Government Assistance and Banks' Funding Cost*

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This study examines the association of government support with recipient banks' funding cost. The U.S. government's Capital Purchase Program (CPP) is utilized as a case study of government assistance. The study's sample includes quarterly data from 2009 to 2018 on 8,327 U.S. financial institutions in the banking sector. The results suggest that government assistance has a significant relationship with the recipient banks' lower funding cost. Augmented public confidence in recipient banks could be a plausible channel to explain the government assistance–funding cost relationship. The findings are robust to alternative funding cost definitions, samples, estimation methods, and model specifications.

JEL Codes: G21, G28.

1. Introduction

Since the great economic depression of the 1930s and possibly next to the recent economic impact of COVID-19, the financial crisis of 2007–08 can be treated as the worst scenario of global economic meltdown. Investors' confidence in the financial markets had faded and financial institutions were struggling to survive, driving the overall U.S. financial system to the edge of collapse. To safeguard the U.S. financial system from a potential collapse and avoid the further impact of contagion, the U.S. government intervened with

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assistance programs to revive the financial institutions through capital injections.

The effect of government assistance has long been a controversial issue for market participants and in academic research. The extant literature provides mixed conclusions while evaluating the influence of government assistance in different facets of financial institutions. Government assistance programs can be important to society and the economy, possibly to prevent the spread of financial crises (Anderson and Bluedorn 2017). Current empirical research offers indications that government assistance programs in the United States aided in mitigating the severe impact of the financial crisis through increased lending activities (Li 2010) and creating real economic value (Bayazitova and Shivdasani 2011). Veronesi and Zingales (2010) concluded that the Troubled Asset Relief Program (TARP) offered positive economic gains to the U.S. economy by increasing the value of banks' financial claims where the net value ranges from $86 billion to $109 billion. TARP-induced spillover effects in the corporate sector positively contributed to borrowing firms' stock returns (Norden, Roosenboom, and Wang 2013). U.S. policymakers also considered the government assistance program a success, as the U.S. Treasury claimed that over $204 billion funds were repaid out of the total assistance provided, emphasizing $30 billion in revenue for taxpayers (U.S. Department of the Treasury 2018).

However, negative consequences of government intervention are also possible. Academic literature criticized the U.S. government assistance program in the 2007–08 financial crisis for not learning from failed precedence in Japan's banking crisis of the 1990s (Hoshi and Kashyap 2010), reducing equity shareholders' potential by the U.S. Treasury's stance in preferred shares (Bayazitova and Shivdasani 2011), and banks' increased risk-taking (Duchin and Sosyura 2010; Black and Hazelwood 2013). However, Berger, Roman, and Sedunov (2020) concluded that large and safer banks with better local economic conditions significantly reduced systemic risk contributions after receiving government aid through TARP. European banks that received the government's support at the beginning of the financial crisis displayed the apparent ineffectiveness of the governmental efforts in significantly enhancing their performance (Gerhardt and Vander Vennet 2017). Harris, Huerta, and Ngo (2013)

document a significant reduction in the operational efficiency of TARP recipient banks due to moral hazards issues. Similarly, banks that received government support through capital injection are found to be significantly less efficient (Palas and Moreira 2022). Chavaz and Rose (2019) linked TARP political influences with banks' lending behavior and concluded that TARP funds adversely affected both the quality and quantity of banks' lending.

Although existing government assistance literature investigated the bank lending and risk-taking areas quite largely, little is explored about banks' funding aspects. Understanding a bank's vulnerability to funding cost fluctuations is crucial since funding cost can represent a bank's counterparty credit risk, which regulators take into account to determine the appropriate capital buffer (Schmitz, Sigmund, and Valderrama 2017). Besides current capital levels, funding costs are also connected to a bank's future required capital due to "adverse dynamics" where the effect's magnitude depends on the bank's response to rising funding costs. An increased cost of fund can negatively affect banks' profitability if banks decide to leave the lending rates unchanged (Beau et al. 2014). Alternatively, banks can raise lending rates that may trigger loan default, resulting in credit losses and driving down profitability. Either way, a substantial erosion of profit can have a severe impact on the banks' capital buffer. Therefore, higher funding cost shrinks the capital buffer by reducing profitability in the short term (Schmitz, Sigmund, and Valderrama 2017). In the long term, the capital buffer can deplete further, as investors would require higher compensation to offset increased risk, extending the persistence of high funding costs. Banks' funding cost also has important implications for monetary policy, as it can influence economic growth and inflation outlook. Such implications became noticeable in the 2007–08 financial crisis when banks' funding costs increased remarkably, causing liquidity shortages and higher lending rates (Beau et al. 2014).

In broader literature, studies on banks' funding cost are mostly concentrated around its association with solvency. The common consensus in the literature supports that solvency has a significant negative relationship with funding costs (Arnould et al. 2022). Solvency, if explained through regulatory capital, acts as deposit insurance and, therefore, the market (debtholders and depositors) imposes higher funding costs on banks with lower capital (Carvalho and

Dantas 2020). The extent of such market discipline is greater for banks suffering from solvency issues in conjunction with lower asset quality (Acharya and Mora 2015). Measuring solvency risk through expected capital shortfall, Pierret (2014) found that higher solvency risk restricts access to short-term funding. Similarly, wholesale market participants demand a higher funding rate if their perception of a bank's solvency is negatively affected (Dent, Hoke, and Panagiotopoulas 2021). Compared with the average funding cost, the sensitivity of market reaction is greater for the interbank funding cost (Aymanns et al. 2016). The overall conclusions remain the same when solvency is defined in terms of market-based leverage (Annaert et al. 2013; Hasan, Liu, and Zhang 2016).

Likewise, an increase in bank capital is found to be significantly associated with lower funding costs (Babihuga and Spaltro 2014; Schmitz, Sigmund, and Valderrama 2017; Moreira 2020). Banks having stronger fundamentals enjoy favorable interest rates in both borrowing and lending activities (Barajas and Stein 2000). Depositors prefer well-capitalized and highly liquid banks and, thus, adjust their funding volumes based on banks' capital and liquidity position (Ungan, Caner, and Özyıldırım 2008). As a result, depositors establish market discipline by requiring higher returns from banks with weaker fundamentals. This market discipline also applies to undercapitalized large banks with low liquidity. Schmitz, Sigmund, and Valderrama (2017) concluded that the influence of regulatory capital on funding costs is stronger than the relationship from the opposite direction, i.e., funding cost to capital.

In the case of government assistance through capital infusion, market participants may perceive the assisted banks with extra capital as safer (safety channel) due to current and/or future, if required, government intervention (Berger et al. 2020). Therefore, funding supply may increase for the bailed-out banks. Furthermore, assisted banks can reduce funding demand due to an inflow of funding from the government source. The banks can also reduce funding demand by getting rid of riskier assets in the post-assistance period. Funding costs would reduce under these high-supply and low-demand scenarios.

However, the non-linear nature of such a negative relationship is also pronounced in literature, which makes it possible for capital and funding cost to have a positive relationship. In the event of a

solvency shock, funding costs' responsiveness against lower solvency is greater at the initial levels (Aymanns et al. 2016; Dent, Hoke, and Panagiotopoulos 2021). Additionally, Arnould et al. (2022) found that the non-linearity is convex such that solvency beyond a certain threshold may positively influence funding costs of senior bond and term deposit. Cummings and Wright (2016) confirmed such a convex relationship by concluding that Australian banks may face increased (ranging from 8 to 24 basis points) funding costs in the long run due to higher capital requirements.

Different bailout scenarios are also likely. Banks receiving capital injection may increase their demand for other funding sources to repay the government funds (Berger et al. 2020), especially if the assistance fund is costlier. In an attempt to recover from the crisis, assisted banks may want to increase the size of their asset portfolio, which would require additional funding. Such increased demand can raise funding costs.

Since TARP-CPP funds were aimed at increasing bank capital, a relevant strand of literature could be the impact of capital on competition because capital improves banks' competitive position in the deposit and lending markets (Calomiris and Mason 2003; Calomiris and Wilson 2004). Empirical findings of Berger and Roman (2015) suggest that TARP recipient banks gained competitive advantages in both market power and market share. A higher TARP bailout probability is found to be positively associated with the post-crisis market power of a bank (Koetter and Noth 2016). The conclusions corroborate with the theoretical explanations of Allen, Carletti, and Marquez (2011) and Mehran and Thakor (2011) regarding a positive association between capital and market share. Berger and Bouwman (2013) found that higher capital positively influences the market share for small banks, but, for medium and large banks, such influence holds in the crisis periods only.

Alternative arguments explain how government assistance through capital infusion can lead to decreased competitive advantage (in terms of funding costs) for the recipient banks. First, through the quiet-life and/or charter-value channel (Hicks 1935; Keeley 1990; Cordella and Yeyati 2003), government assistance may augment the charter value of banks and/or motivate less active business practices, i.e., quiet-life that can have adverse funding cost implications, e.g., missing out on cheaper funding opportunities due to

fewer interactions with banking network partners or not actively monitoring the funding market.

Second, through the stigma channel (Berger and Roman 2015), market participants may consider the banks that applied for and/or accepted the government assistance as financially distressed or likely to fail. Such negative market perception can have adverse impacts on both the volume and cost of funding. Third, through the cost-disadvantage channel (Berger and Roman 2015), if capital from government aid is costlier, the recipient banks will experience increased total funding cost. Fourth, through the inefficiency channel,[1] the government's support through capital infusion can increase its managerial decision power on the assisted banks and trigger changes in the banks' internal managerial practices. If the government is inefficient in managing banks, funding costs can rise. In this connection, related literature provides evidence that government support significantly reduces the recipient banks' operational efficiency (Harris, Huerta, and Ngo 2013) and overall efficiency (Palas and Moreira 2022).

Finally, the government may impose certain restrictions on recipient banks' management, which can cause disagreement or dissatisfaction (conflict channel) between the owner (e.g., government) and management (e.g., executives). For example, the U.S. government put a limit of tax-deductible executive pay to $500,000 for all the CPP recipient banks. Therefore, banks with higher CEO pay were less inclined to accept the CPP funds (Cadman, Carter, and Lynch 2012), possibly to avoid potential CEO dissatisfaction. The conflict channel is further strengthened by the social stigma since bank's high CEO compensation was widely discussed by the news, blogs, and politicians concerning the U.S. government's assistance programs in 2007–08 (Wilson and Wu 2012). Management dissatisfaction in banks, especially in terms of pay, can lead to reduced productivity, inactive market monitoring, loss of skilled human resources, etc., which can adversely affect funding costs. The inefficiency and conflict channels may explain why many recipient banks attempted to repay the CPP fund quickly, e.g., Berger and Roman (2015).

[1]We thank an anonymous reviewer for highlighting the relevant possibilities.

Building on the capital-funding cost and capital-competition literature, possible research hypotheses could be formed as below:

Ha: Government assistance through capital infusion results in the recipient banks' lower funding costs.
Hb: Government assistance through capital infusion results in the recipient banks' higher funding costs.

Besides bank-specific factors, uncertainty in the financial market, the central bank's monetary policy directions, and sovereign risk play important roles in driving banks' funding costs (Arnould et al. 2022). The financial crisis of 2007–08 is of particular interest in this discussion, as it provoked disruptions in both the retail and wholesale funding markets for banks. Aymanns et al. (2016) documented evidence that the solvency–funding cost relationship in the interbank funding market is highly sensitive in periods of economic stress. Similarly, funding costs are influenced by financial market shocks, e.g., 2007–08 financial crisis (Babihuga and Spaltro 2014), and conditions in the market for bank lending (Kiser 2003), e.g., high default rate in the 2007–08 financial crisis. Moreover, the economic recession followed by the financial crisis triggered investors' concern about public finance, which leads to increased funding costs (Panetta et al. 2011). One of the primary motivations of the U.S. government's assistance program (TARP-CPP) in the financial crisis of 2007–08 was to stabilize the financial markets with adequate capital such that the rising tensions around banks' funding positions are attenuated.

Despite being an important research agenda, the question of whether and how government assistance as a crisis response affects funding costs has remained unanswered to date. This paper is an attempt to fill the vacuum in this context by investigating the effect of the U.S. government's Capital Purchase Program (CPP) on the recipient banks' funding costs. The results suggest that government assistance has a significant negative relationship with funding costs. The findings can be interpreted as evidence of increased public confidence in the recipient banks' financial health. This research contributes to the literature in several ways. Firstly, this study is possibly the earliest attempt to provide empirical evidence on the relationship between government assistance and banks' funding cost. Understanding the effect of government support through

the lens of funding cost will provide more insight into the debate about the consequences of governmental assistance. Secondly, unlike most studies in the relevant literature, this study incorporates a relatively long-term evaluation of the government intervention. Thirdly, current funding cost literature focuses mostly on large banks and uses a market-based approach, e.g., Babihuga and Spaltro (2014), Schmitz, Sigmund, and Valderrama (2017), and Dent, Hoke, and Panagiotopoulas (2021), which limits small banks since they have limited or no market-related activities. This study uses balance-sheet-based funding cost measures and provides valuable findings on the government assistance–funding cost relationship by incorporating a generous share of small banks. Most importantly, this study not only investigates whether and how government assistance relates to funding cost but also attempts to explain the possible channels of such relationship.

The study will be important to (i) regulators, as they will get a clearer understanding of the link between government assistance and banks' funding cost that will also facilitate improved intervention programs; (ii) depositors and investors, as they will be in a better position to analyze the implications of government assistance and to manage their funds on the recipient or non-recipient banks accordingly; (iii) practitioners, as they will have enhanced knowledge to guide banks' management on government-assistance-related decisions while considering possible funding cost outcomes; and (iv) finally, banks' management-level executives, who will know what to expect when participating in a government assistance program and how to adjust the bank's business strategies to cope with the aftermaths.

The rest of the paper is organized as follows. Section 2 explains the data and empirical methods used. The results are presented and discussed in Section 3. Section 4 concludes.

2. Data and Method

2.1 Institutional Background and Sample

The Troubled Assets Relief Program (TARP), organized by the Emergency Economic Stabilization Act, was the financial support program undertaken by the U.S. government as a response to the

2007–08 financial crisis. TARP was approved in October 2008 to ensure the overall soundness of the U.S. financial system (Ng, Vasvari, and Wittenberg-Moerman 2011). Several sub-programs were hosted under the broader umbrella of the TARP program, and the noteworthy one was the Capital Purchase Program (CPP), announced in October 2008. The main purpose of CPP was to reinstall stability and robustness of the U.S. financial system. To secure these two pillars and regain investors' lost confidence, CPP provided capital support to financial institutions of all sizes that met the stated criteria (U.S. Department of the Treasury 2018). On numbers, CPP constituted more than 33 percent of total TARP funding, about $250 billion of government assistance, which, however, was reduced to $218 billion in March 2009. By the end of the government assistance period, $204.9 billion was invested under the CPP scheme by the U.S. Treasury. Moreover, during the implementation of the CPP program, the U.S. Treasury provided capital to 707 financial institutions that include small and community banks as well as certified community development financial institutions. The U.S. government maintained transparency in the CPP program and regularly updated data on how the U.S. Treasury was using the fund, who the recipients were, and the latest information on the fund's status (Bayazitova and Shivdasani 2011). The detailed information about CPP beneficiaries is accessible on the U.S. Treasury's website (U.S. Department of the Treasury 2018).

This study concentrates on the banking sector, which was the major recipient of the CPP program. The relevant quarterly data for bank holding companies (BHCs) and commercial banks (CBs) are collected from the FDIC (Federal Deposit Insurance Corporation) Call Reports and S&P Capital IQ Pro database. The BHCs' data are not aggregated at the parent level, since this study is aimed at examining the potentially heterogeneous association between CPP assistance and different subsidiaries of a BHC. Especially when banks' names are not the same, many fund providers (especially retail depositors) may not know that some commercial banks belong to a particular BHC. This study accounts for such an important possibility because funding costs are sensitive and highly connected to the depositors' and/or investors' perceptions.

Savings and loan institutions, and other thrift institutions, are excluded since these institutions report data and compete in the

market differently compared with commercial banks. For convenience, the term bank refers to both types of banks (BHC and CB) from this point onwards, unless stated separately. The sample period for the analysis is from 2009 to 2018, considering that CPP assignments started in the last quarter of 2008. Inactive banks are retained to avoid survival bias. Excluding banks that failed before 2009, 8,408 banks remained from the raw sample of 27,687 FDIC banks.

The CPP transaction data and list of CPP recipients are obtained from the U.S. Treasury's website. The CPP recipient banks from the U.S. Treasury list are matched with the initial sample (8,408 banks) by using the banks' name, city, state, and CPP amount received. In case of acquisition, merger, and name changes, banks are investigated further and updated with the appropriate identification details. Observations with incomplete or missing data on total assets or common equity, and/or negative data on income statement items related to funding costs, e.g., interest expense, are excluded. Following Berger and Bouwman (2013) and Berger and Roman (2015), the equity-to-total-asset ratio (if less than 1 percent) is replaced with 1 percent to avoid distortions. The final sample includes 8,327 banks, among which 414 banks are CPP recipients and the remaining 7,913 banks are non-CPP recipients.[2] The sample contains 1,093 BHCs and 7,234 CBs, among which 332 and 82 are CPP banks, respectively.[3]

The 414 CPP banks were granted $184.90 billion, which is around 90.24 percent of the total CPP fund ($204.9 billion). As compared with the CPP banks' capital structure before CPP, the CPP capital injections can be considered significant. On average, CPP infusion amounts to 28 percent of the CPP banks' pre-CPP total capital and 3 percent of pre-CPP risk-weighted assets. The mean and median of the CPP banks' Tier 1 ratio improved noticeably after the CPP injections. Table 1 provides further details on CPP volume and its significance on the CPP banks' capital structure.

[2]From this point onward, the CPP recipients and non-CPP recipients groups will be termed CPP banks and non-CPP banks, respectively.

[3]Recall that the BHCs' data are not aggregated at the parent level.

Table 1. Details of Capital Purchase Program (CPP)

	Mean	Median	25th Percentile	75th Percentile	Min.	Max.
CPP Amount (in USD Millions)	448	22	11	65	0.301	25,000
CPP/Pre-CPP Total Capital	0.28	0.33	0.22	0.32	0.08	1.36
CPP/Pre-CPP RWA	0.03	0.03	0.02	0.03	0.01	0.16
Pre-CPP Tier 1 Ratio	11.68	10.43	9.40	12.55	7.82	23.73
Post-CPP Tier 1 Ratio	12.33	12.01	10.59	13.7	.22	25.19

Note: This table reports CPP-related summary statistics based on the recipient (CPP) banks. Yearly values are considered for Total Capital and RWA (Risk-Weighted Assets). Since capital infusion under CPP was initiated from the last quarter of 2008, 2007 and 2009 are considered as the pre- and post-CPP years, respectively. Total capital includes common equity, preferred equity, and non-redeemable non-controlling interest of a company. Tier 1 ratio represents equity capital plus minority interests less portion of perpetual preferred stock and goodwill as a percent of adjusted risk-weighted assets.

2.2 Models

2.2.1 The Baseline Equation

$$FC_{i,t} = \beta_0 + \beta_1 CPP_i + \sum_{n=2}^{8} \beta_n X_{n,i,t} + \sum_{n=9}^{12} \beta_n C_{n,s,t} + \tau_t + \alpha_s + \varepsilon_{i,t} \quad (1)$$

In Equation (1), $FC_{i,t}$ stands for the funding cost of bank i at time t. This study uses three different balance-sheet-based indicators of funding cost, namely the cost of fund, cost of deposit, and cost of liabilities. Although banks' funding costs can be identified through multiple measures, typical empirical literature focuses largely on market-based indicators, e.g., Babihuga and Spaltro (2014), Schmitz, Sigmund, and Valderrama (2017), and Dent, Hoke, and Panagiotopoulas (2021). However, market-based measures could be imperfect since they may not offer a fair representation of the banks' actual funding cost (Arnould et al. 2022). These measures ignore that different types of bank liabilities can have varied sensitiveness to stress situations. The commonly exploited market-based measure in the funding cost literature is CDS spreads, which are more related to the risk of bank failure, i.e., credit default, but not necessarily to the funding costs. Even when predicting credit defaults, Grossman and Hansen (2010) concluded that the CDS spreads were unreliable during the financial crisis of 2007–08.

Funding cost studies using CDS spreads assume that investors are risk neutral, do not require risk premium, and are insusceptible to changes in risk-aversion sentiment (Schmitz, Sigmund, and Valderrama 2017). These strong assumptions rarely hold in real-life scenarios. Alternatively, studies employing CDS spreads rely on the strong assumption that the market (or investors) can accurately assess banks' risk and demand interest rates accordingly. Again, such a strong assumption can be doubtful due to the opaqueness of banks and their funding activities. Even if investors' assessment is correct, they could discount part of the risk in light of other factors, e.g., too big to fail. In this case, even if investors perceive a bank as very risky (high CDS spreads), they may expect that some banks, mostly the large ones, would be bailed out and the funding costs of those banks would not increase proportionally. In terms of bond yields, the

arguments presented may also hold besides the fact that bond prices and, consequently, yields are affected by many other issues. For example, bond characteristics are unstable and can change significantly over the bond's life.

This study's context also played an important role in favoring the balance-sheet-based funding cost measures. In stress conditions such as the 2007–08 financial crisis, banks' opportunity to access funds from the market may shrink significantly due to market-wide illiquidity. Therefore, market-based measures may not be a good fit for studies based on crisis times. Besides the context, such measures would not suit properly for this study's sample, since it includes a significant share of small banks that have no or limited market-based activity. Aymanns et al. (2016) suggested that the balance-sheet-based approach would allow rich panel data for a large sample and the study findings would also be directly implementable to banks' stress tests, which depend on balance sheet data.

For an effective measure of funding cost, Schmitz, Sigmund, and Valderrama (2017) recommended considering banks' actual funding structure and the cost of alternative funding sources. A growing number of studies are using a balance-sheet-based approach for funding cost analysis—for example, Ungan, Caner, and Özyıldırım (2008), Aymanns et al. (2016), Carvalho and Dantas (2020), Moreira (2020), and Arnould et al. (2022). Considering the significant issues surrounding the market-based approach and this study's specificity in terms of context and sample, a balance-sheet-based approach is adopted in calculating the funding cost measures.

CPP_i is a dummy equal to 1 if bank i received support from the Capital Purchase Program (CPP) and 0 otherwise. X includes seven control variables focused on bank characteristics (size, deposit volume, and CAMEL variables—capital adequacy, assets quality, management quality, earnings, and liquidity). C represents four control variables based on regional economic conditions (competition, personal income, gross domestic product, and unemployment). The selection of bank-related control variables is inspired by existing literature where size (Altunbas, Gambacorta, and Marques-Ibanez 2010; Anbar and Alper 2011) and volume of liabilities (De Nicoló and Loukoianova 2007; Schaeck 2008; Gropp and Heider 2010; Gambacorta et al. 2017) are extensively used to represent bank characteristics. In addition, Barajas and Stein (2000) concluded that depositors select banks based on strong fundamentals, and banks

having stronger fundamentals enjoy funding cost benefits. Therefore, banks' fundamentals (which can be proxied by CAMELS) are important in funding cost discussion. The item "S" in CAMELS, i.e., "sensitivity to market risk," is excluded due to substantial missing values in the sample banks. Details on the variables' definitions are available in Table 2.

Time (τ_t) and state (α_s) fixed effects are used to control for variations relevant to time and states. Bank fixed effects are not applied, as they would exclude the main variable of interest CPP due to its time-invariant nature. ε_{it} is the error term. Equation (1) is estimated using a linear random-effects model, as it is more suitable in this study's context given that it includes a variable (CPP) that does not vary over the sample period (Baltagi 2008; Wooldridge 2010).

2.2.2 Fixed Effects

This study further investigates the government assistance–funding cost relationship by considering the potential influence of bank-level heterogeneity in terms of the CPP funds allocated. Instead of the CPP dummy, using the CPP amount specific to each bank allows incorporating bank fixed effects into the model, which is an additional methodological advantage. Furthermore, outstanding CPP amount is also examined. In this case, CPP amount of each bank is replaced with its CPP outstanding amount, where outstanding refers to the actual CPP amount in each quarter after adjusting for repayments made by the bank. The following Equations (2) and (3) represent the fixed-effect models:

$$FC_{i,t} = \beta_0 + \beta_1 CPPamount_{i,t} + \sum_{n=2}^{8} \beta_n X_{n,i,t} + \sum_{n=9}^{12} \beta_n C_{n,s,t} + \mu_i + \tau_t + \alpha_s + \varepsilon_{i,t} \quad (2)$$

$$FC_{i,t} = \beta_0 + \beta_1 CPPoutstanding_{i,t} + \sum_{n=2}^{8} \beta_n X_{n,i,t} + \sum_{n=9}^{12} \beta_n C_{n,s,t} + \mu_i + \tau_t + \alpha_s + \varepsilon_{i,t}. \quad (3)$$

Table 2. Variables' Notations and Definitions

Variable	Notation	Definition/Calculation
Cost of Fund	CF	Total interest expense as a percent of the sum of average interest-bearing liabilities and average non-interest-bearing deposits
Cost of Deposit	CD	Total interest expense on deposits as a percent of two-point average interest-bearing deposits. The two-point average is based on the current and previous calendar quarters.
Cost of Liabilities	CL	Total interest expense as a percent of average interest-bearing liabilities
Government Assistance	CPP	1 if the bank received CPP funds; 0 otherwise
CPP Amount	CPPamount	CPP amount received by a bank divided by its risk-weighted assets
CPP Amount Outstanding	CPPoutstanding	CPP amount outstanding by a bank divided by its risk-weighted assets. CPP amount outstanding refers to the actual CPP amount in each quarter after adjusting for the repayments made by the bank.
Capital Adequacy	CA	(Common stock + preferred stock) divided by total assets
Asset Quality	AQ	Non-performing assets divided by total assets
Management Quality	MQ	Cost-to-income ratio = (interest and related expense + non-interest expense) divided by (interest income + non-interest income)
Earnings	ER	Net income divided by average total assets
Liquidity	LQ	Cash and due from banks divided by total assets
Deposit	DP	Total deposit divided by total assets
Size	Size	The logarithm of total assets
Competition	CM	The logarithm of the total number of bank branches in the state
Personal Income	PI	The growth rate of per capita personal income of the state
Gross Domestic Product	GDP	The growth rate of the real gross domestic product of the state
Unemployment	UN	The unemployment rate of the state

Here, $CPPamount_{i,t}$ and $CPPoutstanding_{i,t}$ denote the CPP amount and CPP outstanding amount, respectively, as a fraction of risk-weighted assets of bank i at time t. μ_i is the bank fixed effect. Explanations for the other variables and subscripts are presented in the previous section.

2.2.3 Matching CPP and Non-CPP Banks

The propensity score matching (PSM) technique is used to identify comparable non-CPP banks for the CPP banks. Ten years of pre-CPP data (1999–2008) on bank characteristics (capital adequacy, asset quality, management quality, earnings, liquidity, deposit volume, and size) are used to calculate the propensity score in levels and dynamics (changes in the variables). PSM provides two stricter (caliper 0.01) 1:1 matched samples besides the unmatched sample.[4] Figure 1 shows how the difference between CPP and non-CPP banks in terms of funding cost (in levels and dynamics) changes across the matched and unmatched samples over the sample period.

To strengthen the matching exercise, the mean difference test between the CPP and non-CPP banks is conducted using 10 years' quarterly data before the CPP assignment. Table 3 presents the results of the mean difference test, which show that the two groups (CPP and non-CPP banks) in the sample matched in dynamics[5] are not statistically different in terms of capital adequacy, asset quality, management quality, earnings, liquidity, and size.

3. Results

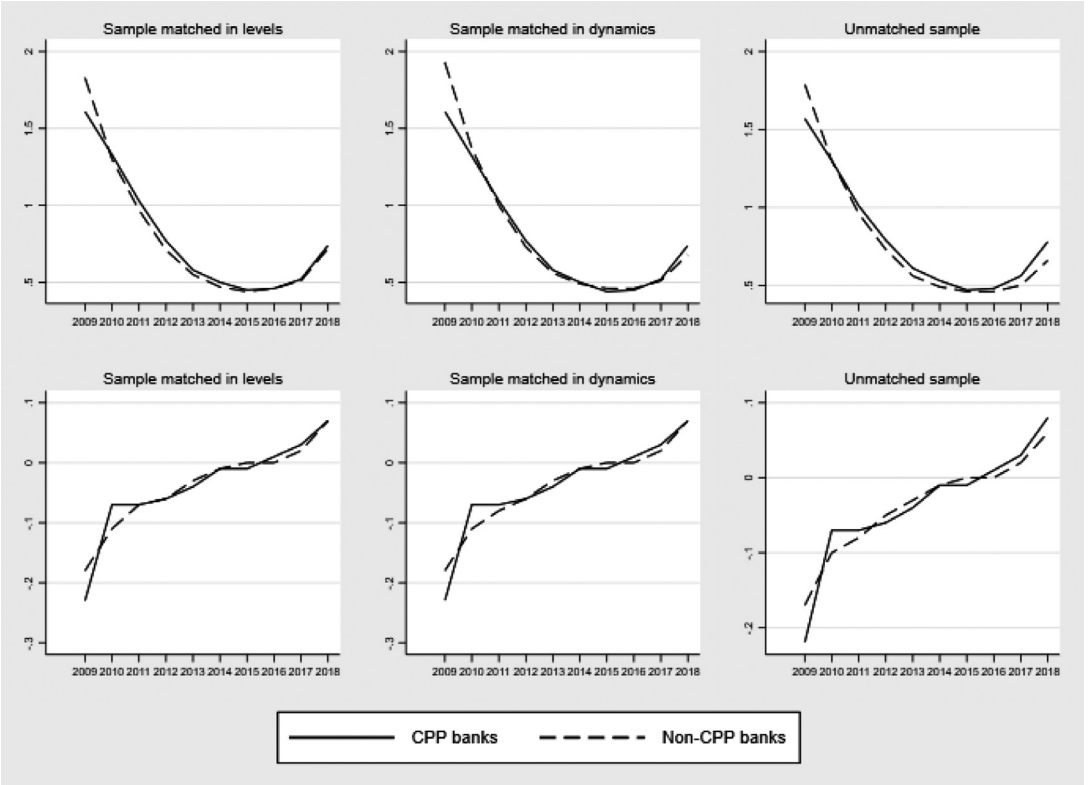
3.1 Descriptive Statistics

Table 4 provides the summary statistics of the study's variables of interest. All the values are in the expected ranges. The negative minimum values of "Personal Income" and "GDP" are explained by the

[4]The respective sample sizes are 1:1 matched sample in levels (total 710 banks, 376 CPP banks, and 334 non-CPP banks), 1:1 matched sample in dynamics (total 736 banks, 377 CPP banks, and 359 non-CPP banks), and unmatched sample (total 8,327 banks, 414 CPP banks, and 7,913 non-CPP banks).

[5]The sample matched in levels provides similar results (unreported) for the mean difference test.

Figure 1. Funding Cost Difference between CPP and Non-CPP Banks (matched and unmatched samples)



Note: The top row shows the difference between CPP and non-CPP banks in terms of funding cost measured in levels. The bottom row shows the difference between those banks when funding cost is measured in dynamics. To avoid confusion, keep in mind that the in-level and in-dynamics approaches are used both in the funding cost calculation and in the sample matching.

Table 3. Mean Difference Test

	Mean CPP Banks	Mean Non-CPP Banks	Normalized Difference in Means	t-stat	Median CPP Banks	Median Non-CPP Banks
Capital Adequacy	0.02	0.02	0.02	1.13	0.01	0.01
Asset Quality	0.01	0.01	0.02	1.61	0.00	0.00
Management Quality	0.79	0.79	0.01	0.40	0.78	0.76
Earnings	0.78	0.80	0.02	1.23	0.98	1.09
Liquidity	0.03	0.03	0.01	0.46	0.03	0.03
Deposit	0.77	0.79	0.20***	14.96	0.79	0.82
Size	13.58	13.56	0.02	1.22	13.58	13.35
Number of Banks	377	359				

Note: CPP means Capital Purchase Program. Banks that received funds from the Capital Purchase Program are termed CPP banks in this table. *** indicates statistical significance at the 1 percent level. This table reports the mean difference of bank characteristics between CPP and non-CPP banks in the sample matched in dynamics based on 10 years' quarterly data from 1999 to 2008 before the CPP.

Table 4. Summary Statistics

	Mean	Standard Deviation	Minimum	25^{th} Percentile	Median	75^{th} Percentile	Maximum
Cost of Fund	0.84	0.60	0.00	0.39	0.66	1.11	4.43
Cost of Deposit	0.94	0.63	0.01	0.47	0.75	1.23	5.41
Cost of Liabilities	1.01	0.65	0.17	0.52	0.82	1.33	5.55
Capital Adequacy	0.02	0.02	0.01	0.01	0.01	0.01	0.15
Asset Quality	0.02	0.03	0.00	0.00	0.01	0.03	0.13
Management Quality	0.77	0.18	0.45	0.66	0.74	0.84	1.58
Earnings	0.70	1.23	–5.55	0.43	0.85	1.26	3.65
Liquidity	0.03	0.02	0.00	0.01	0.02	0.03	0.12
Deposit	0.83	0.07	0.45	0.81	0.85	0.88	0.93
Size	12.43	1.47	9.41	11.43	12.21	13.25	17.23
Competition	7.56	0.79	4.73	7.13	7.49	8.23	8.87
Personal Income	2.58	3.38	–10.00	1.00	3.00	5.00	15.00
GDP	1.45	2.50	–9.00	1.00	2.00	3.00	22.00
Unemployment	6.38	2.40	2.00	4.00	6.00	8.00	15.00

Note: This table reports summary statistics for variables of interest based on quarterly data from the year 2009 to 2018.

fact that they are measured in percentage changes. The funding cost variables (cost of fund, cost of deposit, and cost of liabilities) show a considerable variation, which is evident from their respective standard deviations. CPP capital infusion could be one of the possible explanations for the substantial variation in the sample banks' funding costs. Especially, CPP banks' funding costs may considerably change after the CPP. Analyses ahead will explore these possibilities.

Independent variables included in the regression models are examined for potential collinearity issues. Table 5 shows that the variables are not affected by high collinearity. Variance inflation factors (VIFs) are calculated to detect possible multicollinearity among the independent variables. The corresponding VIF values (unreported) are below 5 and, therefore, rule out the possibility of multicollinearity according to the usual rule of thumb (Simon 2004).

3.2 Regression Results

Table 6 presents the results of Equation (1) using the matched samples and includes the three types of funding costs with different model specifications. The results show that government assistance is negatively related to banks' funding costs and the coefficient is statistically significant at the 1 percent and 5 percent levels. The finding remains consistent across all six model specifications. The relatively large coefficients' values, ranging from −0.064 to −0.264, are also noteworthy since they highlight the strength of the association between government assistance and banks' funding costs.

The results are also significant in an economic sense. In the sample matched in levels, CPP banks reduced their cost of fund, cost of deposit, and cost of liabilities by 8.33 percent, 14.57 percent, and 6.34 percent, respectively.[6] The funding cost reductions are significantly stronger in the sample matched in dynamics where the cost of fund, cost of deposit, and cost of liabilities reduce by 20 percent, 28.09 percent, and 16.04 percent, respectively. Compared with other funding costs, cost of deposit has the largest negative coefficients

[6]The coefficients of CPP in Table 6 are evaluated at the average cost of fund (0.84), cost of deposit (0.94), and cost of liabilities (1.01) to calculate the percentage reductions.

Table 5. Correlation Matrix

	CA	AQ	MQ	ER	LQ	DP	Size	CM	PI	GDP
AQ	0.13									
MQ	0.22	0.43								
ER	–0.19	–0.48	–0.74							
LQ	–0.02	–0.08	0.11	–0.03						
DP	–0.07	0.07	0.10	–0.10	0.15					
Size	–0.02	0.04	–0.20	0.06	–0.36	–0.29				
CM	0.17	0.06	0.08	–0.09	–0.02	0.05	0.12			
PI	0.00	–0.02	–0.11	0.14	–0.02	0.05	0.04	0.02		
GDP	0.00	–0.10	–0.14	0.18	0.00	0.06	0.03	0.05	0.66	
UN	0.20	0.33	0.26	–0.30	0.03	–0.04	0.04	0.33	–0.27	–0.39

Note: This table reports correlation among variables of interest based on quarterly data from the year 2009 to 2018. The notations are explained in Table 2.

Table 6. Government Assistance and Funding Costs

	Sample Matched in Levels			Sample Matched in Dynamics		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**
Government Assistance	–0.070**	–0.137***	–0.064**	–0.168***	–0.264***	–0.162***
	(0.029)	(0.026)	(0.029)	(0.039)	(0.038)	(0.039)
Capital Adequacy	–0.650*	–0.275	–0.781**	–1.110***	–0.760**	–1.227***
	(0.339)	(0.350)	(0.347)	(0.308)	(0.337)	(0.320)
Asset Quality	0.472*	0.568**	0.481	0.404	0.509*	0.434
	(0.284)	(0.288)	(0.299)	(0.249)	(0.282)	(0.278)
Management Quality	0.212***	0.159***	0.233***	0.184***	0.151***	0.215***
	(0.033)	(0.035)	(0.034)	(0.029)	(0.032)	(0.031)
Earnings	–0.006*	–0.010***	–0.005	0.000	–0.002	0.004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Liquidity	–1.707***	–1.651***	–1.722***	–0.556*	–0.272	–0.268
	(0.398)	(0.507)	(0.531)	(0.331)	(0.367)	(0.385)
Deposit	–0.003	0.358**	0.001	–0.167	0.346***	–0.052
	(0.152)	(0.166)	(0.159)	(0.128)	(0.131)	(0.146)
Size	0.011	0.008	0.018	0.059***	0.061***	0.065***
	(0.016)	(0.016)	(0.017)	(0.017)	(0.017)	(0.017)
Competition	0.983***	0.861***	0.740***	0.626***	0.564**	0.328
	(0.232)	(0.262)	(0.253)	(0.229)	(0.240)	(0.246)
Personal Income	0.002	0.004**	0.003*	0.002	0.003	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
GDP	–0.001	–0.001	–0.001	–0.004*	–0.004	–0.004*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment	–0.008	–0.014**	–0.012*	0.000	–0.000	–0.001
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.826	0.823	0.829	0.836	0.809	0.837
Bank-Quarter Observations	21,521	21,521	21,521	22,327	22,327	22,327
No. of Banks	710	710	710	736	736	736

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent levels, respectively. The results are obtained using the linear random-effect estimation of Equation (1) with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008.

in both matched samples. The finding also holds in terms of economic effect, as CPP banks have the largest reduction in the cost of deposit. Consistent with the findings of Berger et al. (2020), depositors (supply side) may have decreased market discipline towards CPP banks, considering these banks as safer and/or with a higher possibility of future bailouts (if needed). Also, CPP banks (demand side) may have decreased deposit demand due to having additional fund from government assistance programs and/or a reduction in asset portfolios. The combined effect (high supply and low demand) may have reduced the cost of deposit significantly. On average, CPP banks' funding costs reduced remarkably after the CPP assignment.

Regarding the control variables, the findings related to the CAMEL variables suggest that banks with better capital adequacy, asset quality, management quality, earnings, and liquidity would attract funding with lower costs. Such findings are consistent with Barajas and Stein (2000), who conclude that banks with stronger fundamentals enjoy funding cost benefits. Regarding deposit volume, the coefficients are only significant in the cost of deposit models, which can be expected because the other two types of funding costs are not focused primarily on deposits. Estimates suggest that banks with higher deposit volume and larger size are more likely to have higher funding costs. Since the findings contradict the usual expectations in literature, e.g., Berger and Roman (2015), and indicate a possibility of non-linearity in the relationship between bank size and funding cost, the analyses are rerun with large banks with assets over $3 billion only. The results (unreported) provide no statistically significant evidence that size and deposit volume positively associate with funding costs. Therefore, banks may have funding cost advantage only after reaching a certain threshold of assets and deposit volume, consistent with Jacewitz and Pogach (2018), who conclude that funding cost advantages are for the largest banks only. Among the regional control variables, the results of competition deserve attention due to the considerably large and significant coefficients indicating that banks facing higher regional competition are more likely to experience significantly higher funding costs.

As discussed in Section 2.2.2, this study takes into account the bank-level heterogeneity in terms of the CPP funds allocated in a fixed-effect model. Table 7 shows the results of Equation (2) using the two matched samples for the three types of funding costs.

Table 7. Government Assistance and Funding Costs: CPP Amount Received

	Sample Matched in Levels			Sample Matched in Dynamics		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**
CPP Amount	–0.002***	–0.003***	–0.000	–0.001	–0.003***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Capital Adequacy	–0.433	0.039	–0.533	–1.024***	–0.622*	–1.121***
	(0.378)	(0.405)	(0.039)	(0.335)	(0.375)	(0.349)
Asset Quality	0.208	0.259	0.195	0.217	0.277	0.227
	(0.286)	(0.292)	(0.302)	(0.253)	(0.290)	(0.283)
Management Quality	0.221***	0.181***	0.247***	0.198***	0.180***	0.234***
	(0.034)	(0.035)	(0.035)	(0.030)	(0.032)	(0.031)
Earnings	–0.004	–0.007**	–0.003	0.003	0.002	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Liquidity	–1.541***	–1.479***	–1.565***	–0.488	–0.183	–0.181
	(0.405)	(0.524)	(0.544)	(0.335)	(0.369)	(0.392)
Deposit	0.030	0.347*	0.030	–0.174	0.315**	–0.052
	(0.161)	(0.177)	(0.169)	(0.131)	(0.134)	(0.151)
Size	0.064**	0.088***	0.081***	0.112***	0.143***	0.128***
	(0.027)	(0.029)	(0.029)	(0.025)	(0.026)	(0.026)
Competition	0.962***	0.840***	0.715***	0.620***	0.559**	0.320
	(0.234)	(0.265)	(0.254)	(0.230)	(0.244)	(0.247)
Personal Income	0.002	0.004*	0.003	0.002	0.003	0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
GDP	–0.001	–0.001	–0.001	–0.004*	–0.004	–0.004*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment	–0.007	–0.013**	–0.010*	0.001	0.001	0.000
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.827	0.824	0.830	0.837	0.810	0.838
Bank-Quarter Observations	21,521	21,521	21,521	22,327	22,327	22,327
No. of Banks	710	710	710	736	736	736

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent levels, respectively. The results are obtained using the fixed-effect estimation of Equation (2) with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008.

Here, the study's main independent variable of interest, i.e., CPP, is replaced with each bank's CPP amount as a ratio of its risk-weighted assets (RWA). Although results are not significant in all the columns, the key finding remains consistent in the significant coefficients, suggesting that government assistance is negatively related to funding costs. In an economic sense, banks reduce 0.24 percent and 0.32 percent of their cost of fund and cost of deposit, respectively, for each unit increase in their CPP allocated amount/RWA ratio. Simply put, higher CPP fund allocation may have resulted in lower funding costs for banks. In line with the conclusion in Table 6, depositors' response remains higher compared with other types of funding costs.

To understand the importance of CPP amount further, this study utilizes another bank-level granular measure that considers the banks' outstanding CPP amount[7] as opposed to the initially allocated CPP amount. Table 8 presents the results of Equation (3), which considers CPP outstanding amount as a ratio of risk-weighted assets as the main independent variable. The main findings remain consistent and, compared with results in Table 7, the coefficients demonstrate a stronger effect.

Market (depositors' and investors') response to CPP banks may be driven by the timing of the CPP fund's repayment. To examine this possibility, CPP banks are grouped into two categories according to their repayment behavior. CPP banks that repaid the CPP fund in full within 2010 are categorized as "repaid early." The other category contains CPP banks that did not repay the full CPP amount within 2010. Table 9 shows the results for the two categories of banks. Banks that repaid early demonstrate significant negative coefficients in cost of fund and cost of deposit, indicating that funding cost benefits may only be applicable for the early repayers. The finding is consistent with relevant research by Berger and Roman (2015), who conclude that recipients of government assistance that repaid early hold a significant competitive advantage, while the other recipients do not show such results.

The CPP banks' level of capital before CPP injection can be linked with their funding cost afterward. To test this possibility,

[7]The actual CPP amount in each quarter after adjusting for repayments made by banks.

Table 8. Government Assistance and Funding Costs: CPP Amount Outstanding

	Sample Matched in Levels			Sample Matched in Dynamics		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**
CPP Outstanding	–0.259	–0.549*	–0.355	–0.854**	–1.291***	–1.057**
	(0.277)	(0.286)	(0.296)	(0.344)	(0.413)	(0.414)
Capital Adequacy	–0.391	0.126	–0.478	–0.878***	–0.400	–0.940***
	(0.379)	(0.409)	(0.391)	(0.331)	(0.377)	(0.348)
Asset Quality	0.239	0.324	0.237	0.301	0.405	0.331
	(0.289)	(0.294)	(0.304)	(0.252)	(0.287)	(0.282)
Management Quality	0.222***	0.182***	0.247***	0.200***	0.182***	0.236***
	(0.034)	(0.035)	(0.035)	(0.029)	(0.031)	(0.031)
Earnings	–0.004	–0.007**	–0.003	0.003	0.002	0.007**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Liquidity	–1.544***	–1.486***	–1.570***	–0.494	–0.191	–0.189
	(0.405)	(0.522)	(0.543)	(0.335)	(0.369)	(0.392)
Deposit	0.032	0.352**	0.033	–0.167	0.325**	–0.044
	(0.161)	(0.177)	(0.168)	(0.131)	(0.133)	(0.150)
Size	0.064**	0.089***	0.082***	0.112***	0.144***	0.128***
	(0.027)	(0.029)	(0.029)	(0.024)	(0.026)	(0.026)
Competition	0.972***	0.860***	0.729***	0.659***	0.617**	0.368
	(0.233)	(0.265)	(0.254)	(0.228)	(0.243)	(0.247)
Personal Income	0.002	0.004*	0.003	0.002	0.003	0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
GDP	–0.001	–0.001	–0.001	–0.003*	–0.004	–0.004*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
Unemployment	–0.007	–0.013**	–0.010*	0.001	0.001	0.000
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.005)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.827	0.824	0.830	0.837	0.811	0.838
Bank-Quarter Observations	21,521	21,521	21,521	22,327	22,327	22,327
No. of Banks	710	710	710	736	736	736

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent levels, respectively. The results are obtained using the fixed-effect estimation of Equation (3) with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008.

Table 9. Government Assistance and Funding Costs: CPP Repayment Behavior

	Banks Repaid Early			Banks Did Not Repay Early		
	Cost of Fund (1)	Cost of Deposit (2)	Cost of Liabilities (3)	Cost of Fund (4)	Cost of Deposit (5)	Cost of Liabilities (6)
CPP Amount	–0.001**	–0.002***	0.001	18.455*	12.572	18.317
	(0.001)	(0.001)	(0.001)	(9.433)	(8.165)	(11.168)
Capital Adequacy	–0.765*	–0.294	–0.863**	–2.244	–1.973	–2.465
	(0.409)	(0.447)	(0.425)	(2.205)	(2.681)	(2.662)
Asset Quality	0.538*	0.773**	0.465	2.067	2.242	1.934
	(0.298)	(0.311)	(0.333)	(1.751)	(1.444)	(1.895)
Management Quality	0.113***	0.044	0.135***	0.235***	0.114	0.243**
	(0.029)	(0.030)	(0.032)	(0.077)	(0.070)	(0.089)
Earnings	–0.005	–0.010***	–0.002	0.006	–0.001	0.009
	(0.003)	(0.003)	(0.003)	(0.008)	(0.006)	(0.010)
Liquidity	–1.032***	–0.483	–0.567	–0.057	–0.785	–0.286
	(0.364)	(0.402)	(0.431)	(0.820)	(0.830)	(0.944)
Deposit	–0.224	0.234	–0.247	1.526	0.874	1.670
	(0.148)	(0.146)	(0.164)	(1.000)	(0.860)	(1.125)
Size	0.038	0.066**	0.057*	1.280**	0.905**	1.129*
	(0.027)	(0.029)	(0.031)	(0.506)	(0.427)	(0.595)
Competition	0.818***	0.763**	0.572*	0.184	–0.202	0.351
	(0.277)	(0.349)	(0.333)	(1.509)	(1.012)	(1.493)
Personal Income	0.001	0.002	0.003	0.002	–0.015	0.006
	(0.002)	(0.002)	(0.002)	(0.020)	(0.016)	(0.022)
GDP	0.000	–0.001	–0.001	–0.004	–0.004	–0.005
	(0.002)	(0.003)	(0.003)	(0.009)	(0.006)	(0.010)
Unemployment	–0.004	–0.007	–0.006	–0.019	–0.021	–0.030
	(0.005)	(0.006)	(0.006)	(0.024)	(0.023)	(0.025)
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.872	0.874	0.868	0.837	0.899	0.832
Bank-Quarter Observations	11,375	11,375	11,375	222	222	222
No. of Banks	349	349	349	27	27	27

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. ***, **, and * indicate statistical significance at 1 percent, 5 percent, and 10 percent levels, respectively. The results are obtained using the fixed-effect estimation of Equation (2) for the sample matched in dynamics with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008. CPP banks that repaid the CPP fund in full within 2010 are categorized as repaid early.

the CPP banks are grouped by the risk-based capital ratio[8] at the time of CPP infusion. Since the average risk-based capital ratio of this study's sample is 16.55 percent in 2018:Q3, banks with such a ratio less than or equal to 16.55 percent in 2008:Q3 are grouped as low-equity banks, otherwise high-equity banks. The results in Table 10 show that low-equity banks experience funding cost benefits after the CPP infusion. This could be due to increased public confidence in such banks after receiving government assistance. However, CPP banks having higher capital before CPP demonstrate no significant results. Possibly, the market perception of high-equity banks remained unchanged after CPP. Existing literature provides support for the findings on low- versus high-equity CPP banks from the non-linearity angle. Aymanns et al. (2016) conclude that funding cost and solvency have a non-linear relationship such that the sensitivity of funding cost is higher at the lower level of solvency. The conclusion is further reinforced by Dent, Hoke, and Panagiotopoulos (2021), who study solvency shocks and found a similar non-linear negative relationship where funding costs' response is greater at the lower solvency levels. Besides the market perception perspective, such a non-linear relationship could be another reason why the low-equity CPP banks demonstrate significant changes in funding costs after CPP allocation.

Regional market concentration can have important implications on the banks' funding costs. Although the main analyses control for regional competition in terms of the number of bank branches, analyses on sub-samples based on the market concentration of deposits can offer further insights. Using the Herfindahl-Hirschman Index (HHI) deposits[9] as of June 30, 2009 (time around CPP), the sample banks are grouped by following the U.S. Department of Justice's

[8]Risk-based capital ratio is total regulatory capital as a percent of risk-adjusted assets. For Call Report and FRY-9C filers, depending on institution attributes and time period, it represents risk-based capital ratio reported under either the U.S. Basel III (B3) revised regulatory capital rules, advanced approaches rules or otherwise, or the general risk-based (GRB) regulatory capital rules. Preference between the GRB, B3, and B3-Post Parallel Run ratios is given based on the nature of the filing, the lowest of the B3 and B3-Post Parallel Run ratios, when available. Additionally, a general preference is given to B3 ratios over the GRB ratios, where applicable.

[9]"Deposit Market Share Reports," Federal Deposit Insurance Corporation: available at https://www7.fdic.gov/sod/sodMarketBank.asp.

Table 10. Government Assistance and Funding Costs: Low- vs. High-Equity Banks

	Sample Matched in Levels			Sample Matched in Dynamics		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**
A. Low-Equity Banks						
Government Assistance	–0.076** (0.033)	–0.144*** (0.031)	–0.073** (0.034)	–0.205*** (0.045)	–0.313*** (0.046)	–0.199*** (0.045)
Bank-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.839	0.843	0.840	0.845	0.847	0.844
Bank-Quarter Observations	18,023	18,023	18,023	18,392	18,392	18,392
No. of Banks	600	600	600	615	615	615
B. High-Equity Banks						
Government Assistance	–0.029 (0.071)	–0.032 (0.063)	–0.003 (0.067)	0.061 (0.064)	–0.038 (0.064)	0.038 (0.069)
Bank-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.783	0.757	0.790	0.805	0.664	0.811
Bank-Quarter Observations	3,498	3,498	3,498	3,933	3,933	3,933
No. of Banks	110	110	110	121	121	121

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. *** and ** indicate statistical significance at 1 percent and 5 percent levels, respectively. The results are obtained using the linear random-effect estimation of Equation (1) with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008. Since the average risk-based capital ratio of this study's sample is 16.55 percent in 2018:Q3, banks with such a ratio less than or equal to 16.55 percent in 2008:Q3 are grouped as low-equity banks, otherwise high-equity banks. Detailed results are available upon request.

guidelines[10] as follows: unconcentrated markets (HHI $\leq$ 1,000) and concentrated markets (HHI $>$ 1,000). The results are reported in Table 11. In most cases, banks in unconcentrated markets show a statistically significant reduction in funding costs after CPP. CPP banks' bargaining power on funding costs could be stronger in regions with low depositors' concentration. From a regulatory perspective, such low market concentration may have useful implications in periods of recovery, e.g., after the 2007–08 crisis. In stress situations, regulators' policy focus aims at maintaining banking system stability and enabling economic recovery with sustained lending exercise. Controlling market concentration through regulations may favorably moderate the effects of government's capital assistance by providing opportunities for banks to raise low-cost fund and fueling the economy with required lending at reasonable interest rates. In addition, low-concentration-led low funding cost can improve banks' profitability (by reducing costs), risk-taking (by reducing high-risk lending to cover high costs), and government assistance fund repayment capacity (by increasing earnings and equity), which are highly important for regulators to maintain banking system stability.

Overall, the results suggest that government assistance through capital injection leads to a decrease in banks' funding costs. The findings can be explained via the safety channel where the market (depositors and investors) may perceive CPP banks as safe and would receive further government support, if necessary. Berger and Roman (2015) advocated such a safety channel while explaining the competitive advantage of banks receiving government assistance. Since CPP banks were government supported and/or government's selection criteria identified these banks as "healthy and viable," depositors and investors might prefer CPP banks and agree to receive lower interest rates, considering these banks as less likely to become financially distressed.

Current literature tends to document relatively more support for the effectiveness of government assistance in boosting the overall market confidence and ensuring stability of the banking system. TARP-CPP funds contributed to reinstating the confidence in financial markets through a considerable increase in bank lending

[10] "Herfindahl-Hirschman Index," U.S. Department of Justice: available at https://www.justice.gov/atr/herfindahl-hirschman-index.

Table 11. Government Assistance and Funding Costs: Unconcentrated vs. Concentrated Markets

	Sample Matched in Levels			Sample Matched in Dynamics		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**
A. Banks in Unconcentrated Markets						
Government Assistance	–0.083** (0.032)	–0.147*** (0.030)	–0.089*** (0.033)	–0.192*** (0.042)	–0.279*** (0.040)	–0.190*** (0.043)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.854	0.858	0.856	0.852	0.816	0.849
Bank-Quarter Observations	15,702	15,702	15,702	16,950	16,950	16,950
No. of Banks	518	518	518	557	557	557
B. Banks in Concentrated Markets						
Government Assistance	–0.043 (0.058)	–0.122** (0.055)	–0.011 (0.057)	–0.085 (0.084)	–0.204** (0.086)	–0.058 (0.083)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.755	0.735	0.762	0.794	0.804	0.808
Bank-Quarter Observations	5,819	5,819	5,819	5,378	5,378	5,378
No. of Banks	192	192	192	179	179	179

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. *** and ** indicate statistical significance at 1 percent and 5 percent levels, respectively. The results are obtained using the linear random-effect estimation of Equation (1) with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008. For regional market concentration, banks are grouped using the Herfindahl-Hirschman Index (HHI) deposits as follows: unconcentrated markets (HHI $\leq$ 1,000) and concentrated markets (HHI $>$ 1,000). Detailed results are available upon request.

(Li 2010). The recipient institutions, on average, retained two-thirds of the TARP funds to maintain a stronger capital position and employed the rest in new loan creation. The government assistance is aimed at regaining confidence both at institutional and consumer levels such that the interbank lending rates decrease and greater liquidity is stimulated in the economy (Northehr 2008).

The positive influence of government assistance in restoring market confidence was also demonstrated in the stock market measures. During the 2007–08 crisis, investors' confidence (captured through investor sentiment measures) plummeted due to high anxiety and uncertainty induced by the economy-wide financial distress (Swedberg 2013). General announcements about the government interventions in the 2007–08 crisis are found to have positive impacts on stock returns (Fratianni and Marchionne 2010). Huerta, Perez-Liston, and Jackson (2011) concluded that government intervention through TARP assisted in diminishing investors' anxiety and stock market volatility in the short run. Similarly, Ncube (2016) documented favorable market responses after TARP announcements, suggesting that government assistance improved investors' confidence.

The safety channel may also be augmented by extensive regulatory oversight, stricter policies, and stabilization in both financial markets and banks' financial health that helped regain the lost public confidence. In periods after the CPP assignment, federal regulators established rigorous monitoring procedures and stricter controls for the CPP banks (Shah 2009; Agarwal et al. 2014). The stringent transparency and monitoring practices can be expected to positively influence the CPP banks' financial health and the investors' confidence in these banks.

The findings agree with the related empirical evidence on the funding cost (Aymanns et al. 2016; Schmitz, Sigmund, and Valderrama 2017), lower deposit rates for protected banks (Koetter and Noth 2016), and theoretical discussion of Northehr (2008) about assisted banks regaining lending confidence and decreasing funding costs. The results broadly align with the branch of literature arguing that more capital is negatively related to banks' funding costs from the solvency perspective (Barajas and Stein 2000; Ungan, Caner, and Özyıldırım 2008; Annaert et al. 2013; Babihuga and Spaltro 2014; Pierret 2014; Acharya and Mora 2015; Hasan, Liu, and Zhang

2016; Carvalho and Dantas 2020; Moreira 2020; Dent, Hoke, and Panagiotopoulos 2021; Arnould et al. 2022) and competition perspective (Calomiris and Mason 2003; Calomiris and Wilson 2004; Allen, Carletti, and Marquez 2011; Mehran and Thakor 2011; Berger and Bouwman 2013; Berger and Roman 2015).

3.3 Robustness Tests

Besides multiple types of funding costs and matched samples analyzed in Section 3.2, several robustness tests are conducted to examine if the main findings remain consistent with alternative samples and estimation methods.

Since the baseline equation uses random effects and some control variables that are jointly determined with funding costs, the regression results in Table 6 are analyzed without any control variables and random effects as a robustness test. Another robustness test is conducted with the unmatched sample while keeping the model specifications of Equation (1) intact. The results, presented in panel A of Table 12, agree with the baseline findings.

Although most CPP recipients participated voluntarily, a few banks were forced to join CPP at its inception. However, the involuntary participants[11] left the program early due to stricter regulatory control, CEO compensation issues, and access to cheaper funds (Berger and Roman 2015). To eliminate the possible bias, the main analyses are repeated excluding the nine involuntary participants in this study's sample. The results remain consistent with the main findings.

The Supervisory Capital Assessment Program (SCAP) required mandatory stress tests of banks having assets exceeding $100 billion.[12] These banks cover about two-thirds of the total banking assets and half of the total loans in the United States (Berger

[11]The nine involuntary participants are Goldman Sachs, Morgan Stanley, JP Morgan Chase, Citigroup, Wells Fargo, State Street, Bank of New York Mellon, Bank of America, and Merrill Lynch (acquired by Bank of America Corp.).

[12]The 19 stress-tested banks are Bank of America, Citigroup, Goldman Sachs, JP Morgan Chase, Morgan Stanley, Wells Fargo, Bank of New York Mellon, BB&T (Truist Financial), Fifth Third Bancorp, Keycorp, PNC Financial, Regions Financial, SunTrust Banks, US Bancorp, Ally Financial, American Express Company, Capital One Financial, Metlife, and State Street.

Table 12. Robustness Tests

Panel A									
	Sample Matched in Levels			**Sample Matched in Dynamics**			**Unmatched Sample**		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**	**Cost of Fund (7)**	**Cost of Deposit (8)**	**Cost of Liabilities (9)**
Government Assistance	–0.016***	–0.099***	–0.010*	–0.033***	–0.150***	–0.038***	–0.225***	–0.324***	–0.230***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.023)	(0.024)	(0.023)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Level Controls	No	No	No	No	No	No	Yes	Yes	Yes
Regional Controls	No	No	No	No	No	No	Yes	Yes	Yes
R-squared (within)	0.638	0.653	0.657	0.671	0.668	0.689	0.819	0.837	0.828
Bank-Quarter Observations	21,521	21,521	21,521	22,327	22,327	22,327	263,562	263,562	263,562
No. of Banks	710	710	710	736	736	736	8,327	8,327	8,327

(*continued*)

Table 12. (Continued)

Panel B									
	Excluding Involuntary Banks			**Excluding Stress-Tested Banks**			**Excluding Large Banks**		
	Cost of Fund (1)	**Cost of Deposit (2)**	**Cost of Liabilities (3)**	**Cost of Fund (4)**	**Cost of Deposit (5)**	**Cost of Liabilities (6)**	**Cost of Fund (7)**	**Cost of Deposit (8)**	**Cost of Liabilities (9)**
Government Assistance	–0.171*** (0.039)	–0.268*** (0.038)	–0.166*** (0.039)	–0.172*** (0.039)	–0.267*** (0.038)	–0.168*** (0.039)	–0.145*** (0.037)	–0.243*** (0.037)	–0.144*** (0.037)
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-Level Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Regional Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared (within)	0.837	0.809	0.838	0.837	0.810	0.838	0.843	0.812	0.845
Bank-Quarter Observations	22,247	22,247	22,247	21,927	21,927	21,927	19,017	19,017	19,017
No. of Banks	728	728	728	717	717	717	630	630	630

Note: The variables are defined in Table 2. The numbers in parentheses are standard errors, robust to heteroskedasticity, and clustered by banks. *** and * indicate statistical significance at 1 percent and 10 percent levels, respectively. The results are obtained using the linear random-effect estimation (except for columns 1–6 in panel A) of Equation (1) with 10 years of quarterly data from 2009 to 2018. 2009 is considered the starting point since banks started to receive government assistance from the last quarter of 2008. The nine involuntary participants are Goldman Sachs, Morgan Stanley, JP Morgan Chase, Citigroup, Wells Fargo, State Street, Bank of New York Mellon, Bank of America, and Merrill Lynch (acquired by Bank of America Corp.). The 19 stress-tested banks are Bank of America, Citigroup, Goldman Sachs, JP Morgan Chase, Morgan Stanley, Wells Fargo, Bank of New York Mellon, BB&T (Truist Financial), Fifth Third Bancorp, Keycorp, PNC Financial, Regions Financial, SunTrust Banks, US Bancorp, Ally Financial, American Express Company, Capital One Financial, Metlife, and State Street. Following Berger and Bouwman (2013), banks with total assets higher than $3 billion are categorized as large banks. Results in panel B are based on the sample matched in dynamics. Detailed results are available upon request.

and Roman 2015). To ensure public confidence in the financial system, SCAP publicized these banks as too big to fail and confirmed that the U.S. Treasury would assist them with adequate capital in case of an adverse scenario. Such special treatment by SCAP may have an important influence on the stress-tested banks' funding cost advantage, which may cause bias in this study's results. Therefore, the main analyses are re-estimated while excluding the stress-tested banks. The baseline conclusions remain valid after such exclusion.

A bank's size may be considered an economic strength by fund providers. Thus, large banks may have a competitive advantage in the funding market, which may cause bias in this study's result. To eliminate this possibility, robustness of the main results is tested after excluding the large banks from the sample. Following Berger and Bouwman (2013), banks with total assets higher than $3 billion are categorized as large banks. The main results remain valid without the large banks.

In general, the main conclusion that CPP support is associated with lower funding costs for CPP banks is robust to several alternative funding cost definitions, samples, estimation methods, and model specifications. To conserve space, a summary of the six robustness tests is presented in Table 12, where panel B shows the last three robustness tests. Detailed results are available upon request.

4. Conclusion

This study aims at documenting empirical evidence about the relationship of government assistance with recipient banks' funding costs. Understanding the link of government assistance to funding cost is the study's main contribution, as we believe that this is the first work in this research space. The results suggest that government assistance has a significant relationship with the recipient bank's lower funding cost. Depositors' and investors' increased confidence in the recipient banks could be a plausible channel to explain the government assistance–funding cost relationship. Extensive regulatory oversight and stricter policies could also amplify the market confidence in the recipient banks. The results are robust to several alternative funding cost definitions, samples, estimation methods, and model specifications. Due to contextual limitations,

the study's sample considers the U.S. banking sector only. Further studies may investigate a cross-country sample to obtain more generalizable results.

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