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TARP and the long-term perception of risk

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ABSTRACT

The Capital Purchase Program (CPP) was intended to enhance capital and preserve lending capacity of banks, but the role of this program in affecting the risk of participating banks has been unresolved. We address this issue by investigating the market's long-term perception of risk for financial institutions participating in the CPP. Leading up to and including the crisis, the systematic and idiosyncratic variances of the stock returns of all financial firms increased; following CPP, the relative idiosyncratic risk of CPP participants remained higher than for those not participating in CPP for four years following CPP.

1. Introduction

The Troubled Asset Relief Program, commonly known as TARP, was designed to help maintain the soundness and liquidity of the financial system during the financial crisis, with some banking institutions, especially larger institutions, receiving funds through the TARP's Capital Purchase Program (CPP).[1] The CPP allowed financial institutions to sell equity instruments to the U.S. Treasury, where this equity could be used by the institutions as Tier 1 capital. Under CPP, the institution could sell equity to the Treasury in an amount up to 3% of its risk-weighted assets. At the time of the program, many banks were perceived by regulators as having more risk than appropriate for their level of capital, and the infusion of funds was intended to stabilize these institutions and, hence, the financial system.[2,3]

At the outset of TARP, there was concern about the effectiveness of the bailouts given the speed at which the initial funding was adopted and whether the risk of the institutions would, in fact, be lowered in the absence of a system of controls.[4] As indicated by the General Accounting Office (2008), there was no system installed to monitor how individual financial institutions used the funds; rather, monitoring was to be done on a macroeconomic level, focusing on the effects of the program on the general economy. The Congressional Oversight Panel for Economic Stabilization, a Congressional Oversight Panel, referred to the lack of individual institution monitoring under CPP as "no-strings-attached subsidies to financial institutions."[5] As such, the injection of funds in shareholder-owned banking institutions, without adequate controls, creates a possible moral hazard; while there is a direct cost of these funds in terms of dividends on the preferred stock, it is not clear that the participants bear the marginal cost of their actions. While there were specific, yet limited, provisions limiting executive compensation, there were no explicit controls to manage the risk-taking of these institutions.

At the time of its creation and implementation, the CPP program was criticized for the potential moral hazard. Our focus is on the long-term perception of risk by the market associated with this potential moral hazard: Did the lack of explicit controls result in the market associating these banks with more risk? We add to

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[1] Though CPP is a program within TARP, the two programs are often used interchangeably because CPP was the largest program within TARP that infused funds into financial institutions. Other programs included the Capital Development Initiative for Community Development Financial Institutions (CDFI), and Temporary Liquidity Guarantee Program (TLGP).

[2] See, for example, the assessment of the survey results in the Senior Supervisors Group *Observations on Risk Management Practices during the Recent Market Turbulence*, March 6, 2008.

[3] The participants also included eight large financial institutions that had passed the Supervisory Capital Assessment Program (more familiarly known as "stress tests") with sufficient capital "buffers" in May of 2009. We perform our analysis with and without these institutions as a further test of the risk signal of participation in CPP.

[4] Congressional Oversight Panel for Economic Stabilization (2008). The Panel was created by Congress, and was charged with the responsibility of providing public accountability of the TARP program.

[5] Congressional Oversight Panel for Economic Stabilization (2008), p. 20.

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Table 1
Descriptive statistics on portfolio compositions. Table includes the observation year and the relevant average market capitalization of firms in each of the three portfolios: CPP participants (CPP), non-CPP banking firms (NCPP), non-banking financial firms (NBANK). All values are in USD thousands. The table also includes the total number of firms, *N*, included in each portfolio.

Year	CPP recipients (CPP)		Non-CPP banking firms (NCPP)		Non-banking financial firms (NBANK)	
	Average market value of equity	*N*	Average market value of equity	*N*	Average market value of equity	*N*
2004	$5,414,187	221	$1,888,583	296	$1,420,581	1728
2005	$5,526,633	227	$1,825,960	336	$1,601,959	1729
2006	$5,959,604	238	$2,023,546	366	$1,838,453	1849
2007	$5,959,985	245	$2,050,138	390	$1,791,400	2032
2008	$3,952,657	247	$1,392,397	403	$1,244,654	2056
2009	$3,066,158	248	$1,154,088	403	$941,832	2044
2010	$4,394,214	245	$1,685,258	361	$1,203,638	2132
2011	$4,379,849	238	$1,850,131	326	$1,325,477	2317
2012	$4,895,451	223	$1,877,655	297	$1,408,831	2434
2013	$7,076,544	201	$2,352,398	280	$1,753,609	2462

Table 2
Results on beta shifts. Estimate of Eq. (2) for the three portfolios (CPP participants (CPP), non-CPP banking firms (NCPP), and non-banking financial firms (NBANK)) for all firms within each portfolio, allowing firms to enter and exit the sample (Panel A), and for the firms that were consistently present throughout the CPP disbursement period (Panel B):

$$R_{pt} = \alpha_{pt} + \beta R_{Mt} + \lambda_{pre}(D_{pre}) + \lambda_{post}(D_{post}) + \beta_{pre}(D_{pre}R_{Mt}) + \beta_{post}(D_{post}R_{Mt}) + e_{pt} \quad (2)$$

where α_{pt} is the intercept representing the average daily abnormal returns during the disbursement period from 2008 Q4 through 2009 Q4. β is the portfolio's beta during the disbursement period, λ_{pre} and λ_{post} are the excess average daily abnormal return in the period before and after the disbursement period, respectively. D_{pre} and D_{post} are the pre- and post-disbursement period dummy variables, respectively. β_{pre}- and β_{post} are the average shifts in the portfolio's beta pre- and post-disbursement periods, respectively. The last two columns present the results on the tests of difference-in-difference between the parameters for CPP and NCPP as well as CPP and NBANK. Our sample size for the regression on each portfolio is 2329 observations representing the portfolio's daily returns during the testing period. We report *p*-values based on the Newey–West standard errors in parentheses below the coefficient estimates.

Estimated parameter	CPP participants (CPP)	Non-CPP banking firms (NCPP)	Non-banking financial firms (NBANK)	DID (CPP–NCPP)	DID (CPP–NBANK)
Panel A: Sample with entry and exit					
α	0.00075	0.00100	0.00075*	−0.00025	0.00000
	(0.6401)	(0.0861)	(0.0150)	(0.8816)	(0.9997)
β	1.70050*	1.21955*	1.09888*	0.48096*	0.60163*
	(0.0000)	(0.0000)	(0.0000)	(0.0011)	(0.0001)
λ_{pre}	−0.00075	−0.00098	−0.00061	0.00023	−0.00014
	(0.6476)	(0.1180)	(0.0705)	(0.8979)	(0.5843)
λ_{post}	−0.00089	−0.00110	−0.00067*	0.00021	−0.00022
	(0.5843)	(0.0700)	(0.0336)	(0.9033)	(0.8947)
β_{pre}	−0.09063	0.02972	−0.03642	−0.12035	−0.05421
	(0.5882)	(0.6539)	(0.3702)	(0.5038)	(0.7530)
β_{post}	−0.30291	−0.07489	−0.15981*	−0.22802	−0.14310
	(0.0355)	(0.1210)	(0.0000)	(0.1333)	(0.3278)
R^2	0.6803	0.8538	0.9333		
Panel B: Consistent sample					
α	0.00074	0.00099	0.00071*	−0.00025	0.00003
	(0.6436)	(0.0886)	(0.0147)	(0.8834)	(0.9869)
β	1.69976*	1.21737*	1.09478*	0.48239*	0.60498*
	(0.0000)	(0.0000)	(0.0000)	(0.0011)	(0.0000)
λ_{pre}	−0.00074	−0.00095	−0.00053	0.00021	−0.00021
	(0.6528)	(0.1264)	(0.0919)	(0.9038)	(0.9007)
λ_{post}	−0.00088	−0.00108	−0.00064*	0.00020	−0.00024
	(0.5877)	(0.0719)	(0.0331)	(0.9050)	(0.8835)
β_{pre}	−0.09385	0.02247	−0.09408*	−0.11632	0.00023
	(0.5749)	(0.7325)	(0.0075)	(0.5177)	(0.9989)
β_{post}	−0.30207*	−0.07260	−0.14509*	−0.22947	−0.15698
	(0.0360)	(0.1315)	(0.0000)	(0.1307)	(0.2826)
R^2	0.6798	0.8536	0.9384		

* Indicates different from zero at the 5% level of significance.

the literature on the analysis of the TARP programs by focusing on the market's perception of the risk. Specifically, we examine the systematic and idiosyncratic variances of the stock returns of all financial institutions and observe that the market considers that these risks increased. We also find that, following the CPP, the relative idiosyncratic risk of CPP participants remained significantly higher than those not receiving CPP funds, even five years following the beginning of the CPP program.[6] Though the perceived risk of financial institutions in general has declined from the levels during

[6] Though the CPP involves the sale of preferred stock to the U.S. Department of the Treasury, the Treasury refers to the cash flow to the banks as "disbursements"; hence, we shall use the term disbursements to indicate the cash flow to banks under this program.

Table 3
Changes in mean volatilities around CPP disbursement period. Average daily volatilities of returns, measured in standard deviations, centered on the CPP disbursement period (Regime 3), using two different event windows: ±2 years (−2, 2) and +4 years (−4, 4). The After-Before% is the percentage change in the relative risk measure between the periods. Significance is based on Newey–West standard errors.

Variable	Event window (−2, 2) years				Event window (−4, 4) years			
	Before CPP	During CPP	After CPP	After−before%	Before CPP	During CPP	After CPP	After−before%
Panel A: Sample with entry and exit								
Total volatility (CPP)	0.02294	0.06274	0.04366	90.35*	0.02018	0.06275	0.03791	87.89*
Total volatility (NCPP)	0.02449	0.06797	0.04183	70.78*	0.02182	0.06794	0.03616	65.77*
Total volatility (NBANK)	0.02144	0.04826	0.02361	10.14	0.01908	0.04831	0.02155	12.97
Systematic volatility (CPP)	0.01007	0.02945	0.01439	42.86*	0.00848	0.02945	0.01335	57.46*
Systematic volatility (NCPP)	0.00928	0.02549	0.01262	35.96*	0.00776	0.02549	0.01175	51.48*
Systematic volatility (NBANK)	0.00870	0.02756	0.01328	52.59*	0.00712	0.02756	0.01239	73.98*
Idiosyncratic volatility (CPP)	0.02061	0.05545	0.04117	99.78*	0.01831	0.05545	0.03551	93.98*
Idiosyncratic volatility (NCPP)	0.02267	0.06296	0.03980	75.56*	0.02039	0.06297	0.03420	67.74*
Idiosyncratic volatility (NBANK)	0.01959	0.03967	0.01959	0.00	0.01770	0.03966	0.01770	0.00
Ratio (SYS/IDIO) (CPP)	0.48238	0.52923	0.34621	−28.23*	0.45077	0.52922	0.37522	−16.76*
Ratio (SYS/IDIO) (NCPP)	0.41312	0.40477	0.32624	−21.03*	0.37427	0.40477	0.35170	−6.03
Ratio (SYS/IDIO) (NBANK)	0.44721	0.69102	0.72400	61.89*	0.39224	0.69102	0.72346	84.44*
Panel B: Consistent sample								
Total volatility (CPP)	0.02273	0.06234	0.04378	92.58*	0.02007	0.06239	0.03798	89.25*
Total volatility (NCPP)	0.02338	0.06463	0.04191	79.25*	0.02103	0.06467	0.03625	72.40*
Total volatility (NBANK)	0.01996	0.04805	0.02316	15.99	0.01729	0.04805	0.02027	17.23
Systematic volatility (CPP)	0.00989	0.02920	0.01454	46.98*	0.00836	0.02920	0.01343	60.71*
Systematic volatility (NCPP)	0.00924	0.02522	0.01272	37.70*	0.00776	0.02522	0.01181	52.28*
Systematic volatility (NBANK)	0.00873	0.02801	0.01305	49.41*	0.00711	0.02801	0.01192	67.59*
Idiosyncratic volatility (CPP)	0.02047	0.05513	0.04134	101.95*	0.01825	0.05507	0.03558	95.01*
Idiosyncratic volatility (NCPP)	0.02148	0.05951	0.04002	86.29*	0.01955	0.05951	0.03427	75.35*
Idiosyncratic volatility (NBANK)	0.01795	0.03902	0.01913	6.56	0.01576	0.03897	0.01639	4.03
Ratio (SYS/IDIO) (CPP)	0.47780	0.52730	0.34798	−27.17*	0.44698	0.52730	0.37631	−15.81*
Ratio (SYS/IDIO) (NCPP)	0.43019	0.42726	0.32748	−23.88*	0.38865	0.42726	0.35260	−9.27
Ratio (SYS/IDIO) (NBANK)	0.50509	0.71983	0.74478	47.45*	0.44641	0.71984	0.76430	71.21*

* Indicates different from zero at the 5% level of significance.

the financial crisis, we find that the market still perceives CPP participants as riskier institutions than non-CPP participants.[7]

We provide an overview of the TARP program, and specifically the CPP, in Section 2, followed by a brief overview of the empirical evidence regarding TARP and risk in Section 3, and then discuss our data and methodology in Section 4. We provide the results of these tests in Section 5, and offer concluding remarks in Section 6.

2. A brief history of TARP

The Emergency Economic Stabilization Act of 2008 was signed into law on October 3rd, 2008, in response to the crisis facing the United States' economy that resulted from careless mortgage lending, the government's takeover in conservatorship of Freddie Mac and Fannie Mae September 7th, 2008, and the spectacular failure of Lehman Brothers on September 15, 2008, among other events.[8] This Act established the Troubled Asset Relief Program, commonly known as TARP.

The Act authorized the U.S. Department of the Treasury to spend up to $700 billion to purchase distressed assets from financial institutions to ultimately supply liquidity to the financial system.[9] This authorization was granted until December 31, 2009, unless otherwise extended by Congress.[10] The first $350 billion was released on October 3, 2008, and Congress voted to approve the release of the second $350 billion on January 15, 2009.

One of the primary means of infusing funds into the financial system was through the Capital Purchase Program, one of five components under TARP directed towards banks.[11] Under this program, a qualifying financial institution (QFI) would sell redeemable senior preferred equity securities to the U.S. Treasury, limited to the lesser of $25 million or 3% of risk-weighted assets of the QFI, and the dividend rate on these securities would be 5% for the first five years, 9% thereafter.[12] Along with the senior preferred securities, each QFI must issue warrants to the Treasury for common shares such that the market value of the common equity is 15% of the senior preferred securities value.

The first funds, totaling $115 billion, were disbursed October 28, 2008, to eight financial institutions, including Goldman Sachs Group, Morgan Stanley, Bank of America, Citigroup, JPMorgan Chase and Wells Fargo & Co. This initial disbursement was followed November 14th and 21st with disbursements to a larger number of financial institutions, many of which were regional institutions, and then December 5th, 12th, 19th, 23rd and 31st, with disbursements primarily to much smaller financial institutions. By December 31st,

[7] This finding is consistent with Duchin and Sosyura (2012) regarding underperforming institutions receiving funds, and with Black and Hazelwood (2013), who document greater risk-taking behavior of TARP participants.

[8] Emergency Economic Stabilization Act of 2008, Pub. L. No. 110-343 §115 (October 3, 2008). Oddly enough, H.R. 1424 is entitled the Paul Wellstone Mental Health and Addiction Equity Act of 2007; the Emergency Economic Stabilization Act of 2008 is Division A of H.R. 1424. Though introduced March 9, 2007, this bill became the vehicle to shepherd in the bailout, along with two other bills (Division B: Energy Improvement and Extension Act of 2008, and Division C: Tax Extenders and Alternative Minimum Tax Relief Act of 2008).

[9] There were actually three levels specified, based on the President's certification, of $250 billion, $350 billion, and $700 billion (Section 115).

[10] The Secretary of the Treasury was required to certify to Congress a need for a two-year extension, if one was needed (Section 120).

[11] The other programs were the Asset Guarantee Program, the Targeted Investment Program, the Community Development Capital Initiative, and the Supervisory Capital Assessment Program. The Asset Guarantee Program and the Targeted Investment Program were specific to Bank of America and Citigroup, respectively. The other two programs did not provide capital to banking institutions.

[12] A QFI is an FDIC-insured depositary institution or bank holding company not controlled by a foreign bank or company.

Table 4
Results on changes in total, systematic, and idiosyncratic variances. We estimate Eq. (4) using total variance, $IDIO_{pt}$ and then SYS_{pt} as the dependent variable:

$$\sigma^2_{pt} = \alpha_{pt} + \gamma_{pt}(T) + \phi_{1pt}(D_{1p}) + \phi_{2pt}(D_{2p}) + \phi_{4pt}(D_{4p}) + \phi_{5pt}(D_{5p}) + e_{pt} \qquad (4)$$

where D_{1p}, D_{2p}, D_{4p} and D_{5p} are dummy variables for regimes 1, 2, 4, and 5, respectively and the coefficients of these dummy variables, ϕ_{1p}, ϕ_{2p}, ϕ_{4p}, and ϕ_{5p}, capture the level change in the average total variance under the respective regimes. Regime 3, the CPP disbursement period, is used as the base period. We estimate Eq. (4) for the complete CPP, NCPP and NBANK portfolios in panels A through C for the sample allowing exit and entry, and then again for the consistent sample CPP, NCPP and NBANK portfolios in panels D through F. We report the results on the difference-in-difference (DID) tests between the NCPP and CPP portfolios and then again between the NBANK and CPP portfolios for each of the parameters in the adjacent columns. Our sample size for the regression on each portfolio is 2,329 observations representing the portfolio's daily returns during the testing period. *p*-Values based on the Newey–West standard errors are reported in parentheses below the coefficient estimates.

Estimated Parameter	CPP	NCPP	NBANK	DID (NCPP–CPP)	DID (NBANK–CPP)
Panel A: Total variance (sample with entry and exit)					
α	0.00451*	0.00541*	0.00243*	0.00090	−0.00208*
	(0.0000)	(0.0000)	(0.0000)	(0.1820)	(0.0000)
γ	−0.00001	−0.00001	0.00000	0.00000	0.00001
	(0.1693)	(0.1021)	(0.6740)	(0.7276)	(0.3170)
ϕ_1	−0.00409*	−0.00488	−0.00214*	−0.00079	0.00195*
	(0.0000)	(0.0000)	(0.0000)	(0.1633)	(0.0000)
ϕ_2	−0.00361*	−0.00429	−0.00190*	−0.00068	0.00170*
	(0.0000)	(0.0000)	(0.0000)	(0.0492)*	(0.0000)
ϕ_4	−0.00181*	−0.00257	−0.00173*	−0.00076*	0.00008
	(0.0000)	(0.0000)	(0.0000)	(0.0295)	(0.7550)
ϕ_5	−0.00251*	−0.00312	−0.00188*	−0.00061	0.00063
	(0.0000)	(0.0000)	(0.0000)	(0.2799)	(0.1373)
R^2	0.8449	0.8432	0.8461		
Panel B: Systematic variance (sample with entry and exit)					
α	0.00094*	0.00071*	0.00084*	−0.00023	−0.00011
	(0.0000)	(0.0000)	(0.0000)	(0.0663)	(0.4206)
γ	0.00000	0.00000	0.00000	0.00000	0.00000
	(0.4485)	(0.3839)	(0.3094)	(0.8814)	(0.9995)
ϕ_1	−0.00088*	−0.00066*	−0.00079*	0.00022*	0.00009
	(0.0000)	(0.0000)	(0.0000)	(0.0375)	(0.4160)
ϕ_2	−0.00079*	−0.00058*	−0.00071*	0.00021*	0.00008
	(0.0000)	(0.0000)	(0.0000)	(0.0016)	(0.2315)
ϕ_4	−0.00063*	−0.00047*	−0.00055*	0.00016*	0.00007
	(0.0000)	(0.0000)	(0.0000)	(0.0141)	(0.2723)
ϕ_5	−0.00066*	−0.00049*	−0.00057*	0.00017	0.00009
	(0.0000)	(0.0000)	(0.0000)	(0.1107)	(0.4258)
R^2	0.8180	0.8486	0.8647		
Panel C: Idiosyncratic variance (sample with entry and exit)					
α	0.00356*	0.00470*	0.00159*	0.00114*	−0.00197*
	(0.0000)	(0.0000)	(0.0000)	(0.0453)	(0.0000)
γ	−0.00001	−0.00001	0.00000	0.00000	0.00001
	(0.1274)	(0.0848)	(0.9001)	(0.6534)	(0.1935)
ϕ_1	−0.00321*	−0.00422*	−0.00134*	−0.00101*	0.00186*
	(0.0000)	(0.0000)	(0.0000)	(0.0334)	(0.0000)
ϕ_2	−0.00282*	−0.00371*	−0.00119*	−0.00089*	0.00162*
	(0.0000)	(0.0000)	(0.0000)	(0.0024)	(0.0000)
ϕ_4	−0.00118*	−0.00210*	−0.00118*	−0.00092*	0.00001
	(0.0000)	(0.0000)	(0.0000)	(0.0017)	(0.9766)
ϕ_5	−0.00185*	−0.00263*	−0.00131*	−0.00078	0.00054
	(0.0000)	(0.0000)	(0.0000)	(0.0997)	(0.0971)
R^2	0.8490	0.8380	0.8170		
Panel D: Total variance (consistent sample)					
α	0.00448*	0.00494*	0.00242*	0.00046	−0.00206*
	(0.0000)	(0.0000)	(0.0000)	(0.4981)	(0.0000)
γ	−0.00001	−0.00001	0.00000	0.00000	0.00001
	(0.1595)	(0.1211)	(0.6320)	(0.7918)	(0.3336)
ϕ_1	−0.00406*	−0.00443*	−0.00220*	−0.00037	0.00186*
	(0.0000)	(0.0000)	(0.0000)	(0.5114)	(0.0000)
ϕ_2	−0.00358*	−0.00390*	−0.00195*	−0.00032	0.00163*
	(0.0000)	(0.0000)	(0.0000)	(0.3597)	(0.0000)
ϕ_4	−0.00176*	−0.00215*	−0.00173*	−0.00039	0.00004
	(0.0000)	(0.0000)	(0.0000)	(0.2626)	(0.8871)

(*continued on next page*)

Table 4 (*continued*)

Estimated Parameter	CPP	NCPP	NBANK	DID (NCPP–CPP)	DID (NBANK–CPP)
ϕ_5	−0.00246* (0.0000)	−0.00272* (0.0000)	−0.00193* (0.0000)	−0.00026 (0.6425)	0.00053 (0.2150)
R^2	0.8421	0.8147	0.8327		
Panel E: Systematic variance (consistent sample)					
α	0.00093* (0.0000)	0.00069* (0.0000)	0.00086* (0.0000)	−0.00024 (0.0624)	−0.00007 (0.5785)
γ	0.00000 (0.4289)	0.00000 (0.3892)	0.00000 (0.3419)	0.00000 (0.8560)	0.00000 (0.9611)
ϕ_1	−0.00087* (0.0000)	−0.00065* (0.0000)	−0.00082* (0.0000)	0.00023* (0.0344)	0.00006 (0.6170)
ϕ_2	−0.00078* (0.0000)	−0.00057* (0.0000)	−0.00073* (0.0000)	0.00021* (0.0014)	0.00005 (0.4773)
ϕ_4	−0.00061* (0.0000)	−0.00045* (0.0000)	−0.00059* (0.0000)	0.00016* (0.0154)	0.00002 (0.7167)
ϕ_5	−0.00064* (0.0000)	−0.00047* (0.0000)	−0.00061* (0.0000)	0.00017 (0.1179)	0.00003 (0.8044)
R^2	0.8133	0.8422	0.8676		
Panel F: Idiosyncratic variance (consistent sample)					
α	0.00355* (0.0000)	0.00425* (0.0000)	0.00157* (0.0000)	0.00070 (0.2211)	−0.00198* (0.0000)
γ	−0.00001 (0.1200)	−0.00001 (0.1050)	0.00000 (0.8037)	0.00000 (0.7230)	0.00001 (0.2163)
ϕ_1	−0.00319* (0.0000)	−0.00379* (0.0000)	−0.00138* (0.0000)	−0.00060 (0.2091)	0.00181* (0.0000)
ϕ_2	−0.00280* (0.0000)	−0.00333* (0.0000)	−0.00121* (0.0000)	−0.00053 (0.0703)	0.00158* (0.0000)
ϕ_4	−0.00115* (0.0000)	−0.00170* (0.0000)	−0.00114* (0.0000)	−0.00055 (0.0610)	0.00001 (0.9513)
ϕ_5	−0.00182* (0.0000)	−0.00225* (0.0000)	−0.00131* (0.0000)	−0.00043 (0.3666)	0.00050 (0.1278)
R^2	0.8465	0.8039	0.7919		

* Indicates different from zero at the 5% level of significance.

the U.S. Department of the Treasury had disbursed over $177.5 billion, and some institutions, such as Bank of America and SunTrust received disbursements more than once.

The TARP authorization was reduced to $475 billion by the Dodd-Frank Wall Street Reform and Consumer Protection Act, and the authority to make new commitments under TARP was eliminated for any commitments not already guaranteed by June 25, 2010.[13] The original disbursements under CPP totaled $204.9 billion to a total of 707 financial institutions.[14] The vast majority of these organizations receiving funds through the CPP program were the 401 private banking institutions and 274 publicly-traded banking institutions.[15] Repayments began in March of 2009, and as of August, 2015, only $276.5 million of loans remain outstanding, and a little over $5 billion was either realized as a loss or written off.[16,17]

3. Review of the literature on TARP

The lack of controls in the CPP may lead to the possibility of banking institutions taking on more risk, an unintended consequence. For example, Black and Hazelwood (2013) observed that banks receiving funds reduced their business lending, while taking on more higher-risk loans. This behavior was confirmed by Montgomery and Takahashi (2014), who examined both U.S. and Japanese capital injections. In contrast to Black and Hazelwood, Li (2013) observed that approximately one-third of the TARP funds were used on new loans, with the remainder used to strengthen the banks' capital adequacy, and that the loans made by TARP participants were no more risky than those of non-TARP participants. This breakdown differs slightly from the survey results of the Office of Financial Stability, where 65% of respondents who received assistance under CPP used the funds to bolster their capital, with the remainder 35% used for lending, making other investments, increase securities' purchases, and purchasing another institutions, among other uses.[18] However, in this survey, 77% of respondents claim to either to have increased lending or to have lent more than they would have otherwise.

Other evidence suggests that TARP participants' operational efficiency declined after receiving TARP funds. For example, Harris et al. (2013) compare the operating efficiency of TARP and non-TARP participants and observe that TARP participants' efficiency declined after receiving the funds, which they attribute to moral hazard.

[13] Public Law 111-203, Section 1302.

[14] One way that TARP money is being spent is to support the "Making Homes Affordable" plan, which was implemented on March 4, 2009, using TARP money by the U.S. Department of the Treasury. Because "at risk" mortgages are defined as "troubled assets" under TARP, the Treasury has the power to implement the plan. Generally, it provides refinancing for mortgages held by Fannie Mae or Freddie Mac. Privately held mortgages were eligible for other incentives, including a favorable loan modification for five years U.S. Department of the Treasury (2009).

[15] Some of the banks participating in CPP converted to the CDCI program.

[16] Almost $5 billion in loans were written off, and the Treasury benefited from almost $8 billion in warrant proceeds and over $19 billion in interest and dividends.

[17] Bayazitova and Shivdasani have a fairly detailed timeline of the events from October 3, 2008, through December 31, 2009, in Table 1 of their study.

[18] U.S. Department of the Treasury (2012).

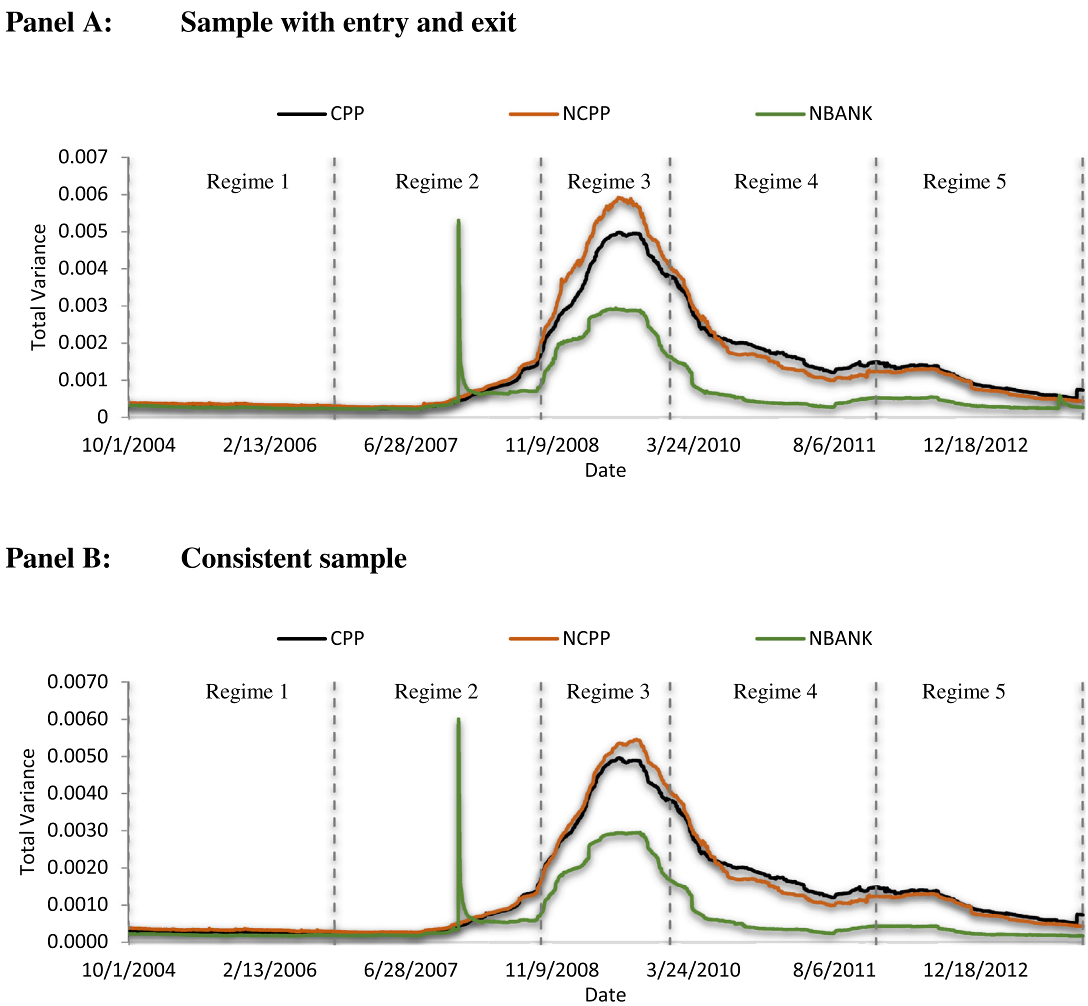

Fig. 1. Total variance, 2004 Q4 – 2013 Q4. Daily moving average total variances for each portfolio, estimated using a 252-day moving window.

Focusing only on CPP participants, Liu et al. (2013) examine stock returns of banking institutions and find that the CPP within TARP contributed to the recovery of U.S. banks. Cornett et al. (2013) observe that there are two types of TARP recipient: those that are poor-performing and those that are performing adequately, yet face liquidity issues. They also find that these two types of recipients differ with respect to repayment of TARP funds. Additionally, there is support in the study by Duchin and Sosyura (2012) that institutions receiving TARP funds were more likely to be politically connected, and yet politically connected firms made the least effective use of the funds. Bayazitova and Shivdasani (2012) examine banks' decision to participate in CPP, and observe that there is a self-selection bias: banks with stronger capital positions chose not to participate. Of the banks that chose to participate, Bayazitova and Shivdasani found that banks with the stronger capital positions tended to exit earlier than those with weaker capital positions.

Looking at the valuation of the common equity of CPP participating banks, Ng et al. (2015) observe that the stocks of participating banks perform well before and when CPP was initiated, and during the period following initiation of the CPP.[19] They examined and classified media coverage of CPP participants to help explain this performance, and find that negative media coverage is associated with lower security performance. They also estimate higher security systematic risk once the CPP is initiated. Elyasiani et al. (2014) examine market reactions to secondary equity offerings during the period of time coinciding with the CPP program, and find that financial institutions not participating in TARP experienced a negative market reaction with the announcement of the offering to the public, those participating in TARP experienced a positive market reaction with the CPP offering to the U.S. Department of the Treasury.

Duchin and Sosyura (2014) compare banks receiving CPP funds with those not receiving funds. Using a unique database of loan activity, they conclude that banks participating in CPP made riskier loans. In addition, they observed that CPP participants made riskier securities investments relative to those not participating in CPP. In other words, they observe increased risk-taking for banks participating in CPP relative to other banks. They attribute some of this to the moral hazards associated with the program, noting that twenty-one percent of CPP participants were permitted to skip dividend payments on the CPP securities. Duchin and Sosya also observe that the total stock market price volatility and beta for CPP participants increased following receiving CPP funds.

Examining whether there was a potential advantage from receiving TARP funds, Berger and Roman (2015b) focus on whether the participants of CPP gained a competitive advantage over banks not participating in CPP. They examined whether any benefit was accrued to CPP participants, despite the potential cost disadvantage of the CPP program, and found that banks repaying early elicited some competitive advantage. Koetter and Noth (2015), also examined the competitive effects of banks receiving CPP funds,

[19] The time period of their analysis extends to fourth quarter 2009.

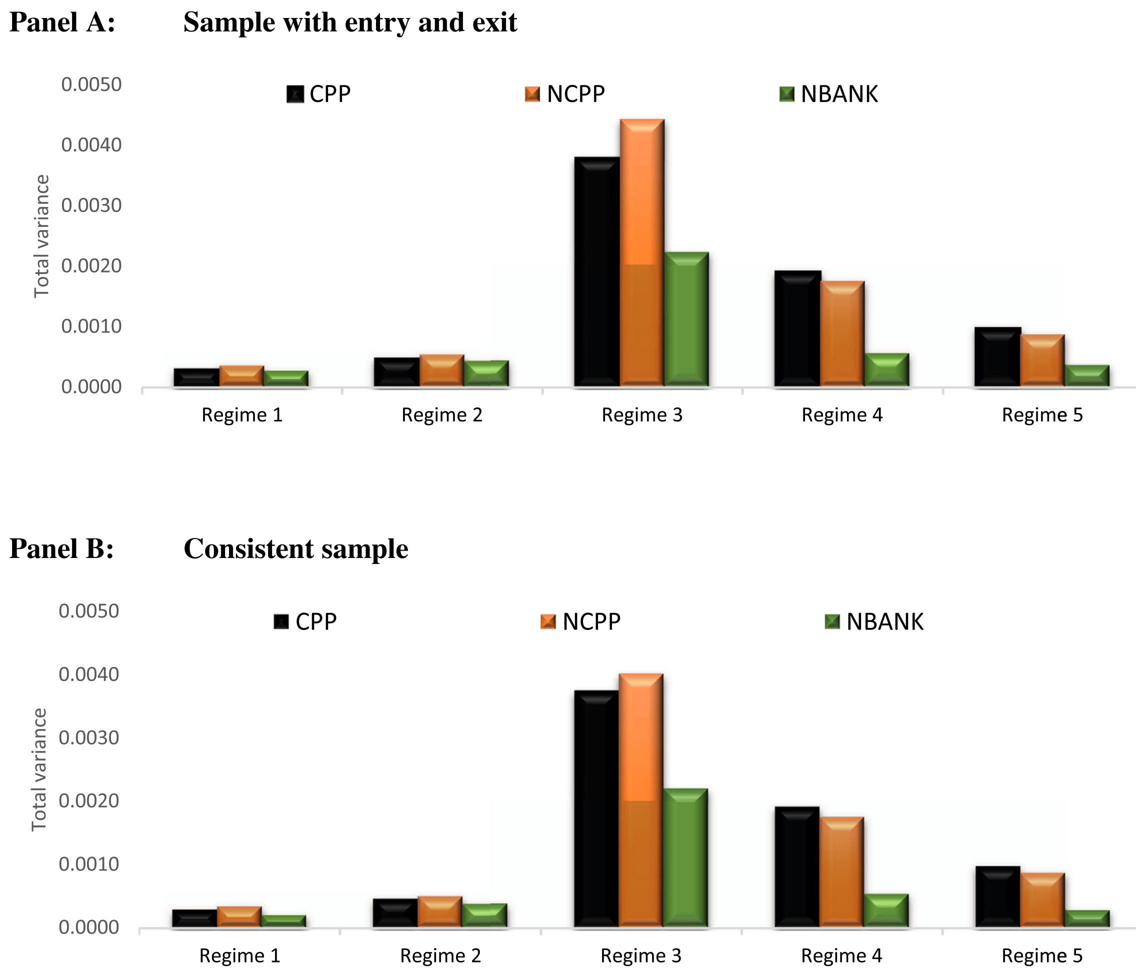

Fig. 2. Average levels of total variance across the five regimes.

modelling bailout expectations and focusing on loan rates. They conclude that the CPP participants did not increase their market shares, vis-à-vis other banks, though they note that TARP may have exaggerated differences in banks' competitiveness that existed prior to the crisis.[20] Veronesi and Zingales (2010) address the issue of whether the TARP program created value or merely transferred resources from taxpayers to others. They find that while there was a net value increase from the bailouts, the primary beneficiaries were the banks that were at the greatest risk of a run. However, they do not find that all recipients of bailout funds have an increase in the value of their equity, which they attribute to the negative signal associated with the CPP.

Berger and Roman (2015a) examine the impact of the CPP at the local level, examining the economic conditions of localities, such as job creation, using a difference-in-difference (DID) methodology to isolate the effect of the local banks participating in CPP. They find evidence to support the idea that the CPP is associated with improved economic conditions.

4. Data and methodology

Our investigation focuses on the effect of CPP participation on the long-term variance of returns of the recipient firms' common stock. Specifically, we focus on systematic and unsystematic risk of returns of CPP participants, comparing these risks to that of other publicly-traded banking institutions and other, non-banking financial institutions that did not participate in TARP. We use the list of CPP participants as reported on the U.S. Department of the Treasury web site.[21] The Treasury lists 950 firms that received TARP support between 2008 and 2009, of which 701 participated in CPP. Of the 701 participating in CPP, 274 were publicly-traded financial institutions.[22,23]

[20] They attribute these differential effects to the differing restrictions on interstate banking that existed among states.

[21] www.treasury.gov/initiatives,stability/reports/Pages/TARP-Investment-Program-Transaction-Reports.aspx.

[22] Firms receiving bailouts of one form or another also included AIG, General Motors, Fannie Mae and Freddie Mac, local housing authorizes, investment funds, and mortgage servicers. Our primary focus is on the banking institutions in CPP.

[23] U.S. Department of the Treasury, Capital Purchase Program. 401 were privately owned small or community banks, and 20 were Certified Development Financial Institutions (CDFIs). A CDFI is a private institution that provides local financial services, such as the Chicago Community Loan Fund. The CDFI program was similar to the CPP, but the dividend rate on the preferred stock was 2 percent, rather than 5%. Of the 709 firms that participated in CPP, we considered only 701 firm. Of the 709 commonly associated with CPP, six were not banking institutions, and therefore not included in the sample: two were financial services firms (American Express and Discover), two were insurance companies (Hartford Financial Services and Lincoln National), one was an investment fund (Alliance Bernstein Legacy Securities Master Fund), and one was a mortgage servicer (VIST Financial). The other two participants, Atlantic City Federal credit Union and Carter Federal Credit Union were counted as two of the 709 participants, but received funds from the Community Development Capital Initiative (CDCI), another component of TARP.

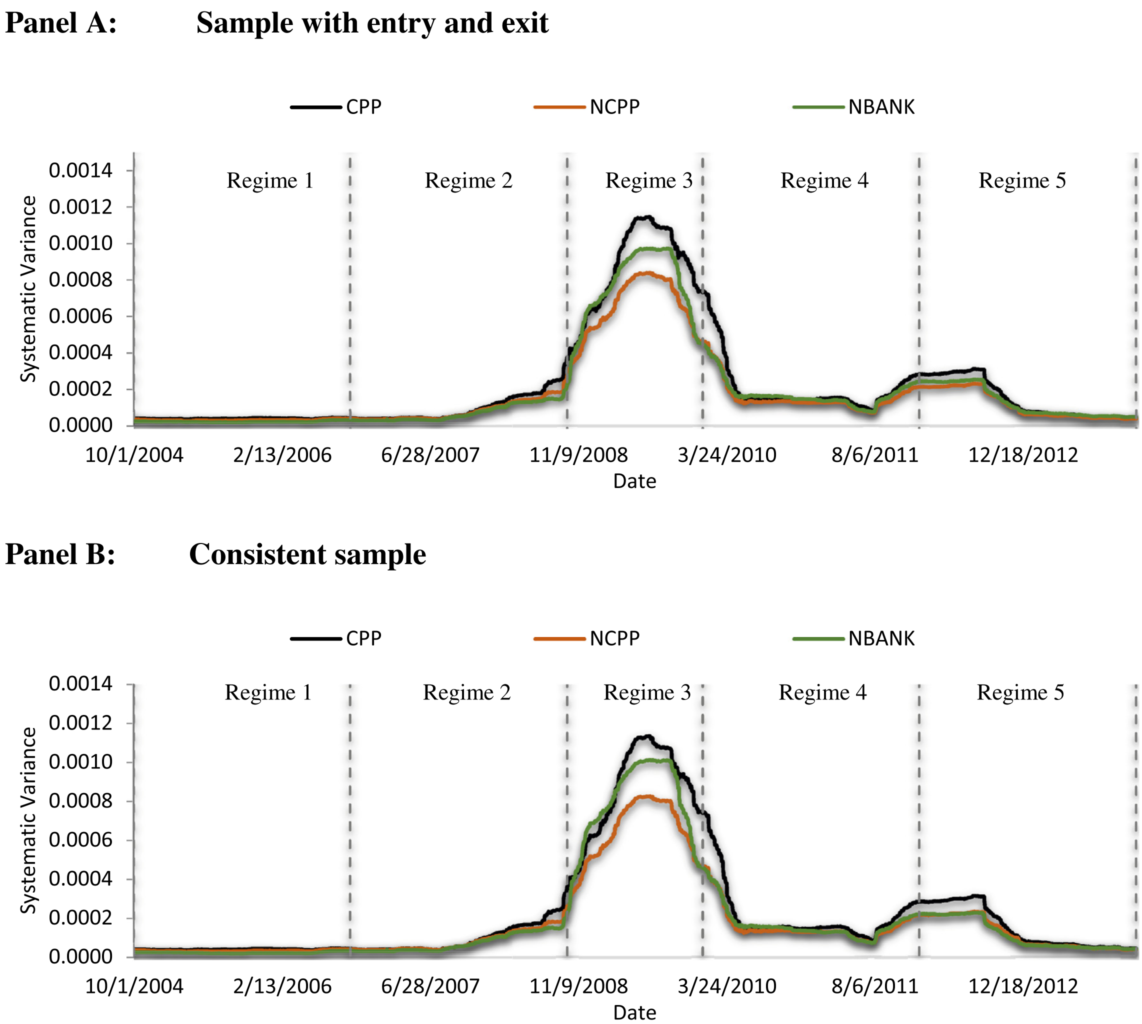

Fig. 3. Systematic variance, 2004 Q4 – 2013 Q4. Daily average systematic variance for each portfolio, estimated using a 252-day moving window.

We collect data on the daily prices, total returns, and shares outstanding spanning the period from 2004 through December for all firms listed on Center for Research in Security Prices (CRSP) classified in the Financial Services industry, and divide this sample of firms into three, mutually-exclusive groups: CPP participants (CPP), banking institutions that are not CPP participants (NCPP), and all other, non-banking financial institutions (NBANK).[24] Of the publicly-traded firms that received TARP assistance, we have a group of CPP participants consisting of 248 firms, though the sample size varies depending on the year we are analyzing.[25]

The portfolio of banking institutions that did not participate in CPP consists of 403 publicly-traded banks, and the portfolio of non-banking financial firms consists of 2056 firms.[26] We provide descriptive statistics on the average firm size and number of firms for each portfolio in presented in Table 1 from 2004 to 2013. As you can see in Table 1, CPP participants are two to three times larger, on average, than non-CPP participants in terms of the market value of equity, but that the non-CPP banking firms are similar in size to the non-banking financial firms in the NBANK portfolio.

Our goal is to examine the market's perception of the risk associated with firms participating in CPP, so we follow the methodology presented by Semaan and Drake (2011) to decompose and compare risk, and proceed to examine the long-term variance of returns and its components using the following set of tests performed on all portfolios:

- shifts in beta, which will provide information on whether market risk changes;
- changes in the average total, systematic, and idiosyncratic variances; and
- changes in the ratio of average systematic variance to average idiosyncratic variance.

Because of the turmoil in the financial industry and the evidence of Fama and French (2004) that is consistent with the explanation that changes in risk components could be, in part, due to trends in the entry and exit of firms into the markets, we control for entry and exit of institutions in this industry. Consistent with Fama and French, Wei and Zhang (2005) find that the entrance of newly-listed firms is associated with increase in return on equity volatility. If new entrants have greater fundamental volatility then changes in relative risk components in a portfolio during our study

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[24] These include other financial institutions, including insurance companies and securities brokers. We include this third group to allow for a comparison of banking firms with non-banking, financial firms.

[25] Some of the publicly-traded banks participating in CPP had stock that was not traded on national exchanges, so these are not included in our analysis.

[26] We selected financial institutions with SIC codes in the 6000-6299, and 6710-6712.

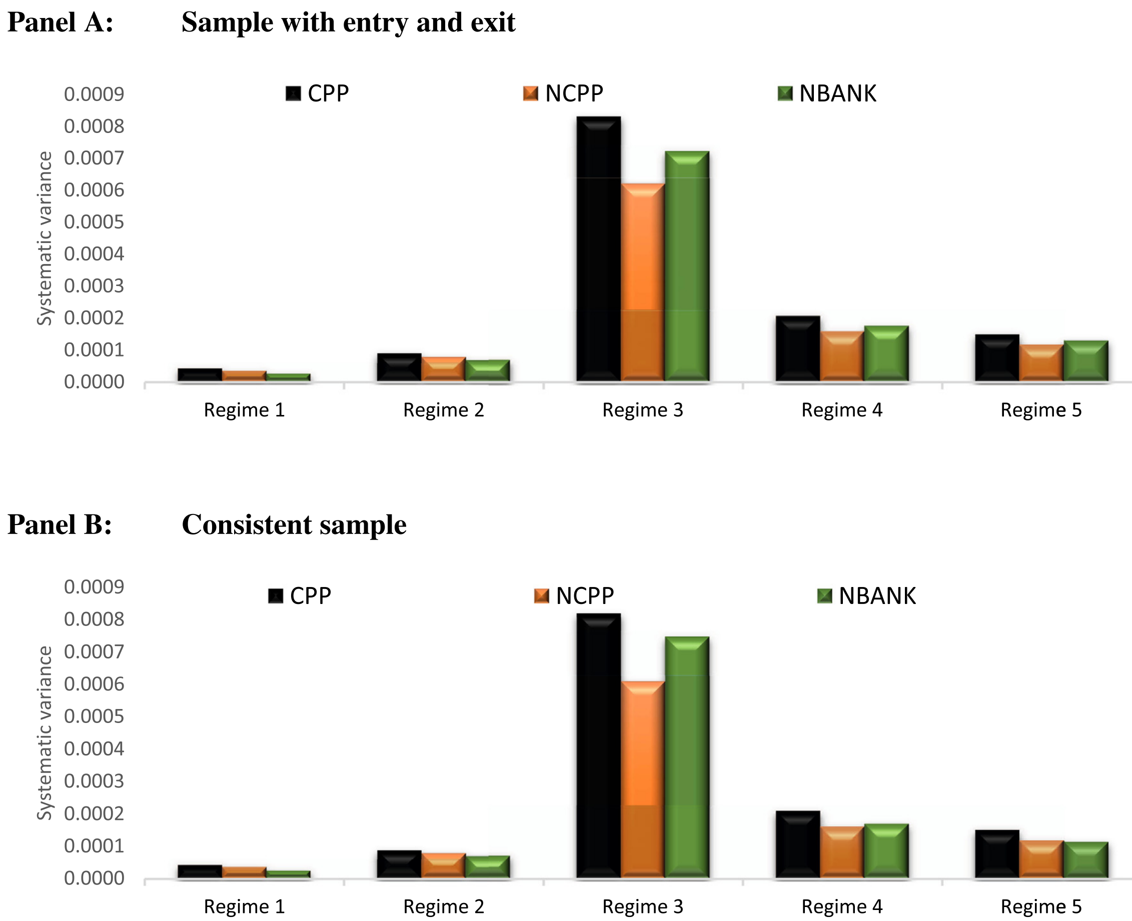


Fig. 4. Average levels of systematic variance across the five regimes.

period could be attributed to changes in portfolio composition. We address this concern by performing each of the aforementioned tests twice; first, allowing for changes in the portfolio composition when firms enter or leave the industry and second, by restricting the portfolios only to the firms that were present consistently throughout the CPP disbursement period; we refer to the latter sample as the "consistent" sample.

We identify the CPP disbursement period as the period extending between the 4th quarter of 2008 (2008 Q4) through 2009 Q4.[27] We proceed with our analysis and focus on the period extending from the 2004 Q4 through 2013 Q4; that is, four years prior and four years following the CPP disbursements period. Therefore, our analysis includes the 9-year period (2004 Q4 through 2013 Q4) surrounding and including the CPP disbursements.

4.1. Measuring shifts in beta

We construct a daily time-series on the value-weighted portfolio excess returns (R_{pt}) for each of the three portfolios of securities:

$$R_{pt} = \frac{\sum_{i=1}^{n_t} v_{it} r_{it}}{v_{pt}} \tag{1}$$

where v_{it} and R_{it} are the market value and the excess return of the ith stock in the respective portfolio at time t and v_{pt} is the total portfolio value at time t. The total number of stocks in the portfolio at time t is n.

We then estimate the following multi-variable equation for each of the three portfolios in our study, both for the sample allowing entry and exit, and for the consistent sample:

$$R_{pt} = \alpha_{pt} + \beta R_{Mt} + \lambda_{pre}(D_{pre}) + \lambda_{post}(D_{post}) + \beta_{pre}(D_{pre}R_{Mt}) + \beta_{post}(D_{post}R_{Mt}) + e_{pt} \tag{2}$$

where R_{Mt} is the CRSP value-weighted index excess returns at time t, λ_{pre} is the average daily abnormal return in the four-year period prior to the CPP disbursement period (Q3 2004 through Q3 2008), λ_{post} is the average daily abnormal return in the four-year period following the TARP disbursement period (2010 Q1 through 2013 Q1), D_{pre} and β_{pre} are the dummy variable and the shift-dummy variables in the portfolio's beta for the for the four-year period prior to the disbursements, respectively, whereas D_{post} and β_{post} are the dummy variable and the shift-dummy for the portfolio's beta for the four-year period following the disbursements, respectively. Therefore, the coefficients λ_{pre} and λ_{post} capture the differences in returns relative to the CPP disbursement period, whereas the β_{pre} and β_{post} coefficients capture differences in beta relative to the base period.

If systematic risk increased during the CPP disbursement period, for example, and remained at this increased level, we would observe a negative coefficient for β_{pre} and would not expect β_{post} to be different from zero. Similar to Duchin and Sosyura (2014),

[27] The first $350 billion was released on October 3, 2008, and Congress voted to approve the release of the second $350 billion on January 15, 2009. (U.S. Dept. of Treasury, MHA Guidelines)

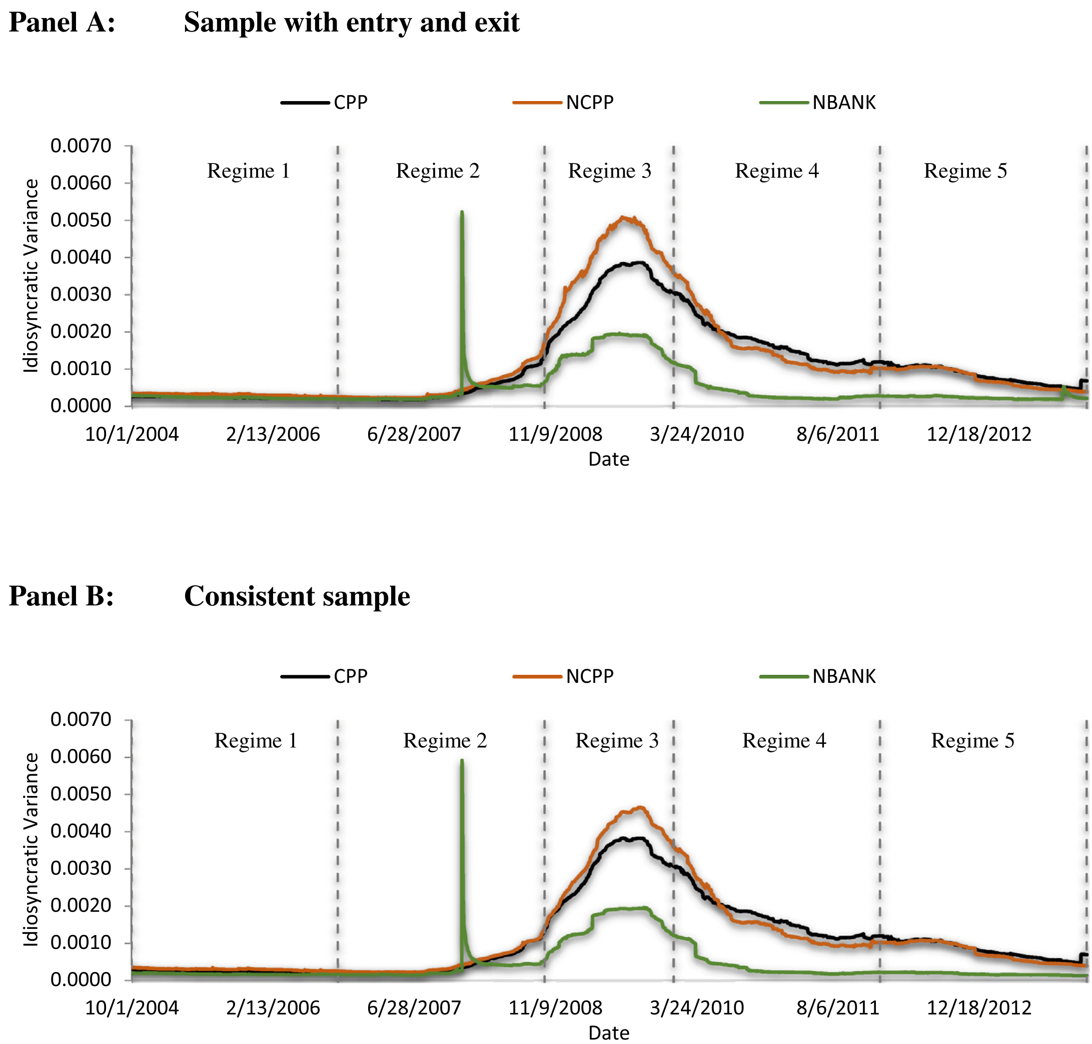


Fig. 5. Idiosyncratic variance, 2004 Q4 – 2013 Q4. Daily average idiosyncratic variance for each portfolio, estimated using a 252-day moving window.

we also employ tests using difference-in-difference to more directly compare the three portfolios.[28]

4.2. Estimating changes in average total, systematic and idiosyncratic variances

For this test, we estimate a daily time-series on each stock's total variance, $\sigma^2(R_{it})$, using a 252-day moving window. We then estimate the average total variance for each portfolio as:

$$\sigma^2_{pt} = \frac{\sum_{i=1}^{n_t} \sigma^2(R_{it})}{n_t} \tag{3}$$

where n_t is the total number of firms in the respective portfolio.

For this analysis, we define five different regimes covering five different periods centered on the CPP disbursement period:

Regime 1: The period extending from 2004 Q4 through 2006 Q3.
Regime 2: The period extending from 2006 Q4 through 2008 Q3.
Regime 3: The period extending from the 2008 Q4through 2009 Q4 (CPP disbursement period).
Regime 4: The period extending from 2010 Q1 through 2011 Q4.
Regime 5: The period extending from 2012 Q1through 2013 Q4.

Therefore, Regime 1 consists of years three and four prior to the CPP disbursement period, Regime 3, and Regime 4 consists of the first and second years following Regime 3. We use Regime 3 as our base period throughout our tests.

We proceed in our analysis by estimating the average daily variance per month during the entire study period. As such, our sample size is 111 observations representing the 111 months between 2004 Q4 and 2013 Q4.[29] We use a dummy-variable event analysis on the moving-average total variance for each portfolio p, σ^2_{pt}, and use four dummy variables to examine the changes in the variance under the five aforementioned regimes:

[28] For Eq. (2), for example, we estimate the following regression: $R_t = \alpha_{1t} + D_2 + D_3 + \beta_{1t} \cdot R_{Mt} + \beta_{2t} \cdot (R_{Mt} \cdot D_2) + \beta_{3t} \cdot (R_{Mt} \cdot D_3) + \lambda_{1pre} \cdot (D_{pre}) + \lambda_{2pre} \cdot (D_{pre} \cdot D_2) + \lambda_{3pre} \cdot (D_{pre} \cdot D_3) + \lambda_{1post} \cdot (D_{post}) + \lambda_{2post} \cdot (D_{post} \cdot D_2) + \lambda_{3post} \cdot (D_{post} \cdot D_3) + \beta_{1pre} \cdot (D_{pre} \cdot R_{Mt}) + \beta_{2pre} \cdot (D_{pre} \cdot R_{Mt} \cdot D_2) + \beta_{3pre} \cdot (D_{pre} \cdot R_{Mt} \cdot D_3) + \beta_{1post} \cdot (D_{post} \cdot R_{Mt}) + \beta_{2post} \cdot (D_{post} \cdot R_{Mt} \cdot D_2) + \beta_{3post} \cdot (D_{post} \cdot R_{Mt} \cdot D_3) + e_t$, where subscripts 1, 2 and 3 represent the portfolios CPP, NCPP and NBANK respectively. In this DID model, for example, β_{2pre} captures the difference in the difference in the betas of portfolios CPP and NCPP in the period before TARP disbursements as compared to their betas during the disbursement period.

[29] For all regressions in Sections 3.2 through 3.4, we also use an alternative approach to calculating the total variance and its components using non-overlapping monthly observations, where the variance of each month is calculated based on the daily returns throughout that month similar to Campbell et al. (2001). The results from this alternative approach remained consistent with our findings in Section 4. The results are available upon request.

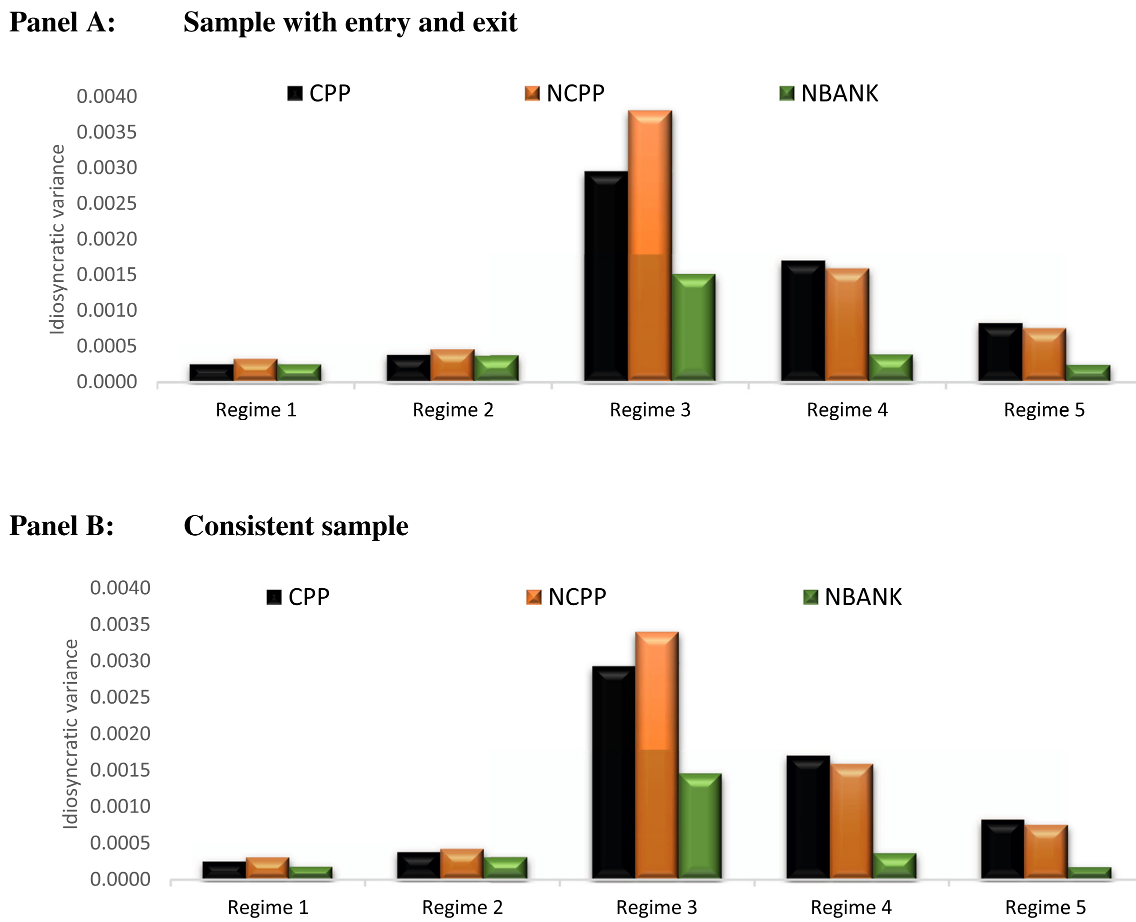


Fig. 6. Average levels of idiosyncratic variance across the five regimes.

$$\sigma^2_{pt} = \alpha_{pt} + \gamma_{pt}(T) + \phi_{1pt}(D_{1p}) + \phi_{2pt}(D_{2p}) + \phi_{4pt}(D_{4p}) + \phi_{5pt}(D_{5p}) + e_{pt} \tag{4}$$

where D_{1p}, D_{2p}, D_{4p} and D_{5p} are dummy variables for regimes 1, 2, 4, and 5, respectively and the coefficients of these dummy variables, ϕ_{1p}, ϕ_{2p}, ϕ_{4p}, and ϕ_{5p}, capture the level change in the average total variance under the respective regimes. As mentioned earlier, Regime 3, the TARP disbursement period, is used as the base case; therefore if ϕ_{1p} is positive and significant, this indicates that the variance for portfolio p is greater in Regime 1 than in Regime 3.

Some researchers report general trends in idiosyncratic volatility and total volatility, so we include T as a proxy for time to account for the possible general trend; therefore the coefficient γ_p captures any potential temporal trend in σ^2_{pt}.[30] We again employ tests using difference-in-difference to more directly compare the three portfolios.

We proceed to regress the excess return of the ith stock for the trading day t, R_{it}, on the CRSP value-weighted index excess returns for that trading day, R_{Mt}:

$$R_{it} = \alpha_i + \beta_i R_{Mt} + e_{it} \tag{5}$$

where α_i is the intercept, β_i is the stock i's beta, and e_{it} is the stock-specific residual. We then separate the total variance of each stock's excess returns into systematic and idiosyncratic components:

$$\sigma^2(R_{it}) = \beta_i^2 \sigma^2(R_{Mt}) + \sigma^2(e_{it}) \tag{6}$$

[30] See for example Campbell et al. (2001), Fama and French (2004), Wei and Zhang (2006), Bali et al. (2008), Brandt et al. (2010) and Bekaert et al. (2012).

We construct a daily time-series on the stock's beta, as well as its systematic and idiosyncratic components of the variance using a 252-day moving window. Using these daily series for the individual stocks, we define the average idiosyncratic variance for each portfolio p on day t, $IDIO_{pt}$, as:

$$IDIO_{pt} = \frac{\sum_{i=1}^{n_t} \sigma^2(e_{it})}{n_t} \tag{7}$$

We define the average systematic variance for portfolio p on day t, SYS_{pt}, as:

$$SYS_{pt} = \frac{\sum_{i=1}^{n_t} \beta_{it}^2 \sigma^2(R_{Mt})}{n_t} \tag{8}$$

We then proceed to estimate Eq. (4), once using average daily $IDIO_{pt}$ per month and then again using the average daily SYS_{pt} per month as the dependent variable. The application of Eq. (4) to these different components of risk allows us to identify whether any shifts in these types of risk take place for the portfolios.

4.3. Estimating changes in the ratio of average systematic variance to average idiosyncratic variance

Next, we focus on relative changes in the average risk components of the industry. Accordingly, we examine each portfolio's ratio of average systematic to average idiosyncratic variances, δ_{pt}:

$$\delta_{pt} = \frac{SYS_{pt}}{IDIO_{pt}} \tag{9}$$

Table 5
Results on changes in the ratio of systematic to idiosyncratic variances. We estimate Eq. (10) using the ratio of systematic to idiosyncratic volatility as the dependent variable:
$\delta_{pt} = \alpha_p + \gamma_p(T) + \phi_{1p}(D_{1p}) + \phi_{2p}(D_{2p}) + \phi_{4p}(D_{4p}) + \phi_{5p}(D_{5p}) + e_{pt}$ (10)
where D_{1p}, D_{2p}, D_{4p} and D_{5p} are dummy variables for regimes 1, 2, 4, and 5, respectively and the coefficients of these dummy variables, ϕ_{1p}, ϕ_{2p}, ϕ_{4p}, and ϕ_{5p}, capture the level change in the ratio of systematic to idiosyncratic volatility under the respective regimes. Regime 3, the CPP disbursement period, is used as the base period. We estimate this equation for the complete CPP, NCPP and NBANK portfolios allowing entry and exit in panels A and then again for the consistent sample CPP, NCPP and NBANK portfolios in panels B. We report the results on the difference-in-difference (DID) analysis between the NCPP and CPP portfolios and then again between the NBANK and CPP portfolios for each of the parameters in the adjacent columns. Our sample size for the regression on each portfolio is 2329 observations representing the portfolio's daily returns during the testing period. *p*-Values based on the Newey–West standard errors are reported in parentheses below the coefficient estimates.

Estimated Parameter	CPP	NCPP	NBANK	DID (NCPP–CPP)	DID (NBANK–CPP)
Panel A: Sample with entry and exit					
α	0.33615*	0.17415*	0.64471*	−0.16200*	0.30856*
	(0.0000)	(0.0000)	(0.0000)	(0.0010)	(0.0218)
γ	−0.00100	−0.00018	−0.00298	0.00082	−0.00198
	(0.1441)	(0.6971)	(0.1715)	(0.3224)	(0.3838)
ϕ_1	−0.15003*	−0.06245*	−0.49985*	0.08758*	−0.34982*
	(0.0000)	(0.0077)	(0.0000)	(0.0321)	(0.0020)
ϕ_2	−0.06698*	0.00325	−0.33668*	0.07024*	−0.26970*
	(0.0015)	(0.8178)	(0.0000)	(0.0052)	(0.0001)
ϕ_4	−0.14009*	−0.05379*	0.10423	0.08630*	0.24432*
	(0.0000)	(0.0002)	(0.1134)	(0.0006)	(0.0004)
ϕ_5	−0.07501*	−0.01511	0.17428	0.05991	0.24930*
	(0.0270)	(0.5125)	(0.1050)	(0.1415)	(0.0267)
R^2	0.5675	0.4144	0.6046		
Panel B: Consistent sample					
α	0.33610*	0.19632*	0.67295*	−0.13979*	0.33684*
	(0.0000)	(0.0000)	(0.0000)	(0.0048)	(0.0331)
γ	−0.00104	−0.00025	−0.00276	0.00079	−0.00173
	(0.1314)	(0.6090)	(0.2865)	(0.3438)	(0.5182)
ϕ_1	−0.15186*	−0.07621*	−0.49497*	0.07565	−0.34311*
	(0.0000)	(0.0016)	(0.0002)	(0.0665)	(0.0096)
ϕ_2	−0.06998*	−0.00228	−0.31694*	0.06770*	−0.24696*
	(0.0009)	(0.8748)	(0.0000)	(0.0076)	(0.0024)
ϕ_4	−0.13674*	−0.07052*	0.09043	0.06623*	0.22717*
	(0.0000)	(0.0000)	(0.2477)	(0.0090)	(0.0052)
ϕ_5	−0.07084*	−0.03043	0.21567	0.04041	0.28651*
	(0.0371)	(0.1997)	(0.0923)	(0.3256)	(0.0302)
R^2	0.5534	0.4900	0.5392		

* Indicates different from zero at the 5% level of significance.

The interpretation of this ratio is that if systematic risk increases vis-à-vis idiosyncratic risk δ_{pt} will increase; on the other hand, if idiosyncratic risk increases for portfolio *p* on day *t*, vis-à-vis systematic risk, δ_{pt} will decrease. The advantage of using this ratio is that this provides a measure of relative risk of the two components.

Again, we employ a dummy-variable event analysis on the average δ_{pt} daily per each month for each portfolio under the 5 regimes:

$$\delta_{pt} = \alpha_p + \gamma_p(T) + \phi_{1p}(D_{1p}) + \phi_{2p}(D_{2p}) + \phi_{4p}(D_{4p}) + \phi_{5p}(D_{5p}) + e_{pt} \tag{10}$$

where the coefficients of the dummy variables, the ϕ_{ip}, provide information of changes in δ_{pt} similar to Eq. (4), and again employ a difference-in difference analysis to more directly compare the three portfolios.

4.4. Testing differences between CPP participants

Though our focus is on the market's interpretation of the signal associated with CPP disbursements, we allow for the possibility that there is a different signal associated with banks that were required to take CPP funds, despite passing Supervisory Capital Assessment Program (SCAP) stress tests. We perform a separate analysis where we break out those forced to take CPP (the FTT) from the rest of the CPP firms, which we designate as CPP^{Δ}. We perform the same estimations and comparisons for FTT and CPP^{Δ} portfolios as between the CPP and NCPP portfolios.

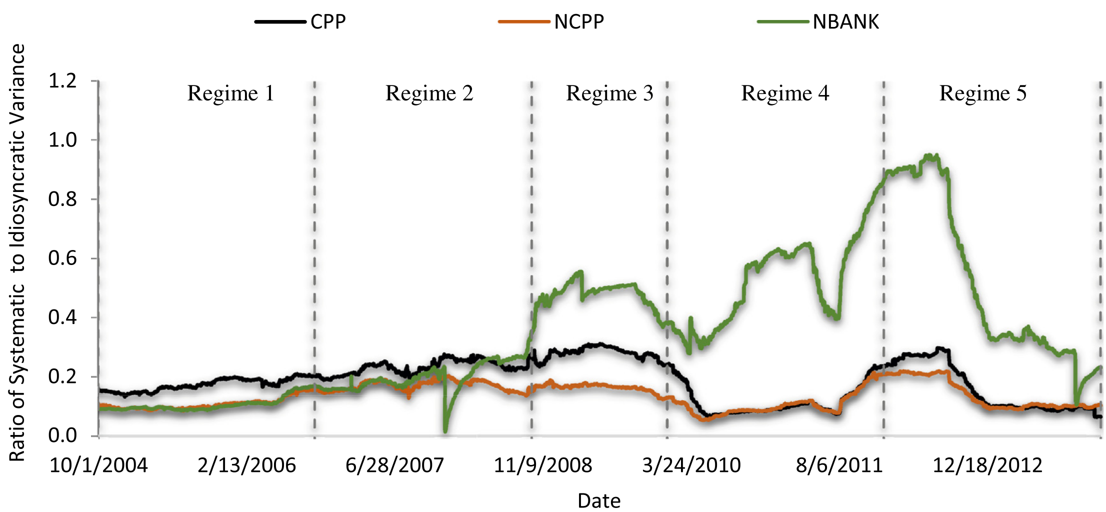
5. Results

We provide the results pertaining to the shifts in beta in Section 5.1, the discussion of the results pertaining to the changes in the variance and its components before and after the CPP disbursement period in 5.2, the discussion of the results pertaining to the changes in variance and its components across the 5 regimes in Section 5.3, results pertaining to the changes in the ratio of systematic to idiosyncratic variances across the 5 regimes in Section 5.4, and the results comparing CPP firms that were forced to take (FTT) with the remaining CPP firms (CPP^{Δ}) in Section 5.5.

5.1. Shifts in beta

We estimate Eq. (2) for each of the three portfolios and present the results in Table 2. The λ_{pre} and λ_{post} coefficients provide tests of whether the returns are different pre- and post-CPP disbursements, respectively, whereas the β_{pre} and β_{post} provide tests of the slope

Panel A: Sample with entry and exit



Panel B: Consistent sample

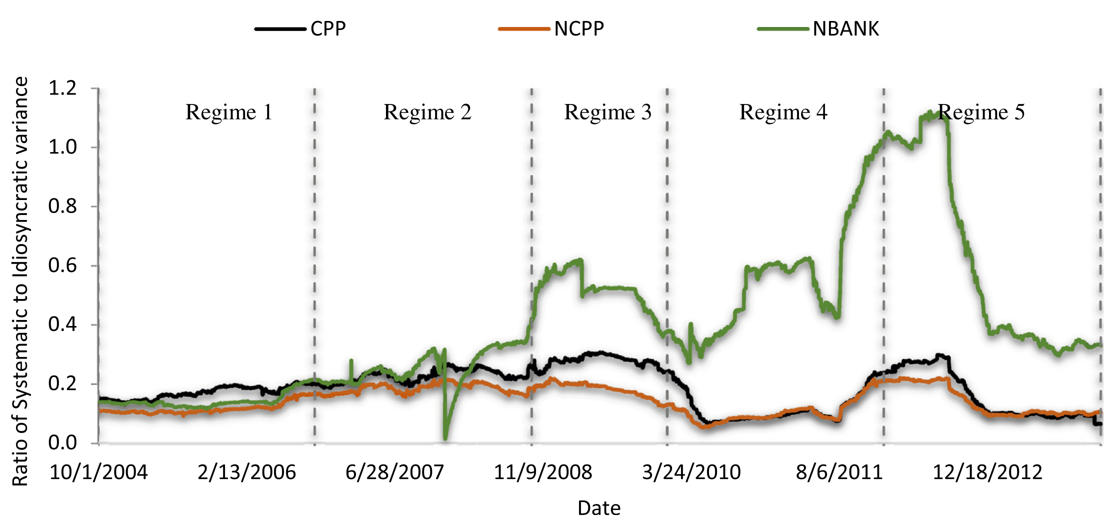


Fig. 7. Ratio of systematic to idiosyncratic variances, 2004 Q4 – 2013 Q4. Daily ratio of systematic to idiosyncratic variances, δ_{pt}, for each portfolio, estimated using a 252-day moving window.

with respect to the market portfolio pre- and post-CPP disbursements.

With regard to abnormal stock returns, the NBANK portfolio returns are lower post-CPP disbursements, as indicated by the significant and negative coefficient on λ_{post}, but no statistically different returns are observed for the CPP or NCPP portfolio.

The CPP and NBANK portfolios experienced lower market risk following the CPP disbursement period, as indicated by the negative and significant coefficients on β_{post}. The results are similar whether considering the sample allowing entry or exit or the consistent sample. Only the NBANK portfolio in the consistent sample has a lower beta before and after when compared to the disbursement period.

Regarding the comparison of the parameters using difference-in-difference methods, reported in the two columns on the right in Table 2, we observe that the CPP portfolio has systematic risk that is higher than the other two portfolios during the disbursement period, as indicated by the significance of β_{pre} and β_{post} in both Panel A and Panel B. We also observe that there is no difference in the change in market risk between the CPP and other portfolios, both pre- and post.

5.2. Changes in total, systematic, and idiosyncratic variances

We estimate the average total, systematic and idiosyncratic variances as well as the ratio of systematic to idiosyncratic variance as presented in Eqs. (3), (7)–(9) for each of the three portfolios, both allowing for entry and exit and with the consistent sample. We calculate the daily mean square root of each of the three variances before, during, and after the CPP disbursement period and, for robustness sake, consider two alternative prior- and post-event windows (two years and four years) of equal length around the disbursement period. We present the results in Table 3.

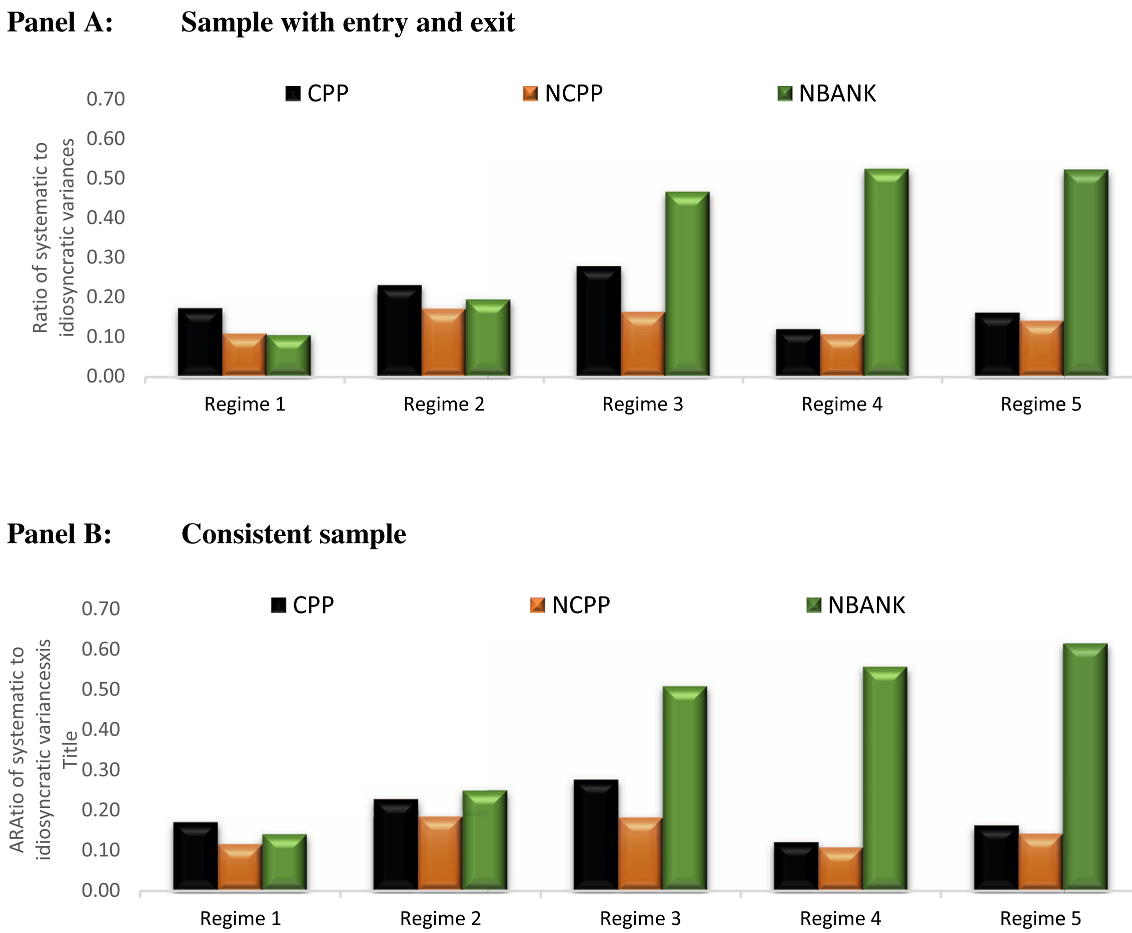


Fig. 8. Ratio of systematic to idiosyncratic variances.

The results in Table 3 are consistent whether we allow for entry and exit in the portfolios (Panel A) or not (Panel B). We see that the total volatility increased from before CPP period to after CPP period for banking institutions (CPP and NCPP), whether we use the two years before and after the CPP period or four years before and after. The total volatility of the NBANK portfolio, however, did not increase when comparing the periods before and after the CPP period. In other words, banking institutions' stock return volatility increased during the CPP disbursements period, and declined after this period, but did not return to pre-CPP disbursements levels in the long run. Systematic volatility for all three portfolios increased following the CPP disbursement period whether we use the two-year or the four-year results. Idiosyncratic volatility, however, increased for both the CPP and the NCPP portfolios, but did not increase for the NBANK portfolio. Similar to the pattern for total volatility, idiosyncratic variance increased during the CPP disbursements period for banking institutions, and was higher after this period for the CPP and NCPP portfolios, as indicated by the tests of differences in Table 3.

The results on the ratio of systematic to idiosyncratic volatility provide a clear picture of the relative changes in the total volatility components. We find that the ratio has decreased for both the CPP and NCPP portfolios in the two years following the disbursement period, but increased for the NBANK portfolio. In other words, idiosyncratic risk has increased relative to systematic risk for these portfolios in the two years following CPP. However, the ratio has increased only for the CPP portfolio in the four years following the disbursement period, decreased for the NBANK and did not change for the NCPP portfolio. This indicates that idiosyncratic risk, relative to systematic risk, increased for CPP banks compared to before the CPP program; therefore, the market perceives the CPP firms as having more relative idiosyncratic risk over the long-term.

In summary, these results indicate is that, for the four years following the CPP disbursement period, relative idiosyncratic volatility increased for the CPP recipients (the CPP portfolio), decreased for the non-banking financial firms (the NBANK portfolio), and returned to pre disbursement levels for the banking institutions that were not CPP participants (the NCPP portfolio).

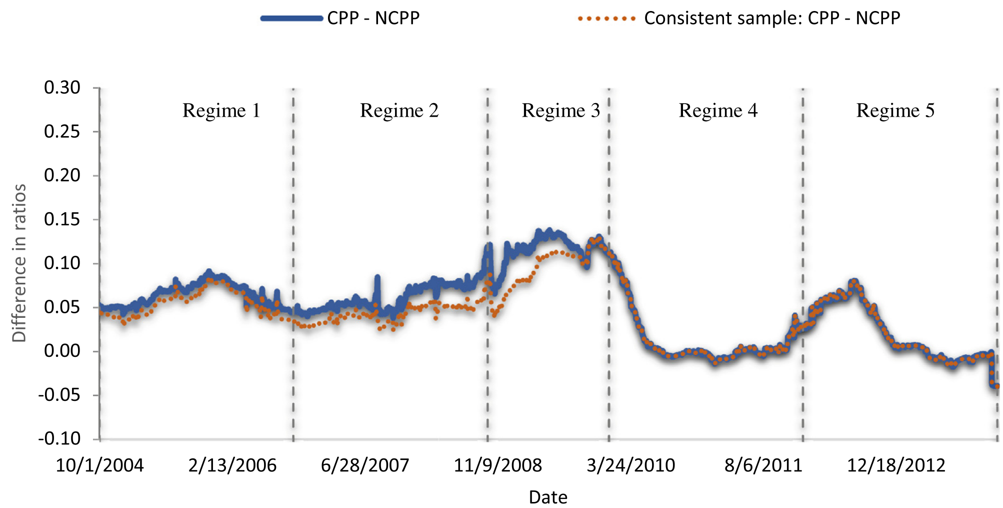
5.3. Changes in total variance and its components across the 5 regimes

We estimate Eq. (4) for the total, systematic and idiosyncratic variance for each of the portfolios under study and across the five temporal regimes, allowing for firms' entering and exiting the sample, and present the results in Panels A, B and C of Table 4, respectively. We repeat the analysis for the consistent sample, presenting the results on total, systematic, and idiosyncratic variances in Panels D, E and F of Table 4, respectively. Consistently, and across all tests on the variance and its components, we find that the time variable is insignificant. That is, we do not find any evidence of trends in the total variance or its components for the portfolios under study during this testing period.

5.3.1. Changes in total variance across the 5 regimes

The results we provide in Table 4 show that the total variance for all portfolios was higher during the CPP disbursement period (Regime 3) than any of the other regimes, as indicated by the significant, negative coefficients ϕ_1, ϕ_2, ϕ_4, and ϕ_5 in panels A and D.

Panel A: Difference between CPP and NCPP ratio of systematic to idiosyncratic variance by regime



Panel B: Difference between CPP and NBANK ratio of systematic to idiosyncratic variance by regime

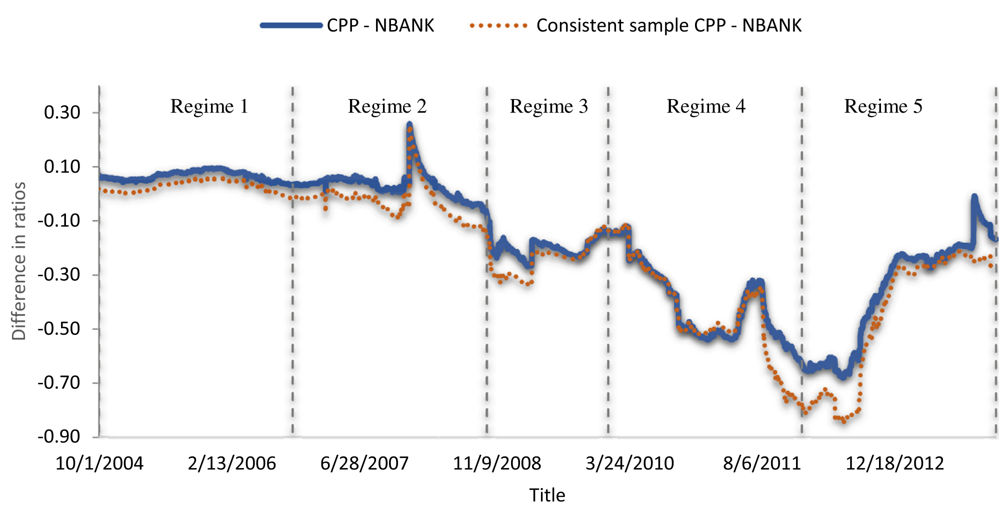


Fig. 9. Difference between ratios of systematic to idiosyncratic variances, 2004 Q4 – 2013 Q4. The difference between portfolios' daily ratio of systematic to idiosyncratic variances, δ_{pt}, estimated using a 252-day moving window.

Table 6
Descriptive statistics on portfolio compositions. Table includes the observation year and the relevant average market capitalization of firms in each of the two portfolios: CPP participants excluding firms that were forced (CPP^{Δ}) and the firms that that were forced to take (FTT). All values are in USD thousands. The table also includes the total number of firms, *N*, included in each portfolio.

Year	(CPP^{Δ})		(FTT)	
	Average market value of equity	*N*	Average market value of equity	*N*
2004	$2,004,982	213	$93,930,053	8
2005	$2,026,749	219	$100,389,824	8
2006	$2,075,962	230	$115,012,958	8
2007	$2,043,787	237	$120,465,853	8
2008	$1,377,650	239	$80,484,034	8
2009	$935,703	240	$66,732,519	8
2010	$1,391,425	237	$92,243,664	8
2011	$1,541,399	230	$83,445,346	8
2012	$1,934,623	215	$80,281,086	8
2013	$2,589,888	193	$110,741,444	8

Table 7
Results on changes in total, systematic, and idiosyncratic variances among CPP$^{\Delta}$ and Forced-to-Take (FTT) portfolios. We estimate Eq. (4) using $IDIO_{pt}$, SYS_{pt} and total variance as the dependent variable in panels A through C, respectively:
$\sigma^2_{pt} = \alpha_{pt} + \gamma_{pt}(T) + \phi_{1pt}(D_{1p}) + \phi_{2pt}(D_{2p}) + \phi_{4pt}(D_{4p}) + \phi_{5pt}(D_{5p}) + e_{pt}$
where D_{1p}, D_{2p}, D_{4p} and D_{5p} are dummy variables for regimes 1, 2, 4, and 5, respectively and the coefficients of these dummy variables, ϕ_{1p}, ϕ_{2p}, ϕ_{4p}, and ϕ_{5p}, capture the level change in the average total variance under the respective regimes. Regime 3, the CPP disbursement period, is used as the base period. We estimate Eq. (4) for the complete and consistent samples for the CPP$^{\Delta}$ and FTT portfolios in each panel. We report the results on the difference-in-difference (DID) analysis between the FTT and the CPP$^{\Delta}$ portfolios for each of the parameters in the adjacent columns. Our sample size for the regression on each portfolio is 2,329 observations representing the portfolio's daily returns during the testing period. *p*-Values based on the Newey–West standard errors are reported in parentheses below the coefficient estimates.

Estimated parameter	Sample with entry and exit			Consistent sample		
	CPP$^{\Delta}$	FTT	DID (FTT–CPP$^{\Delta}$)	CPP$^{\Delta}$	FTT	DID (FTT–CPP$^{\Delta}$)
Panel A: Total variance						
α	0.00447*	0.00550*	0.00103	0.00445*	0.00550*	0.00106
	(0.0000)	(0.0000)	(0.1509)	(0.0000)	(0.0000)	(0.1415)
γ	−0.00001	0.00000	0.00000	0.00000	0.00000	0.00000
	(0.2155)	(0.5898)	(0.6697)	(0.1516)	(0.5898)	(0.6537)
ϕ_1	−0.00405*	−0.00532*	−0.00127*	−0.00402*	−0.00532*	−0.00130*
	(0.0000)	(0.0000)	(0.0349)	(0.0000)	(0.0000)	(0.0311)
ϕ_2	−0.00356*	−0.00493*	−0.00136*	−0.00353*	−0.00493*	−0.00139*
	(0.0000)	(0.0000)	(0.0003)	(0.0000)	(0.0000)	(0.0002)
ϕ_4	−0.00173*	−0.00433*	−0.00261*	−0.00168*	−0.00433*	−0.00266*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ϕ_5	−0.00244*	−0.00445*	−0.00201*	−0.00242*	−0.00445*	−0.00206*
	(0.0000)	(0.0000)	(0.0010)	(0.0000)	(0.0000)	(0.0007)
R^2	0.8441	0.8618		0.8411	0.8618	
Panel B: Systematic variance						
α	0.00087*	0.00282*	0.001940*	0.00086*	0.00282*	0.00196*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
γ	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	(0.4473)	(0.5006)	(0.6997)	(0.4259)	(0.5006)	(0.7086)
ϕ_1	−0.00082*	−0.00273*	−0.00191*	−0.00080*	−0.00273*	−0.00192*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ϕ_2	−0.00073*	−0.00249*	−0.00176*	−0.00072*	−0.00249*	−0.00177
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ϕ_4	−0.00057*	−0.00219*	−0.00160*	−0.00057*	−0.00219*	−0.00162*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ϕ_5	−0.00060*	−0.00217*	−0.00156*	−0.00059*	−0.00217*	−0.00159*
	(0.0009)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	0.8123	0.8620		0.8067	0.8620	
Panel C: Idiosyncratic variance						
α	0.00359*	0.00268*	−0.00091*	0.00358*	0.00268*	−0.00089*
	(0.0000)	(0.0000)	(0.0434)	(0.0000)	(0.0000)	(0.0472)
γ	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000*
	(0.1223)	(0.6914)	(0.3462)	(0.1150)	(0.6914)	(0.3331)
ϕ_1	−0.00323*	−0.00259*	0.00062	−0.00321*	−0.00259*	0.00062*
	(0.0000)	(0.0000)	(0.0896)	(0.0000)	(0.0000)	(0.0999)
ϕ_2	−0.00283*	−0.00243*	0.00039	−0.00281*	−0.00243*	0.00039
	(0.0000)	(0.0000)	(0.0844)	(0.0000)	(0.0000)	(0.0000)
ϕ_4	−0.00115*	−0.00216*	−0.00101*	−0.00112*	−0.00216*	−0.00104*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
ϕ_5	−0.00183*	−0.00228*	−0.00044	−0.00180*	−0.00228*	−0.00048
	(0.0000)	(0.0000)	(0.2376)	(0.0000)	(0.0000)	(0.2023)
R^2	0.8487	0.8582		0.8462	0.8582	

* indicates significance at α level of 5%.

Individually, the NCPP portfolio experienced the sharpest increase in total variance during Regime 3, but also the sharpest decrease in Regimes 4 and 5. This result is further supported by the DID analysis between the NCPP and the CPP parameters in Regimes 2 and 4 when allowing for entry and exit. This result, however, is not supported in the consistent sample. In summary, all three portfolios had their highest total variance during Regime 3, but adjusted in Regimes 4 and 5, with the adjustment being the highest for the banks not participating in the CPP program. The CPP portfolio, however, exhibits the least relative adjustment in Regimes 4 and 5.

For further illustration, we plot the average total variances for each portfolio estimated using a 252-day moving window and present the results in Fig. 1 Panel A (allowing for entry and exit) and Panel B (the consistent sample). We also present the average total variance per regime in Fig. 2 Panel A (allowing for entry and exit) and Panel B (the consistent sample).

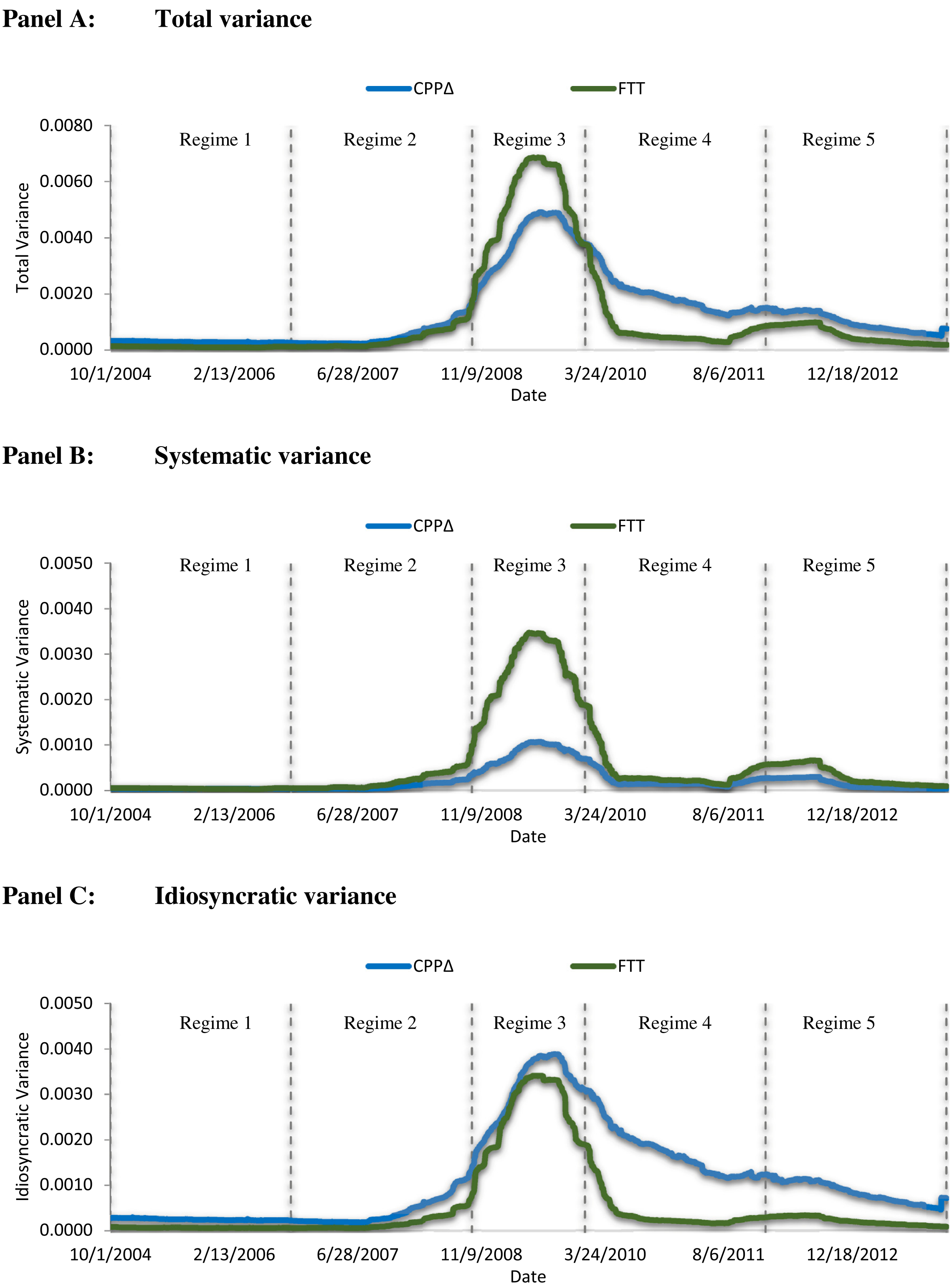


Fig. 10. Total, systematic, and idiosyncratic variance, 2004 Q4 – 2013 Q4. Daily average variance for CPP$^{\Delta}$ and FTT portfolios, estimated using a 252-day moving window.

5.3.2. Changes in systematic variance across the 5 regimes

Similar to the results on the total variance, the results on the systematic variance in Table 4 indicate that the systematic variance for all portfolios was higher during the CPP disbursement period (Regime 3) than any of the other regimes as indicated by the significant, negative coefficients ϕ_1, ϕ_2, ϕ_4, and ϕ_5 in panels B and E. These results are consistent with those of Veronesi and Zingalis and Ng, Vasvari and Wittenberg-Moerman. Individually, and unlike the results on the total variance, the CPP portfolio experienced the sharpest increase in systematic variance during Regime 3 and the sharpest decrease in systematic variance in Regimes 4 and 5. The NCPP portfolio, on the other hand, had the least relative increase in Regime 3 and the least relative decrease afterwards. This result is also supported in the DID analysis between the NCPP and the CPP parameters in Regimes 1, 2 and 4. In summary, all three portfolios had their highest total variance during Regime 3, but

Table 8
Results on changes in the ratio of systematic to idiosyncratic variances among CPP$^{\Delta}$ and Forced-to-Take (FTT) portfolios. We estimate Eq. (10) using the ratio of systematic to idiosyncratic volatility, δ_{pt} as the dependent variable:

$$\delta_{pt} = \alpha_p + \gamma_p(T) + \phi_{1p}(D_{1p}) + \phi_{2p}(D_{2p}) + \phi_{4p}(D_{4p}) + \phi_{5p}(D_{5p}) + e_{pt} \qquad (10)$$

where D_{1p}, D_{2p}, D_{4p} and D_{5p} are dummy variables for regimes 1, 2, 4, and 5, respectively and the coefficients of these dummy variables, ϕ_{1p}, ϕ_{2p}, ϕ_{4p}, and ϕ_{5p}, capture the level change in the ratio of systematic to idiosyncratic volatility under the respective regimes. Regime 3, the CPP disbursement period, is used as the base period. We estimate this equation for the complete sample using the CPP$^{\Delta}$ and FTT portfolios, and then again with the consistent sample CPP$^{\Delta}$ and FTT portfolios. We report the results on the difference-in-difference (DID) analysis between the FTT and CPP$^{\Delta}$ portfolios for each of the parameters in the adjacent columns.. Our sample size for the regression on each portfolio is 2,329 observations representing the portfolio's daily returns during the testing period. *p*-values based on the Newey–West standard errors are reported in parentheses below the coefficient estimates.

Estimated parameter	Sample with entry and exit			Consistent sample		
	CPP$^{\Delta}$	FTT	DID (FTT–CPP$^{\Delta}$)	CPP$^{\Delta}$	FTT	DID (FTT–CPP$^{\Delta}$)
α	0.31159*	1.18502*	0.87343*	0.31097*	1.18502*	0.87406*
	(0.0000)	(0.0000)	(0.0001)	(0.0000)	(0.0000)	(0.0000)
γ	−0.00009	−0.00262	−0.00172	−0.00009	−0.00262	−0.00169
	(0.1478)	(0.4786)	(0.6499)	(0.1335)	(0.4786)	(0.6569)
ϕ_1	−0.13176*	−0.44318*	−0.31255	−0.13306*	−0.44318*	−0.31125
	(0.0000)	(0.0174)	(0.0953)	(0.0000)	(0.0174)	(0.0967)
ϕ_2	−0.05650*	0.03518	0.09167*	−0.05910*	0.03518	0.09430
	(0.0042)	(0.7554)	(0.4234)	(0.0028)	(0.7554)	(0.4103)
ϕ_4	−0.12716*	0.12752	0.25468*	−0.123227*	0.12752	0.25073*
	(0.0000)	(0.2602)	(0.0269)	(0.0000)	(0.2602)	(0.0293)
ϕ_5	−0.06947*	0.48351*	0.55298*	−0.06475*	0.48351*	0.54826*
	(0.0296)	(0.0098)	(0.0034)	(0.0428)	(0.0098)	(0.0037)
R^2	0.5608	0.4492		0.5404	0.4492	

* indicates significance at α level of 5%.

adjusted in the long run in Regimes 4 and 5, with the adjustment being the highest for the CPP portfolio. The NCPP portfolio, however, exhibits the least relative adjustment in Regimes 4 and 5.

For further illustration, we plot the average systematic variances for each portfolio estimated using a 252-day moving window, and present the results in Fig. 3 Panel A (allowing for entry and exit) and Panel B (the consistent sample). We also present the average total variance per regime in Fig. 4 Panel A (allowing for entry and exit) and Panel B (the consistent sample).

5.3.3. Changes in idiosyncratic variance across the 5 regimes

Results on the idiosyncratic variance in Table 4 are very similar to the results on the total variance. The idiosyncratic variance is higher during the CPP disbursement period (Regime 3) than any of the other regimes as indicated by the significant, negative coefficients ϕ_1, ϕ_2, ϕ_4, and ϕ_5 in panels C and F. Individually, the NCPP portfolio, again, experienced the sharpest increase in total variance during Regime 3, yet also the sharpest decrease in Regimes 4 and 5. In relative terms, however, the CPP portfolio exhibited the slowest relative adjustment in Regimes 4 and 5, while the NBANK portfolio exhibited the fastest relative adjustment in these regimes. In other words, the market is perceiving a general long term increase in idiosyncratic risk over the four years following the CPP disbursement period with banking institutions, whether they participated in CPP or not, but the increase in idiosyncratic risk is higher for CPP firms than for NCPP firms.

These relative changes in the levels are presented in the Figs. 3 and 6 for better illustration. We plot the average idiosyncratic variances for each portfolio estimated using a 252-day moving window and present the results in Fig. 5 Panel A (allowing for entry and exit) and Panel B (the consistent sample). We also present the average total variance per regime in Fig. 6 Panel A (allowing for entry and exit) and Panel B (the consistent sample).

5.4. Changes in the ratio of average systematic variance to average idiosyncratic variance across the five regimes

We calculate the ratio of systematic to idiosyncratic variance, δ_{pt}, and estimate Eq. (10), providing the results for each of the portfolios allowing for entry and exit in Panel A of Table 5, and then again for the consistent sample in Panel B of Table 5. The ratio of systematic to idiosyncratic variance, δ_{pt}, provides a means of testing for shifts in the risk composition that is not sensitive to general changes in the total risk, especially during periods of high fluctuations such as our analysis period. An increase in this ratio indicates that systematic risk is increasing relative to idiosyncratic risk; a decrease in this ratio indicates that systematic risk is decreasing relative to idiosyncratic risk irrespective of the total risk level.

In Table 5 we show that the NBANK portfolio exhibits a sharp increase in the ratio, $\delta_{pt,}$ between Regimes 1 and 3, indicated by the significant, negative ϕ_1 and ϕ_2, and does not adjust back to pre-CPP levels in Regimes 4 and 5. That is, the NBANK portfolio exhibits the sharpest decline in relative idiosyncratic risk and sustains this low relative idiosyncratic risk consistently through 2013. The NCPP portfolio's ratio exhibits an increase in Regimes 2 and 3 (up from Regime 1), a decrease in Regime 4 (negative ϕ_4 value) then increases again in Regime 5 (insignificant ϕ_5). The δ_{pt} for the CPP portfolio, however, increases leading to Regime 3 then drops again in regimes 4 and 5. The DID analysis shows that while the drop in the ratio is higher in the CPP portfolio compared to the NCPP portfolio in Regime 4, it is not different in Regime 5. The results are similar when we repeat the analysis for the consistent sample.

In summary, these results suggest that the relative idiosyncratic risk in the CPP portfolio stabilized at higher levels in the four years following the CPP disbursement period than its pre disbursement levels in comparison to both the NCPP and NBANK portfolios. These results further support the analysis presented in Section 4.2. We plot the ratio for each portfolio estimated using a 252-day moving window and present the results in Fig. 7 Panel A (allowing for entry and exit) and Panel B (the consistent sample). We also present the average ratio per portfolio per regime in Fig. 8 Panel A (allowing for entry and exit) and Panel B (the consistent sample).

For further illustration, we present the time series of the difference between the ratio of the CPP portfolio and the ratio of the NCPP portfolio (δ_{CPP} - δ_{NCPP}) in Panel A of Fig. 9 and the difference between the ratio of the CPP portfolio and the ratio of the NBANK portfolio (δ_{CPP} - δ_{NBANK}) in Panel B of the same figure.[31]

[31] For further robustness, we matched firms in the different groups using propensity score matching and repeated the analysis presented in earlier sections on the matched firms in each group. The results remained consistent with the results presented in Section 5. These results are available upon request.

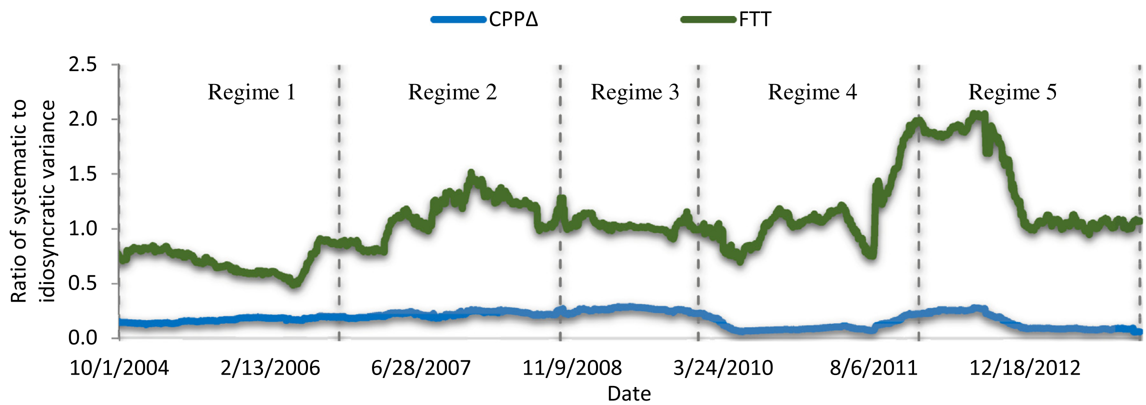


Fig. 11. Ratio of systematic variance to idiosyncratic variance, 2004 Q4 – 2013 Q4. The moving average of the ratio of systematic variance to idiosyncratic variance, δ_{pt}, for the CPP^{Δ} and FTT portfolios.

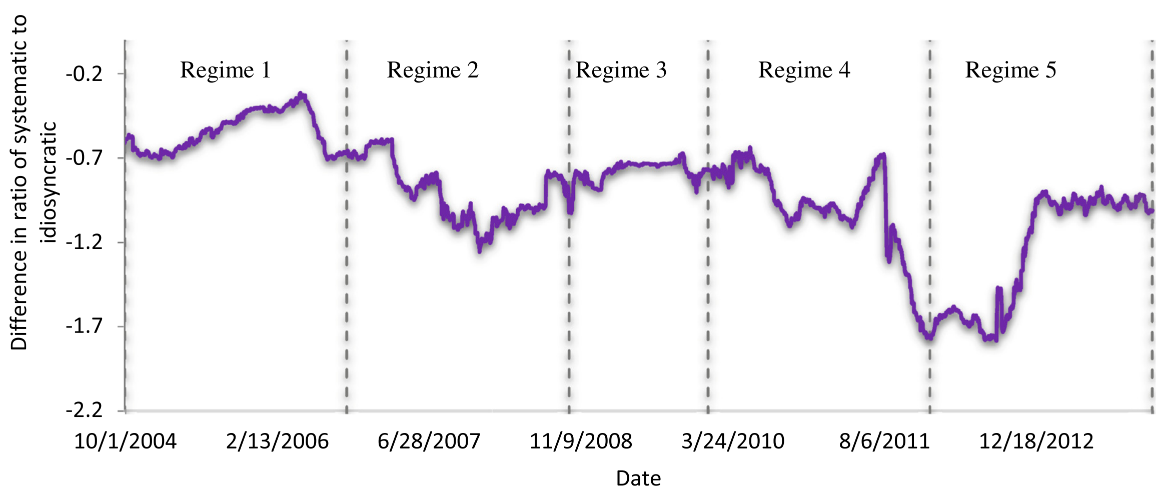


Fig. 12. Difference in the ratios of systematic variance to idiosyncratic variance, 2004 Q4 – 2013 Q4, between CPP participants without forced-to-take and forced-to-take. The moving average of the differences in the portfolio ratios of systematic variance to idiosyncratic variance, δ_{pt}, between CPP^{Δ} and FTT portfolios.

5.5. Analysis of FTT banks

We re-estimated our models, splitting the CPP portfolios into two portfolios: the eight large banks that passed the SCAP stress tests that were required to participate in CPP (the forced-to-take portfolio or FTT), and the other CPP participants in our sample, which we refer to as the CPP^{Δ} portfolio. This allows us to test whether the signal was different for the FTT banks in our CPP portfolio. We provide descriptive statistics on the average firm size and number of firms for each portfolio in presented in Table 6 from 2004 to 2013.

We repeat the analysis conducted on the CPP, NCPP and NBANK portfolios we conducted in the earlier sections on the CPP^{Δ} and FTT portfolios. We provide the estimate of Eq. (4) for the CPP^{Δ} and FTT portfolios for the total, systematic and idiosyncratic variance in Table 7. Both portfolios experienced higher total, systematic, and idiosyncratic variances during the CPP disbursement period as indicated by the negative and significant coefficients ϕ_1, ϕ_2, ϕ_4, and ϕ_5 for each of the three forms of risk. However, the difference-in-difference tests indicates that the FTT firms had the greater increase in all three variance measures leading up to regime 3 and then greater decrease afterwards in regimes 4 and 5.

Using DID, we show that the total variance for FTT is higher than CPP^{Δ}, but then drops faster to lesser levels than CPP^{Δ} in Regimes 4 and 5. The systematic variance for FTT is also higher than CPP^{Δ} in Regime 3 but drops faster in Regimes 4 and 5. Conversely, the idiosyncratic variance on for CPP^{Δ} is higher than FTT in Regime 3, but drops faster for FTT than CPP^{Δ} in Regime 4. The idiosyncratic variance of the CPP^{Δ} portfolio remains higher than the FTT portfolio's in Regimes 4 and 5. For further illustration, we present the time series on the total, systematic and idiosyncratic variances across the five regimes in the panels A, B and C of Fig. 10, respectively.

We proceed to estimate Eq. (10) for the FTT and CPP^{Δ} portfolios, and provide these results in Table 8. We see that the ratio of systematic to idiosyncratic variance, δ_{pt}, for the CPP^{Δ} portfolio increased in Regimes 1 and 2 leading up to Regime 3, it decreased again in Regimes 4 and 5. The FTT portfolio, however, exhibits a large increase in δ_{pt} in Regime 1, and then a sharp decline in Regime 5. The FTT has a consistently higher ratio of systematic to idiosyncratic risk across all regimes, but more so in the long run in Regimes 4 and 5. That is, the FTT portfolio exhibits a lower relative idiosyncratic variance in the regimes following the CPP disbursement period as compared to the CPP^{Δ} portfolio. For further illustration, we present the time series on the ratios in Fig. 11 and present the time series on the difference between the ratios ($\delta_{CPP\Delta} - \delta_{FTT}$) in Fig. 12. Both graphs illustrate the higher relative idiosyncratic risk for the CPP^{Δ} portfolio as compared to the banks that passed the SCAP stress tests, yet were required to participate in CPP. In other words, the market distinguished the risk characteristics of CPP participants, whether they were required to take the CPP or not.

6. Concluding remarks

The TARP funds were disbursed with the intention of maintaining the liquidity of the financial system during the financial crisis. The Capital Purchase Program, one component of TARP, provided funds to banks in exchange for preferred equity and warrants. The structure of the program presents the potential for moral hazard. In our study, we investigate the market's long-term perception of the risk associated with financial institutions participating in CPP to address the issue whether the market perceived these institutions as being riskier than non-participating institutions. A finding of increased risk is consistent with the idea that the market identified these banks as having a higher risk, possibly due to the lack of explicit controls inherent in the program or moral hazard.

We find that leading up to and including the crisis, the systematic and idiosyncratic variances of the stock returns of all financial institutions increased, indicating increased perceived risk for the industry as a whole. Following the TARP program, however, the long-term perceived risk of CPP participants, most notably the relative idiosyncratic risk of their common stock, witnessed and sustained a larger relative increase than those not participating, even four years after the disbursements were completed in 2009.

Further, we isolate those banks that were forced to participate in CPP, even though they did not fail the SCAP stress tests. We find that these banks were not perceived by the market to be as risky as the other CPP participants; in other words, the market may have considered that these specific banks, by virtue of passing the stress tests, did not have the risk associated with other participants.

As noted by Stern (1999), former President of the Federal Reserve Bank of Minneapolis, regulators are limited in their ability to assess the risk of banks. The market, though not privy to internal bank information, was able to perceive the additional risk inherent in the CPP program participants. This no-strings-attached capital introduced a risk that was apparently perceived by the market and persisted over time.

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