Exploring the effect of the ECB's leverage ratio easing on euro-area banks' lending volumes during COVID-19

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Executive Summary

This study examines the European Central Bank's decision to temporarily exclude central bank reserves from the leverage exposure measure (LEM) during the COVID-19 pandemic and assesses its effect on bank lending. Using quarterly data from 2019Q1 to 2024Q2 for twenty-four major euro-area banks, a difference-in-differences approach compares institutions constrained by the leverage ratio with those constrained by risk-weighted capital requirements. The exemption was intended to ease balance sheet pressure and support credit supply, but the analysis finds no statistically significant impact on lending volumes. The estimated effect is weakly positive yet economically small, and the model explains little variation in lending. Euro-area unemployment emerges as the only significant variable, though in a direction that runs counter to standard expectations. Overall, the results suggest that temporary adjustments to capital rules did not materially stimulate bank lending, highlighting the limits of regulatory relief as a crisis-response measure.

AI Statement

I acknowledge the use of generative AI in literature search and code development in this paper. However, the work reported remains my own.

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1. Introduction

1.1 Context

In response to the global financial crisis of 2007-08 (the "GFC"), the Basel Committee on Banking Supervision ("Basel") introduced a comprehensive set of reforms in 2010, known as Basel 3, which aimed at strengthening global capital and liquidity rules to promote a more stable and resilient banking sector that could better withstand severe economic shocks (Bank for International Settlements, 2010). At the centre of the weaknesses exposed in the financial system during the GFC are insufficient loss-absorbing capacity, unsustainable balance sheet leverage, and outsized credit growth, alongside inadequate liquidity buffers.

In addressing these weaknesses, one of the capital rules Basel 3 introduced after the GFC was a backstop risk-agnostic measure, known as the leverage ratio, which takes the total assets from the accounting balance sheet, with some regulatory adjustments, to compute the leverage exposure measure ("LEM"), with banks then required to hold a percentage of this LEM in high quality – tier 1 – capital (Bank for International Settlements, 2010). This aimed to specifically address the build-up of on- and off- balance sheet leverage by banks and reduce the likelihood that banks are forced to systemically deleverage during stressed market conditions. The EU banking sector is subject to a requirement set by the European Banking Authority ("EBA") to hold 3% of LEM as tier 1 capital (EUR Lex, 2013).

The Basel framework provided a mechanism to temporarily exclude central bank reserves from the LEM which supervisors, such as the European Central Bank's Single Supervisory Mechanism ("ECB", "SSM"), are able to utilise in "exceptional macroeconomic circumstances" to "facilitate the implementation of monetary policies" (European Central Bank, 2021). The ECB made first announced that it would temporarily exempt central bank reserves in September 2020 (the "reserves exemption") ahead of the leverage ratio becoming a binding requirement in the EU in June 2021 (European Central Bank, 2020) as a result of the onset of the pandemic.

The ECB explained that it expected the relief to increase the aggregate leverage ratio by c. 30bps (from 5.36% to 5.66%). It later extended this relief until 31 March 2022 (European Central Bank, 2022).

This study seeks to examine the effects of the reserves exemption at the bank-level on the twenty-four largest banking groups' using a DiD identification strategy to understand the incremental impact of the exemption on leverage-constrained groups (the treatment) compared with risk-weight-constrained groups (the control). The principal consideration is whether the exemption had a material impact on the banking groups' lending volumes.

1.2 Rationale

The monetary policy backdrop, where the ECB cut deposit rates across 2020 to minus 0.5%, and initiated a pandemic emergency purchase programme of 1.85 billion euros (European Central Bank, 2020), all else equal, would have led to banks holdings of European Government Bonds ("EGBs") falling, and central bank cash reserves increasing. In this environment, leverage bound groups' abilities to transmit monetary policy – including via their capacity to provide liquidity in repo markets, lend and take deposits – could have been materially constrained. This is because the influx of liquidity (in the form of Euro central

bank cash reserves) could lead to banks' balance sheets (and thus their LEM) growing. This could have had a knock-on impact to the real economy if banks reduced the availability of credit.

The study will test this theoretical consideration across the 24 largest EU banking groups across the pandemic period, using quarterly data that starts pre-pandemic in 2019Q1 and ends in 2024Q2 (22 periods). Banks headquartered in EU member states that are not also euro area members are excluded.

Once completed, this study may also help to determine the usefulness of the reserves exemption and may offer insight over the potential future direction for policymakers in jurisdictions where the temporary reserves exemption remains in force, such as the United Kingdom and Japan, and at the international level.

2. Literature review

2.1 Theory and relevant background

The leverage ratio was designed as a risk-agnostic backstop to prevent excessive leverage accumulation on banks' balance sheets. As set out by Basel (Fender & Lewrick, 2015), it acts as a mechanism to constrain banks' risk-taking during financial booms and prevent undercapitalisation.

The leverage ratio is calculated as a bank's total tier 1 capital divided by the sum of its leverage exposure measure ("LEM"). This is set out in formula 1 below:

Formula 1:

$$Basel\ 3\ Leverage\ Ratio = \frac{Tier\ 1\ Capital}{Leverage\ Exposure\ Measure\ (LEM)}$$

Tier 1 capital comprises both Common Equity (Tier 1) Capital ("CET1") and Additional Tier 1 Capital ("AT1"). Whilst both are perpetual sources of capital, only CET1 has immediate loss absorbing capacity. AT1 is a form of convertible debt instrument that will convert (or be fully written-down) into loss-absorbing CET1 should the risk-weighted CET1 ratio (the highest quality risk-weighted capital measure) fall below 5.125% (EUR Lex, 2013).

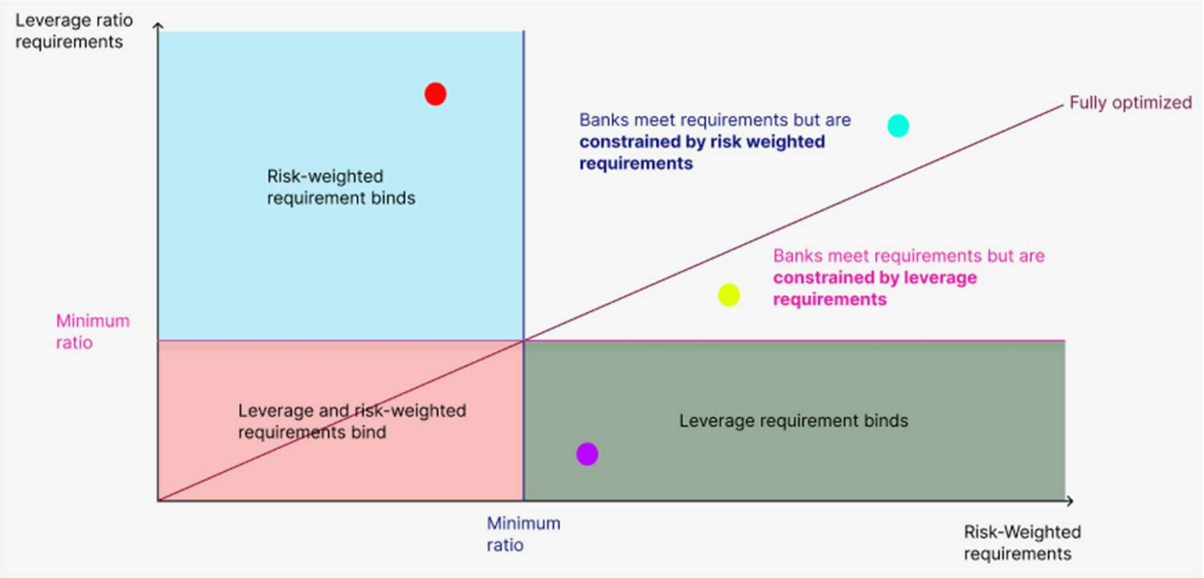
The leverage exposure measure includes: (i) on-balance-sheet assets including loans, cash, investments and collateral for derivatives and securities financing transactions ("SFTs"); (ii) counterparty credit risk exposure and reference asset exposure arising from derivatives; (iii) securities financing exposures including principal SFT exposures (where the bank is the lender of borrower of securities) and agent SFT exposures (where the bank provides an indemnity to facilitate another two parties' SFT); and (iv) other off-balance-sheet exposures such as commitments, liquidity facilities and letters of credit - each subject to a conversion factor (David Polk, 2014).

Alongside the leverage ratio, Basel 3 strengthened the grouping of primary risk-weighted capital requirements. These requirements are risk-sensitive and banks are required to take the value/exposure of each asset and multiply this by a risk weight prescribed by regulators or

determined by internal models and hold a percentage of this in a mix of all forms of capital (with a minimum of 56.25% of the requirement in the most-loss absorbing form of capital – common equity tier 1 ("CET1")) (Bank for International Settlements, 2010).

The theory therefore goes that firms with more higher risk assets, such as credit risk from lending to Small and Medium Enterprises ("SMEs") or market risk from large unhedged trading positions, will have growth in their balance sheet most constrained by the risk-weighted capital requirements (Grill, et al., 2015). Whilst firms with more lower risk assets, such as fully collateralized securities lending transactions or low loan-to-value mortgages, will have growth in their balance sheet more constrained by the leverage ratio (Fender & Lewrick, 2015). The leverage ratio can also be thought of as a floor on capital requirements. Irrespective of how perceptively low risk a firm's asset base might be, there is a minimum capital requirement as a percentage of its assets. This is illustrated in diagram 1 below.

Diagram 1 (Fender & Lewrick, 2015):



The leverage requirement imposes this floor at the minimum ratio line in pink. This has the effect of requiring low-risk, weakly-capitalised banks, represented by the purple dot, to hold additional capital. In a case where the bank represented by the purple dot improves its capital position, but remains low risk, the growth of its balance sheet remains constrained by leverage requirements. This new low-risk, well-capitalised bank is represented by the yellow dot.

Conversely, if bank is high-risk and weakly-capitalised, it will be bound by the risk-weighted capital requirement and required to hold additional capital, as shown by the bank represented by the red dot. If this bank improves its capital position, but remains high risk, the growth of its balance sheet remains constrained by risk-weighted requirements. This new high-risk, well-capitalised bank is represented by the turquoise dot.

The fully optimized line would represent banks that had managed its balance sheet in such a fashion that its capital requirements were exactly equal on a leverage and risk weighted basis. No bank will likely be on this line, but many banks with fully universal models – i.e., that offer an almost-equally weighted balance of higher risk activities like SME lending and credit

cards alongside lower risk-weighted activities like securities financing and mortgage lending – are likely somewhere near to being fully optimised in an unstressed market environment.

The effect of this minimum floor is believed to alter banks' portfolio optimisation decisions. There are two conflicting dynamics at play. Fatouh, et al explored how binding leverage ratio requirements may conceptually incentivise banks to reallocate capital towards higher-risk assets to offset their leverage constraints – known as the risk-shifting hypothesis (Fatouh, et al., 2023). Building on this, an ECB study posited the fact that although there is an incentive to reallocate capital towards higher-risk assets, it is more than outweighed by the stability benefits that greater levels of tier 1 capital bring, reflected in lower net default probabilities for leverage ratio banks in the EU – known as the capital buffer effect (Acosta Smith, et al., 2017).

This central conclusion reached via the capital buffer effect, that stronger and less-leveraged bank balance sheets allow firms to better withstand severe economic shocks (Kapan & Minoiu, 2013), forms the basis of the argument for the introduction of stronger global capital rules for the most systemically-important banks, as part of the Basel 3 capital reforms.

Turning to the ECB's decision to make an exemption for central bank reserves, these assets can be considered the ultimate 'risk free' asset. They are the safest and most liquid of financial assets and the ultimate means of settlement (Bailey, 2024). They carry no revaluation risk when held in the same currency as the underlying matched liability, no counterparty credit risk as the charge is on the issuing central bank, and no operational risk (Lane, 2023). This is a strong justification to support banks not being required to hold capital against reserves, in line with the temporary exemption clause provided by Basel's leverage ratio guidelines for its members.

Additionally, the Bank of England considered the monetary policy transmission implications of the inclusion of central bank reserves in the leverage ratio. Its Financial Policy Committee explained how – during a period of monetary expansion – the increase in the supply of reserves from the central bank would increase LEMs and reduce leverage ratios. It set out that this could act as a disincentive for banks to access central bank liquidity facilities, which would inhibit the transmission of monetary policy, or could prompt banks to deleverage, cut their supply of credit to the real economy, and reduce repo activities which support orderly market functioning (Bank of England, 2016).

In the Eurozone, these dynamics could have weighed on the impact of the ECB's monetary easing policies including: (i) its reduction in the deposit rate to minus 0.5%; (ii) its 1.85-billion-euro pandemic emergency purchase programme ("PEPP", a form of quantitative easing); and (iii) its measures in the targeted long term and pandemic emergency long term financing operations ("TLTRO" and "PELTRO") (European Central Bank, 2020). Without the reserves exemption, banks would have faced a disincentive to take on additional liquidity and – at a time of market wide stress – this could have reduced the resilience of the EU financial system.

2.2 Related studies

There is extensive literature about the relationship between leverage-based bank capital and bank risk-taking. To date, in aggregate, it is rather inconclusive (Acosta Smith, et al., 2017). Results range from predictions that higher leverage-based capital requirements lead to riskier

asset profiles – including a number early studies from the Journal of Finance (Kahane, 1977), (Koehn & Santomero, 1980), (Santomero & Kim, 1988) – to those that argue the effect is ambiguous (Genotte & Pyle, 1991), (Calem & Rob, 1999) and eventually those that believe it leads to lover risk taking incentives (Repullo & Suarez, 2004) and (Acosta Smith, et al., 2017), inter alia.

Taking the first grouping of studies, Kahane argued that risk-agnostic capital rules would lead to moral hazard and incentivise increased risk taking inadvertently by motivation of market incentives to maximise profits (Kahane, 1977). He posited that this would create systemic vulnerabilities which laid the early groundwork for debates on risk-weighted capital requirements. Koehn and Santomero took this further by demonstrating that uniformed capital requirements (like a leverage ratio) failed to constrain banks' risk-taking as they could offset these constraints by reallocating their portfolios towards higher risk assets that earnt a return in excess of the cost of holding the capital (Koehn & Santomero, 1980). A few years later Kim and Santomero proposed risk-weighted capital requirements outrightly to address the shortcomings of risk-agnostic capital requirements (Santomero & Kim, 1988) which directly influenced the direction of Basel 1.

Later, in 2004, however, following the introduction of Basel 2, Repullo and Suarez explained how banks that were able to use internal models to estimate their own credit risk risk-weighted capital requirements had systemically underestimated risk weights to reduce their capital charges and increase which led to an increase in undercapitalised risks in the financial system. This was a function of banks exploiting their monopoly power and the light-touch approach taken to model review by supervisors to make high risk and high margin loans without commensurately high capital requirements (Repullo & Suarez, 2004). This paper makes a strong case for a backstop risk-agnostic measure, to guard against excessive regulatory arbitrage by banks. It – along with a series of other similar studies – provided a strong justification for post-GFC reforms introduced as part of Basel 3.

Bank of England researchers investigated the introduction of the LR in the UK using a difference-in-differences (DiD) framework to compare banks subject to the leverage ratio with those that were not. The empirical findings showed that leverage-subject banks did not increase asset risk and slightly reduced leverage levels compared to their non-leverage-subject peers, leading to an overall reduction in aggregate risk (Fatouh, et al., 2023). This was further evidenced by a decline in credit default swap (CDS) spreads for leverage-subject banks, suggesting improved market perceptions of their stability. The empirical evidence showed that the leverage ratio had not shifted the risk adjusted returns (i.e., by imposing a floor on capital requirements for low risk assets) enough for banks to be incentivised to take on high-risk loans such as those to SMEs, when compared with low-risk assets such as UK Gilts (Fatouh, et al., 2023).

The procyclicality of leverage ratios has also been a critical focus in studies. The BIS found that leverage ratios are generally more countercyclical than risk-weighted capital ratios during normal times but become more procyclical during crises due to deleveraging pressures (Brei & Gambacorta, 2014). This dynamic was evident during the global financial crisis (GFC), where banks with binding leverage constraints were forced to reduce lending at a time when credit demand was high. Similarly, a Brunel University study highlighted that LR requirements incentivize banks to hold riskier assets when capital is costly, amplifying

cyclical fluctuations in credit supply (Davis, et al., 2019). These findings suggest that while the LR enhances stability by limiting excessive leverage, its rigidity can exacerbate economic downturns unless complemented by countercyclical adjustments. This may have influenced the ECB's decision to introduce the reserves exemption.

In the context of interbank markets, an ECB working paper demonstrated that leverage ratio requirements influence liquidity dynamics by constraining banks' ability to provide funding in wholesale markets. Their theoretical model showed that while the leverage reduces systemic risk by increasing capital buffers, it can also lead to higher funding costs and reduced liquidity provision during periods of market dislocation (Acosta Smith, et al., 2017). Empirical evidence from Brunel University's analysis of European and US banks further supports this view, showing that leverage-constrained banks reduce interbank exposures by approximately 10% during crisis periods to comply with regulatory thresholds (Davis et al., 2019).

2.3 Methodology and hypothesis

The current body of research focusses on trying to establish a direct causal relationship between various policies related to the leverage ratio, and several proxies for risk taking (such as asset riskiness, intermediation activities or balance sheet size). Comprehensive analysis has not yet been conducted for the period of the reserves exemption and covering the largest eurozone banking groups.

DiD is utilised by Fatouh et al. (2023) for their study into the impacts of the leverage ratio on risk taking amongst UK banks. Other methods could include the use of DSGE models which could simulate how banks adjust their portfolios under regulatory shocks or simpler methods such as high-frequency identification, which could utilise intraday leverage data or simple counterfactual analysis.

This study will build on this existing literature and focus more narrowly on the largest EU banking groups to better understand the causal relationship between the introduction of the temporary leverage ratio reserves exemption by the ECB and banks' lending volumes.

My hypothesis is that the introduction of the leverage ratio reserves exemption by the ECB will have led to treatment group banks' increasing their lending volumes when compared to control group banks.

My hypothesis builds on the theory that the introduction of the reserves exemption would have loosened leverage-constrained banks' degree of constraint, which would have enabled them to continue transmitting monetary policy effectively and holding on-balance-sheet the additional reserves associated with monetary easing and the ECB's asset purchasing programmes. The theoretical framework in diagram 2 sets out how I perceive banks to react absent the reserves exemption.

Diagram 2

Banks with surplus liquidity could then deploy this into higher returning assets (up to the degree of the leverage constraint) by lending to households and businesses. Absent the exemption, leverage-constrained banks may have faced euro liquidity shortages or seen a significant tightening in the degree of leverage constraint they faced through the trade-off that increased reserves (a form of liquidity, which is necessary to extend credit) tighten leverage constraints.

3. Data and variables of interest

At the bank level, the most utilised source is individual banks' annual Pillar 3 disclosure reports. Across Eurozone financial institutions, Pillar 3 disclosures are prepared according to a standard issued by the European Banking Authority ("EBA") ensuring that the data within the disclosures are consistent and comparable (European Banking Authority, 2018).

Using these Pillar 3 reports, I have constructed a panel dataset which includes 22 quarterly (from 2019Q1 to 2024Q2) observations across the 24 largest EU banking groups headquartered in countries which are also members of the euro area. This time frame was chosen to assess banks capital constraints in a business-as-usual environment (2019) and then incorporate the introduction of the exemption (2020Q3), its removal (2022Q1), and then the normalization of bank balance sheets in the preceding two years up to the present day (2024Q2). For information on banks' assets, I have utilised their individual balance sheets, prepared on the basis of IFRS, which are released to investors on a quarterly basis (except for two banks in the sample, where such releases are only semi-annual).

I have excluded banks that are wholly state controlled (including Belfius, a Belgian state-owned commercial bank), deliver banking services only to the public sector (including BNG, the Dutch state-controlled public sector lending bank), and the German Landesbanken (German regional banks which can act as a form of central bank to local mutual savings banks). This is to best preserve the condition of parallel trends absent the treatment effect for all banks in the study.

Table 1, overleaf, summarises the variables being considered.

Table 1

Variable	Source	Description
Main variables		
Treatment/Control binary variable	Analysis of banks' pillar 3 disclosures	A treatment/control binary that is 1/0 if each bank is/is not leverage constrained
Period binary variable	Analysis of ECB policy	A binary variable that is 1/0 if the policy is active/not active
Interaction variable	Constructed by own analysis	A binary variable combining the policy effect and treatment effect.
Change in total assets	Banks' pillar 3 disclosures	Quarterly percentage change of assets of each bank at each quarter-end balance sheet position
Change in total loans	Banks' IFRS balance sheets	Quarterly percentage change of loan assets of each bank at each quarter-end balance sheet position
Change in total reserves	Banks' IFRS balance sheets	Quarterly percentage change of reserve assets of each bank at each quarter-end balance sheet position
Control variables		
Euro-area HICP	Eurostat	The euro-area harmonized index of consumer prices
Euro-area unemployment rate	Eurostat	The unemployment rate across the euro-area
Euro-area real GDP index	Eurostat	An index of real GDP across the euro-area
Euro-area (ECB) deposit rate	European Central Bank	The ECB deposit facility rate
Total Assets	Banks' IFRS balance sheets	A control to represent banks' overall size (in terms of total IFRS assets)

Using quarterly percentage changes for the main variables of interest will allow for easier interpretation of the results and a better understanding of the policy effect. Using levels for these variables would lead to the results attempting to estimate an 'average' banking group, which is not a particularly useful concept for this study.

The dependent variable in this analysis will be the quarterly change in total loans. This analysis will assess the impact of the introduction of the reserves exemption on banks considered as part of the treatment group relative to the control group. The results for the regression where the quarterly change in total loans is the dependent variable is an appropriate proxy for measuring the effects on the 'real economy'.

The 24 banking groups break down into 12 which are defined as leverage-constrained (the treatment group) and 12 which are defined as risk-weight constrained (the control group). Whilst this is not a deliberate split, the data shows that the largest banking groups tend to be leverage constrained (average assets for the treatment group are EUR 953bn) and the remaining banking groups tend to be risk-weight constrained (average assets for the control group are EUR 518bn). This may have some impact on the results of the analysis and validity of the conclusions drawn. With the aim of capturing some of this potential selection bias

effect, a control measuring each banking group's total assets (on an IFRS basis) has been added to the analysis.

In addition to the main variables of interest, there are several wider macroeconomic variables extensively covered in existing economic theory which are likely to provide some explanatory power. These have been added as control variables to the analysis both for validity and robustness reasons, in addition to reducing bias from omitted variables in the analysis. The control variables include measures of inflation, unemployment, GDP growth and the ECB deposit rate that aim to capture wider trends in the economy at the euro-area level, including during the period which the policy was active.

4. Methodology

The aim of this study is to determine whether there is a statistically significant causal relationship between the presence of the ECB's temporary leverage ratio reserves exemption and treatment banks' lending volumes. This analysis is conducted using a difference-in-difference identification strategy, employed as part of an OLS econometric model. It uses bank-level data across 24 banks and 22 quarterly periods from 2019Q1 to 2024Q2.

4.1 Determining the treatment and control

EU banks had been required to disclose leverage ratios since 2015, as part of their pillar 3 reporting obligations imposed by the EBA. However, it is not until the European Parliament set into force Capital Requirements Regulation 2 ("CRR2"), formally Regulation 2019/876 (EUR-Lex, 2019), in May 2019 that the necessary legal mechanisms for a leverage ratio requirement to be implemented in the EU were made available. Following the EBA's earlier work in 2016 that established the eventual leverage ratio minimum requirement should be 3% (aligned with Basel negotiations at the international level) the EBA confirmed that this 3% requirement for EU banks would take force from 2021Q2.

To determine which banks in the 24-bank sample were leverage constrained, analysis was performed as of the 2019Q2 balance sheet. This analysis calculated whether the tier 1 capital requirement (determined as total RWAs multiplied by a 6% pillar 1 requirement + an institution-specific pillar 2 requirement + an institution-specific fully-phased-in systemically important institutions buffer) or the leverage ratio requirement (determined as total LEM multiplied by a 3% pillar 1 requirement) was greater, in Euro terms. Where the leverage ratio requirement was greater, groups were 'leverage constrained' and considered part of the treatment group. The control group comprised the remaining groups, which were 'risk-weight constrained'.

The primary reason for a point in time assessment of constraint over a continuous assessment of constraint was to ensure that the effects of the policy being tested (the reserves exemption) did not impact groups' classification as treatment or control. For example, the reserves exemption could result in several marginally-leverage-constrained firms becoming risk-weight constrained for a temporary period which could synthetically skew the results of the analysis if a dynamic measure was employed. Under this measure, we can assess the impact of the policy considering groups' underlying balance sheet constraints.

As shown in table 2, the marginal constraints (i.e., difference between the constraining measure capital requirement and non-constraining measure) on average are 3,129mn EUR for the treatment group and 2,460mn EUR for the control group. One leverage-constrained group was only marginally constrained by 35mn EUR, suggesting close to full optimisation.

Table 2

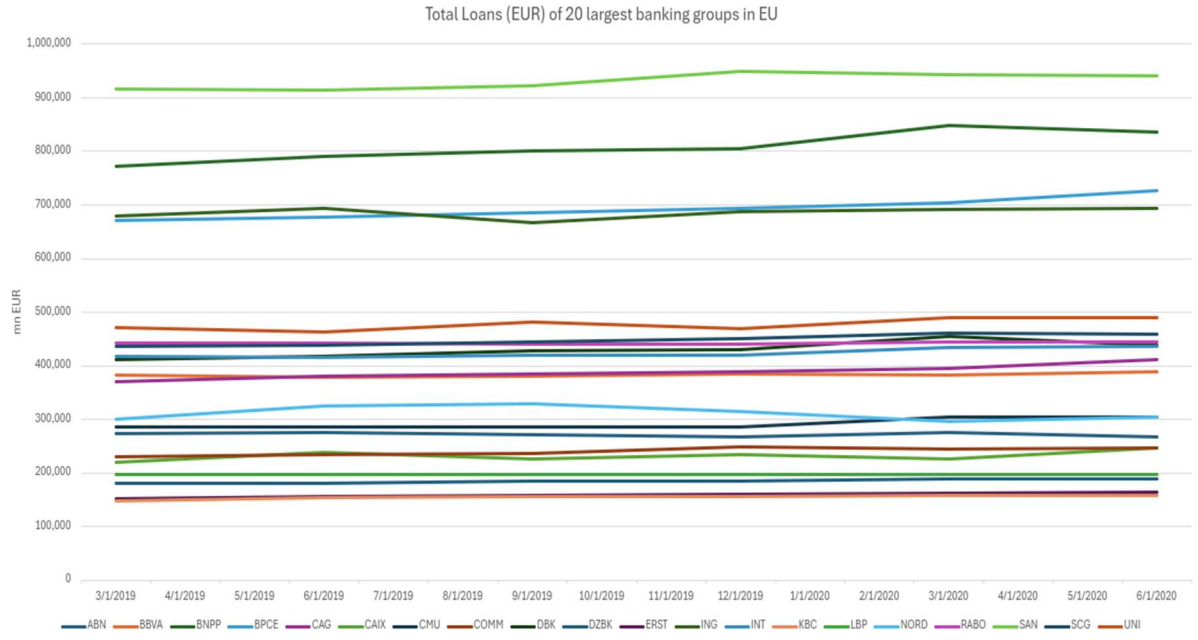
	Treatment	Control
Average marginal constraint (EURmn)	€ 3,129.46	€ 2,460.56
Min marginal constraint (EURmn)	€ 35.27	€ 454.99
Max marginal constraint (EURmn)	€ 8,267.51	€ 7,765.95
Average assets (EURmn)	€ 953,000.00	€ 518,000.00
Amount of banks	12	12

4.1 Testing the data

An approximate analysis of correlation between the leverage ratio and total loans for all 24 groups produced a value of -0.36, indicating that there is a moderate negative correlation between the leverage ratio and total loans (i.e., vindicating the underlying assumption that issuing new loans weakens the leverage ratio) hence motivating a study to identify whether the reserves exemption modified this effect. This, of course, does not prove the existence of any causal relationship.

Using the levels measure of the main dependent variable – total loans – we can see that in the 6 quarterly periods before the introduction of the policy the 24 banking groups in the study did not significantly deviate from one another in gradient (i.e., trend growth). This is illustrated in diagram 3, below.

Diagram 3



Whilst there are some bank-specific deviations observable in the six quarters before the policy was enacted, including a general trend that banks headquartered in Northern Europe grew their total loans by more than banks headquartered in Southern Europe, when looking at the treatment and control groups in aggregate, these are immaterial. In the six-quarter period,

all banks total loans grew at an (unweighted) average rate of 3.66% compared with 3.54% for control group banks and 3.78% for treatment group banks. Thus, the assumption of pre-treatment parallel trends can be considered met.

4.1 Developing the model

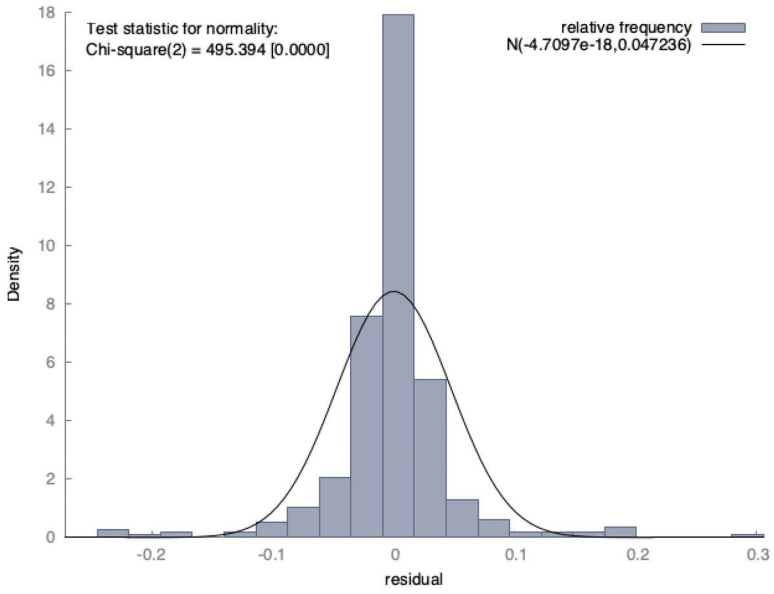
Initially a basic OLS model was run to estimate the effects of the policy without the additional control variables added in. This model had the dependent variable 'change in total loans' and showed a statistically insignificant negative causal relationship on the interaction term for the change in total loans. The model also reported a very low R-squared value in the region of 0.001, indicating very weak estimation and explanatory power.

The full group of control variables shown in table 1 were then added in, and variables that failed an omitted variable test (i.e., where the null hypothesis that the variables' parameters were zero was not rejected at the 10% significance level) were removed. Euro-area HICP and deposit rate control variables were removed.

This left the specified model as an OLS model that incorporated the difference-in-difference interaction term, the treatment/control and period binary variables and total assets, euro-area unemployment and euro-area GDP index controls. The R-Squared value remained weak but had improved to 0.013. Consistent with earlier studies, including Fatouh, et al., 2023, the standard errors were clustered by bank in order to allow for serial correlation over time.

The model was then tested to assess the normality of the error terms, which is a key assumption underpinning OLS. Despite appearing normally distributed, as shown in diagram 4 below, the residual error terms were found not to be normally distributed following a chi-square test with a p-value <0.05 which led to the null hypothesis - that the errors were normally distributed - being rejected.

Diagram 4



As the dependent variable being used is expressed as a percentage change (and negative in many cases), natural logs cannot be used to attempt to remediate this. As such, to correct for

the presence of non-normally distributed errors (which can provide biased coefficients and p-values), robust HACC standard errors were utilised.

Several further tests were then performed on this model specification to assess whether other key assumptions for OLS were met. The tests found a) that no-first order autocorrelation was present in the data (p-value 0.31), b) that the relationship is linear (p-value 0.23), and c) that error variance is not constant and heteroskedasticity is present (p-value 0.00). This is a further justification for the OLS model to include robust HACC standard errors to preserve the validity of statistical inference.

To improve the R-squared value and reduce the prevalence of omitted variable bias, I experimented with several additional independent variables as controls, including euro-area measures of credit demand and credit underwriting standards across households and enterprises. These variables had limited to no effect on improving the explanatory power of the model and were therefore not added into the model. I also explored the merits of including a lagged dependent variable, however it did not seem appropriate to include these lags as they could violate the assumption of strict exogeneity and potentially introduce reverse causality, which would compromise the aim of this difference-in-difference study and the validity of the OLS results.

Lastly, considering the panel dataset construction, a series of tests were performed to establish whether either a fixed or random effects model specification would better explain variations in the dependent variable. A test on the joint significant of differing groups found a p-value of 0.96 against the null hypothesis that pooled OLS is adequate in favour of fixed effects, whilst a Hausman test found a p-value of 0.00 against the null hypothesis that the random effects estimator is accurate. This meant that neither the fixed nor random effects specifications are appropriate for modelling changes in the dependent variable.

5. Model specification

Having considered the specification arrived at following the design choices detailed in the methodology, the final OLS model aims to best capture the relationship between the QoQ change in total loans dependent variable and the reserves exemption policy effect being tested (and represented by the coefficient $\beta 3$). Table 5 sets out the results of the final model specification.

Table 5

Final Model Specification:

$$Y\ (\text{QoQ change in total loans}) = \alpha + \beta 1\ \text{Period}_t + \beta 2\ \text{Treatment}_i + \beta 3\ (\text{Post}_t \times \text{Treatment}_i) + \beta 4\ \text{Unemployment}_{it} + \beta 5\ \text{GDP growth}_{it} + \beta 6\ \text{total assets}_{it} + \epsilon_{it}$$

Dependent Variable: Quarter-on-quarter change in total loans		
Independent variable	**Coefficient**	**p-value**
Constant	0.0031	0.0339**
Period binary	0.0020	0.8044
Treatment binary	-0.0052	0.3832
Interaction term	0.0045	0.6230
Unemployment rate	0.0003	0.0701*
GDP growth	0.0053	0.9967
Total assets	0.0003	0.4753

*Note: * indicates significant at 10% level, ** indicates significant at 5% level*

R-Squared	0.01423
F test p-value	0.92594
S.E. of regression	0.04723

As the underlying data varies in its construction, it is important that the coefficients are interpreted correctly for the effect of each independent variable on the dependent variable, the specific interpretation for each is set out in table 6.

Table 6

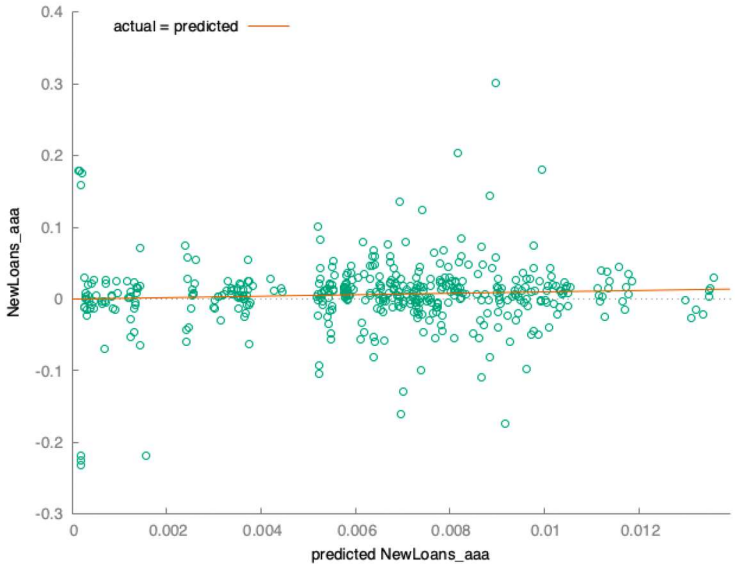
Independent variable	**Coefficient**	**Interpretation**
Constant	0.0031	The value of Y if all independent variables were equal to zero is 0.31%
Period binary	0.0020	Being during the treatment period reduces Y by 0.20%
Treatment binary	-0.0052	Being a leverage constrained (treatment group) bank reduces Y by 0.52%
Interaction term	0.0045	The effect of the reserves exemption on treatment group banks during the treatment period was to increase Y by 0.45%
Unemployment rate	0.0003	A 1pp increase in the unemployment rate increases Y by 0.03%
GDP growth	0.0053	A 1pp increase in the GDP growth rate increases Y by 0.53%
Total assets	0.0003	One extra EUR in total assets increases Y by 0.03%.

6. Empirical analysis

6.1 Model interpretation

Overall, the model remains a weak estimator (R-Squared ~0.014) for the dependent variable, and it finds no statistically significant relationship between the policy effect (captured by weakly-positive coefficient on the interaction term, β3) and the dependent variable. This result holds across multiple model specifications and persists after including macroeconomic controls such as GDP growth, unemployment, and total assets. This is illustrated by the actual (Y) vs fitted (X) values shown in diagram 5, overleaf.

Diagram 5



The estimated coefficient's positive sign aligns with theoretical expectations, but its magnitude and significance are too weak to support any inference over the exemption's effectiveness.

It suggests that whilst the theory outlined in diagram 2, and tested by Acosta Smith et al, 2017, may still hold, for this sample of the 24 largest EU banks from the period 2019Q1 to 2024Q2, there is no evidence to reject the null hypothesis (H0) that the leverage ratio reserves exemption had no determinate effect on leverage constrained banks' lending volumes.

Compared to prior studies suggesting that capital relief may stimulate risk-taking or lending (e.g., Fatouh et al., 2023), this result highlights the potential limits of temporary and targeted regulatory adjustments. It may also reflect the dominance of crisis-period conservatism (a behavioural response), where banks prioritised liquidity and capital preservation over expansionary lending, or were guided to do so by their supervisors.

This could also imply that whilst banks were able to make use of the reserves exemption to increase their demand for reserves (Andreeva, et al., 2025), continuing to swap assets into reserves through participation in ECB facilities and transmit Euro liquidity to other financial institutions, this accumulation of excess Euro liquidity did not spill-over into increased lending to the EU real economy.

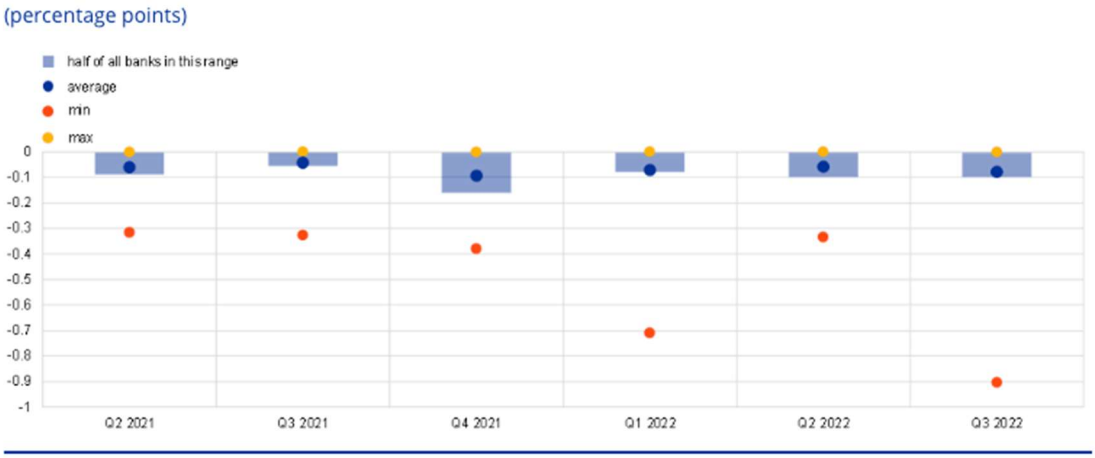
The results of the model show that the only statistically significant relationship (at the 10% level) is that between unemployment and the dependent variable, where a 1pp increase in the unemployment rate is found to lead to a small marginal increase in lending growth (the dependent variable) by 0.03%. This contradicts general theory which establishes a correlation between increasing lending volumes and falling unemployment in line with households and corporates reducing their lending demand significantly during an economic shock or period of uncertainty. This correlation was taken further by a 2016 study which established a causal relationship between lending volumes and unemployment levels (with higher lending volumes reducing unemployment) by analysing data from fourteen Euro-area economies from 1980 to 2012 (Gocer, 2016). The uncertainty of the COVID-driven economic shock may explain why this general theory – only marginally – does not hold.

More broadly, there are a range of additional considerations which might explain some of the limitations of the final model specification. These are discussed in 6.2 and 6.3 below.

6.2 Data limitations and additional quality assurance

As explained in the methodology for this study (section 4.1), data was utilised as at quarter-ends to establish the degree to which banks were leverage constrained. However, it is widely observed that major financial institutions act around reporting periods (including reducing the notional size of the repo book or lightening risk-taking in the trading book) to improve their leverage ratios. An ECB study (Bassi, et al., 2024) illustrates that this "window dressing camouflages the true risks of a bank" as shown in diagram 6 below where c. 50% of banks improve leverage ratios by up to 0.15pp at quarter-ends.

Diagram 6 (Bassi, et al., 2024)



This could have the effect of making firms appear less-leverage-constrained than their intra-quarter balance sheet positions (which are not publicly disclosed) would suggest. This behaviour could distort classification between treatment and control groups, although the random distribution of such actions across banks reduces the likelihood of systematic bias.

To account for this, a robustness check was conducted by re-running the model with a narrowed treatment group that excluded borderline-constrained banks where quarter-end adjustments might have disproportionately influenced constraint classification. This showed

minimal variation in the coefficient of interest, suggesting the null result of the final model is materially not driven by misclassification

Further, a sensitivity analysis was performed by removing the four largest universal GSIBs from the sample, to test whether capital market activities or balance sheet size disproportionately diluted lending impacts. While the sample size reduction weakened the explanatory power of this model, the treatment effect remained statistically insignificant, confirming the robustness of the null finding.

The necessary monthly or average leverage ratio data to assess the full impact of "window dressing" is not required under pillar 3 public disclosures and can be considered confidential supervisory information; hence, it could not be utilised for this study. Nevertheless, the stability of the coefficient across the alternative models with exclusions reinforces confidence in the treatment classification.

Moreover, the dependent variable – quarterly changes in total loans – is a net measure at amortized cost as of the given reporting date that includes new lending, changes in drawn balances, repayments, securitisations, sales and disposals and write-offs etc. (in line with IFRS), rather than isolating gross new lending. This may obscure the underlying flow dynamics that the policy sought to influence. However, this limitation applies uniformly to all banks.

A second dependent variable specification was tested using the percentage change in loan balances adjusted for observable disposals and securitisations (available from selected disclosures and press releases, e.g., BBVA SA, 2023). While the proxy weakened the explanatory power of this model, it also yielded a similar coefficient estimate and significance level for the treatment effect, alluding to the fact that loan book adjustments were again not materially masking a policy effect.

Lastly, to test for sensitivity to macroeconomic confounding, a further restricted version of the model was run using only the macro control variables (i.e., excluding the two binary variables and the interaction/policy effect term). Statistical inference from the results of this model confirmed that macro conditions alone cannot explain lending variation in this sample, further reinforcing final model results.

6.3 Additional bank-specific considerations

In addition to data constraints, strategic and behavioural factors likely shaped banks' responses to the reserves exemption. The temporary nature of the reserves exemption will have weighed on banks' willingness to make significant adjustments to their balance sheet composition knowing that the exemption would eventually be removed, and leverage ratios recalibrated including central bank reserves.

Despite an increase in the opportunity cost of holding reserves during a period of negative deposit rates (such as through 2020), a 2019 study explored that banks appear to hoard liquidity in the form or reserves, across the Eurozone, in the absence of a reliable interbank lending market (which has become less liquid since the financial crisis) (Buchholz, et al., 2019) despite obvious incentives to lend liquidity driven by the increased opportunity cost.

This, coupled with the likely intense supervisory oversight by regulators during the COVID stress period, could have driven banks to prefer holding excess capital and liquidity over their

requirements to demonstrate the resilience of their business model to supervisors and ensure that they could continue to absorb further macroeconomic shocks.

This is supported by the results of the 2021 EU-wide stress test which demonstrates that although sufficient in a business-as-usual environment, some non-GSIB banks in this study did not have sufficient capital resilience to absorb a further shock, and in extreme cases, risked potential balance sheet insolvency (European Banking Authority, 2021). The results of the test also suggest that some banks determined as risk-weight constrained (control group members) are leverage-constrained in stress. This could skew the results of this study by wrongly classifying banks' constraints or overstating their true, usable capital headroom.

Conversely, universal banks, including many of Europe's GSIBs, faced an environment through 2020 and 2021 of very buoyant trading and capital markets activities, where revenues rose year-on-year up to +30-50% (Damyanova & Ahmad, 2021) which may have led to these banks increasing their existing capital allocation towards these trading and capital markets focussed business lines. This, coupled with the broader macroeconomic environment of low interest rates and high loan default expectations, could have dampened universal banks' appetite to lend to the real economy which impacts the Y variable.

7. Conclusion

7.1 Main results summary

This paper utilises a difference-in-difference identification strategy, as part of an OLS regression specification, to assess the impact of the leverage ratio reserves exemption, introduced by the ECB in 2020 as part of its pandemic relief package, on banks' lending volumes during the period that the reserves exemption was active.

The model estimated the coefficient of interest – the effect of the reserves exemption on treatment group banks during the treatment period – to increase Y (quarterly change in loans) by just 0.45% (with a p-value of 0.6230).

It finds no evidence to reject the null hypothesis that the leverage ratio reserves exemption had no determinate effect on leverage constrained banks' lending volumes. The estimated treatment effect was directionally consistent with theory but statistically indistinguishable from zero. This null finding is robust across multiple model specifications and to most DiD assumptions, and it persists despite exploratory efforts to improve explanatory power.

While data limitations, including those relating to a lack of transparency over banks' quarter-end balance sheet "window dressing" activities and the net basis on which the dependent variable is constructed, may attenuate precision, they are unlikely to fully obscure a meaningful policy effect. The persistence of null results suggests that the exemption's temporary nature, coupled with the behavioural and strategic responses by banks during the COVID-19 period, limited its real economy impact.

7.2 Policy implications

This study contributes to the policy debate by highlighting the limits of temporary capital relief in crisis settings. The exemption of central bank reserves from LEM calculations, though theoretically sound, appears to have had no detectable effect on eurozone banks'

credit supply. This does not imply the policy was without merit – future studies could find it supported market functioning or reserve accumulation – but it casts doubt on its ability to stimulate lending under uncertain conditions.

It suggests that the current Basel framework, which permits supervisors to temporarily exempt central bank reserves in "exceptional macroeconomic circumstances" is ineffective. Therefore, this paper recommends that the leverage ratio reserves exemption is introduced – at the Basel level – on a permanent basis. Central bank reserves are the only asset that carries low to zero credit, operational, issuer and liquidity risks – they are the ultimate riskless asset.

Making permanent the exemption would free up significant balance sheet capacity across banks, enabling them to increase the amount of credit they provide to the real economy on a permanent basis and continue providing leverage and liquidity to financial market participants and other financial institutions with certainty that structural balance sheet changes would not need to be systemically undone at a later date. There is no obvious macroprudential trade-off to this approach.

7.3 Future avenues of research

This paper utilised publicly available data and was the first of its kind to study this relationship between the reserves exemption and lending volumes amongst euro-area banks. With better data access, analysis could be deepened, and results made more reliable.

Financial regulators, with the range of information available to them at the bank level, should aim to replicate a similar study that looks includes a wider range of explanatory variables incorporating banks' management decisions and supervisory guidance. This could also make use of more accurate monthly – or average – leverage data which is submitted by banks to regulators across the UK and Europe as part of the COREP reporting framework. Expanding the coverage of banks, and the time series would also produce a more reliable estimation for the impact of the exemption.

This research work could be extended by comparing the effects across different jurisdictions, including the UK and Japan – where a leverage ratio reserves exemption remains in force today – and the United States – where the COVID period exemption also extended to US Treasuries.

This further research work could help to identify some of the shortcomings of the underlying data for and the econometric approach to estimating the effect of the reserves exemption and provide clear guidance to prudential policy makers across jurisdictions over the appropriate future direction of the reserves exemption.

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