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IN THE THICK OF IT: AN INTERIM ASSESSMENT OF MONETARY POLICY TRANSMISSION TO CREDIT CONDITIONS

by Margherita Bottero* and Antonio M. Conti*

Abstract

We use a thick modelling approach to assess the transmission of the unprecedented ECB's monetary policy hiking cycle, which started in July 2022, to the cost of credit to euro area and Italian non-financial corporations. We uncover two findings. First, the range of forecasts obtained via this approach is wide; simple projections based only on a common trend between reference and lending rates fall in the lower part of it. Second, borrower riskiness emerges in the current juncture as a key driver in explaining the evolution of lending rates, improving substantially forecasts' accuracy. We also quantify the additional upward risks on lending rates that may stem from unexpected tensions related to sudden outflows of retail deposits and the reduction of the Eurosystem's balance sheet. Finally, we assess the impact of an adverse credit supply shock on output and inflation dynamics using a Bayesian VAR. The overall results of the paper support the conclusion that a large amount of the effects of monetary tightening is still in the pipeline.

JEL Classification: E51, E52, E32, E37, C32.
Keywords: monetary policy transmission, bank lending channel, credit supply, thick modelling, VAR.
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Contents

* Bank of Italy, DG Economics and Statistics.

1. Introduction[1]

During a tightening cycle, the smooth transmission of policy rate increases to the cost of credit plays a crucial contribution towards price stability, supporting the cooling effect that the hikes have on aggregate demand and employment dynamics by discouraging agents' recourse to bank financing, via the so-called "credit channel". A too strong credit channel, which results in interest rates too high compared to the levels warranted by the initial tightening impulse, may jeopardize the action of the central bank, pushing the economy into a credit crunch (Bernanke and Lown, 1991; Bernanke et al., 1995). From there, potentially, a significantly strong recession may materialize (see Gerali et al., 2010, Gertler and Kiyotaki, 2010, and references therein).

In the advanced economies, after more than a decade of very accommodative monetary policy, considerations on how to assess the strength of the credit channel are getting renewed interest as the main central banks have begun an unprecedented tightening cycle in 2022, reacting to the persistently high inflation dynamics observed in the post-pandemic period. Zooming in on the euro area and on the transmission to non-financial corporations (NFCs), over the first year of the tightening cycle (July 2022 – June 2023), the policy hikes have impacted interest rates on bank loans in an overall orderly way and broadly in line with the 2005-08 tightening cycle (Lane, 2023a, 2023b, 2023c).

Nevertheless, the fact that the tightening has been unprecedented (a cumulative increase of 400 bps in the reference rate up to June 2023),[2] and that the effects of monetary policy decisions fully materialize with some lags casts some doubt on the reliability of observed data for the future and warrants a careful assessment of the projected dynamics of lending rates. In particular, a distinctive feature of the current tightening has been the sharp rise in perceived borrower riskiness by financial intermediaries, also spurred by the unparalleled steepness of the policy rates hikes. According to the Bank Lending Survey (BLS),[3] launched by the Eurosystem in 2003, the lower risk tolerance of euro-area (EA) banks and their higher risk perceptions about NFCs counterparts have been the main factors driving the tightening in credit standards during the monetary restriction.

In this paper, we address the issue of assessing the strength of the transmission of monetary policy to bank interest rates in the current tightening cycle by narrowing the focus on the short-term projected path of lending rates to NFCs in the EA and in Italy. More precisely, (i) we propose a novel approach to model the transmission (pass-through) from policy rates to the cost of credit to

[1] For useful comments, we thank participants to the Eurosystem Working Group on Econometric Modelling meeting of June 6, 2023 in Frankfurt, Simone Auer, Fabio Busetti, Michele Caivano, Matteo Ciccarelli, Paolo Del Giovane, Lucia Esposito, Giuseppe Ferrero, Stefano Neri, Sergio Nicoletti Altimari, Massimiliano Pisani, Alessandro Secchi and Federico M. Signoretti.

[2] Two more hikes, by 25 bps each, were decided by the ECB Governing Council in July and September.

[3] Its main objective is to enhance the Eurosystem's knowledge of bank lending conditions in the euro area. It provides information on the lending policies of euro area banks and supplements existing statistics on loans and bank lending rates with information on the supply of, and demand for, loans to enterprises and households. The BLS provides input to the Governing Council's assessment of monetary and economic developments, which feeds into the monetary policy decision-making process (see www.ecb.europa.eu/stats/ecb_surveys/bank_lending_survey/html/index.en.html).

NFCs and (ii) we investigate the possible role of borrower risk perception, as captured by banks' reports in the BLS, in explaining the future dynamics of lending rates.

We document several results. First, we show that projections of lending rates based only on reference rates dynamics ("technical" or baseline projections in the rest of the paper) are surrounded by a high degree of uncertainty. This follows from the exercise which relies on a thick modelling approach (Granger and Yeon, 2004): using an ampler set of economically meaningful regressors (which includes measures of economic activity and credit risk factors in addition to short- and long-term market rates) results in a wide range of forecast. Second, technical projections tend to fall in the lower part of this range. Third, credit risk, as measured by banks' own perceived risk as reported in the BLS, appears to play a key role in pushing up the dynamics of lending rates. In particular, taking the average of the BLS-based forecast range, NFCs lending rates are projected to be about 20 bps and 50 bps higher than under the technical projections by 2024Q1, respectively in the EA and in Italy; looking at the upper bound of the forecast range, these figures would amount to 80 and 160 bps.

To complement these analyses, we study the evolution of lending rates in two hypothetical stress scenarios, based on the assumption of funding tensions for intermediaries that triggered financial and banking stress in the US economy in March 2023 with the SVB and regional banks cases. Specifically, we consider first a case in which large deposit outflows force banks to increase sharply the remuneration they pay on retail deposits. Second, we assume an increase in the cost of issuing bonds due to tensions in banks' funding markets. According to our quantifications, lending rates would increase more sizably in the first case. Finally, in order to broadly assess the real effects of those scenarios, we quantify the macroeconomic impact of an exogenous credit supply tightening on the Italian economy with a structural vector autoregressive (VAR) model. We find that an unexpected rise by 100 bps in lending margins is associated to a peak reduction by about 2.5 pp of real GDP growth and 1.0 pp of inflation; interestingly, the shock raises banks provisions and persistently lowers bank capital.

We contribute to the literature from two angles. First, we add to the large body of works that investigates econometrically the pass-through from policy rates to lending rates to NFCs (see, e.g. Albertazzi et al., 2014, Illes et al., 2019 and references therein). In this regard, we propose the implementation of a thick modelling approach (Granger and Yeon, 2004), which has already proven useful in addressing the appropriateness of the Phillips curve as a tool to describe core inflation dynamics (Ciccarelli and Osbat, 2017; Conti, 2021).[4] This simple approach allows for detecting the most reliable models and delivers a natural balance of risks for the variable of interest (in this case lending rates to firms), therefore being useful in determining the monetary policy stance. Second, our estimates of the impact of an exogenous credit supply tightening relate to the literature on the macroeconomic impact of loan supply shocks on output and inflation. In this regard, the main novelty is the use of a large VAR model with a rich characterization of the banking sector (Conti et al., 2023) and of state-of-the-art identification techniques (based on narrative sign restrictions;

[4] In a different context, a recent work by Bernardini and Lin (2023) uses a thick modelling approach on the Taylor rule coefficients to show that the increase in expected rates was driven by inflation but also expectations of a higher equilibrium rate.

Antolìn-Diaz and Rubio-Ramìrez, 2018). These features allow us to add to the debate on the propagation mechanism of loan supply shocks in terms of aggregate demand and supply (Gambetti and Musso, 2017; Gilchrist et al., 2017).

From a monetary policy perspective, our results may prove useful in the heated debate on "how much tightening is still in the pipeline" for the ECB (Lane, 2023a; Panetta, 2023). In particular, instead of focusing directly on the final outcome on real variables (output and inflation), we suggest considering the intermediate steps in monetary policy transmission, i.e. the cost of credit. According to our results, if one were to compare the realized loan rates for 2023Q2 with the technical model's forecasts, it appears evident that the latter are insufficient to capture the complex interactions between monetary policy and banks' credit supply decisions. This would obviously impact the correct underpinning of future inflation and output dynamics and, in turn, the appropriate monetary stance.

The structure of the paper is as follows. In Section 2 we first describe developments in lending rates and credit standards of NFCs since the start of the normalisation phase of the monetary policy stance at the end of 2021, also in a historical perspective comparing the current tightening cycle with the 2005-08 one. Then, we compute the expected lending rates using a baseline model which relies on co-integration between reference rates and lending rates, often used by central banks in order to have a reference forecast for the cost of credit. We compare them with realized lending rates and show that they have significantly underestimated the cost of credit in 2023Q2. Section 3 sketches the empirical framework, for the thick modelling analysis for lending rates and the VAR analysis on loan supply shocks as well. Section 4 presents the results of the thick modelling approach and some risk scenarios on wholesale and retail funding. Section 5 quantifies the impact of adverse loan supply shocks on macroeconomic and banking variables. Finally, Section 6 concludes.

2. Stylized facts on the pass-through (PT) to lending rates to NFCs

2.1 The PT so far and in comparison with the previous tightening cycle

In this section we briefly discuss some recent developments in lending rates to NFCs and credit standards as reported by financial intermediaries taking part to the BLS. We focus on Italy and the EA, as in the rest of the paper.

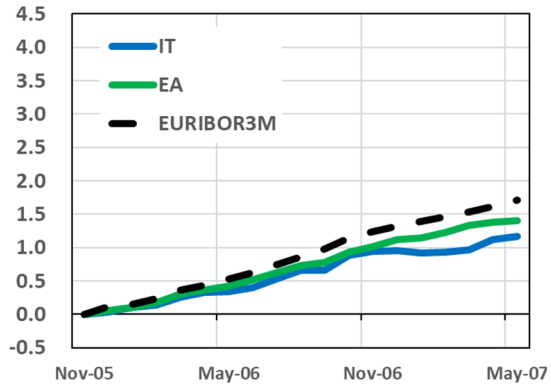
Since the first policy hike announced by the ECB in July 2022, the pass-through from policy rates to lending rates took place quite orderly and it was only slightly weaker than in the 2005-08 tightening cycle over the first 12 months after the start of the tightening. Figure 1a and Figure 1b show the cumulated increase in the composite cost of borrowing to NFCs[5] in the 2005-08 and in the current tightening cycle, with respect to the relevant reference rate (the 3-month Euribor). Although the size of the cumulated increase is different between the considered tightening cycles, in order to evaluate the monetary transmission one can look at the *beta* for the composite indicator of cost of borrowing to NFCs, i.e. the ratio of the cumulated increases in loan rates to the relevant reference rate. The *beta* was about 0.8 in June 2023 for the EA and 0.9 for Italy. In the 2005-08 tightening

[5] We focus on the composite indicator as this is the standard reference considered by the ECB when analyzing the pass-through from policy rates to lending rates (ECB, 2013; Lane, 2023a).

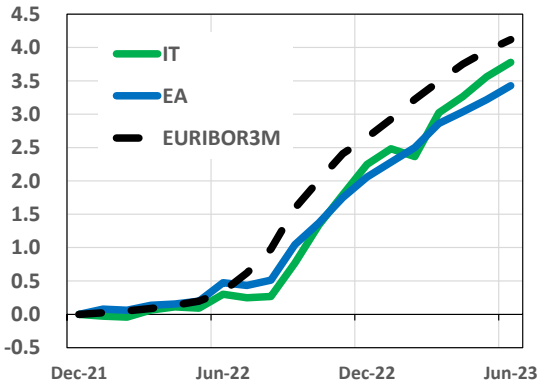
cycle, considering the same time lag since its onset, the *beta* was overall broadly similar for the EA and somewhat lower for Italy (0.8 and 0.7, respectively).

FIGURE 1. PASS-THROUGH (PT) AND BLS CREDIT STANDARDS IN DIFFERENT TIGHTENING CYCLES

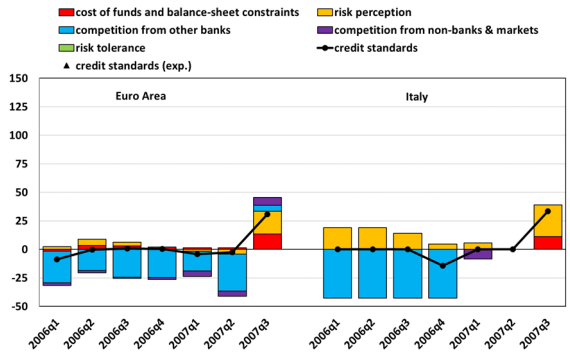
a. PT in the previous tightening
(*monthly data; percentage values*)



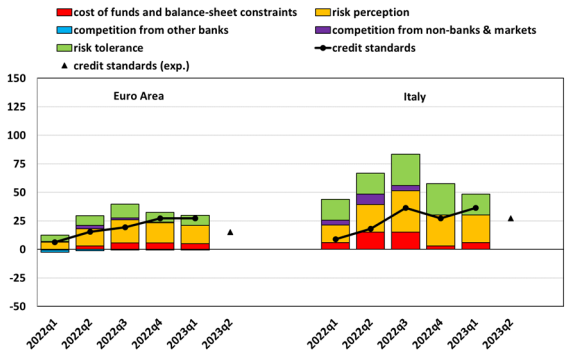
b. PT in the current tightening
(*monthly data; percentage values*)



c. Credit standards in the previous tightening
(*quarterly data; net percentages*)



d. Credit standards in the current tightening
(*quarterly data; net percentages*)



Source: authors' computations on ECB, Bank of Italy and Refinitiv data.
Notes: The top two panels plot the cumulated increases in loan rates to NFCs (the composite cost of borrowing) to the relevant reference rate (3-month Euribor) in Italy and the Euro Area since November 2005 (panel a) and since December 2021 (panel b). The bottom two panels plot credit standards since 2006Q1 (panel c) and since 2022Q1 (panel d). BLS indicators are defined as net percentage of responding banks, i.e. the difference between the share of banks reporting an increase in the selected variable minus the share of banks reporting a decrease. The black triangle denotes banks expectations of the overall indicator for 2023Q2. For further details, see https://www.ecb.europa.eu/stats/ecb_surveys/bank_lending_survey/html/index.en.html.

Despite a similar evolution in the aggregate PT, some differences emerge when comparing credit supply dynamics – as captured by the tightening in BLS' credit standards – in the two hiking cycles. In the current sequence of policy rates hike, banks started to report a tightening in their credit standards to NFCs in 2022Q1 (Figure 1d), before the first actual increase in the deposit facility rate. At that time, the ECB had announced the exit from its large–scale asset purchases programmes and the concerns for the inflation outburst were significant so that long-term market rates shifted upwards, foreseeing a sequence of short-term policy hikes moving from negative territory. In contrast, in the 2005-08 banks' restriction started to materialize only in 2007Q3, about a year after the onset of the tightening cycle and most likely in response to the outbreak of the interbank market crisis (which later developed in the Global Financial Crisis). More importantly for our narrative, risk perception (yellow bars) exerted only a minor tightening impact on credit standards during the

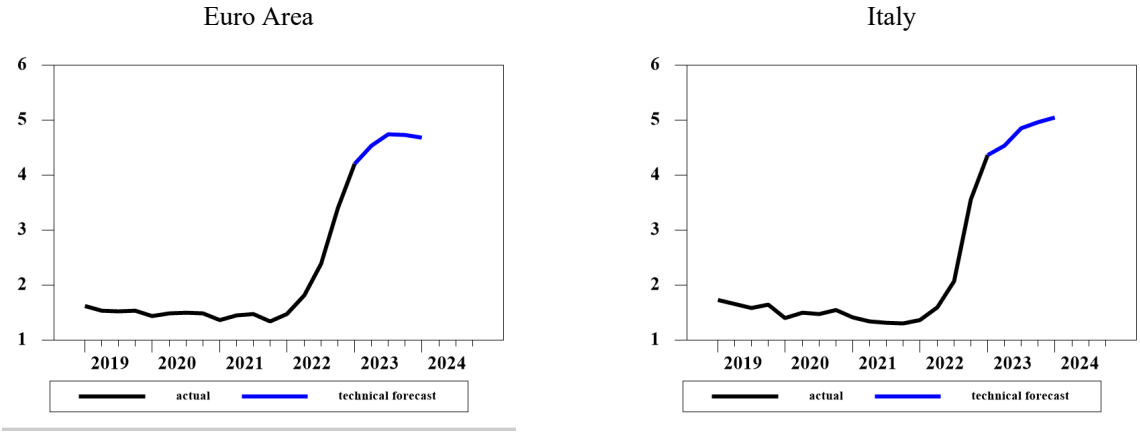
previous tightening cycle (Figure 1c). In stark contrast, since 2022Q1 banks reported a substantial tightening in their credit standards, especially citing higher borrower risk and lower risk tolerance among the factors driving the increase in credit standards.

2.2 The evolution of the cost of borrowing according technical models

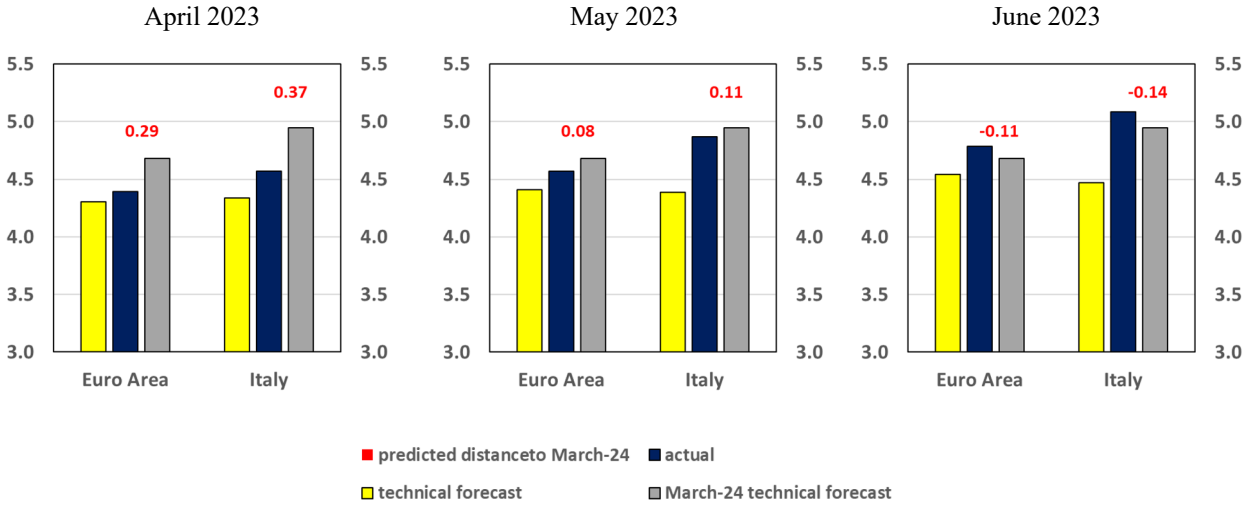
The composite indicator of cost of borrowing to NFCs rose by about 290 and 300 bps between December 2021 and March 2023 in the EA and in Italy, respectively, vis-à-vis to an increase in the 3-month Euribor by about 350 bps, standing at 4.2 and 4.3%.

FIGURE 2. TECHNICAL MODELS FOR LENDING RATES TO NFCS

a. Short-term evolution of lending rates to NFCs according to technical models
(*quarterly data; percentage values*)



b. Forecast errors of technical models
(*monthly data; percentage values*)



Source: authors' computations on ECB, Bank of Italy and Refinitiv data.
Notes: The top row plots the actual and projected dynamics (until 2024Q1 and according to technical models) of the composite indicator of the cost of borrowing to NFCs in the EA (left panel) and in Italy (right panel). The bottom row shows the associated monthly forecast errors by the same models. Yellow bars are actual data, blue bars are actual data, grey bars are the technical forecasts for March 2024. Red values denote the difference between the March 2024 forecast and the actual data.

In order to have a reference forecast for the cost of credit, central banks often use simple but sensible models that posit a co-integration relation between the reference rate (e.g., the 3-month Euribor) and loan rates. According to this baseline model – a 2-variable Vector Error Correction Model (VECM) – the composite indicator of cost of borrowing would have then further increased up to a peak reached in March 2024 of about 4.7% in the EA and 5.0% in Italy (Figure 2a).

However, the last three available monthly actual data at the time of writing (April, May and June 2023) displayed consecutive and significant downward forecast errors in both the EA and Italy (that is, the baseline underestimated the actual dynamics; Figure 2b). In particular, with the June release the composite indicator was already 11 and 14 bps higher – for EA and Italy, respectively – than what foreseen by the technical model for March 2024. This evidence casts some doubts on the appropriateness of the technical forecasts which relies entirely on the policy rate: further variables need to be considered to correctly predict the evolution of cost of credit to NFCs, especially in a period of possibly rising borrower risk.

Motivated by this poor performance, in the next section we present a thick modelling framework à la Granger and Yeon (2004) for the cost of credit to NFCs. The aim is twofold. First, we can infer the balance of risks surrounding the technical forecast. Second, we can appropriately investigate the role of borrower risk in the dynamics of lending rates.

3. Empirical framework

In this section, we first briefly sketch our application of the thick modelling approach developed by Granger and Yeon (2004) to deliver a range of forecasts of lending rates to NFCs (Section 3.1). This approach has been fruitfully employed, for instance, to evaluate the usefulness of the Phillips curve to conditionally forecast core inflation (see Ciccarelli and Osbat, 2017, for a euro-area perspective, and Conti, 2021, for evidence on Italy). Next, we provide a quick overview of the Bayesian VAR model used in Section 5 to quantify the impact of an increase in lending margins on some of the main macroeconomic variables monitored in the conduct of monetary policy (Section 3.2).

3.1 Overview of the thick modelling approach to lending rates projections

We consider and estimate equations for lending rates to NFCs of the following type, building on similar – but more parsimonious – specifications used by Albertazzi et al. (2014):

$$ccb_t = \beta_0 + \beta_1(L)short + \beta_2(L)long + \beta_3(L)ecact + \beta_4(L)risk + dummies + \varepsilon_t \qquad (1)$$

where ccb_t is the composite cost of borrowing for NFCs, $short$ and $long$ denote, respectively, reference short- and long-term market rates, $ecact$ refers to indicators of economic activity, $risk$ refers to various risk proxies, $\beta_i(L), i = 1,2,3,4$ represents lagged operators, $dummies$ are some intervention dummies which take into account the Global Financial Crisis, the Sovereign Debt Crisis and the Covid-19 pandemic and ε_t is a normally independently distributed error term.

For Italy, these broad classes of indicators include:

- $short$: the Weighted Average Cost of Liabilities (WACL) developed by Illes et al. (2019) and routinely employed at the ECB and the Bank of Italy to measure banks' funding cost,[6] the 3-month Euribor and the €-str as short-term rates;
- $long$: the 10-year IRS rate, the 10-year Government bond rate and the 10-year spread between Italy BTP and Germany Bund as long-term rates;
- $ecact$: the q-o-q changes in real GDP, nominal GDP and real private investment as for the economic activity;
- $risk$: loan-loss provisions (Pool et al., 2015), default rates (both taken from supervisory reports) of NFCs and the BLS indicator of banks risk perception as a proxy for risk.

For the euro area we use the same indicators, except for two out of three of the risk proxies. Since the projections for loan-loss provisions and default rates for the euro area are not available over the same time span, we replace them by the CISS, a composite indicator of financial stress, and the evolution of stock price volatility as measured by the Euro STOXX index.

We estimate the models from 2003Q1 to 2023Q1, which was the latest available observation before the Eurosystem June Macroeconomic Projection Exercise. The above combination of indicators delivers 81 forecasts of lending rates, which can be easily extended by augmenting the set of proxies for each broad class of lending rates' determinants. In our exercises, we focus on lending rates projections up to 2024Q1, which is the terminal rate horizon as of the time of writing. To do so, we exploit financial market assumptions at the cut-off date of 23 May 2023, macroeconomic projections obtained from the Eurosystem dataset for Italy and the euro area consistent with this date, and, finally, data from the BLS dataset. As for the other risk proxies, we use Bank of Italy (not publicly available) projections on loan-loss provisions and default rates. Notice that, for the euro area, the $risk$ proxies enter with a somewhat smaller lag than in models for Italy. When necessary, thus, they are projected forward according to AR models.

3.2 Overview of the Bayesian VAR model for the Italian economy

To capture the dynamic feedbacks between lending rates, lending volumes and the macroeconomy, we adopt a simple Vector Autoregressive (VAR) model. Here we briefly recall the specification and the identification scheme, drawing on Conti et al., (2023). In particular, we specify the following VAR:

$$y_t = c + A(L)y_{t-1} + u_t \tag{2}$$

[6] The WACL is constructed as the average of five different rates associated to the components of banks' funding cost, weighted by their respective share over total funding:

$$WACL_t = \sum_{j=1}^{5} \omega_{j,t}\, r_{j,t} \tag{3}$$

In particular, the five funding costs $r_{j,t}$ are those associated respectively to overnight deposits, other (term) deposits, bank bonds, interbank market refinancing and Eurosystem refinancing. See Illes et al. (2019) for further details. The shares $\omega_{j,t}$ are given by the corresponding outstanding amounts of each of these components over total funding.

where y is a vector of endogenous variables, c is a constant term, and u is a vector of forecast errors. $A(L)$ is a matrix polynomial in the lag operator L, and t denotes the time frequency, which in our setting is quarterly.

The vector y of endogenous variables is composed of two main blocks. One block collects macroeconomic variables: real GDP, consumer prices and the short-term policy rate. The second block accounts for banking variables: loans to NFCs, margins charged to NFCs, defined as the difference between lending rates and the policy rate, bank stock prices, loan-loss provisions, tier 1 equity, risk-weighted assets (RWAs) and the sovereign spread, defined as the spread between the 10-year BTP and the correspondent maturity Bund. All variables are sampled at quarterly frequency and cover the time interval ranging from 1993Q1 to 2019Q4. The end of the sample is justified by the problems associated to Covid-19 data and VAR models (see Lenza and Primiceri, 2022). Since we are interested in quantifying the average effects of adverse credit supply shocks, however, we can safely rely on elasticities estimated over the aforementioned sample. In fact, this time span covers four recessions (in the early 1990s; in the early 2000s; the one following the Global Financial Crisis in 2008–09; the one following the Sovereign Debt Crisis, in 2011–12), three of which (i.e. all but the one in the early 2000s) were also characterized by episodes of financial instability. This helps to capture the relation between the business cycle, financial market developments and bank lending, capitalization and profitability. We specify our VAR model by including 4 lags. All variables are taken in logs, except for the policy rate, the margin to NFCs and the sovereign spread which are included in pure levels, as it is standard in the literature. The estimation follows the algorithm developed by Antolín-Díaz and Rubio-Ramírez (2018). We use a Minnesota prior choosing standard values for the hyperparameters. In particular, we set the overall tightness equal to 0.3 and the decay factor to 1.0.

Loan supply shocks are identified combining traditional sign restrictions (SRs; Uhlig, 2005) and narrative restrictions (NRs; Antolín-Díaz and Rubio-Ramírez, 2018). Table 1 presents the identifying assumptions.

TABLE 1. IDENTIFICATION OF LOAN SUPPLY SHOCKS: SIGN RESTRICTIONS

Horizon	x_t	p_t	sr_t	sov_t	mrg_t	l_t	sp_t	llp_t	k_t	rwa_t
$t = 0$	-				+	-	-		-	-

Notes: +/– denote sign restrictions on impact (*t=0*); blank entries imply unconstrained IRFs. x_t is Real GDP, p_t is the index of consumer prices, sr_t is the short-term (shadow) rate, sov_t is the sovereign spread between the 10-year Italian Government bond rate and the corresponding German one, mrg_t is the interest rate margin applied to loans to NFCs (the loan rate minus the short-term rate), l_t are loans to NFCs, sp_t is the bank stock price index; llp_t is loan loss provisions; k_t is Tier 1 equity capital; rwa_t is risk-weighted assets.

For the sake of simplicity, we report the signs of an adverse loan supply shock. An increase in margins and a contraction in lending volumes to NFCs is associated to lower RWAs and bank capital (Gerali et al., 2010). The latter sign restriction allows for disentangling the loan supply shock from

bank capital requirement shocks such as those identified in Conti et al. (2023), i.e. shocks induced by supervisory decisions, which request higher bank capital and imply a fall in RWAs and lending volumes. Moreover, banks' stock prices and economic activity fall as well, consistently with the literature (Gambetti and Musso, 2017; Milcheva, 2013). The response of consumer prices is instead left unrestricted, since there is no consensus in the literature on whether loan supply shocks propagate as aggregate demand or aggregate supply (that is, if they imply a positive or negative co-movement between output and prices; see, among others, Gambetti and Musso, 2017, Gilchrist et al., 2017).

In addition, we impose the following narrative restrictions, consistent with banks' reports in the BLS:

TABLE 2. IDENTIFICATION OF LOAN SUPPLY SHOCKS: NARRATIVE RESTRICTIONS

a. on the sign of the credit supply shock	b. on the contribution of the credit supply shock to lending margins and volumes
1. NR #1: an adverse credit supply shock occurred in 2008Q3 and 2008Q4	1. NR #1: an adverse credit supply shock occurred in 2008Q3 and 2008Q4
2. NR #2: an adverse credit supply shock occurred in 2011Q3 and 2011Q4	2. NR #2: an adverse credit supply shock occurred in 2011Q3 and 2011Q4

Notes: The narrative restrictions on the contribution of the credit supply shock to lending margins and volumes are imposed as "weak" in the sense of Antolìn-Diaz and Rubio-Ramìrez (2018). This means that their contribution is the largest among the structural shocks driving the economy.

Notice that we do not impose any narrative restrictions on the role played by credit supply shock in driving macroeconomic variables. As discussed above, NRs constraint the structural parameters so to ensure that the selected structural shocks are consistent with the established narrative account of these episodes.

4. Findings from the thick modelling approach to the cost of credit to NFCs

To gain some insights on the usefulness of the thick modelling approach for describing the short-term dynamics of the composite cost of borrowing charged to NFCs in the EA and in Italy, we first compare the technical projections delivered by the VECM to the range of thick modelling forecasts (Section 4.1). We then present and discuss the results obtained when focusing on BLS-based projections which stress the role of borrower riskiness (Section 4.2). In Section 4.3 we provide a formal empirical assessment of forecasting performance by looking at the Sovereign Debt Crisis. Finally, in Section 4.4 we also present and discuss two risk scenarios on funding tensions, which could exacerbate the PT.

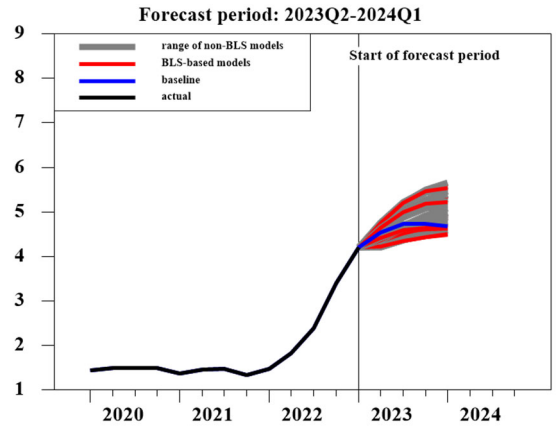
4.1 The balance of risks according to the thick modelling analysis

According to the baseline projections computed relying on market financial expectations obtained on 23 May 2023, the composite cost of borrowing to EA NFCs would increase by about

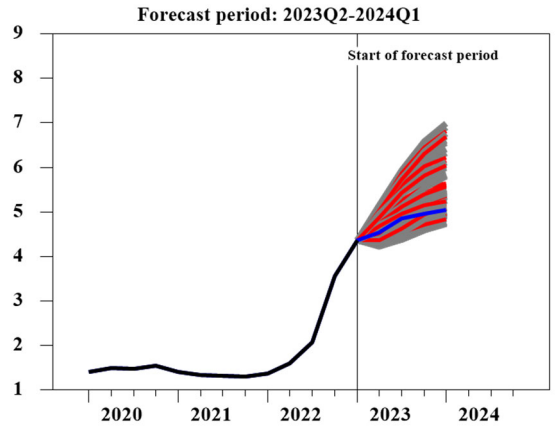
50 bps between 2023Q1[7] and 2024Q1 (to 4.7%; see the blue line in Figure 3). For Italy, the increase over the same time span is projected to be somehow more pronounced, reaching around 5.0%, up from 4.3% in 2023Q1.[8]

FIGURE 3. THICK MODELLING FORECASTS OF LENDING RATES TO NFCS

a. Euro area



b. Italy



Source: authors' computations on ECB, Bank of Italy, Eurostat and Refinitiv data.
Notes: Composite cost of borrowing to NFCs. Last observation included in the estimation sample is 2023Q1 (thin vertical line). The blue line plots the technical forecast obtained using the VECM. The grey lines plot the range of forecast computed using models including alternative indicators of economic activity, short-term and long-term market rates and tightening in financing conditions. The red lines plot the range of forecast computed replacing to the "alternative indicators" the BLS risk-perception indicator as measure of tightening in financing conditions.

The main assumptions underlying these projections are the following. Policy rates will be raised by an additional 50 bps by 2023Q4, as implicit in market expectations at the cut-off date (23 May), and banks' marginal cost of funding (WACL; see Illes et al., 2019) will increase to over 3.0% in 2024Q1 in both the euro area and Italy (by 130 and 160 bps, respectively, with respect to 2023Q1). Finally, the euro-area macroeconomic scenario (i.e., economic activity variables) is given by our aggregation of NCBs projections available at that time, obtained from the confidential ECB Macroeconomic Projections dataset. In contrast, for Italy we use macroeconomic projections produced by the Bank of Italy.

The increase in WACL reflects a smooth increase in all of its components, based on the future paths of financial variables available at the cut-off date. As for deposits, this implies a gradual rise

[7] Since the projection exercise here presented looks at quarterly data – the frequency of economic activity and BLS indicators – the last observation used in the estimation is 2023Q1.
[8] Note that 2023Q4-2024Q1 represents the peak of the increase in EA lending rates to NFCs, even when looking at a longer horizon whereas in Italy the upward trend continues, reaching 5.3% in 2025.

in the deposit *beta* to around its long-run historical value of 0.4,[9] which will follow as competition among banks for deposits eventually kicks in.[10]

The technical projections are surrounded by a high degree of uncertainty. Indeed, the thick modelling approach (Granger and Yeon, 2004) delivers a wide range of forecasts for the composite cost of borrowing for NFCs. This is the result of including – in addition to the lagged values of the endogenous variable – short- and long-term market rates, economic activity and various risk proxies (grey lines in Figure 3). The technical projections (blue lines) lie in the lower part of the range of possible future paths, suggesting that models relying on a common trend between market rates and lending rates such as the VECM provide a benign view of the short-term evolution of the cost of credit in the EA as well as in Italy.

4.2 Assessing the impact of rising borrower risk on the path of future lending rates

The thick modelling exercise above indicates that the inclusion of risk proxies (e.g. indicators of financial stress, default rates) skews the projected loan rate path sensibly upwards. In the current circumstances, this finding is particularly relevant, as higher borrower risk may materialize also owing to the unprecedented rapid pace of policy rates hikes and their impact on economic activity (De Vette et al., 2023). Indeed, since the onset of the monetary normalisation cycle, euro area intermediaries participating to the BLS have reported a steady tightening in lending standards, driven predominantly by risk considerations. Information from the latest BLS at the time of writing, conducted between March and April 2023, confirms a tightening also in 2023Q1 for the euro area as a whole and for Italy and, importantly, it shows expectations of an additional one also for 2023Q2.

Lending standards from BLS are known to lead lending dynamics to NFCs by several quarters (6 for the euro area and 5 for Italy), as it takes time for intermediaries' updated lending policies to affect the actual credit dynamics (see, for example, Huennekes, F. and P. Köhler-Ulbrich, 2022). The leading content of the BLS with respect to lending rates is less explored, but in principle equally valid. BLS indicators look particularly apt for inclusion as predictors in the projection exercise. Indeed, BLS data are not subject to revisions, an important advantage compared to alternative risk proxies such as, for example, default rates and loan-loss provisions. Moreover, BLS data are more promptly available with respect to banks' income statement indicators.

Thus, to study the impact of materializing borrower risk on the evolution of lending rates, we include in the equations used to project the dynamics of the cost of credit to NFCs information on the BLS risk factors driving overall credit standards, for both the euro area as a whole and Italy, by

[9] Again, this *beta* is defined as the ratio of the cumulated increases in deposit rates to the relevant reference rate (the 3-month Euribor, the WACL etc.). See Gambacorta and Iannotti, (2007); Borio et al., (2017); Albertazzi et al., (2014).
[10] The conditions that are slowing down the transmission to this form of deposits are expected to fade for the following reasons. First, as savers progressively reallocate their savings away from deposits to more remunerative assets to counter the effects of inflation, banks may have to compensate for these outflows with a more generous remuneration. Additional deposit outflows will be associated with the possible decision of the private sector to substitute in the sovereign market the Eurosystem as the latter leaves its role as active investor. Second, TLTRO-III repayments will force banks to replace a large part of cheap central bank funding with other funding. While intermediaries are likely to replace the TLTRO-III funds with a diversified mix of sources, a potentially non-negligible part will consist of retail deposits (which are among the cheapest forms of funding), leading to an increase in their remuneration rate.

replacing the alternative risk proxies. This exercise offers a quantitative assessment of the potential tightening already in the pipeline of the monetary policy transmission. We choose to narrow the analysis on the impact of the factor "risk perception"[11] – rather than looking at credit standards as a whole – to avoid compounding the effect of deteriorating borrower quality/economic outlook (captured by the factor "risk perception/risk tolerance") with that of tighter funding constraints (captured by the distinct factor "balance sheet constraints/cost of funding"). Considering the risk factor only allows to more clearly isolating the impact on bank supply of the cooling effect that tightening policy has on the economy. Section 4.4 provides a quantitative assessment of a stress scenario in which funding tensions materialize.[12]

The results of this exercise are shown again in Figure 3, where we can now compare the thick-modelling-based projections of the composite cost of borrowing to NFCs augmented with the BLS data ("BLS-augmented" projections, red lines), with the baseline/technical projection (blue line) and with the alternative paths obtained with a thick modelling approach using risk proxies other than the BLS (grey lines). The red lines provide a quantitative assessment of the balance of risks surrounding the technical forecast when addressing banks' supply tightening owing to increased borrowers' risk.

The inclusion of BLS indicators in the models confirms that the balance of risks surrounding the baseline is tilted to the upside for both the EA and Italy, and the more for the latter. Indeed, considering the average of the BLS forecast range, EA NFCs lending rates would further rise by about 20 bps by 2024Q1 compared to the technical forecast; according to the upper bound of our range of projections, obtained when considering models that include BLS risk factors, lending rates for euro area NFCs could increase by additional 80 bps by 2024Q1 with respect to the baseline forecast.[13] For Italy, the additional increase would be about double those figures (50 bps on average and 160 bps considering the upper bound), mainly reflecting the stronger sensitivity to some determinants (e.g., measures of fragmentation such as the sovereign spread between the 10-year BTP and the 10-year Bund) and a higher cumulated BLS tightening than the one reported for the EA as a whole.

4.3 Validating the reliability of BLS-based forecasts: the Sovereign Debt Crisis

In this section, we present a validation exercise of the goodness of fit of the BLS-augmented projections (i.e., the red lines in Figure 3). In particular, we want to make sure that BLS-based models do not systematically overestimate the future path of lending rates, thereby undermining their ability to correctly assess the balance of risks surrounding a given baseline forecast and to be fruitfully adopted for real-time forecasting.

To do so, we look back at the supply tightening observed during the sovereign debts crisis, as the lack of sufficiently long time series does not allow for reliable inference on the Global Financial

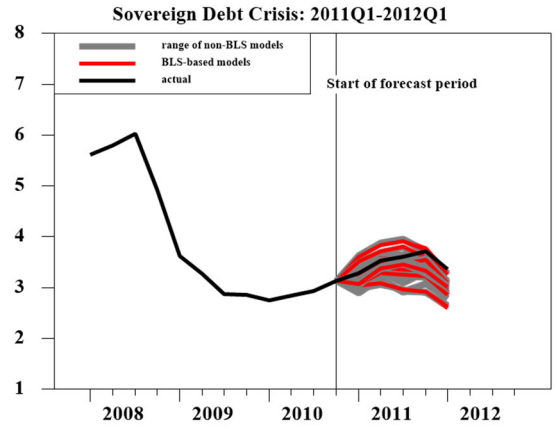
[11] We consider only the "risk perception" factor and not "risk tolerance", as the latter has been included in the survey only at a later stage (since 2015Q1).
[12] All the results, however, are valid if we were to consider the BLS overall credit standards indicator.
[13] Notice that the upper red lines do overlap with a couple of the grey lines (which do not rely on BLS borrower risk): the latter are obtained using the CISS as a proxy of credit risk (for the euro area) and loan loss provisions (for Italy). Also, models at the upper bound of the BLS forecast range display a quite good forecasting performance (low RMSE).

Crisis (BLS indicators are only available since 2003Q1). In practice, we run the thick modelling estimation discussed above, ending the estimation sample in 2010Q4, the last period before the outburst of the crisis and the associated abrupt spikes in government bond yields in the peripheral countries.

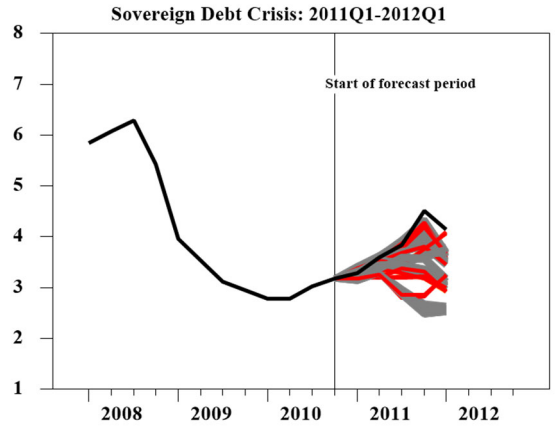
The realized path of lending rates (Figure 4; black line) lies within the range of models that include BLS measures of risk perception about borrowers (red lines), for both the euro area (panel a) and Italy (panel b). This implies that there is no systematic overestimation of lending rates by BLS-based models; on the contrary, at least two of the models that include BLS risk perception track the dynamics of lending rates to NFCs almost perfectly.[14] Importantly, models better describing lending rates evolution during the Sovereign Debt Crisis signal an increase by 2024Q1 significantly stronger than the average, for both the EA and Italy.

FIGURE 4. THICK MODELLING FORECASTS OF LENDING RATES TO NFCS IN THE SOVEREIGN CRISIS

a. Euro area



b. Italy



Source: authors' computations on ECB, Bank of Italy, Eurostat and Refinitiv data.
Notes: Composite cost of borrowing to NFCs. Last observation included in the estimation sample is 2010Q4 (thin vertical line). The black line plots the actual series dynamics. The grey lines plot the range of forecast computed using models including alternative indicators of economic activity, short-term and long-term market rates and tightening in financing conditions. The red lines plot the range of forecast computed using the BLS risk-perception indicator as measure of tightening in financing conditions.

4.4 A quantitative assessment of two possible risk scenarios

The BLS-augmented projections discussed so far assess the possible impact of monetary tightening on lending rates charged to NFCs when accounting explicitly for rising borrower risk (which affects the transmission of monetary policy via the firm balance sheet and profitability channel). The projections imply (*i*) an orderly evolution of bank bond yields, as they assume policy hikes in line with market expectations and no disorders in the end of reinvestments of securities in

[14] In particular, the information set included in these two models relies on (besides the BLS risk-perception factor): (i) the WACL, the 10-year rate and nominal economic activity; (ii) the WACL, the 10-year rate and real economic activity.

the APP portfolio[15] and TLTRO reimbursements, and (*ii*) an underlying pass-through of policy hikes to deposit rates in line with historical regularities (i.e. deposit beta reaching a long-run value of 0.4). Both assumptions are subject to risks, if unexpected tensions hampering the solvency/liquidity of the banking sector materialize.

To provide a broad quantitative assessment of these risks, we relax the above assumptions of an orderly evolution of bank bond yields and of a long-run deposit PT in line with historical regularities. In practice, we consider two risk (or stress) scenarios.

a. "**Higher bank bond rates**":[16] at the end of 2023, the cost of bond financing is assumed to be about 140 bps higher than the baseline in Italy (at 6.9%) and about 30 bps higher in the euro area (around 5.4%), then remaining at that level. Both Italian and euro area bank bond yields are assumed to increase beyond what is currently expected by markets, following a dynamic similar to that observed in the first 9 months of the Sovereign Debt Crisis (January-September 2011). This choice balances the need to be conservative, as the increase was even stronger in the first half of 2012, with the one of providing a meaningful source of stress, i.e. more persistent than the one observed after the bankruptcy of SVB.

   At the same time, the reliance on bank bonds is assumed to increase in order to replace the current share of Eurosystem refinancing, i.e. a share of about 20% of banks' liabilities in Italy and about 15% in the euro area (compared to the current shares of around 7 and 10%). This corresponds to the implicit (extreme) assumption that bank bonds replace the whole TLTRO-III funding. For robustness, we also compute a less extreme case in which banks replace only a half of their current share of Eurosystem refinancing.

b. "**Higher deposit PT**": the long-run PT of official rate hikes to interest rates on deposits is assumed to increase to levels higher than historical regularities. The PT for overnight interest rates is assumed to be 0.8, compared with around 0.4 in the baseline. This is a simple but suitable shortcut to model the likely non-linear effect which could arise in case of larger than expected pressures on banks' funding.

Importantly, the two scenarios may be intertwined and possibly mutually reinforcing. This could be the case if, for example, tensions stemming from deposit outflows – leading to a higher PT to deposit rates – activate at the same time funding problems in the bond market, triggering a sudden spike in bank bond yields.[17] Conversely, tensions in the bond market may undermine banks' reputation with their depositors, triggering retail fund outflows and the associated deposit remuneration increases.

[15] This is an important assumption. Bernardini and Conti (2023) show that the flexible implementation of the asset purchases conducted under the pandemic emergency purchase programme (PEPP) was very effective in lowering sovereign bond yields in the EA.

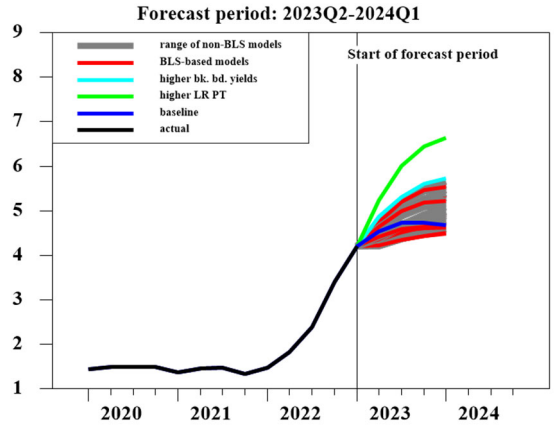
[16] An important caveat on this first scenario is the following: we are not assuming any widening of sovereign spreads or, more generally, a steeper rise of long-term yields. These occurrences would obviously imply an even stronger effect on lending rates.

[17] As we consider linear models, the effects arising from each of the two risk scenarios can be added-up.

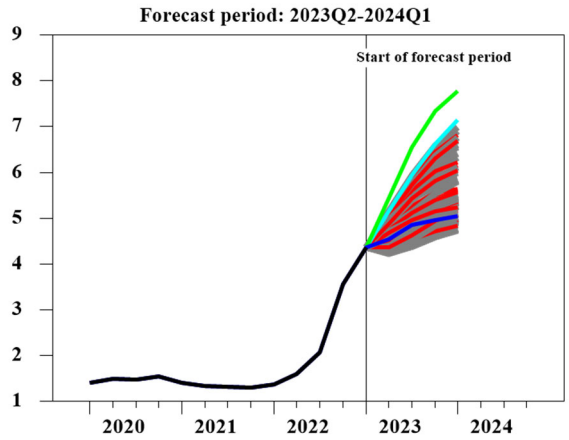
The results of the two scenarios are reported in Figure 5. Each panel compares the baseline projection (blue line), the projections with the thick modelling approach but without BLS data (grey lines), the BLS-augmented projections (red lines) and the projected path under the two risk scenario just described, i.e. the "higher bank bond rate scenario" (cyan line) and the "higher deposit PT scenario" (green line).

FIGURE 5. THICK MODELLING FORECASTS OF LENDING RATES TO NFCS AND TWO RISK SCENARIOS OF (I) HIGHER BANK BOND YIELDS AND (II) HIGHER LONG-RUN PASS-THROUGH TO DEPOSIT RATES

a. Euro area



b. Italy



Source: authors' computations on ECB, Bank of Italy, Eurostat and Refinitiv data.
Notes: Composite cost of borrowing to NFCs. Last observation included in the estimation sample is 2023Q1 (thin vertical line). The blue line plots the technical forecast obtained using the VECM. The grey lines plot the range of forecast computed using models including indicators of economic activity, short-term and long-term market rates and tightening in financing conditions. The red (straight) lines plot the range of forecast computed using the BLS risk-perception indicator as measure of tightening in financing conditions. The cyan line plots the forecast obtained under the first risk scenario, that is adding a higher evolution of the banks' bond yields to the upper bound of BLS-based projections. The green line plots the forecast obtained under the second risk scenario, that is by adding the impact on lending rates of a higher long-run deposit beta to the upper bound of BLS-based projections.

As expected, in both risk scenarios the evolution of interest rates to NFCs is higher than in the BLS-augmented models with no further stress from the banking sector.

The increase arising from higher bank bond yields is modest, reflecting the overall contained share of bonds in banks' liabilities. If we assume the emergence of tensions in the wholesale markets with a consequent negative impact on the cost of banks bonds (respectively 30 and 160 bps higher than the baseline in the euro area and in Italy, at 5.4 and 6.9%), lending rates would increase by around 15 and 30 bps, in the euro area and in Italy respectively.[18] It also follows from the fact that this scenario does not assume any widening of sovereign spreads or, more in general, a steeper rise of long-term yields. These occurrences would imply an even stronger effect on lending rates. For graphical clarity, Figure 5 plots these increases (the cyan line) on top of the upper bound of the BLS-augmented estimate.

[18] In the less extreme case, where banks replace only half of their current share of Eurosystem refinancing, these effects would be reduced to around 9 and 19 basis points respectively.

The quantitative impact of the "higher PT scenario" is larger than that arising from higher bank bond yields. Euro area NFCs lending rates are projected to further rise by an additional amount of 90 bps by 2024Q1, due to the higher deposit beta, and by 100 bps for Italy, reaching around 6.7 and 8.0%, respectively. Figure 5 plots these increases (the green line) on top of the upper bound of the BLS-augmented estimate. For Italy, these levels of composite cost of borrowing to NFCs would be stronger than those observed during the peak of the Global Financial Crisis with the known consequences on creditors' quality, demand and supply of credit, investment and consumption.

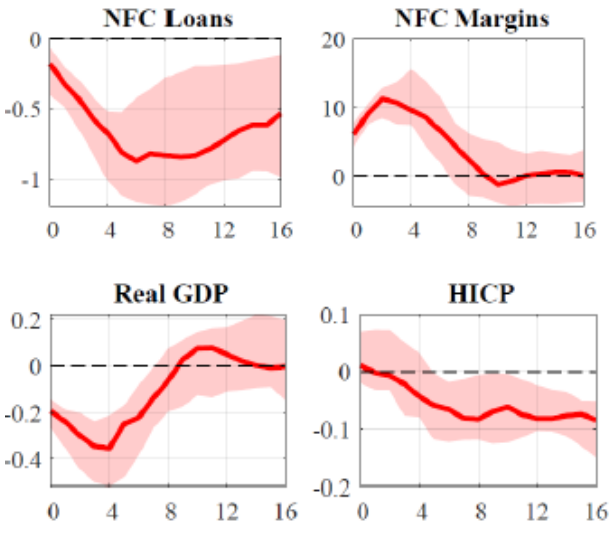
5. On the macroeconomic impact on loans and macroeconomic variables in Italy

To give a broad assessment on how the risk surrounding the technical projections and presented in Section 4 could feed into lending volumes and macroeconomic dynamics, we estimate a VAR model of the Italian economy and identify loan supply shocks by means of narrative sign restrictions. In more detail, we rely on the model by Conti et al. (2023). The estimation sample is quarterly and runs from 1993Q1 to 2019Q4.[19] This time span enables us to cover four recessions (in the early 1990s; in the early 2000s; the one following the Global Financial Crisis in 2008–09; the one following the Sovereign Debt Crisis, in 2011–12), three of which were also characterized by episodes of financial instability (i.e. all but the one in the early 2000s). This helps to better pin-down the relation between the business cycle, financial markets conditions and bank lending.

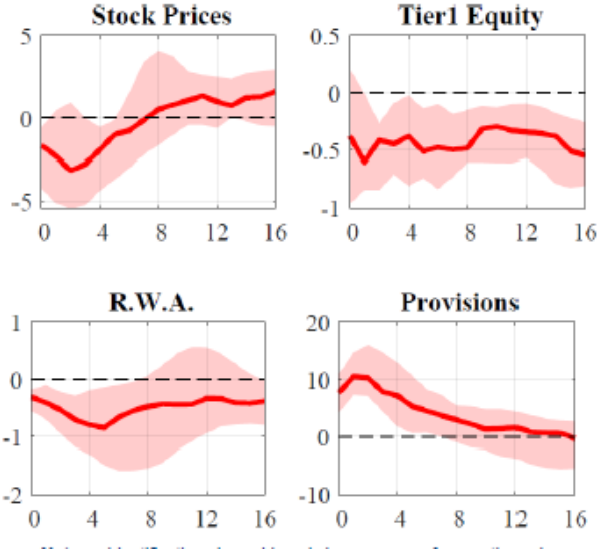
In Figure 6 we show the IRFs to an adverse credit supply shock. The shock triggers a rise in margins and an associated contraction in lending volumes, both very persistent (see Figure 6a).

FIGURE 6. IRFS TO A LOAN SUPPLY SHOCK IN ITALY

a. Main variables



b. Other banking variables



Source: authors' computations on ECB, Bank of Italy, Eurostat and Refinitiv data.
Notes: IRFs to a loan supply shock. Notes: red lines are the median of the posterior distribution obtained when combining sign and narrative identification. Light red shaded areas denote 68% credibility interval of the posterior median when combining sign and narrative identification. Estimation sample is 1993Q1-2019Q4. Units are as follows: percentage changes for Real GDP, Consumer Prices, NFCs Loans, Stock Prices, Tier 1 Equity, R.W.A., Provisions; basis points for NFCs Margins.

[19] The end of the sample is justified by the findings in Lenza and Primiceri (2022), who suggest to drop the Covid-19-related observations, which are characterized by significantly stronger volatility with respect to the rest of the sample.

In turn, this lending supply restriction produces significant contractionary macroeconomic effects in the short run, as real GDP contracts by more than 0.2% and the IRFs' credibility set remains in negative territory for 7 quarters. Interestingly, the response of consumer prices is widely uncertain on impact, thus being in principle consistent with both a supply-type and a demand-type propagation mechanism. After 3 quarters, however, prices start declining up to a peak effect of about -0.1%.

It is worth noting that the magnitude of the impacts is quite consistent with the one reported in papers interested in identifying the effects of loan supply shocks for the EA (see, for example, Altavilla et al., 2019 and references therein).

By re-scaling the IRFs, we obtain that a shock to lending margins equal to 100 bps – a size in the ballpark of risks scenarios suggested by the thick modelling approach (section 4) – implies a contraction in lending volumes of about 7 percentage points and a decrease in real GDP by over 2.5 pp at the peak, from the pre-shock level, with a persistence given by over a two-year horizon.[20] The impact on consumer prices would be around -1.0 pp over a three-year time span. The quantitative evaluation above shows that the contraction in credit to Italian NFCs – already in place since 2022Q4 – is likely to continue, and possibly to worsen in the next quarters.

Our findings on real GDP and HICP show that credit supply shocks propagate as aggregate demand shocks, as they imply a positive co-movement between output and prices (see Gambetti and Musso, 2017). However, the large uncertainty associated to the IRF of consumer prices in the first 4 quarters (the credibility interval includes the zero) shows that the evidence stemming from Italy is not in stark and complete contrast with the aggregate supply propagation mechanism proposed by Gilchrist et al. (2017) in a framework featuring nominal rigidities, financial frictions and customer markets.

As for the remaining variables, bank stock prices and RWA decline for about two years while Tier1 capital displays a more persistent response. Finally, although unrestricted, loan-loss provisions increase on impact, before slowly reverting to their pre-shock steady state (Figure 6b).

All in all, the exercise presented in this section suggests that the quantitative impact of a loan supply shock triggered by rising borrower risk is sizable and could significantly affect economic activity in Italy in the next quarters.

6. Concluding remarks

Accurately forecasting the evolution of the financial variables is of paramount importance to monitor the transmission of monetary policy impulses to the real economy and to promptly adjust their intensity over time, if needed. Motivated by the current phase of tightening, which, owing to its unprecedented intensity, may present aspects that are not captured by forecasting models that work well in more tranquil times, we propose a new, more comprehensive approach to predict the evolution of lending rates to NFCs, based on the thick modelling approach (Granger and Yeon, 2004).

[20] Notice that these impacts are broadly consistent with those obtained by studies relying on bank-level data (see, e.g., Del Giovane et al., 2017).

The wide range of forecasts obtained using this methodology can provide an assessment of the uncertainty surrounding lending rates evolution and therefore discipline a formal balance of risks. Moreover, the methodology proves particularly valuable in accounting for the role of borrower riskiness in explaining the evolution of loan rates, which improves greatly the forecasts' accuracy. Thanks to its flexibility, it is also easy to adapt the thick modelling approach to estimate some potential stress scenarios, by inducing shocks to banks' funding costs. The resulting projections can then inform policymakers about the quantification of the impact of the initial shocks to output and inflation, exploiting an auxiliary dynamic framework (a Bayesian VAR in which the credit supply shock is identified by means of narrative sign restrictions; Antolín-Díaz, and Rubio-Ramírez, 2018; Conti et al., 2023).

The key result of our analyses is that in the current tightening cycle borrower risk is likely to be a core determinant of the evolution of credit supply, possibly reflecting the unprecedented intensity of the hikes, which may reduce borrowers' repayment ability, especially in those sectors where a greater downturn in economic activity is expected. According to our results, explicitly accounting for borrowers' risk shifts the technical projection of the composite cost of credit upward by an average of 50 and 20 bps in 2024Q1, the end of the forecasting sample, for Italy and the euro area, respectively (additionally to the level foreseen by the technical projections of about 5.0 and 4.7% for 2024Q1). Risk scenarios on retail and wholesale funding further tilt the balance of risks to the upside.

Therefore, given that a significant degree of credit supply tightening may be in the pipeline in the euro area, attention should be paid by monetary policy to the risk of exacerbating liquidity and solvency issues in the banking sector.

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