

**ONLINE APPENDIX FOR PERSISTENT EFFECTS OF THE
PAYCHECK PROTECTION PROGRAM AND THE PPPLF ON
SMALL BUSINESS LENDING**

LORA DUFRESNE
MARK M. SPIEGEL

ABSTRACT. This online appendix for "Persistent Effects of the Paycheck Protection Program and the PPPLF on Small Business Lending" contained additional robustness checks and data information. See text for variable definitions and other details.

Date: August 7, 2024.

Dufresne: Federal Reserve Bank of San Francisco (Lora.Dufresne@sf.frb.org); Spiegel: Federal Reserve Bank of San Francisco (Mark.Spiegel@sf.frb.org). 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.

TABLE O.A1. Summary Statistics for Conditioning Variables by Bank Size

SAMPLE		<i>N</i>	Median	Mean	SD	Min	Max
FULL	<i>LIQUID</i>	4,079	0.068	0.088	0.071	0.013	0.338
	<i>COMMIT</i>	4,079	0.023	0.032	0.032	0.000	0.132
	<i>DEPOSITS</i>	4,079	0.849	0.837	0.054	0.651	0.909
	<i>TIER1CAP</i>	4,079	0.151	0.172	0.069	0.104	0.487
	<i>PROB</i>	4,079	0.012	0.017	0.016	0.000	0.071
SMALL	<i>LIQUID</i>	3,415	0.074	0.094	0.073	0.013	0.338
	<i>COMMIT</i>	3,415	0.019	0.027	0.028	0.000	0.132
	<i>DEPOSITS</i>	3,415	0.854	0.841	0.053	0.651	0.909
	<i>TIER1CAP</i>	3,415	0.157	0.178	0.072	0.104	0.487
	<i>PROB</i>	3,415	0.013	0.018	0.017	0.000	0.071
MID	<i>LIQUID</i>	554	0.043	0.059	0.048	0.013	0.338
	<i>COMMIT</i>	554	0.046	0.054	0.037	0.000	0.132
	<i>DEPOSITS</i>	554	0.834	0.821	0.055	0.651	0.909
	<i>TIER1CAP</i>	554	0.130	0.142	0.041	0.104	0.487
	<i>PROB</i>	554	0.009	0.011	0.011	0.000	0.071
LARGE	<i>LIQUID</i>	110	0.036	0.055	0.056	0.013	0.338
	<i>COMMIT</i>	110	0.073	0.075	0.044	0.000	0.132
	<i>DEPOSITS</i>	110	0.788	0.786	0.058	0.651	0.909
	<i>TIER1CAP</i>	110	0.123	0.132	0.035	0.104	0.354
	<i>PROB</i>	110	0.009	0.013	0.013	0.001	0.071

Note: Winsorized at 2.5%-97.5% levels. *LIQUID* measures bank cash and security holdings as a share of total assets, as a measure of bank liquidity. *DEPOSITS* measures core deposits relative to total assets to capture a bank's reliance on deposit funding. *TIER1CAP* is a measure of tier one capital relative to total risk-weighted assets. *COMMIT* is a measure of outstanding loan commitments. *PROB* is an aggregate measure of past-due and non-accrual "problem" loans relative to total assets all at the bank level.

TABLE O.A2. Changes in Specification PPPLF

	Drop Covariates	Total Capital	Lag % Δ SME	% Δ SMEPPP	% Δ SMELT	HighPPP
PPPLF	0.594*** (0.0347)	0.601*** (0.0520)	0.649*** (0.0513)	1.783*** (0.0148)	0.140** (0.0486)	
SMALLBANK	-0.00390*** (0.000473)	0.0338*** (0.000947)	0.0252*** (0.000539)	-0.0325** (0.0103)	0.0374*** (0.00188)	0.0363*** (0.000947)
MIDBANK	-0.0197*** (0.000161)	-0.00218*** (0.000499)	-0.00744*** (0.000635)	-0.0416*** (0.00261)	0.0146*** (0.00131)	0.00261*** (0.000211)
LIQUID		0.188*** (0.0169)	0.164*** (0.0214)	0.338*** (0.0421)	0.0301*** (0.00742)	0.187*** (0.0168)
COMMIT		0.0565 (0.0806)	0.0652 (0.103)	0.748*** (0.161)	0.0312 (0.0714)	0.0699 (0.0888)
DEPOSITS		0.0649 (0.0362)	0.0571 (0.0402)	0.140* (0.0625)	0.0382 (0.0248)	0.0706 (0.0415)
TOTCAP		0.103*** (0.0184)				
SME19H2		-0.345*** (0.0171)	-0.309*** (0.0201)	-0.647*** (0.0315)	-0.111*** (0.0294)	-0.351*** (0.0151)
PROB		-0.127*** (0.00893)	-0.175*** (0.00631)	-0.633*** (0.153)	-0.0180*** (0.00538)	-0.143*** (0.0160)
% Δ SME18			0.0112*** (0.000613)			
TIER1CAP			0.0450* (0.0178)	0.153*** (0.0229)	-0.0265 (0.0143)	0.0945*** (0.0261)
HIGHPPPLF						0.136*** (0.0152)
CONSTANT	0.0716*** (0.00125)	0.0137 (0.0385)	0.0244 (0.0434)	0.0697 (0.0588)	-0.0168 (0.0296)	0.000376 (0.0458)
<i>N</i>	4143	4079	4033	4079	4094	4079

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Column 1 drops all covariates. Column 2 replaces *TIER1CAP* with *TOTCAP*, a measure of a bank's total capital. Column 3 includes % Δ SME18, lagged growth in SME lending 2018H2 to 2019H2. Column 4 replaces % Δ SME with % Δ SMEPPP, average annualized growth in the sum of SME lending and PPP lending between 2019H2 and 2023H1. Column 5 replaces dependent variable % Δ SME with % Δ SMELT, cumulative growth in SME lending between 2019H2 and 2023H1. Column 6 replaces *PPPLF* with *HIGHPPPLF*, equal to 1 if a bank's *PPPLF* value is greater than the median value and 0 otherwise.

TABLE O.A3. Changes in Sample PPPLF

	Truncate	1-99	5-95	DFAST	NONDFAST
PPPLF	0.618*** (0.0570)	0.752*** (0.0147)	0.754*** (0.0948)	0.782 (3.152)	0.590*** (0.128)
LIQUID	0.0521*** (0.0154)	0.291*** (0.0243)	0.120*** (0.0159)	1.438** (0.491)	0.167*** (0.0356)
COMMIT	0.0987*** (0.0124)	0.00127 (0.0431)	0.0463 (0.0825)	-0.253 (1.196)	0.00534 (0.0871)
DEPOSITS	0.0673 (0.0351)	0.0528*** (0.00409)	0.0758 (0.0426)	1.054 (0.819)	0.0977* (0.0487)
TIER1CAP	0.0891*** (0.0225)	0.187*** (0.00969)	0.0484 (0.0282)	0.156 (1.300)	0.125** (0.0444)
SME19H2	-0.192*** (0.0168)	-0.483*** (0.0236)	-0.259*** (0.0191)	0.353 (0.906)	-0.284*** (0.0253)
PROB	-0.253*** (0.00951)	-0.0110 (0.0500)	-0.105*** (0.0276)	8.157 (5.791)	-0.129 (0.148)
SMALLBANK	0.0257*** (0.00268)	0.0108*** (0.000874)	0.0201*** (0.00119)		
MIDBANK	0.00146 (0.00191)	-0.0370*** (0.000432)	-0.00286 (0.00182)		
CONSTANT	-0.00924 (0.0342)	0.0555*** (0.00654)	0.00144 (0.0453)	-0.961 (0.681)	-0.00205 (0.0451)
<i>N</i>	3929	4079	4079	30	4049

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Column 1 truncates our base specification data set at 2.5%-97.5%. Column 2 winsorizes at the 1%-99% level. Column 3 winsorizes at the 5%-95% level. Column 4 reduces the sample to DFAST banks only. Column 5 reduces the sample to NONDFAST banks only.

TABLE O.A4. Changes in Estimation PPPLF

	OLS	Standard SE	Robust SE	Region Cluster	Tobit	Weight by SME Share
PPPLF	0.456 (0.0876)	0.632*** (0.127)	0.632*** (0.129)	0.632*** (0.101)	0.456*** (0.0915)	1.062*** (0.0976)
LIQUID	0.169* (0.0111)	0.171*** (0.0356)	0.171*** (0.0454)	0.171*** (0.0476)	0.170** (0.0566)	0.200*** (0.0301)
COMMIT	0.134 (0.139)	0.0822 (0.0888)	0.0822 (0.0952)	0.0822 (0.105)	0.135 (0.103)	-0.575** (0.213)
DEPOSITS	0.0175 (0.0279)	0.0641 (0.0493)	0.0641 (0.0558)	0.0641* (0.0279)	0.0176 (0.0331)	0.141*** (0.00640)
TIER1CAP	0.0308 (0.0139)	0.0836 (0.0453)	0.0836 (0.0597)	0.0836 (0.0648)	0.0312 (0.0932)	0.0570 (0.0534)
SME19H2	-0.332* (0.0214)	-0.330*** (0.0273)	-0.330*** (0.0308)	-0.330*** (0.0104)	-0.332*** (0.00734)	0.00956 (0.0677)
PROB	-0.178 (0.0514)	-0.143 (0.148)	-0.143 (0.159)	-0.143 (0.139)	-0.178 (0.169)	-0.697*** (0.0933)
SMALLBANK	0.0338* (0.000923)	0.0295 (0.0157)	0.0295 (0.0197)	0.0295 (0.0228)	0.0338 (0.0269)	-0.0589*** (0.00106)
MIDBANK	0.000597 (0.00102)	-0.00449 (0.0157)	-0.00449 (0.0193)	-0.00449 (0.0247)	0.000598 (0.0278)	-0.0381*** (0.000334)
CONSTANT	0.0606 (0.0309)	0.0138 (0.0449)	0.0138 (0.0524)	0.0138 (0.0354)	0.0603 (0.0458)	-0.0225 (0.0247)
var(e.%ΔSME)					0.0220*** (0.00295)	
<i>N</i>	4308	4079	4079	4079	4307	4079

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Column 1 uses OLS estimation. Column 2 replaces clustered SEs with standard SEs. Column 3 replaces clustered SEs with robust SEs. Column 4 clusters by region using the 4 standard regions of the U.S.: Northeast, South, Midwest, and West. Column 5 uses tobit estimation. Column 6 weights by SME share.

TABLE O.A5. High & Low Covariates, PPP

	Deposits High	Deposits Low	Tier1Cap High	Tier1Cap Low
PPP	0.757*** (0.144)	1.157*** (0.0337)	1.183*** (0.00351)	0.748*** (0.160)
COMMIT	-0.346*** (0.0172)	-0.186 (0.140)	-0.327*** (0.0747)	-0.260*** (0.0468)
DEPOSITS	0.221*** (0.0650)	-0.0766 (0.0631)	-0.0204 (0.0162)	0.0610*** (0.00188)
TIER1CAP	0.154*** (0.0394)	0.123*** (0.0143)	0.120*** (0.00123)	-0.107*** (0.0311)
SME19H2	-0.376*** (0.00172)	-0.369*** (0.000319)	-0.488*** (0.00333)	-0.281*** (0.00194)
PROB	0.0419 (0.0998)	0.159** (0.0596)	0.299*** (0.00516)	-0.250*** (0.0462)
SMALLBANK	-0.0165*** (0.00339)	0.0168*** (0.00506)	0.0181*** (0.00129)	-0.00387** (0.00142)
MIDBANK	-0.0417*** (0.00752)	-0.0211*** (0.00275)	-0.0507*** (0.000628)	-0.0213*** (0.00329)
CONSTANT	-0.0797 (0.0575)	0.116 (0.0592)	0.0947*** (0.0153)	0.0668*** (0.0166)
<i>N</i>	2085	1994	1889	2190

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: For PPP participation. Sample is divided in to two subsets by high and low covariate values. Observations are considered high if they are greater than the median value and low otherwise. Columns 1 and 2 are based on the median value of *DEPOSITS*, with column 1 restricting to the high subset and column 2 low. Columns 3 and 4 are based on the median value of *TIER1CAP*, with column 3 restricting to the high subset and column 4 low.

TABLE O.A6. High & Low Covariates, PPP

	SME19H2 High	SME19H2 Low	Prob High	Prob Low
PPP	0.992*** (0.0459)	1.071* (0.444)	1.106*** (0.0355)	0.829*** (0.156)
COMMIT	-0.313*** (0.0460)	-0.182*** (0.0362)	-0.573* (0.254)	-0.0784 (0.0523)
DEPOSITS	-0.0924*** (0.00544)	0.171*** (0.0139)	0.188*** (0.0506)	-0.118*** (0.0000654)
TIER1CAP	0.00329*** (0.000167)	0.0821*** (0.0230)	0.197*** (0.0235)	0.0469*** (0.00256)
SME19H2	-0.141*** (0.00884)	-1.099*** (0.103)	-0.416*** (0.00815)	-0.327*** (0.00658)
PROB	0.0424*** (0.0103)	0.311* (0.129)	-0.242*** (0.00538)	-1.890*** (0.386)
SMALLBANK	-0.0495*** (0.000194)	0.0538*** (0.0116)	-0.0136 (0.00770)	0.00947*** (0.00234)
MIDBANK	-0.0677*** (0.0000852)	-0.00110 (0.0133)	-0.0429*** (0.00287)	-0.0234*** (0.00316)
CONSTANT	0.172*** (0.00546)	-0.0317* (0.0133)	-0.0477 (0.0633)	0.188*** (0.00581)
<i>N</i>	2060	2019	1981	2098

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: For PPP participation. Sample is divided in to two subsets by high and low covariate values. Observations are considered high if they are greater than the median value and low otherwise. Columns 1 and 2 are based on the median value of *SME19H2*, with column 1 restricting to the high subset and column 2 low. Columns 3 and 4 are based on the median value of *PROB*, with column 3 restricting to the high subset and column 4 low.

TABLE O.A7. High & Low Covariates, PPPLF

	Deposits High	Deposits Low	Tier1Cap High	Tier1Cap Low
PPPLF	0.621*** (0.102)	0.771*** (0.0182)	1.057*** (0.0247)	0.503*** (0.109)
COMMIT	-0.0361 (0.0760)	0.224** (0.0704)	0.0635*** (0.00128)	0.0494 (0.0951)
DEPOSITS	0.355*** (0.0293)	0.0581 (0.0733)	0.103*** (0.0148)	0.155*** (0.0263)
TIER1CAP	0.195*** (0.0202)	0.156*** (0.0186)	0.155*** (0.000382)	0.123 (0.0889)
SME19H2	-0.326*** (0.0177)	-0.311*** (0.0168)	-0.444*** (0.00460)	-0.223*** (0.0305)
PROB	-0.130* (0.0513)	-0.183** (0.0623)	0.111** (0.0420)	-0.553*** (0.00691)
SMALLBANK	0.0140*** (0.000505)	0.0391*** (0.00176)	0.0520*** (0.000678)	0.0102*** (0.00224)
MIDBANK	-0.0153*** (0.00292)	-0.000949 (0.000844)	-0.0194*** (0.000332)	-0.00866*** (0.00215)
CONSTANT	-0.224*** (0.0198)	-0.00171 (0.0637)	-0.0309** (0.0119)	-0.0464 (0.0449)
<i>N</i>	2085	1994	1889	2190

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: For PPPLF participation. Sample is divided in to two subsets by high and low covariate values. Observations are considered high if they are greater than the median value and low otherwise. Columns 1 and 2 are based on the median value of *DEPOSITS*, with column 1 restricting to the high subset and column 2 low. Columns 3 and 4 are based on the median value of *TIER1CAP*, with column 3 restricting to the high subset and column 4 low.

TABLE O.A8. High & Low Covariates, PPPLF

	SME19H2 High	SME19H2 Low	Prob High	Prob Low
PPPLF	0.741*** (0.00836)	0.595** (0.227)	0.782*** (0.0464)	0.578*** (0.0594)
COMMIT	0.0626*** (0.0132)	0.219** (0.0684)	-0.282 (0.219)	0.304*** (0.00417)
DEPOSITS	-0.00335 (0.00533)	0.257*** (0.0170)	0.313*** (0.0468)	-0.0335 (0.0230)
TIER1CAP	-0.00676*** (0.00119)	0.138** (0.0527)	0.240*** (0.0269)	0.0635*** (0.00985)
SME19H2	-0.144*** (0.0107)	-0.845*** (0.253)	-0.353*** (0.0261)	-0.278*** (0.0133)
PROB	-0.182*** (0.0141)	-0.0344 (0.0604)	-0.474*** (0.0184)	-2.032*** (0.168)
SMALLBANK	-0.0566*** (0.00103)	0.0665*** (0.0126)	0.00593 (0.00412)	0.0313*** (0.00218)
MIDBANK	-0.0728*** (0.000592)	0.0129 (0.0107)	-0.0220*** (0.00107)	-0.00640*** (0.00116)
CONSTANT	0.135*** (0.00693)	-0.124** (0.0451)	-0.162** (0.0589)	0.104*** (0.0235)
<i>N</i>	2060	2019	1981	2098

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: For PPPLF participation. Sample is divided in to two subsets by high and low covariate values. Observations are considered high if they are greater than the median value and low otherwise. Columns 1 and 2 are based on the median value of *SME19H2*, with column 1 restricting to the high subset and column 2 low. Columns 3 and 4 are based on the median value of *PROB*, with column 3 restricting to the high subset and column 4 low.

TABLE O.A9. Late Sample Robustness

	Condition for % Δ SME1922		Drop SME22H1	
PPP	-0.836*** (0.0209)	-0.829*** (0.0323)	-0.830*** (0.0279)	
% Δ SME1922	0.00123 (0.000639)	0.00121 (0.000645)		
LIQUID22	-0.00405 (0.00571)	-0.00363 (0.00587)	-0.00427 (0.00580)	-0.0373*** (0.0104)
COMMIT22	0.375*** (0.0495)	0.379*** (0.0526)	0.376*** (0.0524)	0.157 (0.0947)
DEPOSITS22	0.0230 (0.0636)	0.0299 (0.0712)	0.0283 (0.0706)	-0.0813 (0.0676)
TIER1CAP22	-0.0635*** (0.00520)	-0.0679*** (0.00957)	-0.0627*** (0.00616)	-0.0642*** (0.00892)
SME22H1	0.0352 (0.0375)			
PROB22	-0.467*** (0.0502)	-0.459*** (0.0398)	-0.459*** (0.0410)	-0.181*** (0.0263)
SMALLBANK	0.0624*** (0.00601)	0.0673*** (0.000913)	0.0673*** (0.000730)	0.0429*** (0.00252)
MIDBANK	0.0210*** (0.00240)	0.0228*** (0.000605)	0.0235*** (0.000795)	0.00345** (0.00114)
PPPLF				-0.669*** (0.0377)
CONSTANT	-0.00300 (0.0591)	-0.00723 (0.0639)	-0.00597 (0.0638)	0.0958 (0.0654)
N	4079	4079	4079	4079

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: Columns 1 and 2 condition in our late sample for % Δ SME1922, which measures average annual growth in SME from 2019H2 through 2022H1. Column 1 includes *SME22H1* while column 2 does not. Columns 3 and 4 drop *SME22H1* for PPP and PPPLF respectively.

TABLE O.A10. Half-yearly Univariate Results

	2018h1	2018h2	2019h1	2019h2	2020h1	2020h2
PPP	0.684 (0.457)	-0.515** (0.176)	-0.167 (0.265)	0.292* (0.114)	14.88* (7.065)	-1.070*** (0.265)
CONSTANT	0.172*** (0.00451)	0.183*** (0.00355)	0.0911*** (0.0147)	0.0700*** (0.0135)	0.390 (0.884)	0.0163*** (0.00107)
<i>N</i>	4127	4136	4147	4165	4172	4179

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: IV univariate regression of average 6-month annualized SME lending growth ending on that date on our instrumented *PPP* variable. Results correspond to coefficient estimates in Figure 3. Shows 2018H1 through 2020H2.

TABLE O.A11. Half-yearly Univariate Results

	2021h1	2021h2	2022h1	2022h2	2023h1
PPP	-0.725*** (0.158)	-3.478*** (0.512)	-2.086*** (0.532)	-2.912*** (0.0734)	0.0988* (0.0461)
CONSTANT	0.0928*** (0.00685)	0.0954*** (0.0244)	0.172*** (0.00839)	0.285*** (0.00227)	0.0606*** (0.00435)
<i>N</i>	4184	4186	4197	4198	4128

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: IV univariate regression of average 6-month annualized SME lending growth ending on that date on our instrumented *PPP* variable. Results correspond to coefficient estimates in Figure 3. Shows 2021H1 through 2023H1.

TABLE O.A12. DFAST Banks

Ally Financial Inc.	Category IV
American Express Company	Category IV
Bank of America Corporation	Category I
The Bank of New York Mellon Corporation	Category I
Barclays US LLC	Category III
BMO Financial Corp.	Category IV
BNP Paribas USA, Inc.	Category IV
Capital One Financial Corporation	Category III
The Charles Schwab Corporation	Category III
Citigroup Inc.	Category I
Citizens Financial Group, Inc.	Category IV
Credit Suisse Holdings (USA), Inc.	Category III
DB USA Corporation	Category III
Discover Financial Services	Category IV
Fifth Third Bancorp	Category IV
The Goldman Sachs Group, Inc.	Category I
HSBC North America Holdings Inc.	Category IV
Huntington Bancshares Incorporated	Category IV
JPMorgan Chase & Co.	Category I
KeyCorp	Category IV
M&T Bank Corporation	Category IV
Morgan Stanley	Category I
MUFG Americas Holdings Corporation ²	Category IV
Northern Trust Corporation	Category II
The PNC Financial Services Group, Inc.	Category III
RBC US Group Holdings LLC	Category IV
Regions Financial Corporation	Category IV
Santander Holdings USA, Inc.	Category IV
State Street Corporation	Category I
TD Group US Holdings LLC	Category III
Truist Financial Corporation	Category III
UBS Americas Holding LLC	Category III
U.S. Bancorp	Category III
Wells Fargo & Company	Category I

Note: Banks identified as DFAST are banks that were required participated in the 2022 Federal Reserve Stress Test. There were a total of 34 banks required to participate in 2022. Our sample reflects 30 observations due to missing values. Column 2 differentiates banks by category. As defined by the Federal Reserve, Category I banks are U.S. global systemically important banks. Category II banks are banks that do not meet the criteria for Category I with at least \$700 billion in total assets or at least \$75 billion in cross-jurisdictional activity. Category III banks are banks that do not meet the criteria for Category I or II with at least \$250 billion in total assets or at least \$75 billion in nonbank assets. Category IV banks are banks that do not meet the criteria for Category I, II, or III with at least \$100 billion in total assets.