

ONLINE APPENDIX FOR SMALL BUSINESS LENDING UNDER  
THE PPP AND PPPLF COVID-RELATED GOVERNMENT  
PROGRAMS

JOSE A. LOPEZ  
MARK M. SPIEGEL

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*Lopez:* Federal Reserve Bank of San Francisco ([Jose.A.Lopez@sf.frb.org](mailto:Jose.A.Lopez@sf.frb.org)); *Spiegel:* Federal Reserve Bank of San Francisco ([Mark.Spiegel@sf.frb.org](mailto:Mark.Spiegel@sf.frb.org)). Remy Beauregard and Jack Mueller provided excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of San Francisco or the Federal Reserve System.

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## I. ROBUSTNESS CHECKS

This section reports the full results for the robustness checks reported in the text. The first table summarizes the coefficient point estimates and estimated standard errors for the key variables of interest, while the remaining tables in this section report the full results of each regression with the covariates and diagnostic statistics included. Please see table notes and descriptions in main paper for details.

Table 1. Robustness Checks: Summary

	(1)	(2)
	PPPR	PPPLFR
PPP and PPPLF both included	1.234*** (13.34)	-0.166 (-0.99)
Lgrowth	1.214*** (80.04)	1.322*** (4.41)
Lgrowth OLS	0.917*** (78.72)	0.0587** (15.95)
Lgrowth (Region)	1.234*** (15.90)	1.322*** (3.39)
Llevel	1.213*** (79.44)	1.321*** (4.48)
Llevel and Lgrowth	1.211*** (77.61)	1.328*** (4.53)
INDMIX inst	1.355*** (16.16)	1.583*** (6.52)
Tier1 risk caprat	1.215*** (96.22)	1.393*** (5.17)
Robust SE	1.216*** (6.95)	1.315*** (4.52)
Regular SE	1.216*** (7.34)	1.315*** (4.66)
WLS	1.153*** (8.42)	-0.0886 (-0.05)
5%-95% Wins	1.216*** (80.30)	1.315*** (4.36)
No winsor	-2.470 (12.80)	-12.21 (9.11)
1% winsor	1.569*** (0.133)	0.725*** (0.0682)
Truncate	2.894*** (0.542)	1.459*** (0.271)

Note: Summary statistics for variables of interest. Full regression results are below. Instrumental variables estimation with standard errors in parentheses clustered by bank size unless otherwise indicated. See text for description of instruments. Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. "PPP and PPPLF both included" runs base spec. with both PPP and PPPLF. "Lgrowth" regressions include lagged lending growth from 2019Q4 to 2020Q2 as specified, while "Llevel" adds lending in levels for 2019Q4. "INDMIX" uses the *INDMIX* variable as an instrument, as described in text. "Tier1" adds 2019Q4 value of risk-adjusted tier 1 capital ratio. "Robust SE" and "Regular SE" refer to heteroscedasticity-robust and conventional standard errors respectively. "WLS" runs weighted least squares, with weighting by the intensity of SME lending. "5%-95% Wins" winsorizes at the 5/95 percent level. "No winsor" is without winsorization, "1% winsor" are 1% winsorization, and "Truncate" are truncated regressions.

Table 2. Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
	PPP and PPPLF	OLS	Lgrowth	Lgrowth	Lgrowth (Region)	Lgrowth (Region)
PPP	1.234*** (13.34)	0.917*** (78.72)	1.214*** (80.04)		1.214*** (15.90)	
PPPLF	-0.166 (-0.99)	0.0587** (15.95)		1.322*** (4.41)		1.322*** (3.39)
INDMIX	0.543*** (3.41)	0.665* (9.12)	0.408** (2.80)	0.777*** (9.20)	0.408* (2.13)	0.777** (2.96)
LIQUIDITY	0.0853 (0.71)	0.222 (2.55)	0.0909 (1.54)	0.714*** (4.75)	0.0909*** (3.36)	0.714*** (13.30)
DEPOSITS	-0.161 (-1.54)	-0.115 (-1.94)	-0.0384 (-0.76)	0.458** (2.99)	-0.0384 (-0.30)	0.458 (1.19)
CAPRAT	0.474*** (5.04)	0.486* (9.75)	0.428*** (7.87)	0.937** (2.62)	0.428** (3.13)	0.937* (2.49)
COMMITMENT	-1.179** (-3.18)	-0.566 (-2.05)	-1.170*** (-5.16)	1.116*** (7.27)	-1.170*** (-3.32)	1.116*** (3.74)
$\Delta$ DEPOSITS	-0.990** (-2.58)	-0.756** (-17.54)	-0.429*** (-13.37)	1.795* (2.42)	-0.429* (-2.25)	1.795 (1.42)
SMALL	0.101*** (7.83)	0.0283 (2.21)	0.0960*** (12.93)	-0.139*** (-5.13)	0.0960*** (4.08)	-0.139*** (-4.95)
MED	0.0718*** (10.60)	0.0469* (5.43)	0.0574*** (9.89)	0.00487 (0.31)	0.0574** (2.65)	0.00487 (0.27)
LGROWTH	-0.0953*** (-3.87)		-0.0833*** (-6.33)	-0.0488 (-1.52)	-0.0833 (-1.61)	-0.0488 (-0.83)
Constant	-0.0607 (-0.69)	0.0135 (0.34)	-0.151*** (-4.34)	-0.277 (-1.20)	-0.151 (-1.55)	-0.277 (-0.68)
Observations	4056	4067	4443	4061	4443	4061

Note: Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. *PPP* is ratio of *PPP* participation to small business and farm lending; *PPPLF* is ratio of borrowing from the *PPPLF* program to *PPP* lending; *INDMIX* is  $\text{Sum}(Z_j * s_{ij})$  in 2019; *LIQUIDITY* is total liquidity in 2019Q4; *DEPOSITS* are the total deposits in 2019Q4; *COMMITMENT* are the unused commitments in 2019Q4;  $\Delta$ *DEPOSITS* are the change in deposits between 2019 Q4 and 2020 Q2; *CAPRAT* represents total capital ratios; and *SMALL* and *MED* are dummy variables for small and medium sized banks, respectively. *LGROWTH* is lending growth from 2019Q4 to 2020Q2. Lgrowth refers to specifications with *LGROWTH* (lagged growth) added. (Region) refers to specifications with clustering by region, rather than size. Instrumental variables estimation with standard errors in parentheses.

Table 2. Robustness Checks (cont.)

	(6)	(7)	(8)	(9)
	Llevel	Llevel	Llevel and Lgrowth	Llevel and Lgrowth
PPP	1.213*** (79.44)		1.211*** (77.61)	
PPPLF		1.321*** (4.48)		1.328*** (4.53)
INDMIX	0.379** (2.83)	0.776*** (10.78)	0.412** (2.80)	0.789*** (10.37)
LIQUIDITY	0.0950 (1.61)	0.709*** (4.98)	0.0915 (1.55)	0.720*** (5.00)
DEPOSITS	-0.0260 (-0.54)	0.456** (2.88)	-0.0397 (-0.78)	0.450** (2.93)
CAPRAT	0.460*** (8.21)	0.944* (2.54)	0.426*** (7.77)	0.918* (2.51)
COMMITMENT	-1.196*** (-5.32)	1.127*** (7.19)	-1.162*** (-5.18)	1.145*** (7.27)
$\Delta$ DEPOSITS	-0.412*** (-13.94)	1.812* (2.52)	-0.433*** (-14.38)	1.821* (2.56)
SMALL	0.0921*** (10.78)	-0.184*** (-6.37)	0.0942*** (11.20)	-0.183*** (-6.33)
MED	0.0528*** (7.62)	-0.0393* (-2.08)	0.0561*** (8.30)	-0.0372* (-2.03)
LGROWTH			-0.0831*** (-6.34)	-0.0466 (-1.42)
LLEVEL	-5.28e-10 (-0.64)	-1.50e-08*** (3.33e-09)	-4.85e-10 (-0.61)	-1.50e-08*** (-4.61)
Constant	-0.161*** (-4.96)	-0.231 (-0.96)	-0.147*** (-4.41)	-0.226 (-0.96)
Observations	4456	4061	4443	4061

Note: Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. *PPP* is ratio of *PPP* participation to small business and farm lending; *PPPLF* is ratio of borrowing from the *PPPLF* program to *PPP* lending; *INDMIX* is  $\text{Sum}(Z_j * s_{ij})$  in 2019; *LIQUIDITY* is total liquidity in 2019Q4; *DEPOSITS* are the total deposits in 2019Q4; *COMMITMENT* are the unused commitments in 2019Q4;  $\Delta$ *DEPOSITS* are the change in deposits between 2019 Q4 and 2020 Q2; *CAPRAT* represents total capital ratios; and *SMALL* and *MED* are dummy variables for small and medium sized banks, respectively. *LLEVEL* is lending level in 2019Q4. Llevel refers to specifications with *LLEVEL* (lagged lending levels) added. Llevel and Lgrowth refers to specifications with lagged levels and growth in lending added. Instrumental variables estimation with standard errors in parentheses.

Table 2. Robustness Checks (cont.)

	(10)	(11)	(12)	(13)
	Third inst	Third inst	Tier1	Tier1
PPP	1.355*** (16.16)		1.215*** (96.22)	
PPPLF		1.583*** (6.52)		1.393*** (5.17)
INDMIX			0.410** (2.97)	0.861*** (7.81)
LIQUIDITY	0.0685 (0.96)	0.745*** (5.13)	0.0615 (1.28)	0.520*** (3.78)
DEPOSITS	0.0261 (0.38)	0.684*** (6.75)	-0.102** (-3.25)	0.504*** (6.91)
CAPRAT	0.563*** (7.34)	1.219*** (3.95)		
COMMITMENT	-1.530*** (-4.05)	1.020*** (5.56)	-1.151*** (-5.30)	1.313*** (7.02)
$\Delta$ DEPOSITS	-0.210 (-1.53)	2.603*** (4.65)	-0.408*** (-24.50)	2.050** (3.15)
SMALL	0.120*** (8.13)	-0.136*** (-6.51)	0.0937*** (11.94)	-0.147*** (-5.58)
MED	0.0577*** (10.04)	0.00507 (0.41)	0.0530*** (8.93)	-0.00231 (-0.16)
TIER1			0.143*** (4.80)	0.650*** (8.43)
Constant	-0.267*** (-3.62)	-0.517** (-3.15)	-0.0667*** (-4.44)	-0.302* (-2.34)
Observations	4456	4073	4456	4073

Note: Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. *PPP* is ratio of *PPP* participation to small business and farm lending; *PPPLF* is ratio of borrowing from the PPPLF program to PPP lending; *INDMIX* is  $\text{Sum}(Z_j * s_{ij})$  in 2019; *LIQUIDITY* is total liquidity in 2019Q4; *DEPOSITS* are the total deposits in 2019Q4; *COMMITMENT* are the unused commitments in 2019Q4;  $\Delta$ *DEPOSITS* are the change in deposits between 2019 Q4 and 2020 Q2; *CAPRAT* represents total capital ratios; and *SMALL* and *MED* are dummy variables for small and medium sized banks, respectively. *TIER1* is tier 1 risk-adjusted capital ratio. Third inst refers to specifications with *INDMIX* added as a third instrument rather than as an independent regressor. Tier1 refers to specifications with tier 1 risk-adjusted capital ratios substituted for total capital ratios. Instrumental variables estimation with standard errors in parentheses.

Table 2. Robustness Checks (cont.)

	(1)	(2)	(3)	(4)	(5)	(6)
	No winsor	No winsor	1% winsor	1% winsor	Truncate	Truncate
PPP	-2.470 (12.80)		1.569*** (0.133)		2.894*** (0.542)	
PPPLF		-12.21 (9.113)		0.725*** (0.0682)		1.459*** (0.271)
LIQUIDITY	1.540 (2.440)	-0.283 (0.451)	0.235*** (0.0423)	0.892*** (0.126)	-0.156 (0.278)	0.571*** (0.135)
DEPOSITS	-1.319* (0.527)	-12.02 (8.792)	-0.0832 (0.0808)	-0.259*** (0.0138)	-0.512 (0.404)	0.730*** (0.148)
CAPRAT	3.539 (6.241)	-1.243 (3.709)	1.013*** (0.0687)	0.639*** (0.132)	2.283*** (0.250)	0.922** (0.299)
COMMIT	-0.155 (1.378)	-5.158 (7.611)	-0.140 (0.0766)	1.349*** (0.258)	-0.354 (0.310)	0.928*** (0.134)
$\Delta$ DEPOSITS	-23.10 (45.00)	-56.54 (38.84)	-0.841*** (0.154)	-1.664*** (0.258)	7.266*** (1.149)	3.089*** (0.596)
SMALL	-1.989 (6.744)	-2.147 (1.475)	0.310*** (0.0564)	-0.241*** (0.0130)	1.219*** (0.277)	-0.101*** (0.0197)
MED	0.571 (2.837)	0.295 (0.739)	0.149*** (0.0197)	-0.0582*** (0.00929)	0.586*** (0.110)	0.0263* (0.0107)
Constant	3.446 (10.21)	13.65 (9.201)	-0.509*** (0.0480)	0.497*** (0.0393)	-1.604*** (0.0834)	-0.544** (0.202)
Observations	4719	4074	4719	4074	4719	4074
$R^2$	.	.	0.285	0.124	.	.

Note: Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. *PPP* is ratio of *PPP* participation to small business and farm lending; *PPPLF* is ratio of borrowing from the PPPLF program to PPP lending; *INDMIX* is  $Sum(Z_j * s_{ij})$  in 2019; *LIQUIDITY* is total liquidity in 2019Q4; *DEPOSITS* are the total deposits in 2019Q4; *COMMITMENT* are the unused commitments in 2019Q4;  $\Delta$ *DEPOSITS* are the change in deposits between 2019 Q4 and 2020 Q2; *CAPRAT* represents total capital ratios; and *SMALL* and *MED* are dummy variables for small and medium sized banks, respectively. No winsor refers to specifications without winsorization. 1% winsor refers to specifications with 1%-99% winsorization. Truncate refers to specifications truncated at a 5% and 95% levels rather than winsorized. Instrumental variables estimation with standard errors in parentheses.

Table 2. Robustness Checks (cont.)

	(1)	(2)	(3)	(4)	(5)	(6)
	TOBIT	TOBIT	TOBIT	TOBIT	PPP 1st stg	PPPLF 1st stg
COUNT	0.0803* (0.0353)	1.165*** (0.0744)	0.0565*** (0.000656)	1.153*** (0.0944)	0.0318*** (0.000834)	0.751*** (0.0368)
COLLATERAL	0.150*** (0.0363)	0.297*** (0.0545)	0.0717** (0.0250)	0.268** (0.0821)	0.0347 (0.0294)	0.144* (0.0570)
SBA2019	0.573*** (0.0118)	1.516*** (0.0958)	0.613*** (0.0432)	1.534*** (0.118)	0.252** (0.0807)	-0.486** (0.160)
SMALL			-0.287*** (0.0176)	-0.0544 (0.0501)	-0.193*** (0.0287)	-0.0393 (0.0711)
MED			-0.0627*** (0.00938)	0.0578* (0.0293)	-0.0239 (0.0161)	-0.0125 (0.0339)
INDMIX					0.757*** (0.218)	3.866*** (0.774)
LIQUIDITY					0.162* (0.0704)	-1.436*** (0.0586)
DEPOSITS					-0.324*** (0.0357)	-3.185*** (0.293)
CAPRAT					-0.788*** (0.0755)	-5.646*** (1.154)
COMMITMENT					2.508*** (0.175)	2.312*** (0.660)
$\Delta$ DEPOSITS					-1.544*** (0.0490)	-8.446*** (0.181)
Constant	0.190*** (0.00928)	-2.157*** (0.149)	0.473*** (0.0192)	-2.106*** (0.193)	0.679*** (0.0362)	1.794*** (0.293)
Observations	4456	4073	4456	4073	4456	4073

Note: Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. *PPP* is ratio of *PPP* participation to small business and farm lending; *PPPLF* is ratio of borrowing from the PPPLF program to PPP lending; *INDMIX* is  $Sum(Z_j * s_{ij})$  in 2019; *LIQUIDITY* is total liquidity in 2019Q4; *DEPOSITS* are the total deposits in 2019Q4; *COMMITMENT* are the unused commitments in 2019Q4;  $\Delta$ *DEPOSITS* are the change in deposits between 2019 Q4 and 2020 Q2; *CAPRAT* represents total capital ratios; and *SMALL* and *MED* are dummy variables for small and medium sized banks, respectively. TOBIT estimation of first stage regressions for PPP and PPPLF ratios as indicated. Instrumental variables estimation with standard errors in parentheses.



## II. PROGRAM EFFECTS ON BANK CAPITAL RATIOS

This section reports results for the movement in bank capital ratios over our sample period. We consider both growth in the total capital ratio,  $CAPRAT$ , and growth in tier 1 risk-based capital ratios,  $T1CAPRAT$ . The distinction is important, as additional lending under the PPP would negatively effect a bank's measured total capital ratio, but since the loans were guaranteed by the Treasury, they should not harm a bank's risk-adjusted capital ratio. Indeed, if a bank substituted lending under the guaranteed PPP (which receives a zero risk weight) for a loan which carries some level of risk, tier-1 capital ratios should increase with PPP participation. We also investigate the robustness of our results to OLS estimation.

Our results are shown in Table ???. We first examine growth in banks' total capital ratios. Columns 1 and 2 repeat our base IV specification with the  $PPP$  and  $PPPLF$  variables included respectively. We obtain a statistically significant negative coefficient point estimate for both variables. Our coefficient point estimates indicate that a one standard deviation increase in  $PPP$  is predicted to be associated with 8.1 percentage point decrease in total capital ratio growth, while a one standard deviation increase in  $PPPLF$  is predicted to be associated with a 6.7 percentage point decrease in total capital ratio growth. Columns 3 and 4 repeat the specification under ordinary least squares with clustered standard errors. Our results remain negative for both variables of interest, but our coefficient point estimates are smaller and both of our variables of interest are only significant at 10% confidence levels.

Columns 5 and 6 report the impact of PPP and PPPLF participation on tier-1 risk-adjusted capital ratios, again with our base IV specification and the same instruments. In contrast to our results for total capital ratios, these specifications yield statistically significant negative coefficient estimates on both  $PPP$  and  $PPPLF$ . Our point estimates indicate that a one standard deviation increase in  $PPP$  is predicted to be associated with 26.6 percentage point *increase* in total capital ratio growth, while a one standard deviation increase in  $PPPLF$  is predicted to be associated with a 22.9 percentage point increase in tier 1 capital ratio growth.<sup>1</sup>

The discrepancy in these results are attributable to the difference in the calculation of total and tier-1 capital ratios. As shown above, participation in both the PPP

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<sup>1</sup>We also estimated the impact of PPP and PPPLF participation on tier-1 capital ratio growth. Our IV results were robust to this perturbation, as both  $PPP$  and  $PPPLF$  continued enter significantly positive. These results were not shown for space considerations, but are available on request from the authors.

Table 3. Growth in bank capital ratios

	(1)	(2)	(3)	(4)	(5)	(6)
	Full	Full	SM/MED Banks	SM/MED Banks	LG Banks	LG Banks
PPP	-0.105*** (0.00800)		-0.100*** (0.00503)		-0.0226 (0.0241)	
INDMIX	0.0513*** (0.0106)	-0.00424 (0.00301)	0.0504*** (0.0124)	-0.00606 (0.00524)	-0.0219 (0.0700)	0.0488 (0.106)
LIQUIDITY	0.0100*** (0.00212)	-0.0353*** (0.00461)	0.00939*** (0.00184)	-0.0378*** (0.00132)	0.0694 (0.0625)	0.111 (0.0647)
DEPOSITS	0.0142** (0.00532)	0.00451 (0.0122)	0.0154*** (0.00369)	0.0173*** (0.00191)	-0.0410 (0.0346)	-0.187 (0.218)
CAPRAT	-0.0437*** (0.00981)	-0.0292 (0.0191)	-0.0378*** (0.00416)	-0.00955 (0.0122)	-0.112 (0.0729)	-0.184 (0.226)
COMMITMENT	-0.161* (0.0638)	-0.397*** (0.0509)	-0.208*** (0.0307)	-0.437*** (0.0155)	0.0141 (0.0437)	-0.00666 (0.0517)
$\Delta$ DEPOSITS	0.357*** (0.0593)	0.297*** (0.0470)	0.369*** (0.0528)	0.320*** (0.0388)	-0.0228 (0.0761)	-0.122 (0.248)
SMALL	-0.0338*** (0.00174)	-0.0170*** (0.00269)	-0.0182*** (0.000681)	-0.00424*** (0.000261)		
MED	-0.0156*** (0.000961)	-0.0137*** (0.00146)				
PPPLF		-0.0774*** (0.00686)		-0.0709*** (0.00772)		-0.0502 (0.0888)
Constant	0.0371*** (0.00731)	0.0144 (0.00796)	0.0200*** (0.00470)	-0.0105* (0.00472)	0.0327 (0.0340)	0.147 (0.215)
Observations	4463	4083	4336	3970	127	113
$R^2$	0.364	0.147	0.374	0.171	0.240	.

Note: Dependent variable: Growth in small business or farm lending from 2019Q4 through 2020Q2. *PPP* is ratio of *PPP* participation to small business and farm lending; *PPPLF* is ratio of borrowing from the *PPPLF* program to *PPP* lending; *INDMIX* is  $\sum(Z_j * s_{ij})$  in 2019; *LIQUIDITY* is total liquidity in 2019Q4; *DEPOSITS* are the total deposits in 2019Q4; *COMMITMENT* are the unused commitments in 2019Q4;  $\Delta$ *DEPOSITS* are the change in deposits between 2019 Q4 and 2020 Q2; *CAPRAT* represents total capital ratios; and *SMALL* and *MED* are dummy variables for small and medium sized banks, respectively. Full (columns 1 and 2) refers to specifications with full sample of banks, SM/MED (columns 3 & 4) reports results for sub-sample of small and medium sized banks, LG (columns 5 & 6) reports results for sub-sample of large banks. Instrumental variables estimation with standard errors in parentheses.

Full (columns 1 and 2) is the full sample of banks, SM/MED (columns 3 & 4) represents the sample of small and medium sized banks, LG (columns 5 & 6) represents the sample of large banks.

and the PPPLF programs were associated with increased lending. This expanded bank balance sheets and lowered total capital ratios, which one could erroneously associate with increased bank vulnerability. However, as our risk-adjusted capital ratio results demonstrate, such an inference would be incorrect, as the risk associated with the increase in bank balance sheets under these programs were borne largely by the US Treasury, not by the banks themselves. Indeed, our negative coefficients demonstrate that despite increased lending activity, bank vulnerability was actually lowered through greater participation in these programs on average.