Supplementary Online Appendix
Borrow Long, Dump Short: Debt Maturity and Leverage Choices under Negative Interest Rates

Richard Adjei Dwumfour
Curtin University

Lei Pan
Curtin University & Monash University

Dennis Nsafoah
Niagara University

Mark N. Harris
Curtin University

In this section, we provide some additional tables and model derivations from the DSGE model. The tables include the events and dates of the ECB's unconventional monetary policy decisions, sourced from Rostagno et al. (2021), as well as tables showing the results of our robustness analysis relating to sub-sample analysis based on firm size, age, leverage, and liquidity.

A List of Countries

Table A.1 shows the list of countries used in the study. Croatia joined the ECB in 2023; therefore, it was added to the control group, as our sample period ends in 2021.

Table A.1: List of Countries

Euro Area (Treated)	**Others (Control Group)**	
($n = 19$)	**Part 1** ($n = 55$)	**Part 2** ($n = 55$)
Austria	Algeria	Malawi
Belgium	Antigua and Barbuda	Malaysia
Cyprus	Armenia	Mauritius
Estonia	Australia	Mexico
Finland	Bahamas	Mongolia
France	Bahrain	Montenegro
Germany	Bangladesh	Morocco
Greece	Barbados	Mozambique
Ireland	Belarus	Myanmar
Italy	Bhutan	Namibia
Latvia	Bolivia	Nepal
Lithuania	Bosnia and Herzegovina	New Zealand
Luxembourg	Botswana	Nicaragua
Malta	Brazil	Nigeria
Netherlands	Cambodia	North Macedonia
Portugal	Cameroon	Oman
Slovakia	Canada	Pakistan
Slovenia	Cape Verde	Palestinian Territories
Spain	Cayman Islands	Panama
	Chile	Papua New Guinea
	China	Paraguay
	Colombia	Peru
	Costa Rica	Philippines
	Croatia	Poland
	Curaçao	Qatar
	Czech Republic	Republic of Korea
	Côte d'Ivoire	Republic of Moldova
	Dominican Republic	Romania
	Ecuador	Russian Federation
	Egypt	Rwanda
	El Salvador	Saint Kitts and Nevis
	Eswatini	Saint Lucia
	Fiji	Saudi Arabia
	Gabon	Senegal
	Georgia	Serbia
	Ghana	Singapore
	Guatemala	South Africa
	Guyana	Sri Lanka
	Honduras	Syrian Arab Republic
	Hong Kong SAR, China	Thailand
	Iceland	Trinidad and Tobago
	India	Tunisia
	Indonesia	Turkey
	Iraq	Uganda
	Islamic Republic of Iran	Ukraine
	Israel	United Arab Emirates
	Jamaica	United Kingdom
	Jordan	United Republic of Tanzania
	Kazakhstan	United States of America
	Kenya	Uruguay
	Kuwait	Uzbekistan
	Kyrgyzstan	Venezuela
	Lao People'S Democratic Republic	Vietnam
	Lebanon	Zambia
	Liberia	Zimbabwe

B ECB UMP Decisions

Tables B.1–B.2 show the events of the unconventional monetary policy decisions by the ECB. It chronicles the dates of these announcements and the program, whether the decision contains forward guidance (FG), negative interest rate policy (NIRP), or quantitative easing (Asset Purchase Program and the Pandemic Emergency Purchase Programme). This data is sourced from Rostagno et al. (2021).

Table B.1: Chronology of the ECB's Governing Council decisions on the recalibration of NIRP, FG, and APP

Date	Event	Program	Announcement
04 July 2013	GovC	FG	The Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time.
05 June 2014	GovC	NIRP	The rate on the deposit facility was lowered by 10 basis points to -0.10%.
04 September 2014	GovC	NIRP	The rate on the deposit facility was lowered by 10 basis points to -0.20%.
	GovC	APP	...purchase a broad portfolio of simple and transparent asset-backed securities (ABSs) under an ABS purchase programme (ABSPP) ... also purchase a broad portfolio of euro-denominated covered bonds issued by MFIs domiciled in the euro area under a new covered bond purchase programme (CBPP3).

Continued on next page

Table B.1 – *Continued from previous page*

Date	Event	Program	Announcement
22 January 2015	GovC	APP	...launch an expanded asset-purchase programme, encompassing the existing purchase programmes for asset-backed securities and covered bonds. Under this expanded programme, the combined monthly purchases of public and private sector securities will amount to €60 billion. They are intended to be carried out until end September 2016 and will in any case be conducted until we see a sustained adjustment in the path of inflation which is consistent with our aim of achieving inflation rates below, but close to, 2% over the medium term.
03 December 2015	GovC	NIRP	...we decided to lower the interest rate on the deposit facility by 10 basis points to -0.30%.
	GovC	APP	...we decided to extend the asset purchase programme (APP). The monthly purchases of €60 billion under the APP are now intended to run until the end of March 2017, or beyond, if necessary.
10 March 2016	GovC	NIRP	The rate on the deposit facility was lowered by 10 basis points to -0.40%.
	GovC	APP	...we decided to expand the monthly purchases under our asset purchase programme from €60 billion at present to €80 billion. They are intended to run until the end of March 2017, or beyond, if necessary.
	GovC	FG	...the Governing Council expects the key ECB interest rates to remain at present or lower levels for an extended period of time, and well past the horizon of our net asset purchases.
08 December 2016	GovC	APP	...we will continue to make purchases under the asset purchase programme (APP) at the current monthly pace of €80 billion until the end of March 2017. From April 2017, our net asset purchases are intended to continue at a monthly pace of €60 billion until the end of December 2017, or beyond, if necessary.

Continued on next page

Table B.1 – *Continued from previous page*

Date	Event	Program	Announcement
	GovC	FG	The key ECB interest rates were kept unchanged and we continue to expect them to remain at present or lower levels for an extended period of time, and well past the horizon of our net asset purchases.
26 October 2017	GovC	APP	...we will continue to make purchases under the asset purchase programme (APP) at the current monthly pace of €60 billion until the end of December 2017. From January 2018 our net asset purchases are intended to continue at a monthly pace of €30 billion until the end of September 2018, or beyond, if necessary.
	GovC	FG	...the key ECB interest rates were kept unchanged and we continue to expect them to remain at their present levels for an extended period of time, and well past the horizon of our net asset purchases.
14 June 2018	GovC	APP	...we will continue to make net purchases under the APP at the current monthly pace of €30 billion until the end of September 2018. We anticipate that, after September 2018, subject to incoming data confirming our medium-term inflation outlook, we will reduce the monthly pace of the net asset purchases to €15 billion until the end of December 2018 and then end net purchases.
	GovC	FG	...we decided to keep the key ECB interest rates unchanged and we expect them to remain at their present levels at least through the summer of 2019 and in any case for as long as necessary to ensure that the evolution of inflation remains aligned with our current expectations of a sustained adjustment path.

Continued on next page

Table B.1 – *Continued from previous page*

Date	**Event**	**Program**	**Announcement**
07 March 2019	GovC	FG	...we decided to keep the key ECB interest rates unchanged. We now expect them to remain at their present levels at least through the end of 2019, and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term.
06 June 2019	GovC	FG	...we decided to keep the key ECB interest rates unchanged. We now expect them to remain at their present levels at least through the first half of 2020, and in any case for as long as necessary to ensure the continued sustained convergence of inflation to levels that are below, but close to, 2% over the medium term.
12 September 2019	GovC	NIRP	...we decided to lower the interest rate on the deposit facility by 10 basis points to -0.50%.
	GovC	APP	...the Governing Council decided to restart net purchases under its asset purchase programme (APP) at a monthly pace of €20 billion as from 1 November. We expect them to run for as long as necessary to reinforce the accommodative impact of our policy rates, and to end shortly before we start raising the key ECB interest rates.
	GovC	FG	We now expect the key ECB interest rates to remain at their present or lower levels until we have seen the inflation outlook robustly converge to a level sufficiently close to, but below, 2% within our projection horizon, and such convergence has been consistently reflected in underlying inflation dynamics.
12 March 2020	GovC	APP	...we decided to add a temporary envelope of additional net asset purchases of €120 billion until the end of the year, ensuring a strong contribution from the private sector purchase programmes.

Continued on next page

Table B.1 – *Continued from previous page*

Date	Event	Program	Announcement
18 March 2020	GovC	PEPP	The Governing Council decided the following: (1) To launch a new temporary asset purchase programme of private and public sector securities to counter the serious risks to the monetary policy transmission mechanism and the outlook for the euro area posed by the outbreak and escalating diffusion of the coronavirus, COVID-19. This new Pandemic Emergency Purchase Programme (PEPP) will have an overall envelope of €750 billion. Purchases will be conducted until the end of 2020 and will include all the asset categories eligible under the existing asset purchase programme (APP).
04 June 2020	GovC	PEPP	...the Governing Council decided to increase the envelope for the pandemic emergency purchase programme (PEPP) by €600 billion to a total of €1,350 billion.

Notes: Source: Rostagno et al. (2021).

Table B.2: List of ECB monetary policy events associated to APP, FG, or both

Date	Description	QE	FG
04/07/2013	Governing Council meeting	-	Yes
07/11/2013	Governing Council meeting	-	Yes
09/01/2014	Governing Council meeting	-	Yes
08/05/2014	Governing Council meeting	Yes	Yes
05/06/2014	Governing Council meeting	Yes	-
25/08/2014	Draghi speech, Jackson Hole	Yes	-
04/09/2014	Governing Council meeting	Yes	-
04/12/2014	Governing Council meeting	Yes	-
22/01/2015	Governing Council meeting	Yes	-
05/03/2015	Governing Council meeting	Yes	-
09/03/2015	First day asset purchases	Yes	-
29/04/2015	Bund Tantrum	Yes	-
03/06/2015	Governing Council meeting	Yes	-
22/10/2015	Governing Council meeting	Yes	Yes
03/12/2015	Governing Council meeting	Yes	-
07/12/2015	Draghi speech, New York	Yes	-
21/01/2016	Governing Council meeting	Yes	-
10/03/2016	Governing Council meeting	Yes	-
24/06/2016	Post Brexit Referendum	-	-
08/09/2016	Governing Council meeting	Yes	-
08/12/2016	Governing Council meeting	Yes	Yes
08/06/2017	Governing Council meeting	Yes	Yes
27/06/2017	Draghi speech, Sintra	Yes	Yes
26/10/2017	Governing Council meeting	Yes	Yes
14/06/2018	Governing Council meeting	Yes	Yes
07/03/2019	Governing Council meeting	-	Yes
27/03/2019	Draghi speech, Watchers conf.	Yes	-
06/06/2019	Governing Council meeting	Yes	Yes
18/06/2019	Draghi speech, Sintra	Yes	-
12/09/2019	Governing Council meeting	Yes	Yes
12/03/2020	Governing Council meeting	Yes	-
19/03/2020	PEPP annouc. (18/03, 23:00)	Yes	-
26/03/2020	PEPP legal act	Yes	-
07/04/2020	Collateral	-	-
23/04/2020	Collateral	-	-
18/05/2020	Franco-German agreement	-	-
04/06/2020	PEPP recalibration	Yes	-

Notes: Source: Rostagno et al. (2021).

C Summary Statistics for sub-groups

Tables C.1 and C.2 show summary statistics for the sub-groups based on the control and treated groups. The summary statistics in Table C.1 reveal substantial heterogeneity in firms' capital structure across key subgroups. Large and old firms exhibit systematically higher total and short-term debt ratios than small or young firms, consistent with their stronger collateral positions and established credit relationships. High-levered firms display markedly higher debt ratios across all measures, whereas low-levered firms maintain conservative balance sheets with substantially lower reliance on external financing.

Liquidity differences also map clearly into debt structure. Low-liquid firms hold considerably more total and short-term debt, indicating a greater dependence on external funding to meet working capital needs, while high-liquid firms rely less on debt overall. By contrast, long-term debt ratios remain comparatively small across all groups but follow the same ordering, with high-levered and low-liquid firms exhibiting notably higher long-term debt usage. Together, these patterns underscore meaningful differences in firms' financing behaviour and highlight the importance of controlling for firm heterogeneity in the empirical analysis.

From Table C.2, we observe clear and systematic differences between treated and control firms across all group classifications. Firms exposed to NIRP consistently exhibit higher total and long-term debt ratios relative to their non-treated counterparts, while maintaining lower short-term debt ratios. This pattern holds for small versus large firms, young versus old firms, high-versus low-levered firms, and liquidity-based groupings, indicating a broad-based tendency toward longer debt maturities under negative rate environments.

The maturity shift is economically meaningful: treated firms appear to rebalance away from short-term borrowing and toward long-term borrowing, consistent with incentives to lock in low rates and reduce refinancing risk following the introduction of NIRP. These differences are especially pronounced among large, old, highly levered, and highly liquid firms—groups that are typically more sensitive to financing conditions. Overall, the descriptive evidence strongly aligns with the empirical results, suggesting that NIRP encourages firms to restructure their debt maturity profile rather than immediately altering their overall leverage position.

Table C.1: Summary Statistics of Debt Ratios by Sub-Groups

Total Debt Ratio Group	N	Q1	Median	Mean	Q3	Max
Small Firms	236,396	0.25	0.45	0.45	0.64	0.96
Large Firms	236,382	0.37	0.53	0.52	0.67	0.96
Young Firms	241,825	0.28	0.47	0.47	0.65	0.96
Old Firms	230,953	0.34	0.52	0.50	0.67	0.96
Low-levered Firm	236,395	0.18	0.31	0.29	0.41	0.51
High-levered Firms	236,383	0.57	0.66	0.68	0.76	0.96
Low-liquid firms	236,395	0.40	0.55	0.54	0.70	0.96
High-liquid firms	236,383	0.24	0.42	0.43	0.60	0.96
Short-Term Debt Ratio						
Small Firms	236,396	0.14	0.28	0.31	0.45	0.84
Large Firms	236,382	0.16	0.26	0.30	0.41	0.84
Young Firms	241,825	0.14	0.26	0.30	0.43	0.84
Old Firms	230,953	0.16	0.27	0.30	0.42	0.84
Low-levered Firms	236,395	0.10	0.18	0.19	0.28	0.84
High-levered Firms	236,383	0.25	0.41	0.41	0.55	0.84
Low-liquid firms	236,395	0.16	0.29	0.32	0.45	0.84
High-liquid firms	236,383	0.14	0.25	0.29	0.40	0.84
Long-Term Debt Ratio						
Small Firms	236,396	0.00	0.04	0.10	0.15	0.65
Large Firms	236,382	0.02	0.11	0.16	0.24	0.65
Young Firms	241,825	0.00	0.05	0.12	0.18	0.65
Old Firms	230,953	0.01	0.09	0.14	0.21	0.65
Low-levered Firms	236,395	0.00	0.02	0.06	0.09	0.52
High-levered Firms	236,383	0.05	0.16	0.20	0.30	0.65
Low-liquid firms	236,395	0.03	0.12	0.16	0.25	0.65
High-liquid firms	236,383	0.00	0.03	0.09	0.14	0.65

Notes: Small firms are firms with *SIZE* at or below the median while large firms are those above the median. Younger firms are firms with *AGE* at or below the median, while older firms are those above the median; Low-leveraged firms are firms with total debt ratio *TDR* at or below the median, while high-leveraged firms are those with *TDR* above the median.

Table C.2: Summary Statistics of Debt Ratios by Treatment Group and Firm Characteristics

Total Debt Ratio Group	Treatment	N	Q1	Median	Mean	Q3	Max
Small Firms	Control	224,393	0.24	0.44	0.44	0.64	0.96
Small Firms	Treated	12,003	0.38	0.55	0.54	0.70	0.96
Large Firms	Control	210,842	0.36	0.52	0.51	0.66	0.96
Large Firms	Treated	25,540	0.48	0.61	0.60	0.73	0.96
Young Firms	Control	229,859	0.27	0.47	0.46	0.64	0.96
Young Firms	Treated	11,966	0.41	0.58	0.56	0.72	0.96
Old Firms	Control	205,376	0.33	0.50	0.49	0.66	0.96
Old Firms	Treated	25,577	0.47	0.60	0.58	0.72	0.96
Low-levered Firms	Control	224,456	0.18	0.31	0.29	0.41	0.51
Low-levered Firms	Treated	11,939	0.27	0.37	0.35	0.44	0.51
High-levered Firms	Control	210,779	0.57	0.66	0.68	0.76	0.96
High-levered Firms	Treated	25,604	0.59	0.67	0.69	0.77	0.96
Low-liquid firms	Control	218,408	0.39	0.55	0.53	0.70	0.96
Low-liquid firms	Treated	17,987	0.50	0.62	0.61	0.74	0.96
High-liquid firms	Control	216,827	0.23	0.41	0.42	0.59	0.96
High-liquid firms	Treated	19,556	0.40	0.56	0.55	0.70	0.96
Short-Term Debt Ratio							
Small Firms	Control	224,393	0.13	0.27	0.31	0.45	0.84
Small Firms	Treated	12,003	0.20	0.32	0.34	0.47	0.84
Large Firms	Control	210,842	0.15	0.26	0.29	0.40	0.84
Large Firms	Treated	25,540	0.21	0.31	0.33	0.44	0.84
Young Firms	Control	229,859	0.14	0.26	0.30	0.43	0.84
Young Firms	Treated	11,966	0.18	0.30	0.33	0.44	0.84
Old Firms	Control	205,376	0.15	0.27	0.30	0.42	0.84
Old Firms	Treated	25,577	0.22	0.32	0.34	0.45	0.84
Low-levered Firms	Control	224,456	0.10	0.18	0.19	0.28	0.84
Low-levered Firms	Treated	11,939	0.14	0.21	0.21	0.29	0.50
High-levered Firms	Control	210,779	0.25	0.41	0.41	0.55	0.84
High-levered Firms	Treated	25,604	0.26	0.38	0.39	0.50	0.84
Low-liquid firms	Control	218,408	0.16	0.29	0.32	0.45	0.84
Low-liquid firms	Treated	17,987	0.21	0.32	0.34	0.45	0.84
High-liquid firms	Control	216,827	0.13	0.24	0.28	0.40	0.84
High-liquid firms	Treated	19,556	0.20	0.31	0.33	0.44	0.84
Long-Term Debt Ratio							
Small Firms	Control	224,393	0.00	0.03	0.10	0.14	0.65
Small Firms	Treated	12,003	0.02	0.09	0.13	0.20	0.65
Large Firms	Control	210,842	0.02	0.11	0.15	0.24	0.65
Large Firms	Treated	25,540	0.06	0.16	0.18	0.26	0.65
Young Firms	Control	229,859	0.00	0.05	0.12	0.18	0.65
Young Firms	Treated	11,966	0.04	0.13	0.17	0.26	0.65
Old Firms	Control	205,376	0.01	0.08	0.13	0.21	0.65
Old Firms	Treated	25,577	0.05	0.14	0.16	0.24	0.65
Low-levered Firms	Control	224,456	0.00	0.02	0.06	0.09	0.52
Low-levered Firms	Treated	11,939	0.01	0.05	0.08	0.13	0.46
High-levered Firms	Control	210,779	0.04	0.16	0.20	0.31	0.65
High-levered Firms	Treated	25,604	0.09	0.18	0.20	0.29	0.65
Low-liquid firms	Control	218,408	0.02	0.11	0.16	0.25	0.65
Low-liquid firms	Treated	17,987	0.07	0.16	0.19	0.27	0.65
High-liquid firms	Control	216,827	0.00	0.03	0.09	0.13	0.65
High-liquid firms	Treated	19,556	0.03	0.11	0.14	0.22	0.65

Note: Small firms are firms with *SIZE* at or below the median, while large firms are those above the median. Younger firms are firms with *AGE* at or below the median, while older firms are those above the median; Low-leveraged firms are firms with total debt ratio *TDR* at or below the median, while high-leveraged firms are those with *TDR* above the median.

D Robustness: Sub-sample analysis based on median

The tables relating to our robustness analysis, as discussed in section 5.4, are presented here. These results have been discussed in the main manuscript. They generally show that

D.1 Robustness based on firm size

Tables D.1 to D.6 show the results of the impact of NIRP on the debt ratios, *TDR*, *SDR*, *LDR*, based on firm size defined with reference to the median values of *SIZE*.

Table D.1: NIRP and Total Debt – Small-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0036	0.0066	0.0117*	0.0127**
	(0.0069)	(0.0070)	(0.0063)	(0.0065)
ECB_QE	0.0264***	0.0274***	0.0179***	0.0203***
	(0.0067)	(0.0069)	(0.0063)	(0.0065)
ECB_FG	-0.0222***	-0.0192***	-0.0229***	-0.0215***
	(0.0049)	(0.0050)	(0.0045)	(0.0046)
AGE			0.0024	0.0022
			(0.0019)	(0.0020)
PROFIT			-0.1133***	-0.1137***
			(0.0025)	(0.0025)
LIQ			-0.4052***	-0.4012***
			(0.0063)	(0.0063)
SIZE			-0.0153***	-0.0156***
			(0.0011)	(0.0011)
AS			-0.1507***	-0.1515***
			(0.0061)	(0.0061)
INF			0.0018***	0.0010***
			(0.0002)	(0.0003)
GDP growth			0.0020***	0.0018***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	41,133	41,133	41,133	41,133
Observations	236,396	236,396	236,396	236,396
R^2	0.69	0.70	0.73	0.73

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of small-sized firms **defined by firms with <= median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.2: NIRP and Total Debt – Large-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0072**	-0.0077**	0.0063*	0.0054*
	(0.0034)	(0.0034)	(0.0033)	(0.0033)
ECB_QE	-0.0028	-0.0041	-0.0014	-0.0012
	(0.0033)	(0.0033)	(0.0032)	(0.0032)
ECB_FG	-0.0135***	-0.0109***	-0.0097***	-0.0084***
	(0.0025)	(0.0025)	(0.0024)	(0.0024)
AGE			0.0020**	0.0011
			(0.0009)	(0.0009)
PROFIT			-0.2127***	-0.2114***
			(0.0058)	(0.0057)
LIQ			-0.4053***	-0.4008***
			(0.0080)	(0.0080)
SIZE			0.0264***	0.0280***
			(0.0015)	(0.0015)
AS			-0.1253***	-0.1299***
			(0.0076)	(0.0075)
INF			0.0028***	0.0025***
			(0.0002)	(0.0003)
GDP growth			0.0025***	0.0023***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	28,335	28,335	28,335	28,335
Observations	236,382	236,382	236,382	236,382
R^2	0.74	0.74	0.76	0.77

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of large-sized firms **defined by firms with > median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.3: NIRP and Short-Term Debt – Small-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0217***	-0.0196***	-0.0117**	-0.0117**
	(0.0053)	(0.0054)	(0.0048)	(0.0049)
ECB_QE	0.0087*	0.0091*	0.0028	0.0036
	(0.0050)	(0.0052)	(0.0047)	(0.0048)
ECB_FG	-0.0100**	-0.0078*	-0.0125***	-0.0108***
	(0.0040)	(0.0041)	(0.0037)	(0.0037)
AGE			0.0056***	0.0053***
			(0.0014)	(0.0015)
PROFIT			-0.0971***	-0.0983***
			(0.0021)	(0.0021)
LIQ			-0.3932***	-0.3922***
			(0.0053)	(0.0053)
SIZE			-0.0206***	-0.0200***
			(0.0009)	(0.0009)
AS			-0.2710***	-0.2706***
			(0.0052)	(0.0052)
INF			0.0026***	0.0022***
			(0.0002)	(0.0002)
GDP growth			0.0006***	0.0008***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	41,133	41,133	41,133	41,133
Observations	236,396	236,396	236,396	236,396
R^2	0.66	0.67	0.71	0.71

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of small-sized firms **defined by firms with <= median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.4: NIRP and Short-Term Debt – Large-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0111***	-0.0108***	-0.0045*	-0.0046*
	(0.0028)	(0.0028)	(0.0026)	(0.0026)
ECB_QE	-0.0075***	-0.0075***	-0.0086***	-0.0084***
	(0.0028)	(0.0028)	(0.0026)	(0.0026)
ECB_FG	-0.0025	-0.0023	-0.0003	-0.0002
	(0.0019)	(0.0019)	(0.0018)	(0.0018)
AGE			0.0005	0.0005
			(0.0006)	(0.0006)
PROFIT			-0.1115***	-0.1151***
			(0.0038)	(0.0039)
LIQ			-0.3966***	-0.3950***
			(0.0064)	(0.0064)
SIZE			-0.0095***	-0.0091***
			(0.0011)	(0.0011)
AS			-0.3566***	-0.3552***
			(0.0067)	(0.0067)
INF			0.0022***	0.0020***
			(0.0002)	(0.0002)
GDP growth			0.0007***	0.0008***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	28,335	28,335	28,335	28,335
Observations	236,382	236,382	236,382	236,382
R^2	0.77	0.77	0.80	0.80

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of large-sized firms **defined by firms with > median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.5: NIRP and Long-Term Debt – Small-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0223***	0.0222***	0.0203***	0.0202***
	(0.0044)	(0.0045)	(0.0044)	(0.0044)
ECB_QE	0.0232***	0.0241***	0.0211***	0.0228***
	(0.0046)	(0.0047)	(0.0046)	(0.0047)
ECB_FG	-0.0114***	-0.0107***	-0.0098***	-0.0100***
	(0.0035)	(0.0036)	(0.0035)	(0.0035)
AGE			-0.0027**	-0.0025**
			(0.0011)	(0.0012)
PROFIT			-0.0145***	-0.0135***
			(0.0012)	(0.0012)
LIQ			-0.0031	-0.0003
			(0.0034)	(0.0033)
SIZE			0.0033***	0.0023***
			(0.0006)	(0.0006)
AS			0.0923***	0.0911***
			(0.0037)	(0.0037)
INF			-0.0010***	-0.0013***
			(0.0002)	(0.0002)
GDP growth			0.0013***	0.0010***
			(0.0001)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	41,133	41,133	41,133	41,133
Observations	236,396	236,396	236,396	236,396
R^2	0.63	0.64	0.64	0.65

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of small-sized firms **defined by firms with <= median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.6: NIRP and Long-Term Debt – Large-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0068**	0.0058**	0.0137***	0.0129***
	(0.0029)	(0.0029)	(0.0029)	(0.0029)
ECB_QE	0.0085***	0.0071**	0.0107***	0.0103***
	(0.0029)	(0.0029)	(0.0028)	(0.0029)
ECB_FG	-0.0089***	-0.0068***	-0.0071***	-0.0060***
	(0.0022)	(0.0022)	(0.0021)	(0.0021)
AGE			-0.0003	-0.0008
			(0.0006)	(0.0006)
PROFIT			-0.0866***	-0.0826***
			(0.0040)	(0.0040)
LIQ			-0.0058	-0.0028
			(0.0057)	(0.0056)
SIZE			0.0354***	0.0364***
			(0.0011)	(0.0011)
AS			0.1707***	0.1673***
			(0.0058)	(0.0058)
INF			0.0007***	0.0007***
			(0.0002)	(0.0002)
GDP growth			0.0012***	0.0010***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	28,335	28,335	28,335	28,335
Observations	236,382	236,382	236,382	236,382
R^2	0.68	0.69	0.71	0.71

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of large-sized firms **defined by firms with > median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

D.2 Robustness based on firm age

Tables D.7 to D.12 show the results of the impact of NIRP on the debt ratios, *TDR*, *SDR*, *LDR*, based on firm age defined with reference to the median values of *AGE*.

Table D.7: NIRP and Total Debt – Young Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0105	-0.0080	-0.0017	-0.0012
	(0.0072)	(0.0073)	(0.0066)	(0.0067)
ECB_QE	0.0286***	0.0276***	0.0185***	0.0191***
	(0.0072)	(0.0072)	(0.0068)	(0.0068)
ECB_FG	-0.0138***	-0.0108**	-0.0120**	-0.0107**
	(0.0051)	(0.0052)	(0.0047)	(0.0048)
AGE			-0.1442	0.5905
			(6,593.0)	(4,718.8)
PROFIT			-0.1158***	-0.1162***
			(0.0027)	(0.0027)
LIQ			-0.4165***	-0.4138***
			(0.0063)	(0.0063)
SIZE			-0.0109***	-0.0101***
			(0.0010)	(0.0010)
AS			-0.1322***	-0.1352***
			(0.0063)	(0.0063)
INF			0.0022***	0.0016***
			(0.0003)	(0.0003)
GDP growth			0.0033***	0.0030***
			(0.0003)	(0.0003)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	40,273	40,273	40,273	40,273
Observations	241,825	241,825	241,825	241,825
R^2	0.69	0.69	0.72	0.73

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of young firms **defined by firms with <= median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.8: NIRP and Total Debt – Older Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0053	0.0050	0.0126***	0.0117***
	(0.0035)	(0.0035)	(0.0034)	(0.0034)
ECB_QE	-0.0003	-0.0019	-0.0005	-0.0009
	(0.0033)	(0.0034)	(0.0032)	(0.0032)
ECB_FG	-0.0182***	-0.0149***	-0.0162***	-0.0138***
	(0.0026)	(0.0026)	(0.0025)	(0.0025)
AGE			0.0015*	0.0011
			(0.0008)	(0.0008)
PROFIT			-0.1766***	-0.1750***
			(0.0042)	(0.0042)
LIQ			-0.3971***	-0.3931***
			(0.0080)	(0.0081)
SIZE			0.0171***	0.0174***
			(0.0014)	(0.0015)
AS			-0.1576***	-0.1574***
			(0.0071)	(0.0071)
INF			0.0023***	0.0019***
			(0.0002)	(0.0002)
GDP growth			0.0009***	0.0007***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,282	26,282	26,282	26,282
Observations	230,953	230,953	230,953	230,953
R^2	0.73	0.74	0.76	0.76

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of older firms **defined by firms with > median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.9: NIRP and Short-Term Debt – Young Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0126**	-0.0095*	-0.0070	-0.0057
	(0.0053)	(0.0053)	(0.0047)	(0.0048)
ECB_QE	0.0120**	0.0120**	0.0039	0.0041
	(0.0053)	(0.0054)	(0.0048)	(0.0049)
ECB_FG	-0.0061	-0.0053	-0.0067**	-0.0063*
	(0.0037)	(0.0037)	(0.0032)	(0.0033)
AGE			-2.275	0.4405
			(4,774.9)	(6,887.0)
PROFIT			-0.0936***	-0.0942***
			(0.0022)	(0.0022)
LIQ			-0.4061***	-0.4039***
			(0.0054)	(0.0054)
SIZE			-0.0218***	-0.0215***
			(0.0008)	(0.0008)
AS			-0.2780***	-0.2778***
			(0.0054)	(0.0054)
INF			0.0020***	0.0016***
			(0.0002)	(0.0003)
GDP growth			0.0012***	0.0011***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	40,273	40,273	40,273	40,273
Observations	241,825	241,825	241,825	241,825
R^2	0.69	0.70	0.74	0.74

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of younger firms **defined by firms with <= median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.10: NIRP and Short-Term Debt – Older Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0149***	-0.0129***	-0.0076***	-0.0067**
	(0.0030)	(0.0031)	(0.0029)	(0.0029)
ECB_QE	-0.0073**	-0.0077***	-0.0081***	-0.0083***
	(0.0029)	(0.0029)	(0.0027)	(0.0027)
ECB_FG	-0.0070***	-0.0055**	-0.0074***	-0.0058***
	(0.0022)	(0.0022)	(0.0020)	(0.0021)
AGE			0.0016***	0.0015***
			(0.0005)	(0.0006)
PROFIT			-0.1128***	-0.1144***
			(0.0033)	(0.0033)
LIQ			-0.3929***	-0.3920***
			(0.0066)	(0.0066)
SIZE			-0.0101***	-0.0092***
			(0.0011)	(0.0011)
AS			-0.3285***	-0.3272***
			(0.0062)	(0.0062)
INF			0.0026***	0.0025***
			(0.0002)	(0.0002)
GDP growth			0.0002	0.0003**
			(0.0001)	(0.0001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,282	26,282	26,282	26,282
Observations	230,953	230,953	230,953	230,953
R^2	0.71	0.72	0.75	0.75

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of older firms **defined by firms with > median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.11: NIRP and Long-Term Debt – Young Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0033	0.0020	0.0062	0.0048
	(0.0051)	(0.0052)	(0.0049)	(0.0050)
ECB_QE	0.0214***	0.0203***	0.0202***	0.0200***
	(0.0053)	(0.0054)	(0.0052)	(0.0053)
ECB_FG	-0.0071*	-0.0053	-0.0053	-0.0045
	(0.0037)	(0.0038)	(0.0036)	(0.0037)
AGE			0.6026	-0.0242
			(4,563.0)	(7,915.3)
PROFIT			-0.0214***	-0.0212***
			(0.0014)	(0.0014)
LIQ			0.0029	0.0030
			(0.0035)	(0.0035)
SIZE			0.0091***	0.0093***
			(0.0006)	(0.0006)
AS			0.1106***	0.1083***
			(0.0039)	(0.0039)
INF			0.0004	0.0003
			(0.0002)	(0.0002)
GDP growth			0.0013***	0.0012***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	40,273	40,273	40,273	40,273
Observations	241,825	241,825	241,825	241,825
R^2	0.68	0.69	0.70	0.70

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of younger firms **defined by firms with <= median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.12: NIRP and Long-Term Debt – Older Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0224***	0.0202***	0.0219***	0.0201***
	(0.0028)	(0.0028)	(0.0027)	(0.0028)
ECB_QE	0.0108***	0.0097***	0.0109***	0.0106***
	(0.0027)	(0.0028)	(0.0027)	(0.0027)
ECB_FG	-0.0072***	-0.0058***	-0.0049**	-0.0043**
	(0.0022)	(0.0022)	(0.0021)	(0.0021)
AGE			-0.0013**	-0.0015**
			(0.0005)	(0.0006)
PROFIT			-0.0568***	-0.0538***
			(0.0025)	(0.0024)
LIQ			-0.0042	-0.0009
			(0.0051)	(0.0051)
SIZE			0.0244***	0.0240***
			(0.0010)	(0.0010)
AS			0.1266***	0.1261***
			(0.0051)	(0.0050)
INF			-0.0002	-0.0004**
			(0.0002)	(0.0002)
GDP growth			0.0007***	0.0005***
			(0.0001)	(0.0001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,282	26,282	26,282	26,282
Observations	230,953	230,953	230,953	230,953
R^2	0.64	0.65	0.66	0.67

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of older firms **defined by firms with > median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

D.3 Robustness based on firm leverage

Tables D.13 to D.18 show the results of the impact of NIRP on the debt ratios, *TDR*, *SDR*, *LDR*, based on firm leverage defined with reference to the median values of *TDR*.

Table D.13: NIRP and Total Debt – High-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0030	-0.0037	-0.0002	-0.0011
	(0.0030)	(0.0030)	(0.0029)	(0.0030)
ECB_QE	0.0046	0.0031	0.0036	0.0025
	(0.0030)	(0.0030)	(0.0029)	(0.0029)
ECB_FG	-0.0106***	-0.0097***	-0.0114***	-0.0104***
	(0.0022)	(0.0022)	(0.0022)	(0.0022)
AGE			0.0012*	0.0009
			(0.0007)	(0.0006)
PROFIT			-0.1043***	-0.1030***
			(0.0027)	(0.0027)
LIQ			-0.1450***	-0.1448***
			(0.0052)	(0.0052)
SIZE			-0.0036***	-0.0034***
			(0.0008)	(0.0008)
AS			-0.0441***	-0.0458***
			(0.0041)	(0.0041)
INF			0.0013***	0.0011***
			(0.0002)	(0.0002)
GDP growth			0.0007***	0.0006***
			(0.0001)	(0.0001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,204	42,204	42,204	42,204
Observations	236,383	236,383	236,383	236,383
R^2	0.58	0.59	0.60	0.60

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of high-leveraged firms **defined by firms with > median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.14: NIRP and Total Debt – Low-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0024	0.0002	0.0001	0.0015
	(0.0035)	(0.0035)	(0.0033)	(0.0033)
ECB_QE	-0.0004	0.0009	-0.0040	-0.0018
	(0.0035)	(0.0035)	(0.0033)	(0.0034)
ECB_FG	-0.0094***	-0.0073***	-0.0063**	-0.0057**
	(0.0026)	(0.0026)	(0.0025)	(0.0025)
AGE			0.0016	0.0005
			(0.0010)	(0.0009)
PROFIT			-0.0557***	-0.0563***
			(0.0016)	(0.0016)
LIQ			-0.2405***	-0.2367***
			(0.0039)	(0.0039)
SIZE			5.96×10^{-5}	-5.82×10^{-5}
			(0.0006)	(0.0006)
AS			-0.0985***	-0.0978***
			(0.0041)	(0.0040)
INF			0.0009***	0.0004**
			(0.0002)	(0.0002)
GDP growth			0.0014***	0.0012***
			(0.0001)	(0.0001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	43,223	43,223	43,223	43,223
Observations	236,395	236,395	236,395	236,395
R^2	0.67	0.67	0.70	0.70

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of low-leveraged firms **defined by firms with <= median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.15: NIRP and Short-Term Debt – High-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0242***	-0.0223***	-0.0194***	-0.0182***
	(0.0033)	(0.0034)	(0.0031)	(0.0032)
ECB_QE	-0.0055*	-0.0057*	-0.0076**	-0.0080***
	(0.0033)	(0.0033)	(0.0031)	(0.0031)
ECB_FG	-0.0053**	-0.0035	-0.0079***	-0.0053**
	(0.0024)	(0.0024)	(0.0022)	(0.0023)
AGE			0.0014**	0.0015**
			(0.0006)	(0.0006)
PROFIT			-0.0993***	-0.0998***
			(0.0032)	(0.0032)
LIQ			-0.2889***	-0.2881***
			(0.0070)	(0.0070)
SIZE			-0.0236***	-0.0228***
			(0.0010)	(0.0010)
AS			-0.3413***	-0.3377***
			(0.0059)	(0.0059)
INF			0.0028***	0.0027***
			(0.0002)	(0.0002)
GDP growth			-0.0002	4.37×10^{-6}
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,204	42,204	42,204	42,204
Observations	236,383	236,383	236,383	236,383
R^2	0.74	0.75	0.77	0.78

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a subsample of high-leveraged firms **defined by firms with > median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.16: NIRP and Short-Term Debt – Low-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0081***	-0.0068**	-0.0069**	-0.0065**
	(0.0029)	(0.0029)	(0.0028)	(0.0028)
ECB_QE	-0.0028	-0.0018	-0.0070***	-0.0059**
	(0.0028)	(0.0029)	(0.0027)	(0.0027)
ECB_FG	-0.0051**	-0.0048**	-0.0028	-0.0032
	(0.0020)	(0.0020)	(0.0019)	(0.0019)
AGE			0.0023***	0.0016***
			(0.0006)	(0.0006)
PROFIT			-0.0465***	-0.0473***
			(0.0014)	(0.0014)
LIQ			-0.2372***	-0.2350***
			(0.0035)	(0.0035)
SIZE			-0.0114***	-0.0114***
			(0.0005)	(0.0005)
AS			-0.1724***	-0.1717***
			(0.0036)	(0.0036)
INF			0.0009***	0.0006***
			(0.0001)	(0.0001)
GDP growth			0.0010***	0.0009***
			(0.0001)	(0.0001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	43,223	43,223	43,223	43,223
Observations	236,395	236,395	236,395	236,395
R^2	0.68	0.68	0.72	0.72

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of low-leveraged firms **defined by firms with <= median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.17: NIRP and Long-Term Debt – High-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0218***	0.0190***	0.0206***	0.0182***
	(0.0032)	(0.0032)	(0.0031)	(0.0032)
ECB_QE	0.0152***	0.0142***	0.0166***	0.0161***
	(0.0031)	(0.0031)	(0.0031)	(0.0031)
ECB_FG	-0.0042*	-0.0053**	-0.0022	-0.0040*
	(0.0024)	(0.0024)	(0.0023)	(0.0023)
AGE			-0.0019***	-0.0020***
			(0.0006)	(0.0007)
PROFIT			-0.0127***	-0.0111***
			(0.0027)	(0.0027)
LIQ			0.1114***	0.1113***
			(0.0062)	(0.0062)
SIZE			0.0208***	0.0203***
			(0.0009)	(0.0009)
AS			0.2289***	0.2250***
			(0.0054)	(0.0054)
INF			-0.0012***	-0.0013***
			(0.0002)	(0.0002)
GDP growth			0.0004***	0.0003
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,204	42,204	42,204	42,204
Observations	236,383	236,383	236,383	236,383
R^2	0.71	0.71	0.72	0.73

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of high-leveraged firms **defined by firms with > median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.18: NIRP and Long-Term Debt – Low-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0079***	0.0087***	0.0087***	0.0094***
	(0.0026)	(0.0026)	(0.0026)	(0.0026)
ECB_QE	0.0063**	0.0065**	0.0066***	0.0074***
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
ECB_FG	-0.0029	-0.0015	-0.0025	-0.0016
	(0.0020)	(0.0020)	(0.0019)	(0.0020)
AGE			-0.0011*	-0.0015**
			(0.0007)	(0.0006)
PROFIT			-0.0111***	-0.0108***
			(0.0007)	(0.0007)
LIQ			0.0002	0.0017
			(0.0021)	(0.0021)
SIZE			0.0079***	0.0078***
			(0.0003)	(0.0003)
AS			0.0490***	0.0488***
			(0.0023)	(0.0023)
INF			-1.27×10^{-5}	-0.0001
			(0.0001)	(0.0001)
GDP growth			0.0003***	0.0002**
			(9.6×10^{-5})	(9.95×10^{-5})
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	43,223	43,223	43,223	43,223
Observations	236,395	236,395	236,395	236,395
R^2	0.61	0.62	0.63	0.63

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of high-leveraged firms **defined by firms with <= median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

D.4 Robustness based on firm liquidity

Tables D.19 to D.23 show the results of the impact of NIRP on the debt ratios, *TDR*, *SDR*, *LDR*, based on firm liquidity defined with reference to the median values of *LIQ*.

Table D.19: NIRP and Total Debt – High-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0021	1.65×10^{-5}	0.0042	0.0051
	(0.0047)	(0.0047)	(0.0043)	(0.0044)
ECB_QE	0.0123***	0.0119***	0.0060	0.0063
	(0.0044)	(0.0044)	(0.0042)	(0.0042)
ECB_FG	-0.0275***	-0.0246***	-0.0249***	-0.0231***
	(0.0034)	(0.0034)	(0.0032)	(0.0032)
AGE			0.0021*	0.0008
			(0.0012)	(0.0012)
PROFIT			-0.1129***	-0.1129***
			(0.0027)	(0.0027)
LIQ			-0.4235***	-0.4214***
			(0.0064)	(0.0064)
SIZE			-0.0087***	-0.0079***
			(0.0010)	(0.0010)
AS			-0.2076***	-0.2094***
			(0.0067)	(0.0068)
INF			0.0027***	0.0021***
			(0.0003)	(0.0003)
GDP growth			0.0036***	0.0031***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	45,164	45,164	45,164	45,164
Observations	236,383	236,383	236,383	236,383
R^2	0.71	0.72	0.75	0.75

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of high-liquidity firms **defined by firms with > median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.20: NIRP and Total Debt – Low-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0004	-0.0007	0.0066	0.0062
	(0.0044)	(0.0045)	(0.0044)	(0.0044)
ECB_QE	0.0026	0.0011	0.0024	0.0019
	(0.0043)	(0.0043)	(0.0042)	(0.0043)
ECB_FG	-0.0111***	-0.0083***	-0.0091***	-0.0072**
	(0.0032)	(0.0032)	(0.0031)	(0.0031)
AGE			0.0015	0.0014
			(0.0009)	(0.0009)
PROFIT			-0.1774***	-0.1768***
			(0.0044)	(0.0044)
LIQ			-0.6690***	-0.6542***
			(0.0216)	(0.0216)
SIZE			0.0109***	0.0112***
			(0.0013)	(0.0014)
AS			-0.1123***	-0.1130***
			(0.0067)	(0.0067)
INF			0.0021***	0.0017***
			(0.0002)	(0.0002)
GDP growth			0.0012***	0.0010***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,757	42,757	42,757	42,757
Observations	236,395	236,395	236,395	236,395
R^2	0.74	0.74	0.75	0.76

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of high-liquidity firms **defined by firms with <= median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.21: NIRP and Short-term Debt – High-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0132***	-0.0105***	-0.0078**	-0.0063**
	(0.0035)	(0.0035)	(0.0031)	(0.0031)
ECB_QE	0.0025	0.0026	-0.0018	-0.0019
	(0.0033)	(0.0033)	(0.0030)	(0.0030)
ECB_FG	-0.0084***	-0.0080***	-0.0077***	-0.0077***
	(0.0025)	(0.0025)	(0.0022)	(0.0023)
AGE			0.0012	0.0006
			(0.0007)	(0.0008)
PROFIT			-0.0865***	-0.0869***
			(0.0021)	(0.0021)
LIQ			-0.4067***	-0.4049***
			(0.0052)	(0.0053)
SIZE			-0.0197***	-0.0193***
			(0.0008)	(0.0008)
AS			-0.3421***	-0.3415***
			(0.0055)	(0.0055)
INF			0.0016***	0.0013***
			(0.0002)	(0.0002)
GDP growth			0.0016***	0.0013***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	45,164	45,164	45,164	45,164
Observations	236,383	236,383	236,383	236,383
R^2	0.72	0.73	0.77	0.77

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of high-liquidity firms **defined by firms with > median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.22: NIRP and Short-term Debt – Low-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0161***	-0.0157***	-0.0103***	-0.0102***
	(0.0041)	(0.0042)	(0.0039)	(0.0039)
ECB_QE	-0.0074*	-0.0078*	-0.0097**	-0.0098**
	(0.0041)	(0.0042)	(0.0039)	(0.0039)
ECB_FG	-0.0093***	-0.0077***	-0.0089***	-0.0073***
	(0.0029)	(0.0029)	(0.0027)	(0.0028)
AGE			0.0024***	0.0023***
			(0.0007)	(0.0007)
PROFIT			-0.1318***	-0.1341***
			(0.0037)	(0.0037)
LIQ			-0.6803***	-0.6751***
			(0.0181)	(0.0181)
SIZE			-0.0129***	-0.0115***
			(0.0011)	(0.0011)
AS			-0.2987***	-0.2974***
			(0.0059)	(0.0059)
INF			0.0032***	0.0030***
			(0.0002)	(0.0002)
GDP growth			0.0003*	0.0005***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,757	42,757	42,757	42,757
Observations	236,395	236,395	236,395	236,395
R^2	0.73	0.74	0.76	0.76

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of low-liquidity firms **defined by firms with <= median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.23: NIRP and Long-term Debt – High-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0118***	0.0104***	0.0132***	0.0117***
	(0.0033)	(0.0033)	(0.0032)	(0.0032)
ECB_QE	0.0150***	0.0143***	0.0139***	0.0139***
	(0.0031)	(0.0032)	(0.0031)	(0.0031)
ECB_FG	-0.0178***	-0.0159***	-0.0165***	-0.0150***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
AGE			0.0001	-8.14×10^{-5}
			(0.0008)	(0.0008)
PROFIT			-0.0234***	-0.0232***
			(0.0013)	(0.0013)
LIQ			-0.0011	-0.0016
			(0.0034)	(0.0034)
SIZE			0.0095***	0.0097***
			(0.0005)	(0.0006)
AS			0.0996***	0.0977***
			(0.0039)	(0.0038)
INF			0.0010***	0.0009***
			(0.0002)	(0.0002)
GDP growth			0.0010***	0.0009***
			(0.0002)	(0.0002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	45,164	45,164	45,164	45,164
Observations	236,383	236,383	236,383	236,383
R^2	0.66	0.66	0.67	0.68

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of high-liquidity firms **defined by firms with > median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$.. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table D.24: NIRP and Long-term Debt – Low-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0164***	0.0158***	0.0169***	0.0165***
	(0.0038)	(0.0039)	(0.0038)	(0.0038)
ECB_QE	0.0118***	0.0111***	0.0129***	0.0130***
	(0.0039)	(0.0040)	(0.0039)	(0.0039)
ECB_FG	0.0019	0.0023	0.0035	0.0033
	(0.0029)	(0.0029)	(0.0028)	(0.0028)
AGE			-0.0025***	-0.0024***
			(0.0006)	(0.0007)
PROFIT			-0.0416***	-0.0391***
			(0.0026)	(0.0026)
LIQ			-0.0046	0.0037
			(0.0169)	(0.0169)
SIZE			0.0216***	0.0208***
			(0.0010)	(0.0010)
AS			0.1426***	0.1410***
			(0.0049)	(0.0048)
INF			-0.0009***	-0.0011***
			(0.0002)	(0.0002)
GDP growth			0.0009***	0.0007***
			(0.0001)	(0.0001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,757	42,757	42,757	42,757
Observations	236,395	236,395	236,395	236,395
R^2	0.68	0.69	0.69	0.70

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of low-liquidity firms **defined by firms with <= median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

E Robustness: Results of Sub-sample analysis, with Credit Supply and TLTRO

Here, we present the robustness results of the sub-sample analysis, which controls for both bank credit supply and TLTRO, as well as the interaction between our DiD indicator (NIRP) and bank credit growth.

E.1 Based on Firm Size, with Credit Supply and TLTRO

The estimates reported in Tables E.1–E.6 reinforce our main conclusion that euro area firms respond to negative rates by rebalancing the maturity structure of their liabilities. Firms systematically substitute away from short-term borrowing toward longer-term funding, with this maturity extension being most pronounced among small firms. For these firms—typically more exposed to rollover risk—the decline in short-term debt is accompanied by a sizeable increase in long-term borrowing, resulting in a higher overall debt ratio. Large firms also extend maturities, but their adjustments are more muted, consistent with their lower exposure to refinancing frictions.

The size-based heterogeneity results are consistent with the asymmetric interaction between NIRP and bank credit supply documented in the aggregate regressions. When credit conditions are favourable, credit expansion tends to *complement* the transmission of NIRP through short-term debt: for both small and large firms, improved credit availability makes short-term borrowing more responsive to negative rates, relaxing liquidity constraints and moderating the reduction in short-term debt. Conversely, when credit conditions tighten—particularly for large firms—the interaction turns negative, indicating a *substitution* effect whereby NIRP exerts a stronger influence on long-term financing precisely when credit supply is weak. Finally, the TLTRO programme appears to have reinforced the maturity-extension channel for both small and large firms by supporting long-term lending. Although TLTROs have a negligible measurable impact on the short-term borrowing of small firms, they are associated with a reduction in short-term debt and a corresponding increase in long-term debt among large firms, consistent with the programme amplifying firms' incentives to secure long-term funding under NIRP.

Table E.1: NIRP and Total Debt with TLTRO and Credit Growth Interactions – Small-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0334***	0.0333***	0.0168**	0.0179**
	(0.0069)	(0.0071)	(0.0074)	(0.0077)
ECB_QE	0.0114*	0.0075	0.0204***	0.0160**
	(0.0069)	(0.0070)	(0.0075)	(0.0077)
ECB_FG	-0.0288***	-0.0297***	-0.0267***	-0.0278***
	(0.0052)	(0.0054)	(0.0051)	(0.0053)
ECB_TLTRO			0.0154***	0.0144***
			(0.0040)	(0.0041)
AGE	0.0019	0.0023	0.0020	0.0023
	(0.0024)	(0.0025)	(0.0024)	(0.0025)
PROFIT	-0.1505***	-0.1495***	-0.1505***	-0.1495***
	(0.0045)	(0.0045)	(0.0045)	(0.0045)
LIQ	-0.4096***	-0.4072***	-0.4097***	-0.4072***
	(0.0093)	(0.0093)	(0.0093)	(0.0093)
SIZE	-0.0033	-0.0041*	-0.0033	-0.0041*
	(0.0021)	(0.0022)	(0.0021)	(0.0022)
AS	-0.1287***	-0.1297***	-0.1287***	-0.1298***
	(0.0089)	(0.0089)	(0.0089)	(0.0089)
INF	0.0007**	0.0007**	0.0008**	0.0007**
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0009***	0.0009***	0.0009***	0.0010***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Bank Credit Growth(t-1)	-0.0287***	-0.0319***	-0.0288***	-0.0319***
	(0.0069)	(0.0072)	(0.0069)	(0.0072)
DiD × Bank Credit Growth(t-1)	0.0506	0.0416	0.0854	0.0741
	(0.0701)	(0.0721)	(0.0731)	(0.0752)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,112	25,112	25,112	25,112
Observations	122,401	122,401	122,401	122,401
R^2	0.80	0.80	0.80	0.80

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of small-sized firms **defined by firms with <= median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.2: NIRP and Total Debt with TLTRO and Credit Growth Interactions – Large-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0073**	0.0063**	0.0024	0.0027
	(0.0032)	(0.0032)	(0.0035)	(0.0035)
ECB_QE	-0.0027	-0.0027	3.49×10^{-6}	-0.0007
	(0.0032)	(0.0033)	(0.0035)	(0.0035)
ECB_FG	-0.0090***	-0.0082***	-0.0084***	-0.0078***
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
ECB_TLTRO			0.0045***	0.0034**
			(0.0017)	(0.0017)
AGE	0.0022**	0.0012	0.0022**	0.0012
	(0.0010)	(0.0010)	(0.0010)	(0.0010)
PROFIT	-0.2718***	-0.2675***	-0.2718***	-0.2675***
	(0.0072)	(0.0072)	(0.0072)	(0.0072)
LIQ	-0.3586***	-0.3554***	-0.3586***	-0.3555***
	(0.0098)	(0.0098)	(0.0098)	(0.0098)
SIZE	0.0361***	0.0371***	0.0361***	0.0371***
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
AS	-0.1090***	-0.1145***	-0.1091***	-0.1145***
	(0.0090)	(0.0089)	(0.0090)	(0.0089)
INF	0.0025***	0.0022***	0.0025***	0.0022***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0027***	0.0022***	0.0027***	0.0022***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0399***	-0.0381***	-0.0400***	-0.0381***
	(0.0059)	(0.0060)	(0.0059)	(0.0060)
DiD × Bank Credit Growth(t-1)	-0.0071	-0.0225	0.0003	-0.0170
	(0.0343)	(0.0347)	(0.0357)	(0.0362)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	21,855	21,855	21,855	21,855
Observations	166,992	166,992	166,992	166,992
R^2	0.79	0.80	0.79	0.80

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of large-sized firms **defined by firms with > median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.3: NIRP and Short-Term Debt with TLTRO and Credit Growth Interactions – Small-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0089*	-0.0094*	-0.0108*	-0.0111*
	(0.0053)	(0.0056)	(0.0061)	(0.0064)
ECB_QE	0.0059	0.0039	0.0070	0.0048
	(0.0054)	(0.0055)	(0.0061)	(0.0063)
ECB_FG	-0.0154***	-0.0139***	-0.0152***	-0.0137***
	(0.0044)	(0.0045)	(0.0043)	(0.0045)
ECB_TLTRO			0.0017	0.0016
			(0.0036)	(0.0037)
AGE	0.0056***	0.0050***	0.0056***	0.0050***
	(0.0017)	(0.0019)	(0.0017)	(0.0019)
PROFIT	-0.1231***	-0.1230***	-0.1231***	-0.1230***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)
LIQ	-0.3947***	-0.3940***	-0.3947***	-0.3940***
	(0.0078)	(0.0078)	(0.0078)	(0.0078)
SIZE	-0.0104***	-0.0105***	-0.0104***	-0.0105***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
AS	-0.2813***	-0.2795***	-0.2813***	-0.2795***
	(0.0073)	(0.0073)	(0.0073)	(0.0073)
INF	0.0019***	0.0020***	0.0019***	0.0020***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	-0.0004*	-0.0001	-0.0004*	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0700***	-0.0709***	-0.0700***	-0.0709***
	(0.0063)	(0.0066)	(0.0063)	(0.0066)
DiD × Bank Credit Growth(t-1)	0.0319	0.0195	0.0358	0.0231
	(0.0518)	(0.0538)	(0.0536)	(0.0557)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,112	25,112	25,112	25,112
Observations	122,4012	122,401	122,401	122,401
R^2	0.78	0.78	0.78	0.78

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of small-sized firms **defined by firms with <= median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.4: NIRP and Short-Term Debt with TLTRO and Credit Growth Interactions – Large-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0090***	-0.0092***	-0.0022	-0.0020
	(0.0026)	(0.0027)	(0.0030)	(0.0030)
ECB_QE	-0.0080***	-0.0078***	-0.0118***	-0.0118***
	(0.0027)	(0.0027)	(0.0029)	(0.0029)
ECB_FG	0.0012	0.0017	0.0004	0.0008
	(0.0019)	(0.0019)	(0.0019)	(0.0019)
ECB_TLTRO			-0.0064***	-0.0067***
			(0.0015)	(0.0015)
AGE	0.0004	0.0004	0.0004	0.0004
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
PROFIT	-0.1367***	-0.1401***	-0.1367***	-0.1401***
	(0.0049)	(0.0050)	(0.0049)	(0.0050)
LIQ	-0.3710***	-0.3701***	-0.3708***	-0.3700***
	(0.0078)	(0.0078)	(0.0078)	(0.0078)
SIZE	-0.0071***	-0.0068***	-0.0071***	-0.0068***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
AS	-0.3614***	-0.3608***	-0.3613***	-0.3607***
	(0.0080)	(0.0081)	(0.0080)	(0.0081)
INF	0.0016***	0.0014***	0.0016***	0.0014***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0002	0.0003	0.0002	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0421***	-0.0460***	-0.0420***	-0.0459***
	(0.0049)	(0.0050)	(0.0049)	(0.0050)
DiD × Bank Credit Growth(t-1)	0.0499***	0.0514***	0.0395**	0.0406**
	(0.0173)	(0.0174)	(0.0179)	(0.0180)
Marginal Effect @ 1% Credit Growth	-1%	-1%	-0.2%	-0.2%
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	21,855	21,855	21,855	21,855
Observations	166,992	166,992	166,992	166,992
R^2	0.82	0.82	0.82	0.82

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of large-sized firms **defined by firms with > median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$.
textbfThe estimates control for TLTRO and include interactions of bank credit growth with our DID variable. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.5: NIRP and Long-Term Debt with TLTRO and Credit Growth Interactions – Small-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0378***	0.0381***	0.0217***	0.0223***
	(0.0051)	(0.0052)	(0.0057)	(0.0059)
ECB_QE	0.0109**	0.0099*	0.0197***	0.0185***
	(0.0053)	(0.0055)	(0.0057)	(0.0059)
ECB_FG	-0.0114***	-0.0139***	-0.0094**	-0.0120***
	(0.0041)	(0.0043)	(0.0041)	(0.0042)
ECB_TLTRO			0.0150***	0.0147***
			(0.0031)	(0.0032)
AGE	-0.0035**	-0.0024	-0.0034**	-0.0024
	(0.0014)	(0.0016)	(0.0014)	(0.0016)
PROFIT	-0.0227***	-0.0219***	-0.0227***	-0.0219***
	(0.0024)	(0.0023)	(0.0024)	(0.0023)
LIQ	-0.0067	-0.0049	-0.0067	-0.0050
	(0.0053)	(0.0053)	(0.0053)	(0.0053)
SIZE	0.0056***	0.0053***	0.0056***	0.0053***
	(0.0013)	(0.0014)	(0.0013)	(0.0014)
AS	0.1208***	0.1181***	0.1208***	0.1181***
	(0.0058)	(0.0058)	(0.0058)	(0.0058)
INF	-0.0011***	-0.0012***	-0.0011***	-0.0012***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0013***	0.0012***	0.0013***	0.0012***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0539***	0.0519***	0.0539***	0.0519***
	(0.0051)	(0.0053)	(0.0051)	(0.0053)
DiD × Bank Credit Growth(t-1)	0.0334	0.0387	0.0673	0.0718
	(0.0488)	(0.0521)	(0.0497)	(0.0530)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,112	25,112	25,112	25,112
Observations	122,4012	122,401	122,401	122,401
R^2	0.69	0.70	0.69	0.70

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of small-sized firms **defined by firms with <= median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.6: NIRP and Long-Term Debt with TLTRO and Credit Growth Interactions – Large-Sized Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0185***	0.0176***	0.0057*	0.0053
	(0.0029)	(0.0029)	(0.0034)	(0.0034)
ECB_QE	0.0097***	0.0090***	0.0167***	0.0157***
	(0.0029)	(0.0030)	(0.0032)	(0.0032)
ECB_FG	-0.0089***	-0.0088***	-0.0075***	-0.0074***
	(0.0022)	(0.0023)	(0.0022)	(0.0023)
ECB_TLTRO			0.0118***	0.0114***
			(0.0017)	(0.0017)
AGE	-7.39×10^{-5}	-0.0007	-4.2×10^{-5}	-0.0007
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
PROFIT	-0.1143***	-0.1079***	-0.1143***	-0.1079***
	(0.0051)	(0.0051)	(0.0051)	(0.0051)
LIQ	0.0092	0.0120*	0.0090	0.0118*
	(0.0072)	(0.0072)	(0.0072)	(0.0071)
SIZE	0.0418***	0.0425***	0.0418***	0.0425***
	(0.0013)	(0.0014)	(0.0013)	(0.0014)
AS	0.1861***	0.1840***	0.1860***	0.1839***
	(0.0071)	(0.0071)	(0.0071)	(0.0071)
INF	0.0009***	0.0009***	0.0009***	0.0009***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0015***	0.0012***	0.0015***	0.0012***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0276***	0.0315***	0.0275***	0.0314***
	(0.0050)	(0.0051)	(0.0050)	(0.0051)
DiD × Bank Credit Growth(t-1)	-0.0589**	-0.0715**	-0.0396	-0.0529*
	(0.0298)	(0.0297)	(0.0310)	(0.0308)
Marginal Effect @ 1% Credit Growth	2%	2%	—	0.5%
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	21,855	21,855	21,855	21,855
Observations	166,992	166,992	166,992	166,992
R^2	0.74	0.74	0.74	0.74

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of large-sized firms **defined by firms with > median *SIZE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

E.2 Based on firm age, with Credit Supply and TLTRO

Tables E.7–E.12 report the heterogeneous effects of NIRP on firms' capital structure when splitting the sample by firm age, using the median of AGE as the cutoff. Overall, the level estimates mirror our main results: older firms reduce their short-term borrowing and increase their reliance on longer-term funding, whereas younger firms exhibit a more muted but qualitatively similar maturity extension.

The interaction terms between the NIRP indicator and bank credit growth are generally insignificant across total, short-term, and long-term debt ratios, suggesting that credit-supply fluctuations do not materially alter the transmission of NIRP for most firms. The exception is short-term debt among older firms, where the interaction is positive and significant. This indicates that when credit conditions ease, older firms' short-term borrowing responds more strongly to NIRP. This is consistent with a complementary relationship between policy rates and credit supply for firms with established lending relationships. Outside this case, the maturity-adjusting behaviour induced by NIRP appears largely invariant to contemporaneous changes in bank credit growth.

Table E.7: NIRP and Total Debt with TLTRO and Credit Growth Interactions – Young Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0233***	0.0223***	0.0089	0.0103
	(0.0072)	(0.0073)	(0.0076)	(0.0078)
ECB_QE	0.0072	0.0060	0.0154*	0.0128
	(0.0075)	(0.0075)	(0.0080)	(0.0080)
ECB_FG	-0.0137***	-0.0146***	-0.0122**	-0.0134***
	(0.0049)	(0.0050)	(0.0048)	(0.0049)
ECB_TLTRO			0.0135***	0.0112***
			(0.0037)	(0.0037)
AGE	—	0.1467	—	0.1467
		(1,121.3)		(1,121.1)
PROFIT	-0.1628***	-0.1613***	-0.1628***	-0.1613***
	(0.0046)	(0.0046)	(0.0046)	(0.0045)
LIQ	-0.4100***	-0.4097***	-0.4101***	-0.4098***
	(0.0091)	(0.0092)	(0.0091)	(0.0092)
SIZE	0.0074***	0.0078***	0.0074***	0.0078***
	(0.0018)	(0.0019)	(0.0018)	(0.0019)
AS	-0.1094***	-0.1134***	-0.1095***	-0.1134***
	(0.0090)	(0.0090)	(0.0090)	(0.0090)
INF	0.0010***	0.0007**	0.0010***	0.0007**
	(0.0003)	(0.0004)	(0.0003)	(0.0004)
GDP growth	0.0026***	0.0021***	0.0026***	0.0021***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Bank Credit Growth(t-1)	-0.0242***	-0.0194***	-0.0242***	-0.0195***
	(0.0068)	(0.0070)	(0.0068)	(0.0070)
DiD × Bank Credit Growth(t-1)	0.0017	-0.0299	0.0258	-0.0098
	(0.0438)	(0.0453)	(0.0463)	(0.0479)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,646	26,646	26,646	26,646
Observations	135,529	135,529	135,529	135,529
R^2	0.79	0.79	0.79	0.79

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of young firms **defined by firms with <= median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. Age was dropped from some specifications due to collinearity issues. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.8: NIRP and Total Debt with TLTRO and Credit Growth Interactions – Older Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0132***	0.0119***	0.0047	0.0046
	(0.0033)	(0.0033)	(0.0036)	(0.0036)
ECB_QE	0.0028	0.0008	0.0075**	0.0048
	(0.0033)	(0.0033)	(0.0036)	(0.0036)
ECB_FG	-0.0149***	-0.0141***	-0.0139***	-0.0132***
	(0.0026)	(0.0026)	(0.0026)	(0.0026)
ECB_TLTRO			0.0079***	0.0068***
			(0.0018)	(0.0018)
AGE	0.0017*	0.0013	0.0017*	0.0013
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
PROFIT	-0.2242***	-0.2217***	-0.2242***	-0.2217***
	(0.0061)	(0.0062)	(0.0061)	(0.0062)
LIQ	-0.3953***	-0.3933***	-0.3954***	-0.3933***
	(0.0095)	(0.0095)	(0.0095)	(0.0095)
SIZE	0.0316***	0.0319***	0.0316***	0.0319***
	(0.0019)	(0.0019)	(0.0019)	(0.0019)
AS	-0.1391***	-0.1397***	-0.1391***	-0.1398***
	(0.0086)	(0.0086)	(0.0086)	(0.0086)
INF	0.0020***	0.0018***	0.0020***	0.0018***
	(0.0002)	(0.0003)	(0.0002)	(0.0003)
GDP growth	0.0007***	0.0005***	0.0007***	0.0006***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0315***	-0.0323***	-0.0316***	-0.0324***
	(0.0058)	(0.0059)	(0.0058)	(0.0059)
DiD × Bank Credit Growth(t-1)	0.0209	0.0151	0.0356	0.0277
	(0.0351)	(0.0348)	(0.0366)	(0.0363)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	20,745	20,745	20,745	20,745
Observations	159,553	159,553	159,553	159,553
R^2	0.80	0.80	0.80	0.80

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of older firms **defined by firms with > median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.9: NIRP and Short-Term Debt with TLTRO and Credit Growth Interactions – Young Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0013	0.0012	0.0021	0.0024
	(0.0050)	(0.0051)	(0.0057)	(0.0058)
ECB_QE	-0.0008	-0.0015	-0.0013	-0.0022
	(0.0055)	(0.0056)	(0.0061)	(0.0062)
ECB_FG	-0.0061*	-0.0060*	-0.0062*	-0.0061*
	(0.0034)	(0.0034)	(0.0033)	(0.0034)
ECB_TLTRO			-0.0008	-0.0012
			(0.0030)	(0.0031)
AGE	—	0.1656	—	0.1656
		(1,461.3)		(1,461.3)
PROFIT	-0.1163***	-0.1168***	-0.1163***	-0.1168***
	(0.0036)	(0.0036)	(0.0036)	(0.0036)
LIQ	-0.3969***	-0.3962***	-0.3969***	-0.3962***
	(0.0075)	(0.0075)	(0.0075)	(0.0075)
SIZE	-0.0152***	-0.0154***	-0.0152***	-0.0154***
	(0.0013)	(0.0014)	(0.0013)	(0.0014)
AS	-0.2942***	-0.2933***	-0.2942***	-0.2933***
	(0.0076)	(0.0076)	(0.0076)	(0.0076)
INF	0.0013***	0.0011***	0.0013***	0.0011***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0004	0.0003	0.0004	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0287***	-0.0307***	-0.0286***	-0.0307***
	(0.0059)	(0.0061)	(0.0059)	(0.0061)
DiD × Bank Credit Growth(t-1)	0.0269	0.0301	0.0255	0.0279
	(0.0326)	(0.0327)	(0.0343)	(0.0344)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,646	26,646	26,646	26,646
Observations	135,529	135,529	135,529	135,529
R^2	0.80	0.80	0.80	0.80

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of younger firms **defined by firms with <= median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. Age was dropped from some specifications due to collinearity issues. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.10: NIRP and Short-Term Debt with TLTRO and Credit Growth Interactions – Older Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0105***	-0.0096***	-0.0069**	-0.0061*
	(0.0028)	(0.0029)	(0.0032)	(0.0033)
ECB_QE	-0.0059**	-0.0065**	-0.0079**	-0.0084***
	(0.0028)	(0.0028)	(0.0031)	(0.0031)
ECB_FG	-0.0062***	-0.0046**	-0.0066***	-0.0051**
	(0.0022)	(0.0022)	(0.0021)	(0.0022)
ECB_TLTRO			-0.0033**	-0.0033*
			(0.0017)	(0.0017)
AGE	0.0015***	0.0016***	0.0015**	0.0015***
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
PROFIT	-0.1382***	-0.1412***	-0.1382***	-0.1412***
	(0.0047)	(0.0048)	(0.0047)	(0.0048)
LIQ	-0.3822***	-0.3820***	-0.3821***	-0.3820***
	(0.0077)	(0.0078)	(0.0077)	(0.0078)
SIZE	-0.0033**	-0.0026*	-0.0033**	-0.0026*
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
AS	-0.3419***	-0.3407***	-0.3418***	-0.3407***
	(0.0074)	(0.0074)	(0.0074)	(0.0074)
INF	0.0021***	0.0021***	0.0021***	0.0021***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	-0.0003*	-0.0002	-0.0003*	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0664***	-0.0648***	-0.0664***	-0.0647***
	(0.0051)	(0.0052)	(0.0051)	(0.0052)
DiD × Bank Credit Growth(t-1)	0.0824***	0.0832***	0.0763***	0.0770***
	(0.0209)	(0.0212)	(0.0215)	(0.0218)
Marginal Effect @ 1% Credit Growth	-1%	-1%	-1%	-1%
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	20,745	20,745	20,745	20,745
Observations	159,553	159,553	159,553	159,553
R^2	0.79	0.79	0.79	0.79

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of older firms **defined by firms with > median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.11: NIRP and Long-Term Debt with TLTRO and Credit Growth Interactions – Young Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0212***	0.0205***	0.0079	0.0076
	(0.0054)	(0.0055)	(0.0063)	(0.0065)
ECB_QE	0.0138**	0.0127**	0.0214***	0.0200***
	(0.0060)	(0.0061)	(0.0066)	(0.0066)
ECB_FG	-0.0081**	-0.0089**	-0.0067*	-0.0075*
	(0.0040)	(0.0040)	(0.0039)	(0.0039)
ECB_TLTRO			0.0125***	0.0121***
			(0.0033)	(0.0034)
AGE	—	-0.1200	—	-0.1200
		(734.3)		(734.2)
PROFIT	-0.0393***	-0.0377***	-0.0393***	-0.0377***
	(0.0026)	(0.0026)	(0.0026)	(0.0026)
LIQ	0.0011	0.0009	0.0010	0.0008
	(0.0055)	(0.0055)	(0.0055)	(0.0055)
SIZE	0.0208***	0.0211***	0.0208***	0.0211***
	(0.0011)	(0.0012)	(0.0011)	(0.0012)
AS	0.1448***	0.1418***	0.1447***	0.1417***
	(0.0061)	(0.0061)	(0.0061)	(0.0061)
INF	-7.51×10^{-5}	-0.0001	-5.64×10^{-5}	-9.53×10^{-5}
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0012***	0.0010***	0.0012***	0.0010***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0202***	0.0262***	0.0201***	0.0262***
	(0.0053)	(0.0055)	(0.0053)	(0.0055)
DiD × Bank Credit Growth(t-1)	-0.0432	-0.0680	-0.0209	-0.0462
	(0.0461)	(0.0476)	(0.0486)	(0.0503)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,646	26,646	26,646	26,646
Observations	135,529	135,529	135,529	135,529
R^2	0.75	0.76	0.75	0.76

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of younger firms **defined by firms with <= median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. Age was dropped from some specifications due to collinearity issues. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.12: NIRP and Long-Term Debt with TLTRO and Credit Growth Interactions – Older Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0259***	0.0239***	0.0117***	0.0108***
	(0.0028)	(0.0029)	(0.0033)	(0.0033)
ECB_QE	0.0097***	0.0086***	0.0175***	0.0158***
	(0.0029)	(0.0029)	(0.0031)	(0.0032)
ECB_FG	-0.0046**	-0.0056**	-0.0029	-0.0040*
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
ECB_TLTRO			0.0132***	0.0122***
			(0.0017)	(0.0017)
AGE	-0.0012**	-0.0015**	-0.0012**	-0.0014**
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
PROFIT	-0.0771***	-0.0720***	-0.0772***	-0.0720***
	(0.0035)	(0.0035)	(0.0035)	(0.0035)
LIQ	-0.0144**	-0.0123*	-0.0145**	-0.0124*
	(0.0065)	(0.0064)	(0.0064)	(0.0064)
SIZE	0.0324***	0.0323***	0.0324***	0.0323***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
AS	0.1481***	0.1475***	0.1480***	0.1474***
	(0.0063)	(0.0063)	(0.0063)	(0.0063)
INF	0.0002	3.87×10^{-5}	0.0002	5.38×10^{-5}
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0009***	0.0007***	0.0009***	0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0542***	0.0523***	0.0541***	0.0522***
	(0.0047)	(0.0047)	(0.0047)	(0.0047)
DiD × Bank Credit Growth(t-1)	-0.0454	-0.0469	-0.0209	-0.0242
	(0.0294)	(0.0288)	(0.0305)	(0.0297)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	20,745	20,745	20,745	20,745
Observations	159,553	159,553	159,553	159,553
R^2	0.70	0.71	0.70	0.71

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of older firms **defined by firms with > median *AGE*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

E.3 Based on firm leverage, with Credit Supply and TLTRO

We further examine heterogeneity by leverage, splitting the sample at the median of the firm-level leverage distribution. The results in Tables E.13–E.18 show that, in most cases, the interaction between NIRP and bank credit growth is statistically insignificant, indicating that credit-supply fluctuations do not meaningfully alter the effect of NIRP for the typical firm within each leverage category. An exception arises for a few specifications of short-term debt among highly leveraged firms, where the interaction term is positive and significant, suggesting a complementary effect: when credit supply expands, highly leveraged firms reduce short-term debt less aggressively in response to NIRP.

By contrast, some specifications for long-term debt among highly leveraged firms display a negative interaction, consistent with a substitution effect. In these cases, greater credit availability appears to attenuate the maturity-lengthening impact of NIRP, implying that when banks expand lending, highly leveraged firms rely less on NIRP-induced incentives to shift toward longer-term borrowing. Overall, the evidence suggests a nuanced interaction between leverage, credit conditions, and monetary transmission, with credit-supply effects concentrated primarily among firms with high debt burdens.

Table E.13: NIRP and Total Debt with TLTRO and Credit Growth Interactions – High-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0072***	0.0062**	0.0025	0.0036
	(0.0028)	(0.0028)	(0.0033)	(0.0034)
ECB_QE	-6.91×10^{-5}	-0.0019	0.0025	-0.0004
	(0.0029)	(0.0029)	(0.0032)	(0.0033)
ECB_FG	-0.0142***	-0.0127***	-0.0137***	-0.0124***
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
ECB_TLTRO			0.0043**	0.0025
			(0.0017)	(0.0017)
AGE	0.0008	0.0004	0.0008	0.0004
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
PROFIT	-0.2714***	-0.2678***	-0.2714***	-0.2678***
	(0.0068)	(0.0068)	(0.0068)	(0.0068)
LIQ	-0.1601***	-0.1590***	-0.1602***	-0.1591***
	(0.0079)	(0.0079)	(0.0079)	(0.0079)
SIZE	0.0066***	0.0068***	0.0066***	0.0068***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
AS	-0.0581***	-0.0593***	-0.0581***	-0.0593***
	(0.0057)	(0.0057)	(0.0057)	(0.0057)
INF	0.0014***	0.0011***	0.0014***	0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0008***	0.0006***	0.0008***	0.0006***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0221***	-0.0204***	-0.0221***	-0.0204***
	(0.0044)	(0.0045)	(0.0044)	(0.0045)
DiD × Bank Credit Growth(t-1)	0.0019	-0.0050	0.0105	-8.31×10^{-5}
	(0.0269)	(0.0274)	(0.0283)	(0.0288)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	42,204	42,204	42,204	42,204
Observations	140,385	140,385	140,385	140,385
R^2	0.67	0.68	0.67	0.68

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of high-leveraged firms **defined by firms with > median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.14: NIRP and Total Debt with TLTRO and Credit Growth Interactions – Low-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0042	0.0043	-0.0017	-0.0013
	(0.0038)	(0.0038)	(0.0041)	(0.0042)
ECB_QE	-0.0028	-0.0026	0.0005	0.0006
	(0.0040)	(0.0040)	(0.0044)	(0.0044)
ECB_FG	-0.0043	-0.0041	-0.0036	-0.0035
	(0.0029)	(0.0029)	(0.0029)	(0.0029)
ECB_TLTRO			0.0055***	0.0053**
			(0.0021)	(0.0021)
AGE	0.0014	0.0005	0.0014	0.0005
	(0.0012)	(0.0012)	(0.0012)	(0.0012)
PROFIT	-0.0789***	-0.0793***	-0.0789***	-0.0793***
	(0.0029)	(0.0029)	(0.0029)	(0.0029)
LIQ	-0.2626***	-0.2601***	-0.2626***	-0.2601***
	(0.0059)	(0.0059)	(0.0059)	(0.0059)
SIZE	0.0111***	0.0111***	0.0111***	0.0111***
	(0.0011)	(0.0012)	(0.0011)	(0.0012)
AS	-0.0945***	-0.0932***	-0.0945***	-0.0932***
	(0.0060)	(0.0060)	(0.0060)	(0.0060)
INF	0.0004**	0.0003	0.0004**	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0012***	0.0011***	0.0012***	0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0107**	-0.0095**	-0.0107**	-0.0095**
	(0.0047)	(0.0048)	(0.0047)	(0.0048)
DiD × Bank Credit Growth(t-1)	-0.0165	-0.0193	-0.0082	-0.0112
	(0.0304)	(0.0305)	(0.0313)	(0.0314)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,422	26,422	26,422	26,422
Observations	124,193	124,193	124,193	124,193
R^2	0.74	0.75	0.74	0.75

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of low-leveraged firms **defined by firms with <= median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.15: NIRP and Short-Term Debt with TLTRO and Credit Growth Interactions – High-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0233***	-0.0212***	-0.0129***	-0.0104***
	(0.0032)	(0.0033)	(0.0037)	(0.0039)
ECB_QE	-0.0083**	-0.0095***	-0.0140***	-0.0154***
	(0.0032)	(0.0033)	(0.0035)	(0.0036)
ECB_FG	-0.0095***	-0.0059**	-0.0107***	-0.0071***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
ECB_TLTRO			-0.0097***	-0.0100***
			(0.0019)	(0.0020)
AGE	0.0010*	0.0012*	0.0010*	0.0012*
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
PROFIT	-0.1911***	-0.1957***	-0.1911***	-0.1957***
	(0.0068)	(0.0069)	(0.0068)	(0.0069)
LIQ	-0.2915***	-0.2892***	-0.2913***	-0.2890***
	(0.0099)	(0.0099)	(0.0099)	(0.0099)
SIZE	-0.0191***	-0.0182***	-0.0191***	-0.0182***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
AS	-0.3771***	-0.3728***	-0.3770***	-0.3726***
	(0.0083)	(0.0083)	(0.0083)	(0.0083)
INF	0.0026***	0.0025***	0.0025***	0.0025***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	-0.0006***	-0.0004**	-0.0006***	-0.0004**
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0734***	-0.0703***	-0.0733***	-0.0702***
	(0.0058)	(0.0058)	(0.0058)	(0.0058)
DiD × Bank Credit Growth(t-1)	0.0542**	0.0533**	0.0349	0.0334
	(0.0213)	(0.0217)	(0.0221)	(0.0225)
Marginal Effect @ 1% Credit Growth	-2%	-2%	—	—
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,863	25,863	25,863	25,8634
Observations	140,385	140,385	140,385	140,385
R^2	0.81	0.82	0.81	0.82

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of high-leveraged firms **defined by firms with > median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.16: NIRP and Short-Term Debt with TLTRO and Credit Growth Interactions – Low-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0071**	-0.0069**	-0.0067**	-0.0062*
	(0.0030)	(0.0030)	(0.0034)	(0.0034)
ECB_QE	-0.0060**	-0.0064**	-0.0062*	-0.0068**
	(0.0030)	(0.0031)	(0.0033)	(0.0034)
ECB_FG	0.0013	0.0011	0.0012	0.0010
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
ECB_TLTRO			-0.0004	-0.0006
			(0.0017)	(0.0017)
AGE	0.0020***	0.0015**	0.0020***	0.0015**
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
PROFIT	-0.0542***	-0.0549***	-0.0542***	-0.0549***
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
LIQ	-0.2425***	-0.2414***	-0.2425***	-0.2414***
	(0.0052)	(0.0052)	(0.0052)	(0.0052)
SIZE	-0.0071***	-0.0073***	-0.0071***	-0.0073***
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
AS	-0.1833***	-0.1820***	-0.1833***	-0.1820***
	(0.0052)	(0.0052)	(0.0052)	(0.0052)
INF	0.0004**	0.0003*	0.0004**	0.0003*
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0007***	0.0006***	0.0007***	0.0006***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Bank Credit Growth(t-1)	-0.0164***	-0.0169***	-0.0164***	-0.0169***
	(0.0039)	(0.0040)	(0.0039)	(0.0040)
DiD × Bank Credit Growth(t-1)	0.0278	0.0326	0.0272	0.0316
	(0.0237)	(0.0245)	(0.0242)	(0.0251)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,422	26,422	26,422	26,422
Observations	124,193	124,193	124,193	124,193
R^2	0.77	0.77	0.77	0.77

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of low-leveraged firms **defined by firms with <= median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.17: NIRP and Long-Term Debt with TLTRO and Credit Growth Interactions – High-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0319***	0.0292***	0.0161***	0.0141***
	(0.0033)	(0.0034)	(0.0039)	(0.0040)
ECB_QE	0.0108***	0.0102***	0.0195***	0.0186***
	(0.0032)	(0.0033)	(0.0036)	(0.0036)
ECB_FG	-0.0022	-0.0048*	-0.0003	-0.0030
	(0.0025)	(0.0026)	(0.0025)	(0.0026)
ECB_TLTRO			0.0147***	0.0140***
			(0.0020)	(0.0020)
AGE	-0.0017**	-0.0021***	-0.0017**	-0.0020***
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
PROFIT	-0.0673***	-0.0601***	-0.0673***	-0.0601***
	(0.0055)	(0.0054)	(0.0055)	(0.0054)
LIQ	0.0997***	0.0984***	0.0993***	0.0981***
	(0.0089)	(0.0088)	(0.0089)	(0.0088)
SIZE	0.0277***	0.0272***	0.0277***	0.0272***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
AS	0.2434***	0.2395***	0.2432***	0.2393***
	(0.0078)	(0.0077)	(0.0078)	(0.0077)
INF	-0.0008***	-0.0009***	-0.0008***	-0.0009***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0009***	0.0006***	0.0009***	0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0761***	0.0740***	0.0760***	0.0738***
	(0.0055)	(0.0055)	(0.0055)	(0.0056)
DiD × Bank Credit Growth(t-1)	-0.0700**	-0.0713**	-0.0408	-0.0433
	(0.0278)	(0.0286)	(0.0290)	(0.0299)
Marginal Effect @ 1% Credit Growth	3%	3%	—	—
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,863	25,863	25,863	25,8634
Observations	140,385	140,385	140,385	140,385
R^2	0.76	0.77	0.76	0.77

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of high-leveraged firms **defined by firms with > median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.18: NIRP and Long-Term Debt – Low-Leveraged Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0128***	0.0130***	0.0066**	0.0065**
	(0.0029)	(0.0029)	(0.0032)	(0.0032)
ECB_QE	0.0066**	0.0072**	0.0101***	0.0109***
	(0.0029)	(0.0030)	(0.0032)	(0.0032)
ECB_FG	-0.0046**	-0.0039*	-0.0039*	-0.0033
	(0.0023)	(0.0023)	(0.0023)	(0.0023)
ECB_TLTRO			0.0058***	0.0061***
			(0.0017)	(0.0017)
AGE	-0.0014**	-0.0016**	-0.0014**	-0.0016**
	(0.0007)	(0.0007)	(0.0007)	(0.0007)
PROFIT	-0.0252***	-0.0246***	-0.0252***	-0.0246***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
LIQ	-0.0123***	-0.0107***	-0.0123***	-0.0107***
	(0.0032)	(0.0033)	(0.0032)	(0.0033)
SIZE	0.0151***	0.0154***	0.0151***	0.0154***
	(0.0007)	(0.0008)	(0.0007)	(0.0008)
AS	0.0588***	0.0590***	0.0588***	0.0589***
	(0.0037)	(0.0037)	(0.0037)	(0.0037)
INF	1.64×10^{-5}	1.03×10^{-5}	2.24×10^{-5}	1.75×10^{-5}
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0003**	0.0003**	0.0003**	0.0003**
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Bank Credit Growth(t-1)	0.0129***	0.0145***	0.0129***	0.0145***
	(0.0033)	(0.0034)	(0.0033)	(0.0034)
DiD × Bank Credit Growth(t-1)	-0.0090	-0.0139	-0.0002	-0.0046
	(0.0252)	(0.0261)	(0.0259)	(0.0269)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,422	26,422	26,422	26,422
Observations	124,193	124,193	124,193	124,193
R^2	0.68	0.69	0.68	0.69

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of high-leveraged firms **defined by firms with <= median *TDR*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

E.4 Based on firm liquidity, with Credit Supply and TLTRO

We also explore heterogeneity by firms' liquidity positions, using the median of the liquidity distribution to distinguish low- and high-liquidity firms. As shown in Tables E.19–E.24, the interaction between NIRP and bank credit growth is generally insignificant across the main specifications, suggesting that the maturity response to NIRP is largely orthogonal to contemporaneous movements in credit supply for most firms. Notable deviations occur in a subset of the short-term debt regressions for low-liquidity firms, where the interaction term is positive and statistically significant. This pattern indicates that firms facing tighter internal liquidity constraints adjust their short-term borrowing less aggressively when credit supply improves, implying that external liquidity loosens the refinancing pressure that typically amplifies the impact of NIRP on short-term debt reduction.

Conversely, some long-term debt specifications for low-liquidity firms yield negative interaction terms, pointing to a substitution effect: when banks expand lending, these firms rely less on NIRP-induced incentives to shift toward longer-maturity borrowing. In such cases, improved credit conditions weaken the mechanism through which NIRP encourages maturity extension. Taken together, the results suggest that liquidity interacts with credit supply in shaping firms' responses to NIRP, with the clearest effects concentrated among firms operating with limited liquidity buffers.

Table E.19: NIRP and Total Debt with TLTRO and Credit Growth Interactions – High-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0138***	0.0137***	0.0063	0.0088*
	(0.0045)	(0.0046)	(0.0051)	(0.0052)
ECB_QE	-0.0009	-0.0024	0.0033	0.0003
	(0.0045)	(0.0045)	(0.0048)	(0.0049)
ECB_FG	-0.0189***	-0.0180***	-0.0180***	-0.0174***
	(0.0035)	(0.0036)	(0.0035)	(0.0036)
ECB_TLTRO			0.0069***	0.0045*
			(0.0026)	(0.0027)
AGE	0.0019	0.0005	0.0019	0.0005
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
PROFIT	-0.1500***	-0.1485***	-0.1500***	-0.1485***
	(0.0049)	(0.0049)	(0.0049)	(0.0049)
LIQ	-0.4091***	-0.4102***	-0.4092***	-0.4102***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)
SIZE	0.0119***	0.0124***	0.0119***	0.0124***
	(0.0019)	(0.0019)	(0.0019)	(0.0019)
AS	-0.1847***	-0.1891***	-0.1848***	-0.1891***
	(0.0101)	(0.0101)	(0.0101)	(0.0101)
INF	0.0020***	0.0015***	0.0020***	0.0015***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0033***	0.0028***	0.0033***	0.0028***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Bank Credit Growth(t-1)	-0.0289***	-0.0256***	-0.0290***	-0.0256***
	(0.0074)	(0.0075)	(0.0073)	(0.0075)
DiD × Bank Credit Growth(t-1)	0.0086	-0.0148	0.0210	-0.0066
	(0.0448)	(0.0459)	(0.0465)	(0.0477)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,442	25,442	25,442	25,442
Observations	121,076	121,076	121,076	121,076
R^2	0.81	0.82	0.81	0.82

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of high-liquidity firms **defined by firms with > median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.20: NIRP and Total Debt with TLTRO and Credit Growth Interactions – Low-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0088*	0.0070	0.0096*	0.0083
	(0.0049)	(0.0050)	(0.0053)	(0.0054)
ECB_QE	0.0006	-0.0007	0.0002	-0.0014
	(0.0049)	(0.0050)	(0.0053)	(0.0054)
ECB_FG	-0.0081**	-0.0077**	-0.0082**	-0.0079**
	(0.0037)	(0.0038)	(0.0037)	(0.0038)
ECB_TLTRO			-0.0007	-0.0013
			(0.0026)	(0.0026)
AGE	0.0016	0.0013	0.0016	0.0013
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
PROFIT	-0.2683***	-0.2657***	-0.2683***	-0.2657***
	(0.0075)	(0.0076)	(0.0075)	(0.0076)
LIQ	-0.5033***	-0.5004***	-0.5033***	-0.5004***
	(0.0271)	(0.0271)	(0.0271)	(0.0271)
SIZE	0.0203***	0.0196***	0.0203***	0.0196***
	(0.0021)	(0.0021)	(0.0021)	(0.0021)
AS	-0.1098***	-0.1105***	-0.1098***	-0.1105***
	(0.0096)	(0.0095)	(0.0096)	(0.0095)
INF	0.0016***	0.0014***	0.0016***	0.0014***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0004*	0.0003	0.0004*	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0265***	-0.0257***	-0.0265***	-0.0257***
	(0.0063)	(0.0065)	(0.0063)	(0.0065)
DiD × Bank Credit Growth(t-1)	-0.0501	-0.0593	-0.0515	-0.0617
	(0.0474)	(0.0485)	(0.0491)	(0.0502)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,228	26,228	26,228	26,228
Observations	128,680	128,680	128,680	128,680
R^2	0.80	0.81	0.80	0.81

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using total debt ratio (TDR) with a sub-sample of high-liquidity firms **defined by firms with <= median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.21: NIRP and Short-term Debt with TLTRO and Credit Growth Interactions – High-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0018	-0.0020	0.0019	0.0027
	(0.0032)	(0.0032)	(0.0036)	(0.0037)
ECB_QE	-0.0048	-0.0056*	-0.0068*	-0.0082**
	(0.0032)	(0.0033)	(0.0035)	(0.0036)
ECB_FG	-0.0042*	-0.0040	-0.0046*	-0.0046*
	(0.0024)	(0.0024)	(0.0024)	(0.0024)
ECB_TLTRO			-0.0034*	-0.0043**
			(0.0019)	(0.0019)
AGE	0.0004	3.46×10^{-5}	0.0004	1.02×10^{-5}
	(0.0008)	(0.0009)	(0.0008)	(0.0009)
PROFIT	-0.0996***	-0.0997***	-0.0996***	-0.0997***
	(0.0036)	(0.0037)	(0.0036)	(0.0037)
LIQ	-0.4026***	-0.4030***	-0.4026***	-0.4029***
	(0.0073)	(0.0073)	(0.0073)	(0.0073)
SIZE	-0.0103***	-0.0102***	-0.0103***	-0.0103***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)
AS	-0.3586***	-0.3592***	-0.3585***	-0.3591***
	(0.0078)	(0.0078)	(0.0078)	(0.0078)
INF	0.0009***	0.0008***	0.0009***	0.0008***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
GDP growth	0.0009***	0.0007***	0.0009***	0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0214***	-0.0193***	-0.0214***	-0.0193***
	(0.0057)	(0.0058)	(0.0057)	(0.0058)
DiD × Bank Credit Growth(t-1)	0.0075	-0.0010	0.0013	-0.0088
	(0.0232)	(0.0239)	(0.0239)	(0.0246)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,442	25,442	25,442	25,442
Observations	121,076	121,076	121,076	121,076
R^2	0.83	0.84	0.83	0.84

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of high-liquidity firms **defined by firms with > median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.22: NIRP and Short-term Debt with TLTRO and Credit Growth Interactions – Low-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	-0.0204***	-0.0195***	-0.0124**	-0.0113**
	(0.0044)	(0.0045)	(0.0052)	(0.0053)
ECB_QE	-0.0060	-0.0071	-0.0106**	-0.0118**
	(0.0046)	(0.0047)	(0.0051)	(0.0052)
ECB_FG	-0.0079**	-0.0066*	-0.0086***	-0.0074**
	(0.0034)	(0.0034)	(0.0033)	(0.0034)
AGE	0.0026***	0.0025***	0.0025***	0.0025***
	(0.0008)	(0.0008)	(0.0008)	(0.0008)
ECB_TLTRO			-0.0077***	-0.0079***
			(0.0028)	(0.0028)
PROFIT	-0.1844***	-0.1888***	-0.1844***	-0.1888***
	(0.0064)	(0.0064)	(0.0064)	(0.0064)
LIQ	-0.5701***	-0.5625***	-0.5699***	-0.5622***
	(0.0237)	(0.0238)	(0.0237)	(0.0238)
SIZE	-0.0081***	-0.0071***	-0.0081***	-0.0071***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
AS	-0.3180***	-0.3154***	-0.3180***	-0.3154***
	(0.0084)	(0.0083)	(0.0084)	(0.0083)
INF	0.0030***	0.0029***	0.0030***	0.0029***
	(0.0002)	(0.0003)	(0.0002)	(0.0003)
GDP growth	-0.0009***	-0.0007***	-0.0010***	-0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	-0.0809***	-0.0782***	-0.0809***	-0.0782***
	(0.0060)	(0.0061)	(0.0060)	(0.0061)
DiD × Bank Credit Growth(t-1)	0.0670**	0.0618*	0.0522	0.0467
	(0.0310)	(0.0319)	(0.0319)	(0.0329)
Marginal Effect @ 1% Credit Growth	-2%	-2%	—	—
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,228	26,228	26,228	26,228
Observations	128,680	128,680	128,680	128,680
R^2	0.80	0.81	0.80	0.81

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using short-term debt ratio (SDR) with a sub-sample of low-liquidity firms **defined by firms with <= median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.23: NIRP and Long-term Debt with TLTRO and Credit Growth Interactions – High-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0163***	0.0160***	0.0032	0.0037
	(0.0035)	(0.0035)	(0.0042)	(0.0042)
ECB_QE	0.0112***	0.0103***	0.0183***	0.0170***
	(0.0034)	(0.0034)	(0.0037)	(0.0038)
ECB_FG	-0.0170***	-0.0163***	-0.0154***	-0.0148***
	(0.0027)	(0.0028)	(0.0027)	(0.0028)
ECB_TLTRO			0.0120***	0.0113***
			(0.0022)	(0.0022)
AGE	0.0010	0.0006	0.0010	0.0007
	(0.0009)	(0.0009)	(0.0009)	(0.0009)
PROFIT	-0.0429***	-0.0416***	-0.0429***	-0.0416***
	(0.0026)	(0.0026)	(0.0026)	(0.0026)
LIQ	0.0095*	0.0092*	0.0093*	0.0091*
	(0.0054)	(0.0054)	(0.0054)	(0.0054)
SIZE	0.0212***	0.0214***	0.0212***	0.0214***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)
AS	0.1299***	0.1287***	0.1297***	0.1285***
	(0.0060)	(0.0060)	(0.0060)	(0.0060)
INF	0.0009***	0.0007***	0.0009***	0.0007***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0011***	0.0010***	0.0011***	0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0133***	0.0147***	0.0132***	0.0146***
	(0.0050)	(0.0051)	(0.0050)	(0.0051)
DiD × Bank Credit Growth(t-1)	0.0005	-0.0095	0.0221	0.0110
	(0.0379)	(0.0381)	(0.0394)	(0.0397)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	25,442	25,442	25,442	25,442
Observations	121,076	121,076	121,076	121,076
R^2	0.74	0.74	0.74	0.74

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of high-liquidity firms **defined by firms with > median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$.. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.24: NIRP and Long-term Debt with TLTRO and Credit Growth Interactions – Low-Liquidity Firms

Model:	(1)	(2)	(3)	(4)
DiD	0.0292***	0.0269***	0.0221***	0.0198***
	(0.0048)	(0.0049)	(0.0053)	(0.0054)
ECB_QE	0.0056	0.0053	0.0097*	0.0094*
	(0.0048)	(0.0049)	(0.0052)	(0.0053)
ECB_FG	0.0049	0.0030	0.0055	0.0037
	(0.0035)	(0.0035)	(0.0035)	(0.0035)
ECB_TLTRO			0.0068***	0.0068***
			(0.0026)	(0.0026)
AGE	-0.0032***	-0.0034***	-0.0031***	-0.0034***
	(0.0008)	(0.0009)	(0.0008)	(0.0009)
PROFIT	-0.0735***	-0.0673***	-0.0735***	-0.0673***
	(0.0049)	(0.0049)	(0.0049)	(0.0049)
LIQ	0.0389*	0.0358	0.0387*	0.0356
	(0.0231)	(0.0231)	(0.0231)	(0.0231)
SIZE	0.0271***	0.0259***	0.0271***	0.0259***
	(0.0018)	(0.0018)	(0.0018)	(0.0018)
AS	0.1547***	0.1525***	0.1546***	0.1525***
	(0.0075)	(0.0074)	(0.0075)	(0.0074)
INF	-0.0009***	-0.0010***	-0.0009***	-0.0009***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
GDP growth	0.0013***	0.0011***	0.0014***	0.0011***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Bank Credit Growth(t-1)	0.0695***	0.0680***	0.0694***	0.0680***
	(0.0054)	(0.0055)	(0.0054)	(0.0055)
DiD × Bank Credit Growth(t-1)	-0.1161***	-0.1182***	-0.1029***	-0.1050***
	(0.0375)	(0.0383)	(0.0386)	(0.0392)
Marginal Effect @ 1% Credit Growth	3%	3%	2%	2%
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	26,228	26,228	26,228	26,228
Observations	128,680	128,680	128,680	128,680
R^2	0.74	0.75	0.74	0.75

Notes: This table provides the estimates of the difference-in-difference estimates of the impact of NIRP on capital structure using long-term debt ratio (LDR) with a sub-sample of low-liquidity firms **defined by firms with <= median *LIQ*** following Equation 1 with Two-way Fixed Effects (TWFE), where DiD is $Treated_i \times POST_t$. **The estimates control for TLTRO and include interactions of bank credit growth with our DID variable**. *Clustered (firmid) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

E.5 Results based on OECD Countries

The results of our robustness checks comparing the Eurozone firms with those of other OECD countries are presented in Tables E.25, E.26, and E.27. These results are already discussed in section 5.6 in the main paper.

Table E.25: NIRP and Long-Term Debt Ratio – OECD Countries Sub-Sample

Model:	(1)	(2)	(3)	(4)
DiD	0.0072**	0.0061**	0.0074**	0.0069**
	(0.0029)	(0.0030)	(0.0030)	(0.0031)
ECB_QE	0.0076***	0.0086***	0.0082***	0.0079***
	(0.0028)	(0.0029)	(0.0030)	(0.0031)
ECB_FG	-0.0155***	-0.0142***	-0.0180***	-0.0171***
	(0.0020)	(0.0020)	(0.0021)	(0.0021)
ECB_TLTRO	0.0080***	0.0080***	0.0091***	0.0091***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
AGE	-0.0002	-0.0001	0.0002	-3.7×10^{-5}
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
PROFIT	-0.0237***	-0.0230***	-0.0447***	-0.0420***
	(0.0013)	(0.0013)	(0.0024)	(0.0024)
LIQ	0.0049	0.0051	0.0030	0.0026
	(0.0037)	(0.0036)	(0.0055)	(0.0055)
SIZE	0.0104***	0.0103***	0.0214***	0.0212***
	(0.0006)	(0.0006)	(0.0011)	(0.0012)
AS	0.1045***	0.1033***	0.1478***	0.1471***
	(0.0041)	(0.0040)	(0.0061)	(0.0061)
INF	0.0046***	0.0040***	0.0041***	0.0037***
	(0.0004)	(0.0004)	(0.0004)	(0.0005)
GDP growth	0.0020***	0.0019***	0.0017***	0.0015***
	(0.0002)	(0.0002)	(0.0003)	(0.0003)
Bank Credit Growth(t-1)			-0.0141**	-0.0138**
			(0.0056)	(0.0059)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	30,480	30,480	30,480	30,480
Observations	257,246	257,246	157,290	157,290
R^2	0.66	0.67	0.72	0.72

Notes: This table presents difference-in-differences estimates of the impact of NIRP on long-term debt ratio (LTDR) using only OECD member countries. The sample includes 32 OECD countries with 30,480 firms. DiD is $Treated_i \times POST_t$. All specifications include firm-level controls (age, profitability, liquidity, size, asset structure) and macroeconomic controls (inflation, GDP growth). Columns (3) and (4) additionally control for lagged bank credit growth. *Clustered (firm) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.26: NIRP and Short-Term Debt Ratio – OECD Countries Sub-Sample

Model:	(1)	(2)	(3)	(4)
DiD	0.0014	0.0027	0.0047	0.0050*
	(0.0030)	(0.0031)	(0.0030)	(0.0030)
ECB_QE	-0.0139***	-0.0127***	-0.0127***	-0.0126***
	(0.0028)	(0.0028)	(0.0028)	(0.0028)
ECB_FG	-0.0015	-2.21×10^{-5}	0.0003	7.45×10^{-5}
	(0.0018)	(0.0019)	(0.0019)	(0.0019)
ECB_TLTRO	-0.0066***	-0.0055***	-0.0052***	-0.0052***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
AGE	0.0016***	0.0010*	0.0011*	0.0007
	(0.0006)	(0.0006)	(0.0006)	(0.0006)
PROFIT	-0.0882***	-0.0886***	-0.1042***	-0.1047***
	(0.0020)	(0.0020)	(0.0031)	(0.0031)
LIQ	-0.4297***	-0.4257***	-0.4136***	-0.4112***
	(0.0055)	(0.0056)	(0.0073)	(0.0073)
SIZE	-0.0234***	-0.0237***	-0.0194***	-0.0197***
	(0.0007)	(0.0007)	(0.0011)	(0.0012)
AS	-0.3138***	-0.3122***	-0.3273***	-0.3256***
	(0.0056)	(0.0056)	(0.0073)	(0.0073)
INF	0.0034***	0.0027***	0.0022***	0.0022***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)
GDP growth	-0.0002	-0.0004*	-8.85×10^{-5}	-0.0002
	(0.0002)	(0.0002)	(0.0002)	(0.0003)
Bank Credit Growth(t-1)			0.0162***	0.0182***
			(0.0055)	(0.0057)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	30,480	30,480	30,480	30,480
Observations	257,246	257,246	157,290	157,290
R^2	0.70	0.70	0.77	0.78

Notes: This table presents difference-in-differences estimates of the impact of NIRP on short-term debt ratio (STDR) using only OECD member countries. The sample includes 32 OECD countries with 30,480 firms. DiD is $Treated_i \times POST_t$. All specifications include firm-level controls (age, profitability, liquidity, size, asset structure) and macroeconomic controls (inflation, GDP growth). Columns (3) and (4) additionally control for lagged bank credit growth. *Clustered (firm) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

Table E.27: NIRP and Total Debt Ratio – OECD Countries Sub-Sample

Model:	(1)	(2)	(3)	(4)
DiD	0.0071*	0.0078**	0.0114***	0.0106***
	(0.0038)	(0.0038)	(0.0036)	(0.0036)
ECB_QE	-0.0132***	-0.0097***	-0.0105***	-0.0096***
	(0.0036)	(0.0037)	(0.0037)	(0.0037)
ECB_FG	-0.0191***	-0.0158***	-0.0188***	-0.0177***
	(0.0025)	(0.0025)	(0.0025)	(0.0025)
ECB_TLTRO	-0.0006	0.0002	-0.0014	-0.0011
	(0.0017)	(0.0017)	(0.0017)	(0.0017)
AGE	0.0032***	0.0023**	0.0031***	0.0021**
	(0.0009)	(0.0009)	(0.0010)	(0.0010)
PROFIT	-0.1154***	-0.1146***	-0.1589***	-0.1558***
	(0.0024)	(0.0024)	(0.0041)	(0.0041)
LIQ	-0.4385***	-0.4345***	-0.4259***	-0.4245***
	(0.0067)	(0.0067)	(0.0092)	(0.0092)
SIZE	-0.0097***	-0.0101***	0.0060***	0.0052***
	(0.0010)	(0.0010)	(0.0017)	(0.0018)
AS	-0.1757***	-0.1758***	-0.1356***	-0.1359***
	(0.0069)	(0.0068)	(0.0093)	(0.0092)
INF	0.0085***	0.0069***	0.0063***	0.0055***
	(0.0005)	(0.0005)	(0.0006)	(0.0006)
GDP growth	0.0021***	0.0017***	0.0017***	0.0012***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Bank Credit Growth(t-1)			-0.0181**	-0.0188**
			(0.0074)	(0.0078)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Industry × Year FE	No	Yes	No	Yes
No. of Firms	30,480	30,480	30,480	30,480
Observations	254,845	254,827	153,993	153,977
R^2	0.71	0.72	0.77	0.78

Notes: This table presents difference-in-differences estimates of the impact of NIRP on total debt ratio (TDR) using only OECD member countries. The sample includes 32 OECD countries with 30,480 firms. DiD is $Treated_i \times POST_t$. All specifications include firm-level controls (age, profitability, liquidity, size, asset structure) and macroeconomic controls (inflation, GDP growth). Columns (3) and (4) additionally control for lagged bank credit growth. *Clustered (firm) standard errors in parentheses. Signif. codes: ***: 0.01, **: 0.05, *: 0.1.*

F Calibration of DSGE Model

Table F.1 reports the baseline calibration at quarterly frequency, targeting euro area data. Household and production parameters follow Smets and Wouters (2007). The financial intermediation block draws on the framework of Gertler and Karadi (2011), which is extended to incorporate corporate finance frictions and NIRP-specific channels. Below, we discuss the calibration strategy for each parameter group.

Preferences and production. The discount factor $\beta = 0.995$ implies a 2% annualised real rate, consistent with the low-rate euro area environment targeted by Smets and Wouters (2007) and comparable to the $\beta = 0.9975$ (1% annual) in Darracq Pariès et al. (2023). Risk aversion $\sigma = 1.38$, habit persistence $h = 0.70$, and the Calvo parameter $\theta_p = 0.75$ are taken directly from Smets and Wouters (2007). The Frisch elasticity $1/\varphi = 0.50$ is consistent with the macro elasticity range in Chetty et al. (2011).

Corporate finance frictions. The consol coupon decay $\kappa = 0.975$ implies a Macaulay duration of $1/(1 - \beta\kappa) \approx 33$ quarters (≈ 8 years), following the perpetuity modelling approach in Woodford (2001). The persistence parameters ρ_m and ρ_b are derived from quadratic adjustment costs through the firm's first-order conditions: $\rho_j = \phi_j/(1+\phi_j)$, where $\phi_m = 2.0$ yields $\rho_m = 0.667$ and $\phi_b = 8.0$ yields $\rho_b = 0.889$. This structural derivation ensures that higher adjustment costs simultaneously increase persistence and reduce contemporaneous impact.

The maturity adjustment cost $\phi_m = 2.00$ and maturity-spread sensitivity $\eta_m = 2.00$ are calibrated to match the sluggish maturity adjustment dynamics documented by Badoer and James (2016) and the gap-filling behaviour in Greenwood et al. (2010). The magnitude of ϕ_m is comparable to the investment adjustment cost $\kappa_I = 2.48$ (SE 0.43) estimated by Christiano et al. (2005), reflecting a similar degree of friction in the maturity margin as in the investment margin. We adopt the CEE point estimate $\kappa_I = 2.48$ directly.

The leverage adjustment cost, $\phi_b = 8.00$, implies a half-life of leverage rebalancing of $\ln 2/\ln(1/\rho_b) \approx 5.9$ quarters, consistent with the 2–4 year adjustment documented in Leary and Roberts (2005). The value lies within the 95% credible interval $[4.03, 18.27]$ of the bank capital adjustment cost parameter κ_b^K estimated by Gerali et al. (2010) in a Bayesian DSGE model of the euro area (posterior median 11.07; see their Table 2A). The debt yield sensitivity, $\eta_b = 0.50$, and the credit supply channel, $\zeta_b = 0.30$, are calibrated to match the model's steady-state spread and credit-to-GDP ratio.

Financial intermediation. The steady-state leverage, $\phi = 4$, follows Gertler and Karadi (2011). The leverage response parameter, $\phi_{lev} = 0.60$, governs the sensitivity of bank leverage

to net worth deviations; it is calibrated so that a 1% increase in net worth raises leverage by 0.60, generating procyclical bank balance sheet dynamics consistent with the financial accelerator literature. The net worth persistence, $\rho_N = 0.85$, implies a 15% quarterly payout rate, following the net worth accumulation framework in Abadi et al. (2023), where the bank equity retention rate $(1-\upsilon) = 0.886$ serves an analogous role. Other NIRP models adopt similar values: Darracq Pariès et al. (2023) use a banker survival rate of $\theta = 0.90$.

The spread sensitivity $\gamma_N = 8.0$ is calibrated to the euro area bank leverage ratio of approximately 8 in Darracq Pariès et al. (2023). The bond valuation sensitivity, $\chi_Q = 0.50$, captures the share of the bank's long-term assets that generate capital gains when yields fall. The reserve-carry coefficient $\chi_\tau = 2.00$ governs the strength of the reserve-carry cost mechanism under NIRP; the value is calibrated to the steady-state reserves-to-equity ratio, consistent with $H/\bar{E} = 2$ in McLeay et al. (2025) and Ulate (2021). The natural rate sensitivity $\chi_\theta = 0.50$ maps demand shocks to the natural rate of interest.

Monetary policy. The policy smoothing parameter $\rho_r = 0.80$ is standard in the literature (e.g., Clarida et al., 1999; Gertler and Karadi, 2011; Abadi et al., 2023). The inflation response, $\phi_\pi = 1.25$, follows Campos et al. (2024), who adopt this value as standard in a New Keynesian framework; it satisfies the Taylor principle while capturing the ECB's comparatively accommodative stance during the NIRP period. The output response, $\phi_y = 0.125$, follows Darracq Pariès et al. (2023); on an annualised basis, this equals $4 \times 0.125 = 0.50$, consistent with the Taylor (1993) benchmark and the euro area estimates in Smets and Wouters (2007). The NIRP floor $\underline{R} = 0.99749$ ($\approx -1\%$ annualised) is calibrated to the reversal rate concept in Brunnermeier and Koby (2018); Abadi et al. (2023) estimate the reversal rate at approximately -1% in their quantitative model, supporting this calibration.

Steady state and shocks. The steady-state rate $\bar{R} = 0.999$ (approximately -0.4% annualised) corresponds to the ECB's deposit facility rate during 2016–2019. The model studies *within-NIRP dynamics*—the effect of marginal rate cuts when negative rates are already in place—rather than the initial transition from conventional to negative rate policy. The reserve-to-GDP ratio $\bar{S}/\bar{Y} = 0.21$ is the sufficient statistic for the reserve-carry mechanism in the log-linearised model. The model includes five exogenous shocks: monetary policy (ε_t^r), demand (ε_t^θ), maturity (ε_t^m), net worth (ε_t^N), and TFP (ε_t^a). In the baseline analysis, $\sigma_m = \sigma_N = \sigma_a = 0$; only the policy and demand shocks are active. Demand shock persistence $\rho_\theta = 0.90$ is in the range estimated by Smets and Wouters (2007) for euro area preference shocks.

Table F.1: Baseline Calibration

Parameter	Description	Symbol	Value	Reference
Preferences				
Discount factor	$\approx 2\%$ ann. real rate	β	0.995	Standard
Risk aversion		σ	1.38	Smets and Wouters (2007)
Habit persistence		h	0.70	Smets and Wouters (2007)
Labour disutility		ω	1.00	Standard
Frisch elasticity		$1/\varphi$	0.50	Chetty et al. (2011)
Production				
Capital share		α	0.33	Standard
Depreciation rate		δ	0.025	Standard
Price stickiness (Calvo)		θ_p	0.75	Smets and Wouters (2007)
Corporate Finance				
Consol coupon decay	Target: ≈8yr duration	κ	0.975	Woodford (2001)
Maturity adjustment cost		ϕ_m	2.00	Calibrated
Maturity persistence	$= \phi_m/(1+\phi_m)$	ρ_m	0.667	Derived
Maturity sensitivity		η_m	2.00	Calibrated
Leverage adjustment cost	Half-life ≈ 6 qtrs	ϕ_b	8.00	Gerali et al. (2010)
Debt persistence	$= \phi_b/(1+\phi_b)$	ρ_b	0.889	Derived
Debt yield sensitivity		η_b	0.50	Calibrated
Credit supply channel		ζ_b	0.30	Calibrated
Investment adj. cost	CEE point estimate	κ_I	2.48	Christiano et al. (2005)
Financial Intermediation				
Steady-state leverage		ϕ	4.00	Gertler and Karadi (2011)
Leverage response		ϕ_{lev}	0.60	Calibrated
Net worth persistence		ρ_N	0.85	Abadi et al. (2023)
Bond valuation sensitivity		χ_Q	0.50	Calibrated
Reserve-carry coefficient		χ_τ	2.00	Calibrated
Spread sensitivity	Euro-area leverage	γ_N	8.00	Darracq Pariès et al. (2023)
CB balance sheet / GDP		$\bar{S}/\bar{Y}$	0.21	ECB data
Monetary Policy				
Steady-state gross rate	$\approx -0.4\%$ ann.	$\bar{R}$	0.999	ECB DFR
NIRP floor (gross)	$\approx -1.0\%$ ann.	$\underline{R}$	0.99749	Abadi et al. (2023)
Inflation response		ϕ_π	1.25	Campos et al. (2024)
Output response		ϕ_y	0.125	Darracq Pariès et al. (2023)
Policy smoothing		ρ_r	0.80	Clarida et al. (1999)
Exogenous Processes				
Demand shock persistence		ρ_θ	0.90	Smets and Wouters (2007)
Natural rate sensitivity		χ_θ	0.50	Calibrated
TFP persistence		ρ_a	0.95	Smets and Wouters (2007)
Aggregation				
Consumption share of GDP		c_y	0.60	Euro area data
Investment share of GDP		i_y	0.20	Euro area data
Govt. spending share	$= 1 - c_y - i_y$	G/Y	0.20	Residual

Notes: "Calibrated" denotes parameters specific to the corporate finance and financial intermediation extensions; justifications are discussed above. "Derived" denotes parameters computed from structural first-order conditions. All values are at quarterly frequency.

G Complete Equilibrium System

This appendix lists all equilibrium conditions for the log-linearised OccBin implementation. The system comprises 30 equations in 30 endogenous variables: $\{\hat{y}_t, \hat{c}_t, \hat{i}_t, \hat{k}_t, \hat{l}_t, \hat{w}_t, \widehat{mc}_t, \hat{q}^k_t, \hat{r}^k_t, \pi_t, R^{Pol}_t, R^S_t, R^D_t, Q^L_t, \hat{r}^L_t, \hat{r}^S_t, \hat{n}_t, \hat{\mu}_t, \hat{lev}_t, \hat{m}_t, \hat{b}_t, \hat{\lambda}_t, \hat{\theta}_t, \hat{r}^{nat}_t,$
$\text{rcost}_t, \text{ltshare}_t, \text{stshare}_t, \hat{a}_t, \mu^{\text{floor}}_t, RsGap_t\}$. Relative to the 28-core-equation system, two auxiliary equations govern the floor multiplier and floor-gap variables used by OccBin. Two additional i.i.d. shocks (ε^m_t, ε^N_t) enter the maturity and net worth equations directly. In the baseline analysis, $\sigma_m = \sigma_N = \sigma_a = 0$; the shocks are retained for structural completeness and estimability.

G.1 Household Block

With external habit persistence $h \in (0, 1)$, the marginal utility of consumption and Euler equation yield:

$$\hat{\lambda}_t = -\frac{\sigma}{1-h}(\hat{c}_t - h\hat{c}_{t-1}) \tag{1}$$

$$\hat{\lambda}_t = \ln R^S_t - \ln \bar{R} - \mathbb{E}_t[\pi_{t+1}] + \mathbb{E}_t[\hat{\lambda}_{t+1}] + \hat{r}^{nat}_t \tag{2}$$

where $\hat{r}^{nat}_t = -\chi_\theta \hat{\theta}_t$ is the natural rate of interest. The Euler equation uses the reserve/policy rate R^S_t rather than the deposit rate R^D_t because wholesale funding and money market rates track the policy rate. This is the relevant rate for marginal investment and saving decisions by firms and institutional investors (see Gertler and Karadi, 2011).

Labour supply satisfies:

$$\varphi \hat{l}_t = \hat{\lambda}_t + \hat{w}_t \tag{3}$$

where φ is the inverse Frisch elasticity.

G.2 Production Block

The Cobb–Douglas production function log-linearises to:

$$\hat{y}_t = \hat{a}_t + \alpha \hat{k}_{t-1} + (1-\alpha)\hat{l}_t \tag{4}$$

where $\hat{a}_t$ is log TFP and capital is predetermined. Capital accumulates according to:

$$\hat{k}_t = (1-\delta)\hat{k}_{t-1} + \delta \hat{i}_t \tag{5}$$

Investment is governed by a Tobin's Q framework with adjustment costs κ_I:

$$\hat{q}_t^k = \beta(1-\delta)\mathbb{E}_t[\hat{q}_{t+1}^k] + (1-\beta(1-\delta))\mathbb{E}_t[\hat{r}_{t+1}^k] + \kappa_I\beta(\mathbb{E}_t[\hat{i}_{t+1}] - \hat{i}_t) - \kappa_I(\hat{i}_t - \hat{i}_{t-1}) \tag{6}$$

$$\hat{i}_t = \hat{i}_{t-1} + \frac{1}{\kappa_I}\hat{q}_t^k \tag{7}$$

Marginal cost and factor demands:

$$\widehat{mc}_t = \hat{w}_t - (\hat{y}_t - \hat{l}_t) \tag{8}$$

$$\hat{r}_t^k = \widehat{mc}_t + \hat{y}_t - \hat{k}_{t-1} \tag{9}$$

G.3 Phillips Curve

$$\pi_t = \beta\mathbb{E}_t[\pi_{t+1}] + \kappa_p\widehat{mc}_t \tag{10}$$

where $\kappa_p \equiv \frac{(1-\theta_p)(1-\beta\theta_p)}{\theta_p}$. With $\theta_p = 0.75$ and $\beta = 0.995$, this gives $\kappa_p \approx 0.085$.

G.4 Monetary Policy Block

$$\ln R_t^{Pol} = (1-\rho_r)\ln\bar{R} + \rho_r \ln R_{t-1}^{Pol} + (1-\rho_r)[\phi_\pi\pi_t + \phi_y\hat{y}_t] + \varepsilon_t^r \tag{11}$$

$$R_t^S = R_t^{Pol} \quad \text{(relax regime)} \tag{12}$$

$$R_t^S = \underline{R} \quad \text{(bind regime)}$$

$$\mu_t^{\text{floor}} = 0 \quad \text{(relax regime)}$$

$$\mu_t^{\text{floor}} = R_t^{Pol} - \underline{R} \quad \text{(bind regime)}$$

$$RsGap_t = \ln R_t^S - \ln \underline{R}$$

$$R_t^D = \xi R^{D,\text{floor}} + (1-\xi)R_t^S, \quad \xi \in \{0,1\} \tag{13}$$

The NIRP floor is $\underline{R} = 0.99749$ ($\approx -1\%$ annualised), calibrated to the reversal rate concept in Brunnermeier and Koby (2018); Abadi et al. (2023) estimate the reversal rate at approximately -1%. The OccBin switching rule in the code is: `bind if` $RsGap_t < -10^{-6}$ and `relax if` $\mu_t^{\text{floor}} > 0$. In the baseline within-NIRP calibration, $\xi = 1$ and $R^{D,\text{floor}} = 1$, so deposits are fixed

at the floor. The reserve-carry cost is:

$$\text{rcost}_t = (R_t^D - R_t^S) \cdot \frac{\bar{S}}{\bar{Y}} \tag{14}$$

G.5 Real Short Rate

The real short rate deviation (used in the term spread):

$$\hat{r}_t^S = \ln R_t^S - \ln \bar{R}^S - \mathbb{E}_t[\pi_{t+1}] \tag{15}$$

G.6 Corporate Finance Block

The maturity and leverage equations are derived from firms' first-order conditions with quadratic adjustment costs. With maturity adjustment cost ϕ_m and leverage adjustment cost ϕ_b, the FOCs yield:

$$\hat{m}_t = \frac{\phi_m}{1+\phi_m}\hat{m}_{t-1} - \frac{1}{1+\phi_m}\eta_m(\hat{r}_t^L - \bar{r}^L) + \varepsilon_t^m \tag{16}$$

$$\hat{b}_t = \frac{\phi_b}{1+\phi_b}\hat{b}_{t-1} + \frac{1}{1+\phi_b}[-\eta_b(\hat{r}_t^L - \bar{r}^L) + \zeta_b(\hat{n}_t - \bar{n})] \tag{17}$$

The structural derivation ensures that persistence and sensitivity are jointly identified: $\rho_m = \phi_m/(1+\phi_m)$ and $\rho_b = \phi_b/(1+\phi_b)$. With $\phi_m = 2.0$ and $\phi_b = 8.0$, this yields $\rho_m = 0.667$ and $\rho_b = 0.889$.

In the implemented reduced-form maturity equation (16), the short-rate benchmark is absorbed into constants, so adjustment depends directly on $(\hat{r}_t^L - \bar{r}^L)$. The short-term share is defined as the complement: $(1 - \hat{m}_t) = -\hat{m}_t$.

G.7 Financial Intermediation Block

$$\hat{n}_t = \rho_N \hat{n}_{t-1} + (1-\rho_N)[\chi_Q(\hat{Q}_t^L - \bar{Q}^L) - \chi_\tau(\text{rcost}_{t-1} - \overline{\text{rcost}})] + \varepsilon_t^N \tag{18}$$

$$\hat{\mu}_t = \exp(-\gamma_N \hat{n}_t) - 1 \tag{19}$$

$$\hat{lev}_t = \bar{\phi} + \phi_{lev}(\hat{n}_t - \bar{n}) \tag{20}$$

$$\hat{Q}_t^L = \frac{\beta(1+\kappa\mathbb{E}_t[\hat{Q}_{t+1}^L])}{R_t^S(1+\hat{\mu}_t)(1+\mathbb{E}_t[\pi_{t+1}])} \tag{21}$$

Note that the net worth equation (18) uses *lagged* reserve-carry cost (rcost_{t-1}), reflecting that

banks observe the margin squeeze from the previous period's operations. The consol pricing equation (21) discounts at the policy rate R_t^S (not the deposit rate R_t^D), capturing the signalling channel whereby rate cuts directly affect bond prices.

Remark 1 (Net Worth Implementation)**.** *The Dynare implementation uses levels rather than pure deviations for net worth. An intercept* $n_{ss} = -\chi_\tau \cdot \overline{rcost}$ *is added to ensure the correct steady state under NIRP. At steady state, the deviation form* (18) *with* $\hat{n}_t = \hat{n}_{t-1} = 0$ *and* $(rcost_{t-1} - \overline{rcost}) = 0$

G.8 Definitions

$$\hat{r}_t^L = \ln\left(\frac{1+\kappa Q_t^L}{Q_{t-1}^L}\right) - \mathbb{E}_t[\pi_{t+1}] \tag{22}$$

G.9 Market Clearing

$$\hat{y}_t = c_y \hat{c}_t + i_y \hat{i}_t \tag{23}$$

where $c_y = 0.60$ is the steady-state consumption share and $i_y = 0.20$ is the investment share of GDP (with the remainder being government spending). Consumption is derived from the resource constraint:

$$\hat{c}_t = \frac{\hat{y}_t - i_y \hat{i}_t}{c_y}. \tag{24}$$

Note that equation (24) is obtained by rearranging (23) and is not an independent equilibrium condition. The full OccBin system contains 30 equations (28 core equations plus 2 auxiliary floor-regime equations).

G.10 Exogenous Processes

$$\hat{\theta}_t = \rho_\theta \hat{\theta}_{t-1} + \varepsilon_t^\theta \tag{25}$$

$$\hat{a}_t = \rho_a \hat{a}_{t-1} + \varepsilon_t^a \tag{26}$$

The maturity shock ε_t^m enters equation (16) and the net worth shock ε_t^N enters equation (18). In the baseline analysis, $\sigma_m = \sigma_N = \sigma_a = 0$; these shocks are retained for structural completeness

and would be activated in an estimation exercise.

H Proofs of Propositions

This section provides formal proofs for the three propositions stated in Section 6.8.

H.1 Proof of Proposition 1 (Maturity Rebalancing)

Proposition 1 (Maturity Rebalancing)**.** *Under NIRP, the long-debt share m_t increases on impact. In the implemented maturity equation, a fall in $(\hat{r}_t^L - \bar{r}^L)$ directly increases $\hat{m}_t$.*

Proof. The maturity dynamics follow equation (16):

$$\hat{m}_t = \rho_m \hat{m}_{t-1} - (1-\rho_m)\eta_m(\hat{r}_t^L - \bar{r}^L), \tag{A.1}$$

which is the reduced-form maturity law used in the Dynare implementation.

Step 1: Impact of NIRP on long yields. Consider a negative monetary policy shock $\varepsilon_t^r < 0$ (rate cut). The consol pricing equation (21) implies:

$$Q_t^L = \frac{\beta(1+\kappa\mathbb{E}_t[Q_{t+1}^L])}{R_t^S(1+\mu_t)(1+\mathbb{E}_t[\pi_{t+1}])}. \tag{A.2}$$

Note that consol prices are discounted at the policy rate R_t^S, not the deposit rate R_t^D. This is crucial for the signalling channel: a rate cut (lower R_t^S) directly raises Q_t^L through the discount factor. When the NIRP floor binds, agents anticipate the rate will remain at the floor, amplifying the forward guidance effect. A useful approximation (holding endogenous inflation/output feedback fixed) is:

$$\mathbb{E}_t[R_{t+k}^{Pol}] = \rho_r^k R_t^{Pol} + (1-\rho_r^k)\bar{R}, \quad \forall k \geq 1. \tag{A.3}$$

This forward guidance is capitalised into consol prices through the recursive structure. Specifically, log-linearising (A.2) around steady state:

$$\hat{Q}_t^L \approx \beta\kappa\mathbb{E}_t[\hat{Q}_{t+1}^L] - \hat{R}_t^S - \hat{\mu}_t - \mathbb{E}_t[\pi_{t+1}]. \tag{A.4}$$

The policy rate $\hat{R}_t^S$ enters directly, so a rate cut ($\hat{R}_t^S < 0$) immediately raises bond prices. Iterating forward and using the spread equation $\hat{\mu}_t = -\gamma_N \hat{n}_t$ (first-order approximation):

$$\hat{Q}_t^L = -\sum_{j=0}^{\infty}(\beta\kappa)^j \mathbb{E}_t[\hat{R}_{t+j}^S + \hat{\mu}_{t+j} + \pi_{t+j+1}]. \tag{A.5}$$

The rate cut ($\hat{R}^S_{t+j} < 0$) tends to raise Q^L_t through the discount factor. When the NIRP floor binds, the forward guidance channel amplifies this effect: agents anticipate the rate will remain at the floor for an extended period. This forward guidance effect dominates inflation expectations and spread movements, so Q^L_t *rises* on impact when the floor binds. The real long yield is:

$$\hat{r}^L_t = \ln\left(\frac{1+\kappa Q^L_t}{Q^L_{t-1}}\right) - \mathbb{E}_t[\pi_{t+1}] \approx -\frac{\kappa}{1+\kappa\bar{Q}^L}\hat{Q}^L_t - \frac{1}{\bar{Q}^L}\hat{Q}^L_{t-1} - \mathbb{E}_t[\pi_{t+1}]. \tag{A.6}$$

Since the forward guidance channel dominates when the floor binds, Q^L_t rises on impact. The real long yield falls on impact (reflecting forward-looking expectations of continued bond price appreciation):

$$\hat{r}^L_0 < 0 \quad \Rightarrow \quad (\hat{r}^L_0 - \bar{r}^L) < 0. \tag{A.7}$$

Step 2: Maturity response. Substituting (A.7) into (A.1) with $\hat{m}_{-1} = 0$ (starting from steady state):

$$\hat{m}_0 = -(1-\rho_m)\eta_m(\hat{r}^L_0 - \bar{r}^L) > 0, \tag{A.8}$$

since $\eta_m > 0$, $(1-\rho_m) > 0$, and $(\hat{r}^L_0 - \bar{r}^L) < 0$.

Step 3: Magnitude. With calibration $\eta_m = 2.0$ and $\rho_m = 0.667$ (from $\phi_m = 2.0$, Table F.1):

$$\hat{m}_0 = 0.333 \times 2.0 \times |(\hat{r}^L_0 - \bar{r}^L)| = 0.667 \times |(\hat{r}^L_0 - \bar{r}^L)|. \tag{A.9}$$

The model simulations show the long-debt share rising by approximately 0.15 percentage points, peaking in quarter 2. With persistence $\rho_m = 0.667$, the cumulative effect builds rapidly, reaching approximately 90% of the peak response within 2 quarters.

Conclusion. Under NIRP, a rate cut compresses long yields. When the floor binds, the forward guidance channel amplifies this compression. In the implemented maturity law, this lower long yield directly increases the long-debt share through equation (A.1). □ □

H.2 Proof of Proposition 2 (Delayed Leverage Response)

Proposition 2 (Delayed Leverage Response)**.** *Total leverage b_t responds with a lag relative to maturity, despite net worth rising on impact when the NIRP floor binds. The forward guidance channel—whereby agents anticipate the rate will remain at the floor—generates immediate capital gains on bank bond portfolios that dominate the reserve-carry cost. Total debt adjusts slowly due to (i) high persistence $\rho_b = 0.889$ (from $\phi_b = 8.0$) reflecting real-world frictions in leverage adjustment, and (ii) the inherent stickiness of corporate capital structure decisions.*

Proof. Total debt dynamics follow equation (17):

$$\hat{b}_t = \rho_b \hat{b}_{t-1} + (1-\rho_b)\left[-\eta_b(\hat{r}_t^L - \bar{r}^L) + \zeta_b(\hat{n}_t - \bar{n})\right]. \tag{A.10}$$

Step 1: Net worth dynamics under NIRP. From equation (18):

$$\hat{n}_t = \rho_n \hat{n}_{t-1} + (1-\rho_n)\left[\chi_Q(\hat{Q}_t^L - \bar{Q}^L) - \chi_\tau(\text{rcost}_{t-1} - \overline{\text{rcost}})\right]. \tag{A.11}$$

Note that the reserve-carry cost uses *lagged* values (rcost_{t-1}), reflecting that banks observe the margin squeeze from the previous period's operations. Two opposing forces operate on bank net worth:

(i) Bond valuation gains (positive): A rate cut raises Q_t^L, generating capital gains $\chi_Q(\hat{Q}_t^L - \bar{Q}^L) > 0$.

(ii) Reserve-carry cost (negative): Under NIRP, $R_t^D = 1$ while $R_t^S < 1$. The carry cost is:

$$\text{rcost}_t = (R_t^D - R_t^S) \cdot \frac{\bar{S}}{\bar{Y}} = (1 - R_t^S) \cdot \frac{\bar{S}}{\bar{Y}}. \tag{A.12}$$

A deeper rate cut (lower R_t^S) *increases* the carry cost, creating a drag $-\chi_\tau(\text{rcost}_t - \overline{\text{rcost}}) < 0$.

On impact ($t = 0$, with $\hat{n}_{-1} = 0$ and $\text{rcost}_{-1} = \overline{\text{rcost}}$):

$$\hat{n}_0 = (1-\rho_n)\left[\chi_Q \hat{Q}_0^L - \chi_\tau(\text{rcost}_{-1} - \overline{\text{rcost}})\right] = (1-\rho_n)\chi_Q \hat{Q}_0^L. \tag{A.13}$$

The lagged timing means that on impact, net worth responds only to bond valuation gains (the carry cost drag enters with a one-period delay). When the NIRP floor binds, the forward guidance channel dominates: agents anticipate the rate will remain at the floor, raising consol prices immediately ($\hat{Q}_0^L > 0$). This produces $\hat{n}_0 > 0$ (net worth rises on impact). In the baseline calibration with a -1% floor and 25bp shock, net worth rises by approximately $+0.0031\%$ on impact. In subsequent periods ($t \geq 1$):

$$\hat{n}_t = \rho_n \hat{n}_{t-1} + (1-\rho_n)\left[\chi_Q \hat{Q}_t^L - \chi_\tau \Delta\text{rcost}_{t-1}\right], \tag{A.13'}$$

where $\Delta\text{rcost}_{t-1} = \text{rcost}_{t-1} - \overline{\text{rcost}} > 0$ captures the margin squeeze from the previous period.

Step 2: Forward guidance effect when floor binds. When the NIRP floor binds, net worth *rises* on impact ($\hat{n}_0 \approx +0.0031\%$) due to the forward guidance channel: agents anticipate the rate will remain at the floor, raising bond prices immediately.

Under *conventional* monetary policy (no deposit floor), both R_t^D and R_t^S decline with the policy rate, so $\text{rcost}_t = 0$ always. Net worth responds to bond valuation gains without the carry

cost drag.

Under *NIRP with binding floor*, the forward guidance effect amplifies bond price movements. The impact response ($t = 0$) is:

$$\hat{n}_0^{\text{NIRP, binding}} = (1 - \rho_n)\chi_Q \hat{Q}_0^L > 0. \tag{A.14}$$

From $t = 1$ onwards, the lagged carry cost enters and attenuates net worth accumulation:

$$\hat{n}_1^{\text{NIRP}} = \rho_n \hat{n}_0 + (1 - \rho_n)\left[\chi_Q \hat{Q}_1^L - \chi_\tau \Delta\text{rcost}_0\right] < \hat{n}_1^{\text{conv}}. \tag{A.15}$$

The attenuation factor (for $t \geq 1$) is:

$$\alpha_t \equiv \frac{\hat{n}_t^{\text{NIRP}}}{\hat{n}_t^{\text{conv}}} < 1. \tag{A.16}$$

With calibration $\chi_Q = 0.50$, $\chi_\tau = 2.0$, and $\bar{S}/\bar{Y} = 0.21$ (Table F.1), the cumulative attenuation is quantitatively meaningful.

Step 3: Impact on total debt. Substituting into (A.10) with $\hat{b}_{-1} = 0$:

$$\hat{b}_0 = (1 - \rho_b)\left[-\eta_b(\hat{r}_0^L - \bar{r}^L) + \zeta_b \hat{n}_0\right]. \tag{A.17}$$

(i) High persistence effect: With $\rho_b = 0.889$ (from $\phi_b = 8.0$), only $(1 - \rho_b) = 0.111$ of the steady-state deviation materialises on impact:

$$\hat{b}_0 = 0.111 \times \left[-\eta_b(\hat{r}_0^L - \bar{r}^L) + \zeta_b \hat{n}_0\right]. \tag{A.18}$$

This is substantially smaller than the maturity response, which has $(1 - \rho_m) = 0.333$ (from $\phi_m = 2.0$).

(ii) Credit supply channel: The term $\zeta_b \hat{n}_0$ represents the credit supply channel. When the floor binds, $\hat{n}_0 > 0$ (net worth rises), providing an *expansionary* impulse to credit supply. However, this positive impulse is modest, and the high persistence of leverage adjustment ($\rho_b = 0.889$) means total debt responds slowly despite the favourable credit supply signal. The attenuation factor from $t \geq 1$ is:

$$\alpha_t \equiv \frac{\hat{n}_t^{\text{NIRP}}}{\hat{n}_t^{\text{conv}}} < 1 \quad \text{for } t \geq 1. \tag{A.19}$$

Step 4: Comparison of adjustment speeds. Define the half-life as $t_{1/2} = \ln(2)/\ln(1/\rho)$. For maturity: $t_{1/2}^m = \ln(2)/\ln(1/0.667) \approx 1.7$ quarters. For total debt: $t_{1/2}^b = \ln(2)/\ln(1/0.889) \approx 5.9$ quarters.

Alternatively, define time to reach 90% of peak. Solving $\rho^{t_{90}} = 0.10$:

$$t_{90}^{m} = \frac{\ln(0.10)}{\ln(0.667)} \approx 5.7 \text{ quarters}, \tag{27}$$

$$t_{90}^{b} = \frac{\ln(0.10)}{\ln(0.889)} \approx 19.6 \text{ quarters}. \tag{A.20}$$

Note that the model simulations show maturity reaching 90% of peak in 2 quarters and total debt in 3 quarters. The discrepancy between the analytical formula (5.7 quarters) and the simulation (2 quarters) arises because the AR(1) formula assumes a *permanent* forcing term, whereas the policy shock is *transitory* ($\rho_r = 0.80$). With a transitory shock, the impulse to the real long yield ($\hat{r}_t^L - \bar{r}^L$) is itself hump-shaped and mean-reverting, so the maturity response peaks earlier than the pure AR(1) dynamics would suggest.

Clarification on half-life formulas: The analytical half-life formula $t_{1/2} = \ln(2)/\ln(1/\rho)$ provides an *upper bound* on adjustment time, valid only under permanent forcing. Under transitory shocks—the empirically relevant case—the system converges faster because the shock itself decays. The formula remains useful for comparative statics: higher ρ always implies slower adjustment, regardless of shock persistence. The simulation-based t_{90} values (2 quarters for maturity, 3 quarters for total debt) are the appropriate measures for interpreting the IRF analysis.

Conclusion. Total debt adjusts slowly primarily due to high intrinsic persistence ($\rho_b = 0.889 > \rho_m = 0.667$), reflecting real-world frictions in corporate capital structure adjustment. When the floor binds, net worth rises on impact due to the forward guidance channel, providing a positive credit supply impulse. However, the lagged reserve-carry cost attenuates net worth accumulation from $t = 1$ onwards. The differential persistence ($\rho_b > \rho_m$) ensures that maturity adjusts faster than leverage regardless of the net worth dynamics. □ □

H.3 Proof of Proposition 3 (Central Bank Balance Sheet Amplification)

Proposition 3 (Central Bank Balance Sheet Amplification)**.** *The delayed leverage response is more pronounced when $\bar{S}/\bar{Y}$ is large, because the reserve-carry tax is proportional to the stock of reserves.*

Proof. We show that the attenuation of leverage response is increasing in $\bar{S}/\bar{Y}$.

Step 1: Reserve-carry cost dependence on balance sheet size. From equation (14):

$$\text{rcost}_t = (R_t^D - R_t^S) \cdot \frac{\bar{S}}{\bar{Y}}. \tag{A.21}$$

The change in carry cost from a rate cut $\Delta R_t^S < 0$ (with $R_t^D = 1$ fixed) is:

$$\Delta\text{rcost}_t = -\Delta R_t^S \cdot \frac{\bar{S}}{\bar{Y}} = |\Delta R_t^S| \cdot \frac{\bar{S}}{\bar{Y}}. \tag{A.22}$$

Thus $\partial(\Delta\text{rcost}_t)/\partial(\bar{S}/\bar{Y}) = |\Delta R_t^S| > 0$: the carry cost increase is *linear* in the CB balance sheet ratio.

Step 2: Net worth attenuation. Due to the lagged timing of rcost, the impact response at $t = 0$ is:

$$\hat{n}_0 = (1 - \rho_n)\chi_Q \hat{Q}_0^L, \tag{A.23}$$

which does not depend on $\bar{S}/\bar{Y}$ directly. However, from $t = 1$ onwards:

$$\hat{n}_1 = \rho_n \hat{n}_0 + (1 - \rho_n)\left[\chi_Q \hat{Q}_1^L - \chi_\tau |\Delta R_0^S| \cdot \frac{\bar{S}}{\bar{Y}}\right]. \tag{A.23'}$$

Taking the derivative with respect to $\bar{S}/\bar{Y}$:

$$\frac{\partial \hat{n}_1}{\partial(\bar{S}/\bar{Y})} = -(1 - \rho_n)\chi_\tau |\Delta R_0^S| < 0. \tag{A.24}$$

Net worth responds *less* to a rate cut when the CB balance sheet is larger, with this effect materialising from $t = 1$ due to the lagged timing.

Step 3: Total debt response. From (A.17), the impact response of total debt includes the credit supply term:

$$\hat{b}_0 = (1 - \rho_b)\left[-\eta_b(\hat{r}_0^L - \bar{r}^L) + \zeta_b \hat{n}_0\right]. \tag{A.25}$$

Since $\hat{n}_0$ does not depend on $\bar{S}/\bar{Y}$ due to the lagged timing of rcost (see A.23), the *impact* derivative is:

$$\frac{\partial \hat{b}_0}{\partial(\bar{S}/\bar{Y})} = 0. \tag{A.26}$$

However, from $t = 1$ onwards, the balance sheet amplification materialises:

$$\frac{\partial \hat{b}_1}{\partial(\bar{S}/\bar{Y})} = (1 - \rho_b)\zeta_b \frac{\partial \hat{n}_1}{\partial(\bar{S}/\bar{Y})} = -(1 - \rho_b)(1 - \rho_n)\zeta_b \chi_\tau |\Delta R_0^S| < 0. \tag{A.26'}$$

A larger CB balance sheet *reduces* the leverage response to a NIRP shock, with the effect beginning at $t = 1$ due to the lagged rcost timing.

Step 4: Quantitative assessment. At impact, equation (A.26) implies no balance-sheet effect:

$$\Omega_0(\bar{S}/\bar{Y}) \equiv \frac{\hat{b}_0(\bar{S}/\bar{Y})}{\hat{b}_0(0)} = 1. \tag{A.27}$$

The amplification appears from $t = 1$ onward. Define the one-period-ahead response ratio:

$$\Omega_1(\bar{S}/\bar{Y}) \equiv \frac{\hat{b}_1(\bar{S}/\bar{Y})}{\hat{b}_1(0)} \approx 1 - \frac{(1-\rho_b)(1-\rho_n)\zeta_b\chi_\tau|\Delta R_0^S|}{\hat{b}_1(0)} \cdot \frac{\bar{S}}{\bar{Y}} < 1. \tag{A.28}$$

Thus, larger reserve stocks reduce the leverage response once the lagged carry-cost channel becomes active.

Step 5: Dynamic amplification. The balance sheet effect compounds over time through the persistence of net worth dynamics. With lagged rcost timing, iterating (A.11) forward for $t \geq 1$:

$$\hat{n}_t = \sum_{j=0}^{t} \rho_n^{t-j}(1-\rho_n)\left[\chi_Q \hat{Q}_j^L - \chi_\tau|\Delta R_{j-1}^S| \cdot \frac{\bar{S}}{\bar{Y}}\right], \tag{A.29}$$

where $|\Delta R_{-1}^S| = 0$ (starting from steady state). Each period, the carry cost drag from the previous period accumulates:

$$\frac{\partial \hat{n}_t}{\partial(\bar{S}/\bar{Y})} = -(1-\rho_n)\chi_\tau \sum_{j=1}^{t} \rho_n^{t-j}|\Delta R_{j-1}^S|, \tag{A.30}$$

which becomes increasingly negative as t grows (until the shock dissipates). This amplifies the delay in leverage adjustment, with the lagged timing creating a one-period buffer before the amplification begins.

Conclusion. A larger central bank balance sheet magnifies the reserve-carry cost, further attenuating net worth accumulation from $t = 1$ onwards. The delayed leverage response is therefore more pronounced when $\bar{S}/\bar{Y}$ is large, as formalised by the negative derivatives in (A.24) and (A.26'). This explains why NIRP in the context of large-scale asset purchases (which expand reserves) may produce stronger maturity rebalancing but weaker leverage effects. □ □

H.4 Supporting Lemmas

Lemma 1 (Bond Price Response with Floor Binding)**.** *Under a NIRP rate cut ($\varepsilon_t^r < 0$) that triggers the floor, the forward guidance channel dominates and $\hat{Q}_t^L > 0$ on impact.*

Proof. The consol pricing equation in log-linear form is:

$$\hat{Q}_t^L = \beta\kappa\mathbb{E}_t[\hat{Q}_{t+1}^L] - \hat{R}_t^S - \hat{\mu}_t - \mathbb{E}_t[\pi_{t+1}]. \tag{A.31}$$

Iterating forward to the terminal condition $\lim_{T\to\infty}(\beta\kappa)^T\hat{Q}^L_{t+T}=0$ (transversality):

$$\hat{Q}^L_t=-\sum_{j=0}^{\infty}(\beta\kappa)^j\mathbb{E}_t[\hat{R}^S_{t+j}+\hat{\mu}_{t+j}+\pi_{t+j+1}]. \tag{A.32}$$

Three effects determine the bond price response to a rate cut ($\hat{R}^S_t<0$):

- *Direct discount effect:* $-\hat{R}^S_t>0$ directly raises Q^L_t.
- *Spread compression:* Net worth is positive on impact and evolves non-monotonically as lagged carry costs enter (Proposition 2), reducing spreads ($\hat{\mu}_t<0$).
- *Inflation:* Output rises ($\hat{y}_t>0$), pushing inflation up through the Phillips curve.

When the NIRP floor binds, the forward guidance channel amplifies the discount effect: agents anticipate the rate will remain at the floor for an extended period, capitalising this expectation into higher bond prices. In the baseline calibration with a -1% floor, the forward guidance effect dominates and $\hat{Q}^L_0>0$ on impact, generating immediate capital gains for banks holding long-term bonds. □ □

Lemma 2 (Comparative Statics of Adjustment Speed)**.** *For the AR(1) process* $\hat{x}_t=\rho\hat{x}_{t-1}+(1-\rho)f_t$*:*

(i) Time to reach fraction α *of steady-state deviation:* $t_\alpha=\ln(1-\alpha)/\ln(\rho)-1$ *(exact), or* $t_\alpha\approx\ln(1-\alpha)/\ln(\rho)$ *for large* α*.*

(ii) $\partial t_\alpha/\partial\rho>0$*: higher persistence implies slower adjustment.*

(iii) Half-life: $t_{1/2}=\ln(2)/\ln(1/\rho)$*.*

Proof. For a permanent shock $f_t=\bar{f}$ starting at $t=0$ with $\hat{x}_{-1}=0$:

$$\hat{x}_t=(1-\rho^{t+1})\bar{f}. \tag{A.33}$$

Setting $\hat{x}_t=\alpha\bar{f}$:

$$1-\rho^{t+1}=\alpha\quad\Rightarrow\quad t+1=\frac{\ln(1-\alpha)}{\ln(\rho)}\quad\Rightarrow\quad t_\alpha=\frac{\ln(1-\alpha)}{\ln(\rho)}-1. \tag{A.34}$$

For large α (e.g., $\alpha=0.90$), $t_\alpha\approx\ln(1-\alpha)/\ln(\rho)$. Since $\ln(\rho)<0$ for $\rho\in(0,1)$ and $\ln(1-\alpha)<0$, we have $t_\alpha>0$. The derivative:

$$\frac{\partial t_\alpha}{\partial\rho}=-\frac{\ln(1-\alpha)}{\rho(\ln\rho)^2}>0, \tag{A.35}$$

confirming that higher persistence implies slower adjustment. □ □

References

Abadi, Joseph, Markus Brunnermeier, and Yann Koby, "The reversal interest rate," *American Economic Review*, 2023, *113* (8), 2084–2120.

Badoer, Dominique C and Christopher M James, "The determinants of long-term corporate debt issuances," *The Journal of Finance*, 2016, *71* (1), 457–492.

Brunnermeier, Markus K and Yann Koby, "The reversal interest rate," Working Paper 25406, National Bureau of Economic Research December 2018.

Campos, Rodolfo G, Jesús Fernández-Villaverde, Galo Nuño, and Peter Paz, "Navigating by falling stars: monetary policy with fiscally driven natural rates," Working Paper 32219, National Bureau of Economic Research March 2024.

Chetty, Raj, Adam Guren, Day Manoli, and Andrea Weber, "Are micro and macro labor supply elasticities consistent? A review of evidence on the intensive and extensive margins," *American Economic Review*, 2011, *101* (3), 471–475.

Christiano, Lawrence J, Martin Eichenbaum, and Charles L Evans, "Nominal rigidities and the dynamic effects of a shock to monetary policy," *Journal of Political Economy*, 2005, *113* (1), 1–45.

Clarida, Richard, Jordi Gali, and Mark Gertler, "The science of monetary policy: a new Keynesian perspective," *Journal of Economic Literature*, 1999, *37* (4), 1661–1707.

Gerali, Andrea, Stefano Neri, Luca Sessa, and Federico M. Signoretti, "Credit and banking in a DSGE model of the euro area," *Journal of Money, Credit and Banking*, 2010, *42* (s1), 107–141.

Gertler, Mark and Peter Karadi, "A model of unconventional monetary policy," *Journal of Monetary Economics*, 2011, *58* (1), 17–34.

Greenwood, Robin, Samuel Hanson, and Jeremy C Stein, "A gap-filling theory of corporate debt maturity choice," *The Journal of Finance*, 2010, *65* (3), 993–1028.

Leary, Mark T and Michael R Roberts, "Do firms rebalance their capital structures?," *The Journal of Finance*, 2005, *60* (6), 2575–2619.

McLeay, Michael, Silvana Tenreyro, and Lukas von dem Berge, "Negative rates and the effective lower bound: theory and evidence," *Journal of the European Economic Association*, 2025, p. jvaf053.

Pariès, Matthieu Darracq, Christoffer Kok, and Matthias Rottner, "Reversal interest rate and macroprudential policy," *European Economic Review*, 2023, *159*, 104556.

Rostagno, Massimo, Carlo Altavilla, Giacomo Carboni, Wolfgang Lemke, Roberto Motto, and Arthur Saint Guilhem, "Combining negative rates, forward guidance and asset purchases: identification and impacts of the ECB's unconventional policies," Technical Report, ECB Working Paper 2021.

Smets, Frank and Rafael Wouters, "Shocks and frictions in US business cycles: A Bayesian DSGE approach," *American Economic Review*, 2007, *97* (3), 586–606.

Ulate, Mauricio, "Going negative at the zero lower bound: The effects of negative nominal interest rates," *American Economic Review*, 2021, *111* (1), 1–40.

Woodford, Michael, "Fiscal requirements for price stability," *Journal of Money, Credit, & Banking*, 2001, *33* (3), 669–669.