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Tax effects on bank liability structure

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ABSTRACT

Using supervisory data, we test the tax effects on the liability structure (the composition of deposits and other forms of debt) of the credit cooperative banks (BCC) by exploiting exogenous variations in the rates of tax on productive activities (IRAP) across Italian regions and over time. The testable predictions are derived from a model of bank liability structure that incorporates regulatory closure, endogenous default, and deposit insurance. We show that banks endogenously respond to tax cuts mainly by reducing non-deposit debt ratios, instead of deposit ratios, when lowering leverage. The overall liability structure adjustment substantially reduces non-equity funding costs.

1. Introduction

Since the global financial crisis, tax reform has gained attention as a policy tool for enhancing the stability of banks (International Monetary Fund, 2009, 2010). The European Commission has recommended its member countries to reduce the tax advantage of debt for the financial sector by either limiting the deductibility of interest expenses or extending the deductibility to equity costs (European Commission, 2014). During 2011–2017, some EU member countries have lowered corporate tax rates (Ricotti, 2018). Given these developments, it is important to understand how tax policy affects banks.

A key step to a better understanding of the tax effects on banks is to understand the effects on their liability structure (i.e., the ratios of deposits and non-deposit debt to assets, along with the equity ratio). The choice of liability structure is an integral part of a bank's decision on capital structure. It is different from the capital decision of non-financial firms because these firms do not have deposits on balance sheets. While the tax advantage motivates both banks and non-financial firms to use debt, it exerts different effects on deposits and non-deposit debt because of deposit service, deposit insurance, and capital requirement. A bank needs to

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choose liability structure strategically to balance the benefits of deposit service and deposit insurance against the costs of capital requirement and insurance premium when it weighs the tax advantage against the distress cost. Tax advantage is generally more important for banks than for non-financial firms because banks are usually more leveraged than non-financial firms.

Bank liability structure is important for the provision of banking service and financial stability in an economy. Since banks provide payment services and perform maturity transformation by accepting deposits and extending loans, bank liability structure affects the credit channel in the economy. In addition, the cost of bank capital depends on its liability structure because deposits are a less expensive funding source than non-deposit debt. Since lower funding cost means more profitable loans, liability structure affects bank credit supply.[2] Bank liability structure is also important for financial stability because non-deposit debt protects deposits. Many types of non-deposit debt are treated in ways similar to capital in bank regulation. The roles of those forms of debt in financial stability have been the focus of Flannery (1999), Goyal (2005), and Ashcraft (2008).

While many empirical studies suggest a positive relation between tax rate and bank leverage,[3] only a few studies examine the tax effects on bank liability structure. The long list of studies of the tax effects on bank leverage includes Keen (2011), Heckemeyer and de Mooij (2013), Horváth (2013), Cèlèrier et al. (2016), Milonas (2016), Bond et al. (2016), Panier et al. (2015), Schepens (2016), and Martin-Flores and Moussu (2018). These studies generally suggest that bank leverage is positively related to tax rate, but they do not examine how taxation affects bank liability structure. A rare study of the tax effect on non-deposit debt is conducted by Ashcraft (2008), who shows that subordinate debt of individual banks is positively related to tax rate but the subordinate debt of bank-holding companies is negatively related to tax rate. Schandlbauer (2017) conducts another study of the tax effects on non-deposit debt. He finds that the effects of tax cuts on bank liability structure are particularly unclear: bank-holding companies increase non-deposit debt ratio in response to tax hikes but do not reduce it in response to tax cuts. These studies do not examine the tax effects on the composition of deposits and non-deposit debt, besides being inconclusive about the tax effects on non-deposit debt.

The inconclusive results about the tax effects on non-deposit debt may arise from three difficulties in empirical identification. First, the business activities of a bank (especially a bank-holding company) are usually subject to multiple tax rates, not just a single tax rate that happens to change. Researchers need to approximate a bank's exposure to the tax-rate change. For instance, some studies use estimated deposits distribution to approximate tax allocation, while some other studies use the branches of a bank-holding company in a state or country as a proxy. Second, tax rates rarely change over time. Many studies of tax effects on banks focus on a single tax reform that affects all banks simultaneously. Those studies typically use the timing of the reform, ignoring the magnitude of the tax rate change. Third, a change in corporate tax rate usually affects all corporations, not just banks. The tax effects on non-financial firms can shift the demand for bank credits, and the demand shift can further affect the balance sheets of banks.

Overcoming the above three difficulties, we provide clear empirical evidence on how taxation affects bank liability structure. We use Italian credit cooperative banks (Banche di credito cooperativo, or BCC) and the regional taxation on productive activities (Imposta regionale sulle attivita produttive, or IRAP). The BCCs and IRAP present a laboratory nearly ideal for a study of the tax effects on bank liability structure. First, a BCC resembles other commercial banks except it is restricted to conduct business in its local region. Second, the IRAP resembles corporate taxes except the IRAP rates vary substantially over time and across regions. Third, the IRAP allows banks, but not non-financial firms, to deduct interest expenses. Taking advantage of these special features of BCCs and IRAP, we exploit the differences in the tax exposure of banks in different regions and at different times to identify the relation between bank liability structure and tax rate.

A common concern about empirical tests of tax effects on banks is that tax policy may endogenously depend on the economy in which the banks operate. The use of IRAP and BCCs in our tests should alleviate, if not eliminate, this concern because IRAP is a tax introduced by the central government to finance the nation's healthcare system. The tax base and the rates are decided mostly by the central government despite the regional economic conditions. Our empirical tests show that the IRAP rates are uncorrelated with the regional economies and financing conditions of BCCs. However, to guard against any potential connection between the healthcare expenditures and the regional economies, we control for regional economic conditions and BCCs' financial conditions in all our empirical tests.

To develop the hypotheses and to identify the control variables for our empirical tests, we construct a structural model of BCCs. The model captures the institutional features of BCCs and delivers testable predictions of the banks' strategic responses to tax rates. The banks in the model recognize the tax advantages brought by both deposits and non-deposit debt. They are also cognizant of the fact that deposits are cheaper than non-deposit debt, thanks to the profits in serving deposit accounts and to the deposit insurance backed by the government. Banks are aware of the costs associated with financial distress and capital requirement. These realistic economic underpinnings allow our model to make sharp predictions that are empirically testable. The major prediction of our model is that non-deposit debt ratio is more sensitive to a tax rate change than deposit ratio, while both are positively related to the tax rate. This prediction means that a bank tends to adjust non-deposit debt, instead of deposits, when optimizing its liability structure. This is consistent with the common view that deposits are more sticky than other debt (Drechsler et al., 2018). The model also predicts that the non-equity funding cost is positively related to the tax rate if the deposit ratio is higher than the non-deposit ratio.

[2] Carletti et al. (2021) provide evidence on how deposit funding affects bank lending. For identification, the authors exploit a tax reform in Italy that induced households to substitute bonds with deposits.

[3] There is also a literature debating the tax effects on the leverage of non-financial firms. For example, Graham (2003) provides evidence of the tax effects on firm leverage, but Strebulaev (2007) shows that firms do not adjust leverage. The focus of our study is on banks instead of non-financial firms.

Using the data on BCCs and IRAP, we empirically test the theoretical predictions. Our focus is to explore how the variations in tax rates affect the ratios of deposits and non-deposit debt (i.e., the liability structure).[4] Consistent with the prediction of our model, we find that non-deposit debt ratio is more sensitive to tax rate than deposit ratio. The non-deposit debt ratio of BCCs increases with the tax rate, and the marginal increase is statistically significant.

Empirically, we find that deposit ratio increases slightly with the tax rate, but the marginal increase is statistically insignificant. Since banks do not control the amount deposited by their customers, the primary way for banks to adjust their leverage and deposit ratio must be through adjusting non-deposit debt and assets. The weak sensitivity of deposit ratio may be partially attributed to banks' limitation in controlling the level of deposits on balance sheet. However, the nonnegative response of deposit ratio to tax rate and the strong positive response of non-deposit debt ratio agree with our theoretical predictions.

In view of our model, these findings are consistent with the theory that BCCs do their best to maximize value in capital decisions by adjusting non-deposit debt. These findings suggest that a tax cut has an effect in lowering the non-deposit debt ratio but not necessarily in lowering the deposit ratio. So, a tax cut leads to a lower bank leverage but not necessarily an improvement in the balance-sheet protection of deposits.[5]

Furthermore, we investigate how bank funding cost is related to tax rate. Our model predicts that the non-equity funding cost should be higher for a higher tax rate if the bank has more deposits than non-deposit debt on its balance sheet. On average, BCCs hold more deposits than non-deposit debt. We find that their funding costs indeed increase with the tax rate, as predicted by the theory. A tax cut by one percentage-point is associated with a drop by 12 basis points in the non-equity funding cost. This effect on the funding cost is significant not only statistically but also economically. It results mainly from the response of non-deposit debt because the response of deposit ratio is insignificant. Therefore, the effect of a tax cut on non-deposit debt substantially lowers the funding cost for banks.

While we focus on bank liabilities, the literature focuses mostly on bank leverage and bank credits. Most prior empirical studies agree that taxation affects bank leverage, as we have mentioned earlier, and that leverage affects the supply of bank credits.[6] We empirically test the tax effects on the leverage and credits of BCCs. We find that if the tax rate is higher, a bank uses higher leverage and allocates a smaller proportion of assets to supply credits. These findings are consistent with the existing literature, suggesting that the BCCs in our sample behave in the same way as the banks used in other studies.

The evidence of tax effects identified in BCCs confirms that tax is a factor in the determination of bank liability structure. We can identify the factor clearly because of the restrictions imposed on BCCs. By contrast, in a large, complex bank (or bank-holding company) that operates in multiple areas or countries with different tax policies, the liability structure could be dominated by many other factors or driven by many tax rules. The effect of a tax-rate change in the large, complex bank is then hard to detect. This may be why the prior literature finds that the tax effect on non-deposit debt in individual banks is different from the effect in bank-holding companies.

We find significant tax effects thanks to the large variations in the IRAP rates. While the variations across regions help us to identify the tax effects, the variations over time can be double-edged. Frequent variations lead to more precise statistical inference. However, a bank is likely to make smaller adjustment for a short-term (or temporary) tax-rate change than for a long-term (or permanent) change Hennessy et al. (2018). If this is true, the effects of a long-run (or permanent) tax-rate change on bank liability structure is likely to be larger than our estimates.

The rest of the paper is organized as follows. Section 2 discusses the BCCs and the IRAP rates. Section 3 develops the hypotheses of the tax effects on BCC liability structure. Section 4 presents the empirical results. Section 5 concludes the paper.

2. Italian mutual banks and regional tax

2.1. Credit cooperative banks

The supervisory data are about a specific typology of Italian banks: the credit cooperative banks. A BCC is a public company. A BCC can issue new shares at any time, just like a typical firm or bank. So, the shares outstanding of a BCC can vary over time. A BCC can also issue corporate bonds to finance their assets, just like other banks. Although BCC shares cannot be listed in stock exchanges, shareholders can trade the shares over the counter.

BCCs are for-profit organizations that operate in the interest of their shareholders. The shareholders of a BCC realize their gains either as dividends or as appreciation in share value or both. Most earnings of BCCs are retained as reserves to accumulate equity value, and the rest can be paid as dividends to shareholders. Profits retained in specific reserves are tax deductible from the Italian corporate income (IRES) taxation, but not from IRAP taxation. BCCs are not obligated to pay dividends, and the size of dividend depends on the profit, same as the dividends of other corporations. Besides distributing earnings to shareholders via dividends, BCCs may also distribute earnings as discounts awarded on a pro rata basis relating to the activity between the members and their cooperative (so called "ristorni"). "Ristorni" represents an important way to avoid the IRES tax when increasing shareholders' value.

A BCC can enter bankruptcy if it is no longer profitable for shareholders. The shareholders, as well as the bond holders, bear the risk of losing their investments if the BCC is liquidated for bankruptcy. Therefore, the equity of a BCC is not different from the equity of a typical corporation.

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[4] Bond et al. (2016) use the same data to investigate bank leverage, but they did not examine the composition of deposits and non-deposit debt.

[5] The total balance-sheet protection of deposits is measured by the capital adequacy ratio, which is the sum of Tier-1 equity, which includes retained earnings, and Tier-2 debt, which includes many types of non-deposit debt, divided by the risk-weighted assets.

[6] See European Banking Authority (2015), Michelangeli and Sette (2016), and Cèlèrier et al. (2016).

Like typical banks, BCCs are supervised by the central bank and subject to capital requirement and regulatory closure. The Bank of Italy requires BCCs to comply with the same set of supervisory ratios as the other banks in Italy. As required by the regulations in Italy, deposits at BCCs are covered by deposit insurance up to 100,000 euros per account, just like deposits at other commercial banks.

The law restricts BCCs to operate in their own local areas. The charter of a BCC must state that it operates in its territorial jurisdiction, which consists of the communities where the BCC has at least one branch and the neighboring communities. BCCs do not have sizable trading books on balance sheets, unlike large, complex banks. The legislation does not allow BCCs to take speculative positions in derivatives; derivatives are allowed only for hedging. BCCs do not actively participate in the market of securitization. BCCs are restricted to focus on making loans to households and small businesses. These restrictions entail that the business of BCC is very similar to the core business of a commercial bank.

Our data include all BCCs operating in the regions of the Italian territory during 1999–2011. They represent more than half of the banks operating in Italy, although their assets constitute only a sixteenth of the total assets in the Italian banking system. Although BCCs have been decreasing during these years, mainly because of merger and acquisitions, there were still 405 BCCs by the end of 2011.

To show the effects of the restrictions on BCCs, we compare them with Italian commercial banks, which are not restricted to operate in local areas. Commercial banks do not include foreign banks that are part of Italian banking groups or branches of foreign banks operating in Italy. Panel A of Table 1 compares the balance sheets of BCCs and commercial banks in three different years of our sample: the beginning year (1999), the middle year (2005) and the last year (2011).

The top half of the panel compares the assets. BCCs make most of their loans to non-bank residents, which include individual, small businesses, and the public administrations of the local regions. BCCs invest a nontrivial part of their assets in government bonds but only a trivial proportion in private-sector securities. By comparison, commercial banks devote a much larger portion of their assets to non-residents. Commercial banks also allocate a larger portion of assets to banks and a smaller portion to government bonds.

The bottom half of panel compares the liabilities of BCCs and commercial banks. BCCs are more conservative in financing than commercial banks. For example, BCCs are mostly funded by the deposits from residents, while commercial banks are financed partly by deposits from foreigners and other banks. BCCs hold more capital and reserves than commercial banks. For instance, in 2011, the ratio of capital and reserves to total assets was 11.8% on average in BCCs, which is about one percentage point higher than the ratio in commercial banks.

Corporate bonds constitute a significant part of liabilities in both BCCs and commercial banks. For BCCs, corporate bonds are essentially the non-deposit debt. Panel A of Table 1 shows that corporate bonds were about 20% of the liabilities on BCC balance sheets in 1999. This percentage increased to nearly 30% in 2005 and 31% in 2011. The other part of non-deposit debt on BCC balance sheets is a tiny amount of foreign liabilities (only 0.02%). Commercial banks also issue a significant amount of corporate bonds (24.8% in 2011), but the bonds are only part of their non-deposit debt because their foreign liabilities are substantial (7.7% in 2011). The significant amount of bonds on the BCC balance sheets demonstrates that non-deposit debt is an important financing source for BCCs. A theoretical or empirical study of bank capital structure must not simply assume that a bank balance sheet has only deposits and equity.

Some BCCs have been closed by the regulator, but no BCC has ever defaulted its corporate bonds before its regulatory closure. This does not mean that BCC bonds are as safe as deposits because equity holders can default the bonds and liquidate the bank if they wish. Moreover, BCC bonds are not covered by insurance. The holders of a BCC bond may suffer a loss if the assets are not enough to repay for both the deposits and the bonds. Our theoretical model in Section 3 explains why it is not optimal for BCCs to default bonds before regulatory closure. The absence of early default of BCC bonds is consistent with value maximization (see Section 3.2).

Panel B of Table 1 presents the statistics of the deposits, non-deposit debt, and equity on the balance sheets of BCCs. BCCs generally have more deposits than non-deposit debt. The average ratio of deposits to assets (50.29%) is much higher than the average ratio of non-deposit debt to assets (24.72%). The variations of the ratios are substantial. The standard deviation is about 12% for both the deposit ratios and the non-deposit debt ratios. These variations reflect the differences in the liability structure among BCCs.

BCCs have several important features that are particularly useful for the econometric identification of tax effects. Because a BCC operates in a single region, a regional statutory tax rate applies to the whole balance sheet of the BCC. By contrast, a commercial bank operates in multiple regions, and a large commercial bank can even operate in multiple countries. A bank that is subject to different tax rates allocates its balance sheet proportionally for the tax rates according to the deposits from the regions. It is difficult to identify the effects of a tax rate on the liability structure because the tax applied to the bank balance sheet is the average of the tax rates weighted by the sources of the deposits. Making the identification of tax effects even more difficult, researchers usually do not observe the weights.

As each BCC is not part of any bank group during the sample period for our analysis,[7] using BCCs to test tax effects avoids a complication often involved with the test using commercial banks. A commercial bank is often part of a bank group, and the effect of the average tax rate on the capital structure of commercial banks belonging to a group are difficult to calculate because

[7] A BCC is prohibited from holding more than 20% of other banks. This means that a BCC cannot belong to or be the parent company of a banking group. The Italian government enacted a reform in 2016 that has removed this restriction by 2019.

Table 1
Summary statistics. Panel A presents the items of assets and liabilities as percent of total assets of BCCs (or commercial banks) for selected years. Assets do not include cash, fixed assets, and tangibles. Residents in a region include individuals, business, banks, and public administrations located in the region. Panels B and C include the summary statistics of the variables used in regressions. The sample includes 462 BBCs. There are a total of 5180 observations on each bank financial ratio and 280 observations on each regional economic variable. The number of available observations is reduced in the regressions for the calculation of first differences of the ratios and the inclusions of lags.
Source: Annual Report for 1999, 2005, and 2011 — Statistical Annexes, published by Bank of Italy.

A. Comparison of BCC with commercial banks

	BCCs			Commercial banks		
	1999	2005	2011	1999	2005	2011
Assets:						
Loans to resident banks	6.3	5.5	4.9	12.1	17.6	11.1
Loans to non-bank residents	58.8	71.8	73.9	60.8	56.0	56.2
Securities issued by residents	3.5	1.8	5.0	5.0	5.8	13.5
Non-resident loans/securities	1.9	1.2	0.8	12.2	12.7	10.5
Government bonds	28.6	18.7	14.6	5.4	3.2	5.2
Shares issued by residents	0.9	1.0	0.9	4.6	4.7	3.7
Liabilities:						
Deposits by banks	8.0	2.1	9.0	16.6	19.4	17.9
Deposits by non-bank residents	58.8	56.7	48.0	36.0	35.6	38.9
Bonds	19.7	29.9	31.0	19.9	23.2	24.8
Foreign liabilities	0.2	0.2	0.2	17.0	13.0	7.7
Capital and reserves	13.4	11.1	11.8	10.5	8.9	10.7

B. Financial ratios (in %) and total assets (in million euros) of BCC

	Mean	Stdev	Min	10%	Median	90%	Max
Assets	316.68	423.78	11.02	56.36	196.26	675.67	8116.22
Debt/Asset	24.724	12.050	0.003	7.822	25.524	40.312	69.023
Deposit/Asset	50.290	12.055	15.644	36.415	48.161	68.418	89.694
Equity/Asset	11.866	3.560	−0.765	7.869	11.402	16.827	27.163
Funding cost	2.121	0.714	0.160	1.250	2.051	3.100	4.490
Credit/Asset	83.825	6.330	47.597	75.498	85.219	90.571	95.646
Asset growth	9.294	10.627	−18.041	0.637	7.848	17.803	156.691
ROE	6.024	6.301	−109.301	1.558	6.147	11.687	45.707
ROA	0.691	0.650	−9.219	0.159	0.701	1.327	3.668
Service income	0.007	0.003	0.001	0.004	0.007	0.010	0.122
RWA density	65.476	14.185	17.546	47.143	65.464	83.652	131.114

C. Regional economic variables

	Mean	Stdev	Min	10%	Median	90%	Max
Log(GDP per capita)	10.008	0.279	9.358	9.617	10.064	10.334	10.471
Log(GDP)	11.703	1.100	8.714	9.906	11.616	12.947	13.800
Log(Employment)	6.652	1.060	3.998	5.050	6.507	7.739	8.454
Log(Employment ratio)	−0.905	0.174	−1.276	−1.174	−0.837	−0.722	−0.671
Log(Credit)	24.102	1.306	21.040	22.094	24.117	25.741	26.924

the relation between a tax rate and the liability structure of banks can be distorted by the capital allocation decided by the group managements.

The supervisory data on BCCs offer a rich set of observable financial ratios, such as the proportions of deposits, non-deposit debt, equity, and credits on balance sheets. In addition, we observe each bank's non-equity funding cost, which is the weighted average of the cost for deposits and the cost for non-deposit debt. While tax is a factor in the liability structure, many bank characteristics, such as the profitability of deposit services, the risk of assets, and the cash flow, also affect bank liability structure. The data contain information about commissions and fees, which are the income from deposit services. The supervisory data include the risk-weighted assets (RWA), from which we can calculate the RWA density (the ratio of RWA to the total assets) to measure the riskiness of bank assets. The data also contain information about the profitability and cash flows of BCCs: the return on equity (ROE) and the return on assets (ROA). Panel B of Table 1 presents the summary statistics of these characteristics of BCCs.

2.2. Regional tax on productive activities

The tax rates in our empirical tests regard a special type of Italian tax: the regional tax on productive activities (IRAP). The IRAP was introduced in 1998, aimed at financing the national healthcare system. The tax is levied on the earnings generated by all

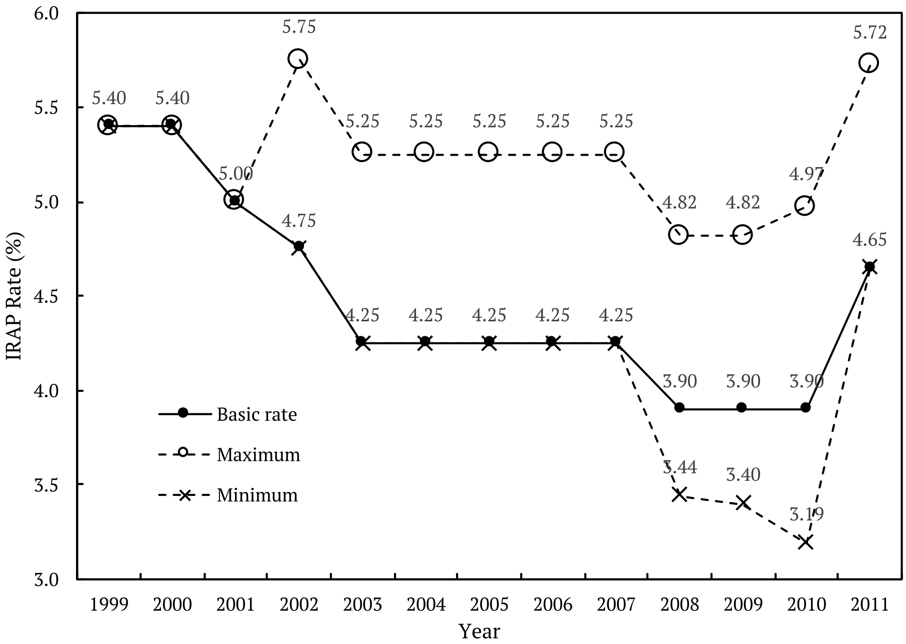

Fig. 1. IRAP rates for the financial sector. The figure shows the basic IRAP rate and the cross-sectional maximum and minimum of the IRAP rates in the Italian regions. Rates are presented in percentage points over the period of 1999–2011.

sectors, which include both corporations and unincorporated businesses (partnerships, sole traders, public administrations). Fig. 1 shows the highest and lowest IRAP rates for the financial sector across Italian regions during 1999–2011.[8]

The IRAP started with a basic rate in 1999, which was a flat rate for all regions. The basic IRAP rate was initially 4.25% for the non-financial sector and 5.4% for the financial sector. The rate for the financial sector was lowered gradually during the next ten years. It was cut to 5% in 2001, to 4.75% in 2002, and to 4.25% in 2003. It reached its lowest level of 3.9% in 2008. The rate was kept at 3.9% for three years until the Italian government raised the rate back to 4.65% in 2011.

Since 2002, the IRAP rate in a region can deviate from the basic rate. The deviation is limited to one percentage point until 2008 and 0.92 percentage points since then. The spread between the highest and lowest IRAP rates is one percentage point in 2002–2007 and much larger since 2008 (Fig. 1). Both the average IRAP rates and time variations are heterogeneous across regions (Fig. 2). Because the revenues from IRAP are earmarked to finance the national healthcare expenditure, the Italian central government introduced automatic IRAP-rate increases in 2006 for regions where a healthcare budget deficit arises. Each of the IRAP rates in Abruzzo, Campania, and Liguria automatically increased by one percentage point in 2006. These changes generate large variations in the IRAP rates over time and across regions.[9]

Non-financial firms and financial firms calculate the tax base differently for IRAP. The tax base of a non-financial firm includes profits, wages, and interest payments. IRAP does not discriminate debt financing and equity financing for non-financial firms: interest expenses, like dividend payouts, are not deductible from taxable earnings. The case for financial firms is different. The tax base of a financial firm includes profits and wages but excludes interest expenses. Therefore, banks can deduct interest expenses from IRAP, but non-financial firms cannot.

Even though the Italian corporate income tax (IRES) allows all firms, banks and non-financial firms, to deduct interest expenses, the variation of IRES tax rate should not exert effects on the balance sheets of BCCs. This is for two reasons. First, any modification of IRES tax rate applies to all Italian banks, without any variation between regions. Second, and most importantly, BCCs actually paid little IRES tax during our sample period. To avoid IRES tax, they exploited the rule that retained earnings and profits distributed via the so called "ristorni" are considered as costs. Even though the IRES tax rate is high (varied from 27.5% to 37% in the sample period), by retaining profits or paying "ristorni", BCCs practically avoided IRES taxation.

During our sample period, the IRAP rates range from 3.19% to 5.75% and they are different from region to region. Although the IRAP statutory rates are lower than the IRES statutory rate, the tax burden shouldered by BCCs due to IRAP is much higher because

[8] We do not use data after 2011 because of the 2012 tax reform in Italy. The reform changed the taxes that households pay for the interests on deposit and bonds and affected the demands for deposits and bonds (Carletti et al., 2021). This complicates the tax effects after 2011. The household tax rates are constant during our sample period and do not vary across regions.

[9] Note that the regional governments, not the central government, choose their IRAP rates to vary in the cross section. A change in the basic rate by the central government would raise or reduce the rates of all the regions.

Fig. 2. Map of the Italian regions and their IRAP rates. Each pair of numbers under the region name shows the average IRAP rate (in percentage points) and its standard deviation (in parenthesis) during 1999–2011.

the IRAP tax base is broader. The main reason is that retained earnings, "ristorni" and wages are not deductible from IRAP while they are deductible from IRES.

One may suspect that BCCs choose their locations based on the IRAP, but data show that the initial locations of BCCs are independent of the IRAP. Ninety-three percent of the BCCs in our sample was established before 2002, the year when the IRAP started to have different rates across regions. Most of the BCCs that established since 2002 chose regions with IRAP rates higher than the cross-sectional median. Although Trentino Alto Adige has the most BCCs and the lowest tax rate, all BCCs in this region were established before the introduction of IRAP.[10] Once established, each BCC stays to operate in the same region. The shareholders must liquidate the BCC before moving its operations to a different region. Liquidation of a BCC is prohibitively expensive because, by law, all reserved earnings must be surrendered to public mutual funds.

During our sample period, there were a total of 114 changes in the IRAP rates across all the regions. Table 2 lists the changes in each year. Among the 114 changes, 39 are increases and 75 are decreases. We divide the changes into three categories based on decision makers. The table shows that 96 changes were exclusively decided by the central government, and 13 changes were decided by local governments. The remaining 5 changes happened when the central and local governments decided to change rates in the same year. We also divide the changes by their applicability. The table shows that 80 changes applied to banks exclusively, 6 changes applied to banks plus certain firms such as oil companies, and the remaining 28 changes applied to all firms including banks.

[10] We repeat all tests by excluding the BCCs located in Trentino Alto Adige and do not find this region drives our results. We also repeat all tests using only the BCCs established before 2002 and find similar empirical results.

The IRAP-rate changes decided by the central government are 96 in total and of two types. The first type of changes (89 cases) results from discretionary changes in the basic rate and apply to all banks, regardless the region where they are headquartered. The central government made these changes only to increase (or decrease) tax revenues.[11] These changes are independent of regional banking and economic conditions.

The second type of the IRAP changes decided by the central government (7 cases) results from automatic changes owed to a healthcare budget deficit. If a region has a healthcare budget deficit, the local and central governments set a plan to cover the healthcare deficit. If the local government fails to comply with the plan, the IRAP rate increases automatically. It is worth stressing that these IRAP changes are not directly related to changes in macroeconomic conditions in the region but to the necessity to cover the healthcare budget deficit, which is only a specific part of the regional fiscal budget.

Most of the changes in the IRAP rates do not apply to non-financial firms and thus should not affect the demand for credit by non-financial firms. Since the IRAP applies different tax rates for financial institutions and non-financial firms, the central government and the local government can modify the tax rates for the banking sector while keeping the non-financial sector untouched. Table 2 shows that 80 IRAP-rate changes during 1999–2011 apply only to banks and other financial intermediaries. Another six changes apply to mostly banks. Only 28 changes apply to all banks and non-financial firms.

Although the decisions on IRAP rates are supposed to be independent of the regional banking and economic conditions, we test the potential influence of the regional banking and economic conditions on the IRAP rates. Our regression is

$$\Delta(\text{IRAP rate})_{jt} = \alpha' B_{jt} + \beta' Y_{jt} + \text{Type of IRAP change} + \text{Fixed effect} + \epsilon_{jt}, \quad (1)$$

where $\Delta(\text{IRAP rate})_{jt}$ is the IRAP-range change in region j from year $t-1$ to year t. We control for the type of decisions on the IRAP-rate changes and for the region fixed effects. The current banking conditions, denoted by B_{jt}, are the return on equity, the ratio of non-performing loans to total assets, and the ratio of equity to assets.

The regional economic conditions, denoted by Y_{jt}, are the change in regional per-capita GDP and the change in regional employment ratio. The regional GDP per capita is deflated to the 2005 value using the consumer price index (CPI). The employment ratio of a region is the total number of employments divided by the total population in the region. The source of the economic data is National Institute of Statistics (Istituto Nazionale di Statistica, or ISTAT). Panels C of Table 1 present the summary statistics of these economic variables.

Table 3 presents the results of regression (1) and shows that the IRAP-rate changes are not influenced by the current regional banking and economic conditions. The coefficients of the five banking and economic variables are insignificant regardless of the control variables. The first column of estimates shows the results controlling for the direction of rate decisions (up or down). The second column shows the results controlling for the motivations for the rate decisions (for healthcare budget or other reasons). Since the government decisions are usually based on the reported data, we test whether the IRAP-rate changes are correlated with the lagged banking and economic conditions. We do not find correlations either, as the last two columns show. Overall, we do not find evidence that the current or past banking and economic conditions influence the changes in the IRAP rates.

Since the IRAP-rate changes may be influenced by the local government forecasts of healthcare budget, a concern is that the healthcare expenditure in a region is related to the regional economy, causing the determination of IRAP rate to be related to the demand for banking services. For this concern, we test whether the IRAP rate changes predict the regional economy. The regression for this test is

$$y_{jt} = \alpha + \sum_{k=0}^{3} \beta_k \Delta(\text{IRAP rate})_{jt-k} + \text{Fixed effects} + \epsilon_{jt}, \quad (2)$$

where the dependent variable is either the change in the logarithm of regional GDP, the change in the logarithm of regional employment, or the change in the logarithm of total bank credit. The regressions are controlled for the region and year fixed effects. To be conservative, we include three lagged changes in the tax rates, besides the current change. The null hypothesis of the predictability test is $\beta_0 + \beta_1 + \beta_2 + \beta_3 = 0$. The results of the test are reported in Table 4. The coefficients of the IRAP rate changes are insignificant. The p-value of the predictability test is well above 5% for GDP, employment and total credits. The test on total credits indicates that the commercial banks that operate on the whole Italian territory are not significantly affected by regional specific IRAP changes.

The results of the regressions (1) and (2) suggest that the determination of IRAP rates is exogenous from the regional banking and economic conditions. However, one may concern that some hidden channels in politics allow the regional economies to influence the IRAP rates and simultaneously affect the balance sheets of the banks. Therefore, we do not assume that IRAP rates are exogenously determined. Instead, we control for the regional economic conditions in all empirical tests, assuming that the IRAP rates potentially depend on the conditions of regional economies.

3. Hypotheses about the BCC liability structure

3.1. A model of liability structure

We use an economic model to develop testable hypotheses and to interpret empirical results. The literature has argued that some determinants of the capital structure of banks are unique for banks while some other determinants are shared by non-financial firms.

[11] A specific example is the change in 2011 when the IRAP basic rate increased from 3.9% to 4.65% only for financial companies.

Table 2
Categories of the changes in the IRAP rates are classified by direction, decision maker, and coverage. The direction of a change is either an increase or a decrease. Decisions are made either by the central government, or by a regional government, or by both simultaneously. A change is applied to (1) banks, which include all financial intermediaries, (2) banks plus certain firms such as oil companies, or (3) all companies, which include both banks and non-financial firms.

Year	01	02	03	04	05	06	07	08	09	10	11	Total	%
Number of changes	20	20	19	1	1	3	3	20	2	5	20	114	100
Direction:													
Increase	0	4	0	1	1	3	3	2	1	4	20	39	34
Decrease	20	16	19	0	0	0	0	18	1	1	0	75	66
Decision by													
Central gov	20	16	17			2		17		4	20	96	84
Regional gov		4		1	1	1	3		2	1		13	11
Both at same time			2					3				5	4
Applied to													
Only banks	20	18	19	1		1	1				20	80	70
Banks and some firms		2			1		2	1				6	5
All banks and firms						2		19	2	5		28	25

Table 3
Influence of regional banking and economic conditions on the IRAP rates. Robust standard errors (clustered at region-year level) are reported in brackets for the estimated regression coefficients. The marks *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively. The regressions in the first three columns use 256 observations, and the last regression uses 236 observations.

Dependent variable: $y = \Delta(\text{IRAP rate})_{jt}$ / *Independent variable*	Control For: Direction of IRAP-Rate change	Decision of IRAP-Rate change	Lagged bank characters	Lagged economic variables
$(\text{Bad loan/Asset})_{jt}$	−0.0013	−0.0033	−0.0231	−0.0127
	(0.0130)	(0.0120)	(0.0154)	(0.0175)
$(\text{Equity/Asset})_{jt}$	−0.0196	−0.0127	−0.0122	−0.0200
	(0.0145)	(0.0135)	(0.0137)	(0.0164)
$(\text{ROE/Asset})_{jt}$	0.0048	0.0039	0.0039	0.0040
	(0.0032)	(0.0031)	(0.0032)	(0.0044)
$\Delta\text{Log(GDP per capita)}_{jt}$	0.5735	0.5112	0.5386	0.6727
	(0.8796)	(0.8683)	(0.8818)	(0.9299)
$\Delta\text{Log(Employment ratio)}_{jt}$	0.3571	0.2931	0.3256	−1.0209
	(1.2849)	(1.2695)	(1.3583)	(1.5721)
$(\text{Bad loan/Asset})_{jt-1}$			0.0188	0.0145
			(0.0189)	(0.0213)
$(\text{Equity/Asset})_{jt-1}$			−0.0092	−0.0122
			(0.0100)	(0.0118)
ROE_{jt-1}			−0.0052	−0.0086
			(0.0046)	(0.0070)
$\Delta\text{log(GDP per capita)}_{jt-1}$				1.7036
				(1.0539)
$\Delta\text{log(Employment)}_{jt-1}$				1.2897
				(1.3021)
$(\text{IRAP GOV UP})_t$	0.6117***			
	(0.0633)			
$(\text{IRAP GOV DOWN})_t$	−0.4455***			
	(0.0275)			
$(\text{IRAP GOV HEALTH UP})_t$		0.3823**	0.3844**	0.4363***
		(0.1718)	(0.1708)	(0.1596)
$(\text{IRAP GOV HEALTH DOWN})_t$		−0.1398**	−0.1104	−0.0805
		(0.0672)	(0.0691)	(0.0820)
$(\text{IRAP GOV OTHER UP})_t$		0.6786***	0.6331***	−0.6037***
		(0.0358)	(0.0536)	(0.0724)
$(\text{IRAP GOV OTHER DOWN})_t$		−0.4599***	−0.4745***	−0.4896***
		(0.0262)	(0.0280)	(0.0387)
Region fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.5341	0.5454	0.5429	0.5504

For instance, Diamond and Rajan (2000) theorize that deposit insurance and regulatory capital requirement play important roles in bank capital structure and that the choice of leverage results from the trade-off between the income of deposit service and the ability to force borrower repayment. Gropp and Heider (2010) empirically show that bank leverage depends on capital requirement besides the two traditional factors, tax and financial distress, which determine the leverage of non-financial firms. Sundaresan and Wang (2014) demonstrate that the liability structure of a value-maximizing bank should strategically balance the tax advantage,

Table 4
Predictive power of the IRAP rate on the changes of regional economic conditions. The economic conditions are the logarithms of the per capita GDP (log(GDP)), employment (log(Empl)), and total bank credit (log(Credit)). Regional economic variables are winsorized at 5%. Similar results are obtained without winsorization. Robust standard errors (clustered at region-year level) are reported in brackets for the estimated regression coefficients. The marks *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively. The null hypothesis in the predictability test is that the sum of the coefficients of the current and three lagged IRAP rates is zero. Each regression uses 240 observations.

	Dependent variable		
	$\Delta\log(\text{GDP})_{jt}$	$\Delta\log(\text{Empl})_{jt}$	$\Delta\log(\text{Credit})_{jt}$
$\Delta(\text{IRAP rate})_{jt}$	0.4003	−0.0156	0.8872
	(0.2828)	(0.2317)	(0.6395)
$\Delta(\text{IRAP rate})_{jt-1}$	−0.1428	0.3800	0.7609
	(0.3349)	(0.2835)	(0.5481)
$\Delta(\text{IRAP rate})_{jt-2}$	0.1383	0.4347	0.4052
	(0.3360)	(0.2788)	(1.0366)
$\Delta(\text{IRAP rate})_{jt-3}$	−0.0148	0.1803	−0.0300
	(0.3226)	(0.2335)	(0.7081)
Region fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
p-value of predictability test	0.6026	0.1389	0.2475
Adjusted R-squared	0.9974	0.5205	0.3726

deposit service, and deposit insurance against the distress cost, capital requirement, and insurance premium. Our model of BCCs follows Sundaresan and Wang's idea and is consistent with the taxation and regulation of BCCs.

There are n heterogeneous banks (BCCs). Bank i is subject to tax rate τ_j if its location is in region j. Each bank owns a portfolio of assets such as loans and securities that generate cash flows. The cash flows of the bank asset portfolios are risky, and we assume that they follow geometric Brownian motions. The volatilities of the asset cash flows are heterogeneous across banks, and σ_i denotes the volatility of the asset cash flow in bank i. The after-tax asset value of bank i, denoted by V_i, is the all-equity bank value, assuming the bank is financed only by equity. The asset value, under these assumptions, follows a geometric Brownian motion with volatility σ_i. In an equilibrium, there is a risk-neutral probability measure such that the value of each asset and security is the expected value discounted at the risk-free rate. Let r be the risk-free rate.

Each BCC takes deposits, which are a source of the bank's funding. As we have pointed out in Section 2.1, deposits of BCCs are insured. Let D_i be the deposits in bank i. The deposit ratio of the balance sheet of bank i is D_i/V_i. The insurance organization in Italy uses a uniform, fixed assessment rate, denoted by ρ.[12] The insurance premium that bank i pays is ρD_i. Insured deposits are safe assets. Deposits bring income to the bank, besides being a source of funding. Banks pay low (often zero) interests on deposits or earn fees for providing financial services to depositors. Assume the income from serving deposits is $\eta_i D_i$, proportional to deposits, where η_i is the income per unit of deposits in bank i. The bank's net liability to depositors is $(r-\eta_i)D_i$. We assume $r \geq \eta_i > \rho$. The assumption of $\rho < \eta_i$ means that the insurance premium is smaller than the income from serving deposits. Otherwise, the banks see no benefit in the business of serving deposits. This assumption ensures that the net benefit of deposits after paying insurance premium is still positive. This positive net benefit incentivizes banks to hold deposits. Italian banks do not pay ex ante deposit insurance premium during our sample period. So, we actually have $\rho = 0$ for BCCs, and thus the assumption of $\rho < \eta_i$ holds.

Besides taking deposits, each BCC finances loans and securities in its assets by borrowing from financial markets. We refer to all the borrowing from the markets as non-deposit debt. Corporate bonds are almost the entire non-deposit debt in BCCs, as we have seen in Table 1. Let B_i be the value of non-deposit debt in bank i. The non-deposit debt ratio (or simply, the debt ratio) of the balance sheet is B_i/V_i. The bank has to pay a premium for credit risk because non-deposit debt is uninsured and because the debt holders are ranked lower than the depositors in claiming the liquidation value of bank assets. Let s_i be the credit spread on non-deposit debt. The bank's liability for non-deposit debt is $(r+s_i)B_i$. The credit spread endogenously depends on the liquidation risk associated with the liability structure. It is an endogenous variable to solve in our model.

The total debt of bank i consists of deposits and non-deposit debt: $D_i + B_i$. The bank's leverage is measured by $(D_i + B_i)/V_i$, which is the leverage ratio. Alternatively, the bank's leverage is reflected by its tangible equity: $E_i = V_i - (D_i + B_i)$. The tangible equity ratio is $E_i/V_i = 1-(D_i+B_i)/V_i$, which measures how well a bank is capitalized. A higher tangible equity ratio means a lower leverage. The tangible equity ratio in our model resembles the tier-1 ratio or equity ratio used in bank regulation.

The equity holders of a BCC garner all the residual value and earnings of the bank after paying the contractual obligations associated with deposits and non-deposit debt. Since the taxable earnings exclude interest expenses, the total after-tax liability of deposits and non-deposit debt of bank i is $(1-\tau_j)[(r+\rho-\eta_i)D_i + (r+s_i)B_i]$ if it is located in region j. Let δ_i be the rate of cash flow of the bank's assets. Then, $\delta_i V_i - (1-\tau_j)[(r+\rho-\eta_i)D_i + (r+s_i)B_i]$ is the flow of earnings to the equity holders. The value of equity, denoted by S_i, is the value of all earnings accumulated to the bank or to be paid out as dividends later.

[12] The exogenously fixed assessment rate is a special institutional feature of the deposit insurance in Italy. By contrast, the assessment rate used by the FDIC in the U.S. endogenously depends on the bank liability structure and the asset risk. Sundaresan and Wang (2014) introduces a model of bank liability structure with endogenous insurance premium. We modify that model to fit the special institutional feature in Italy.

The regulator, which is the Bank of Italy, closes a BCC for liquidation if its total capital ratio, which is $(V_i - D_i)/V_i$, falls to or below a threshold β.[13] So, the value of assets that triggers a regulatory closure is $V_i^c = D_i/(1-\beta)$. Since liquidation is costly, the liquidation value is $(1-\alpha)V_i^c$, where $\alpha \in (0,1)$ measures the dead-weight loss in liquidation. We assume $\beta < \alpha$, i.e., when the regulator closes a bank, it does not have enough to payback the entire deposits. If $\beta \geq \alpha$ otherwise, then $(1-\alpha)V_i^c \geq D$, which implies that deposits would always be covered by the liquidated assets and thus risk-free. If this were true, there would have been no reason for deposit insurance. After a regulatory closure, depositors are paid in full because the insurance organization covers the shortfall. The debt holders will be paid fully or partially, depending on how much money is left after repaying the depositors. Thus, the recovery value of non-deposit debt at a regulatory closure is $[(1-\alpha)V_i^c - D_i]^+$, where $[x]^+$ equals x if $x > 0$ or 0 otherwise.

The equity holders of a BCC can also close and liquidate the bank if they wish. The optimal point for equity holders to liquidate the bank should maximize equity value. Therefore, equity holders should fulfill the obligation of the bank's liability until the equity value reaches zero. This is called an endogenous default in the literature. Equity holders of a BCC should never liquidate their bank before its equity value reaches zero because, as we mentioned earlier, they must surrender the retained earnings to the local administration. Let V_i^d be the asset value at which the equity value reaches zero, the liquidation value of the assets is $(1-\alpha)V_i^d$ after the liquidation cost. Then, the recovery value of the non-deposit debt at liquidation is $[(1-\alpha_i)V_i^d - D]^+$. To sum up, a BCC is liquidated if the asset value falls to either the regulatory closure boundary V_i^c or the endogenous default boundary V_i^d. So, the liquidation boundary is $V_i^l = \max\{V_i^c, V_i^d\}$.

The bank value of a BCC, denoted by F_i, is the combined value of deposits, non-deposit debt, and equity. That is, $F_i = D_i + B_i + S_i$. The bank value can be different from the asset value because of the benefits of financing through deposits and non-deposit debt. The difference, $F_i - V_i$, is the bank's charter value. We can also view $(F_i - V_i)/V_i$ as the bank's return on assets (ROA). A bank in our model adds value to assets by earning income from deposit service and by taking advantage of the tax benefits. A firm, by contrast, takes advantage of the tax benefits but is not involved in the business of serving deposits.

Since BCCs are for-profit organizations, each BCC should strategically choose liability structure to maximize its bank value. The next proposition gives a closed-form formula of the optimal liability structure. The derivation of the formula is detailed in section A.1 of the Online Appendix.

Proposition 1. *In equilibrium, bank i in region j chooses the liability structure so that the regulatory closure boundary equals the endogenous default boundary: $V_{ij}^c = V_{ij}^d$. The deposit ratio and non-deposit debt ratio of the balance sheet are*

$$D_{ij}/V_i = \pi_{ij}^{1/\lambda_i}(1-\beta) \tag{3}$$

$$B_{ij}/V_i = (1-\pi_{ij})\pi_{ij}^{1/\lambda_i}\left(\frac{1+\lambda_i}{\lambda_i}\cdot\frac{1}{1-\tau_j} - (1-\beta)\frac{r+\rho-\eta_i}{r}\right), \tag{4}$$

and the credit spread is

$$s_{ij} = r\pi_{ij}/(1-\pi_{ij}), \tag{5}$$

where π_{ij} is the state price of bank liquidation given by

$$\pi_{ij} = \frac{1}{1+\lambda_i}\cdot\frac{(1-\tau_j)\lambda_i(1-\beta)(\eta_i-\rho)+\tau_j(1+\lambda_i)r}{(1-\tau_j)\lambda_i\beta r + (1-\tau_j)\lambda_i(1-\beta)(\eta_i-\rho)+\tau_j(1+\lambda_i)r} \tag{6}$$

and λ_i is a positive number that summarizes the characteristics of bank assets:

$$\lambda_i = \frac{1}{\sigma_i}\left\{\left[\left(\frac{r-\delta_i}{\sigma_i} - \frac{\sigma_i}{2}\right)^2 + 2r\right]^{1/2} + \frac{r-\delta_i}{\sigma_i} - \frac{\sigma_i}{2}\right\}. \tag{7}$$

The proposition says that the value-maximizing bank balances between deposits and non-deposit debt so that endogenous default and regulatory closure happen simultaneously. This implies that the equity holders do not liquidate a bank before a regulatory closure, consistent with the fact that no BCC has ever been liquidated by equity holders. This result has an intuitive economic reason. Because deposits are cheaper than non-deposit debt as financing sources, a bank should generally prefer deposits to non-deposit debt. However, if non-deposit debt is so low that the endogenous default boundary is below the regulatory closure boundary, an increase in non-deposit debt will capture more tax benefit without increasing the liquidation risk. So, the bank should take as much non-deposit debt as possible until the endogenous default boundary is as high as the regulatory closure boundary.

The liability structure in the above proposition depends on τ_j, σ_i, δ_i, η_i, r, and β but is independent of α. The liquidation cost α is irrelevant for the liability structure in equilibrium because the assessment rate ρ of deposit insurance in Italy is fixed, independent of the risk of the deposits. Had the FGD use a risk-based assessment rate, as the FDIC does in the U.S., the liability structure would have been a function of α. For the bank liability structure with a risk-based assessment rate, we refer readers to Sundaresan and Wang (2014).

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[13] The regulator's liquidation or resolution decision (taken when bank's asset value is lower than that of deposits) reflects a Total Loss-Absorbing Capacity (TLAC) approach. The TLAC standard requires banks to have enough equity and bail-in debt (bonds and other liabilities) to be able to pass losses to investors in case of bank closure, and minimize the risk of a government bailouts. The TLAC standards in Europe are designed as Minimum Requirement for own funds and Eligible Liabilities (MREL, see https://srb.europa.eu/en/content/mrel), including specific rules for credit cooperative banks. In the model, the inclusion of bonds together with equity to absorb losses is a simplification but allows us to consider the possible existence of convertible bonds (hybrid securities that combine features of straight debt and equity) and other forms of subordinated debt.

3.2. Comparative statics and testable hypotheses

The closed-form formula of BCC liability structure in Proposition 1 is convenient for analyzing the comparative statics and for developing testable hypotheses. The next proposition presents the comparative statics for the tax effects on liability structure. The derivations of all comparative statics are provided in section A.2 of the Online Appendix.

Proposition 2. *If BCC i is located in region j, the marginal effects of tax rate on the deposit and debt ratios are both positive, and the effect on non-deposit debt ratio is larger than the effect on deposit ratio. That is,*

$$\frac{\partial(B_{ij}/V_i)}{\partial\tau_j} > \frac{\partial(D_{ij}/V_i)}{\partial\tau_j} > 0. \tag{8}$$

Inequality (8) implies that both the deposit ratio D_{ij}/V_i and debt ratio B_{ij}/V_i of the BCC in region j are higher for a higher tax rate τ_j. It immediately follows that the tangible equity ratio is lower if the tax rate is higher, or equivalently, the leverage is higher for a higher tax rate. The relation between bank leverage and tax has already been extensively studied in the literature. The focus of this paper is the choice between deposits and non-deposit debt. Proposition 2 predicts that the non-deposit debt ratio B_{ij}/V_i is more sensitive to tax than the deposit ratio D_{ij}/V_i.

The predictions in Proposition 2 are empirically testable. We test the following three alternative hypotheses:

Hypothesis 1: *The proportion of non-deposit debt ratio on a BCC balance sheet is an increasing function of the IRAP rate in its region.*
Hypothesis 2: *The deposit ratio of a BCC balance sheet is an increasing function of the IRAP rate in its region.*
Hypothesis 3: *The difference between the non-deposit debt ratio and deposit ratio of a BCC balance sheet is a positive function of the IRAP rate.*

Because the equity ratio is lower for a higher tax rate, the credit risk of the bank's non-deposit debt is higher. Intuitively, this implies that the credit spread s_{ij} should be wider for a higher tax rate. We do not observe the credit spreads of BCCs. Instead, we observe each BCC's weighted average of non-equity funding costs. The tax effect on the credit spread translates to an effect on the non-equity funding cost, but the direction of the effect is generally undetermined. Bank i's non-equity funding cost is the weighted average of costs of deposits and non-deposit debt:

$$c_{ij} = \frac{(r-\eta_i)D_{ij} + (r+s_{ij})B_{ij}}{D_{ij}+B_{ij}}. \tag{9}$$

The relation of non-equity funding cost to the tax rate is subtler than the relation of credit spread to the tax rate. The tax effect on c_{ij} can be either positive or negative, depending on the deposits and non-deposit debt on balance sheet. If the balance sheet has more deposits than non-deposit debt, the tax effect on the non-equity funding cost is positive, as stated in the next proposition.

Proposition 3. *If bank i is located in region j, the marginal effect of tax rate on the bank's credit spread is positive, i.e.,*

$$\frac{\partial s_{ij}}{\partial\tau_j} > 0. \tag{10}$$

If the bank's has more deposits than non-deposit debt, i.e., $D_{ij}/V_i > B_{ij}/V_i$, the marginal effect of tax rate on the non-equity funding cost is also positive, i.e.,

$$\frac{\partial c_{ij}}{\partial\tau_j} > 0. \tag{11}$$

The condition $D_i/V_i > B_i/V_i$ is sufficient for the tax effect on non-equity funding cost to be positive, although it is not a necessary condition. The liability structure of most BCCs satisfies this condition. In view of the cross-sectional distributions shown in Table 1, BCCs tend to have a larger deposit ratio than the debt ratio. This is consistent with Table 1, in which the average deposit ratio of BCCs is about 50%, whereas the average debt ratio is about 24%. We thus empirically test the following alternative hypothesis:

Hypothesis 4: *The non-equity funding cost of a BCC is an increasing function of the IRAP rate in its region.*

According to Proposition 1, tax is just one of the many factors that affect bank liability structure. The bank characteristics that determine liability structure are the asset volatility σ_i, the cash flow rate δ_i, and the deposit service income η_i. If two banks differ in these characteristics, their liability structures should be different, even if they are subject to the same tax rate. We need to control for the effects of these characteristics when we measure the tax effects. The next proposition summarizes the comparative statics of the bank characteristics.

Proposition 4. *The marginal effects of asset volatility and cash flow on the deposit and non-deposit debt ratios are negative, but their marginal effects on the bank's credit spread are positive. That is,*

$$\frac{\partial(B_{ij}/V_i)}{\partial\sigma_i} < 0, \quad \frac{\partial(D_{ij}/V_i)}{\partial\sigma_i} < 0, \quad \frac{\partial s_{ij}}{\partial\sigma_i} > 0 \tag{12}$$

$$\frac{\partial(B_{ij}/V_i)}{\partial\delta_i} < 0, \quad \frac{\partial(D_{ij}/V_i)}{\partial\delta_i} < 0, \quad \frac{\partial s_{ij}}{\partial\delta_i} > 0. \tag{13}$$

The marginal effects of service income on the deposit and non-deposit debt ratios are positive, and its marginal effect on the credit spread is also positive, i.e.,

$$\frac{\partial(B_{ij}/V_i)}{\partial\eta_i} > 0, \quad \frac{\partial(D_{ij}/V_i)}{\partial\eta_i} > 0, \quad \frac{\partial s_{ij}}{\partial\eta_i} > 0. \tag{14}$$

In the literature, empirical studies of banks typically use bank size (measured by the logarithm of total assets) as a control variable for bank characteristics. Bank size controls for the market power or for the capacity of banks to tap funds on the market (Kashyap and Stein, 1995, 2000; Kishan and Opiela, 2000), but it is unclear why bank size helps to control for the characteristics important for bank liability structure. Proposition 4 points to those important characteristics clearly. More over, the proposition predicts the directions in which those characteristics affect bank liability structure.

The supervisory data used in our study contain information about the asset risk, asset cash flow, and service income of each BCC, although we do not observe σ_i, δ_i, or η_i directly. We use Proposition 4 as a guide in choosing a set of variables that proxy for the asset risk, cash flow, and service income. In the data, we observe the risk-weighted assets (RWA) and the total assets of each BCC. The ratio of RWA to assets is the widely-used measure of bank asset risk, called RWA density. We thus use RWA density as a proxy for σ_i. The asset cash flow should be reflected in both the growth of assets and the return on equity. We observe these two variables and thus use them as proxies for δ_i. The overdraft commissions and other fees are major sources of the income earned by BCCs from deposit services. We observe the commissions and fees of each BCC and thus use them as a proxy for η_i. It is also possible that the return on equity partially reflects the service income besides asset cash flow. If so, we can view the return on equity as a proxy for both cash flow and service income.

4. Empirical results

4.1. Main results: Effects on bank liability structure

The tax effects we focus on are those listed in Propositions 2 and 3. We test the IRAP effects on the ratios of non-deposit debt and deposits on BCC balance sheets, and the non-equity funding cost of BCCs. The deposit ratio, non-deposit debt ratio, and funding cost characterize a bank's choice on its funding structure (Gambacorta and Shin, 2016). For the ratios of non-deposit debt and deposits, we test Hypotheses 1, 2, and 3, which predict that they are positively related to the IRAP rate and that non-deposit debt ratio is more sensitive to the tax rate than the deposit ratio. For non-equity funding cost, we test Hypothesis 4, which predicts that the cost is positively related to the tax rate.

We examine the changes in the balance sheets associated with the changes in the IRAP rates. The association of balance-sheet changes with tax-rate changes is consistent with the propositions about the marginal tax effects discussed in Section 3.2. The use of changes avoids the problem of spurious correlations caused by the co-integration of the levels (Kashyap and Stein, 1995). Hemmelgarn and Teichmann (2014) and Bond et al. (2016) use the same approach when they examine the relation of bank leverage to tax rate. They show that the changes in tax rates take approximately one year to affect bank balance sheets.

We use $\Delta(\text{IRAP rate})_{jt}$ to denote the change in the IRAP rate in region j from year $t-1$ to year t. For bank i that operates in region j, we use $\Delta(\text{Debt/Asset})_{ijt}$ to denote the change in the non-deposit debt ratio of the bank's balance sheet from year $t-1$ to year t. The regression for testing Hypothesis 1 is

$$\Delta(\text{Debt/Asset})_{ijt} = \gamma \cdot \Delta(\text{IRAP rate})_{jt-1} + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt}, \tag{15}$$

in which the ratio of non-deposit debt to total assets is the dependent variable. We lag the changes in the IRAP rates to test the causality between tax and bank ratios. The regression includes the year and bank fixed effects. The region fixed effects are not included because it is redundant to the bank fixed effects, given that each bank is restricted to operate in only one region. BCCs do not move from one region to another region either, as we have noted in Section 2.1. Adding the region fixed effects to the regression would make the matrix of the independent variables nonsingular.

The cash flow of assets, the profitability of deposit, and the risk of assets affect a bank's decision on liability structure, as theorized in Proposition 1. We therefore control for bank characteristics, which are lagged by one period in the regression. In view of Proposition 1, the non-deposit debt ratio depends on bank characteristics δ_i, η_i, σ_i. Changes in these parameters may cause the bank to adjust its liability structure. As discussed in Section 3.2, we have a set of observable variables to use as proxies for these parameters. The ROE and asset growth are proxies for δ_i, and their lagged changes, denoted by denoted by ΔROE_{ijt-1}, and $\Delta(\text{Asset growth})_{ijt-1}$, are included as control variables in the regression. The total service income scaled by assets is a proxy for η_i, and its lagged change, denoted by $\Delta(\text{Service income})_{ijt-1}$, is included as another control variable. The RWA density is a proxy for σ_i. (Recall that the RWA density is the ratio of the risk-weighted assets to the total assets.) The lagged change in the RWA density, denoted by $\Delta(\text{RWA density})_{ijt-1}$, is also included as a control variable. The summary statistics of these bank characteristics can be found in panel B of Table 1.

We also control for the change in regional economic variables. Although our empirical tests in Tables 3 and 4 suggest no endogenous link between the regional economy and its tax rate, we still do not assume that IRAP rates are exogenous. We control for the regional economy to guard against such a potential link. The regional economic variables used in our tests are the lagged changed in the logarithm of the per-capita regional GDP, denoted by $\Delta\log(\text{GDP per capita})_{jt-1}$, and lagged change in the logarithm of the regional employment ratio, denoted by $\Delta\log(\text{Employment ratio})_{jt-1}$. The summary statistics of these variables can be found in panel C of Table 1.

A concern with the control variables in empirical tests is that the results may be statistical artifacts of the control variables (Angrist and Pischke, 2010). We do three things to mitigate this concern. First, we guide the choice of control variables for the bank characteristics by a theoretical model, not by data mining. Second, we lag all the control variables by one period to ensure that they are in the conditional information before the current change. Third, we separately add the control variables to see how the estimated tax effects depend on the controls. Especially, we provide the estimates of the tax effects without the control variables for comparison.

The empirical estimates of the tax effects on the non-deposit debt ratio are reported in panel A of Table 5. If we do not control for bank characteristics or regional economy in regression (15), the estimated coefficient of the IRAP-rate change is about 0.35 and significant at the 5% level (the first column of the estimates in the panel). If we control for cash flow and service income, the coefficient is about 0.39 (second column). If we add the control for regional economy, the estimated coefficient changes only lightly, dropping to about 0.37 (third column). After we add the control for both asset risk and regional economy, the estimate is around 0.39 (fourth column). The statistical significance remains at the 5% level in each of these regressions. The positive effect of tax on the debt ratio is consistent with the prediction of the theoretical model. Overall, panel A suggests that a change by one percentage point in the tax rate tends to cause a change by 0.32~0.39 percentage points in the non-deposit debt ratio.

Panel A of Table 5 demonstrates the importance of bank characteristics in the determination of non-deposit debt ratio. The effects of the bank characteristics on non-deposit debt are consistent with Proposition 4. The theory predicts that the cash flow and asset risk have negative effects on the proportion of non-deposit debt on bank balance sheets. The coefficients of $\Delta(\text{Asset growth})_{ijt-1}$, ΔROE_{ijt-1}, and $\Delta(\text{RWA density})_{ijt-1}$ are all negative. The theory predicts that the service income has a positive effect on the non-deposit debt ratio. The coefficient of $\Delta(\text{Service income})_{ijt-1}$ is indeed positive and significant at the 5% confidence level. These signs of the control variables are strong evidence to support the theory.

To test the tax effects on deposit ratio, we use the change in deposit ratio as the dependent variable in regressions:

$$\Delta(\text{Deposit/Asset})_{ijt} = \gamma \cdot \Delta(\text{IRAP rate})_{jt-1} + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt}, \tag{16}$$

where $\Delta(\text{Deposit/Asset})_{ijt}$ is the change in the deposit ratio of bank i operating in region j from year $t-1$ to year t. The independent variables are the same as in regression (15).

The results of regression (16) are reported in panel B of Table 5. The tax effect on deposit ratio is much smaller than the effect on the non-deposit debt ratio. The estimated coefficient of the IRAP-rate change is about 0.21 and insignificant in the regression without the control variables (the first column of the estimates). If we control for cash flow and service income, the estimated coefficient is about 0.18 (second column). The estimated coefficient drops to about 0.11 after controlling for the regional economy (third column). It drops further to 0.09 after controlling for the bank risk (fourth column). The positive estimates of the coefficient suggest a positive association between deposit ratio and tax rate, consistent with our theoretical prediction. However, the estimates are all statistically insignificant, suggesting that the tax effect on deposits is small. The result is consistent with the stickiness of deposits explained by Drechsler et al. (2018). As we have pointed out in the introduction, banks do not fully control the amount deposited by their customers. Banks then must adjust their leverage and deposit ratio by adjusting non-deposit debt and assets. This may also contribute to the weak sensitivity of deposit ratio to the tax rate.

In panel B of Table 5, the signs of the coefficients of the bank characteristics, i.e., the changes in asset growth, ROE and RWA density, are negative and consistent with the predictions in Proposition 4. However, only asset growth has a marginally significant coefficient. The coefficient of service income is not statistically different from zero.

Panels A and B of Table 5 together suggest that the effects of the tax rate on the ratios of non-deposit debt and deposits are very different. The estimated tax effect on the non-deposit debt ratio, controlling for both bank characteristics and regional economy, is about 0.39, and the effect on deposit ratio is about 0.09, as discussed earlier. These estimates imply that the differential effect is about 0.3, supporting Hypothesis 3. For a formal statistical test of the difference, we can use the following regression:

$$\begin{aligned}\Delta(\text{Debt/Asset} - \text{Deposit/Asset})_{ijt} &= \delta \cdot \Delta(\text{IRAP rate})_{jt-1} \\ &\quad + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt},\end{aligned} \tag{17}$$

The estimate of δ is 0.31 with a standard error of 0.16, implying that the difference between the effects on the two ratios is significant at the 5% level. This result is consistent with the prediction in Proposition 2.

The tax effect on non-equity funding cost in Hypothesis 4 can be tested by a similar regression:

$$\Delta(\text{Funding cost})_{ijt} = \gamma \cdot \Delta(\text{IRAP rate})_{jt-1} + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt}, \tag{18}$$

where $\Delta(\text{Funding cost})_{ijt}$ denotes the change in the non-equity funding cost of bank i located in region j from year $t-1$ to year t. Proposition 3 predicts that the effect is positive if the bank has more deposits than non-deposit debt. As we have discussed earlier, Table 1 shows that BCCs indeed hold more deposits than non-deposit debt. We therefore expect γ to be positive. Since the interest rate is an important determinant of funding costs, we should point out that the year fixed effects in our regressions serve as the control for the interest rate.

The empirical results of regression (18) are reported in panel A of Table 6. The positive, significant coefficient of the IRAP rate change supports the theoretical prediction in Proposition 3. Without controlling for bank characteristics or regional economy, the estimated coefficient is about 0.11 (the first column of the estimates). It is about 0.12 if we control for cash flows and service income (second column). The estimate is quite similar after adding the control variables for regional economy (third column) and the control variable for bank risk (fourth column). All these estimates are significant at the 1% level. This evidence on funding cost supports Gambacorta and Shin (2016), who argue that better-capitalized banks pay less on their non-equity funding. The evidence

Table 5
Tax effects on liability structure. Robust standard errors (clustered by region-year) are reported in brackets for the estimated regression coefficients. The marks *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively. Each regression uses 4734 observations.

	Adding control for			
	Fixed effects	Cash flow	Economy	Asset risk
A. Effects on non-deposit debt: $\Delta(\text{Debt/Asset})_{ijt}$				
$\Delta(\text{IRAP rate})_{jt-1}$	0.3510**	0.3897**	0.3718**	0.3906**
	(0.1751)	(0.1767)	(0.1829)	(0.1853)
$\Delta(\text{Asset growth})_{ijt-1}$		−0.0097**	−0.0098**	−0.0092**
		(0.0040)	(0.0040)	(0.0040)
ΔROE_{ijt-1}		−0.0086	−0.0083	−0.0086
		(0.0101)	(0.0102)	(0.0102)
$\Delta(\text{Service income})_{ijt-1}$		20.6217***	20.5524**	20.5984**
		(7.9484)	(8.1497)	(8.1391)
$\Delta(\text{RWA density})_{ijt-1}$				−0.0138*
				(0.0079)
Adjusted R-squared	0.1442	0.1494	0.1500	0.1505
B. Effects on deposits: $\Delta(\text{Deposit/Asset})_{ijt}$				
$\Delta(\text{IRAP rate})_{jt-1}$	0.2122	0.1822	0.1129	0.0913
	(0.4308)	(0.4579)	(0.5040)	(0.5028)
$\Delta(\text{Asset growth})_{ijt-1}$		−0.0110*	−0.0108*	−0.0114*
		(0.0063)	(0.0062)	(0.0062)
ΔROE_{ijt-1}		−0.0150	−0.0150	−0.0147
		(0.0121)	(0.0120)	(0.0121)
$\Delta(\text{Service income})_{ijt-1}$		−51.4041	−47.7362	−44.7309
		(81.8344)	(81.6971)	(81.0426)
$\Delta(\text{RWA density})_{ijt-1}$				−0.0134
				(0.0105)
Adjusted R-squared	0.1513	0.1659	0.1673	0.1676
C. Effects on equity: $\Delta(\text{Equity/Asset})_{ijt}$				
$\Delta(\text{IRAP rate})_{jt-1}$	−0.1465***	−0.1496**	−0.1430**	−0.1520**
	(0.0649)	(0.0647)	(0.0669)	(0.0666)
$\Delta(\text{Asset growth})_{ijt-1}$		0.0014	0.0013	0.0005
		(0.0012)	(0.0012)	(0.0013)
ΔROE_{ijt-1}		0.0077	0.0079	0.0079
		(0.0050)	(0.0050)	(0.0050)
$\Delta(\text{Service income})_{ijt-1}$		−3.5696*	−3.5666*	−3.5782*
		(1.9986)	(2.0063)	(2.0054)
$\Delta(\text{RWA density})_{ijt-1}$				0.0033
				(0.0023)
Adjusted R-squared	0.1743	0.1753	0.1751	0.1724
Regional economy	No	No	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

also supports Berger and Bouwman (2013) who argue that better-capitalized banks have better access to wholesale funding markets. We should note that the coefficients of bank characteristics (cash flow, income, and asset risk) are all significant. This supports our theory that these variables are important considerations in banks' choices of liability structure, even when the tax advantage is a reason for banks to borrow.

The results in panel A of Table 6 suggest that a tax hike by one percentage point raises the non-equity funding cost by 11∼13 bps. This increase is significant in terms of economic magnitude. Since the equity ratios of BCCs are on average 11.866% (Table 1), the increase in the total funding cost is around 10 bps, which is more than 15% of the BCCs' return on assets, given that the average return on assets is 69 bps (Table 1). The effect on funding cost mainly results from the effect on the non-deposit debt ratio because the effect on the deposit ratio is insignificant. We have seen that a tax hike by one percentage point raises the proportion of non-deposit debt ratio by 0.39 percentage point. The increase in the non-deposit debt ratio appears to be small, but it jacks up the funding cost substantially. Therefore, the tax effect on bank liability structure is significant not only statistically but also economically.

One may question whether BCCs behave similarly to general banks. This question is important for our estimates of tax effects because the empirical results obtained from BCCs can be generalized to other banks only if BCCs behave similarly to a typical bank. This question is especially important when tax policy is considered as a tool to affect banks' financing decisions. Our empirical results and our model of BCC may together shed light on the question. In our model, each BCC takes deposits and provides banking services. It borrows from the debt markets and issues equity. It enjoys deposit insurance and is subject to regulatory capital requirement. All these are the basic features of a typical bank. The theoretical predictions about the tax effects on liability structure are derived under the assumption that BCCs maximize their values, just like typical banks as for-profit corporations. Then, the empirical confirmation of the predictions obtained from BCCs may be viewed as an indirect evidence that BCCs behave just like typical banks. In the next

Table 6

Tax effects on non-equity funding cost and bank credits. Robust standard errors (clustered by region-year) are reported in brackets for the estimated regression coefficients. The marks *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively. Each regression uses 4734 observations.

	Adding control for			
	Fixed effects	Cash flow	Economy	Asset risk
A. Effects on non-equity funding cost: $\Delta(\text{Funding cost})_{ijt}$				
$\Delta(\text{IRAP rate})_{j,t-1}$	0.1055***	0.1185***	0.1295***	0.1247***
	(0.0197)	(0.0205)	(0.0216)	(0.0211)
$\Delta(\text{Asset growth})_{ijt-1}$		0.0009***	0.0009***	0.0011***
		(0.0003)	(0.0004)	(0.0004)
ΔROE_{ijt-1}		0.0070***	0.0072***	0.0071***
		(0.0016)	(0.0016)	(0.0016)
$\Delta(\text{Service income})_{ijt-1}$		1.6622	1.6368	1.2213
		(1.0341)	(1.0290)	(0.9248)
$\Delta(\text{RWA density})_{ijt-1}$				0.0053***
				(0.0015)
Adjusted R-squared	0.7897	0.7914	0.7916	0.7938
B. Effects on bank credits: $\Delta(\text{Credit/Asset})_{ijt}$				
$\Delta(\text{IRAP rate})_{jt-1}$	−0.8931**	−0.8412**	−0.5128**	−0.5461**
	(0.4307)	(0.4147)	(0.2173)	(0.2174)
$\Delta(\text{Asset growth})_{ijt-1}$		0.0193***	0.0177***	0.0138***
		(0.0069)	(0.0054)	(0.0052)
ΔROE_{ijt-1}		0.0178	0.0325*	0.0355**
		(0.0202)	(0.0178)	(0.0173)
$\Delta(\text{Service income})_{ijt-1}$		−87.9773	−78.3497	−66.3094
		(68.8303)	(60.1971)	(52.0036)
$\Delta(\text{RWA density})_{ijt-1}$				−0.0980***
				(0.0124)
Adjusted R-squared	0.0653	0.0691	0.0698	0.0810
Regional economy	No	No	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes

section, we will investigate further how the other parts of BCC balance sheets respond to the tax rate changes and compare with the typical banks studied in the literature.

4.2. Additional results: Effects on leverage and credits

Since a large part of the banking literature is about bank leverage and bank credits, we check whether the leverage and credits of BCCs respond to the tax rate changes similarly to those reported in the literature. Consistency between the results obtained from BCCs and the results reported in the literature can be viewed as an evidence that BCCs operate similarly to the commercial banks.

As we have discussed in the Introduction, empirical studies of bank leverage generally agree that bank leverage is higher for a higher tax rate. We therefore examine the tax effect on the leverage of BCCs in the following regression:

$$\Delta(\text{Equity/Asset})_{ijt} = \gamma \cdot \Delta(\text{IRAP rate})_{jt-1} + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt}, \tag{19}$$

where $\Delta(\text{Equity/Asset})_{ijt}$ is the change in the equity ratio of BCC i in region j from year $t-1$ to year t. The fixed effects and control variables are the same as in regression (15). Since a lower equity ratio means a higher leverage, the alternative hypothesis in this test is that the coefficient (γ) of the change in the IRAP rate is negative.

The results of regression (19) are reported in panel C of Table 5. The first column of estimates is obtained without the control for bank characteristics or regional economy. The estimated coefficient of the change in the IRAP rate is about −0.15 and significant at the 5% level. The estimate remains similar if we gradually add the control variables for cash flow and service income (second column), for regional economy (third column), and for asset risk (fourth column). Therefore, a tax hike by one percentage point leads to a drop by 0.15 percentage points in the equity ratio. The negative tax effect on equity ratio, which is equivalent to a positive tax effect on leverage, is consistent with the results general reported in the literature.

Empirical studies of bank credits generally agree that an improvement in funding costs increases the credit supply. The European Banking Authority (2015) and Michelangeli and Sette (2016) report that better-capitalized banks supply more credit. Cèlèrier et al. (2016) show that the changes in tax policy in some European countries affected bank credit supply. Intuitively, a drop in funding cost makes more loans profitable to banks. In addition, a tax cut may incentivize banks to lend more because it leaves more money for the after-tax earnings. A drop in leverage may also increase credit supply, as Bolton et al. (2016) and Gobbi and Sette (2015) argue that in an economic system underpinned by relationship-based lending, adequate bank capital allows financial intermediaries to shield firms (borrowers) from the effects of unexpected shocks. Since a tax cut leads to lower leverage, it should lead to more lending.

We investigate the effects of the IRAP-rate changes on bank credits. The change in the ratio of total credits to total assets is used as the dependent variable in the following regression:

$$\Delta(\text{Credit/Asset})_{ijt} = \gamma \cdot \Delta(\text{IRAP rate})_{jt-1} + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt}, \tag{20}$$

where $\Delta(\text{Credit/Asset})_{ijt}$ is the change in this ratio from year $t-1$ to t in bank i in region j. The summary statistics of the credit-to-assets ratio can be found in panel B of Table 1. The control variables in the regression are the same as in the previous regressions. If BCCs behave in the same way as other banks, we expect a negative estimate of γ.

The empirical results of regression (20) are reported in panel B of Table 6. The estimated coefficient of the change in the IRAP rate is indeed negative. It is −0.89 and significant at the 5% level, without controlling for bank characteristics or regional economy. The estimated coefficient, if we control for cash flow and service income, is -0.84. If we add the control variables for bank risk and regional economic conditions, the estimate changes slightly to about -0.51. All these estimates are significant at the 5% level. The negative relation of bank credit ratio to the tax rate is consistent with the empirical evidence that has been reported in the literature.

Estimation of the tax effects on bank credit ratio can potentially be confounded with the tax effects on the loan demand by non-financial firms, caused by a change in their tax burden. We may observe a change in the credit ratio even if taxation does not affect bank decisions. The IRAP is advantageous for separating the effects on bank decisions from the effects on the loan demand of non-financial firms. A change in tax rate affects the demand for loans from a non-financial firm only if the tax-rate change is applicable to (i.e., covers) the non-financial firm. Among the 114 changes of the IRAP rates, 80 changes do not apply to non-financial firms. Another six changes apply to only some special firms such as oil companies. These changes should have no or very little effects on the aggregate loan demand by non-financial firms. Only 28 changes, which are a quarter of the 114 changes, cover all firms.

To separate the effects of tax-rate changes that are applicable to only banks, we add an interaction term, $\Delta(\text{IRAP rate})_{jt-1} \times I^{\text{all}}_{jt-1}$, where I^{all}_{jt-1} is a dummy variable that equals 1 if the IRAP change applies to all firms or 0 otherwise. The coefficient of $\Delta(\text{IRAP rate})_{jt-1}$ is then the effect of the tax-rate change that applies to only banks. The sum of the coefficients of $\Delta(\text{IRAP rate})_{jt-1}$ and $\Delta(\text{IRAP rate})_{jt-1} \times I^{\text{all}}_{jt-1}$ measures the effect of the IRAP change that applies to all firms. The difference in the coverages of the tax rates is a unique feature of IRAP rates. Most other tax rates cover all firms, not allowing researchers to isolate the tax effects on banks.

The results indicate that the estimated coefficient of the change in the IRAP rate is indeed negative (−0.91) after controlling for bank characteristics and regional economy. Meanwhile, the estimate of the coefficient of $\Delta(\text{IRAP rate})_{jt-1} \times I^{\text{all}}_{jt-1}$ is positive (0.88) and significant at the 5% level. The two coefficients sum up to −0.03, which means there is very little effect associated with those tax-rate changes that cover all firms. An explanation is that a tax hike leaves less money available for non-financial firms to invest, this could increase their need to borrow from banks. Then, the rise in the demand for bank loans counteracts the desire of banks to decrease loan supply.[14]

4.3. Controlling for asymmetric tax effects

As pointed out in the Introduction, there are studies finding that the tax effects are sometimes asymmetric for a tax hike and a tax cut. Some argue that banks should be less responsive to tax cuts. A potential reason is that the inability to commit future funding could cause banks to ignore the tax cut and remain highly leveraged, as theorized by Admati et al. (2018). There is also reason for another type of asymmetry. A bank may find it risky to raise leverage in response to a tax hike. Particularly, a bank may not risk getting too close to the regulatory capital constraint when it lowers equity ratio in response to a tax hike. If this is true, the effect of a tax hike should be smaller than the effect of a tax cut.

To test the potential asymmetry of the tax effects on the BCC balance sheets, we modify the previous regressions by including the product of $\Delta(\text{IRAP rate})_{ijt-1}$ and I^{hike}_{jt-1}. Here, I^{hike}_{jt-1} is a dummy variable that indicates whether the tax-rate change is positive. That is, $I^{\text{hike}}_{jt-1} = 1$ if the change is positive, or $I^{\text{hike}}_{jt-1} = 0$ otherwise. The coefficient of $\Delta(\text{IRAP rate})_{ijt-1}$ is then the effect of a tax cut. The results are reported in panel A of Table 7. We do not find evidence of asymmetry. The coefficient of the product term $\Delta(\text{IRAP rate})_{ijt-1} \times I^{\text{hike}}_{jt-1}$ is insignificant in each of the regressions. Therefore, the estimates of tax effects obtained for tax cuts and increases are quantitatively very similar.

When we allow asymmetric tax effects, the empirical results do not change. For the effects on non-deposit debt ratio and non-equity funding cost (the first and third columns of the estimates), the coefficients of $\Delta(\text{IRAP rate})_{ijt-1}$ remain positive, and they are significant at the 10% or 5% levels. For the effect on deposit ratio (the second column), the coefficient of $\Delta(\text{IRAP rate})_{ijt-1}$ is positive and insignificant. For the equity and credit ratios (the fourth and fifth columns), the coefficients of $\Delta(\text{IRAP rate})_{ijt-1}$ are negative and significant at 10% and 1% levels. Overall, the results indicate that tax changes have the effects on the financial ratios as predicted by the theory. BCCs seem to have the flexibility to adjust balance sheets in response to tax changes in both directions. A potential reason for the tax effects to be symmetric is that BCCs have solid equity ratios. The average BCC's equity ratio is 11.1%, as Table 1 shows.

[14] The robustness of the results reported in Tables 5 and 6 have been checked in two ways. First, by distinguishing IRAP changes at the central and local government level. In particular, we have augmented the models inserting an interaction term between $\Delta(\text{IRAP rate})_{jt-1}$ and a dummy CENTRAL that takes the value of one in case the IRAP change is decided at the central government level (zero otherwise). The significance of the interaction term $\Delta(\text{IRAP rate})_{jt-1} \times \text{CENTRAL}$ should indicate if such changes at the central level have a different effect with respect to the average effect of IRAP changes. The interaction terms are never significant, indicating that the effects of IRAP changes decided by the central government are statistically similar to the ones decided by the local government. Second, we excluded from the sample the 33 BBCs that were established after the IRAP started to have different rates across regions. The results remained qualitatively very similar, pointing to the fact that the initial locations of BCCs are independent of regional IRAP conditions.

Table 7
Controlling for asymmetric tax effects and for bank size. The parameter estimates are obtained from regressions and reported with robust standard errors in brackets (clustered by region-year). The marks *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively. Each regression uses 4734 observations.

	Dependent variable: Change in				
	Debt ratio	Deposit ratio	Funding cost	Equity ratio	Credit ratio
A. Controlling for asymmetric tax effects					
Δ(IRAP rate)$_{jt-1}$	0.3335*	0.2821	0.1849**	−0.1222*	−0.8039***
	(0.2001)	(0.3775)	(0.0768)	(0.0734)	(0.2721)
Δ(IRAP rate)$_{jt-1} \times I^{\text{hike}}_{jt-1}$	0.1910	−0.6006	−0.0913	−0.0954	0.6311
	(0.3478)	(0.9471)	(0.1510)	(0.1350)	(0.4434)
Adjusted R-squared	0.1503	0.1679	0.7953	0.1724	0.0839
B. Controlling for bank size					
Δ(IRAP rate)$_{jt-1}$	0.3916**	0.1914	0.1254*	−0.1651**	−0.6849***
	(0.1835)	(0.5237)	(0.0670)	(0.0694)	(0.2226)
(Bank size)$_{ijt-1}$	−1.0827***	0.2131	−0.0188	1.0600***	1.5372***
	(0.4020)	(0.5022)	(0.0662)	(0.1738)	(0.3667)
Adjusted R-squared	0.1505	0.1773	0.7938	0.2077	0.0839
Bank characteristics	Yes	Yes	Yes	Yes	Yes
Regional economy	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

4.4. Controlling for bank size

Guided by our theory, we control for the cash flow, service income, and asset risk of the banks in our regressions. Empirical studies in the prior literature, however, usually choose the control variables based on tradition. The major difference between our choice of control variables and those in the literature is that our regressions do not control for bank size, which is the logarithm of the total assets of the bank. We do not include bank size mainly because bank size is not justified by the theoretical model to be a separate factor in the liability structure.

Bank size plays other roles in our empirical tests of the tax effects. The total assets are the denominator of the dependent variables in all regressions. The non-deposit debt, deposits, non-equity funding cost, equity, and credits are all scaled by bank size according to the hypotheses developed in Section 3. In addition, the bank fixed effects capture the differences in size across BCCs. Moreover, the RWA density is the ratio of RWA assets to total assets.

We check whether our findings are robust if bank size is included as an additional control variable. Panel B of Table 7 shows that we obtain the same results. The tax effects on non-deposit debt is positive and significant. The estimated coefficient of the IRAP rate change is 0.39, almost identical to our previous estimate. The significance is at the 5% level. The tax effect on deposits is much smaller and insignificant. The coefficient of the IRAP rate change is 0.19, also similar to our earlier estimate. The effect on the non-equity funding cost is positive and significant at the 5% level. The effects on the equity ratio and credit ratio are both negative and significant, consistent with the earlier results.

4.5. The cross-sectional variation

In our empirical tests so far, we have examined how the bank balance sheets change in response to the tax-rate changes, but there is a potential issue in focusing on changes. The response of banks to a tax-rate change could be affected by the expectation of future tax policy changes if the changes are frequent. After a tax-rate increase, a further increase may be less likely than a decrease. If a bank expects the current tax-rate change to be reversed, the bank should make smaller adjustment for the current change than the optimal adjustment for a permanent change. Hennessy et al. (2018) construct a structural model of firms to show that in an economy with a stochastic tax rate that switches between a high-tax regime and a low-tax regime, the response of firm leverage to a tax-rate change is smaller than the response in an economy with a permanent tax-rate change. If we apply this idea to our study, the effects of a permanent tax-rate change should be larger than the effects we estimate based the frequent IRAP-rate changes. More generally, the effects of a long-term change in tax rate should be at least as large as suggested by our estimates.

To get more information about the long-run relation between bank balance sheets and tax rates, we examine the levels of the balance-sheet components and the tax rates across regions or banks, instead of the changes over time. The regressions using the levels are motivated by Eqs. (3), (4), and (5). Taking the non-deposit debt as an example, the logarithm of Eq. (4) implies

$$\log(B_{ij}) = f(\tau_j, \delta_i, \eta_i, \sigma_i) - \log(V_i), \tag{21}$$

where $f(\cdot)$ is the logarithm of the right-hand side of Eq. (4).

The levels of the balance-sheet components and the IRAP rates appear to be related if we look at the time-series averages. In panel A of Table 8, we regress the time-series average of the logarithm of a balance-sheet component on the time-series average

Table 8
Tax effects estimated from levels of balance-sheet components. Panel A reports cross-sectional regression of the time-series averages for the 20 regions. Panels B and C report the panel regressions using 4734 observations. In panel B and C, the estimates are reported with robust standard errors in brackets (clustered by region-year). The marks *, **, and *** indicate the significance levels of 10%, 5%, and 1%, respectively.

A. Casual relations of time-series averages					
	Dependent variable: Time-Series average of				
	log(Debt)	log(Deposit)	log(Cost)	log(Equity)	log(Credit)
Time-series average of log (IRAP rate)	3.8308	1.4873	1.1282	−0.5987	−0.8869
Adjusted R-squared	0.0988	0.0554	0.0994	0.0019	0.0037
B. Elasticities to tax rate					
Independent variable	Dependent variable				
	log(Debt)	log(Deposit)	log(Cost)	log(Equity)	log(Credit)
$\log(\text{IRAP rate})_{jt-1}$	0.1562*	0.0239	0.3140***	−0.0944**	−0.0549**
	(0.0922)	(0.0339)	(0.1174)	(0.0376)	(0.0272)
Adjusted R-squared	0.9554	0.9891	0.9772	0.9898	0.9936
Bank characteristics	Yes	Yes	Yes	Yes	Yes
Regional economy	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes
C. Semi-Elasticities to tax rate					
Independent variable	Dependent variable				
	log(Debt)	log(Deposit)	log(Cost)	log(Equity)	log(Credit)
$(\text{IRAP rate})_{jt-1}$	0.0263*	0.0067	0.0587**	−0.0192**	−0.0141**
	(0.0158)	(0.0077)	(0.0277)	(0.0089)	(0.0060)
Adjusted R-squared	0.9554	0.9891	0.9770	0.9898	0.9936
Bank characteristics	Yes	Yes	Yes	Yes	Yes
Regional economy	Yes	Yes	Yes	Yes	Yes
Bank fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

of the logarithm of tax rate. The coefficient of the logarithm of tax rate is the elasticity of the balance-sheet component to the tax rate. The estimates suggest that the elasticities of non-deposit debt, deposits, and funding cost are positive, but the elasticities of equity ratio and credits are negative. The estimates also suggest that the elasticity of non-deposit debt is larger than the elasticity of deposits. These results are consistent with the theory in Section 3.2. However, we cannot draw precise statistical inference in these cross-sectional regressions because there are only 20 data points in each regression, one for each Italian region.

To draw statistical inferences, we use the panel data of the levels across regions and banks over time. In view of Eq. (21), we use the following regression of non-deposit debt:

$$\log(\text{Debt})_{ijt} = \gamma \log(\text{IRAP rate})_{jt-1} + \text{Control variables} + \text{Fixed effects} + \epsilon_{ijt}, \tag{22}$$

where the control variables are levels of the bank characteristics and regional economy. The variables to control for the regional economy are the same as those in Section 4.1, except the levels, instead of changes, of the variables are used. The bank characteristics are also the same as those in Section 4.1, except bank size is included because the logarithm of assets appears in Eq. (21). The regression also controls for the bank fixed effects and year fixed effects. The regressions of deposits, funding cost, equity, and credits are similar to Eq. (22).

The results of regression (22) are reported in panel B of Table 8. In the regression of $\log(\text{Debt})_{ijt}$, the estimated coefficient of $\log(\text{IRAP rate})_{jt-1}$ is positive and significant at the 10% level. In the regression of $\log(\text{Deposit})_{ijt}$, the estimated coefficient is smaller, but still positive. However, it is statistically insignificant. In the regression of $\log(\text{Cost})_{ijt}$, the coefficient of $\log(\text{IRAP rate})_{jt-1}$ is positive and significant at the 1% level. The coefficient is negative and significant in the regressions of $\log(\text{Equity})_{ijt}$ and $\log(\text{Credit})_{ijt}$. These results are consistent with those obtained earlier with the changes.

If we use the tax rates without taking the logarithm, the results are almost same, although the coefficient of the tax rate should be interpreted as semi-elasticity. The results are reported in panel C of Table 8. The estimated coefficient of the tax rate is positive in the regressions of non-deposit debt, deposits, and funding cost. It is negative in the regressions of equity and credits. These results are consistent with the earlier ones and support the predictions of our model. The coefficient of the tax-rate is insignificant only in the regression of deposits. This can be considered as further evidence of the stickiness of deposits on bank balance sheets.

5. Conclusion

We provide evidence that tax policy affects bank liability structure. The Italian credit cooperative banks (BCC) and the Italian regional taxation on productive activities (IRAP) present a laboratory to examine the role of taxation in the choice of liability structure by banks. Each BCC is restricted to conduct business in its own region, and IRAP rates vary over time and differ across regions. Our empirical identification of the tax effects takes advantage of the business restrictions of BCCs and the variations in the IRAP rates. Together, the BCCs and IRAP rates allow us to separate the tax effects from the confounding factors in banks' decisions on balance sheets.

Our unambiguous results contrast with the mixed findings in the prior literature about the tax effects on non-deposit debt. The prior findings are based on data that include banks with complex balance sheets or murky tax exposures. Our estimations take advantage of the simple balance sheets and clear-cut tax exposures of the Italian cooperative credit banks. The prior findings are also based on small variations in tax rate (sometime just a single change), whereas our empirical results are estimated from the tax rates that vary over time and widely differ across regions.

Our empirical results clearly show that the ratios of deposits and non-deposit debt to bank assets are larger for a higher tax rate, but the marginal tax effect on non-deposit debt ratio is much larger than the effect on deposit ratio. The results also show that the non-equity funding cost is higher for a higher tax rate. Clearly, banks' adjustments to liability structure take advantage of a tax cut to lower the non-equity funding cost.

These results are important for understanding the consequences of tax policy proposals. If banks keep the deposit ratio unchanged by lowering the non-deposit debt ratio and leverage simultaneously in response to a tax cut, they will not reduce the risk of deposits because deposits are protected by both the non-deposit debt and equity on bank balance sheets. Consequently, a tax cut will not reduce the risk faced by the government that backs the deposit insurance. This consequence is not expected or intended by the policy proposals that cut tax for banks to reduce the incentives for leverage.

The empirical results obtained using BCCs are consistent with the theoretical predictions of a structural model of bank liabilities that incorporates the most common elements of banks. These elements are profit maximization with assets financed by deposits, non-deposit debt, and equity under the regulation of capital requirement and deposit insurance. The structural model captures the tradeoff between deposit service and capital requirement, as well as the tradeoff between tax advantage and financial distress. The model makes sharp predictions on bank liability structure. The consistency between the empirical results obtained from BCCs and the theoretical predictions by the model is an indirect evidence that the Italian credit cooperative banks behave like a typical profit-maximizing bank.

Beyond liability structure, we test the tax effects on the leverage and credits of BCCs because bank leverage and credits have already received lots of attention in the literature. We find that the equity ratios of BCCs respond to tax rate in the same way as the banks studied in the literature: a bank chooses a higher equity ratio for a lower tax rate. We also find that BCCs allocate a larger proportion of their assets to supply credits if the tax rate is lower, supporting the extant empirical evidence that better-capitalized banks supply more credits. Our empirical results about leverage and credits further suggest that the Italian credit cooperative banks behave similarly to the banks studied in the literature. Therefore, the evidence of tax effects we obtained from BCCs confirms that taxation is an important factor in the choice of liability structure of commercial banks.

Appendix A. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.euroecorev.2021.103820.

References

Admati, A., Demarzo, P., Hellwig, M., Pfleiderer, P., 2018. The leverage ratchet effect. J. Financ. 73, 145–198.
Angrist, J., Pischke, J., 2010. The credibility revolution in empirical economics: how better research design is taking the con out of econometrics. J. Econ. Perspect. 24, 3–30.
Ashcraft, A., 2008. Does the market discipline banks? New evidence from regulatory capital mix. J. Financ. Intermediation 17, 543–561.
Berger, A., Bouwman, C., 2013. How does capital affect bank performance during financial crises?. J. Financ. Econ. 109, 146–176.
Bolton, P., Freixas, X., Gambacorta, L., Mistrulli, P., 2016. Relationship and transaction lending in a crisis. Rev. Financ. Stud. 29 (10), 2643–2676.
Bond, S., Ham, K., Maffini, G., Nobili, A., Ricotti, G., 2016. Regulation, tax and capital structure: evidence from administrative data on Italian banks. Quest. Econ. Finanz. 361.
Carletti, E., De Marco, F., Ioannidou, V., Sette, E., 2021. Banks as patient lenders: evidence from a tax reform. J. Financ. Econ. 141, 6–26.
Cèlèrier, C., Kick, T., Ongena, S., 2016. Changes in the Cost of Bank Equity and the Supply of Bank Credit. mimeo.
Diamond, D., Rajan, R., 2000. A theory of bank capital. J. Financ. 55, 2431–2465.
Drechsler, I., Savov, A., Schnable, P., 2018. Banking on Deposits: Maturity Transformation Without Interest Rate Risk. NYU Stern Working Paper.
European Banking Authority (EBA), 2015. EU-Wide Transparency Exercise Results. EBA, London.
European Commission, 2014. Tax Reforms in EU Member States: Tax Policy Challenges for Economic Growth and Fiscal Sustainability. The European Economy Series, 2014 Report.
Flannery, M., 1999. Using market information in prudential bank supervision: A review of the US empirical evidence. Money Credit Bank. 33, 273–305.
Gambacorta, L., Shin, H., 2016. Why bank capital matters for monetary policy. J. Financ. Intermediation 35 (Part B), 17–29.
Gobbi, G., Sette, E., 2015. Relationship lending during a financial crisis. J. Eur. Econ. Assoc. 13 (3), 453–481.
Goyal, V., 2005. Market discipline of bank risk: Evidence from subordinated debt contracts. J. Financ. Intermediation 14, 318–350.
Graham, J., 2003. Taxes and corporate finance: a review. J. Financ. Econ. 16, 1075–1129.
Gropp, R., Heider, F., 2010. The determinants of bank capital structure. Rev. Financ. 17, 1947–1988.
Heckemeyer, J., de Mooij, R., 2013. Taxation and Corporate Debt: Are Banks Any Different?. IMF Working Paper 221.
Hemmelgarn, T., Teichmann, D., 2014. Tax reforms and capital structure of banks. Int. Tax Public Financ. 21, 645–693.
Hennessy, C., Kasahara, A., Strebulaev, I., 2018. Empirical analysis of corporate tax reforms: what is the null and where did it come from?. Working paper, Stanford University.
Horváth, B., 2013. The Impact of taxation on bank leverage and asset risk. CentER Discussion Paper, 2013-076.
International Monetary Fund, 2009. Debt bias and other distortions: crisis-related issues in tax policy.

International Monetary Fund, 2010. A Fair and Substantial Contribution By the Financial Sector: Final Report for the G-20.
Kashyap, A., Stein, J., 1995. The impact of monetary policy on bank balance sheets. Carnegie-Rochester Conf. Ser. Public Policy 42, 151–195.
Kashyap, A., Stein, J., 2000. What do a million observations on banks say about the transmission of monetary policy?. Amer. Econ. Rev. 90, 407–428.
Keen, M., 2011. The Taxation and Regulation of Banks. Working Paper, International Monetary Fund.
Kishan, R., Opiela, T., 2000. Bank size, bank capital and the bank lending channel. J. Money Credit Bank. 32, 121–141.
Martin-Flores, J., Moussu, C., 2018. Is bank capital sensitive to a tax allowance on marginal equity?. Eur. Financ. Manag. 25 (2), 325–357.
Michelangeli, V., Sette, E., 2016. How Does Bank Capital Affect the Supply of Mortgages? Evidence from a Randomized Experiment. BIS Working Paper, 557.
Milonas, K., 2016. Bank taxes, leverage and risk. J. Financ. Serv. Res. 1–33.
Panier, F., Perez-Gonzales, F., Villanueva, P., 2015. Capital structure and taxes: what happens when you (also) subsidize equity?. Working paper, Instituto Tecnologico Autonomo de Mexico.
Ricotti, G., 2018. Taxing corporate income: a tax halfway across the ford?. In: Italian Fiscal Policy Review 2017. Roma Tre Press, pp. 111–123.
Schandlbauer, A., 2017. How do financial institutions react to a tax increase?. J. Financ. Intermediation 30, 86–106.
Schepens, G., 2016. Taxes and bank capital structure. J. Financ. Econ. 120, 585–600.
Strebulaev, I., 2007. Do tests of capital structure theory mean what they say?. J. Financ. 62, 1747–1787.
Sundaresan, S., Wang, Z., 2014. Bank Liability Structure. Working Paper, Columbia University and Indiana University.