The Financing Structure of Non-Financial Corporations and Macro-Financial Implications in France

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ABSTRACT

How does the corporate funding mix affect economic and financial stability in France? To address this question, we develop a model for the financing structure of French non-financial corporations (NFCs) and incorporate it in the Banque de France's semi-structural macroeconomic model (FR-BDF). We document that while on average more than half of external financing for French NFCs is provided by bank credit, the share of bond financing has increased markedly after the great Financial Crisis of 2008/2009. We then use the augmented model to simulate several macro-financial stress scenarios and show that the new macro-financial linkages imply a non-negligible financial accelerator effect that affects corporate investment decisions and matters for the transmission of monetary policy. In particular, corporate leverage plays a key role for investment, and we discuss the relative strength of shocks affecting the leverage ratio via corporate credit and equity.

Keywords: Semi-Structural Models, Non-Financial Corporation Financing, Corporate Debt.

JEL classification: E51, C32

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NON-TECHNICAL SUMMARY

This paper aims at shedding light on the relationship between firms' indebtedness, the corporate funding mix, financing costs and NFC investment. While we focus on the case of France, our results may hold more generally for many developed economies with equally evolved banking systems and financial markets. First, we seek to identify the determinants of the financing structure of NFCs and its impact on the cost of capital that ultimately drives NFC investment activity. To this end, we first develop a partial equilibrium framework capturing NFC financing decisions, which we match to the particular conditions and empirical relationships observed in France. Second, this work aims at discussing external financing decisions faced by NFCs through the lens of an integrated macro model as commonly used for forecasting and policy analysis. Thus, we integrate our derived NFC financing block into the Banque de France's semi-structural macroeconomic model FR-BDF and use the general equilibrium framework for several macro-financial scenario analyses.

Our comprehensive model of the aggregate NFC balance sheet enables us to derive an NFC leverage variable summarizing the degree of corporate financial vulnerability. In turn, the leverage position of NFCs determines risk premia and bank loan and bond spreads, taking financial accelerator effects into account. Thus, augmenting the FR-BDF macroeconomic forecasting model with our NFC financing block provides a better understanding of the dynamics of corporate debt and enriches the description of the NFC balance sheet and macro-financial linkages as a function of shocks on long-term rates, spreads, and NFC investment. Our model can therefore be used both for forecasting purposes and in macro-financial scenario and financial stability analyses.

Our empirical results show first that NFCs rely on bank lending to cover a large share of their new financing needs, which is sensitive to bank lending rate conditions. Second, the trade-off between bank loans and bond issuance is determined by the relative cost of these two debt instruments. Finally, shocks that move equity markets affect, through equity revaluations, the market leverage of firms, which in turn translates into adjustments of debt-related risk premia. While integrating our NFC financing block does not fundamentally change the macroeconomic properties of the FR-BDF model, we find that the resulting financial accelerator mechanism significantly modifies the response of firms' investment to changes in financing conditions. The augmented model is therefore able to capture and identify macro-financial linkages, a feature particularly useful to describe times of tensions in debt markets or risks related to excessive corporate indebtedness.

Moreover, we employ the model to simulate the response of corporate funding mix and investment to a wide range of macro-financial stress and macroprudential policy scenarios. Overall, we find a dampening effect of an exogenous increase in bank credit and leverage on economic activity, with a particular role for firms' assets valuation on their financing conditions. Beyond forecasting, the augmented FR-BDF model can therefore contribute to the evaluation of risks related to corporate indebtedness and to financial stability analyses.

Impulse response of corporate investment to a 100bp 5-year sovereign bond rate shock with and without financial accelerator

% deviation w.r.t to the baseline
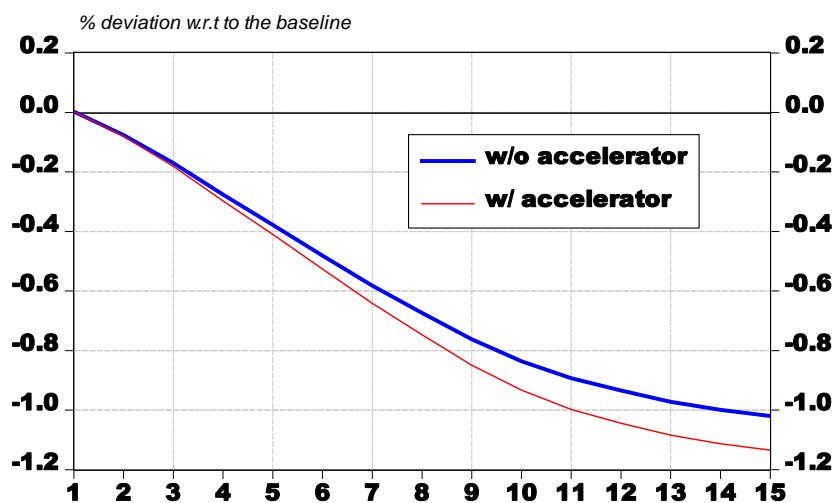
Note: the figure shows the impulse response of corporate investment to a 5-year sovereign bond rate shock in the FR-BDF model with and without the integration of the NFCs financing block into the model.

Sources: Authors' calculations.

Structure de financement des sociétés non-financières et implications macrofinancières en France

RÉSUMÉ

Comment la structure de financement des entreprises affecte-t-elle la stabilité économique et financière en France ? Pour répondre à cette question, nous modélisons la structure de financement des sociétés non financières (SNF) françaises et l'incorporons dans le modèle macroéconomique semi-structurel de la Banque de France (FR-BDF). Nous utilisons ensuite le modèle augmenté pour simuler plusieurs scénarios de stress macro-financier et nous montrons que les nouveaux canaux modélisés impliquent un effet d'accélérateur financier non négligeable, qui affecte les décisions d'investissement des entreprises avec une incidence sur la transmission de la politique monétaire. En particulier, le levier d'endettement des entreprises joue un rôle clé pour l'investissement, et nous discutons de
l'impact relatif des chocs affectant le levier via le crédit bancaire ou la valorisation des fonds propres.

1 Introduction

Like most economies, France has been hit hard by two major crises in the last 15 years: the Great Financial Crisis (GFC) of 2008/2009 and the economic crisis related to the Covid-19 pandemic starting in 2020. While these two crises evolved differently in many aspects, the difference in their impact on financing conditions and economic activity of non-financial corporations (NFCs) is particularly striking. During the GFC, high financing costs and a "wait and see" behavior of firms related to heightened financial uncertainty strongly contributed to a significant decline in NFC investment in France (see figure 1).[1] In contrast, the investment rate in France – as measured by the ratio of investment to value added – reached its highest level since the end of the 1960s in 2021, at the height of the Covid-19 pandemic. While particularly in 2020, pandemic-related sanitary restrictions in France resulted in a forced decline in firms' value added pushing up the investment rate, two further factors were crucial for the relative stable trajectory of the NFC investment rate during the Covid pandemic. First, despite large pandemic-related uncertainties, financing conditions remained favorable and second, the NFC sector exhibited a large degree of resilience despite adverse conditions during the pandemic. These factors were mainly due to the specific nature of the Covid shock and the unprecedented support from monetary and fiscal policies. In addition to the strong support from the combined pandemic-related monetary policy measures implemented by the European Central Bank[2], large-scale public support measures such as state-guaranteed loans helped keeping financing costs and firm default rates at bay, mitigating the adverse economic and financial effects of the most severe health and economic crisis since the end of World War II for French NFCs.

Parallel to the steady increase in the investment rate in France, firm indebtedness has been rising over the last 25 years (see figure 2). While debt may improve economic welfare and stimulates economic growth if it remains at moderate levels (Cecchetti et al., 2011), it also creates the conditions for financial instability when it reaches levels considered as excessive, increasing the likelihood of a financial crisis and a subsequent drop in investment. While NFC debt has decreased since the GFC in other euro area countries such as Spain and Italy, the indebtedness of French NFCs further increased since 2011, despite a double-dip recession during the GFC and the subsequent European sovereign debt crisis of 2011. This divergence may be partly rooted in the particular degree of fiscal support

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[1]Due to heightened financial uncertainty, the irreversible character of long-term investments can enforce a "wait and see" behavior of firms, with dampening effects for investment activity. See e.g. Gilchrist et al. (2014).

[2]An overview of the ECB's pandemic-related monetary policy measures can be found here.

Figure 1: NFC investment rate France (% of corporate value-added)
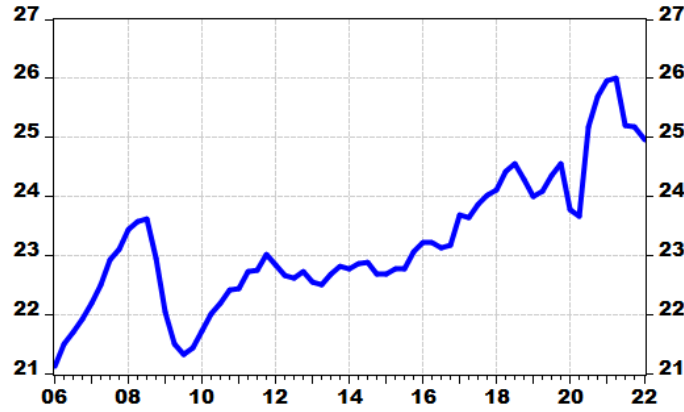
over the last decade. For instance, the French government offered corporate financing mechanisms which on the one side succeeded in avoiding massive waves of bankruptcies, but on the other side fostered NFC borrowing.[3] Thereby, these measures potentially contributed to the elevated corporate indebtedness levels in France in comparison with other European economies.

Figure 2: NFC indebtedness (bank loans and debt securities, % of corporate value-added)

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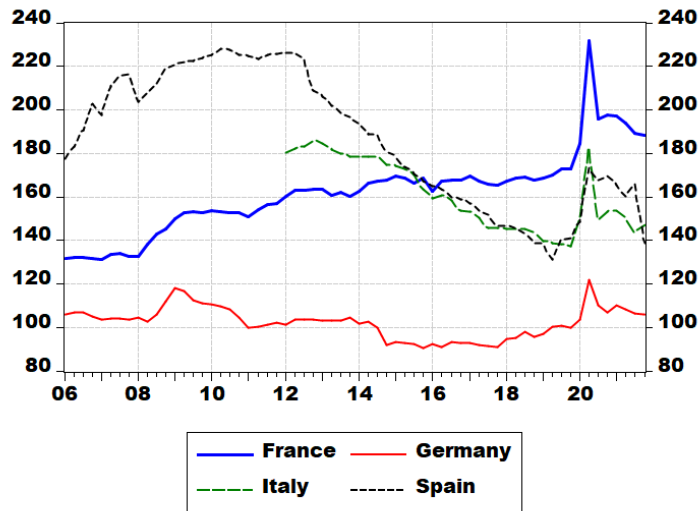
[3]The most important fiscal measures to support corporate financing being the so-called "fonds de solidarité" to avoid massive business failures and the state-guaranteed loans that amount to more than €140 bn.

This paper aims at shedding light on the relationship between firms' indebtedness, the corporate funding mix, financing costs and NFC investment for the case of France. However, we argue that our results may hold more generally for many developed economies with equally evolved banking systems and financial markets. First, we seek to identify the determinants of the financing structure of NFCs and its impact on the cost of capital that ultimately drives NFC investment activity. To this end, we first develop a partial equilibrium framework capturing NFC financing decisions, which we match to the particular conditions and empirical relationships observed in France. Second, this work aims at discussing external financing decisions faced by NFCs through the lens of an integrated macro model as commonly used for forecasting and policy analysis. Thus, we integrate our derived NFC financing block into the Banque de France's semi-structural macroeconomic model FR-BDF (Lemoine et al., 2019) and use the general equilibrium framework for several macro-financial scenario analyses.

Our comprehensive model of the aggregate NFC balance sheet enables us to derive an NFC leverage variable summarizing the degree of corporate financial vulnerability. In turn, the leverage position of NFCs determines risk premia and bank loan and bond spreads, taking financial accelerator effects into account. Thus, augmenting the FR-BDF macroeconomic forecasting model with our NFC financing block provides a better understanding of the dynamics of corporate debt and enriches the description of the NFC balance sheet and macro-financial linkages as a function of shocks on long-term rates, spreads, and NFC investment. Our model can therefore be used both for forecasting purposes and in macro-financial scenario and financial stability analyses.

To understand the financial accelerator mechanism and the macro-financial risks associated with a mix of bank and market-based borrowing taken out by NFCs, it is necessary to identify the factors influencing the composition of the corporate funding mix. First, NFCs partly finance real and financial investments through internal financing, i.e. with funds acquired through retained earnings and depreciation allowances. However, firm financing needs exceeding retained earnings have to be covered by external financing, which may be mainly provided in the form of debt and equity financing. Naturally, the optimal mix between external and internal financing is central in funding decisions of firms. In France, the shares of equity and debt (bank lending and debt securities) financing in value added are almost even, although equity financing has been more volatile in the past (see figure 3). In fact, the share of equity financing is mainly driven by valuation effects underlining the role of stock market fluctuations in the value of NFC equity stocks (see figure 4). Moreover, these valuation effects contribute significantly to fluctuations in

NFC market leverage as measured by the stock of debt (in value terms) over the stock of equity, which in turn is an important determinant in the financial accelerator mechanism.

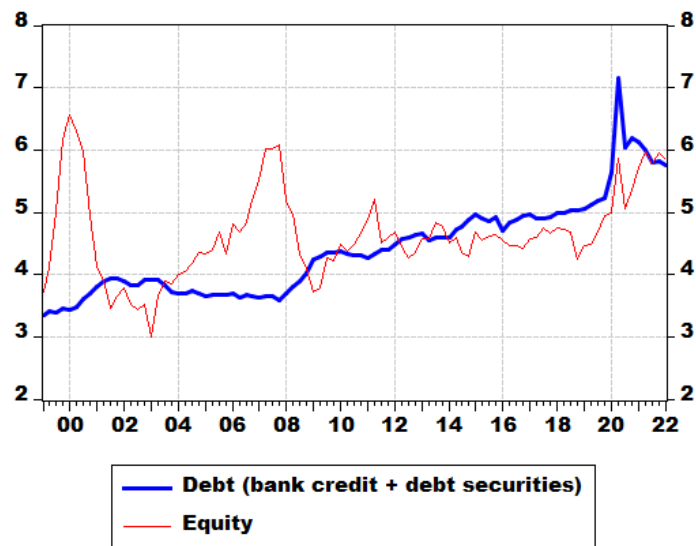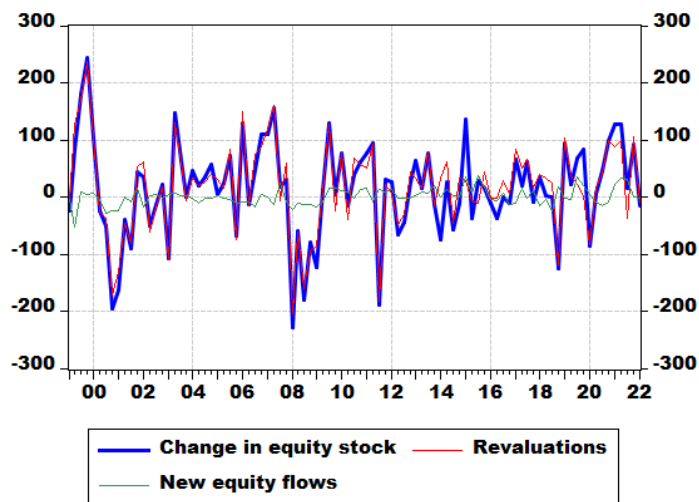Figure 3: NFC financial liabilities France (% of corporate value-added)

Figure 4: Equity (non-financial corporations), €bn.

While, as described in the following section, the Modigliani and Miller (1958) theorem predicts that a firm's value is unaffected by its funding mix in an efficient market, the trade-off between the sources of financing is not value-neutral in reality and depends on

the balance-sheet structure of the firms. Consequently, highly indebted NFCs are likely to face higher borrowing costs, as they have to compensate potential default risks with a higher external financing premium (see Bernanke et al., 1999). In France, as depicted in figure 5, this premium as measured by the spread between an average bank lending rate and a risk-free rate broadly moves in tandem with NFC market leverage measured by the ratio of total financial debt over equity. Strikingly, the largest increase in the spread during the 2008-09 and 2011-12 periods coincide with bank lending contractions (figure 6).

Figure 5: Bank loan spreads and corporate leverage
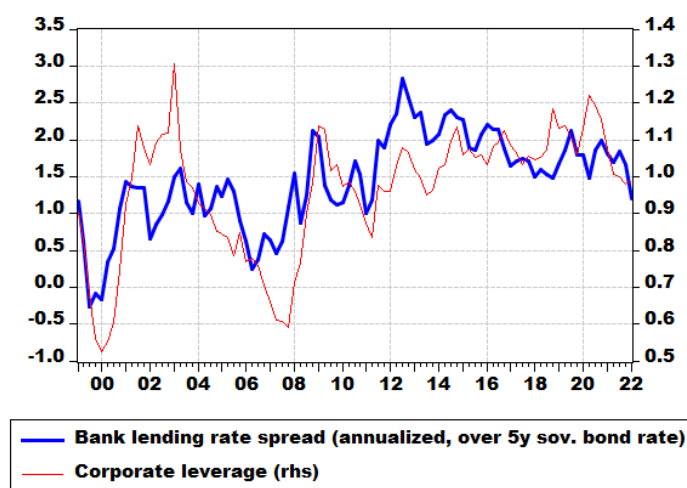
A further dimension of the corporate funding mix concerns the trade-off between different debt instruments, in particular between bank lending and debt securities. Although bank lending still depicts the largest share of external financing to small-and medium-sized enterprises (SMEs) in the euro area, corporate bond issuance has soared since the GFC (see figure 7). This surge has been supported by structural reforms facilitating NFC access to market financing such as the creation of a "Capital Markets Union" at the European level, and by expansionary monetary policy (see e.g. De Santis and Zaghini, 2021).

Finally, firms have to decide on the optimal funding mix between internal financing and different debt instruments, and the corporate finance structure ultimately depends on the respective relative costs of the different funding sources. In return, these costs depend to a large extent on the initial financial situation of the respective firm and affect firm investment decisions. On the macroeconomic level, the funding mix and related financing

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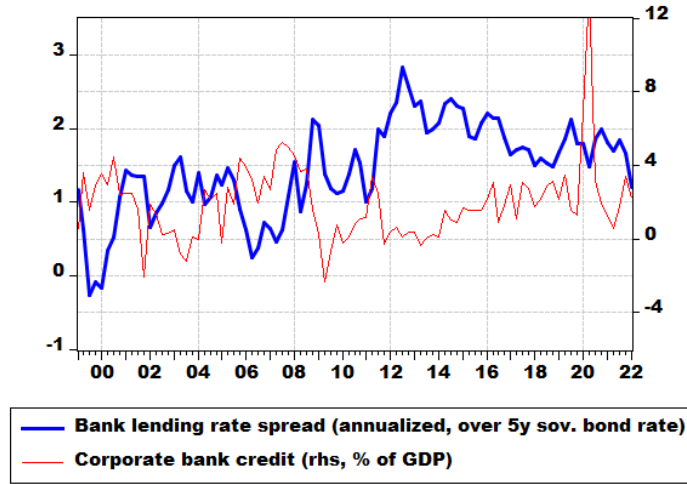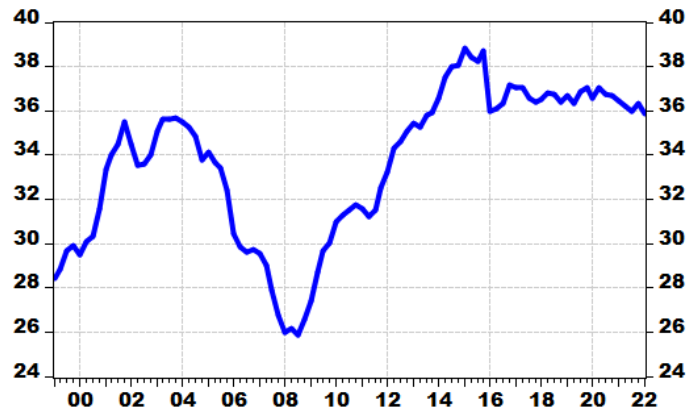Figure 6: Bank loan spreads and corporate credit

Figure 7: Bond ratio (NFC bond financing as % of total NFC debt)

costs therefore play a crucial role for both short-term business cycle fluctuations and for the long-term trajectory of an economy's growth potential. Figure 8 shows that business investment in France is positively correlated with an inverted weighted average cost of capital (a composite including the cost of equity, bank lending rates, and yields on debt securities).

Our empirical results show first that NFCs rely on bank lending to cover a large share of their new financing needs, which is sensitive to bank lending rate conditions. Second, the trade-off between bank loans and bond issuance is determined by the relative cost of these two debt instruments. Finally, shocks that move equity markets affect, through

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Figure 8: Business investment rate and the weighted cost of capital
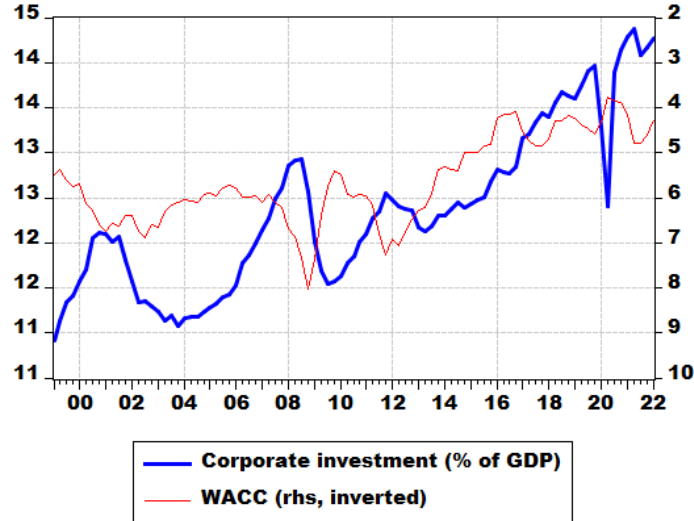
equity revaluations, the market leverage of firms, which in turn translates into adjustments of debt-related risk premia. While integrating our NFC financing block does not fundamentally change the macroeconomic properties of the FR-BDF model, we find that the resulting financial accelerator mechanism significantly modifies the response of firms' investment to changes in financing conditions. The augmented model is therefore able to capture and identify macro-financial linkages, a feature particularly useful to describe times of tensions in debt markets or risks related to excessive corporate indebtedness.

The paper is organized as follows. Section 2 provides a brief review of the existing literature. Section 3 presents the structure of the NFC financing block and its integration to the FR-BDF model, as well as an empirical analysis of the determinants of NFC financing choices. In section 4, we provide results on simulation analyses to assess how external financing of NFCs reacts to exogenous shocks and to empirically measure financial accelerator effect for France trough the lens of our model. Section 5 concludes.

2 Literature Review

Firms need to decide on their capital holdings and financing structure to obtain sufficient funds to carry out investment projects. On the theoretical side, in their seminal work, Modigliani and Miller (1958) present a model to assess the capital-structure decision of firms. They show that the capital structure of firms is not related to the value of the firm

under perfectly functioning financial markets, as in the absence of taxes or transactions and bankruptcy costs, a firms' value is independent of the firm's financial structure. In Modigliani and Miller (1963), they relax the assumptions of market perfection and show that the value of a company increases if the level of debt increases, such that the initial MM theorem does not hold anymore once more realistic features of corporate finance are taken into account.

Over the last few decades, different theories have been further developed to complement and challenge the key insights of the MM analysis. One prominent strand of the literature describes the trade-off theory, which supposes that companies calculate the costs and benefits of each means of financing in order to find the most advantageous one. For instance, in addition to tax deductibility, debt holdings may be beneficial for firms due to their disciplining effect when agency problems between firm managers and shareholders exist (Jensen and Meckling, 1976; Grossman and Hart, 1982), or due to their signaling role of firm productivity (Brealey et al., 1977; Ross, 1977). In contrast, costs of debt holdings are usually related to higher default probabilities and potential bankruptcy costs, ultimately reflected in rising external finance premia demanded by investors (Myers, 1977; Stiglitz and Weiss, 1981).

In contrast to the trade-off theory, the pecking order theory developed by Myers and Majluf (1984) stresses that the cost of financing tends to increase with asymmetric information, as managers may be reluctant to issue equity which may signal to investors that the firm is overvalued. Therefore, the pecking order theory postulates hierarchical choices in the financing means of firms: Firms would prefer to use their retained earnings first to finance investment projects before resorting to external financing. If external financing would be required, they would prefer debt financing before, as a last resort, raising capital externally via equity issuance. The NFC financing block we present below features a pecking-order financing decision scheme for firms, as firms prefer financing their activities out of retained earnings before turning to credit markets and equity financing.

Various empirical studies have been carried out to test these theories. Titman and Wessels (1988) were among the first to study the financing structure of firms relying on US data for 469 companies over the 1974-1979 period. In line with the pecking order theory, they find firm profitability to play a crucial role, as productive NFCs benefit particularly from retained earnings to carry out their investment projects. Moreover, they find evidence that profitable firms have relatively less debt relative to the market value of their equity and that short-term leverage ratios are negatively related to firm size, probably due to the fact that smaller firms face higher costs on long-term debt. Rajan

and Zingales (1995) also examine the determinants of the choice of capital structure by analyzing the financing decisions of NFCs in the major G-7 industrialized countries over the period 1987-1990. They find that tangibility and size positively affect leverage, while the market-to-book ratio and profitability are associated with lower levels of leverage. Fama and French (2002) empirically test the pecking order and the trade-off theory. Their results confirm the findings of Rajan and Zingales (1995), according to which the firms with the highest profitability usually exhibit lower book and market leverage.

Both the trade-off and the pecking order theories imply that firms may not only have to decide between internal and external financing, but also between different sources of external financing, e.g. on credit versus bond financing. In our framework, we assume that all firm expenses not covered by internal financing will be financed either by bank loans or bonds, with the ratio between the two being a crucial decision variable for firms in our framework. In contrast to our approach, many studies on NFC debt do not distinguish between the type of indebtedness. However, some studies show that banks may particularly efficient in resolving informational problems through screening and monitoring, and that the special informational role of banks can affect the structure of corporate finances via the cost of bank finance relative to the cost of bond finance. De Fiore and Uhlig (2011) develop a DSGE model including the informational role of banks to replicate some differences between the United States and the euro area in terms of corporate finance and to determine the choices by NFCs among different debt instruments. According to their findings, the trade-off between bank and market financing depend on the level of risk: Firms experiencing high default risk choose to abstain from production possibilities, while firms with relatively low risk choose to raise external finance through bonds. Only firms with intermediate degrees of risk choose to sign a contract with banks, because they value the option of getting further information before deciding whether or not to produce. In De Fiore and Uhlig (2015), they extend the analysis and show that the choice between credit and bond financing can result from an increase in the "iceberg" cost of obtaining bank financing inducing a fall in the ratio of bank loans to debt securities.

Finally, the choice of the firm funding mix may have real economic consequences. For instance, Grjebine et al. empirically analyse the evolution of corporate debt structure over the economic cycle and show that the substitution of bonds for loans during recoveries is a regular property of economic cycles. They also find that cyclical recoveries are stronger in economies where the share of bonds in corporate debt is high, as well as in economies where the substitution between bank and bond financing is larger. Xiao (2016) shows that during the Great Financial Crisis, firms that substituted bank loans with bonds

hoarded relatively more cash and invested less than those that did not.

In addition to the composition of the external funding mix, the overall size of external financing may be a crucial determinant of investment activity. Several empirical studies identify a negative link between high firm leverage and investment activity (Vermeulen, 2002; Benito and Hernando, 2007; Martinez-Carrascal and Ferrando, 2008; Pal and Ferrando, 2010; Kalemli-Özcan et al., 2018; Barbiero et al., 2020; Gebauer et al., 2018). Studying a sample of Portuguese firms, Barbosa et al. (2007) find that the strength of a negative corporate debt-investment links depends on several firm-specific factors such as bank lending relationships, credit default in the past, and firm size. Investigating the evolution of the debt-investment link over time, they do not find evidence for different effects of debt holdings on investment over the business cycle. In contrast, Vermeulen (2002) shows the leverage-investment link to be particularly relevant during downturns and for small firms. ECB (2013) indicate that the reduction in investment (and output) during the Great Financial Crisis generally reflected the intensity of corporate debt accumulation prior to the crisis.

In line with the trade-off theory, some studies find evidence for a target level of debt holdings, beyond which further accumulation of debt may negatively affect investment activity. Gebauer et al. (2018) employ a panel threshold model for a sample of euro area NFCs and identify a threshold debt-to-asset ratio of around 80%-85% beyond which debt holdings have a significantly negative effect on investment activity. Similarly, Hernando and Martinez-Carrascal (2008) show for a sample of Spanish firms that beyond 75th percentile of indebtedness, firms face further constraints on investment activity. Goretti and Souto (2013) confirm these findings, even though their identified threshold is lower, with a debt-to-equity threshold at the 25th percentile in their sample for euro area firms. Ferrando et al. (2017) derive the target debt level from an estimated leverage equation and show that firms with below-target leverage holdings invest more in the following years. Finally, Jäger (2003) use flow of funds data for the US and Germany and find that corporate indebtedness is negatively associated with investment particularly during years of above-average debt holdings.

3   Model overview

In this section, we briefly introduce the core elements of FR-BDF, the large-scale macroeconomic model of Banque de France. We then provide a description of the NFC financing block that we developed to augment the FR-BDF model with macro-financial linkages

related to the corporate sector. First, we derive financing needs from income statement accounting and model bank loan demand by firms to cover part of such funding requirements, which depends on the lending conditions by banks. Second, a bond ratio, computed as the share of debt securities over total debt, determines how the spread in costs between bank loans and bond issuance influences the firm holdings of these two forms of debt financing. Finally, the remaining part of the financing needs is covered by the issuance of equities. As mentioned above, equity flows only explain a small share of the change in the stock of equity, so we also model equity revaluations and stock market prices which depend on firm profits and the cost of equity.

3.1 The FR-BDF model

FR-BDF is a semi-structural, large-scale model for France, which is used both for medium-run projection exercises and for policy analyses[4]. The long-run equilibrium of the model is based on theoretical foundations, while short-run dynamics are based on empirical relationships that allow for temporary deviations from this long-run equilibrium. Furthermore, agents' expectations drive short-term dynamics, and FR-BDF allows for different assumptions regarding the expectation formation process ("VAR-based" or "model-consistent" expectations). Two key features of the model allow for an explicit consideration of macro-financial linkages. First, FR-BDF allows for several financial channels, operating for instance through a large set of interest rates yielding an endogenous term structure, or via a detailed breakdown of the different financing costs for firms. Second, the role of expectations is crucial in the model, playing a significant role in the transmission of shocks (e.g. monetary policy shocks) on financial and non-financial variables.

Against this background, the NFC financing block developed in this paper presents a significant part of the ongoing macro-financial extensions of FR-BDF. In a first extension, a household financial block, modeling in detail the interactions between household debt and real estate prices (see Bove et al., 2020), has been introduced into the main FR-BDF model. The augmented model yields interesting results and allows for a wide range of policy analyses related to the core activities at central banks, such as the assessment of borrower-side macroprudential policies, their interactions with monetary policy, and their implications on macro-financial variables at the aggregate level. In particular, Bove et al. (2020) show that large credit and asset price fluctuations may reinforce each other over short- to medium-term horizons, creating potential financial accelerator effects that

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[4]See Lemoine et al. (2019) for a detailed description of FR-BDF.

are detrimental to financial stability. In this paper, we complement the household block with a comparable framework for NFCs. The resulting NFC block shares similarities - such as the introduction of financial accelerator effects - with the approach applied for the household sector, but also relies on partly different modeling choices in relation to the choice of financing means for firms, through arbitrage behaviors between debt securities, bank credit or equity.

3.2 Overview of the NFC financing model

Figure 9 shows a flowchart summarizing the structure of the NFC financing model. It comprises three main elements. First, following the pecking-order theory described above, financing decisions start with external financing needs resulting from NFC operations (in blue in the flowchart). These financing needs determine the amount of external financing that NFCs demand, mainly to invest in fixed capital and to build up stocks. Firms can meet their financing needs via two sources of external funding: obtaining bank lending or issuing debt securities. The amount of obtained bank lending depends on bank lending rates (as a spread over a risk-free rate), and arbitrage between bank loans and bonds is modeled via a bond ratio describing the stock of debt securities over total debt, which depends on the spread between bank lending rates and the yield of BBB debt securities. The total of the two debt instruments held on the firm balance sheet enters the numerator of the corporate leverage ratio.

Second, both revaluations of existing stock and the flow of new equity issuance determine equity stocks (in green in the flowchart). Revaluations are linked to a stock market index (CAC40), which depends via a dividend discount model on profits and the cost of equity (i.e. the sum of a risk-free rate and an exogenous risk premium defined in FR-BDF). Equity flows are defined from an accounting constraint covering all financing needs and aggregate financial assets (mainly cash holdings) not covered by debt holdings. The framework therefore strongly resembles a pecking order approach, as firms tend to turn to internal funding first (their savings), then to debt and only cover the remaining part of financing needs with equity. The resulting stock of equity enters the denominator of the leverage ratio.

Finally, the real economic effects of NFC financing depend on the funding mix on NFC balance sheets. The real economic channel of NFC financing (in red in the flowchart) works via corporate investment, and starts from the leverage ratio that influences, through a financial accelerator mechanism, both the bank lending spread and the BBB rate spread.

Figure 9: Overview of the NFC financing model
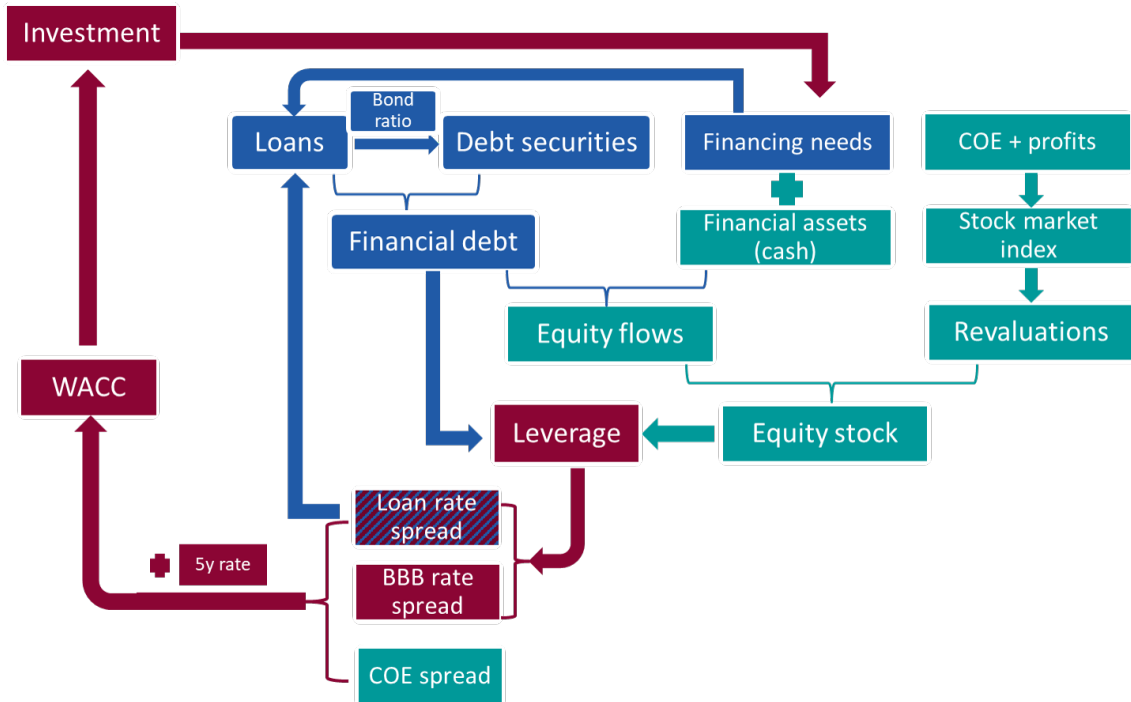
These two spreads, converted in actual debt costs by adding the risk-free rate (at 5-year maturity), and the cost of equity determine the weighted average cost of capital (WACC), which is the relevant cost variable in the investment equation of FR-BDF.

3.3 Econometric estimation of the model's core equations

As figure 9 shows, most of the relationships within the model rely on accounting identities. In addition, we estimate four core equations econometrically: the equations for bank loans, the bond ratio, the stock market index and the interest rate spreads.

Estimations are based on quarterly data over the period 1993Q1 to 2019Q4 obtained from two main data sources. First, we gather data on bank loans and interest rates for France from the Balance Sheet Items (BSI) database compiled by euro area monetary financial institutions. Second, we rely on financial quarterly national accounts data drawn up by Banque de France which provide additional information on components of the aggregated firm balance sheet such as debt securities and equity on the liability side and liquid and other assets on the asset side.

Bank loans: As previously discussed, bank credit measured as the ratio of corporate bank loans over GDP depends on financing needs (also measured as a ratio over GDP) and a spread variable (the difference between the bank lending rate for firms and the 5-years sovereign bond yield) in the model. The equation also contains dummy variables controlling for episodes when bank credit strongly deviates from historical regularities, such as during the GFC. All variables entering the equation are stationary.

Estimation results are shown in table 1. The coefficient on FN_t/GDP_t indicates that on average, more than half of external financing needs are met by bank credit, reflecting the importance of bank financing in France. The coefficient on $blr_t - rf_t$ depicts the elasticity of demand for bank credit with respect to bank financing costs: according to our estimations, a 100 bp increase in spreads leads to a 1 GDP pp decrease in bank loans.

$$L_t/GDP_t = \alpha_0 + \alpha_1 \frac{FN_t}{Y_t} - \alpha_2(blr_t - rf_t) + \alpha_3 \frac{L_{t-1}}{GDP_{t-1}} + \alpha_4 \frac{L_{t-2}}{GDP_{t-2}} + dummies + \epsilon_t \quad (3.1)$$

Table 1: Estimation results for the bank loan equation

Variable	Coefficient	S.E.
Constant	0.004	0.003
FN_t/GDP_t	0.526***	0.149
$blr_t - rf_t$	−4.051***	0.826
L_{t-1}/GDP_{t-1}	0.221**	0.091
L_{t-2}/GDP_{t-2}	0.173**	0.086
Adjusted R^2 = 0.630		

***, ** and * denote the 1%, 5% and 10% significance levels.

Figure 10 shows the dynamic simulation and the historical contributions to corporate bank credit. Dynamic simulations of corporate bank credit based on equation 3.1 are overall in line and strongly correlated with the actual data. The simulated credit series captures the decline of the ratio of bank credit over GDP in the early 2000s and attibutes this decline to a tightening of financial conditions (increase of bank loan spreads) following the burst of the DotCom bubble. The GFC episode and the subsequent credit crunch are only partially reflected in the simulations, but the impacts of lower financing needs on credit due to a fall in investment and some tensions on the cost of financing are clearly apparent in the historical decomposition. Over the course of the euro area sovereign debt crisis, financing condition remain tight according to the simulations and explain why the ratio of credit-to-GDP ratio remained below its historical average for several years.

During 2020, the first year of the Covid-19 pandemic, the unexplained contribution to the credit-to-GDP ratio is exceptionally high, mainly as a result of largely unprecedented economic policy and health measures, such as guarantee schemes for bank loans targeting the corporate sector and moratoria on loan repayments. The relatively large contributions of crisis dummies or residuals during the GFC and the subsequent years (on the negative side) and the Covid-19 episode (on the positive side) is also likely to capture the role of loan supply, a aspect which is ignored in our modelling approach but which appears to play a role only in very specific crisis periods (banking sector stress or credit support schemes by governments).

Figure 10: Dynamic simulation of corporate credit (€bn.) and historical contributions to the corporate bank credit-to-GDP ratio (%)
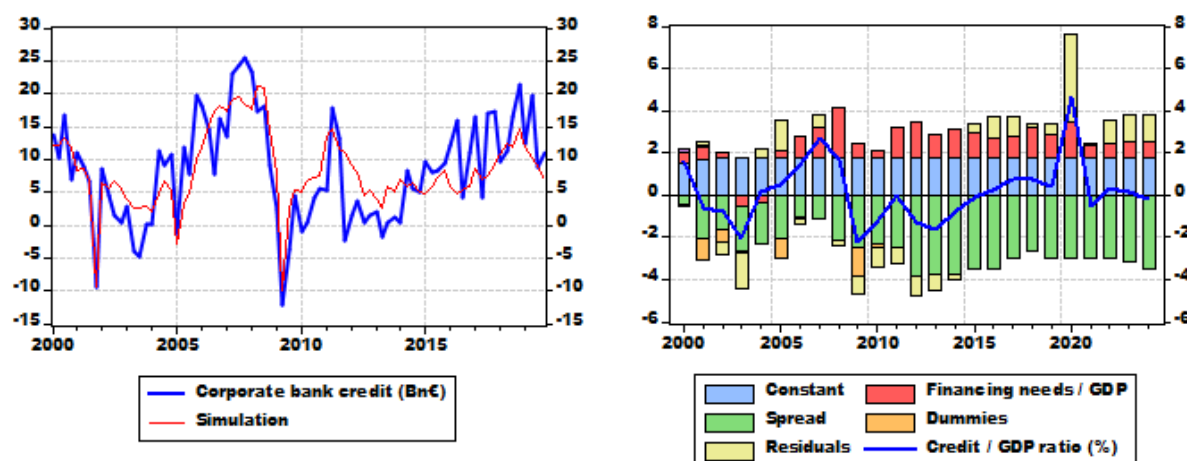
Bond ratio: In the historical sample, the ratio of debt securities to total NFC debt fluctuates around a long-term average. However, two periods with opposite low-frequency movements can be identified (see figure 7). Between the beginning of the 2000s and the onset of the GFC, the bond ratio declined continuously, followed by a sharp inversion of this trend after 2008-2009. This increase in the post-crisis period seems consistent with the findings in Grjebine et al., who document a substitution of bonds for loans during recoveries. The share of bond in total debt financing increased for several years, before stabilizing at approximately 37% from 2015 onward.

Overall, it is difficult to find a long-run relationship that links the bond ratio to

macro-financial determinants. Testing a large variety of specifications including several short-term cyclical determinants, we find that in particular the spread between the bank lending rate and the BBB-rated corporate bond yield is able to explain a significant share of the movement in the bond ratio. We therefore specify a relatively simple bond ratio equation, linking the relative share of bond financing in total debt to the cost differential of the two types of debt. We present estimation results for this equation in table 2.

$$\Delta B_t / D_t = \beta_0 + \beta_1 \cdot \Delta(blr_t - bbb_t) + dummies + \epsilon_t \tag{3.2}$$

Table 2: Estimation results for the bond ratio equation

Variable	Coefficient	S.E.
Constant	0.002***	0.001
$\Delta(blr_t - bbb_t)$	1.666***	0.621
Adjusted $R^2 = 0.376$		

***, ** and * denote the 1%, 5% and 10% significance levels.

Revaluations and equity price: In the introduction and in Section 3.2, we discuss that historically, the outstanding amount of equity was mostly driven by revaluations of the existing stock of equity. Properly modeling the dynamics of equity revaluations is therefore crucial to understand the determinants of firm equity, which also enters the denominator of the corporate leverage ratio. In our model, revaluations are linked to a stock market index (the French CAC40), which is linked to profits and the cost of equity (i.e. the sum of a risk-free rate and an exogenous risk premium defined in FR-BDF) through a standard dividend discount model (Gordon and Shapiro, 1956).

In this constant-growth form of the dividend discount model, the long-run equilibrium aggregate stock price P_t of the French stock market index ($cac40$) is determined by the ratio of dividend payments and the cost of equity: $P_t = \frac{D_t}{COE_t - g}$. We use firms' gross operating surplus (gos_t) as a measure of profits. COE_t is the cost of equity and g is the nominal GDP growth rate in the steady state of FR-BDF. In the short run, we allow the index to vary around its trend with profits and $COE - g$ also driving the stock market price in the short run:

$$\Delta cac40 = \lambda_0 + ect_1(cac40_{t-1} - gos_{t-1} + log(COE_{t-1} - g)) + ...$$
$$\lambda_1 \Delta cac40_{t-1} + \lambda_2 \Delta gos_{t-1} + \lambda_3 \Delta log(COE_{t-1} - g)) + dummies + \epsilon_t \quad (3.3)$$

Estimation results for the stock market equation are reported in table 3. The coefficient on the error correction term (ect_1) is relatively large and statistically significant, and the determinants appearing in the long-run relationship (profits and $COE - g$) also influence short-run dynamics of the stock market price.

Table 3: Estimation results for the equity price equation

| Variable	Coefficient	S.E.
Constant	-0.82^{***}	0.214
ect_1	-0.11^{***}	0.029
$\Delta cac40_{t-1}$	0.27^{***}	0.069
Δgos_{t-1}	1.01^{***}	0.314
$\Delta log(COE_{t-1} - Y_{t-1}))$	-0.47^{***}	0.068
Adjusted $R^2 = 0.589$		

***, ** and * denote the 1%, 5% and 10% significance levels.

Figure 11 shows the dynamic simulation and the historical contributions to the stock market index. Overall, the equation captures well the dynamics of the stock market price, except in times with potentially strong "irrational exuberance" (e.g. the GFC or the stock market recovery from mid-2020) when stock prices did not necessarily follow macroeconomic fundamentals. The right panel in figure 11 shows that the discount rate $(COE_t - g)$ is a key variable determining peaks and troughs of the stock market index while profits contribute less on average. Note that from mid-2020 onward, the contribution of profits is more pronounced due to a rapid recovery of profit margins after the first phase of the pandemic, thanks to a massive support from government support schemes such as subsidies, or the vast reliance on short-time working schemes.

Interest rate spreads: Finally, we present the equations capturing the feedback effect of corporate leverage $(\frac{D_t}{E_t})$ on both bank lending and BBB rate spreads through a financial accelerator mechanisms. Each of these two spreads, converted in actual debt costs by adding the risk-free rate (at 5-year maturity), evolve according to the following equations:

$$\begin{cases} sp_t = \kappa_0 + \kappa_1 \frac{D_t}{E_t} + u_t \\ u_t = \kappa_2 u_{t-1} + \epsilon_t \end{cases} \quad (3.4)$$

Figure 11: Dynamic simulation of CAC40 and historical contributions to the stock market index
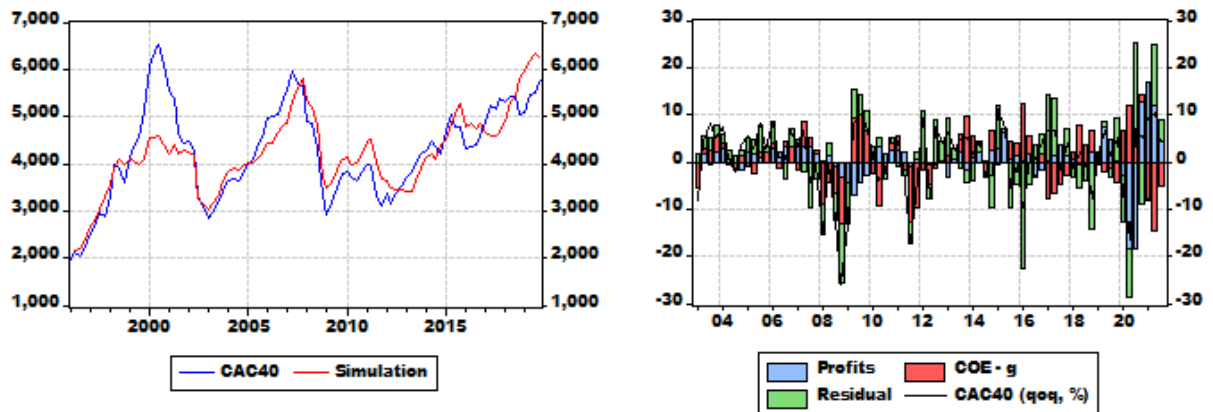
Estimation results are shown in table 4. According to our estimates, a 10 pp increase in corporate leverage results in a 20 bp increase in bank credit spreads (and a 15 bp increase in bond spreads).

Table 4: Estimation results for credit and debt securities spread equations

	Bank loan rate spread	Bond yield spread
κ_0	-0.001	-0.001
κ_1	0.005***	0.004***
κ_2	0.81***	0.83***
Adjusted R^2	0.81	0.72

***, ** and * denote the 1%, 5% and 10% significance levels.

4   Model simulations

In the following, we assess the properties of the NFC financing model in FR-BDF by conducting several simulation exercises. We first study the transmission of financial and macroeconomic shocks through the NFC sector by presenting impulse response functions of macro-financial variables to such disturbances. In particular, we simulate a credit spread shock resembling in nature a credit supply shock, and a shock to credit flows we interpret as a credit demand shock. To calibrate the respective shock processes, we match the impulse responses for the credit spread (credit supply shock) and the response

to credit flows (credit demand shocks) to estimated responses obtained from a structural Bayesian vector autoregression (BVAR) model in which credit demand and supply shocks are identified via sign restrictions. The modeling follows methodologies à la Gambetti and Musso (2017) that have become standard in the literature to identify and assess credit supply shocks at the aggregate level. The model is applied to the case of France in order to assess the role of credit-related shocks on business cycle fluctuations.[5] We then present simulation results on financial accelerator effects related to the NFC financing model.

4.1 Impulse responses to macro-financial shocks

To evaluate how financial and economic shocks affect the financial position of the NFC sector on the macro level, we study impulse responses of NFC financial variables to financial sector and macroeconomic shocks. In the analysis, we define several shocks with the aim to study a range of macro-financial stress scenarios, differing concerning the origin, duration, and persistence of the shock. We also consider scenarios of firm financing stress related to both prices and quantities, i.e. on lending rate spreads and credit volumes. We simulate the model over a long period, such that shocks occur once the model is at the steady state, and compare the discrepancy between the baseline and the shock scenario.

In a first scenario, the effect of a persistent increase in the benchmark risk-free interest rate is evaluated. We assume the 5-year sovereign bond yield to increase by 100bp in order to assess deteriorating financing conditions. The increase is assumed to prevail for four years, before gradually declining over the following years. Figure 12 shows the resulting shock process and impulse response functions of several NFC financial variables over the near to medium term are presented in figures 13. Due to the direct link between the cost of equity (COE) and the 5-year sovereign rate (COE equal to the 5-year sovereign rate plus an exogenous risk premium), the shock feeds directly into higher firm equity costs over the scenario horizon. Higher COE in return implies downward revaluations of NFC equity holdings, which translates into higher firm leverage due to a decline in the denominator of the leverage ratio. A worsening leverage position implies higher bank lending rates and bond yields due to rising risk premia on both types of debt, and higher external finance costs translate into a gradual decline in the stock of bank loans on NFCs' aggregate balance sheet. Finally, the decline in NFC debt in form of lower credit holdings

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[5]See Dees (2022) for more details.

is partly compensated by higher financing needs in the short term due to the recessive impact of the shock on economic activity and profit margins as a source of internal financing. Since the shock does not affect the relative cost of issuing bonds with respect to bank loans, debt securities holdings also decrease such that the bond ratio remains at its baseline value.

Figure 12: Shock on 5-year sovereign bond rate
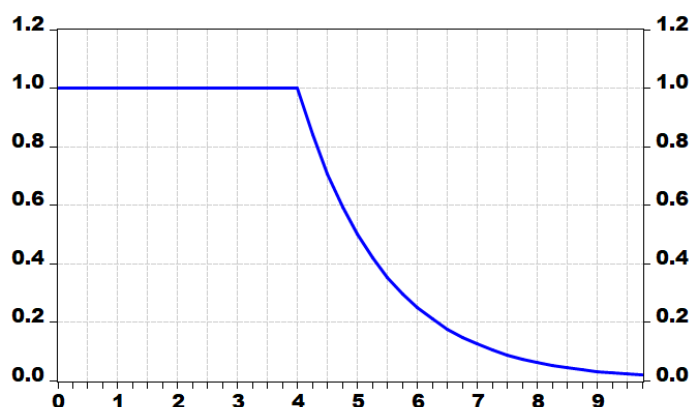
In addition to the short-to medium term developments presented in figure 13, long-term effects of the same sovereign bond yield shock are shown in figure 14. In the first five to ten years after the shock, both firm-level debt and equity holdings decline, while the decline of the latter is driven by the revaluation channel. The relative stronger decline in equity holdings implies a surge in leverage over this horizon. However, the fading of the revaluation channel implies a reversal of the denominator effect, such that the leverage ratio declines rapidly thereafter and stabilizes at the pre-shock level roughly 25 years after the shock occurred.

In a second scenario, we study the effects of an adverse shock to the firm external finance premium. To do so, we simulate a 100bp transitory shock on the spread of the long-term bank lending rate (BLR) over the 5-year sovereign bond yield, while the corporate bond yield spread and the COE are not directly affected by the shock.[6] The spread shock is calibrated such that it matches as closely as possible the impulse response to a credit supply shock, obtained from the empirical BVAR model, while the credit flow

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[6]We also simulated an external finance premium shock increasing both bank lending rate and corporate bond yield spreads contemporaneously on impact. While the resulting responses for leverage, equity and investment are comparable, we decided in favor of a shock to the BLR only to study whether the model is able to account for substitution effects between bank loans and bonds.

Figure 13: Impulse responses to adverse 5-year sovereign bond rate shock
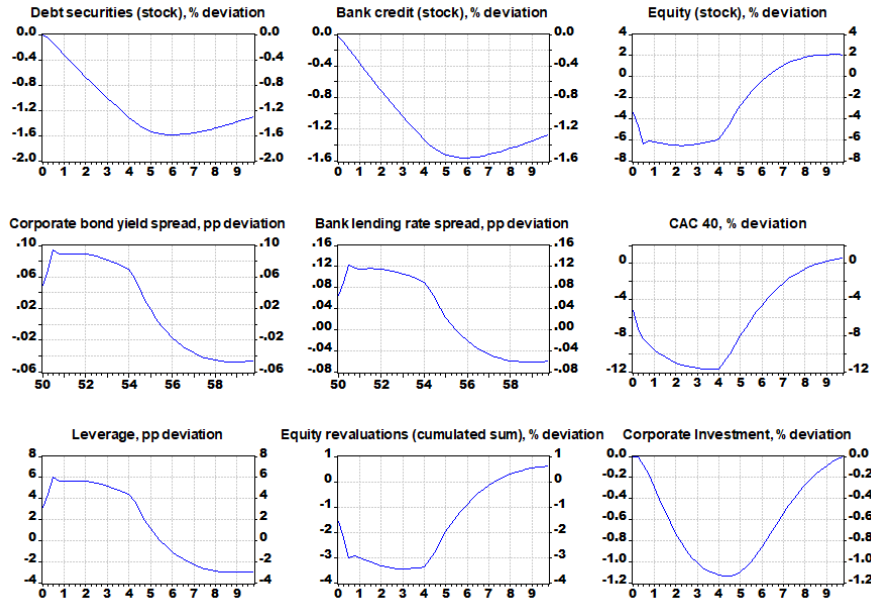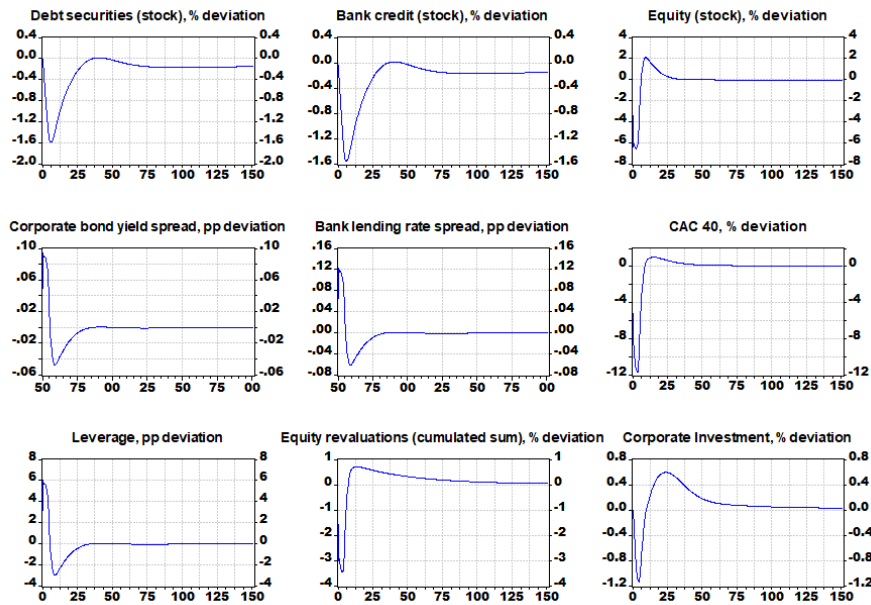

Figure 14: Long-term impulse responses to adverse 5-year sovereign bond rate shock

and GDP responses are solely determined by the dynamics of the NFC financing model. As shown in figure 15, a positive spread shock implies that bank credit drops significantly amid higher loan costs, while firms partly substitute lower credit holdings with bonds in

the short run, implying an initial increase in the bond ratio (not shown). Over all, the demand for credit financing declines and firms compensate both lower bank lending *and* bond holdings by higher equity issuance over time, such that leverage declines due to both a decline in the numerator and an increase in the denominator. Finally, the drop in external finance is more pronounced than the reduction on the asset side of the consolidated NFC balance sheet, due to a portfolio rebalancing towards equity holdings driven by a relatively lower COE.

Figure 15: Impulse responses to adverse 100bp loan rate spread shock
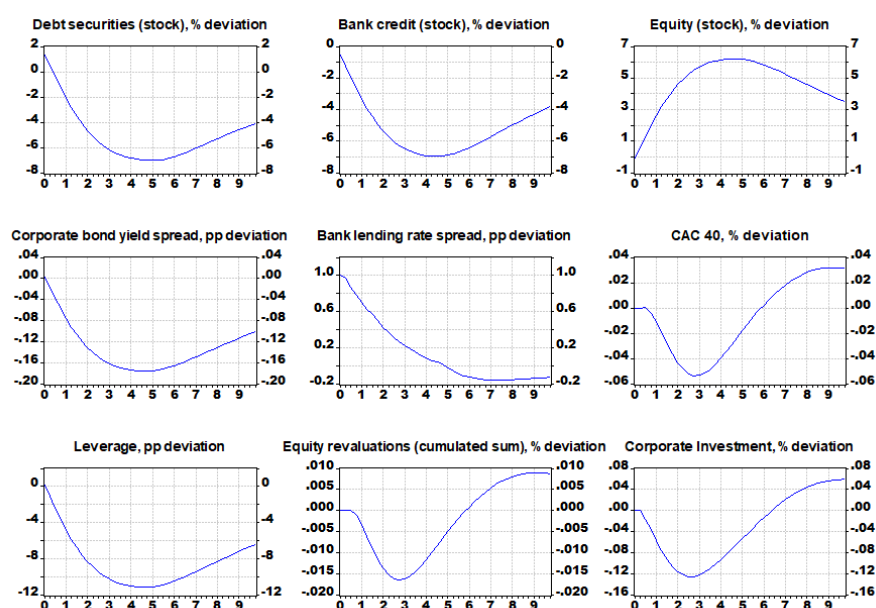
Due to the transitory but persistent nature of the shock, the passive side of the consolidated NFC balance sheet returns to its long-run decomposition after approximately 25 years (figure 16).

Following adverse scenarios related to external financing costs, we also study a stress scenario where the quantity of lending increases unexpectedly. We therefore simulate an unexpected and temporary increase in the flow of corporate credit by one GDP point. Similar to the spread shock above, we rely on the impulse responses for credit flows obtained from the BVAR to calibrate the dynamics of the credit demand shock. We do so by matching the credit flow impulse response in our NFC financing model to the empirical impulse response of credit flows to a credit demand shock obtained with the BVAR. Thus, the credit flow shock in our model resembles closely a credit demand shock estimated in the BVAR. This seems justified given that our credit flow equation 3.1

Figure 16: Long-term impulse responses to adverse 100bp loan rate spread shock
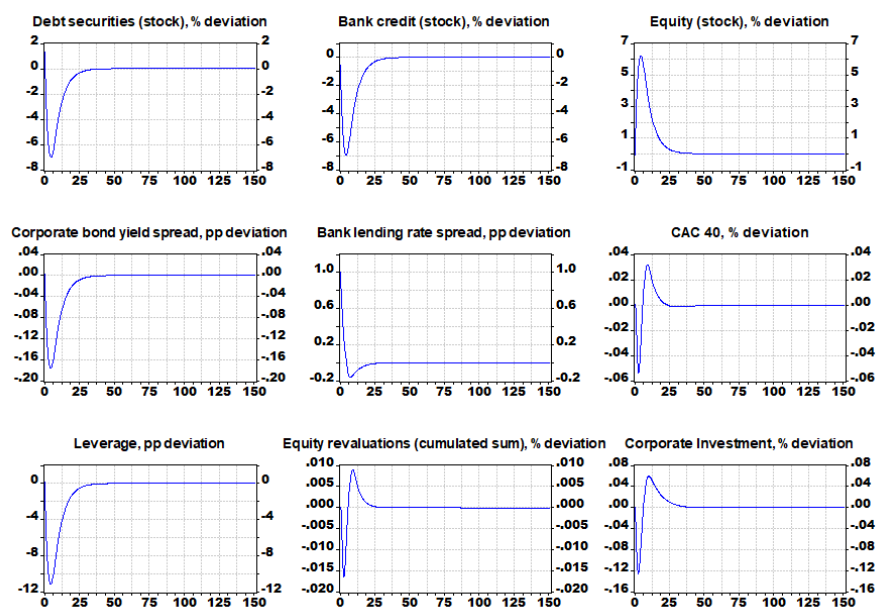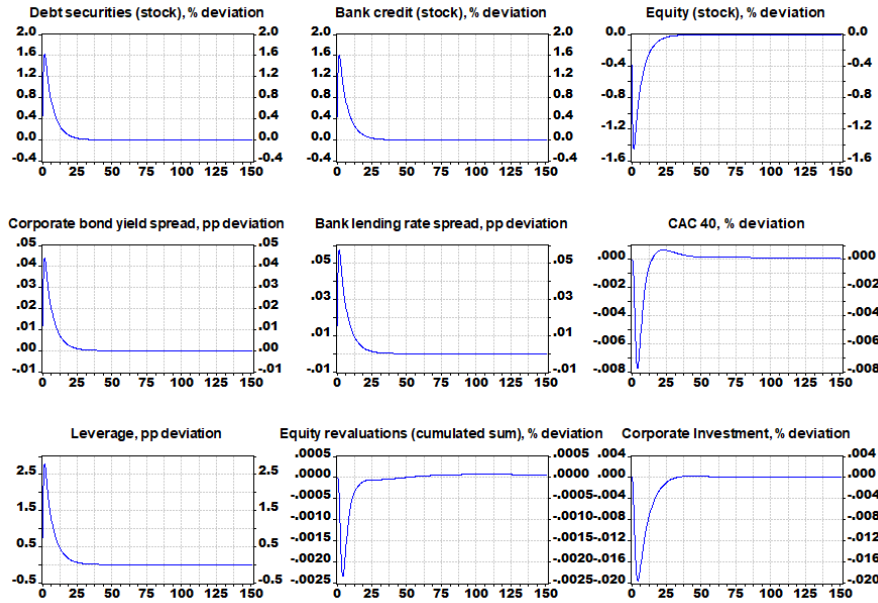

resembles in nature a credit demand equation. Figures 17 and 18 show impulse responses to an unexpected increase in firm borrowing over different horizons.

Figure 17: Impulse responses to a credit demand shock
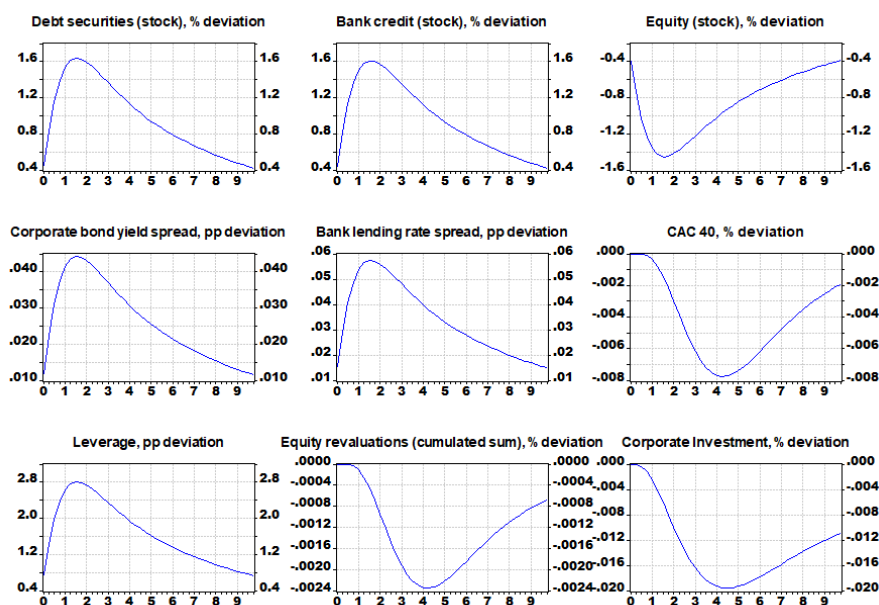
An increase in credit implies an increase in corporate leverage, resulting in higher

Figure 18: Long-term impulse responses to a credit demand shock

financing costs for both credit and debt securities. In this respect, the credit shock resembles a credit demand shock, as lending costs rise contemporaneously. As both spreads rise, the bond ratio is not significantly affected by the shock (equation 3.2), yielding a contemporaneous increase in debt securities as well. Thus, an expansionary credit shock implies an increase in both components of external financing in the model, as both credit and bond spreads depend equally on overall firm leverage (equations 3.1 and 3.2). The increase in leverage is aggravated by a contemporaneous decline in firm equity, reflecting some rebalancing on the liability side of the consolidated firm balance sheet in response to an increase in external financing. Finally, an exogenous increase in credit negatively affects firm activity: corporate investment declines due to adverse effects from increasing leverage and financing costs. In the long run, this positive credit shock completely vanishes due to the dampening effect of a higher corporate leverage on debt dynamics.

Finally, we assess the transmission of a macroeconomic shock on NFC financial positions, to gauge the effect of changes in real economic conditions on NFC finances. To do so, we simulate an exogenous decline in corporate investment by one percent in the first period of simulation, reflecting a negative macroeconomic surprise in a given quarter.

As shown in figures 19 and 20, the negative surprise on firm activity is associated with a tightening of financial conditions, as lower firm earnings translate into lower stock

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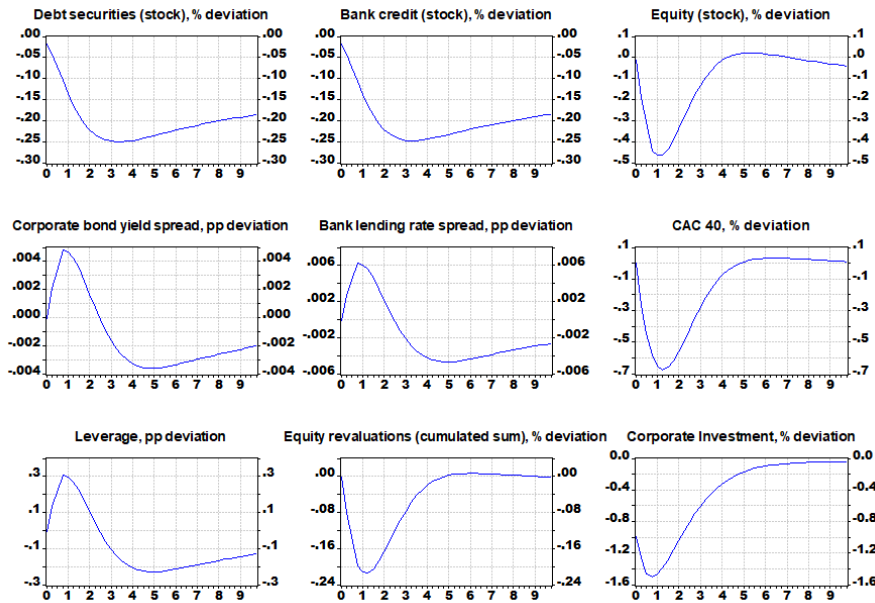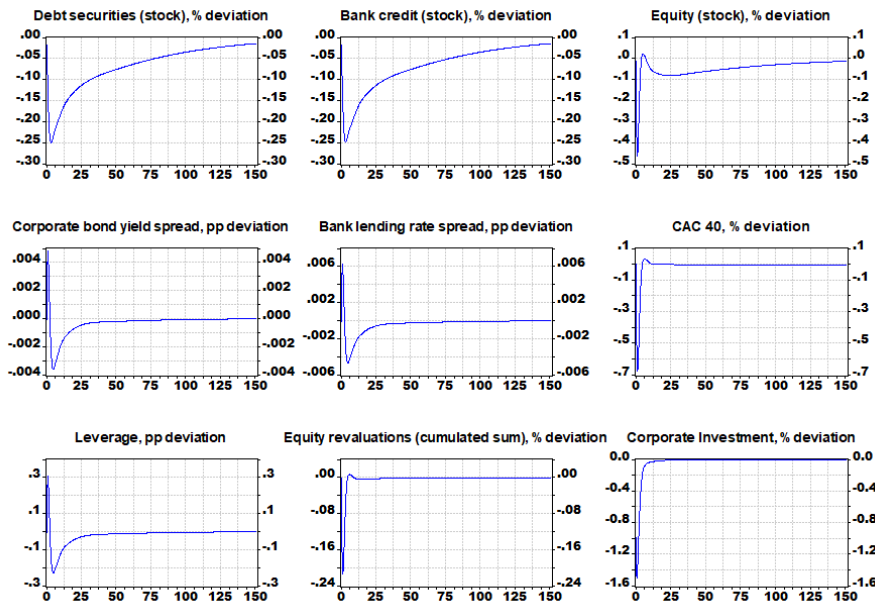Figure 19: Impulse responses to 1 percent decline in corporate investment

Figure 20: Long-term impulse responses to 1 percent decline in corporate investment

prices and equity revaluations, resulting in a higher leverage ratio in the short run. Thus both credit and bond spreads increase, which further accelerates the decline in investment in the quarters following the shock. In response to deteriorating financing conditions, the

shrinking of the asset side of the aggregate firm sector balance sheet is accommodated by a decline in all liability-side components in the medium term following an initial increase to cover higher financing expenses. In return, an adverse investment shock is largely neutral on the firm leverage ratio in the medium term, with the initial increase in leverage being followed by a period of low leverage.

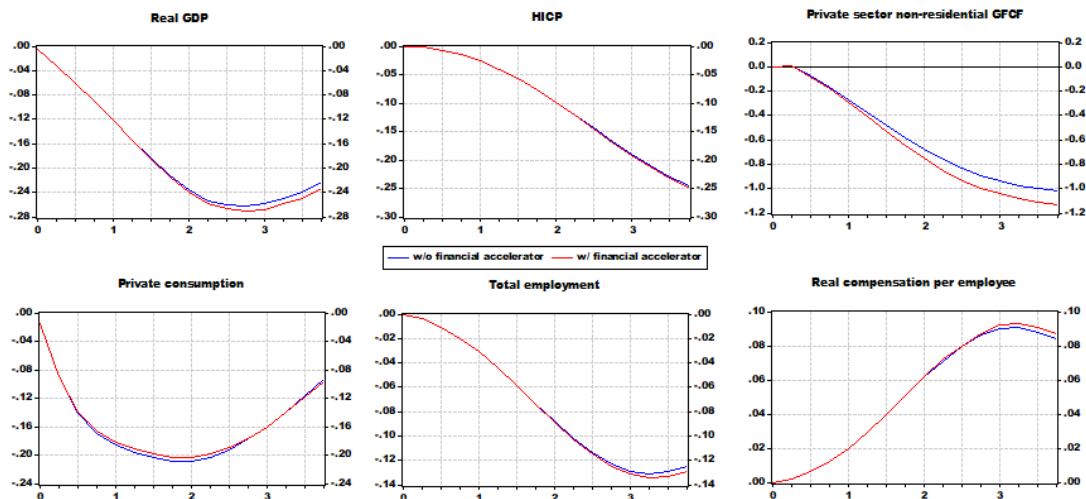## 4.2   The financial accelerator in the NFC financing model

In a second analysis, we assess the magnitude of the financial accelerator mechanism that the NFC financing model adds to the FR-BDF model. To do so, we compare the impulse responses to a permanent 5-year sovereign yield shock in the FR-BDF model excluding the NFC financing block with responses from the full FR-BDF model augmented by the NFC financing block. We therefore study the implications from introducing a financial accelerator mechanism to the model in the context of tightening financing conditions for firms induced by an exogenous steepening of the yield curve. Such a steepening may be caused by global financial shocks, or by a tightening of unconventional monetary policy measures – such as for instance a reduction of long-term government bond purchases or forward guidance prescribing a tighter policy stance in the future – that affect the long end of the yield curve. Given the current path of monetary policy normalization in the euro area, we find the respective scenario particularly appealing.[7]

Figure 21 indicates that while including the NFC financing block in FR-BDF reinforces the financial accelerator, quantitative differences are overall benign with respect to differences in real GDP. However, for corporate investment, accelerator effects are non-negligible: An adverse interest rate shock implies a lower path of firm investment in the augmented FR-BDF, with the difference amounting to -0.1 percent in cumulative terms, i.e. an IRF that is about 9% below the non-accelerator IRF by the end of the simulation horizon.

In the model, as indicated in figure 21, an exogenous shock to the 5-year sovereign rate increases COE. In return, the CAC40 and equity revaluations decline, increasing again firm leverage via the denominator channel. In return, higher firm leverage induces a widening of the bank loan rate spread and the weighted average capital cost (WACC),

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[7]We also conducted the financial accelerator exercise by studying a shock to the short-term rate, reflecting an upward shift to the yield curve. However, as changes to short-term interest rates in the FR-BDF model affect the broader macro economy only indirectly through their effect on long-term rates and their impact on agents' expectations, they do not impact directly corporate financing costs. Thus quantitative effects of a short-term rate shock on firms' financing conditions and investment are small.

Figure 21: Impulse responses to a 100bp 5-year sovereign bond rate shock with and without financial accelerator

limiting the scope for firm investment activity. In the FR-BDF model excluding the NFC financing block, the decline in equity values does not trigger an increase in firm leverage and a widening of bank loan rate spreads, implying no accelerator effect.

5 Conclusion

In this paper, we develop a model for the French NFC sector to study corporate financing choices and macro-financial linkages. From a macroeconomic perspective, an adequate representation of the corporate funding mix is important for forecasters, as aggregate financial variables such as corporate indebtedness, its separation into bank credit and bond financing, interest rate spreads, or equity prices can affect macroeconomic conditions.

To this end, we augment the Banque de France's semi-structural macroeconomic model (FR-BDF), its main model for macroeconomic policy and projection exercises, with our block for NFC finances. This block incorporates a financial accelerator mechanism working through feedback effects between corporate leverage and borrowing rate spreads. It also allows for an explicit determination of the corporate funding decision between bank loans, securities and equity, an important feature to study the evolution and sustainability of the financial situation of firms. We estimate the core of the NFC block with data for France and find a small but non-negligible financial accelerator effect affecting firms' financial situation and ultimately investment activity.

Moreover, we employ the model to simulate the response of corporate funding mix and investment to a wide range of macro-financial stress and macroprudential policy scenarios. Overall, we find a dampening effect of an exogenous increase in bank credit and leverage on economic activity, with a particular role for firms' assets valuation on their financing conditions. Beyond forecasting, the augmented FR-BDF model can therefore contribute to the evaluation of risks related to corporate indebtedness and to financial stability analyses.

Our work could still be extended along several dimensions. First, the model does not include any direct impact of credit supply and/or debt leverage on corporate investment; in the current version of the model, these channels play indirectly through the impact on corporate debt spreads. We might reconsider this by testing for alternative specifications for the FR-BDF investment equation. Second, the focus of our model is on firm liabilities: more effort might be useful for a better understanding of asset accumulation in corporate balance sheet, i.e. the accumulation of cash and equity holdings. Third, further work may be required on the macro-financial determinants of debt security financing. Last but not least, since we find a rather modest financial accelerator in "normal" times, one could explore non-linearities in periods of financial stress.

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6 Appendix

In this appendix, we study the effects of an adverse shock to the firm external finance premium. To do so, we simulate a 100bp transitory shock on both the spread of the long-term bank lending rate and the corporate bond yield over the 5-year sovereign bond yield, while the COE is not affected. We simulate a temporary one-quarter persistent spread shock that is assumed to fade out gradually over the following three years. As shown in figure 22, a positive spread shock implies that bank credit and bond holdings drop significantly amid higher credit costs. The drop in external finance is more pronounced than the reduction on the asset side of the consolidated NFC balance sheet, due to a portfolio rebalancing towards equity holdings driven by a relatively lower COE. Due to the transitory but persistent nature of the shock, the passive side of the consolidated NFC balance sheet returns to its long-run decomposition after approximately 25 years (figure 23).

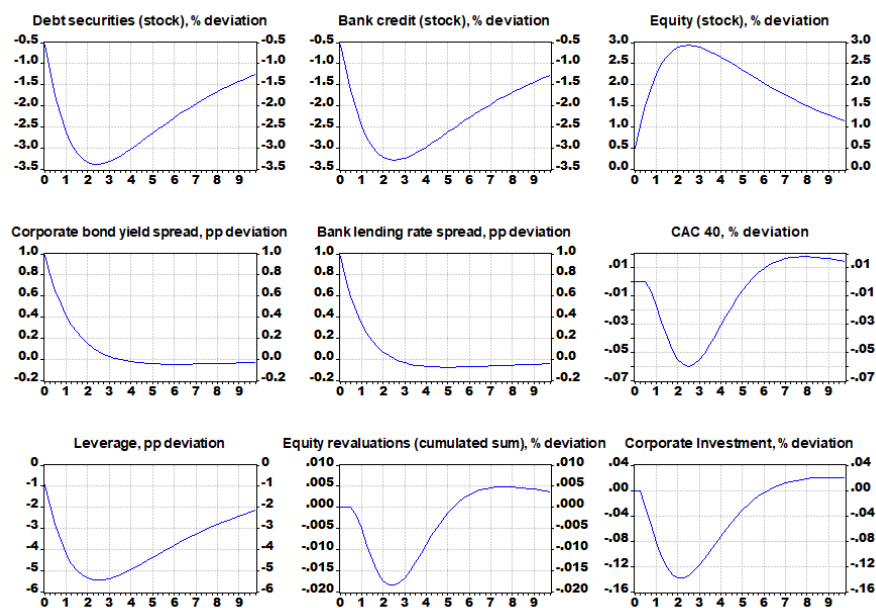Figure 22: Impulse responses to adverse 100bp loan rate and bond yield shock

Figure 23: Long-term impulse responses to adverse 100bp loan rate and bond yield shock