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THE OPPOSITE EFFECTS OF BANK TAX ON THE REAL ECONOMY

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Abstract. This paper aims to study the real effects of a bank tax in an economy with imperfect banking market. In this sense, we propose an extension of the financial accelerator model with bank capital channel, by introducing a tax on the banks' profits. We note two opposite influences of the "bank tax" on the cost of financing for banks: (i) a direct one, which corresponds to the tax shield channel and translates the impact of the "fiscal saving" on the cost of external finance for banks, and (ii) an indirect one, which comes from the reaction of the banks' net worth to a fiscal change, corresponding to the bank capital channel manifestation. If the impact of the first one is easier to observe in the short-run, the second one is more powerful in the long-run. The external financing cost for banks then turns into higher financing cost for firms, reducing investment and output.

1. Introduction

Risk-taking of financial institutions has undeniably increased prior to the financial crisis of 2007/2008[1] and one of the reasons explaining this behavior is the common knowledge that the lender of last resort would intervene in case of trouble to bail out a distressed banking sector. This was the case in the aftermath of the Global Financial Crisis (GFC), when risks taken by banks materialized in large losses which obliged governments to spend billions to rescue their financial systems.[2] If these interventions proved to be beneficial for the overall economy, reducing the severity of the financial crisis and avoiding the collapse of the banking sector, they remain unfair to taxpayers who had nothing to do with the excessive risk-taking of banks, which poses an ethical problem. One of the immediate and obvious solutions to deal with this problem,[3] was the introduction in several EU countries of a banking tax. Indeed, taxes are a common policy tool used to change the behavior of specific economic agents, to internalize negative externalities and create new incentives. In this specific case, the banking tax is supposed to reduce risk-taking behavior by directing investments towards less risky assets, to oblige banks to pay for their own mistakes and to incentivize them to use longer term financing sources.

As this type of response to the GFC was widespread[4] and given that fiscal pressure on banks has progressively increased during the last fifteen years in several countries, the purpose of this

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[1]The extensive use of securitization to take risks off-balance sheet while maintaining an acceptable level of capital requirements and the use of short-term wholesale funding rather than traditional deposits are only two examples of the risky behavior of banks.

[2]See Laeven and Valencia (2013) for the exact type of measures adopted in countries mostly affected by the financial crisis.

[3]Other solutions came later on and took the form of new prudential regulation, a bail-in procedure or the creation of a Resolution Fund as part of the Banking Union Pillar II.

[4]In Europe, banking taxes were introduced in several countries among which Belgium, France, Germany, Hungary, Latvia, Romania, Sweden, Slovakia and Slovenia and the UK.

paper is to investigate the impact of the introduction of a bank tax on financial outcomes and on the real economy by means of a theoretical macroeconomic model. It is indeed important to understand the economic mechanisms behind this policy tool in order to evaluate its effectiveness at a macroeconomic level. To answer our research question, we extend a previous financial accelerator DSGE model with bank capital (Badarau and Levieuge, 2011) and let the government collect a banking tax. Therefore, the tax contributes to the general state budget as is the case in most of the countries where this type of tax was introduced.[5] As banks are also subject to other types of taxes – like the income tax, corporate tax and even to contributions to the Single Resolution Fund – we provide here a general framework in which the tax is applied on the bank's profit. The tax can have two opposite effects. On the one hand, as one expects, the tax has a negative effect on credit, as banks pass through the higher cost onto entrepreneurs. Therefore, due to low credit, investment decreases and so does the output. On the other hand, as the fiscal base for the tax is given by profits, computed as the difference between interest income and interest expenses, the higher the tax rate, the higher the "fiscal savings"[6] for the bank. An increase in the tax will therefore have a positive impact on the financial and real sectors and might even encourage banks to increase their debt ratio. The objective of our study is to theoretically highlight the presence of these two channels and therefore to compare/quantify these two opposite effects and see which of them prevails.

Several papers took interest in the study of banking taxes introduced over the financial crises (Demirguç-Kunt and Huizinga, 2001; Chiorazzo and Milani, 2011; Albertazzi and Gambacorta, 2010; Balutel and Voia, 2022). They empirically prove the bank tendency to pass the tax burden on the customers by increasing the interest rate spread and thus provoking the decrease of the credit demand. Balutel and Voia (2022) for instance recently provided empirical assessment of the banks' taxation related to the financial sector support plans implemented by the governments of the Central and Eastern European Countries in the post-crisis period. They show that the effect of taxation on the real economy was often negative and explain it by the fact that banks internalize these taxes and treat them as an additional cost of the banking activity, which is transferred to the financing cost of the real economy. We contribute to the discussion on the impact of a banking tax on the real economy and provide a theoretical framework to explain these results obtained in empirical literature thus far. Indeed, our results are in line with the ones obtained by the previous empirical studies in Europe. We show that the additional tax can lead to an increase in the cost of financing in the economy, a reduction in credits, with a negative impact on investment and growth.

Our starting point are the financial accelerator mechanism highlighted by Bernanke et al. (1999) and the additional accelerator mechanism related to the bank capital channel (Badarau and Levieuge, 2011). In this paper, we propose an extension of the model provided by Badarau and Levieuge (2011) to account for banking sector fragility, government constraint and the introduction of a tax on the banks' profits as potential source of financing public expenditures.

The rest of the paper is structured as follows. A brief literature review on the effects of bank tax is presented in section 2. Section 3 presents the main features of the model, with an emphasis on explaining the appearance of the two opposite effects of the banking tax. In section 4, we present the results and compare them to the ones obtained in empirical studies. Section 5 concludes and presents some policy implications from our study.

[5]In Europe, the banking tax rate and its fiscal base differ from country to country. Some countries apply the tax rate to total assets, while others use liabilities as base for their tax. The tax rate is sometimes a flat rate (as is the case in Romania, Slovenia, the UK) or a progressive rate (Slovakia). Moreover, in most countries the tax is directly considered as revenue for the state budget, but some countries opted for the use of this revenue to finance a specially created fund (Romania for example).

[6]The fiscal savings are simply the interest expenses multiplied by the tax rate.

2. Literature Review

In order to analyze the effects of the bank tax, we take into account its different forms possible. We first rely on the propositions made by international financial institutions in the period after the financial crisis occurrence. The International Monetary Fund suggested a Financial Stability Contribution defined as a tax on the banks' balance sheet basis, but also a Financial Activities Tax established on the profits and remunerations of the financial institutions. The proposition of the European Commission was less specific and pointed towards a tax on the assets or on the liabilities or on the profits of banks and other financial institutions. The financial literature on the other hand also considers the effects of a value added tax (VAT) on the financial services (Chiorazzo and Milani (2011) and Mullineux (2012) among others).

According to Diamond-Mirrlees Theorem (Diamond and Mirrlees, 1971), the taxation should be applied on final consumption, not on intermediary one, creating the premises of passing it through to the financial consumers. Boadway and Keen (2003) sustain this opinion and conclude that taxation should not be applied on the financial services addressed to the companies, while low-rate taxation can be acceptable for the financial services provided to households. Demirgüç-Kunt and Huizinga (1999) base on a sample of banks from 80 countries and provide empirical results consistent with the hypothesis that corporate income tax applied for banks is passed onto the customers by means of the interest rate spreads. The conclusion is confirmed in Demirgüç-Kunt and Huizinga (2001) on a sample of domestic and foreign-owned banks.

Chiorazzo and Milani (2011) in a study on 3617 banks from 15 European countries extend the analysis and consider the influence of both corporate income tax and value added tax on the profitability and behavior of the banks. Their main conclusion using a dynamic panel approach is that corporate income tax is almost completely (80%) passed onto the customers by the interest rate spread, mainly transforming into a "lending tax". On the other side, they demonstrate that the non-interest income of the banks is also affected by an increase of income tax, denoting the need of the banks to develop new financial services to maintain their position on the market in the context of a decrease in credit demand. Another distressing conclusion of their study is that the increase of the bank tax rate negatively influences the level of the loss provision kept by banks, hence increasing their financial fragility. The result is consistent with a tendency of the bank managers to reduce loss provisions to avoid altering net income margin in the context of the bank tax introduction.

An interesting approach is provided in Albertazzi and Gambacorta (2010). They construct a model to explain the effect of taxation on bank profitability considering two effects of the corporate income tax increase. A so-called "market effect" generated by the bank tendency to pass the tax burden on the customers by increasing the interest rate spread and thus provoking the decrease of the credit demand is demonstrated. The second effect termed "cost of equity effect" consists in an increase of the cost of equity due to the corporate income tax upsurge which will enhance the lending rate, because the lending activity is affected by capital requirements. The corporate tax rate is empirically demonstrated to shift its burden towards customers almost totally (around 90%) confirming the predictions of the model.

Regarding the effect of the VAT, Chiorazzo and Milani (2011) demonstrate that it has a negative and significant effect on the net-interest income, consistent with passing the VAT burden onto the customers towards deposits. Mullineux (2012) on the other side, advocates the introduction of the value added tax for the financial services, stressing on its capacity of eliminating the useless bank operations often ordered by customers and in the meantime on the possibility of mitigating the financial system fragility if the raised capital is used to this purpose. He also considers that the introduction of the VAT on financial services is a modality for insuring equitable treatment among big and small banks.

Recent work more directly related to ours includes Balutel and Voia (2022), who empirically assessed bank taxation in the context of financial sector support schemes introduced by Central and Eastern European governments following the financial crisis. Their findings suggest that

such taxes tend to have adverse effects on the real economy, as banks tend to pass these costs on to borrowers, thereby raising the cost of financing for the broader economy.

In our paper, the starting points are previous empirical proofs that a corporate tax applied to banks shifts its burden towards borrowers. We are proposing a purely micro-founded theoretical model where the bank tax is introduced in the form of a corporate income tax applicable strictly to banks, which corresponds to the way it was implemented in Europe following the financial crisis (2007-2009). Our attempt is to put in evidence the effects of the introduction or of the increase of bank tax after a period of financial distress. It is justified by the economic reality marked by several increases of the bank tax in the second decade of the 21st century. Slater (2013) mentioned that the UK raised the bank tax at six instances during the last three years, or by the introduction of new "taxes" in order to fund the Single Resolution Mechanism for banks of the Banking Union project for Europe.

In the literature, Hasman et al. (2011) previously inquire on the best way for the government to intervene in financial crisis periods to support banks. They particularly model banks' recapitalization and capital infusion into the banking system through credit lines and provide evidence that the first is less costly and more attractive in terms of welfare. They also consider the creation of a buffer and the imposition of a Tobin tax as alternative measures particularly suitable for small and emerging economies, the last being appropriate in regions where the citizens highly value the public services and are not very affected by liquidity problems, or in case of high difficulties to raise the necessary funds. We do not inquire about the opportunity of government intervention, but consider banks recapitalization as hypothesis and focus on the effect of the government policies on the real economy.

The financial crisis started in 2007-2008 has shown, once more, the major role of financial institutions for the transmission of shocks to the real economy. From a theoretical point of view, the financial accelerator mechanism highlighted by Bernanke et al. (1999) becomes the starting point towards new developments providing evidence of an additional accelerator mechanism passing by the banks channel. Badarau and Levieuge (2010) show the importance of this channel in Europe and its asymmetry among countries. In reference to the macroeconomic policy analysis, Badarau and Levieuge (2011) develop a dynamic stochastic general equilibrium model with asymmetric bank capital channel in a monetary union. Our model is based on this model. We transpose it to a single country and modify it to account for banking tax and its macroeconomic implications.

3. The Model

We consider here a new-Keynesian closed economy model with seven categories of agents: entrepreneurs, financial intermediaries and households, who act simultaneously on the credit market; retailers and capital producers whose presence allows us to introduce real and nominal rigidities in the model; the Government and the Central Bank responsible for the conduct of the fiscal and monetary policy, respectively. Figure 1 below summarizes the relationships among these different categories of agents.

The model is quite standard, very close to Badarau and Levieuge (2011), but particular attention is paid to the bank tax and its influence on the cost of financing for agents on the credit market. This is the reason why we start the description of the model by explicitly presenting the partial equilibrium on the credit market before giving the general equilibrium equations.

Optimal contract between firms and banks: The external finance premium for firms. For simplicity, we analyze a representative financial contract of one period maturity, concluded between a representative entrepreneur and its financial intermediary.

At the end of period t, the entrepreneur purchases the capital K_{t+1} at price Q_t. We assume that all capital is homogenous and that K_{t+1} is purchased in period t, but will only be used in

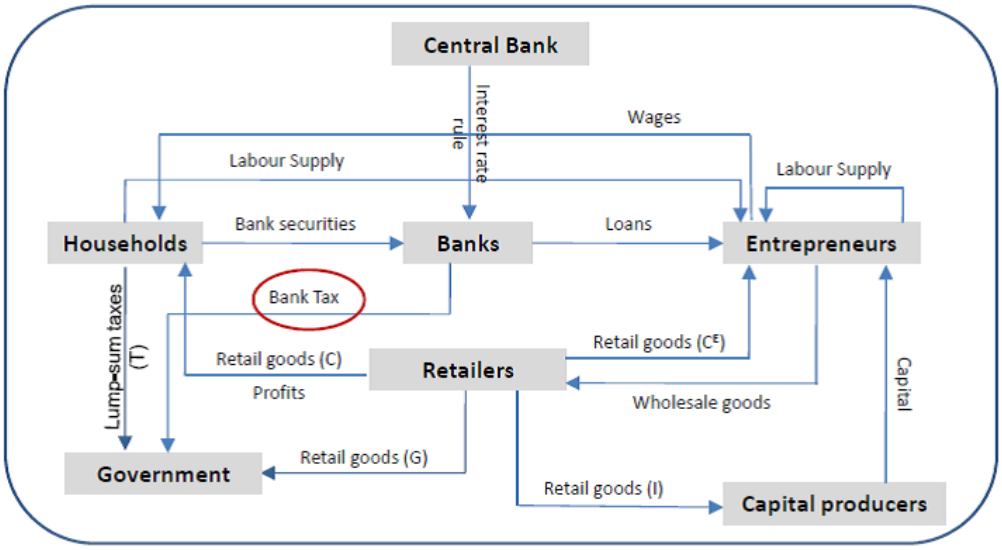

FIGURE 1. Structure of the economy

production in the following period $t+1$. At the investment decision moment, the entrepreneur has available net worth, NF_t, and finances his investment with internal funds and a supplement of external funds B_t borrowed from a financial intermediary:

$$Q_t K_{t+1} = NF_t + B_t \tag{1}$$

The gross rate of return on capital investment is given by $\omega_{t+1} R^K_{t+1}$, where ω_{t+1} and R^K_{t+1} are the idiosyncratic and the non-idiosyncratic components of the firm's rate of return to capital in $t+1$. The idiosyncratic component ω_{t+1} is related to the firm specific risk and $\log(\omega)$ is assumed to follow a normally distributed random variable with mean $-\sigma^2/2$ and variance σ^2, i.i.d. across time. The non-idiosyncratic component R^K_{t+1} represents a normal rate of return to capital in the economy, which doesn't depend on the firm specific factors. The rate of return on the firm's capital expected by the creditor is R^K_{t+1}, and it is used to determine the loan interest rate. It thus becomes, as in Bernanke et al. (1999), an expression of the cost of external finance for firms.

Following the "costly state verification" (CSV) approach, provided by Townsend (1979), the realization of the random component of return ω_{t+1} is a private information of the entrepreneur, to which the intermediary has access only if he pays a verification cost. The financial contract is, thus, a standard debt contract including a bankruptcy clause. If we note by R^F_t the non-default loan rate associated with the borrower, an implicit threshold value of ω_{t+1}, namely $\overline{\omega}^F_{t+1}$, is obtained as solution of the debt contract, under which the borrower goes bankrupt and does not pay his debt. As in Bernanke et al. (1999), it respects the bankruptcy clause:

$$\overline{\omega}^F_{t+1} R^K_{t+1} Q_t K_{t+1} = R^F_{t+1} B_t \tag{2}$$

For $\overline{\omega}^F_{t+1}$ given, two possible situations exist: *i)* $\omega_{t+1} \geq \overline{\omega}^F_{t+1}$, in which case the realized return of the firm is sufficiently high to repay its debt to the bank. The firm even obtains a benefit which is: $(\omega_{t+1} - \overline{\omega}^F_{t+1}) R^K_{t+1} Q_t K^i_{t+1}$; or *ii)* $\omega_{t+1} < \overline{\omega}^F_{t+1}$, in which case the firm revenues are insufficient to fulfill the loan contract, it declares bankruptcy and is liquidated. The auditing cost that the bank must spend if the firm declares bankrupt $(\mu^F \omega_{t+1} R^K_{t+1} Q_t K_{t+1})$ is supposed to be proportional to the gross return on the firm's investment, where μ^F is the factor of proportionality. The bank thus only receives $(1-\mu^F)\omega_{t+1} R^K_{t+1} Q_t K_{t+1}$, after the verification procedure.

But at the same time the banker must collect funds from households to finance the entrepreneur. Thus, he must implicitly consider the cost of such operations. Banks operate in a perfectly competitive environment, are neutral to the idiosyncratic risk and to the aggregate risk associated with banking activity, but adverse to the aggregate risk associated to the entrepreneurs' activity[7]. As in Badarau and Levieuge (2011), banks' loan portfolios are of finite size. The risk associated with the firms' investment projects is thus partly transferred to banks (which can default), and ultimately to households. By analogy with the bank-firm relation, the return on the loans portfolio of the bank is supposed to be private information. A creditor household must engage a costly state procedure to observe the return of the bank to which he has lent funds, if the bank declares bankrupt. A second agency problem then arises, now between banks (borrowers) and households (lenders), whose treatment will render the external financing costly for banks and will oblige them to accumulate inside capital. Like in Krasa & Villamil (1992), households perform the role of 'monitoring the monitors'.

To maintain the model tractability at the aggregate level, we follow hereafter Goodhart et al. (2004) when supposing that a bank can only participate in the investment projects of one firm[8]. In such a way, the idiosyncratic risk is fully diversified at the aggregate level, but not at the bank level.

In such a context, at the period t, the representative bank uses its inside accumulated capital NB_t and other complementary funds raised from households A_t to lend B_t to a representative firm. According to the aforementioned assumptions, the risk of the firm ω_{t+1} is directly transferred to the bank's balance sheet. Let's denote by R^A_{t+1} the non-default gross return on bank securities subscribed by the household. The threshold value of ε_{t+1} that describes the default of the bank R^B_{t+1} must thus satisfy the relation:

$$\left(1-\mu^F\right)\overline{\omega}^F_{t+1}Q_tR^K_{t+1}K_{t+1}=R^A_{t+1}A_t \tag{3}$$

The left-hand side of the relation (3) corresponds to the gain obtained by the banker from financing the entrepreneur, in the bad scenario, when the firm goes bankrupt and the bank pays the monitoring cost μ^F. The right-hand side of (3) gives the amount of the banker's pledge towards the household. As in Goodhart et al. (2004), the threshold value for the bank's bankruptcy is always lower than the threshold value calculated for the firm's default $\left(\overline{\omega}^F_{t+1}>\overline{\omega}^B_{t+1}\right)$. The bank's default is always conditional to the previous default of firms. But the defaulting of a firm does not necessarily imply that its bank goes bankrupt. If, after the costly verification procedure, the banks can recuperate sufficient funds to pay the households, they can survive. Three situations are thus possible: *i)* $\omega_{t+1}>\overline{\omega}^F_{t+1}>\overline{\omega}^B_{t+1}$, in which case there is no default and the financial contract runs without any difficulty; *ii)* $\overline{\omega}^F_{t+1}>\omega_{t+1}>\overline{\omega}^B_{t+1}$, in which case only the entrepreneur goes bankrupt, while the banker receives sufficient funds after the monitoring procedure to pay the creditor household; and *iii)* $\overline{\omega}^F_{t+1}>\overline{\omega}^B_{t+1}>\omega_{t+1}$, when entrepreneur and bank declare default, and the household starts a costly verification of the banker, whose cost $\left(\mu^A\omega_{t+1}R^K_{t+1}Q_tK_{t+1}\right)$ is proportional to the bank's gross return: $\mu^A\left(1-\mu^F\right)\omega_{t+1}Q_tR^K_{t+1}K_{t+1}$, with $\mu^A>\mu^F$.[9]

The external finance premium for firms is determined by the contract between the bank and the entrepreneur. It comes from the resolution of an optimization program that seeks to maximize the entrepreneur's expected earnings, subject to the participation condition for

[7]As R^K_{t+1} is predetermined, all shocks affecting the aggregate component R^K_{t+1} are borne only by firms.

[8]As discussed in Goodhart et al. (2004), with the assumption of a finite size for the banks' loan portfolios, the aggregation should depend on the distribution of risky projects in each bank. An equivalent situation occurs when supposing that one bank can lend to several firms, but the return on the firms' investment projects is perfectly correlated within a bank, while it is i.i.d. across banks.

[9]The monitoring procedure is more costly for households than for banks (which are specialized in this kind of operations). This justifies the intermediation activity by banks.

the bank, and implicitly to that for the household[10]. The solutions of this program give the firm demand for capital and the value of the thresholds $\overline{\omega}^F_{t+1}$ and $\overline{\omega}^B_{t+1}$. The non-default loan rate associated with the contract between the entrepreneur and the bank R^F_{t+1} is then easily obtained from (2), and the gross return to be paid to the household R^A_{t+1} comes from (3). The first order conditions of the program lead to the following external finance premium for the firm, as solution to the agency problem:

$$S^F_t = \Psi_F\left(k^F_{t+1}\right), \quad \text{where} \quad S^F_t = E_t\left[\frac{R^K_{t+1}}{R^f_{t+1}}\right] \quad \text{and} \quad \frac{\partial \Psi_F(\cdot)}{\partial k^F_{t+1}} > 0 \tag{4}$$

In a logarithmic form, S^F_t simply defines the firm's external finance premium in the model, i.e. the difference between the net return on the firm's physical capital required by the bank R^K_{t+1} and the risk-free rate R^f_{t+1}.

The firm's external finance premium depends on the firm's financial position $k^F_{t+1} = \frac{Q_t K_{t+1}}{NF_t + NB_t}$, but also on the accumulated inside capital of the bank NB_t given by the relation (8) below. This fact clearly shows the internalization by the entrepreneurs of the banks' external financing costs. So much so that a deterioration in banks' balance sheet finally implies a tightening of the lending conditions to firms. It is the bank capital channel manifestation depicted in Badarau and Levieuge (2011).

The firm's net worth NF_t mainly comes from the accumulated profits (VF_t). In addition, it is assumed that the entrepreneur offers its labour force[11] and perceives a wage (WF_t), which increases its firm's net worth, so that:

$$NF_t = \gamma^F\left[VF_t + WF_t\right] \tag{5}$$

where the coefficient γ^F corresponds to the survival probability of the firm, assuming that a constant proportion $\left(1-\gamma^F\right)$ of firms leave the market each period. When leaving the market, the remaining net wealth is entirely used to consume final goods (CF_t): $CF_t = \left(1-\gamma^F\right)\left[VF_t + WF_t\right] = \frac{1-\gamma^F}{\gamma^F} NF_t$. Besides, the value of the firm (VF_t) is given by the gross return on capital, after the repayment of the debt and of the associated interests. So, for $\left(R^F_{t+1}\right)$ given in (4): $VF_t = Q_{t-1}R^K_t K_t - S^F_{t-1}R^f_t B_{t-1}$.

Optimal contract between banks and households: The external finance premium for banks. Contracting with firms, the banks also interact with households to collect funds. Households are neutral to the idiosyncratic risk, but averse to the aggregate risk[12]. They elaborate their gain expectations based on the average (aggregate) return for banks in the economy $\left(R^B_{t+1}\right)$. As previously, the lender (household) knows that the return of the borrower (bank) is subject to an idiosyncratic (and not spontaneously observable) risk[13], noted ε_{t+1}, supposed to follow a log-normal distribution similar to that of ω_{t+1}. Precisely, a threshold $\overline{\varepsilon}_{t+1}$ exists for the banker, under which he goes bankrupt. This threshold value satisfies the condition:

[10]As discussed hereafter in the description of the DSGE model, the participation constraints of different agents to the financial contract take into account the presence of an opportunity cost for investments, given by the risk-free rate.

[11]This assumption allows the wholesale producers to have dotation to borrow immediately; otherwise, they should face an unrealistically high external finance premium.

[12]It means that the aggregate risk will be borne by firms and banks. The mechanism which protects households from the aggregate risk is the following. The non-default interest rate on bank securities is predetermined at the end of period t. So, if in $t+1$, the effective return on non-idiosyncratic component of firms' or banks' investments is lower than expected, households will be compensated with the higher non-default interest rate on bank securities.

[13]In other words, not only a defaulting entrepreneur can drag a bank down with him, as we have seen in the previous subsection, but also a bank can declare bankruptcy because of an adverse idiosyncratic shock.

$$\overline{\varepsilon}_{t+1} R^B_{t+1} B_t = R^A_{t+1} A_t \tag{6}$$

where R^A_{t+1} is the non-default gross return to be paid by the bank on the funds raised from household at the end of period t. So, if $\varepsilon_{t+1} \geq \overline{\varepsilon}_{t+1}$, the bank's revenues are sufficient to fulfill its commitments towards the household. On the contrary, if $\varepsilon_{t+1} < \overline{\varepsilon}_{t+1}$, the bank declares bankrupt. But the realization of ε_{t+1} is private information. In case of bankruptcy announcement, the household must pay an auditing cost $\left(\mu^A \varepsilon_{t+1} R^B_{t+1} B_t\right)$ proportional to the gross return of the bank's loans portfolio to obtain the real value of $\left(1-\mu^A\right) \varepsilon_{t+1} R^B_{t+1} B_t$. He thus recovers: $\left(1-\mu^A\right) \varepsilon_{t+1} R^B_{t+1} B_t$.

The terms of the financial contract between the bank and a representative household are simply obtained by maximizing the expected bank's earning (after taxes), subject to the household participation constraint. The solution of the program allows determining R^B_{t+1} and the threshold value $\overline{\varepsilon}_{t+1}$, in function of the realizations of τ_t[14]. The solution to this agency problem gives rise to an external finance premium for the banker, defined by:

$$S^B_t = \frac{1 + r^B_{t+1}\left(1-\tau_{t+1}\right)}{R^f_{t+1}} \tag{7}$$

where τ_t defines the bank tax imposed on their earning, S^B_t simply represents (after log-linearization) the difference between the effective cost of external finance for banks (considering the "fiscal saving" allowed by the deductibility of interests from the earnings before taxes) and the risk-free interest rate, r^B_{t+1} and R^f_{t+1}. As expected, the non-default return on the bank's loans portfolio required by the household $\left(R^B_{t+1}\right)$ is higher than the risk-free interest rate. The spread depends on the bank's financial leverage, defined here by the accumulated inside capital to loans ratio (as in Badarau and Levieuge (2011)), but also on the "bank tax".

In the previous relations, the bank inside capital (NB_t) mainly comes from the accumulated profits of the intermediation activity (VB_t), after the payment of taxes. Besides, it is assumed that a proportion $\left(1-\gamma^B\right)$ of banks leave the market each period, transferring a small part $\left(T^B_t\right)$ of their inside capital to new banks[15] (for an aggregated amount (NB_t)). Then, for $\left(S^B_t\right)$ given in (7), banks' net wealth can be written:

$$NB_t = \gamma^B VB_t + T^B_t \tag{8}$$

where $VB_t = B_{t-1}\left[R^K_t + \tau_t\left(1-R^K_t\right)\right] - S^F_{t-1} R^f_t A_{t-1}$, which negatively depends on the bank tax (τ_t).

The outgoing banks, once their transfers to newcomers done, consume in final goods their remaining capital: $CB_t = \left(1-\gamma^B\right)\left(1-t^B\right) VB_t = \dfrac{\left(1-\gamma^B\right)\left(1-t^B\right)}{\gamma^B\left(1-t^B\right)+t^B} NB_t$.

Coming back to the external finance premium for banks (7) we note two opposite influences of the "bank tax" (τ_t) on it: *i)* a direct one, which corresponds to the tax shield channel and translates the impact of the "fiscal saving" on the cost of external finance for banks, and *(ii)* an indirect one, which comes from the reaction of the banks' net worth (NB_t) to a fiscal change. It is the bank capital channel manifestation. Indeed, as in all standard accelerator models (see, Badarau and Levieuge (2011), among others), the firms' and respectively banks' net worth mainly come from their accumulated profits. An increase in the "bank tax" has a negative impact on the banks' profits and in turn on their net worth.

Speaking about the tax shield channel, an increase in the "bank tax" (τ_t) in t and maintained in the future $(t+1)$, would have a decreasing contribution on the external finance premium for

[14]The mathematical derivations underlying equation (7) are available upon request in a technical appendix.

[15]In line with other financial accelerator models, this assumption gives the possibility to new banks to benefit from initial capital, which is essential for the access to external financing. Without initial wealth, the external financial premium would be prohibitive for newcomers.

banks, because the "fiscal saving" is higher for banks in that case. Indeed, using relation (6), we obtain: $\frac{\partial S_t^B}{\partial \tau_{t+1}} = (1-\tau_{t+1})\frac{\partial S_t^B}{\partial \Psi_B}\frac{\partial \Psi_B(k_{t+1}^B)}{\partial k_{t+1}^B}\frac{\partial k_{t+1}^B}{\partial NB_t}\frac{\partial NB_t}{\partial \tau_t} > 0$, for a fixed NB_t.

On the contrary, the bank capital channel acts in an opposite direction, because lower net worth has a negative impact on the banks' accumulated inside capital on loans ratio $\left(k_{t+1}^B\right)$, giving rise to a higher external finance premium $\left(k_{t+1}^B\right)$. Indeed, without taking into account the tax shield channel, we obtain from (6): $\frac{\partial S_t^B}{\partial \tau_{t+1}} = \frac{1-\Psi_B\left(k_{t+1}^B\right)R_{t+1}^f}{R_{t+1}^f} < 0$.

However, the intuition is that when a tax is introduced in the economy, the bank capital channel is more active than the tax shield channel conducing to a global increase in the cost of external finance for banks. Additionally, this corporate tax applied to banks shifts its burden towards borrowers. The external finance premium for firms will increase. The tax could thus have a potential negative impact on the real economy.

Brief overview of the general equilibrium. In this section, we integrate the partial equilibrium of the credit market in a complete macroeconomic framework, similar to that used in Badarau and Popescu (2014)[16]. To write the complete general equilibrium model, we analyze the behavior of the representative agents acting on the goods markets: entrepreneurs, households, retailers, capital producers, as well as that of the government and the central bank.

Households are infinitely-lived agents who decide on their consumption, savings and work-time so as to maximize their intertemporal utility function:

$$E_t \sum_{k=0}^{\infty} \beta^k \left[\frac{\sigma_c - 1}{\sigma_c} C_{t+k}^{\frac{\sigma_c - 1}{\sigma_c}} - \frac{\sigma_h}{1+\sigma_h} H_{t+k}^{\frac{\sigma_h+1}{\sigma_h}} \right] \tag{9}$$

where β represents the subjective discount rate of the representative household, C_t is the consumption and H_t is the number of hours worked. σ_c represents the intertemporal elasticity of substitution, whereas σ_h is elasticity of disutility associated with work. The household is subject to the following budgetary constraint:

$$P_t C_t + D_t + A_t \leq W_t H_t + A_{t-1} R_t^A + D_{t-1} R_t - T_t + \Delta_t \tag{10}$$

Households' resources come from wages (W), remunerated deposits at the bank (A), savings (D) remunerated at the risk-free rate and profits received from the retail firms (Δ). Their revenue is consumed by paying lump-sum taxes (T), buying retailer goods (C) at price P and investing their savings. The first order conditions are standard and yield the equilibrium consumption level, as well as the optimum level of labor supply.

Retailers are introduced in the model only to motivate sticky prices. They buy wholesale goods from entrepreneurs, differentiate them at no cost and sell them in a monopolistic competition market. As in Calvo (1983), only a part of the retailers, $(1-\theta)$, can change prices in a given period, independent of history. The optimizing behavior of retailers involves the maximization of the present value of future dividends subject to a constraint of expected demand for retail goods. The equilibrium solution allows us to obtain the New Keynesian Phillips curve:

$$\pi_t = \beta E_t \left[\pi_{t+1}\right] + \kappa \rho_t \tag{11}$$

with π_t the log-deviation of inflation relative to its steady-state, κ a parameter depending on θ and ρ_t the real marginal cost of a representative retailer.

Capital producers differentiate their goods according to the needs of entrepreneurs. This process demands an adjustment cost which permits a variable price of capital. The adjustment cost function is modeled as in Badarau and Levieuge (2011):

[16]This model is based on Badarau and Levieuge (2011), but transposed to a single economy.

$$\Phi(I_t, K_t) = \frac{\phi}{2}\left(\frac{I_t}{K_t} - \delta\right)^2 K_t \tag{12}$$

with $\phi > 0$. I_t denotes aggregate investment expenditures, K_t the aggregated capital stock and δ the depreciation rate of capital. Then, the evolution of the capital stock is given by:

$$K_{t+1} = (1-\delta)\, K_t + I_t \tag{13}$$

Entrepreneurs produce wholesale goods by combining capital K_t bought from capital producers and labor supplied by households H_t and by entrepreneurs themselves (H^f, constant and normalized to one). The production technology is a Cobb-Douglas function with constant returns to scale:

$$Y_t = A K_t^{\alpha}\left[H_t^{\Omega}\left(H^f\right)^{1-\Omega}\right]^{1-\alpha} \tag{14}$$

where Ω represents the share of income going to entrepreneurial labor and A an exogenous technology parameter.

Entrepreneurs' optimization program consists in maximizing profits[17] under the capital accumulation constraint. Note that entrepreneurs internalize the adjustment costs of capital producers. First order conditions give the classic result of production factors being paid according to their marginal productivity, but also an equation for the expected return on capital:

$$E_t\left[R_{t+1}^K\right] = E_t\left[\frac{\rho_{t+1}\alpha\frac{Y_{t+1}}{K_{t+1}} - \frac{\phi}{2}\left[\delta^2 - \left(\frac{I_{t+1}}{K_{t+1}}\right)^2\right] + (1-\delta)\, Q_{t+1}}{Q_t}\right] \tag{15}$$

The expected return on capital equals the expected marginal productivity of capital after deduction of adjustment costs and taking into account the residual value of capital[18].

Finally, the equilibrium on the goods and service markets holds:

$$Y_t = C_t + CF_t + CB_t + I_t + G_t \tag{16}$$

The central bank conducts the monetary policy by means of a classical Taylor rule, mostly oriented towards a price stability objective, also containing a smoothing coefficient β_0 of the interest rate, in line with the empirical results on the European countries:

$$\hat{r}_t^a = \beta_0 \hat{r}_{t-1}^a + (1-\beta_0)\,\beta_\pi \hat{\pi}_t \tag{17}$$

Where $\hat{r}_t^a$ is the deviation of the nominal interest rate from its steady state and $\hat{\pi}_t$ is the log-deviation of inflation relative to its steady state. β_π corresponds to the reaction of the monetary policy to the inflation deviation from its steady-state level.[19]

The government made public expenditures financed by taxes (bank tax and lump sum taxes). Its budget constraint is given by equation (18):

$$G_t = T_t + \tau_t\left[B_{t-1}R_t^K - S_{t-1}^B R_t^f A_{t-1}\right] \tag{18}$$

[17]Revenues from the production process minus production costs like wages, capital adjustment costs and capital investment. For a better understanding of the bank tax, the corporate tax on firms is ignored in this model. Badarau and Semenescu (2010) analyze the impact of such a tax on the economy in a financial accelerator model.

[18]Given that credit contracts last only one period, the entrepreneur is required to sell its capital at the end of this period to reimburse his debt to the bank.

[19]We follow Bernanke et al. (1999) and fix $\beta_0 = 0.9$ and $\beta_\pi = 1.1$.

Persistent public expenditures and bank tax shocks are introduced in the model by the autoregressive processes: $\hat{\tau}_t = \rho_\tau \hat{\tau}_{t-1} + \varepsilon_t^\tau$ and $\hat{g}_t = \rho_g \hat{g}_{t-1} + \varepsilon_t^g$, respectively. $\hat{\tau}_t$ and $\hat{g}_t$ are log-deviations of the bank-tax and of the public expenditures from their steady-state, ρ_τ and ρ_g are autoregressive coefficients and ε_t^τ and ε_t^g are deterministic exogenous shocks at the government disposal.

4. Simulation and Results

The table in the Appendix presents the baseline calibration of our model. To demonstrate the presence of the two transmission channels, we conduct two simulation exercises.

The first consists in simulating the impact on the economy of a stochastic fiscal shock of 1 standard deviation from the steady state, translated into an increase in the bank tax (Figure 2). To better understand the impact of this bank tax – implicitly related to the bank capital channel in the model – we compare the response of real variables to the shock under two scenarios: a model with a low bank capital channel (low sensitivity of banks' external finance premium to their financial leverage, set at 0.004) and a model with a high bank capital channel (higher sensitivity of banks' external finance premium to their financial leverage, set at 0.008).

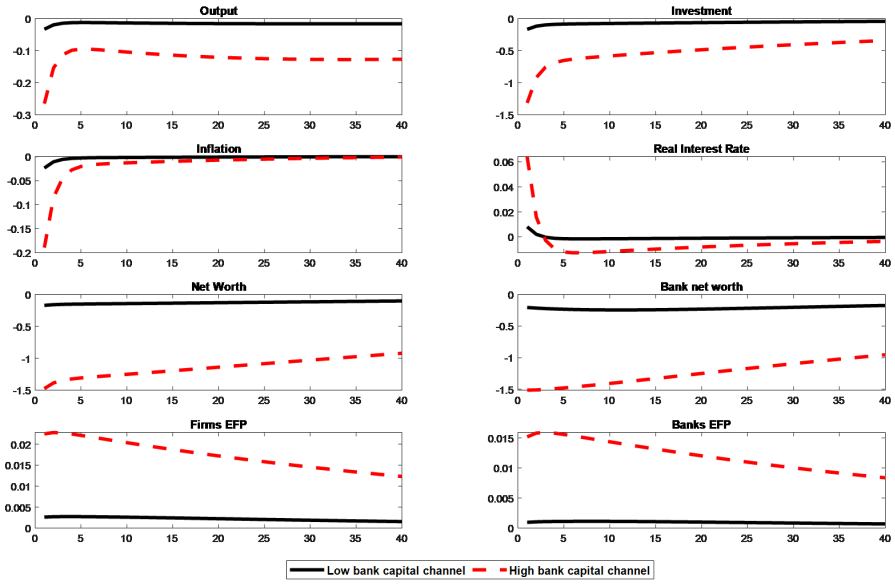

Figure 2. Bank tax impact on the real economy

Note: Solid line – low bank capital channel; dashed line – high bank capital channel.

As can be observed in Figure 2, in an economy with a low bank capital channel (solid lines), the impact of the tax on investment and output is very limited, as banks' financing costs are nearly insensitive to the shock and therefore have little effect on borrowing costs. The stronger the bank capital channel, the greater the negative impact of the tax on economic activity. This is explained by the fact that an increase in the bank tax reduces banks' profitability and their net worth accumulation, weakens their financial soundness, and translates into a higher external finance premium for banks. This premium is then passed on to borrowers, who face an even higher finance premium – and thus higher credit costs – ultimately weighing on investment and output.

Consistent with previous empirical studies in the literature, this simulation clearly shows that the negative effect of the bank tax on the external finance premium unambiguously dominates the positive impact associated with the tax shield channel.

In order to identify the presence and the tax shield channel we propose to conduct a second simulation exercise in which we consider the model without bank capital channel[20] and we compare the impact of a monetary shock in a model with and respectively without bank tax (Figure 3). We simulate a restrictive monetary shock (interest rate increase) of 1% standard deviation shock from the steady state.

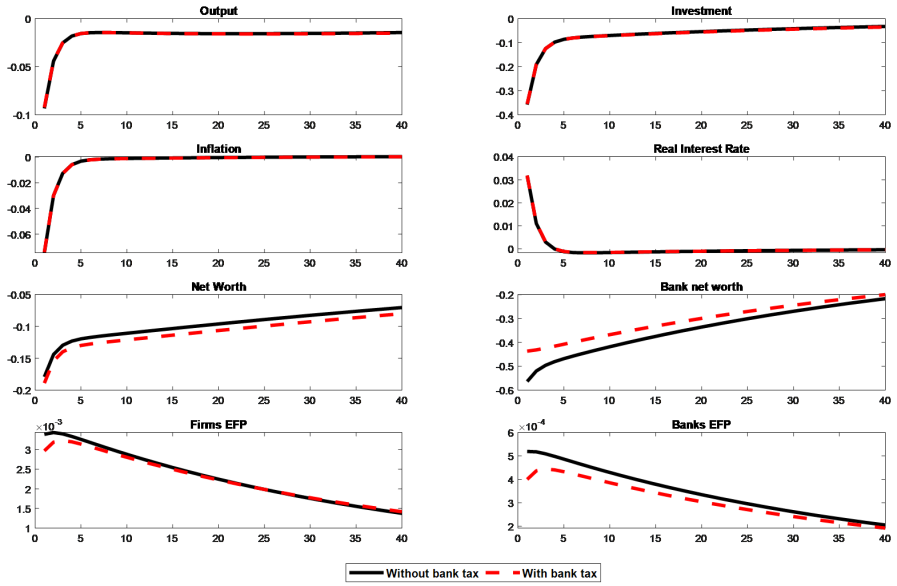

FIGURE 3. Bank tax shield channel identification

Note: Solid line – without bank tax; dotted line – with bank tax.

As expected, an increase in the central bank interest rate has a negative impact on the economy in both models. However, the bank tax shield channel can be identified through the smaller impact of the monetary shock on banks' net worth in the model with a bank tax (dotted lines). The increase in banks' external finance premium following the shock is also more limited, and it is worth noting that the bank tax has the strongest positive effect for banks in the short run (immediately after the shock).

It should also be noted that the bank tax shield channel partially benefits firms as well. Even though firms' net worth is more adversely affected by the shock in the bank tax model, their external finance premium does not differ significantly from that in the model without a bank tax. This explains why investment and output remain largely unchanged. Thus, while the bank tax shield channel may have a small positive effect at the bank level, its impact on the real economy (investment and output) is almost negligible.

[20]Considering a higher bank capital channel would not allow us to clearly identify the tax shield channel, as restrictive monetary policy would exert an additional negative impact on banks' net worth, automatically leading to an increase in banks' external finance premium. This would in turn raise the cost of borrowing for firms, with adverse effects on output and investment through the bank capital channel.

5. Conclusion and Discussion

This article contributes to the discussion on the impact of bank taxation on the real economy and provides a theoretical framework to explain the results previously obtained in the empirical literature. It extends the financial accelerator model with a bank capital channel by introducing a tax on banks' profits. From a microeconomic perspective, it highlights two opposing effects of the bank tax on banks' earnings, consistent with the tax shield channel and the bank capital channel respectively. From a macroeconomic perspective, we show that an additional bank tax can lead to higher financing costs in the economy, a reduction in credit supply, and a negative impact on investment and growth.

Further analyses will be conducted to show that the structural features of the banking sector affect the transmission of a bank tax to the real economy. In line with the bank capital channel, the more fragile the banking system, the greater the negative impact of the tax on investment and output. The Bayesian estimation of the model on real data represents another avenue for future extension of this preliminary work. In this regard, this research also carries important implications for the ongoing European Banking Union project, as the harmonization of bank taxation across member states may have significant and heterogeneous macroeconomic consequences depending on the financial soundness of national banking systems, thereby raising key questions about the design of a common regulatory and fiscal framework for the European banking sector.

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Appendix: Baseline Calibration of the Model

Description	**Parameter**	**Value**
Intertemporal elasticity of substitution	σ_c	0.75
Elasticity of labour disutility	σ_h	0.32
Subjective discount factor	β	0.99
Part of retailers with unchanged prices on the period	θ	0.75
Capital contribution to GDP	α	0.35
Part of entrepreneurial labour in total labour	$1-\Omega$	0.01
Depreciation rate for capital	δ	0.03
Internal capital adjustment costs parameter	ϕ	10
Part of inside capital transfers to survival banks	ζ	0.001
Survival rate for firms	γ^F	0.9831
Survival rate for banks	γ^B	0.99
Banks' external finance premium elasticity	χ^B	0.001
Firms external finance premium elasticity	χ^F	0.025
Steady state: Exogenous fixed values		
Real marginal cost	ρ	1/1.1
Banks inside capital/loans ratio	NB/B	0.2
Firms' net wealth/capital ratio	NF/K	0.4
Public expenditures/GDP ratio	G/Y	0.16
Firms' probability of default	$F\left(\overline{\omega}^F\right)$	0.03
Banks' probability of default	$F\left(\overline{\omega}^B\right)$	0.007
Average external finance premium for firms (annual basis)	$r^K - r^f$	0.02
Steady state: Calculated values		
Auditing cost for banks	μ^A	0.077
Auditing cost for households	μ^B	0.545
Variance for the ω distribution	σ^2	0.2531
ω threshold value for banks	$\overline{\omega}^B$	0.52
ω threshold value for firms	$\overline{\omega}^F$	0.6016
Banks probability to leave the market	$1-\gamma^B$	0.01
Firms' probability to leave the market	$1-\gamma^F$	0.017
Investment/GDP ratio	I/Y	0.24
Banks consumption expenses/GDP	CB/Y	0.006
Firms' consumption expenses/GDP	CF/Y	0.035
Total consumption expenses/GDP	$(C+CF+CB)/Y$	0.6