

Online Appendix for Monetary Policy and Credit Flows: A Tale of Two Effective Lower Bounds

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Abstract

This paper evaluates the quantitative effects of monetary policy on credit flows. Using Compustat data and a factor-augmented vector autoregression where monetary policy shocks are identified via an external instrument, we show that monetary policy promotes long-term credit creation while delaying or preventing long-term credit destruction. In parallel, it reduces short-term credit creation and destruction, effectively reallocating credit toward longer maturities. Focusing on two effective lower bound periods, we show that monetary policy prompted a reshuffling of credit toward financially constrained firms, notably small, young, and high-default-probability firms. Our findings underscore the effectiveness of monetary policy in steering credit toward financially constrained firms and stimulating future economic activity near the effective lower bound.

Keywords: Monetary Policy, Credit Reallocation, Business Cycles, External Instruments.

JEL Classification: E44, E51, E52, E58.

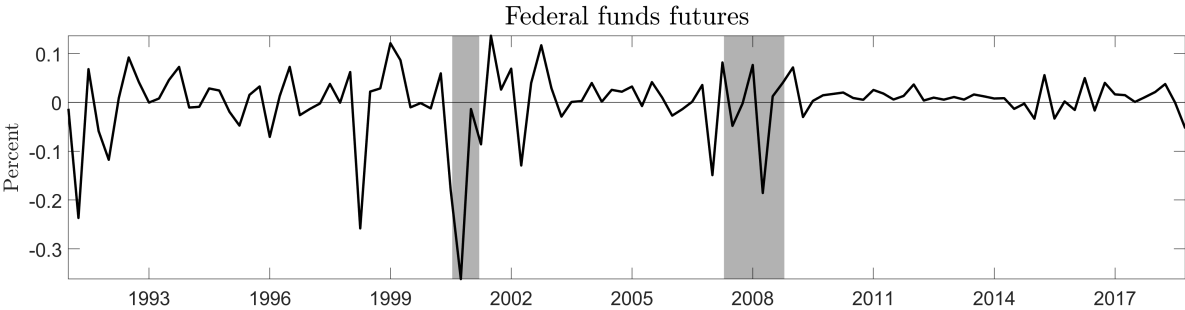
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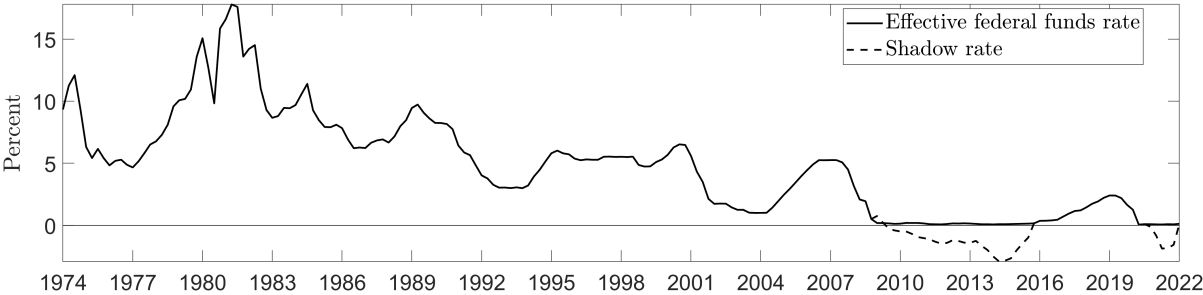
Appendix A. Additional Figures, Macroeconomic Data, and Factor Loadings

Figure A.1: External Instrument: Federal Funds Futures



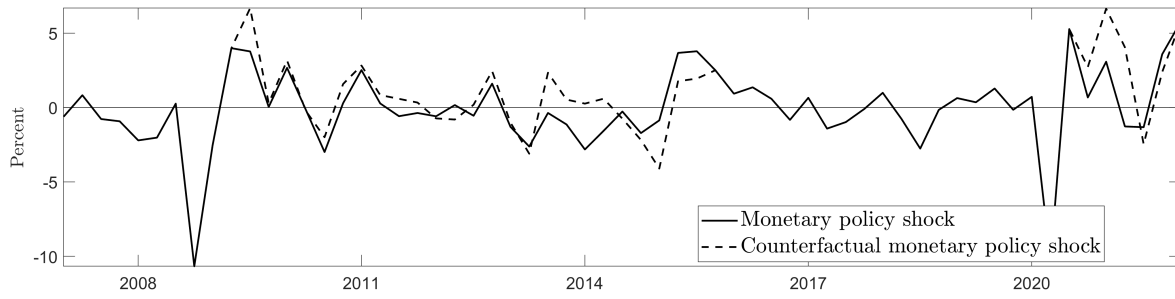
Note: The external instrument is the residuals of the first principal component of federal funds future rates within 30-minute windows around FOMC announcements when regressed on lags four quarterly lags.

Figure A.2: Effective Federal Funds Rate and Shadow Rate



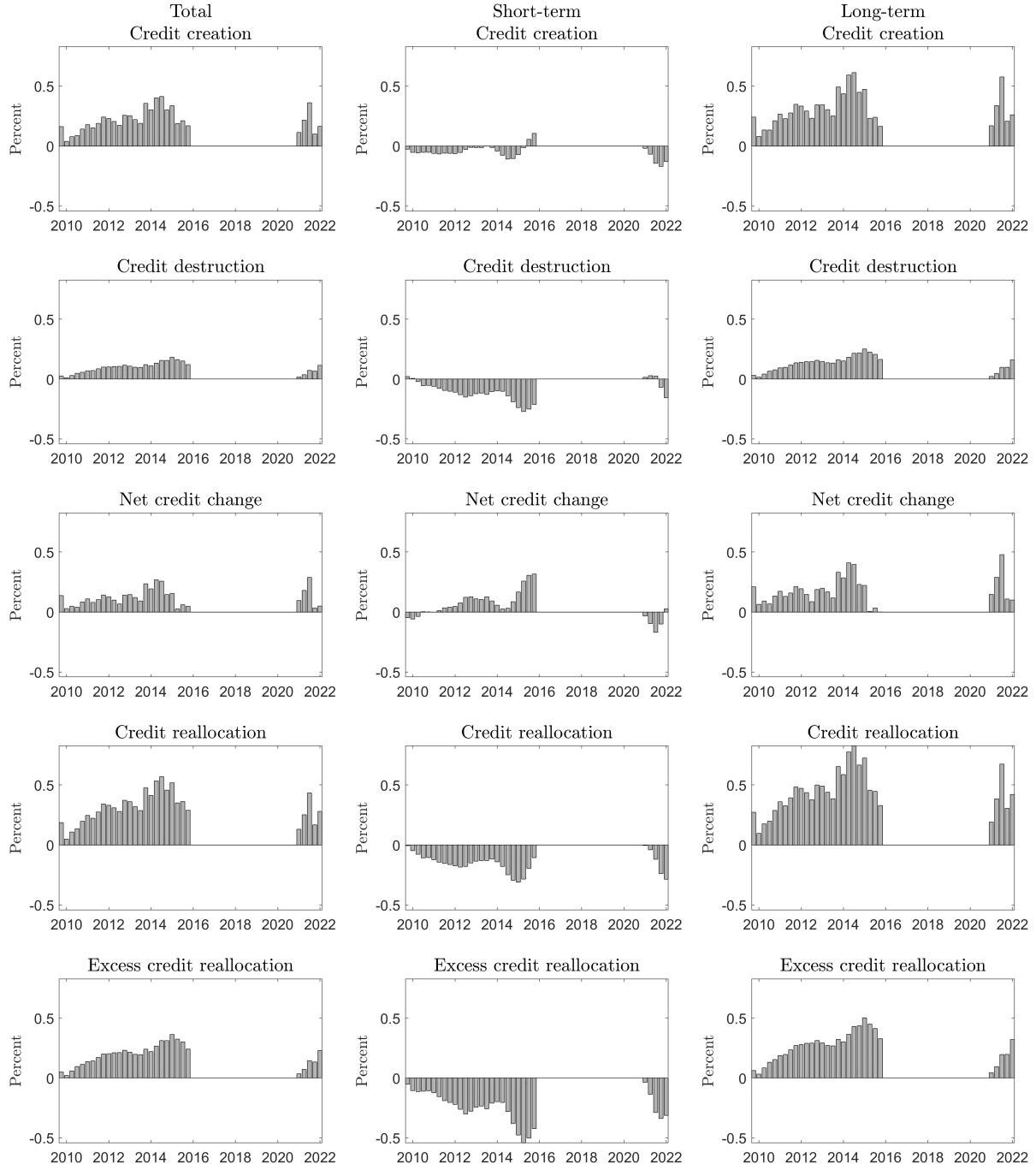
Source: Federal Reserve Board; Federal Reserve Bank of Atlanta.

Figure A.3: Monetary Policy Shocks



Note: The estimated monetary policy shocks come from a Proxy-FAVAR(4) that includes three purged factors and the monetary policy rate. The counterfactual shock is the series that forces the monetary policy to the effective lower bound.

Figure A.4: Aggregate Counterfactual Wedges



Note: The counterfactual wedges are the differences between the counterfactual credit flows and the actual credit flows during the two ELB periods (Q3:2009 – Q3:2015 and Q4:2020 – Q4:2021).

Table A.1: Average Credit Flows of Firm Groups (Q1:1974 to Q1:2022)

	POS	NEG	NET	SUM	EXC
Smaller firms	12.22	9.16	3.07	21.38	17.40
Large firms	5.18	3.39	1.79	8.56	6.51
High-leverage firms	5.35	3.00	2.35	8.35	5.84
Low-leverage firms	8.95	9.39	-0.44	18.34	13.57
Young firms	7.69	2.64	5.05	10.33	5.22
Old firms	4.85	2.87	1.98	7.71	5.51
High-default-probability firms	7.46	4.22	3.24	11.68	6.57
Low-default-probability firms	5.05	3.61	1.44	8.66	6.84

Note: This table presents the average total credit flows from Q1:1974 to Q1:2020. The classification of firms is based on certain criteria within each quarter. Firms whose total assets fall within the bottom tercile among all firms in a given quarter are considered smaller, and those in the top tercile are large. Firms whose number of years listed in Compustat falls within the bottom tercile among all firms in a given quarter are considered young and those in the top tercile are old. Following Farre-Mensa and Ljungqvist (2016), firms whose default probability exceeds 25 percent in a given quarter are considered high-default-probability firms and all others are low-default-probability firms. Firms whose leverage ratio falls within the top tercile among all firms in a given quarter are considered high-leverage firms, those in the bottom tercile are low-leverage firms.

Table A.2a: Macroeconomic Data and Loadings on Factors

	Source	Transformation	Factor 1 loading	Factor 2 loading	Factor 3 loading
Real output and income					
1. Industrial production: total index	Federal Reserve Board (G.17)	log difference	1.68	-0.54	-0.19
2. Industrial production: final products	Federal Reserve Board (G.17)	log difference	1.65	-0.32	-0.29
3. Industrial production: final products: consumer goods	Federal Reserve Board (G.17)	log difference	1.38	-0.46	-0.25
4. Industrial production: final products: consumer goods: durable	Federal Reserve Board (G.17)	log difference	1.35	-0.58	-0.59
5. Industrial production: final products: consumer goods: nondurable	Federal Reserve Board (G.17)	log difference	1.04	-0.06	0.13
6. Industrial production: final products: equipment, total: business equipment	Federal Reserve Board (G.17)	log difference	1.64	-0.25	-0.26
7. Industrial production: materials	Federal Reserve Board (G.17)	log difference	1.60	-0.67	-0.18
8. Industrial production: materials: non-energy: durable	Federal Reserve Board (G.17)	log difference	1.54	-0.65	0.05
9. Industrial production: materials: non-energy: nondurable	Federal Reserve Board (G.17)	log difference	1.23	-0.43	-0.13
10. Industrial production: manufacturing	Federal Reserve Board (G.17)	log difference	1.65	-0.53	-0.10
11. Industrial production: final products: equipment, total: oil and gas well drilling and manufactures homes	Federal Reserve Board (G.17)	log difference	0.92	-0.08	-0.51
12. Industrial production: final products: consumer goods: nondurable: energy: residential utilities	Federal Reserve Board (G.17)	log difference	-0.29	0.10	0.28
13. Industrial production: total index	Federal Reserve Board (G.17)	log difference	1.68	-0.54	-0.19
14. Capacity utilization: manufacturing, percent of total industry	Federal Reserve Board (G.17)	-	0.99	0.85	1.43
15. Purchasing managers' index	ISM	-	1.07	-0.90	0.53
16. NAPM index	ISM	-	0.99	-0.93	0.40
17. Personal income	Bureau of Economic Analysis	log difference	0.01	0.75	0.58
18. Personal income less transfer payments	Bureau of Economic Analysis	log difference	1.23	-0.47	0.44
Hours and employment					
19. Employment level	Bureau of Labor Statistics	log difference	1.62	-0.20	-0.50
20. Employment level, nonagricultural industries	Bureau of Labor Statistics	log difference	1.63	-0.18	-0.48
21. Civilian unemployment rate	Bureau of Labor Statistics	-	-0.56	0.05	-1.96
22. Average duration of unemployment, in weeks	Bureau of Labor Statistics	-	-0.08	-1.82	-1.45
23. Number of unemployed: Less than 5 weeks	Bureau of Labor Statistics	-	-0.96	0.94	0.01
24. Number of unemployed: 5 to 14 weeks	Bureau of Labor Statistics	-	-1.34	-0.33	-0.55
25. Number of unemployed: 15 weeks and over	Bureau of Labor Statistics	-	-0.21	-1.50	-2.21
26. Number of unemployed: 15 to 26 weeks	Bureau of Labor Statistics	-	-0.16	-1.08	-2.09
27. All employees, thousands: total nonfarm	Bureau of Labor Statistics	log difference	1.70	-0.20	-0.33
28. All employees, thousands: total private	Bureau of Labor Statistics	log difference	1.71	-0.26	-0.34
29. All employees, thousands: goods-manufacturing	Bureau of Labor Statistics	log difference	1.66	-0.54	0.34
30. All employees, thousands: mining and logging: mining	Bureau of Labor Statistics	log difference	0.63	0.29	-0.63
31. All employees, thousands: construction	Bureau of Labor Statistics	log difference	1.44	-0.55	1.04
32. All employees, thousands: manufacturing	Bureau of Labor Statistics	log difference	1.64	-0.54	0.05
33. All employees, thousands: durable goods	Bureau of Labor Statistics	log difference	1.62	-0.54	0.20
34. All employees, thousands: nondurable goods	Bureau of Labor Statistics	log difference	1.53	-0.48	-0.36
35. All employees, thousands: service-providing	Bureau of Labor Statistics	log difference	1.60	-0.01	-0.52
36. All employees, thousands: trade, transportation, and utilities	Bureau of Labor Statistics	log difference	1.71	-0.11	-0.34
37. All employees, thousands: wholesale trade	Bureau of Labor Statistics	log difference	1.63	0.16	0.12
38. All employees, thousands: retail trade	Bureau of Labor Statistics	log difference	1.62	-0.04	-0.56
39. All employees, thousands: government	Bureau of Labor Statistics	log difference	1.00	0.43	0.01
40. Average weekly hours of production and nonsupervisory employees: manufacturing	Bureau of Labor Statistics	-	0.56	-1.60	0.86
41. Average weekly overtime hours of production and nonsupervisory employees: manufacturing	Bureau of Labor Statistics	-	0.44	-1.36	1.56
42. NAPM employment index	ISM	-	1.01	-0.92	0.11
Consumption					
43. Personal consumption expenditures	Bureau of Economic Analysis	log difference	1.49	0.59	-0.90
44. Personal consumption expenditures: durable goods	Bureau of Economic Analysis	log difference	0.75	-0.12	-0.20
45. Personal consumption expenditures: nondurable goods	Bureau of Economic Analysis	log difference	1.22	0.69	-0.98
46. Personal consumption expenditures: services	Bureau of Economic Analysis	log difference	1.40	0.71	-0.90
Housing starts and sales					
47. New privately-owned housing units started, thousands: United States: total	Census Bureau	log	0.86	0.75	2.32
48. New privately-owned housing units started, thousands: Northeast: total	Census Bureau	log	0.78	1.00	1.82
49. New privately-owned housing units started, thousands: Midwest: total	Census Bureau	log	0.79	0.88	1.95
50. New privately-owned housing units started, thousands: South: total	Census Bureau	log	0.77	0.48	2.20
51. New privately-owned housing units started, thousands: West: total	Census Bureau	log	0.85	0.67	2.36
52. New privately-owned housing units authorized in permit-issuing places, thousands: total	Census Bureau	log	0.81	0.35	2.46
53. Shipments of new manufactured homes	Census Bureau	log	0.61	1.48	1.50

Table A.2b: Macroeconomic Data and Loadings on Factors

	Source	Transformation	Factor 1 loading	Factor 2 loading	Factor 3 loading
Orders					
54. NAPM inventories index	ISM	-	0.69	-0.48	0.50
55. NAPM new orders index	ISM	-	0.97	-0.98	0.47
56. NAPM supplier deliveries index	ISM	-	0.69	-0.63	0.53
57. New orders: nondefense capital goods	Census Bureau	log difference	0.87	-0.56	-0.17
Stock prices					
58. S&P common stock price index: composite	S&P Dow Jones Indices	log difference	-0.04	-0.21	-0.15
59. S&P common stock price index: industrials	S&P Dow Jones Indices	log difference	-0.26	-0.23	-0.04
Exchange rates					
60. Foreign exchange rate: United Kingdom	Federal Reserve Board (H.10)	log difference	0.30	-0.03	0.06
61. Foreign exchange rate: Canada	Federal Reserve Board (H.10)	log difference	-0.34	-0.01	0.51
Interest rates					
62. 3-month Treasury yield	Federal Reserve Board (H.10)	-	0.33	1.99	0.30
63. 6-month Treasury yield	Federal Reserve Board (H.10)	-	0.33	1.97	0.32
64. 1-year Treasury yield	Federal Reserve Board (H.10)	-	0.35	1.98	0.27
65. 5-year Treasury yield	Federal Reserve Board (H.10)	-	0.33	1.85	0.19
66. 10-year Treasury yield	Federal Reserve Board (H.10)	-	0.31	1.78	0.05
67. 3-month Treasury yield less effective federal funds rate	Federal Reserve Board (H.10)	-	-0.03	-1.97	-0.47
68. 6-month Treasury yield less effective federal funds rate	Federal Reserve Board (H.10)	-	-0.00	-1.90	-0.40
69. 1-year Treasury yield less effective federal funds rate	Federal Reserve Board (H.10)	-	0.11	-1.69	-0.57
70. 5-year Treasury yield less effective federal funds rate	Federal Reserve Board (H.10)	log difference	-0.03	-1.66	-0.57
71. 10-year Treasury yield less effective federal funds rate	Federal Reserve Board (H.10)	-	-0.10	-1.74	-0.75
Money and credit quantity aggregates					
72. Commercial bank assets: bank credit: loans and leases in bank credit: commercial and industrial loans	Federal Reserve Board (H.8)	log difference	-0.47	0.65	1.21
73. Consumer credit outstanding: nonrevolving: total	Federal Reserve Board (G.19)	log difference	0.59	-0.07	0.81
74. Money stock measure: M1	Federal Reserve Board (H.6)	log difference	-1.07	-0.10	0.37
75. Money stock measure: M2	Federal Reserve Board (H.6)	log difference	-0.78	0.29	0.16
76. Monetary base: total	Federal Reserve Board (H.3)	log difference	-1.04	-0.18	0.01
Price indexes					
77. Producer price index: all commodities	Bureau of Labor Statistics	log difference	0.86	0.75	-1.19
78. Producer price index: finished consumer goods	Bureau of Labor Statistics	-	0.24	0.52	-0.52
79. Producer price index: intermediate material supplies and components	Bureau of Labor Statistics	log difference	-0.06	0.94	-0.72
80. Producer price index: crude materials	Bureau of Labor Statistics	log difference	0.88	0.17	-0.92
81. Consumer price index: all items	Bureau of Labor Statistics	log difference	0.66	1.77	-1.17
82. Consumer price index: apparel and upkeep	Bureau of Labor Statistics	log difference	0.85	0.96	-1.45
83. Consumer price index: transportation	Bureau of Labor Statistics	log difference	0.95	0.76	-1.47
84. Consumer price index: medical care	Bureau of Labor Statistics	log difference	0.01	1.92	-0.61
85. Consumer price index: commodities	Bureau of Labor Statistics	log difference	0.78	1.24	-1.40
86. Consumer price index: durables	Bureau of Labor Statistics	log difference	0.49	1.24	-1.42
87. Consumer price index: services	Bureau of Labor Statistics	log difference	0.38	1.94	-0.66
88. Consumer price index: all items less food	Bureau of Labor Statistics	log difference	0.70	1.73	-1.23
89. Consumer price index: all items less shelter	Bureau of Labor Statistics	log difference	0.74	1.54	-1.38
90. Consumer price index: all items less medical care	Bureau of Labor Statistics	log difference	0.69	1.71	-1.18
91. Avg. hourly earnings of all employees on private nonfarm payrolls: total private: goods-producing: construction	Bureau of Labor Statistics	log difference	0.06	1.51	-0.56
Average hourly earnings					
92. Avg. hourly earnings of all employees on private nonfarm payrolls: total private: goods-producing: manufacturing	Bureau of Labor Statistics	log difference	-0.08	1.65	-0.34
Miscellaneous					
93. Business cycle indicator, consumer expectations	University of Michigan	-	0.59	-0.67	2.53
Credit flows					
94. Credit destruction		-	0.22	-0.22	1.46
95. Credit creation		-	0.00	0.12	1.66

Appendix B. Robust Bayesian SVAR Results

To explore whether our results are robust to using alternative identification schemes with sign and zero restrictions, we employ the robust Bayesian procedure developed by Giacomini and Kitagawa (2021). That is, we estimate an extended version of the four-variable SVAR of Aruoba and Schorfheide (2011) and Granziera et al. (2018) employed by Giacomini and Kitagawa (2021). Our model differs from theirs in that we include total credit creation and destruction, extend the estimation period to match the sample used in our Proxy-FAVAR, replace the federal funds rate with WX's shadow rate for the ELB periods, and include four lags instead of two so as to better match the dynamics of our Proxy-FAVAR.¹ The model is given by:

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} & a_{15} & a_{16} \\ a_{21} & a_{22} & a_{23} & a_{24} & a_{25} & a_{26} \\ a_{31} & a_{32} & a_{33} & a_{34} & a_{35} & a_{36} \\ a_{41} & a_{42} & a_{43} & a_{44} & a_{45} & a_{46} \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & a_{56} \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{pmatrix} \begin{pmatrix} i_t \\ \Delta y_t \\ \pi_t \\ m_t \\ POS_t \\ NEG_t \end{pmatrix} = a + \sum_{j=1}^4 A_j \begin{pmatrix} i_{t-j} \\ \Delta y_{t-j} \\ \pi_{t-j} \\ m_{t-j} \\ POS_{t-j} \\ NEG_{t-j} \end{pmatrix} + \begin{pmatrix} \epsilon_{i,t} \\ \epsilon_{y,t} \\ \epsilon_{\pi,t} \\ \epsilon_{m,t} \\ \epsilon_{POS,t} \\ \epsilon_{NEG,t} \end{pmatrix}$$

where i_t denotes the shadow rate, y_t is the GDP growth, π_t is inflation, m_t is the monetary base, POS_t is total credit creation, and NEG_t is total credit destruction.

We explore four alternative specifications that differ in the combination of sign and zero restrictions. All specifications impose sign restrictions similar to Granziera et al. (2018): (i) following a monetary easing shock the response of inflation and money balances are nonnegative on impact and two quarters after the shock; and (ii) the response of the interest rate is nonpositive on impact and after two quarters. Regarding the sign of the response of credit flows, we explore two scenarios. On the one hand, theoretical work on the effect

¹A smaller number of lags produce similar results.

of monetary policy on credit indicates that monetary policy easing results in higher credit creation (see e.g., Kashyap and Stein (2023)), thus we restrict the response of credit creation to monetary policy easing to be nonnegative on impact and after two quarters. The theoretical literature has less to offer regarding the sign of the effect of monetary policy on credit destruction. Lower interest rates could result in loan restructuring and the search for yield, leading to higher credit destruction. Yet, financially constrained firms might be less able to refinance. Hence, in the aggregate, the literature is less informative regarding the sign of the response of credit destruction. Thus, we consider two alternatives one where we do not impose any sign restriction on the response of credit destruction and another where we assume the response is nonnegative on impact and after two quarters. The four combinations of zero and sign restrictions are detailed in Table B.1.

Table B.1: Identification Restrictions for Sign-Restricted SVARs

Restrictions/Model	I	II	III	IV
(i) $a_{12} = 0$	x	x	-	-
(ii) $a_{15} = 0$	x	x	-	-
(iii) $a_{16} = 0$	x	x	-	-
(iv) $CIR^\infty(\Delta y, i) = 0$	-	-	x	x
(v) $CIR^\infty(\Delta POS, i) = 0$	-	-	x	x
(vi) $CIR^\infty(\Delta NEG, i) = 0$	-	-	x	x
(vii) Sign restrictions on <i>NEG</i>	-	x	-	x

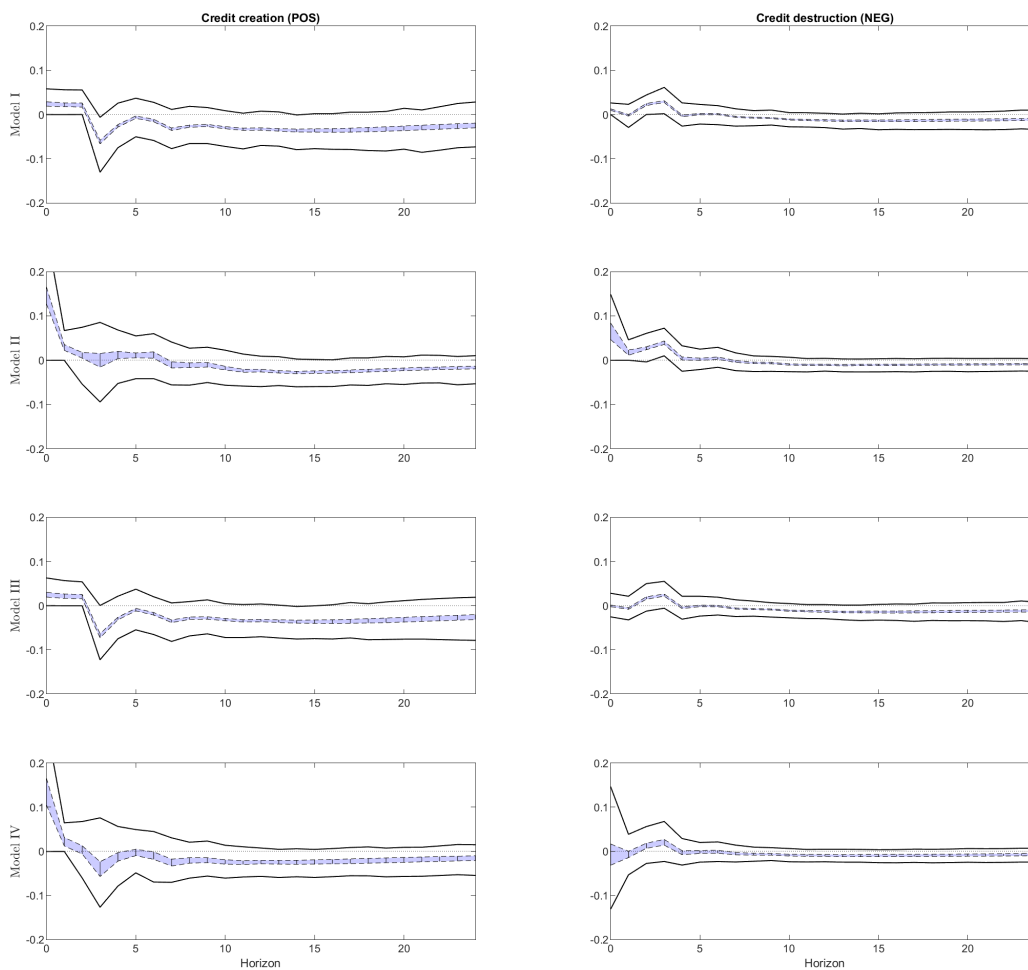
Note: $a_{1j} = 0$ implies the monetary authority does not respond contemporaneously to variable j , $CIR^\infty(\Delta j, i) = 0$ implies that the long-term impulse response of variable j to the monetary policy shock is zero.

Figure B.1 reports the set of posterior means for the impulse responses of credit creation and destruction to a -25 basis point monetary policy shock (shaded areas) and the smallest robust 90% credible region denoted by the solid lines.² We draw three conclusions from the robust Bayesian analysis. First, all combinations of sign and zero restrictions are informative about the sign of the response of credit creation. All models point to a short-run increase

²We are thankful to Raffaella Giacomini and Toru Kitagawa for making their codes publicly available.

in credit creation in response to monetary policy easing. Yet, models that impose long-run restrictions on credit flows estimate a larger increase in credit creation. Second, all models imply a smaller increase in credit destruction than credit creation, thus resulting in an increase in net credit growth. Finally, while the magnitude of the impact effect on credit flows is similar to that estimated by the Proxy-FAVAR, the responses estimated by the SVARs are smaller and less persistent in the medium run.

Figure B.1: Impulse Response of Credit Flows from Bayesian SVAR

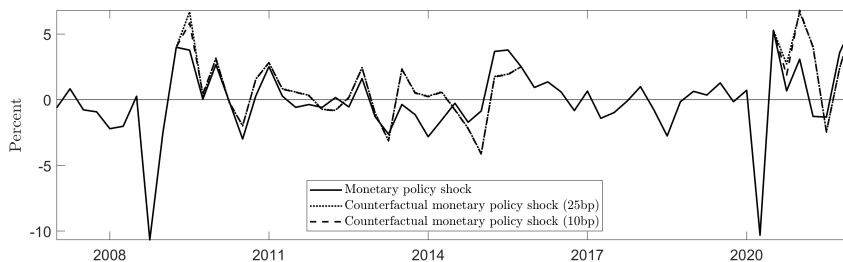


Note: The vertical bars in the shaded areas represent the set of posterior means and the solid lines denote the lower and upper bounds of the robust credible sets with 90% credibility.

Appendix C. Alternative Counterfactual Scenario

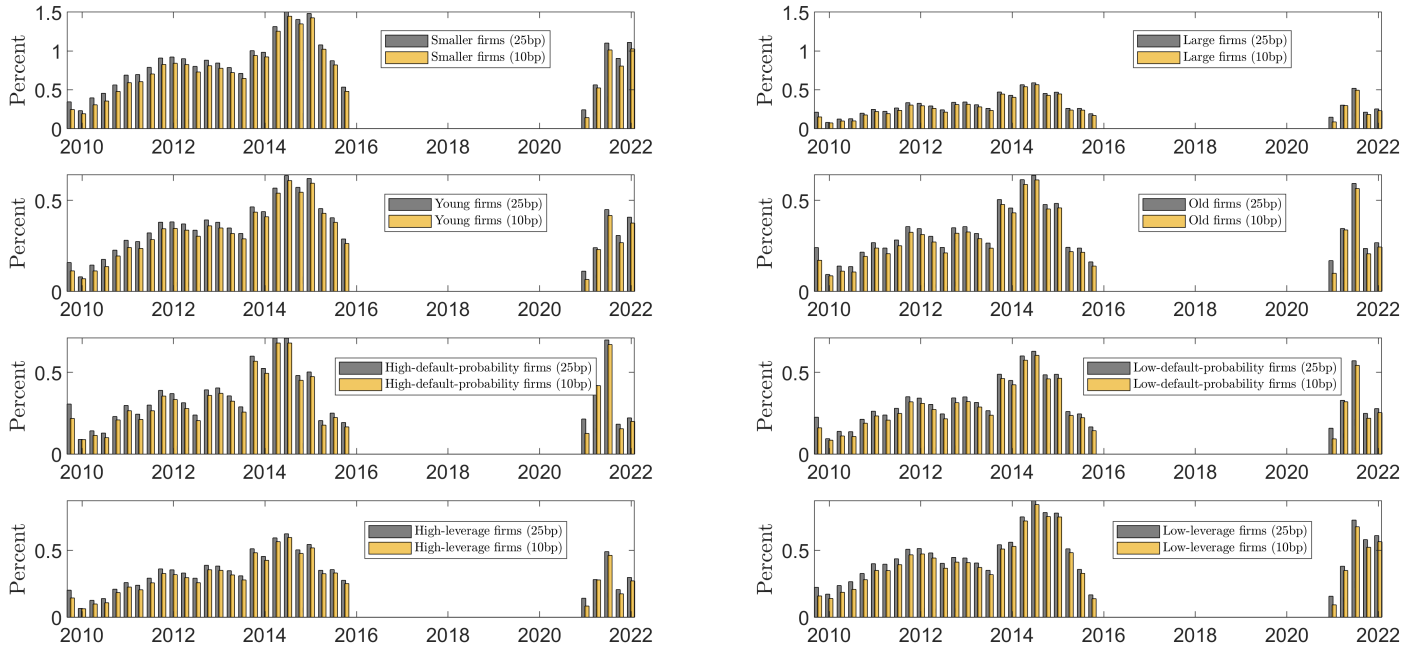
In this appendix, we report the wedges estimated for an alternative counterfactual scenario where the shadow federal funds rate is set to 0.10%. For ease of comparison, we also report the estimates for the baseline counterfactual where the rate is set at 0.25%. As the Figure C.1 illustrates, while implementing a sequence of monetary policy shocks that moved the rate from the ELB to 0.10% would have produced a slightly smaller stimulus for long-term credit creation than setting it at 0.25% the difference across counterfactual is small. Indeed, the differences are even smaller for long-term credit destruction. Regarding, short-term credit flows, the sign of the unconventional monetary policy effect and the magnitude of the wedge are also very similar across counterfactuals. That the difference between these two counterfactuals is small is perhaps not surprising as the series of monetary policy shocks implied by both are almost identical.

Figure C.1: Monetary Policy Shocks for Alternative Vounterfactuals



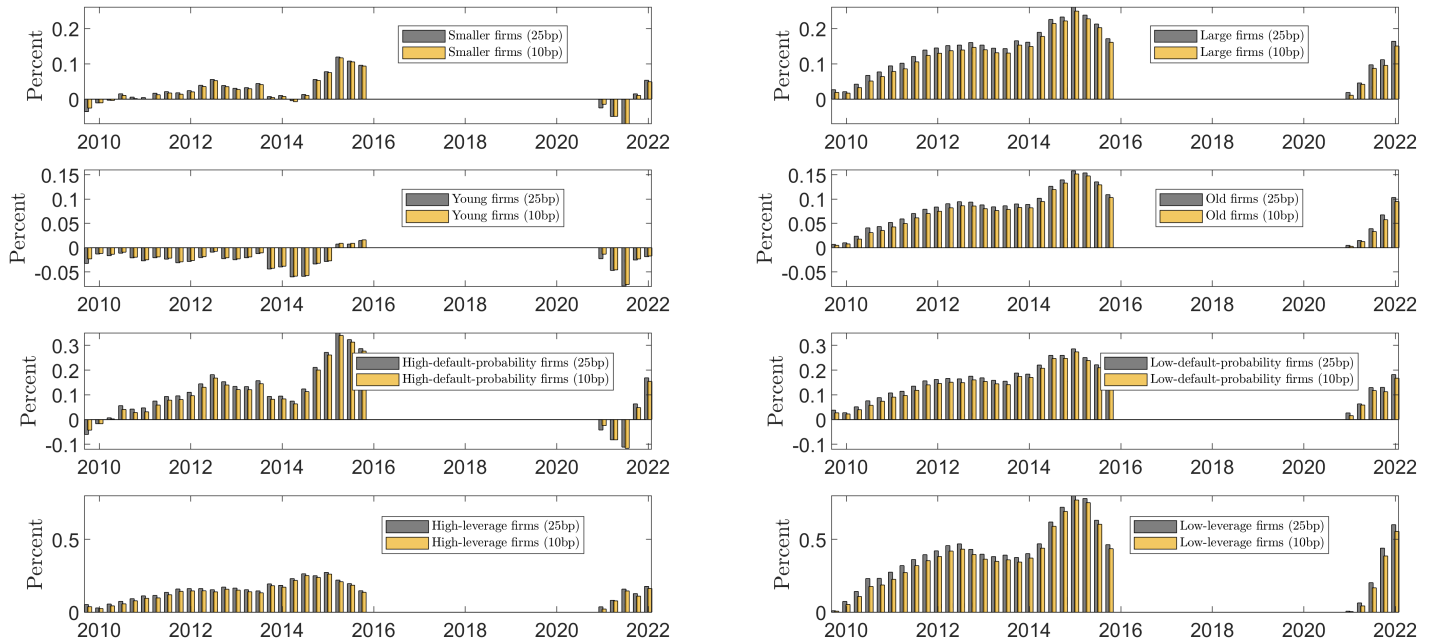
Note: This figure reports the estimated monetary policy shocks from the Proxy-FAVAR(4) and the shocks implied by the counterfactual that forces the shadow federal funds rate to the effective lower bounds of 25 or 10 basis points.

Figure C.2: Alternative Counterfactual Wedges for Long-Term Credit Creation (*POS*) by Firm Groups



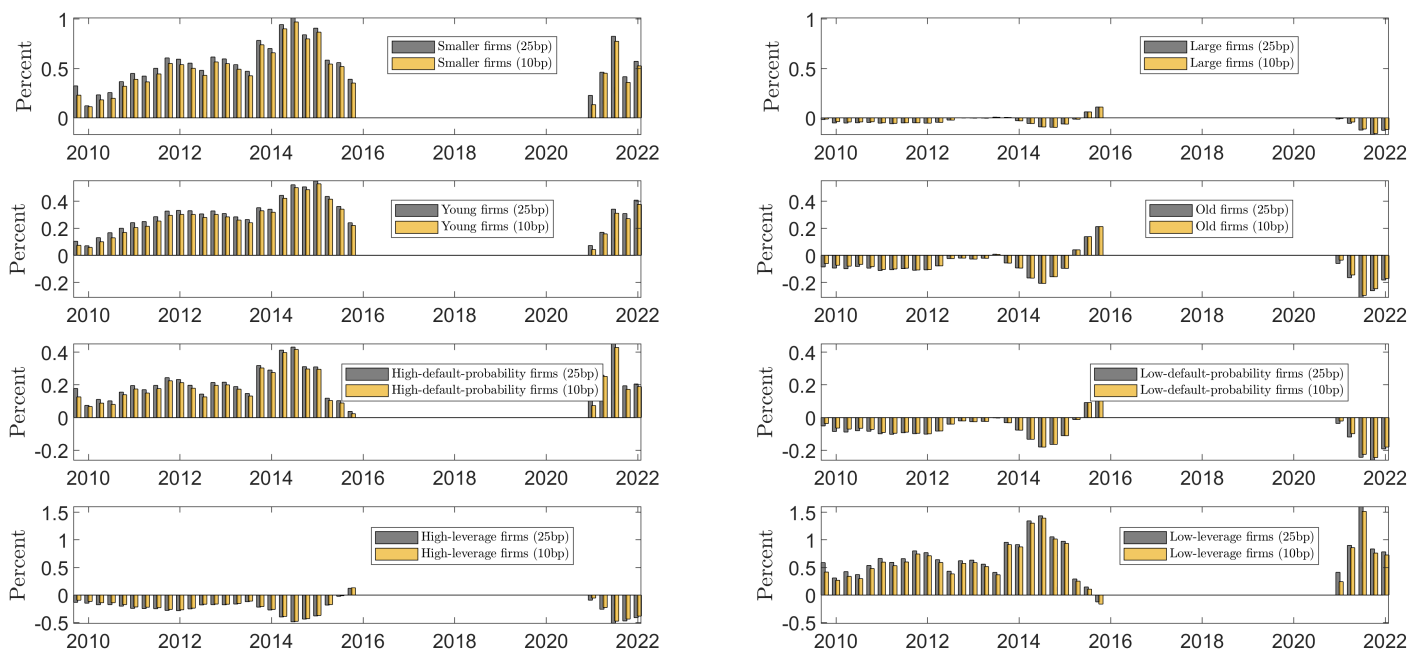
Note: The counterfactual wedges are the differences between the counterfactual credit flows and the actual credit flows during the two ELB periods (Q3:2009 – Q3:2015 and Q4:2020 – Q4:2021).

Figure C.3: Alternative Counterfactual Wedges for Long-Term Credit Destruction (*NEG*) by Firm Groups



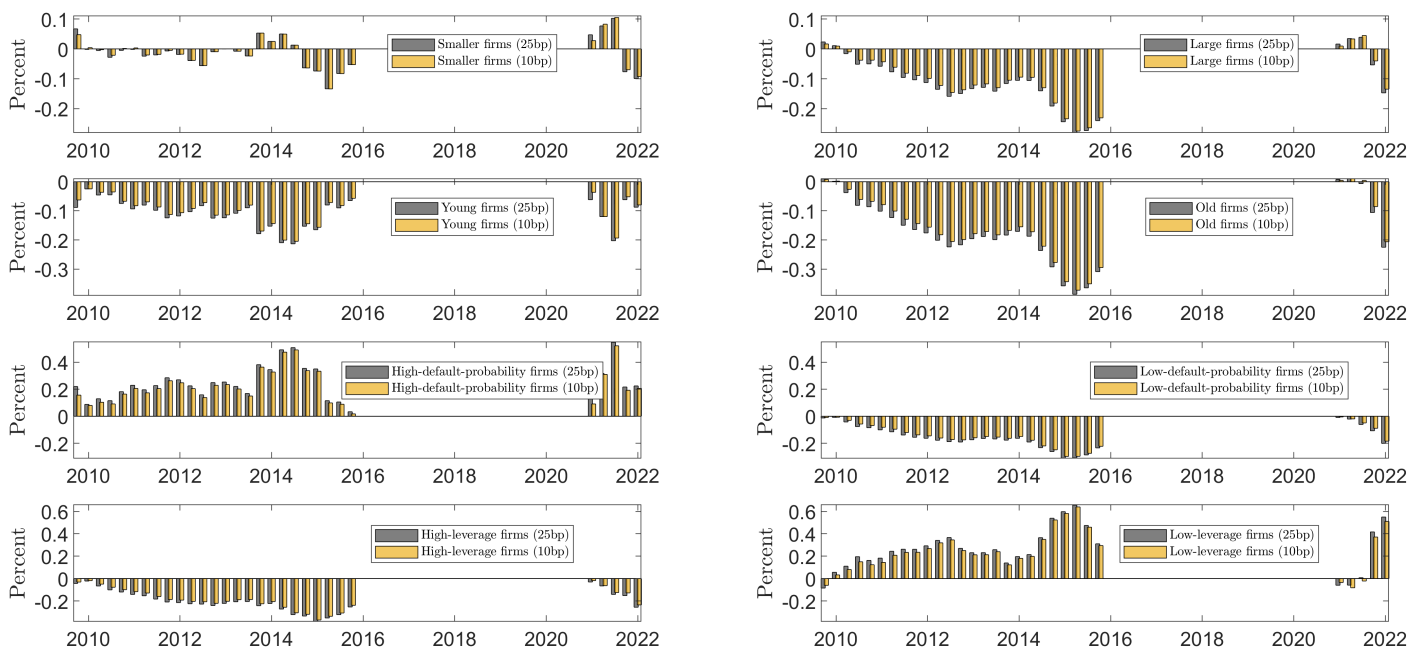
Note: The counterfactual wedges are the differences between the counterfactual credit flows and the actual credit flows during the two ELB periods (Q3:2009 – Q3:2015 and Q4:2020 – Q4:2021).

Figure C.4: Alternative Counterfactual Wedges for Short-Term Credit Creation (*POS*) by Firm Groups



Note: The counterfactual wedges are the differences between the counterfactual credit flows and the actual credit flows during the two ELB periods (Q3:2009 – Q3:2015 and Q4:2020 – Q4:2021).

Figure C.5: Alternative Counterfactual Wedges for Short-Term Credit Destruction (*NEG*) by Firm Groups



Note: The counterfactual wedges are the differences between the counterfactual credit flows and the actual credit flows during the two ELB periods (Q3:2009 – Q3:2015 and Q4:2020 – Q4:2021).

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