 0 | 1 | -0.91 | 3.69 |

The **Asset Concentration** group consists of two variables: **real-estate mortgage loans** ($AC_1$ in tables) and **commercial and industrial loans** ($AC_2$ in tables), normalized by total loans.

Real-Estate Mortgage Loans ($AC_1$) include commercial and construction mortgages; thus, the relative size could be positively correlated with the size of commercial and industrial loans ($AC_2$). It appears, though, that these groups of loans are highly but negatively correlated with each other (the correlation coefficient is -0.89; Table 2). It means that if a bank is concentrated in real-estate mortgage lending, it provides fewer loans for commercial and industrial purposes[4]. That can be interpreted as a bank's loan portfolio "specialization."

Liquidity-related variables (**Liquidity group)** measure the share of liquid assets on the balance sheet of a bank. Moody's RiskCalc v3.1 US Banks model (2006) and the Basel II regulation classified mortgage-backed securities (MBS) as safe and liquid holdings. That was indeed the case at the time; MBSs also included government mortgages offered by the Government National Mortgage Association or other US Federal agencies.

In the recent crisis, MBSs became highly risky and illiquid assets. That is why the initial indicator proposed in Moody's RiskCalc model that brought together Treasury securities and mortgage-backed securities (as both representing liquid groups of assets) has been replaced by two separate ratios.

The **Asset Quality group** is represented by the **share of non-performing loans in total loans**. Lower asset quality is expected to increase the probability of default and, consequently, the probability of the bailout. Nevertheless, the correlation coefficient between the bailout dummy and normalized non-performing loans in 2007 is negative (-0.11, Table 2).

### 3.3.3 BondScore Model

The BondScore Credit Model is another model that calculates credit risks for publicly traded US non-financial corporations with total assets in excess of $250 million.

Three variables from the BondScore Model are analyzed (the others are similar to the indicators from Moody's RiskCalc Model): the ratio of earnings before interest, taxes, depreciation, and amortization (EBITDA) to a bank's net revenues (EBITDA margin, $EM$); leverage ($Lev$); and the volatility of EBITDA ($Vol$). It is expected that commercial banks with higher margins,

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[4] Commercial and industrial loans represent a general amount of loans made to business and industry, excluding commercial mortgages and including consumer loans.

**Table 2. Correlation Between Dependent Variables and Explanatory Balance Sheet Variables for US Banks**

| Model | Var | $BD$ | $R$ | $TR$ | $Z$ | $CS_1$ | $CS_2$ | $P_1$ | $P_2$ | $AC_1$ | $AC_2$ | $Liq_1$ | $Liq_2$ | $AQ$ | $EM$ | $Lev$ | $Vol$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bailout dummy | $BD$ | 1.00 | | | | | | | | | | | | | | | |
| Repayment | $R$ | 0.82 | 1.00 | | | | | | | | | | | | | | |
| Time | $TR$ | -0.09 | 0.57 | 1.00 | | | | | | | | | | | | | |
| Altman's Z-score | $Z$ | -0.20 | -0.22 | -0.16 | 1.00 | | | | | | | | | | | | |
| Moody's | $CS_1$ | -0.15 | -0.15 | -0.06 | **0.66** | 1.00 | | | | | | | | | | | |
| RiskCalc | $CS_2$ | 0.11 | 0.06 | -0.06 | -0.06 | -0.19 | 1.00 | | | | | | | | | | |
| | $P_1$ | -0.05 | -0.03 | 0.03 | 0.24 | -0.07 | -0.08 | 1.00 | | | | | | | | | |
| | $P_2$ | 0.04 | 0.04 | 0.14 | 0.11 | -0.02 | -0.03 | 0.15 | 1.00 | | | | | | | | |
| | $AC_1$ | -0.16 | -0.05 | 0.22 | 0.01 | 0.06 | 0.10 | -0.19 | -0.08 | 1.00 | | | | | | | |
| | $AC_2$ | 0.15 | 0.06 | -0.15 | -0.04 | -0.06 | -0.12 | 0.20 | 0.08 | **-0.89** | 1.00 | | | | | | |
| | $Liq_1$ | -0.17 | -0.14 | 0.04 | 0.00 | 0.07 | -0.08 | -0.15 | -0.02 | -0.01 | -0.03 | 1.00 | | | | | |
| | $Liq_2$ | -0.10 | -0.15 | -0.14 | 0.03 | 0.00 | 0.26 | -0.31 | -0.05 | -0.01 | -0.02 | -0.02 | 1.00 | | | | |
| | $AQ$ | -0.11 | 0.03 | 0.21 | -0.24 | -0.08 | 0.04 | 0.15 | 0.13 | 0.07 | -0.03 | 0.03 | -0.11 | 1.00 | | | |
| Bond | $EM$ | 0.05 | -0.05 | -0.18 | **0.56** | 0.12 | 0.29 | 0.02 | -0.02 | 0.03 | -0.05 | -0.03 | 0.11 | -0.43 | 1.00 | | |
| | $Lev$ | 0.15 | 0.20 | 0.25 | **-0.77** | -0.44 | 0.14 | -0.22 | -0.11 | 0.07 | -0.08 | 0.02 | -0.03 | 0.19 | -0.37 | 1.00 | |
| | $Vol$ | 0.02 | 0.07 | 0.09 | -0.15 | -0.12 | 0.12 | 0.22 | -0.02 | 0.10 | -0.01 | -0.11 | -0.06 | 0.18 | -0.14 | 0.02 | 1.00 |

lower leverage, and less volatility would exhibit a smaller probability of default and, consequently, would suffer less from liquidity shortages during the crisis.

However, the first two BondScore variables cannot be kept in regressions due to the high risk of multicollinearity.

## 3.4 Systemic Risk Variables

One of the goals of the CPP was to prevent the crisis spreading from one big institution to another and from the financial sector to the economy at large. Thus, regulators were focused on rescuing those financial institutions they believed were critical to the survival of the entire system.

One of the most frequently used proxies for systemic risk is a firm's **size** (standardized, $Size_{i,2007}$, Table 3). It supports the "too big to fail" argument: the lender of last resort cannot deny support to large financial institutions whose closure would significantly affect the rest of the market (Freixas and Parigi, 2008). Correlation coefficients are presented in Table 4. A bank's size is indeed highly and positively correlated with bailout dummy $BD_i$.

The second variable that represents the systemic risk is $\boldsymbol{Beta_{i,2007}}$. It is the correlation between the share value of a financial institution and the overall market. The details on the construction of systemic risk variables are presented in Appendix A.2. During the crisis period, the stock market in general performed abominably; thus, a company with a higher beta should exhibit a higher probability of default and, accordingly, require government intervention.

$\boldsymbol{\Delta CoVaR}$ was developed by Adrian and Brunnermeier (2009). $\Delta CoVaR$ represents the difference between the Value-at-Risk of the financial sector—conditional on institution "i" being in distress—and the unconditional Value-at-Risk of the financial sector.

The **Marginal Expected Shortfall** ($MES$) is the expected percentage loss in market value faced by a financial institution when a shock drives the market beyond some threshold.

($MES$) is calculated over three different periods (it could not be done with $\Delta CoVaR$ as there are not enough observations): for the year 2007 ($MES_{i,2007}$), for the period of eight years preceding the crisis (from 2000 to 2007, $MES_{i,2000-2007}$), and for the periods surrounding the Bear Stearns and Lehman Brothers bankruptcies (February, March, September, and October of 2008, $MES_{BSLB}$).

**Table 3. Summary of BondScore Balance-Sheet Characteristics, Systemic Risk, Political Involvement, and Individual Risk-Taking Related Variables**

| Variable | Name | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| **BondScore U.S.** | | | | | | |
| $\frac{EBITDA_{2007}}{Sales_{2007}}$, winsorized at 2%level, standardized | $EM$ | 632 | 0 | 1 | -3.24 | 1.83 |
| $\frac{Debt_{2007}}{MarketCap+BookValueDebt_{2007}}$, winsorized at 1% level, standardised | $Lev$ | 604 | 0 | 1 | -3.57 | 2.52 |
| $Volatility_{2007}$, standardized | $Vol$ | 502 | 0 | 1 | -1.88 | 3.43 |
| **Systemic Risk** | | | | | | |
| Size (logarithm of total assets), standardized | $Size_{i,2007}$ | 661 | 0 | 1 | -2.84 | 3.49 |
| Beta, standardized | $Beta_{i,2007}$ | 621 | 0 | 1 | -1.76 | 2.78 |
| Marginal expected shortfall (MES) for 2007, standardized | $MES_{i,2007}$ | 626 | 0 | 1 | -2.41 | 2.95 |
| Marginal expected shortfall (MES) over 8 years between 2000 and 2007, winsorized at 1% level, standardized | $MES_{2000-2007}$ | 632 | 0 | 1 | -1.87 | 3.65 |
| Marginal expected shortfall (MES) for the Bear Stearns and Lehman Brothers near-collapse, winsorised at 1% level, standardized | $MES_{BSLB}$ | 608 | 0 | 1 | -1.81 | 2.51 |
| Conditional Value-at-Risk, standardized | $\Delta CoVaR_{i,1990-2007}$ | 628 | 0 | 1 | -3.13 | 1.97 |
| **Political influence and location** | | | | | | |
| Political influence dummy | $PD_{2006-2008}$ | 658 | 0.03 | 0.18 | 0 | 1 |
| State | $State$ | 661 | 25.90 | 14.39 | 1 | 51 |
| **Individual risk-taking** | | | | | | |
| Change in log stock prices during 2003-2006, winsorised at 1% level, standardised | $\ln(q_{i,2003-2006})$ | 525 | 0 | 1 | -3.09 | 2.64 |

**Table 4. Correlation Between Dependent Variables and Explanatory Systemic Risk, Political Influence, Location, and Individual Risk Variables For US Banks**

| Model | Var | $BD$ | $R$ | $TR$ | $Size$ | $Beta$ | $MES_{i,2007}$ | $MES_{i,2000-2007}$ | $MES_{i,BSLB}$ | $\Delta CoVaR$ | $PD$ | $State$ | $\ln(q_{i,2003-2006})$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bailout dummy | $BD$ | 1.00 | | | | | | | | | | | |
| Repayment | $R$ | 0.82 | 1.00 | | | | | | | | | | |
| Time | $TR$ | -0.09 | 0.57 | 1.00 | | | | | | | | | |
| Systemic | $Size$ | 0.24 | 018 | -0.24 | 1.00 | | | | | | | | |
| Risk | $Beta$ | 0.26 | 0.19 | -0.09 | **0.62** | 1.00 | | | | | | | |
| | $MES_{i,2007}$ | 0.12 | -0.02 | -0.22 | **0.74** | **0.62** | 1.00 | | | | | | |
| | $MES_{i,2000-2007}$ | 0.16 | 0.00 | -0.28 | **0.78** | **0.61** | 0.80 | 1.00 | | | | | |
| | $MES_{i,BSLB}$ | 0.15 | 0.00 | -0.20 | **0.68** | **0.59** | 0.90 | 0.74 | 1.00 | | | | |
| | $\Delta CoVaR$ | 0.05 | 0.00 | 0.01 | 0.25 | 0.14 | 0.19 | 0.20 | 0.17 | 1.00 | | | |
| Political inf-ce | $PD$ | 0.12 | 0.08 | -0.07 | 0.39 | 0.20 | 0.19 | 0.24 | 0.18 | 0.15 | 1.00 | | |
| State | $State$ | -0.04 | -0.03 | -0.05 | -0.01 | -0.06 | 0.02 | 0.02 | 0.02 | 0.01 | 0.01 | 1.00 | |
| Risk-taking | $\ln(q_{i,2003-2006})$ | -0.04 | -0.04 | -0.05 | -0.12 | -0.09 | -0.09 | -0.09 | -0.08 | -0.11 | -0.02 | -0.03 | 1.00 |

All the measures of systemic risk are calculated in such a way that the higher value of the variable indicates a higher contribution of the commercial bank in question to systemic risk. The correlation coefficients from Table 4 are positive, confirming that a higher contribution to systemic risk is associated with the higher probability of CPP funds disbursement.

## 3.5 Political Involvement and Location Indicators

Wall Street is one of the largest contributors to Federal political campaigns. Monetary contributions to political campaigns and lobbying activities on behalf of the industry are carried out through political action committees (PACs). The data on PAC contributions contain information on official contributions of bank-related PACs. Surprisingly, only 3.3% of financial firms were found to be official contributors between 2006 and 2008. Lobbying expenditures are another way for the private sector to curry favor with those in power.

The political-involvement dummy is then constructed, $PD_{2006-2008}$. The dummy takes on a value of one if, in the underlined period, the PAC related to the bank made a political campaign or lobbying contribution, zero otherwise. The correlation of the political-involvement dummy with the bailout dummy suggests a positive influence of the former on the latter (the correlation coefficient is 0.12, Table 4). To control for bank location, the state dummy is then included into regressions.

## 3.6 Bank's Excessive Risk-Taking

The literature describes several attempts to discern from the past performance of financial institutions whether those who had pursued riskier strategies had learned from financial crises to be more careful or continued in the same vein.[5]

The representative variable from this group aims to account for individual risk-taking of a bank. It is calculated as the difference in log stock prices of the bank between 2003 and 2006, $\ln(q_{i,2003-2006})$.

Firms that take on more risk and follow more aggressive investment strategies to achieve higher returns are expected to have experienced a major run-up in their stock prices during that period. These should also be the same entities that sustained the most damage during the crisis and that required government intervention to survive.

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[5] For instance, through the performance of the banks during the LTCM crisis in 1998, Fahlenbrach *et al.* (2011)..

# 4. Results

## 4.1 Polytomous Logistic Model

The multinomial (polytomous) logistic model is used to define the factors that determined the probability of the bank bailouts under CPP and their repayment/non-repayment in the period between 2009 and 2012. The dependent variable indicates if a bank was bailed out or not, and, if it was, how much did it repay to the Treasury by July 2012: the total amount, a part of the disbursed amount, or nothing at all (see Figure 1 and Section 3.2.1 for details).

The results for the multinomial regressions are presented in Table 5. The base outcome is disbursement of the CPP funds to bank *i* and total repayment by July 2012.

The coefficients presented in Table 5 are multinomial log-odds (logits)[6]. They are interpreted as a change in the logit of outcome $m$ ("no bailout," "bailout and partial repayment," "bailout and no repayment") relative to the reference group ("bailout and total repayment") for a unit change in the predictor variable, if the other variables in the model are held constant.

Table 5 reports the results for three model specifications with distinct measures of systemic risk: beta ($Beta_{i,2007}$) in Column 3; bank size ($Size_{i,2007}$) in Column 4, and Marginal Expected Shortfall measured over eight years, from 2000 to 2007 ($MES_{i,2000-2007}$), in Column 5.

Balance-sheet characteristics, systemic risk, and individual excessive risk-taking indicators are standardized. The standard deviation of each of these indicators is then equal to one, which makes the size of the parameters comparable within each column.

The first section in Table 5 (Section "no bailout" of Table 5) reveals factors that affect the probability of a bank having received no bailout (group "0"), as opposed to the group of banks that received the bailout and repaid it totally (group "1"). Bear in mind that the "no bailout" outcome could have been caused by the bank's own decision not to apply for the CPP funds or by the Treasury's rejection of the bank's application.

The empirical evidence suggests that the CPP funds were provided to financially distressed firms. A one-unit increase in a bank's Z-score ($Z$) is associated with a 0.489 rise in the multinomial log-odds for the "no bailout" outcome relative to the "bailout and total repayment" outcome (Column 3, Section "no bailout", Table 5).

6 Another possibility would be to present the coefficients in terms of relative risk ratios.

**Table 5. Determinants of the Bank Bailout and its Repayment Under TARP's Capital Purchase Program Between 2008 and 2012, US Commercial Banks, Polytomous Logistic Regressions. Base Outcome: Bailout and Total Repayment**

| Type of var | Name | Polytomous logit with $Beta$ | Polytomous logit with $Size$ | Polytomous logit with $MES$ |
|---|---|---|---|---|
| No bailout | | | | |
| **Balance-sheet characteristics** | | | | |
| Altman's Z-score | $Z$ | **0.489**** | **0.681***** | **0.617***** |
| | | (2.912) | (3.640) | (3.594) |
| Moody's RiskCalc | $CS_2$ | -0.165 | 0.036 | -0.225 |
| | | (-1.18) | (0.24) | (-1.67) |
| | $P_1$ | 0.368* | 0.272 | 0.251 |
| | | (2.252) | (1.641) | (1.632) |
| | $P_2$ | -0.035 | 0.244 | -0.014 |
| | | (-0.211) | (1.380) | (-0.093) |
| | $AC_1$ | **0.598***** | | **0.572***** |
| | | (4.428) | | (4.274) |
| | $AC_2$ | | **-0.451***** | |
| | | | (-3.450) | |
| | $Liq_1$ | **0.321*** | **0.334*** | **0.343*** |
| | | (2.092) | (2.100) | (2.245) |
| | $Liq_2$ | **0.456**** | **0.534**** | **0.437**** |
| | | (2.840) | (3.144) | (2.748) |
| | $AQ$ | **0.709***** | **0.813***** | **0.674***** |
| | | (3.911) | (4.062) | (3.736) |
| BondScore Model | $Vol$ | 0.337* | 0.308 | 0.263 |
| | | (1.987) | (1.853) | (1.597) |
| **Systemic Risk** | $Beta_{i,2007}$ | **-0.731***** | | |
| | | (-5.042) | | |
| | $Size_{i,2007}$ | | **-1.243***** | |
| | | | (-6.765) | |
| | $MES_{i,2000-2007}$ | | | **-0.625***** |
| | | | | (-4.577) |

| | | | | |
|---|---|---|---|---|
| | $\Delta CoVaR_{i,1990-2007}$ | 0.135 | 0.241 | 0.178 |
| | | (1.040) | (1.78) | (1.385) |
| **Political inv-t** | $PD_{2006-2008}$ | -0.379 | 1.091 | -0.210 |
| **and location** | | (-0.495) | (1.330) | (-0.306) |
| | $State$ | 0.005 | 0.007 | 0.009 |
| | | (0.607) | (0.86) | (1.05) |
| **Individual** | $\ln(q_{i,2003-2006})$ | 0.118 | 0.048 | 0.039 |
| **risk-taking** | | (0.732) | (0.286) | (0.254) |
| | Constant | 1.003*** | 1.113*** | 0.967*** |
| | | (3.802) | (4.140) | (3.748) |
| Bailout and partial repayment | | | | |
| **Balance-sheet characteristics** | | | | |
| Altman's | $Z$ | 0.134 | 0.236 | 0.140 |
| Z-score | | (0.385) | (0.619) | (0.381) |
| Moody's | $CS_2$ | -0.013 | 0.104 | 0.033 |
| RiskCalc | | (-0.041) | (0.334) | (0.114) |
| | $P_1$ | -0.091 | -0.193 | -0.147 |
| | | (-0.255) | (-0.541) | (-0.444) |
| | $P_2$ | **0.595**** | **0.756***** | **0.636**** |
| | | (2.913) | (3.410) | (3.160) |
| | $AC_1$ | 0.525 | | 0.388 |
| | | (1.748) | | (1.358) |
| | $AC_2$ | | -0.269 | |
| | | | (-0.988) | |
| | $Liq_1$ | -0.194 | -0.202 | -0.188 |
| | | (-0.539) | (-0.555) | (-0.523) |
| | $Liq_2$ | 0.059 | 0.047 | 0.033 |
| | | (0.173) | (0.128) | (0.101) |
| | $AQ$ | **0.592*** | **0.821**** | **0.657*** |
| | | (2.006) | (2.640) | (2.288) |
| BondScore | $Vol$ | 0.472 | 0.573 | 0.538 |
| Model | | (1.445) | (1.869) | (1.753) |
| **Systemic Risk** | $Beta_{i,2007}$ | 0.305 | | |
| | | (1.017) | | |
| | $Size_{i,2007}$ | | -0.237 | |
| | | | (-0.675) | |

| | | | | |
|---|---|---|---|---|
| | $MES_{i,2000-2007}$ | | | -0.028 |
| | | | | (-0.105) |
| | $\Delta CoVaR_{i,1990-2007}$ | -0.081 | -0.043 | -0.058 |
| | | (-0.291) | (-0.155) | (-0.213) |
| **Political inv-t** | $PD_{2006-2008}$ | 1.603 | 1.815 | 1.747* |
| **and location** | | (1.816) | (1.665) | (1.995) |
| | $State$ | -0.021 | -0.021 | -0.022 |
| | | (-1.156) | (-0.179) | (-1.222) |
| **Individual** | $\ln(q_{i,2003-2006})$ | 0.370 | 0.297 | 0.283 |
| **risk-taking** | | (1.245) | (1.023) | (1.009) |
| | Constant | -1.673** | -1.402** | -1.484** |
| | | (-3.109) | (-2.748) | (-2.932) |
| Bailout and no repayment | | | | |
| **Balance-sheet characteristics** | | | | |
| Altman's | $Z$ | -0.254 | -0.088 | -0.120 |
| Z-score | | (-1.207) | (-0.392) | (-0.560) |
| Moody's | $CS_2$ | -0.157 | 0.082 | -0.106 |
| RiskCalc | | (-0.985) | (0.466) | (-0.665) |
| | $P_1$ | 0.047 | -0.019 | -0.023 |
| | | (0.250) | (-0.101) | (-0.117) |
| | $P_2$ | 0.140 | 0.364 | 0.168 |
| | | (0.832) | (1.920) | (0.990) |
| | $AC_1$ | **0.415**** | | **0.364*** |
| | | (2.666) | | (2.328) |
| | $AC_2$ | | **-0.301*** | |
| | | | (-2.004) | |
| | $Liq_1$ | -0.076 | -0.044 | -0.067 |
| | | (-0.393) | (-0.229) | (-0.350) |
| | $Liq_2$ | -0.347 | -0.211 | -0.304 |
| | | (-1.639) | (-0.984) | (-1.436) |
| | $AQ$ | **0.543**** | **0.695**** | **0.571**** |
| | | (2.797) | (3.281) | (2.945) |
| BondScore | $Vol$ | 0.251 | 0.293 | 0.303 |
| Model | | (1.351) | (1.597) | (1.649) |
| **Systemic Risk** | $Beta_{i,2007}$ | **-0.338*** | | |
| | | (-2.075) | | |

| | | | | |
|---|---|---|---|---|
| | $Size_{i,2007}$ | | **-1.040*** ** | |
| | | | (-4.886) | |
| | $MES_{i,2000-2007}$ | | | **-0.757*** ** |
| | | | | (-4.303) |
| | $\Delta CoVaR_{i,1990-2007}$ | -0.014 | 0.160 | 0.148 |
| | | (-0.102) | (1.024) | (0.963) |
| **Political inv-t and location** | $PD_{2006-2008}$ | 0.229 | 1.327 | 0.258 |
| | | (0.290) | (1.465) | (0.312) |
| | $State$ | 0.004 | 0.004 | 0.005 |
| | | (0.381) | (0.408) | (0.458) |
| **Individual risk-taking** | $\ln(q_{i,2003-2006})$ | 0.157 | 0.099 | 0.067 |
| | | (0.878) | (0.551) | (0.369) |
| | Constant | -0.146 | -0.004 | -0.173 |
| | | (-0.460) | (-0.008) | (-0.555) |
| | Pseudo $R^2$ | 0.156 | 0.168 | 0.153 |
| | Obs | 505 | 514 | 519 |

**Notes**: t-statistics in parentheses; ***, ** and * denote p-value less than 0.1%, 1%, and 5%, respectively.

Safer or financially stable banks (with a higher Altman's Z-score in 2007) are less likely to have applied for the CPP funds, as they had easier access to alternative sources of financing. Besides, they were less likely to be approved by the Treasury for participation in the CPP as the stipulated amount was limited ($250 billion, later reduced to $218 billion), and the program was aiming at illiquid financial institutions.

Recall that real-estate mortgage loans ($AC_1$) and commercial industrial loans ($AC_2$) normalized as total loans, are negatively correlated (the correlation coefficient is -0.89, Table 2). This can be assumed to mean that many banks either specialized in mortgage lending or in commercial and industrial lending. When thinking of these specializations in relation to the origin of the financial crisis (the boom-and-bust housing market and, particularly, the excesses in the subprime-mortgage market), one might understandably assume that those banks highly active in mortgage lending were the ones left holding a disproportionate share of illiquid assets and having to apply for the CPP. After all, wasn’t the government intent on helping American homeowners by supporting mortgage lending and preventing massive residential defaults?

However, the results show the opposite. Banks well known for their mortgage lending ($AC_1$) were more likely not to receive the CPP funds, as suggested by the coefficients from Section "no bailout." A one-percentage-point increase in the share of real-estate mortgage loans leads to a 0.598 rise in multinomial log-odds for a "no bailout" outcome relative to a "bailout and total repayment" outcome (Column 3, Section "no bailout," Table 5).

In any case, even if the banks that were heavily into that sort of loans had received the bailout, they were more likely not to have repaid it (Section "Bailout and no repayment," Table 5). A one-percentage-point increase in the share of real-estate mortgage loans in total loans leads to a 0.415 rise in multinomial log-odds for the bailed-out banks that did not repay the CPP funds relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (Column 3, Section "bailout and no repayment," Table 5).

An opposite effect is found for the banks that were more exposed to commercial and industrial loans ($AC_2$): they were more likely to be bailed out and less likely to fail to repay the funds before July 2012. All these findings confirm the results for logit and OLS regressions, with the dependent variables being, respectively, a binary outcome regarding the CPP funds disbursement ("bailout"/"no bailout") and the relative size of the disbursed amount (for more details, see Isyuk, 2012).

If the reason for no bailout was the bank's own decision (no application or the last-stage refusal of the Treasury's conditions), then those specializing in mortgages must have found Treasury's conditions too strict (and looked for alternative financing) or they did not need to be recapitalized. The former explanation does not seem to be very plausible, as CPP conditions were relatively lenient. Most financial institutions participating in the CPP had to pay Treasury a 5% dividend on preferred shares for the first five years and a 9% rate thereafter[7]. In the United Kingdom, the dividend to be paid to the Treasury was set at 12% for the first five years and the three-month London Interbank Offered Rate (LIBOR) plus 700 basis points thereafter[8].

The latter explanation suggests that the banks leaning toward mortgage activity were not willing to apply for the CPP, perhaps because the pre-crisis assets on their books were of a good quality. If so, such banks preferred to leave the high-quality loans on their balance sheets and to securitize and sell off the less safe ones (including subprime loans) to other entities via off-balance-sheet vehicles. (for more information on adverse selection practices, see Acharya *et al*., 2010).

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7 In addition, Treasury received warrants to purchase common shares or other securities from the banks at the time of the CPP investment.

8 Not mentioning restrictions on executive compensation, dividends, lending commitments, and board appointments.

In cases where the Treasury decided to bail out a commercial bank, it seems as though the regulators had a bias for petitioners specializing in commercial lending (in order to avoid the drying up of liquidity for businesses). One of the explanations for this could be the relative risk weight of corporate and mortgage loans—if the Treasury was basing its decision on pre-crisis indicators. According to both Basel I and Basel II, the weight of mortgage loans in risk-weighted assets was smaller than that of corporate loans.

Another possibility is that banks that specialized in commercial and industrial loans could have been regarded as more viable and only temporarily illiquid due to the deterioration of the interbank market, while those that were predominantly mortgage lenders were seen as insolvent due to their predatory behavior before the crisis. Moreover, the former group of banks had a higher probability of repaying CPP funds in full before July 2012, minimizing the risk of non-repayment of CPP investments.

The coefficients for the relative size of non-performing loans ($AQ$) have to be interpreted in a similar way. The results show that a one-unit rise in the share of non-performing loans in total loans leads to a 0.709 rise in multinomial log-odds for the not-bailed-out banks relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (Column 3, Section "no bailout," Table 5).

Thus, the banks more exposed to non-performing loans had a higher probability of not being bailed out, while they also exhibited a higher probability of not repaying the CPP funds. A one-unit larger share of non-performing loans in total loans is associated with a 0.543 rise in multinomial log-odds for the bailed-out banks that did not repay the CPP funds relative to the bailed-out banks that totally repaid the CPP funds by July 2012 (Column 3, Section "Bailout and no repayment," Table 5).

This result correlates with findings of the US Government Accountability Office (GAO) in March 2012. The GAO reported that the institutions remaining in the CPP tended to hold riskier assets than other institutions of similar asset size (US GAO report, 2012).

It is possible that banks that were more exposed to non-performing loans did not apply for CPP funding because they found the program’s conditions too onerous. However, it is more probable that it was the Treasury's decision to reject the applications of these banks. A higher share of non-performing loans could be considered an indicator of a bank's insolvency, which would also be associated with greater risks of CPP funds non-repayment.

Banks with stronger positions in Treasury securities ($Liq_1$) and MBSs ($Liq_2$) before the crisis are less likely to have been bailed out in 2008-09. The first relationship is justified by the high safety and liquidity of Treasury bills, especially in a time of crisis (the "flight to safety" argument). The banks with the highest level of such liquid assets had a lesser need for external financing and tended not to apply for the CPP. For its part, the Treasury apparently selected temporarily illiquid banks that were holding few Treasury bills.

The second relationship is less clear, as a significant part of MBSs became illiquid during the crisis. Potential explanations are similar to those given for mortgage loans. First, the adverse selection argument suggests that the MBSs kept on the books of the banks were of a prime loan type and thus remained liquid during the crisis. Second, regulators were able to make their decision based on the pre-crisis risk weights of assets (as in regulatory capital ratios). In that case, larger shares of MBSs in banks' portfolio would be an indicator of higher liquidity.

The last possibility is that the Treasury classified the banks having greater amounts of MBSs as less viable than other banks or even insolvent. If so, then such a bank was considered an excessive risk taker that was in trouble due to its own faulty strategy and not due to temporary market factors. In addition, a bank in this category would be seen as being less likely to repurchase its shares from the Treasury (even though this scenario is not confirmed by the coefficients from Section "bailout and no repayment," Table 5).

Analysis of the repayments of the CPP funds from the point of view of the taxpayers reveals that the investment risks were minimized. This is because the CPP funds were provided to the banks with the highest probability of repaying them in the short term: those that were less exposed to MBSs, mortgages, and non-performing loans and those specializing in commercial loans.

However, from the perspective of consumers and borrowers, the program had a potentially counterproductive effect. Since banks with disproportionnately large positions in MBSs, mortgages, and non-performing loans were not helped by the government, which regarded them as less viable than others or more likely to fold, they faced severe liquidity problems. Many mortgage lenders, in particular, couldn’t restructure much of their portfolios and were hit by a record number of foreclosures; finding themselves with cash shortfalls, these institutions were forced to raise the interest rates on their mortgages, thus putting the squeeze on even the most creditworthy of homeowners.

All systemic risk variables are significant with negative coefficients when predicting "no bailout" and "bailout and no repayment" outcomes. Larger banks that correlated more with the market ($Beta_{i,2007}$) and with greater contribution to systemic risk ($MES_{i,2000-2007}$) were more likely to apply for CPP assistance (as they experienced greater losses during the crisis) and to be accepted into the CPP by the Treasury. This confirms the assumption that the CPP was designed to provide liquidity to systemically critical and "too big to fail" commercial banks in order to restore financial stability and avoid negative spillover effects, as happened when Lehman Brothers imploded.

Moreover, these banks tended to exhibit a higher probability of repurchasing their shares from the Treasury compared with other banks. This should not be surprising: it should not be forgotten that the leading banks in the US always had a greater capacity to restore themselves to financial health, given their multiplicity of business lines and ability to attract alternative sources of financing—partly a result of the conventional wisdom that they were too big for the government to allow them to fail.

Nevertheless, the justification for the CPP remains: saving these banks helped head off damage to other sectors of the economy and, in any case, the taxpayers got their money back relatively quickly.

## 4.2 Time-to-Repayment Analysis

Another way to look at the factors that brought about the CPP funds repayments is to analyze the time it took for a bank to exit the program. The choice of parametrizations for that analysis is described in Section 2.2. Each continuous variable that enters the model is checked for correlation with a dependent variable. In addition, the models with single continuous predictors are considered as well as the results of the Chi-squared tests in order to choose predictors for the final model.

Results for three types of regressions (with Cox PH, Weibull, and log-logistic parametrizations) are presented in Table 6. Similar to the results from the previous section, model specifications include different systemic risk measures: beta ($Beta_{i,2007}$) and Marginal Expected Shortfall ($MES_{i,2000-2007}$).

The coefficients for proportional-hazard models (Cox PH and Weibull PH, Columns 3, 4, 5, and 6, Table 6) have to be interpreted differently from those for accelerated failure time models (log-logistic AFT, Columns 7 and 8, Table 6). The coefficients from the first pair of models indicate how covariates affect the hazard rate. Positive coefficients increase the hazard rate and, therefore, reduce the expected duration. The positive coefficients from AFT models indicate how covariates influence the logged survival time and, hence, increase the expected duration.

**Table 6. Time-To-Repayment Analysis, US Commercial Banks, Proportional Hazards (PH) and Accelerated Failure Time (AFT) Models**

| Type of var | Name | Cox PH With $Beta$ | Cox PH With $MES$ | Weibull PH With $Beta$ | Weibull PH With $MES$ | Log-logistic AFT With $Beta$ | Log-logistic AFT With $MES$ |
|---|---|---|---|---|---|---|---|
| **Balance-sheet characteristics** | | | | | | | |
| Altman's | $Z$ | 0.199** | 0.128 | 0.212*** | 0.143* | -0.143** | -0.103 |
| Z-score | | (2.562) | (1.569) | (2.693) | (1.775) | (-2.294) | (-1.610) |
| Moody's | $P_2$ | -0.108** | -0.113*** | -0.107** | -0.114*** | 0.073** | 0.085*** |
| RiskCalc | | (-2.468) | (-2.625) | (-2.468) | (-2.653) | (2.260) | (2.708) |
| | $AC_1$ | -0.315*** | -0.301*** | -0.303*** | -0.289*** | 0.206*** | 0.177*** |
| | | (-3.488) | (-3.209) | (-3.415) | (-3.171) | (2.862) | (2.659) |
| | $AQ$ | -0.366*** | -0.418*** | -0.381*** | -0.434*** | 0.250*** | 0.264*** |
| | | (-2.919) | (-3.131) | (-2.986) | (-3.196) | (2.910) | (3.062) |
| **Systemic Risk** | $Beta_{i,2007}$ | 0.221** | | 0.213** | | -0.134** | |
| | | (2.364) | | (2.275) | | (-2.018) | |
| | $MES_{i,2000-2007}$ | | 0.395*** | | 0.392*** | | -0.291*** |
| | | | (4.639) | | (4.611) | | (-4.384) |
| | Constant | | | -11.796*** | -12.108*** | 7.040*** | 7.010*** |
| | | | | (-12.849) | (-12.979) | (74.831) | (73.900) |
| | $Ln(p)$ | | | 0.483*** | 0.510*** | | |
| | | | | (5.976) | (6.372) | | |
| | $Ln(gamma)$ | | | | | -0.654*** | -0.701*** |
| | | | | | | (-7.690) | (-8.339) |
| | AIC | 1406.630 | 1406.519 | 546.147 | 536.265 | 549.771 | 537.188 |
| | Obs | 275 | 279 | 275 | 279 | 275 | 279 |

Notes: t-statistics in parentheses; ***, ** and * denote p-value less than 0.1%, 1%, and 5%, respectively.

For the models with Weibull parametrization, the logarithm of the shape parameter $p$ is 0.483 and 0.510 (for the regressions with beta and MES as systemic risk indicators, respectively), which means that the value of the parameter is larger than one, and the hazard is monotonically increasing with time. These results fit the observations made from Figure 2. The more time that passes following disbursement of the CPP funds, the more banks repurchase their stakes from the Treasury.

Moreover, the logarithm of the shape parameter $\gamma$ estimated for log-logistic regressions is negative (-0.654 and -0.710, respectively); thus, the value of the parameter is less than one, and the conditional hazard function first rises and then starts to fall. The more banks exit the CPP program, the fewer banks are left in the sample, and those remaining in the CPP experience difficulties with repaying CPP funds.

As the lowest value of AIC criteria is found for the Weibull model (Columns 5 and 6, Table 6), the more detailed interpretation of results is given for that model.

The rate of repayment (i.e. hazard rate) increases by 21.2% for the specification with beta ($Beta_{i,2007}$) and by 14.3% for the specification with MES ($MES_{i,2000-2007}$) with a unit increase in Altman's Z-score. Thus, more financially stable banks repurchase their preferred shares faster. These results are in line with the findings of the US Government Accountability Office (US GAO report, 2012). They report that the institutions remaining in the CPP by March 2012 were financially weaker than the ones that had exited the program.

Both the relative size of non-performing loans ($AQ$) and mortgage loans ($AC_1$) negatively affect the repayment hazard: a one-unit increase in the former one is associated with a drop in rate of repayment by 38.2% (43.4% for the regression with MES); a one-unit increase in the latter one is associated with a 30.3% decline in the repayment hazard rate (28.9%).

Higher systemic risk values, vice versa, have a positive influence on the repayment hazard: with a one-unit increase in beta, rate of repayment increases by 21.3%. In the case of a rise in MES, the repayment hazard rises by 39.2%.

These results are in line with those presented in the previous section. More systemically risky banks managed to repurchase their preferred shares faster than the rest, while those with larger shares of non-performing and mortgage loans experienced more difficulties with repayments.

These findings can be thought of as the realized risks of the CPP investments. As was reported in the previous section, the banks exposed to non-performing and mortgage loans were less likely to be bailed out, while larger banks with a greater potential for contributing to systemic risk were more likely to receive the CPP funds. In terms of probability of repayment and time until repayment, the allocation decision is seen as having been correct, as it allowed regulators to select those banks that would be able to repurchase their shares from the Treasury in the shortest time.

Interestingly, higher cash flow per share ($P_2$) becomes significantly negative when explaining the repayment hazard rate. There can be several explanations of why the banks with higher cash flow repurchased their shares later. One of them is that these banks had higher cash flows due to their exposure to risky assets such as subprime loans. Thus, during the crisis, such bailed-out banks had greater difficulty repaying the CPP funds.

Another possibility is that the banks with higher cash flow per share did not wish to repurchase their shares from the Treasury too fast (this predictor also has a positive impact on the probability of partial repayment, Section "bailout and partial repayment," Table 5), as it was a comfortable and relatively cheap source of external funding compared to market financing costs.

## 5. Conclusion

Conventional wisdom today holds that the Capital Purchase Program of the US government was an unalloyed success. However, looking back, we perceive a number of flaws in the methodology of the program and their effects. Smaller banks that were heavily into mortgage-backed securities, mortgages, and non-performing loans were less likely to be bailed out relatively to the banks specialized in commercial and industrial lending. That could become a reason of a low number of loan restructurings and welfare loses for the homeowners. Most importantly, the overall positive impression of the efficacy of the CPP does not confirm the soundness of the "too big to fail" principle. In fact, such a philosophical driver of the allocation of CPP funds might have contributed to the creation of moral hazard and triggered more future bailouts of mammoth and “too interconnected” banks. Thus, more reforms should be introduced (expanding the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, see Acharya *et al.*, 2011 for discussion) in order to limit the propensity of the financial sector to put the entire system at risk and to benefit from its "too big to fail" position.

More accuracy in the assessment of the effectiveness of the CPP funds could be achieved if the Treasury reported individual information on the status of CPP applications for each stage of the selection procedure. Distinguishing between financial institutions that did not apply for CPP funds, were rejected by the Treasury, or did not accept the Treasury's conditions would clarify the conclusions.

# Appendices

## A. Construction of Variables

### A.1 Altman's Z-score

Altman's Bankruptcy model suggests an index based on five main financial ratios where the weight of each variable is determined through discriminant analysis:

$$Z = 0.012X_1 + 0.014X_2 + 0.033X_3 + 0.006X_4 + 0.999X_5,$$

where $X_1$ is the difference between current assets and current liabilities normalized by total assets; $X_2$ are retained earnings normalized by total assets; $X_3$ are earnings before interest and taxes (EBIT) normalized by total assets; $X_4$ is the ratio of market value of equity to total liabilities; $X_5$are sales (revenues) normalized by total assets.

### A.2 Systemic Risk Indicators

**Bank size** ($Size_{i,2007}$) is the logarithm of total assets of the bank.

**Beta** ($Beta_{i,2007}$) is obtained from DataStream and represents the measure of the asset's risk with respect to the market (correlation with the market) over the past five years. Thus, ($Beta_{i,2007}$) is calculated for the period from 2002 to 2007.

$\Delta CoVaR_p$ measures the marginal contribution of a separate financial firm to the risk of the whole financial sector (Adrian and Brunnermeier, 2011). It is calculated as a difference between Value-at-Risk of the financial sector conditional on institution $i$ being in distress $VaR_p^{FS|\text{"i"}\ distress}$ and the unconditional Value-at-Risk of financial sector $VaR_p^{FS}$:

$$\Delta CoVaR_p^i = VaR_p^{FS|\text{"i"}\ distress} - VaR_p^{FS}.$$

Institution *i* is said to be in distress when it exhibits the lowest growth rates of its market-valued total assets. $VaR_p^{FS}$ is the mean growth rates of the financial sector at the $p^{th}$ percentile ($5^{th}$ percentile here) of its distribution unconditionally on other institutions.

The growth rate of market-valued total assets $X_t^i$ is calculated in the following way:

$$X_t^i = \frac{ME_t^i \cdot Lev_t^i - ME_{t-1}^i \cdot Lev_{t-1}^i}{ME_{t-1}^i \cdot Lev_{t-1}^i} = \frac{A_t^i - A_{t-1}^i}{A_{t-1}^i}.$$

Knowing that

$$A_t^i = ME_t^i \cdot Lev_t^i = BA_t^i \cdot \left(\frac{ME_t^i}{BE_t^i}\right),$$

where $ME_t^i$ is the market value of a bank *i*'s total equity, $Lev_t^i$ is the ratio of total assets to book equity, $A_t^i$ are market-valued total assets, $BA_t^i$ are book-valued total assets, and $\frac{ME_t^i}{BE_t^i}$ is market-to-book ratio of institution *i*.

According to Adrian and Brunnermeier (2011), the growth rate of the financial sector is calculated as a weighted average of market-valued returns of all financial institutions in the sample:

$$X_t^{FS}=\sum_i (X_t^i \cdot w_{t-1}^i),$$

where $w_{t-1}^i$ is the weight of financial institution *i* in banking sector at period *t-1*.

The (unconditional) Value-at-Risk of the financial sector is then defined as the bottom 5% growth rates of the financial sector between July 1990 and July 2008 (quarterly data from Compustat). The Value-at-Risk of the financial system conditional on institution *i* being in distress is calculated as the mean growth rates of the financial sector in the periods when institution *i* was found to be in distress. The difference between the two measures is $\Delta CoVaR_p^i$.

**Marginal Expected Shortfall** ($MES_\alpha$) is expected percentage loss in market value faced by institution *i* given that a shock drives the market beyond the threshold C (market drop by more than a certain threshold).

Expected shortfall is the average of financial market returns on days when the portfolio's loss exceeds its $VaR$ limit. Financial market return $R$ is a weighted sum of each bank's return $r_i$:

$$R = \sum_i w_i \cdot r_i,$$

where $w_i$ is the weight of bank *i* in the banking system. Expected shortfall of the financial sector can be then represented as a weighted sum of individual banks' expected shortfalls:

$$ES_\alpha = -\sum_i w_i E[r_i | R \leq -VaR_\alpha] \, .$$

The Marginal Expected Shortfall of the bank *i* can be expressed as the derivative of the expected shortfall of the banking sector with respect to the bank's weight $w_i$:

$$\frac{\partial ES_\alpha}{\partial w_i} = -E[r_i | R \leq -VaR_\alpha] = MES_\alpha^i.$$

The threshold is defined at the 5th percentile of market returns. Marginal Expected Shortfall of the bank $i$ ($MES^i_{5\%}$) is computed in the following way:

$$MES^i_{5\%} = \frac{1}{N}\sum_{t:R-in-its-5\%-tail} r^i_t,$$

where $\frac{1}{N}\sum_{t:R-in-its-5\%-tail} r^i_t$ are average returns of financial firm $i$ when the banking sector returns are in their 5% tale (measured on a daily basis using the S&P 500 index). $MES^i_{5\%}$ is calculated for 2007, over eight years, between 2000 and 2007, and for the periods surrounding the Bear Stearns and Lehman Brothers collapses (February, March, September, and October of 2008).

## References

Acharya, Viral V., Lasse Pedersen, Thomas Philippon and Matthew Richardson, (2010), "Regulating Sytemic Risk", *Federal Reserve Bank of Cleveland, Working Paper 10-02*.

Acharya, Viral V. and Raghu Sundaram, (2009), "The Financial Sector Bailout, Sowing the Seeds of the Next Crisis?", in V. Acharya and M. Richardson (eds.), *Restoring Financial Stability: How to Repair a Failed System*, New Jersey, Wiley Finance Series, pp. 327-339.

Acharya, Viral V., Thomas F. Cooley, Matthew Richardson and Ingo Walter, (2011), *Regulating Wall Street: the Dodd-Frank Act and the New Architecture of Global Finance*, New Jersey, Wiley Finance Series.

Adrian, Tobias and Markus K. Brunnermeier, (2011), "CoVaR," *National Bureau of Economic Research, Inc., NBER Working Paper No. 17454.*

Cooley, Thomas F. and Thomas Philippon, (2009), "The Role of the Federal Reserve", in V. Acharya and M. Richardson (eds.), *Restoring Financial Stability: How to Repair a Failed System*, New Jersey, Wiley Finance Series, pp. 277-282.

Dam, Lammertjan and Michael Koetter, (2011), "Bank Bailouts, Interventions, and Moral Hazard", *Deutsche Bundesbank, Discussion Paper No. 10/2011*, Series 2: Banking and Financial Studies.

Duchin, Ran and Denis Sosyura, (2012), "The Politics of Government Investment", *Journal of Financial Economics*, 106(1), pp. 24-48.

Fahlenbrach, Rüdiger, Robert Prilmeier and René M. Stulz, (2011), "This Time Is the Same: Using Bank Performance in 1998 to Explain Bank Performance During the Recent Financial Crisis", *NBER Working Paper No.* 17038.

Fender, Ingo and Jacob Gyntelberg, (2008), "Overview: Global Financial Crisis Spurs Unprecedented Policy Actions", *BIS Quarterly Review*, December, pp. 1–24.

Freixas, Xavier and Bruno M. Parigi, (2008), "The Lender of Last Resort of the 21st Century", *CEPR, VoxEU.org* Publication.

Gale, Douglas M. and Xavier Vives, (2002), "Dollarization, Bailouts, And The Stability Of The Banking System", *The Quarterly Journal of Economics*, MIT Press, 117(2), pp. 467-502.

Isyuk, Varvara, (2012), "CPP Funds Allocation: Restoring Financial Stability or Minimising Risks of Non-repayment to Taxpayers?," Centre d'Economie de la Sorbonne Working Paper, Université Paris 1 Panthéon Sorbonne.

Khatiwada, Sameer, (2009), "Stimulus Packages to Counter Global Economic Crisis: A Review", Technical Report, *International Labor Organization Discussion Paper DP/196/2009*.

Kibritcioglu, Aykut, (2002), "Excessive Risk-Taking, Banking Sector Fragility, and Banking Crises", *University of Illinois at Urbana-Champaign, College of Commerce and Business Administration, Office of Research Working Papers, No.* 02-0114.

King, Michael R., (2009), "Time to Buy or Just Buying Time? The Market Reaction to Bank Rescue Packages", *BIS Working Paper No. 288*.

Panetta, Fabio, Thomas Faeh, Guiseppe Grande, Corrinne Ho, Michael R. King, Aviram Levy, Federico M. Signoretti, Marco Taboga and Andrea Zaghini, (2009), "An assessment of financial sector rescue programmes", *BIS Paper No.* 48.

Ratnovski, Lev and Rocco Huang, (2009), "Why Are Canadian Banks More Resilient?", *IMF Working Paper WP/09/152*.

Stiglitz, Joseph E., (2012), "Restoring growth and Stability in a World of Crisis and Contagion: Lessons from Economic Theory and History", presentation at the *Conference at PSE, Paris, February 2012*.

U.S. Government Accountability Office Report to Congressional Committees, (2009), "Troubled Asset Relief Program. June 2009 Status of Efforts to Address Transparency and Accountability Issues", *GAO-09-658*.

U.S. Government Accountability Office Report to Congressional Committees, (2012), "Capital Purchase Program: Revenues Have Exceeded Investments, but Concerns about Outstanding Investments Remain", *GAO-12-301*.

Wilson, Linus and Yan Wu, (2010), "Common (stock) Sense About Risk-shifting and Bank Bailouts", *Financial Markets and Portfolio Management*, 24(1), pp. 3-29.