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Corporate debt structure and monetary policy transmission: a general equilibrium approach

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Abstract

We analyse how corporate debt structure can shape the transmission of monetary policy in a general equilibrium model. We endogenise firms' choice between bond and loan financing in a dynamic setting, building on the analytical framework of the financial accelerator and show that the corporate structure of firms is not irrelevant. We assume that banks have an informational advantage over other market participants in evaluating firms' projects. This results in a lower cost of bank finance compared to market finance in a steady state, given institutional factors and market size. Over time, shocks to the cost of finance or liquidity shocks feed back into the dynamics of firms' net worth, investment and output. In our framework, monetary policy can have asymmetric effects. On one hand, higher banks' refinancing costs due to more stringent conventional monetary policies have a greater impact on firms that cannot easily substitute loans for bonds. Firms with easier access to the bond market have a competitive advantage over firms that can only rely on bank financing. On the other hand, shocks that increase the liquidity in the bond markets, such as unconventional monetary policies, benefit firms with a more diversified corporate debt structure. From this perspective, the development of bond markets can have important macroeconomic implications for building resilience.

Keywords: Corporate debt structure, Investment, Monetary policy transmission
JEL classification: E22, E43, E44, E52

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1 Introduction

The global financial crisis has fostered the view that banks and markets have different abilities to absorb shocks due to their unique operational mechanisms (Bats and Houben (2020). While markets function as platforms, banks assume risks on their balance sheets and are vulnerable to economic upturns and downturns that determine asset-liability mismatches (Langfield and Pagano (2015)). Given their high leverage and interconnection, they can amplify the propagation of shocks to the real economy when a deleveraging process is in place (Badarau and Levieuge (2011)). At the same time, banks are essential for the functioning of the financial system, being non-substitutable in the provision of specific financial services and representing the only source of financing for small businesses that lack access to markets; thus, they are subject to stringent regulation and supervision to reduce the risk of systemic instability. When balance-sheet effects raise firms' external finance premium (Bernanke, Gertler, and Gilchrist (1999), BGG hereinafter), markets can act as a "spare tyre" and attenuate the negative outcomes in the adjustment to equilibrium (Kashyap, Stein, and Wilcox (1993); Bats and Houben (2020)).

In the euro area (EA), post-crisis dynamics have accelerated the development of capital markets, challenging the traditional dominance of bank financing. Despite this global trend, heterogeneities between European countries persist. The ongoing fragmentation poses concerns for economies' long-run growth and their macroeconomic vulnerability to shocks (Cavallaro and Villani (2024)). Corporate debt structures play a crucial role in this context, as they shape the transmission of monetary policy. This question is gaining increasing attention and sparking debate among academics and policymakers, especially in recent empirical contributions. Thus, Holm-Hadulla and Thurwächter (2021), Holm-Hadulla, Musso, et al. (2022), and Alder, Coimbra, and Szczerbowicz (2023) highlight that monetary tightening conditions can impact firms' investment decisions differently, depending on the ease of access to alternative sources of finance. In other words, the financial accelerator can work in asymmetric ways, making some firms more vulnerable than others to shocks. The type of monetary policy matters, too. A rise in banks' refinancing rates, due to a shock in global financial markets or a conventional monetary policy (CMP), will impact more investment decisions of firms that cannot raise funds on the bond market. Conversely, in the case of an unconventional monetary policy (UMP), central bank bond purchases increase bond prices and reduce borrowing costs, especially benefiting the firms with easy access to market-based finance. When economies differ in financial market access, breadth, and efficiency, the asymmetric effects at the firm level are accompanied by heterogeneous effects at the country level, which can result in heterogeneous macroeconomic vulnerabilities to idiosyncratic shocks. If the empirical proofs seem clear in the literature, to the best of our knowledge, there is no theoretical contribution to explain these issues.

Against this backdrop, we develop a model that endogenises the loan-bond choice of firms in a dynamic setting, extending the BGG framework. Firms raise funds through loans from banks, as in BGG, and by issuing securities purchased by households on bond markets. These two financing channels are imperfect substitutes, and the corporate financial structure is shaped by both habits and structural features of financial markets. We assume that financial frictions differ across credit markets and bond markets: due to economies of scale and comparative advantage (Diamond (1984)), banks have an information advantage and trade-off relatively lower interest rates on loans in exchange for long-term relationships with firms; households, on the other side, face larger transaction costs (e.g. intermediation fees, liquidation costs) than banks, and thus require a higher premium to participate in the investment projects of firms.[1] The loan rate charged by the bank and the cost of bonds are endogenous, jointly determined by the firm's maximisation problem, given the participation constraint of banks and households and the market equilibrium condition for bonds and loans. In a steady state, the two costs reflect the structural characteristics of the two markets in any given country. With deeper and more liquid bond markets, information is easier to acquire and the wedge between loan and bond risk premia is smaller. Thus, increased financial openness, enhanced protection of creditors, favourable tax regimes, and increased availability of instruments and capital markets institutions (e.g., underwriters) reduce financial frictions for households and the risk premia required to participate in firms' investment projects.

For simplicity, in our model, we focus on firms that may have access to both bank credit and market bonds (see large firms).[2] In the EA, these firms have benefited from the recent reduction in the relative cost of market finance, as reflected in the observed shift of corporate financial structures towards increased bond shares. From 2013 to 2019-2020, the ECB implemented unprecedented purchase programs that drove down the cost of market-based finance below the cost of loans. We show that a liquidity shock induced by the Central Bank bond purchases determines higher bond prices and a lower "effective" cost of market finance. The beneficial effect on firms' balance sheets leads to higher investment and output. The larger the share of bonds in firms' debt structure in a given economy, the greater the macroeconomic effect of unconventional monetary policy shocks.

We also show that the corporate debt structure matters under CMP. In response to rising interest rates, firms switch to bonds, partly compensating for the reduction in loans. The macroeconomic effects are more pronounced in economies where the share of bonds in corporate debt is higher.

Our work contributes to the literature on corporate financial structures and monetary policy by developing a model where the choice of loans and debt and the costs of the two types of finance are endogenous. The analytical framework we propose maintains the general characteristics of the BGG model, with risk premia determined by the monitoring costs, which are proportional to the size of the investment, but assume a different sensitivity of banks and households to firms' leverage, resulting from their different information availability.

There are very few theoretical studies in the literature that address this issue, such as De Fiore and Uhlig (2011) or Chang, Fernandez, and Gulan (2017), for instance. Our analytical framework differs from the one proposed by De Fiore and Uhlig (2011), where high-quality firms raise external funds on the market, which is the cheaper form of external finance, while lower-quality firms resort to bank loans, but have to pay the creditor for the information acquisition before the realisation of the shock. This information cost is the financial friction that explains the wedge between the cost of loans and bonds. In our model, corporate structures are characterised by a combination of bonds and loans.

Similarly, we differ from Chang, Fernandez, and Gulan (2017), who model a dynamic setting where firms either access direct finance, if they have enough equity, or apply for a

[1] In the EA, the lower availability of public information on corporate riskiness and firms' preference for relationship finance are the basis of the lower cost of bank finance than market finance, while the opposite holds for US firms (De Fiore and Uhlig (2011)).

[2] The consideration of economies where small and large firms coexist and small firms are bank dependent, is the next natural step in understanding the transmission of ECB monetary policy in the euro area.

loan if their equity is below a threshold. As in BGG and in our framework, the relationship between banks and firms is characterised by moral hazard, whereby monitoring costs generate a wedge between the risk-free interest rate and the loan rate required by banks to participate in firms' investment projects. A decline in global interest rates increases the demand for capital, while simultaneously increasing the required return on bank equity due to its relative scarcity. This dynamics leads to a rise in the cost of loans, whereas bond financing remains unaffected. Differently from their model, in our analytical setting, all (large) firms can choose between loans and bonds, so the rise in the cost of loans determines a shift towards more market finance, i.e., the "spare-tyre", which attenuates the negative balance-sheet effects.

A further contribution of our work is the analysis of the implications of corporate financial structures for the asymmetries in the monetary policy transmission, an issue which is not addressed in the above-mentioned theoretical contributions.

The results from our simulations are very close to those of Holm-Hadulla and Thurwächter (2021), who use Jorda (2005)'s local projection method to analyse how key macroeconomic aggregates are impacted by the interaction of monetary policy with the financing structure of firms. In their analysis, the overall impact of a CMP tightening is mitigated in economies with a higher share of bond financing; conversely, the real effects of shocks to long-term interest rates are amplified when bond financing represents a larger portion of corporate debt. Our paper is also closely related to Alder, Coimbra, and Szczerbowicz (2023), who use French firms' data and show that corporate debt structure plays a significant role in ECB monetary policy transmission. The transmission of CMP shocks is stronger for firms with a higher share of bank debt. Conversely, contractionary liquidity shocks (i.e. a UMP shock) lower investment more for firms with higher bond shares in total debt.

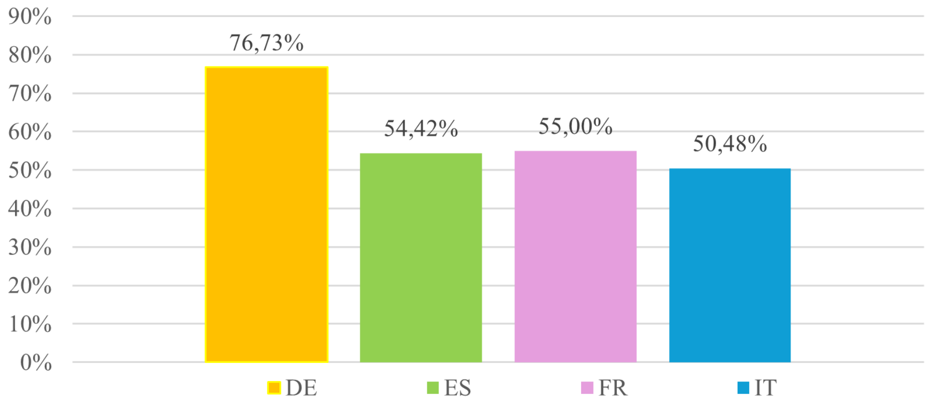
The paper is organised as follows. In Section 2, we present some stylised facts based on European data, in Section 3, we outline the model and in Section 4, we show the calibration. In Section 5, we present the results of our simulated conventional and unconventional monetary policy shocks, and in Section 6, we draw conclusions and final remarks.

2 Stylised facts in brief

The literature underscores recent upward trends in the share of bonds in external finance for EA non-financial companies. The empirical evidence for the EA shows that large firms, less opaque, highly leveraged and with a long-standing lending relationship with several banks, are the firms that typically raise directly market finance (Holm-Hadulla, Musso, et al. (2022)). These firms are also characterised by lower bank financing costs than SMEs.

We thus focus on the class of large firms, corresponding to corporations with more than 249 employees, and restrict our analysis to the four main EA economies, namely Germany, France, Italy and Spain. Throughout 2000-2023, on average, large firms contribute to about 50-55 per cent of total Gross Value Added (GVA) in France, Italy and Spain and to over 75 per cent in Germany, as shown in Figure 1.

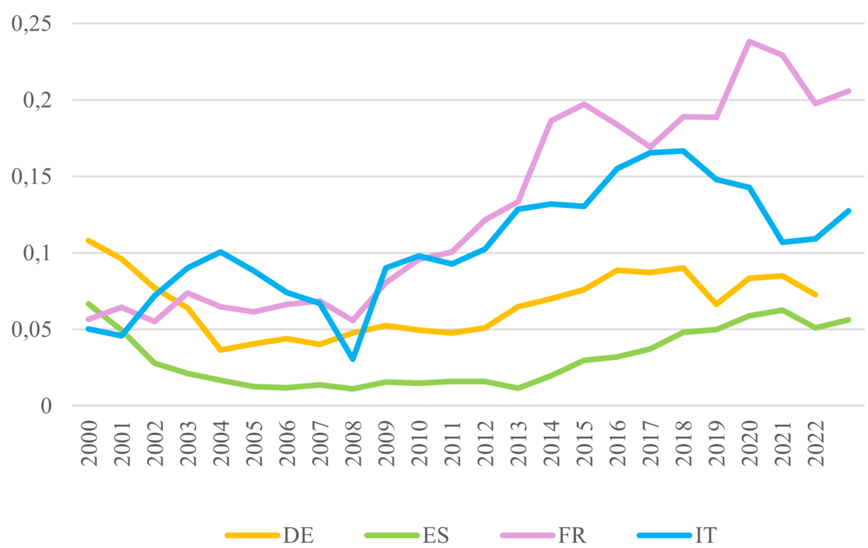
Figure 1. Large firms' share of GVA over total firms' GVA. Averages over 2000-2023.



Source: Bach Dataset, own calculations

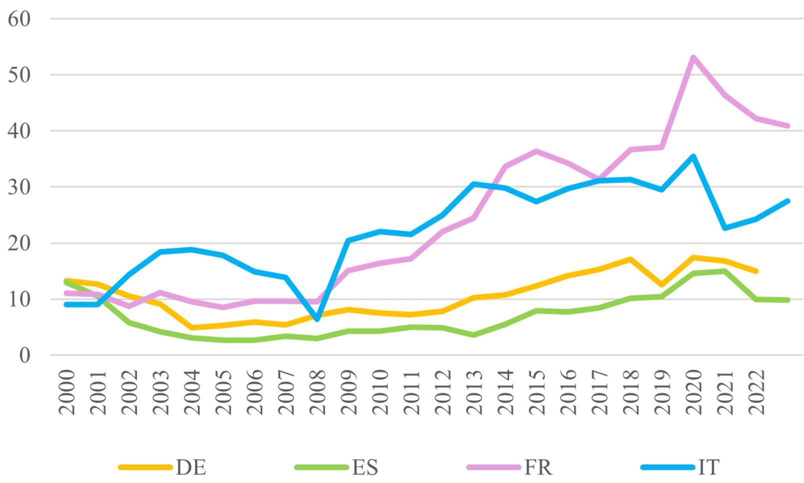
In Figure 2 and Figure 3, we show the evolution of the bonds-to-loans ratio and the bonds-to-GVA ratio for the four economies, throughout 2000-2023.

Figure 2. Bonds-to-Loans Ratio, France, Germany, Italy and Spain, 2000-2023



Source: Bach Dataset, own calculations

Figure 3. Bonds-to-GVA Ratio, France, Germany, Italy and Spain, 2000-2023



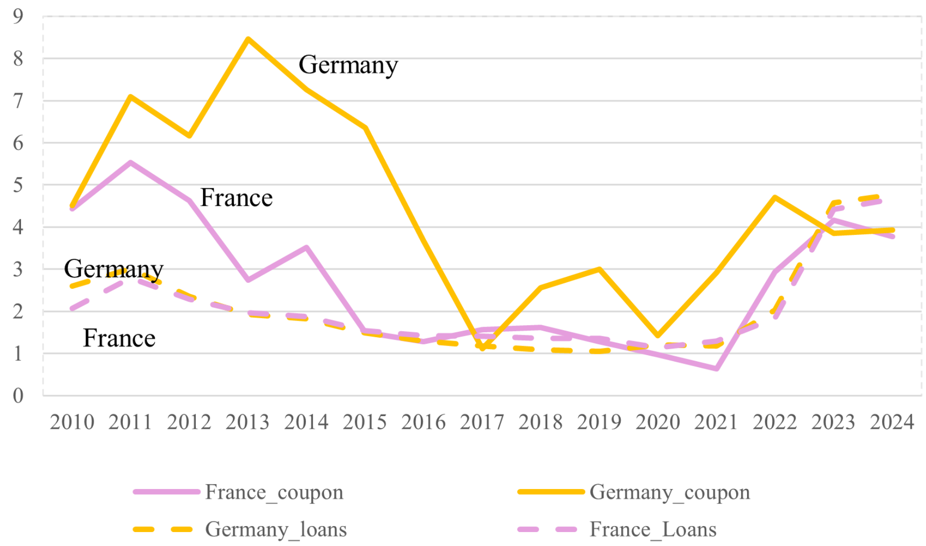
Source: Bach Dataset, own calculations

We can remark a global trend toward an increase in market finance, but a large heterogeneity among countries, with the bonds-to-GVA ratio at 40 per cent in France compared to less than 15 per cent in Germany or Spain.

As to the cost of finance, in Figure 4 we compare the cost of bonds and loans for French and German large non-financial corporations (throughout 2010-2024). For bonds, we take the average coupon rate of bonds with a fixed coupon, and for loans, the annualised interest rates on loans of over 1 million euros (new business).

The graph shows that the cost of bonds is higher in Germany than in France throughout the period, while the conditions on the credit markets are quite similar across the two economies. In France, the cost of raising market finance issuing bonds declined almost continuously from approximately 5.5 per cent in 2011 to around 0.6 per cent in 2021, when it fell below the cost of bank finance. This trend was inverted in the more recent phase of monetary tightening, when the cost of bonds began to rise again, reaching about 4.5 per cent . In Germany, the cost of market debt reached a peak, at about 8 per cent, in 2013 and then fell steadily to about 1 per cent in 2017. A new rise followed, which became more pronounced after 2020, reaching 5 per cent in 2022. The graph shows similar patterns for the cost of loans in the two countries.

Figure 4. The cost of borrowing for Germany and France



Note: The cost of borrowing is defined as the average coupon rate for fixed-coupon bonds, and the annualised rate on loans of over 1 million euros for loans (new business).

Source: Datastream, ECB Database

From these slylized facts on large firms' borrowing, we retain four main features for the rest of our analysis: 1) in the EA the cost of market finance (debt) is globally higher than the cost of bank credit; 2) there are large asymmetries in the deepness of corporate bond markets across European countries; 3) the spread between the cost of market finance and the cost of bank credit is inversely correlated with the degree of market finance deepness; 3) the cost of market (debt) finance can temporarily go below the cost of bank credit, namely in countries with more developed corporate bond markets.

We thus propose, in what follows, a simple theoretical general equilibrium model to explain how the corporate debt structure determines firms' reaction to shocks and impacts the transmission of CMPs and UMPs. We also seek to explain a temporary situation where corporate bonds become cheaper than bank credit for large firms having access to both types of finance.

3 The Model

Our model adopts the approach proposed by BGG as its foundation. However, it differs from their model by introducing an additional financing option for firms: while bank loans remain a source of external funding, we also incorporate corporate bonds as an alternative one. This enhancement provides firms with greater flexibility to secure funding in their financing decisions. Moreover, this innovation in the DSGE model also allows us to consider the corporate debt structure within a macroeconomic framework, facilitating an assessment of its importance for firms' resilience to shocks and the transmission of CMPs and UMPs to macroeconomic aggregates.

Our main contribution is to model the decision-making process of large companies when choosing between market (debt) financing and bank credit, and determine the equilibrium in the corporate bond market. We begin with two dedicated subsections on the firm's financial strategy and the corporate bond market equilibrium before revisiting the rest of the model, which follows closely the structure of BGG.

3.1 *Firm's financial strategy*

Consistent with the one-period structure of the BGG framework, companies acquire capital in period t at a price Q_t, which will be used in the production process during the subsequent period K_{t+1}. The gross capital return of a representative firm for $t+1$ is $\omega_{t+1}R^K_{t+1}$. It depends on the average (aggregate) return on capital in the economy R^K_{t+1} and is affected by an idiosyncratic risk ω_{t+1} whose realization is private information.[3]

To finance investment, firms rely on their net worth (N_t) and two additional sources of debt contracted in t for the period $t+1$: bank loans (L_{t+1}) and corporate bonds (B^C_{t+1}). This leads to the following relation:

$$Q_tK_{t+1} = N_t + L_{t+1} + B^C_{t+1} \tag{1}$$

Firms' external debt is represented by $D^C_{t+1} = L_{t+1} + B^C_{t+1}$. The ratio $k^F_t = \frac{Q_tK_t+1}{N_t} = 1 + \frac{D^C_{t+1}}{N_t}$ is an expression of the financial leverage of firms defined as the external debt ratio to total assets. A higher value of k^F_t is associated with a firm's higher indebtedness and worse financial health.

Risk premia, which depend on firms' financial leverage, arise from asymmetric information problems between firms and creditors, driven by the idiosyncratic risk associated with firms' investment projects. As in BGG, they are obtained from firms' profit-maximisation programs, given the constraints imposed by banks and households for their participation to financing the investment projects:

$$Max\Pi^e_{t+1} = E_t\left[1-\Gamma(\overline{\omega}_{t+1})\right]R^K_{t+1}Q_tK_{t+1} \tag{2}$$

subject to:

$$\begin{gathered}\left[\beta_{t+1}\Gamma(\overline{\omega}_{t+1}) - b_t\mu^LG(\overline{\omega}_{t+1})\right]R^K_{t+1}Q_tK_{t+1} = R_tL_{t+1}\\ \left[(1-\beta_{t+1})\Gamma(\overline{\omega}_{t+1}) - (1-b_t)\mu^CG(\overline{\omega}_{t+1})\right]R^K_{t+1}Q_tK_{t+1} = R_tB^C_{t+1}\end{gathered}$$

In the optimization program (2), Π^e_{t+1} represents the expected profit in t for the period $t+1$. $\Gamma(\overline{\omega}_{t+1})$ gives the share of the gross return on capital used by firms to pay creditors, with a part β_{t+1} going to banks and $1-\beta_{t+1}$ going to investors in corporate bonds. $G(\overline{\omega}_{t+1})$ measures, for creditors, the probability of supporting monitoring costs if the debtor defaults (see BGG for details), b_t is the share of bank loans in total corporate debt, μ^L denotes the monitoring cost for banks and μ^C the monitoring cost for households. Both monitoring costs are proportional to firms' assets, and $\mu^L < \mu^C$ because bankers can better address asymmetric information issues than households.

The two participation constraints in the optimisation program (2) may be added to obtain one single constraint associated with the firm's external debt D^C_t as follows:

[3]Following BGG, ω_{t+1} is a random variable that follows a log-normal distribution with mean $-\sigma^2/2$ and standard deviation σ, independent and identically distributed among firms and in time, fulfilling all general conditions for the existence of a financial contract.

$$\left[\Gamma(\overline{\omega}_{t+1}) - \mu_t^D G(\overline{\omega}_{t+1})\right] R_{t+1}^K Q_t K_{t+1} = R_t D_{t+1}^C \tag{3}$$

where $\mu_t^D = b_t\mu_L + (1-b_t)\mu_C$ is the average cost of external debt contracted by the firm in period t.

Following the financial accelerator model, we solve the expected profit maximisation problem for firms (2), subject to the aggregate participation constraint imposed by creditors (3). We thus obtain the following solution for the external finance premium $S_t^D = \frac{E_t(R_{t+1}^K)}{Rt}$:

$$S_t^D = f(k_t^F) \quad with \quad \frac{\partial S_t^D}{\partial k_t^F} > 0 \tag{4}$$

External finance is costly for firms, with an average risk premium that depends positively on their financial leverage k_t^F. The greater a firm's indebtedness, the worse its financial health and the higher its default probability. Considering the expected monitoring costs in the case of a default, in line with the costly state verification procedure introduced by Townsend (1979), a higher value of k_t^F justifies a higher external finance premium S_t^D.

Noticeably, compared to the baseline BGG model, two distinct external finance premia contribute to the average risk premium (S_t^D): the one on the credit market(S_t^L) and the one on the corporate bond market (S_t^C). Since banks can obtain information about firms' performance at a lower cost, the sensitivity of the required premium on bank loans to a firm's financial leverage is lower than that in the corporate bond market.

$$S_t^L = \frac{E_t(R_{t+1}^L)}{R_t} = g^L(k_t^F) \quad and \quad S_t^C = \frac{E_t(R_{t+1}^C)}{R_t} = g^C(k_t^F), \tag{5}$$

with S_t^C exhibiting higher sensitivity to financial leverage than S_t^L $\left(i.e., \frac{\partial S_t^C}{\partial k_t^F} > \frac{\partial S_t^L}{\partial k_t^F}\right)$. $E_t(R_{t+1}^L)$ denotes the expected gross return on bank loans, while $E_t(R_{t+1}^C)$ denotes the expected gross return on corporate bonds. Looking at the two participation constraints defined in (2), we recognise, in the second term of the left-hand side, the expected monitoring costs, which justify the risk premia required by creditors. Considering the expected monitoring cost per unit of investment, we note the following relation between the required premium on bank loans and the required premium on the corporate bond market:

$$\frac{S_t^L}{S_t^C} = \frac{\mu_L}{\mu_C} \tag{6}$$

Firms have to choose between bank loans and corporate bonds when faced with alternative financing options. The trade-off is determined by comparing the "effective" cost of funds in each market.

The cost of one unit of bank loan is evaluated using R_t^L. The payment on the bond market for one unit of debt is R_{t+1}^C. However, the market price of a corporate bond can influence the "effective" cost of funds for firms. A corporate bond is structured as a unit-value bond, where the household pays the market price (Q_t^C) today and receives $E_t(R_{t+1}^C)$ in the next period. At the steady-state equilibrium, the market price remains at (Q_t^C) = 1, ensuring the bond is issued at fair value. However, in response to shocks that influence investors' behaviour, the market price may temporarily deviate from its steady-state value, potentially creating opportunities for firms to opt for market-based financing rather than traditional bank financing. For $Q_t^C > 1$, the "effective" cost of the market finance for firms decreases, so that:

$$E_t(R_{t+1}^{C\text{Eff}}) = \frac{E_t(R_{t+1}^C)}{Q_t^C} \tag{7}$$

Since bank loans and corporate bonds are imperfect substitutes, we can assume that total corporate debt follows a Dixit-Stiglitz aggregator:

$$D_t^C = \left[a^{\frac{1}{\theta}} L_t^{\frac{\theta-1}{\theta}} + (1-a)^{\frac{1}{\theta}} B_t^{C\,\frac{\theta-1}{\theta}} \right]^{\frac{\theta}{\theta-1}}, \tag{8}$$

where θ represents the elasticity of substitution between bank debt and market-based debt, and a reflects the domestic bias toward bank credit. This bias may stem from firms' preference for bank financing or from a regulatory and legal framework that favours bank loans over market debt.

From the firm's optimisation problem, which seeks to minimise the cost per unit of debt while considering both financing alternatives, we obtain:

$$S_t^D = \left[a\,(S_t^L)^{1-\theta} + (1-a)\,(S_t^{C\text{Eff}})^{1-\theta} \right]^{\frac{1}{1-\theta}}, \quad ^{4} \tag{9}$$

where S_t^D represents the average risk premium per unit of debt, which depends on the risk premium per unit of bank loans (S_t^L) and on the effective risk premium per unit of corporate bond investment $\left(S_t^{C\text{Eff}} = \frac{E_t[R_{t+1}^{C\text{Eff}}]}{R_t} \right)$.

The share of loans in total corporate debt (b_t) is endogenously determined by firms at each period t and depends on the relative cost of loans compared to the cost of the debt:

$$b_t = \frac{L_t}{D_t^C} = a \left(\frac{S_t^L}{S_t^D} \right)^{-\theta}, \tag{10}$$

which is derived from the following two equations:

$$L_t = a \left(\frac{S_t^L}{S_t^D} \right)^{-\theta} D_t^C \tag{11}$$

$$B_t^C = (1-a) \left(\frac{S_t^{C\text{Eff}}}{S_t^D} \right)^{-\theta} D_t^C \tag{12}$$

The lower the cost of loans in the economy, the higher the share of loans in total corporate debt. Alternatively, the share of market debt in total corporate debt, also endogenously determined, is given by:

$$1 - b_t = \frac{B_t^C}{D_t^C} = (1-a) \left(\frac{S_t^{C\text{Eff}}}{S_t^D} \right)^{-\theta} \tag{13}$$

[4] Accordingly, the average cost of debt is $R_t^D = \left[a\,(R_t^L)^{1-\theta} + (1-a)\,(R_t^{C\text{Eff}})^{1-\theta} \right]^{\frac{1}{1-\theta}}$

3.2 *Households' financial strategy*

Households' financial decisions play a crucial role in determining the availability of funds for both bank loans and the corporate bond market.

As in BGG, households supply labour to firms and, in turn, receive wages that they use for consumption or saving. We differentiate from BGG by assuming that households can choose to keep their savings in bank deposits or invest in corporate bonds issued by firms.

Households aim to maximise their intertemporal utility:

$$\max U_{\text{Intertemporal}} = E_t \sum_{s=0}^{\infty} \beta^s \left\{ \log(C_{t+s}) + \psi \frac{(H_{t+s})^{1+v}}{1+v} \right\}, \tag{14}$$

where β represents the subjective discount factor, reflecting how households value present consumption relative to future consumption. The variable C_t denotes consumption at time t. The coefficient ψ acts as a labour adjustment factor, influencing how labour supply responds to changes in wages. Lastly, v corresponds to the inverse Frisch elasticity, which measures the elasticity of labour supply to wage variations.

The budgetary constraint of households for the period t, written in real terms, is the following:

$$C_t + \frac{B^C_{t+1} Q^C_t}{P_t} + \frac{D_{t+1}}{P_t} = W_t H_t + \frac{[1 - F(\overline{w})] R^C_t B^C_t}{P_t} + \frac{R_t D_t}{P_t} + P_{r_t}, \tag{15}$$

where B^C_{t+1} represents the corporate bonds that households invest in, t, at the price Q^C_t. The variable D_{t+1} refers to the bank deposits made at period t and remunerated at the risk-free rate. W_t is the real wage earned by households for their labour and H_t represents the total labour supplied by households in t. The general price level, denoted by P_t, is used to convert nominal variables into real terms. $[(1 - F(\overline{w})] R^C_t B^C_t$ represents the financial revenues from the investment in corporate bonds in the previous period. $F(\overline{w}_t)$ denotes the default rate or default probability for a representative firm during the period. All interest rates are announced at the beginning of each period, so they are decided in *t-1* when applied to period t. P_{r_t} are the profits from retailers accruing to households, with no significant impact on the model dynamics given the monopolistic competition among retailers.

From the households' dynamic optimisation, the optimal portfolio allocation ensures indifference between holding bank deposits and corporate bonds, eliminating any potential arbitrage opportunities between the two assets:

$$R_{t+1} = E_t \left[\frac{[1 - F(\overline{w})] R^C_{t+1}}{Q^C_t} \right] \tag{16}$$

where the right-hand side represents the expected gross return from holding corporate bonds, given the possibility that some issuers will default. Households' expected effective return on corporate bonds, call it the gross yield, is also influenced by the dynamics of the market price of bonds (Q^C_t). When $Q^C_t > 1$, the gross yield to maturity decreases, leading to a reduction in the risk premium (i.e., the spread between the corporate bond yield and the risk-free rate). Firms benefit from this scenario because their financing costs decrease; on the other side, investors find this less appealing due to the lower return on their investment. Conversely, when $Q^C_t < 1$, the gross yield to maturity increases, thus resulting in a higher risk premium.

The equilibrium price of bonds Q_t^C at which households' demand for corporate debt is equal to firms' supply, is obtained from households' arbitrage condition stated in (16) after substitution of (5), which results from firms' profit maximisation problem (2):

$$Q_t^C = E_t\left[[1 - F(\overline{w})]S_{t+1}^C\right] \tag{17}$$

3.3 *The rest of the model*

The rest of the model is similar to BGG. Firms maximise their real gross operating income over time, subject to capital accumulation constraints and investment adjustment costs. They produce wholesale goods and sell them to retailers who transform wholesale goods into final differentiated goods available for consumption or investment. Retailers thus introduce Calvo (1983) price rigidity, summarised in the following new-Keynesian Phillips curve:

$$\pi_t = \beta E_t(\pi_{t+1}) + \frac{(1-\varphi)(1-\varphi\beta)}{\varphi}\rho_t \tag{18}$$

The variable π_t represents the inflation rate at time t. The parameters β and φ correspond to the discount factor, the probability that firms do not adjust their prices, and ρ_t is the price margin set by retailers, respectively.

The central bank can implement two types of monetary interventions: a CMP or a UMP.

In the conventional approach, as in BGG, the short-term nominal interest rate r_t^n is the policy instrument. The central bank adjusts it in response to the expected inflation rate and the lagged interest rate:

$$r_t^n = \bar{r^n} + \rho_r r_{t-1}^n + \phi_\pi(\pi_{t+1} - \bar{\pi}) + \varepsilon_t^{cmp} \tag{19}$$

where the nominal interest rates $r_t^n = R_t E_t[\Pi_{t+1}] - 1$, in line with the Fisher equation. $\bar{r^n}$ and $\bar{\pi}$ are the natural nominal interest rate and the inflation target of the central bank, respectively. They are both supposed to equal their respective steady-state solution.[5]

In contrast, the unconventional policy involves direct market interventions. Specifically, the central bank injects liquidity into the corporate bond market by purchasing bonds. Thus, the market price of corporate bonds temporarily goes up, transforming equation (17) into the log-linearised form:

$$q_t^c = E_t[r_{t+1}^c] - r_t + u_t^{liq}, \quad with \quad u_t = \rho_{liq}u_{t-1} + \varepsilon_t^{liq} \tag{20}$$

This exogenous shock raises the price of bonds Q_t^C, increasing the demand for corporate bonds and decreasing the effective cost of funds for firms. We introduce an exogenous shock to liquidity, u_t^{liq}, which is persistent over time. It takes an autoregressive form, with ρ_{liq} the autoregressive coefficient and ε_t^{liq} an i.i.d. process that follows a normal distribution with a standard deviation of 0.1 and a mean of 0.

[5] Using previous notations, $R_t = r_t + 1$ and $\Pi_t = \pi_t + 1$.

3.4 *Market clearing conditions*

To achieve equilibrium in the model, the clearing condition in all markets must be fulfilled.

As seen previously, the corporate bond market equilibrium is implicitly established at the price at which households' demand consistent with their optimisation program is equal to firms' supply derived from their profit maximisation program.

The equilibrium of the bank credit market is also implicit to the determination of the external finance premium (S_t^L), as in BGG.

The labour market is in equilibrium when labour demand from firms matches the labour supply from households, exactly like in BGG.

Finally, the goods market equilibrium is expressed as:

$$Y_t = C_t + I_t + C_t^E + \text{Monitoring costs} \tag{21}$$

with expected negligible values for the monitoring costs and C_t^E the consumption of entrepreneurs who leave the market at the period t, like in BGG.

4 Calibration of the parameters

This section presents the calibration strategy for the parameters employed in the DSGE model, detailing the chosen parameter values for the specific part of the model and reminding, in the calibration table below, of the other parameters which are in line with the BGG model.

Because of the specific ability of banks to treat asymmetric information problems, their monitoring costs are lower. Thus, the required premium on bank loans at the steady state ($s^L = 0.005$) is lower than the required premium on the corporate bond market ($s^C = 0.0217$). The monitoring costs parameter for banks μ^L, corresponding to the fraction of realised payoffs lost in bankruptcy, is 0.12, as in BGG, lower than 0.122 for households. In a steady state, the market price of corporate bonds is equal to unity. This corresponds in equation 16 to an annualised business failure rate of 2%, close to the BGG baseline calibration. We consider two scenarios each time for the transmission of monetary policy shocks: 1) with a bank-dependent corporate financial structure ($a = 0.97$) and 2) with a more market-oriented corporate financial structure ($a = 0.4$).

The rest of the parameters are taken from BGG and presented in the table hereafter:

Parameter	Value	Description
C/Y	0.61	Share of households consumption in GDP
Ce/Y	0.01	Share of firms consumption in GDP
I/Y	0.18	Share of investment in GDP
G/Y	0.20	Share of public expenditure in GDP
K/N	2.00	Capital to net worth ratio for firms
X	1.10	Mark-up of the retail goods over wholesale goods
β	0.99	Discount factor
R	$1/\beta$	Gross steady-state interest rate
α	0.35	Capital share in production
v	3.00	Elasticity of substitution of labour
δ	0.025	Depreciation rate of capital
ω	0.99	Share of households' labour in total labour
ρ_A	0.999	Persistence of productivity shock
ψ	0.25	Adjustment cost parameter
R_k	$R + 0.02$	Return on capital (200 b.p. spread)
γ	$1 - 0.0272$	Share of firms staying on the market
θ	0.75	Calvo parameter (price stickiness)
ρ_r	0.90	Autoregressive parameter
ϕ_π	0.11	Investment adjustment cost
κ	$\frac{(1-\theta)}{\theta}(1-\theta\beta)$	Phillips curve slope

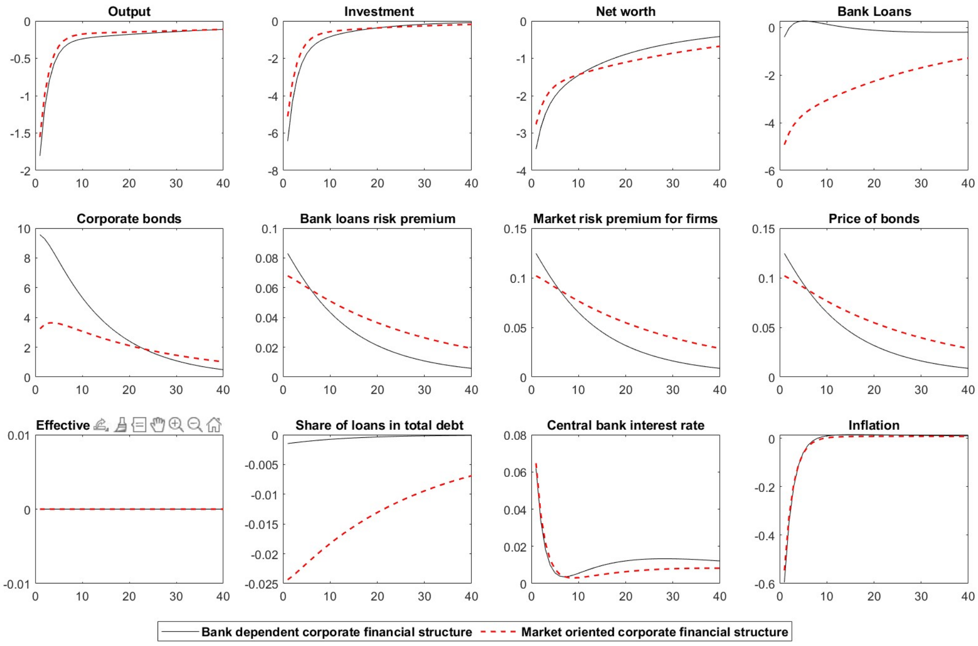
Table 1: Calibration of standard parameters in the DSGE model

5 Simulation results

Figure 5 presents the economy's response to a positive 0.1 standard deviation increase in the central bank interest rate, representing a restrictive CMP measure.

As expected, there is the standard negative impact on investment and output, amplified by the financial accelerator mechanism. A CMP tightening leads to a decrease in firms' net worth, and negatively affects the risk premia, which go up in both the credit and corporate bond markets. This, in turn, reduces investment and output. Because of the higher sensitivity of the market risk premium to firms' financial position (see equation (5)), the market risk premium temporarily increases more than the credit risk premium, raising the expected return on savings for investors in corporate bonds. The households' arbitrage between bank deposits and corporate bonds leads to an increase in investment in the corporate bonds market. Consequently, the market price of corporate bonds increases, offsetting the additional required market risk premium. Thus, the effective cost of funds for firms in the corporate bond market remains nearly unchanged after the shock, while the cost of bank credit increases.

Figure 5. Impulse response functions following a restrictive conventional monetary policy



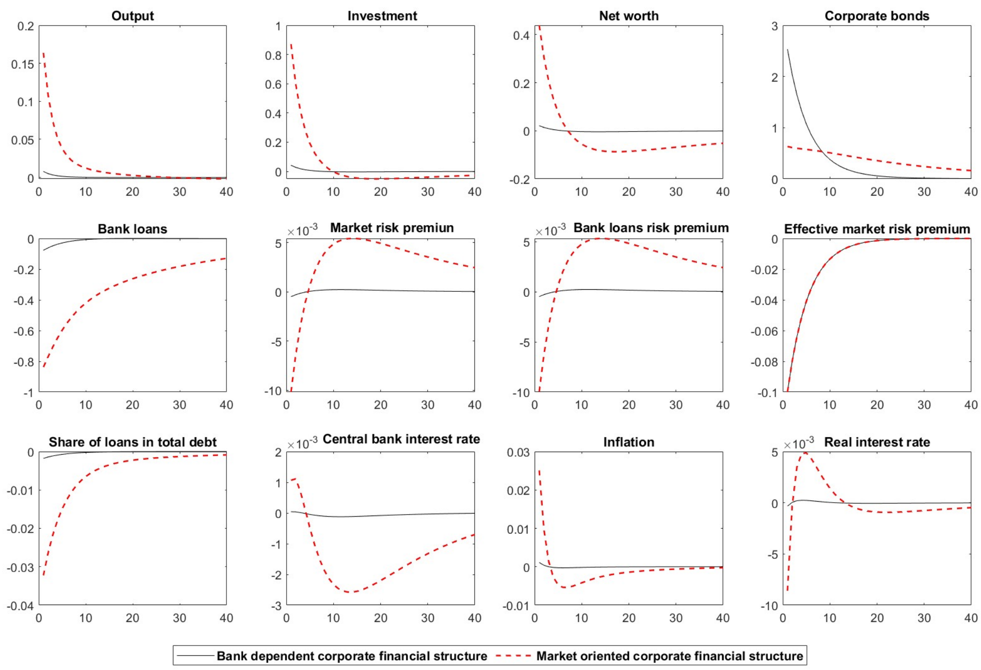
Source: Authors' own compilation using Matlab

Two scenarios are presented in Figure 5. The first one, represented with a black line in our simulations, refers to a financial system monopolised by banks ($a = 0.97$), in which the firms' financial structure is bank-dependent. The second one, represented with the red dashed line, is a market-oriented financial system scenario ($a = 0.4$), where firms can easily combine bank loans and market debt. When our firms have the possibility to choose between the two alternative sources of financing (essentially in the second scenario), they substitute bank loans with corporate bonds when the former becomes more expensive. As observed in Figure 5, the share of bank loans in total debt decreases after the shock in that case. The more the corporate financial structure is market-oriented, the more the firms will substitute bank credit with market debt, and the share of loans in total debt will decrease. Banks' loans remain below the steady-state level even after several quarters, while corporate bonds surpass the steady-state level, compensating for firms' financial needs.

The negative impact of a CMP shock on investment and output is thus more pronounced in economies with a bank-dependent financial system than in those with a more market-oriented financial system.

Figure 6 presents the economy's response to a positive 0.1 standard deviation liquidity shock in the corporate bond market, induced, for example, by a UMP decision to purchase assets in this market. As a result, the demand for corporate bonds exogenously increases, leading to a rise in bond prices and transforming corporate bonds into a more attractive financing opportunity for firms (as the effective market premium for firms decreases). By suddenly reducing the cost of market-based finance for firms, the liquidity shock has a positive impact on the firms' profits and net worth, providing an incentive to invest more and support aggregate demand. Subsequently, inflation temporarily increases, requiring a monetary policy intervention to stabilise it. However, given the inertia in the CMP conduct, the real interest rate slightly decreases after the shock, further supporting investment. As a result, output increases and the liquidity shock has a positive impact on the real economy, especially with a market-oriented financial system (red dotted line). On the contrary, this transmission channel is very limited in a bank-dependent financial system.

Figure 6. Impulse response functions following a UMP that impacts the corporate bonds market liquidity



Source: Authors' own compilation using Matlab

The increase in firms' investment is followed by the deterioration of their financial leverage (debt-to-capital ratio), leading to higher required risk premia for both bank credit and corporate bonds. However, the market price adjustment of bonds significantly reduces the effective cost of raising funds by issuing bonds compared to bank credit, and provides an incentives to firms to substitute bank loans with corporate bond debt. In Figure 6, the share of loans in total debt decreases, while the share of corporate bonds increases compared to the steady-state level in the scenario with a market-oriented corporate financial structure.

Such liquidity regulations seem to be particularly useful for stimulating economic activity during a recession, for example, especially in countries with a less bank-dependent financial system (i.e., those with a higher share of market-based finance in total financing). Indeed, in response to an identical liquidity shock (one with the same dynamics of the effective market premium), the economy's reaction varies depending on the financial system's composition, i.e., whether it is more or less bank-oriented. When the share of market-based debt in total financing is higher, firms benefit more from liquidity regulation, leading to increased economic growth. As seen in Figure 6, the reaction of investment and output is very limited in more bank-dependent financial systems, i.e. the black response function, because the liquidity shock transmission passes through the corporate bond market and has no positive spillover effects to the credit market.

6 Conclusions

The paper presents a dynamic general equilibrium model where we endogenise the choice of bonds and loans of firms, building on the BGG analytical framework. We show that the corporate debt structure of firms matters for the transmission of external shocks to the economy.

We assume that banks have an information advantage compared to households, and trade off a lower interest rate on loans in exchange for a long-term relationship with the firm. Thus, having in mind the empirical evidence for the EA economies, we assume that households require a higher risk premium than banks to participate in firms' investment projects. Ultimately, the wedge between the cost of bonds and the cost of loans reflects the availability of information in the market and the habits/structural features of the economy. The deeper and more liquid the bond market, the easier the information acquisition and the lower the wedge between the bond and the loan risk-premia. In this perspective, increased financial openness, enhanced protection of creditors, favourable tax regimes, and increased availability of instruments and capital market institutions (e.g., underwriters) reduce financial frictions for households and the effective risk premia required to hold debt securities isued by firms.

We run simulations based on parameter values that reflect the EA features of the loan and bond markets. We show that external shocks to the cost of finance for banks or liquidity shocks feed back dynamically into firms' net worth, investment and output and that monetary policy can have asymmetric effects. Higher banks' refinancing costs due to more stringent monetary policies have a greater impact on those firms that cannot easily substitute loans with bonds. Firms with easier access to the bond market have a competitive advantage over firms that can only rely on bank financing. On the other hand, shocks that increase the liquidity in the bond markets, such as UMP, affect firms with a more diversified corporate debt structure.

From this perspective, heterogeneities in the development of bond markets in European economies can have important macroeconomic implications.

A further step in our research could be to examine more deeply the interaction between banks and other types of creditors to better understand potential spillover effects. This may be linked, for instance, to the greater ability of banks to deal with asymmetric information issues. This ability positions them as effective monitoring agents for other types of creditors, such as corporate bond investors, thus contributing to the optimisation of risk premia in the economy.

It is also important to note that in the current model, only firms with access to both financing options are considered, which are typically large firms in reality. However, real-world economies are composed of both small and large firms; most of the time, small firms lack access to market-based finance. In such a configuration, their activity would be much more affected by a CMP than the activity of large firms. Therefore, a CMP shock is expected to have an even higher asymmetric impact on the real economy, depending on the share of small and large firms. Incorporating two distinct types of firms into the model would be the next step in our analysis, allowing us to discuss in more depth the question of financial asymmetries in the euro area.

References

Alder, M., N. Coimbra, and U. Szczerbowicz (2023). *Corporate debt structure and heterogeneous monetary policy transmission.* Banque de France Working Paper No. 933.

Badarau, C. and G. Levieuge (2011). "Assessing the effects of financial heterogeneity in a monetary union: A DSGE approach". In: *Economic Modelling* 28.6, pp. 2451–2461.

Bats, J. and A. Houben (2020). "Bank-based versus market-based financing: Implications for systemic risk". In: *Journal of Banking and Finance* 114, p. 105776.

Bernanke, B., M. Gertler, and S. Gilchrist (1999). "The financial accelerator in a quantitative business cycle framework". In: *Handbook of Macroeconomics.* Ed. by J. B. Taylor and M. Woodford. Vol. 1. North-Holland.

Calvo, A. Guillermo (1983). "Staggered Prices in a Utility-Maximizing Framework". In: *Journal of Monetary Economics* 12, pp. 383–398. DOI: 10.1016/0304-3932(83)90060-0. URL: https://doi.org/10.1016/0304-3932(83)90060-0.

Cavallaro, E. and I. Villani (2024). "Financial resilience, growth and risk sharing in the EU". In: *International Economics* 180, pp. 1–21. DOI: 10.1016/j.inteco.2024.100550.

Chang, R., A. Fernandez, and A. Gulan (2017). "Bond finance, bank credit, and aggregate fluctuations in an open economy". In: *Journal of Monetary Economics* 85, pp. 90–109. DOI: 10.1016/j.jmoneco.2016.10.009.

De Fiore, F. and H. Uhlig (2011). "Bank finance versus bond finance". In: *Journal of Money, Credit and Banking* 43.7, pp. 1399–1421.

— (2015). "Corporate debt structure and the financial crisis". In: *Journal of Money, Credit and Banking* 47.8, pp. 1571–1598.

Diamond, D. W. (1984). "Financial intermediation and delegated monitoring". In: *Review of Economic Studies* 51, pp. 393–414.

Holm-Hadulla, F., A. Musso, et al. (2022). "Firm debt financing structures and the transmission of shocks in the euro area". In: *ECB Economic Bulletin* 4.

Holm-Hadulla, F. and C. Thurwächter (2021). "Heterogeneity in corporate debt structures and the transmission of monetary policy". In: *European Economic Review* 136. DOI: 10.1016/j.euroecorev.2021.103743.

Jorda, O. (2005). "Estimation and inference of impulse responses by local projections". In: *American Economic Review* 95.1, pp. 161–182.

Kashyap, A. K., J. C. Stein, and D. W. Wilcox (1993). "Monetary policy and credit conditions: Evidence from the composition of external finance". In: *American Economic Review* 83.1, pp. 78–98.

Langfield, Sam and Marco Pagano (May 2015). *Bank Bias in Europe: Effects on Systemic Risk and Growth.* Working Paper Series 1797. ECB Working Paper No. 1797. European Central Bank.

Stancu, S. (2024). "The effects of COVID-19 and their mitigation through fiscal policy: Results from a DSGE model with financial frictions". In: *The Review of Finance and Banking* 16.2, pp. 295–308. DOI: 10.24818/rfb.24.16.02.07.

Townsend, R. M. (1979). "Optimal contracts and competitive markets with costly state verification". In: *Journal of Economic Theory* 21.2, pp. 265–293. DOI: 10.1016/0022-0531(79)90031-0.