Some Simple Analytics of the Taxation of Banks as Corporations

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Abstract: Taxation of the banking sector has become an important policy issue since the financial crisis; for instance, the most recent Tax Reform proposal in the US includes a .035% quarterly tax on bank assets over $500 billion. The Obama Administration has proposed a tax on bank liabilities. The IMF is in favor of a Financial Activities Tax (FAT). Yet the effects of such a tax remain an under-researched area in public economics both theoretically and empirically. Our goal here is to partially fill this gap by analyzing different ways to tax banks as a corporation. Some of the main results are that (i) a tax on bank assets decreases loans and net borrowing by banks; (ii) a tax on deposits decreases deposits and increases net borrowing by banks; (iii) a tax on bank liabilities decreases both loans and deposits and has an indeterminate effect on net borrowing by banks; and (iv) the effects of a tax on bank profits depends crucially on the deductibility management costs. These results extend to the case of monopoly power.

Keywords: financial services, banks, taxation of banks, corporate tax

JEL Classification: G21, H25

I. Introduction

Taxation of the banking sector has become an important policy issue since the financial crisis. For instance, the most recent Tax Reform proposal in the US includes a .035% quarterly tax on bank assets over $500 billion. The Obama Administration has proposed a tax on bank liabilities. The European Union has proposed a tax on bank deposits. The IMF is in favor of a Financial Activities Tax (FAT).

Despite the focus of policy-makers, the effects of taxes on banks remain an under-researched area in public economics both theoretically and empirically. Often the papers in this area focus on tax evasion, such as Huizinga and Nicodeme (2004) and profit-shifting opportunities, such as Demirguc and Huizinga (2001). An interesting recent paper by Keen and de Mooij (2012) investigates the impact of the corporate tax on bank leverage. Our goal here is to contribute to the theoretical understanding of taxing banks as corporations by analyzing different ways to tax banks in a simple but standard model that emphasizes the role of banks in providing services such as the management of loans and deposits.

As discussed in Freixas and Rochet (1999) Arrow-Debreu models (with perfect financial markets) are not very useful for analyzing the banking sector as banks become redundant and essentially serve no useful purpose in such models. Two distinct types of models have been developed to explain the usefulness of banks. One method is to appeal to incomplete information; a recent example of the effects of the taxation of banks in this type of model is presented in Caminal (2003). A second method is to appeal to the role of banks in offering services to customers, both borrowers and depositors. This second type of way of modeling banks is called the industrial organization approach and is typified by the models of Monti (1972) and Klein (1971). It is this second type of model on which we build. The approach is to incorporate the taxation of banks into this type of model.

We analyze four types of taxes on banks. The first type of tax is a tax on bank assets, the second is a tax on bank deposits, the third is a tax on bank liabilities, and the fourth is a tax on bank profits. We model these under different types of market structure, one with perfect competition and one with market power (taken initially as monopoly but expandable to the oligopoly case.) In all cases, the return in the interbank market is taken as being determined in international capital markets.

We note that the capital structure of a bank in this type of model is simply that the bank finances its loans through demand deposits and borrowing on international capital markets. Hence to the extent that the taxes analyzed affect these margins, the results relate to the capital structure of the bank.

Some of the main results are the following. A tax on bank assets decreases loans and net borrowing by banks. A tax on deposits decreases deposits and increases net borrowing by banks. A tax on bank liabilities decreases both loans and deposits and has an indeterminate effect on net borrowing by banks. The effects of a tax on bank profits depends crucially on the deductibility management costs; if fully deductible, a tax on bank profits does not alter the bank's demand for deposits or supply of loans. These results extend to the case of monopoly power.

II. The Structure of the Model Under Competitive Assumptions

In this model, banks are assumed to take in deposits, D, from households, and make loans, L, to businesses. Banks charge an interest rate r_L on loans and pay an interest rate r_D on deposits. Besides deposits, banks may also obtain funds by borrowing, M. Banks must hold a certain proportion (α) of their deposits as non-interest bearing cash reserves. The assets of a bank are composed of its reserves, R, and its loans, while its liabilities consist of its deposits and any borrowing. The bank's reserves are the non-interest bearing cash that it holds with the central bank; its borrowing or lending position is measured by its net position on international capital markets, M, which can be positive or negative.

Since cash earns no interest, it is optimally chosen to be the minimum αD. The interest earned or paid on the international capital market, r, is exogenously determined. The net position of the bank in this market is the difference between the remaining deposits and its loans:

(1) $$M = (1-\alpha)D - L$$

Banks are assumed to have a cost function for managing deposits and loans C(D,L) that is convex, C' ≥ 0, C'' ≥ 0. A bank's profit is the sum of interest income that it earns on loans and its net position on the interbank market less interest that it pays on deposits less its management costs:

(2) $$\pi = r_L L + rM - r_D D - C(D,L)$$

Substituting for M yields:

(3) $$\pi = (r_L - r)L + [r(1-\alpha) - r_D]D - C(D,L)$$

Under competitive assumptions, banks are price-takers, taking the interest rates as given. The bank chooses D and L to maximize profits:

(4) $$\begin{aligned} \frac{\partial \pi}{\partial L} &= r_L - r - \frac{\partial C}{\partial L} = 0 \\ \frac{\partial \pi}{\partial D} &= r(1-\alpha) - r_D - \frac{\partial C}{\partial D} = 0 \end{aligned}$$

Consider the equilibrium of the banking sector under competitive assumptions in which there are N banks. A competitive equilibrium is characterized by equilibrium in three markets, the loans market, the savings market, and the international capital market; however, as mentioned the return on international capital markets is exogenous.

The demand for loans by private firms is given by $I(r_L)$ where we assume $I' < 0$. The aggregate supply of loans is the sum over banks of their individual loan supplies $L_n(r_L, r_D, r)$. The equilibrium in the market for loans is given by:

(5) $$I(r_L) = \sum_{n=1}^{N} L_n(r_L, r_D, r)$$

The savings of households is given by $S(r_D)$ which are either deposited in banks or used to buy Treasury bills, B. (Banking deposits and Treasury bills are assumed to be perfect substitutes so their interest rate is the same at equilibrium, r_D.) We assume $S' > 0$. Equilibrium in the savings market is thus characterized by:

(6) $$S(r_D) = B + \sum_{n=1}^{N} D_n(r_L, r_D, r)$$

As noted, the interest rate on the interbank market is exogenously determined on international capital markets.

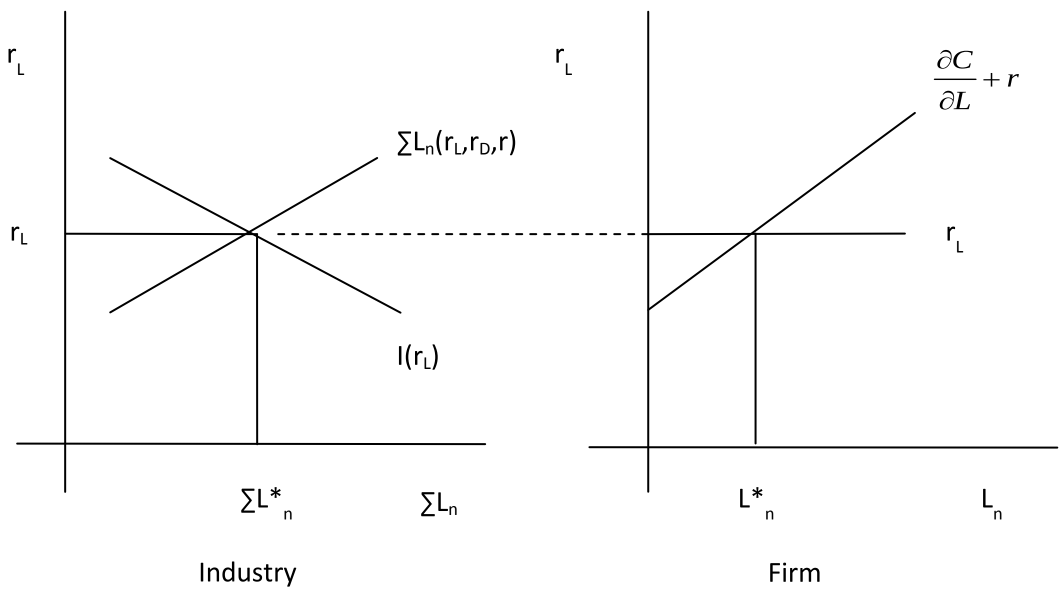
Figure 1 illustrates the competitive equilibrium in the market for loans and deposits. The upper left graph represent the market equilibrium for loans. The upper right graph is a single bank's equilibrium, taking the market determined interest rate on loans as given. The lower left graph represents the market equilibrium for deposits. The lower right graph shows a single bank's profit maximizing deposit decision, taking as given the market determined interest rate on deposits.

III. Analysis of Taxes on Competitive Banks

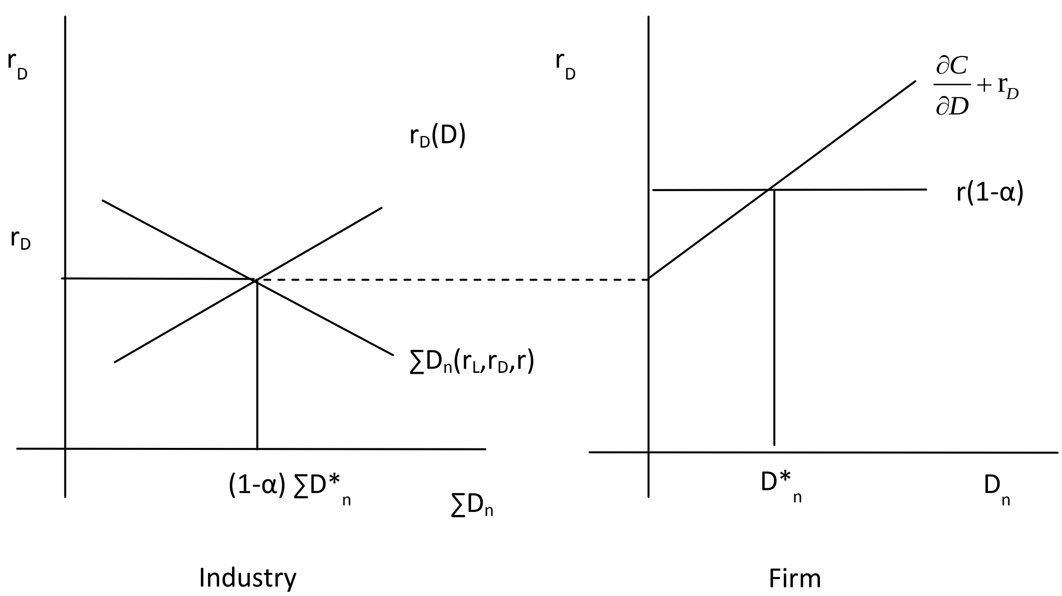
A. A Tax on Bank Assets

Figure 1: The competitive banking equilibrium

The market for loans



The market for deposits



We next consider the effect of a proportional tax on bank assets, t_A. The assets of a bank in this setting are its loans plus its reserves. Assuming that the tax on assets would exempt reserves, the taxes owed by bank n would be:

(7) $$L_n t_A$$

After-tax profits are:

(8) $$\pi = (r_L - r - t_A)L + [r(1-\alpha) - r_D]D - C(D,L)$$

We can simplify by assuming management costs are separable so that the cross-partials are equal to zero. Choosing D and L to maximize profits yields:

(9) $$\begin{aligned} \phi_L &= \frac{\partial \pi}{\partial L} = (r_L - r - t_A) - \frac{\partial C}{\partial L} = 0 \\ \phi_D &= \frac{\partial \pi}{\partial D} = r(1-\alpha) - r_D - \frac{\partial C}{\partial D} = 0 \end{aligned}$$

Proposition 1: A tax on assets lowers a bank's supply of loans and has no effect on its demand for deposits if management costs are separable.

Proof: The proof follows directly from the first order conditions (12). Using the implicit function theorem:

(10) $$\begin{aligned} \frac{\partial L}{\partial t_A} &= -\frac{\partial \phi_L / \partial t_A}{\partial \phi_L / \partial L} = -\frac{-1}{-\partial^2 C / \partial L^2} < 0 \\ \frac{\partial D}{\partial t_D} &= -\frac{\partial \phi_D / \partial t_D}{\partial \phi_D / \partial D} = -\frac{0}{-\partial^2 C / \partial D^2} = 0 \end{aligned}$$

The market equilibrium equates supply to demand in the loans market and also in the deposits market. The equilibrium conditions in the loans and deposits markets are:

(11)
$$F_L = I(r_L) - \sum L^* = 0$$
$$F_D = \sum D^* - S(r_D) = 0$$

Proposition 2: In a small open economy in which the interbank interest rate is determined on world markets, a tax on bank assets will raise the before-tax interest rate on loans.

Proof: Using the equilibrium conditions and the implicit function theorem, and assuming downward sloping demand for investment yields:

(12)
$$\frac{\partial r_L}{\partial t_A} = -\frac{\partial F_L / \partial t_A}{\partial F_L / \partial r_L} = -\frac{-\sum \partial L^* / \partial t_A}{\partial I / \partial r_L - \sum \partial L^* / \partial r_L} = -\frac{+}{-} > 0$$

where

$$\frac{\partial L}{\partial r_L} = -\frac{\partial \phi_L / \partial r_L}{\partial \phi_L / \partial L} = -\frac{1}{-\partial^2 C / \partial L^2} > 0$$

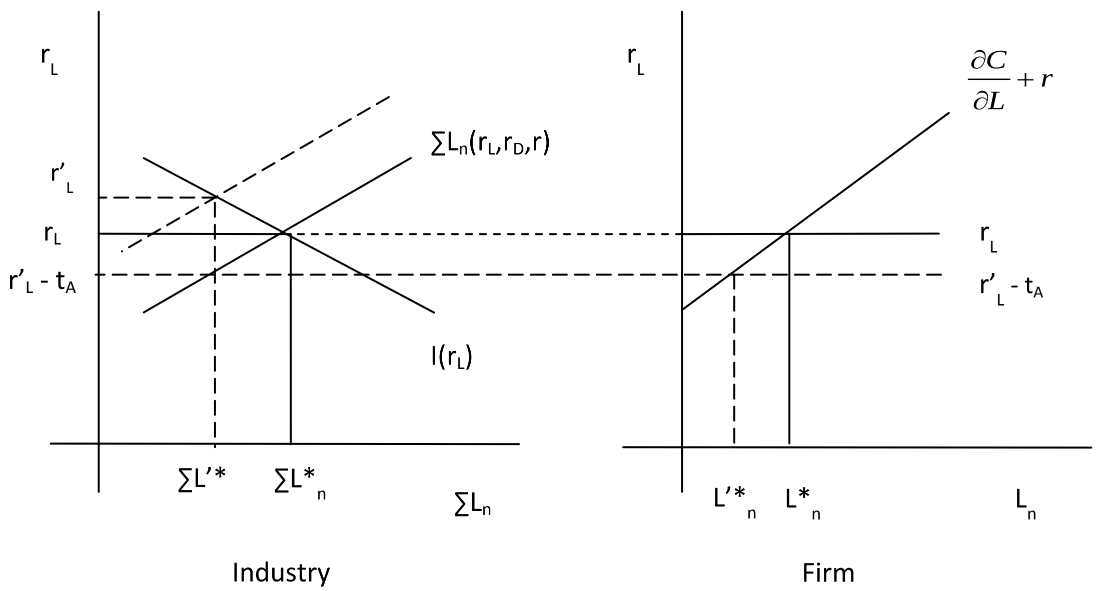
These results are illustrated in Figure 2. As in Figure 1 the market for loans is depicted in the top two diagrams and the market for deposits in the bottom two. The right hand diagrams relate to the decision of an individual bank. The tax on assets reduces the profit margin on loans which induces a bank to lower its supply of loans. The market for deposits is unaffected by the tax. Proposition 2 relates to the market diagrams on the left hand side of Figure 2. The interest rate on loans to consumers rises while the interest rate paid on deposits is unaffected as illustrated.

There remains the question of whether a tax on assets would increase borrowing by banks on international capital markets. We can state the following proposition:

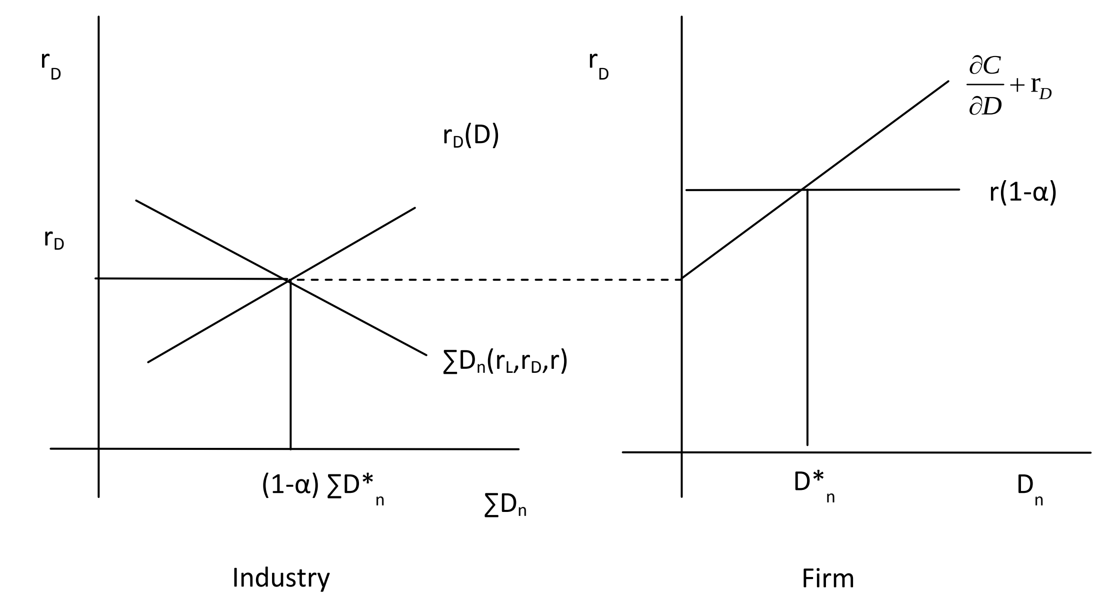
Proposition 3: A tax on assets will decrease net borrowing by banks.

Figure 2: A tax on bank assets in a competitive banking market, holding the interbank rate fixed

The market for loans



The market for deposits



Proof: Net borrowing is the negative of (1). The effect of the asset tax on net borrowing can be derived by differentiating the negative of (1):

(1')
$$-\frac{\partial M}{\partial t_A} = -(1-\alpha)\frac{\partial D}{\partial t_A} + \frac{\partial L}{\partial t_A}$$

Noting that the first term is zero and substituting from (10) yields:

(1'')
$$-\frac{\partial M}{\partial t_A} = \frac{\partial L}{\partial t_A} = -\frac{-1}{-\partial^2 C / \partial L^2} < 0$$

Net borrowing falls because loans fall leaving less need for funds.

B. A Tax on Bank Deposits

We next consider the effect of a proportional tax on deposits, t_D:

(13)
$$D_n t_D$$

After-tax profits are:

(14)
$$\pi = (r_L - r)L + [r(1-\alpha) - r_D - t_D]D - C(D,L)$$

Choosing D and L to maximize profits yields:

(15)
$$\begin{aligned} \phi_L &= \frac{\partial \pi}{\partial L} = (r_L - r) - \frac{\partial C}{\partial L} = 0 \\ \phi_D &= \frac{\partial \pi}{\partial D} = \left[r(1-\alpha) - r_D - t_D\right] - \frac{\partial C}{\partial D} = 0 \end{aligned}$$

Proposition 4: If management costs are separable, a tax on deposits lowers a bank's demand for deposits and has no effect on its supply of loans.

Proof: Applying the implicit function theorem yields:

(16)
$$\frac{\partial L}{\partial t_D} = -\frac{\partial \phi_L / \partial t_D}{\partial \phi_L / \partial L} = -\frac{0}{-\partial^2 C / \partial L^2} = 0$$
$$\frac{\partial D}{\partial t_D} = -\frac{\partial \phi_D / \partial t_D}{\partial \phi_D / \partial D} = -\frac{-1}{-\partial^2 C / \partial D^2} < 0$$

Figure 3 illustrates this result. The market for loans is unaffected by the tax on deposits as shown in the upper diagrams. In the market for deposits, the intercept of the marginal cost of deposits for a bank shifts up as shown in the lower right hand diagram, leading to a lower demand for deposits.

Proposition 5: In a small open economy in which the interbank interest rate is determined on world markets, a tax on bank deposits will lower the after-tax interest rate paid on deposits.

Proof: Using the equilibrium conditions and the implicit function theorem, and assuming upward sloping supply of deposits yields:

$$\frac{\partial r_D}{\partial t_D} = -\frac{\partial F_D / \partial t_D}{\partial F_D / \partial r_D} = -\frac{\sum \partial D^* / \partial t_D}{\sum \partial D^* / \partial r_D - \partial S / \partial r_D} = -\frac{-}{-} < 0$$

where

$$\frac{\partial D}{\partial r_D} = -\frac{\partial \phi_D / \partial r_D}{\partial \phi_D / \partial D} = -\frac{-1}{-\partial^2 C / \partial D^2} < 0$$

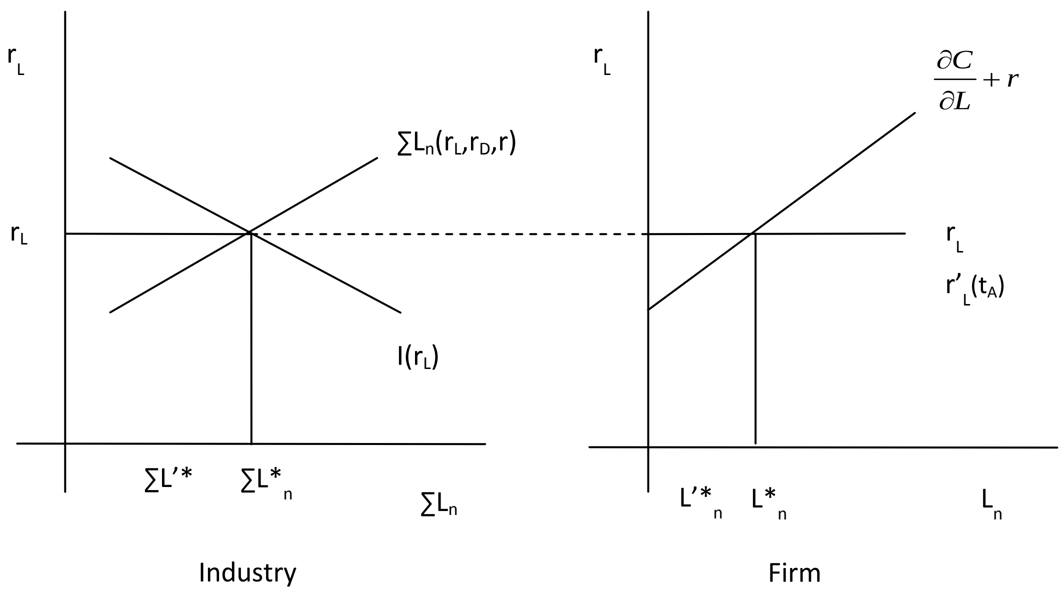
Proposition 6: If management costs are separable, a tax on deposits will increase a bank's net borrowing.

The proof proceeds as before. Differentiating the negative of (1) yields:

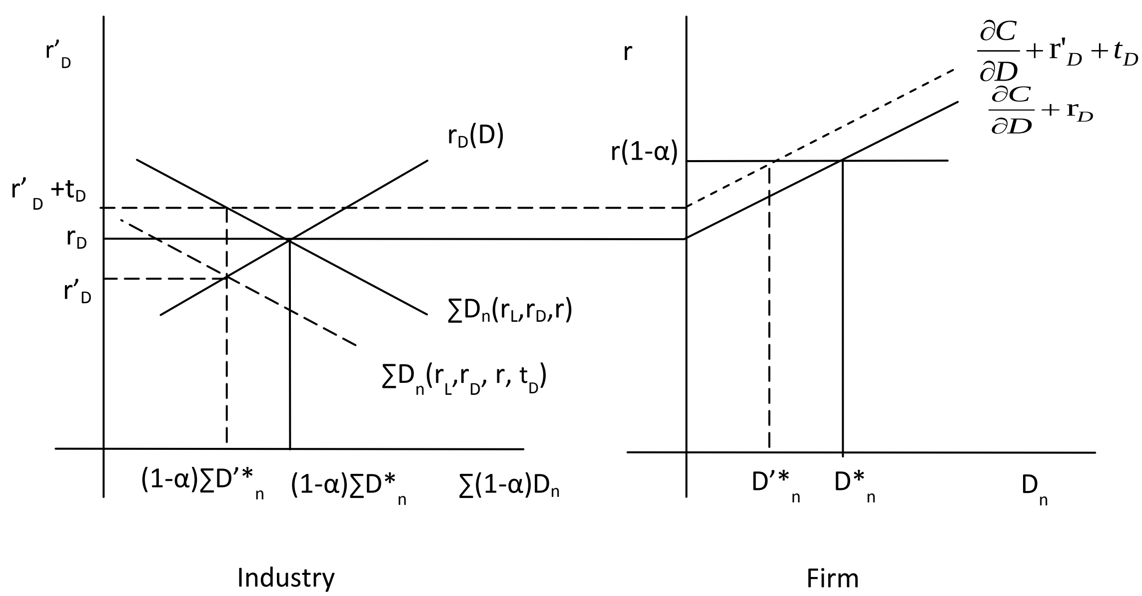
(1')
$$-\frac{\partial M}{\partial t_D} = -(1-\alpha)\frac{\partial D}{\partial t_D} + \frac{\partial L}{\partial t_D}$$

Figure 3: A tax on bank deposits in a competitive banking market, interbank rate fixed, separable costs

The market for loans



The market for deposits



Substituting from (16) and rearranging terms implies:

(1'') $$-\frac{\partial M}{\partial t_D} = -(1-\alpha)\frac{1}{-\partial^2 C/\partial D^2} > 0$$

Intuitively, as long as profitable loan opportunities are available, it will make sense to borrow at a lower interest rate and lend at a higher one. Since loans are unaffected by the tax but deposits are lower, banks will borrow on international capital markets at the interest rate r to make up for the lower deposits and lend at the higher interest rate r_L.

C. A Tax on Bank Liabilities

Thirdly, we consider a tax on bank liabilities. This amounts to a tax on deposits plus a tax on borrowing; as net borrowing is –M, this tax would be:

(17) $$(D_n - M_n)(t_B) = (D_n - (1-\alpha)D_n + L_n)(t_B) = (\alpha D_n + L_n)(t_B)$$

Thus it is equivalent to a tax on assets that does not exempt reserves. After-tax profits are:

(18) $$\pi = (r_L - r - t_B)L + [r(1-\alpha) - r_D - \alpha t_B]D - C(D,L)$$

Choosing D and L to maximize profits yields:

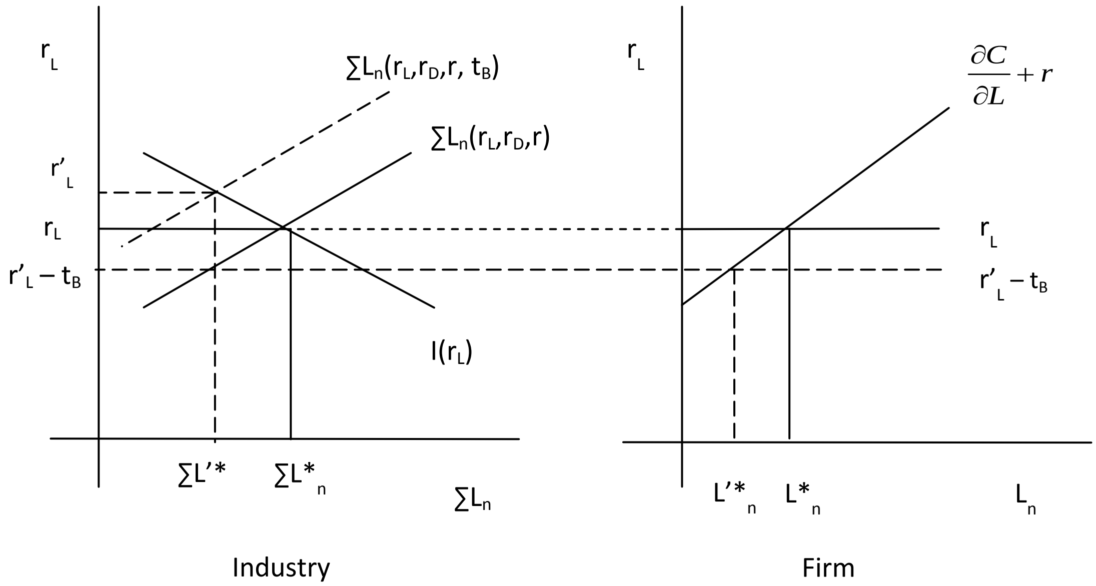
(19) $$\begin{aligned}\phi_L &= \frac{\partial \pi}{\partial L} = (r_L - r - t_B) - \frac{\partial C}{\partial L} = 0\\ \phi_D &= \frac{\partial \pi}{\partial D} = \left[r(1-\alpha) - r_D - \alpha t_B\right] - \frac{\partial C}{\partial D} = 0\end{aligned}$$

Proposition 7: If management costs are separable, a tax on liabilities lowers a bank's demand for deposits and its supply of loans.

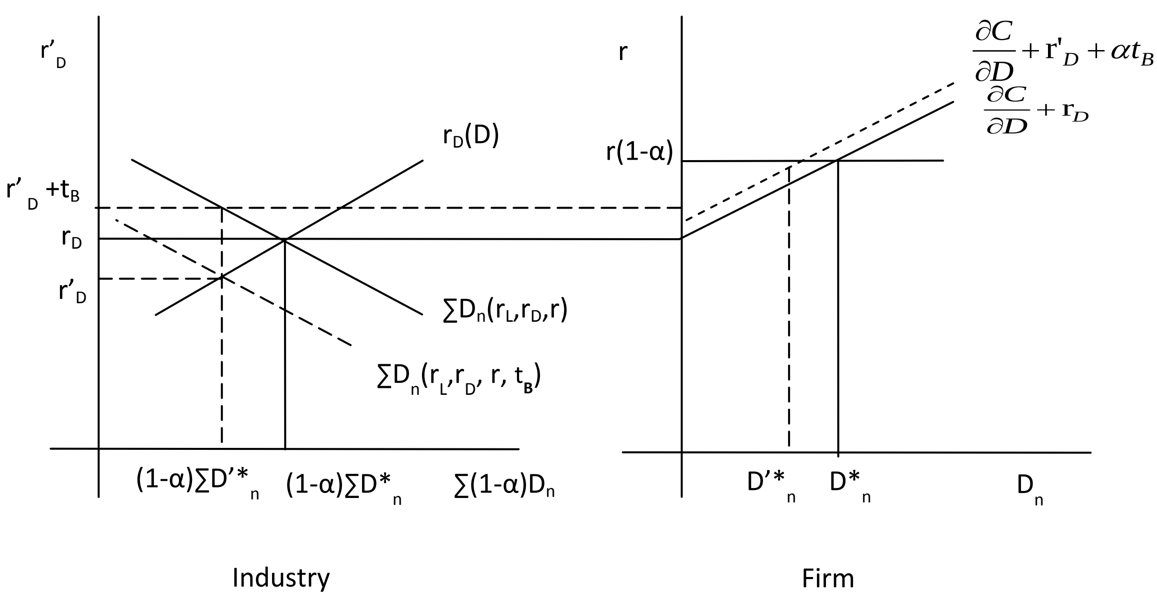
Proof: Applying the implicit function theorem yields:

Figure 4: A tax on bank liabilities in a competitive banking market, interbank rate fixed, separable costs

The market for loans



The market for deposits



(20)
$$\begin{aligned}\frac{\partial L}{\partial t_D} &= -\frac{\partial \phi_L / \partial t_B}{\partial \phi_L / \partial L} = -\frac{-1}{-\partial^2 C / \partial L^2} < 0 \\ \frac{\partial D}{\partial t_D} &= -\frac{\partial \phi_D / \partial t_B}{\partial \phi_D / \partial D} = -\frac{-\alpha}{-\partial^2 C / \partial D^2} < 0\end{aligned}$$

Figure 4 illustrates this result. The tax has identical effects in the market for loans as a tax on assets. In the market for deposits, the marginal cost of deposits is shifted up by the fraction α of the tax. Other things equal, this lowers the demand for deposits. In equilibrium, the interest rate paid for deposits also falls; hence the overall effect in equilibrium depends on the degree to which the interest rate falls relative to the required reserve ratio α.

Proposition 8: The effect of a tax on liabilities on a bank's borrowing is indeterminate and depends on the reserve ratio, the ratio of loans to deposits, the ratio of the marginal cost of deposits, and the ratio of the elasticity of the marginal cost of loans with respect to loans and the elasticity of the marginal cost of deposits with respect to deposits. However, if multiplication of these three ratios is less than 4, loans fall by more than deposits and the tax on liabilities must decrease borrowing.

The proof proceeds as before. Differentiating the negative of (1) yields:

(1')
$$-\frac{\partial M}{\partial t_D} = -(1-\alpha)\frac{\partial D}{\partial t_D} + \frac{\partial L}{\partial t_D}$$

Substituting from (20):

(1'')
$$-\frac{\partial M}{\partial t_D} = \frac{(1-\alpha)\alpha}{\partial^2 C / \partial D^2} - \frac{1}{\partial^2 C / \partial L^2}$$

It follows that

(1''') $$-\frac{\partial M}{\partial t_D} > 0 \Rightarrow \alpha(1-\alpha)\frac{L}{D}\frac{\partial C/\partial D}{\partial C/\partial L}\frac{\varepsilon_{MCL,L}}{\varepsilon_{MCD,D}} > 1$$

Since the α is between zero and 1, α(1- α) has a maximum value of .25 when α =.5. Therefore if the latter three terms multiply to something less than 4 the derivative is negative. Intuitively, the impact on banks net borrowing depends on the change in loans relative to the change in deposits. If deposits fall by more than loans, net borrowing increases while if loans fall by more than deposits net borrowing decreases.

D. A Tax on Bank Profits

Finally, we consider the effect of a tax on bank profits, t_π. After-tax profits are:

(28) $$\pi = \left[(r_L - r)L + (r(1-\alpha) - r_D)D - \gamma C(D,L)\right]\left(1 - t_\pi\right)$$

where γ is the proportion of management costs that are deductible. Choosing D and L to maximize profits yields:

(29) $$\begin{aligned} \frac{\partial \pi}{\partial L} &= (r_L - r) - \gamma\frac{\partial C}{\partial L} = 0 \\ \frac{\partial \pi}{\partial D} &= \left[r(1-\alpha) - r_D\right] - \gamma\frac{\partial D}{\partial L} = 0 \end{aligned}$$

A tax on bank profits has identical effects to a tax on any corporation. The effects of the tax depend crucially on whether management costs are fully deductible.

Proposition 9: To the extent that management costs for both loans and deposits are labor and capital costs that are fully deductible, the tax does not change the bank's demand for deposits or supply of loans.

Proof: If costs are fully deductible, γ = 1. The proposition follows from a comparison of first order conditions.

IV. The Structure of the Model Under a Monopolistic Banking Sector

The simplest form of noncompetitive behavior to analyze is when the banking sector forms a monopoly. In this case, the profits of the monopoly bank (with no tax) are:

$$\pi = (r_L(L) - r)L + [r(1-\alpha) - r_D(D)]D - C(D,L) \tag{13}$$

The difference with the competitive case is that banks are not price-takers and face the entire demand for loans and supply of deposits. (The functions inserted above are the inverse functions.) The bank chooses D and L to maximize profits, taking account of the fact that higher L lowers r_L and higher D implies payment of a higher r_D:

$$\begin{aligned} \frac{\partial \pi}{\partial L} &= \frac{\partial r_L}{\partial L}L + r_L - r - \frac{\partial C}{\partial L} = 0 \\ \frac{\partial \pi}{\partial D} &= -\frac{\partial r_D}{\partial D}D + r(1-\alpha) - r_D - \frac{\partial C}{\partial D} = 0 \end{aligned} \tag{14}$$

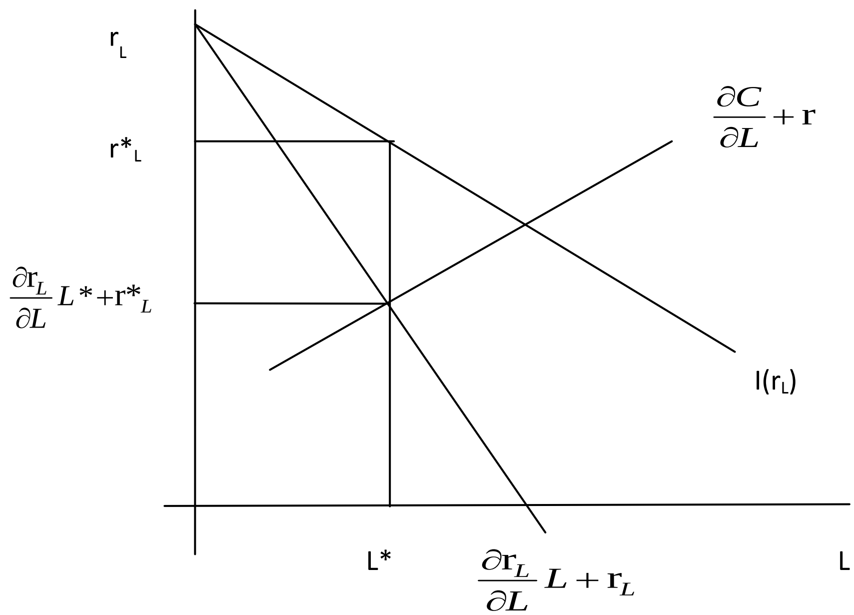
These can be re-written as

$$\begin{aligned} \frac{r_L - (r + \frac{\partial C}{\partial L})}{r_L} &= \frac{1}{\varepsilon_L(r_L)} \\ \frac{r(1-\alpha) - \frac{\partial C}{\partial D} - r_D}{r_D} &= \frac{1}{\varepsilon_D(r_D)} \end{aligned} \tag{15}$$

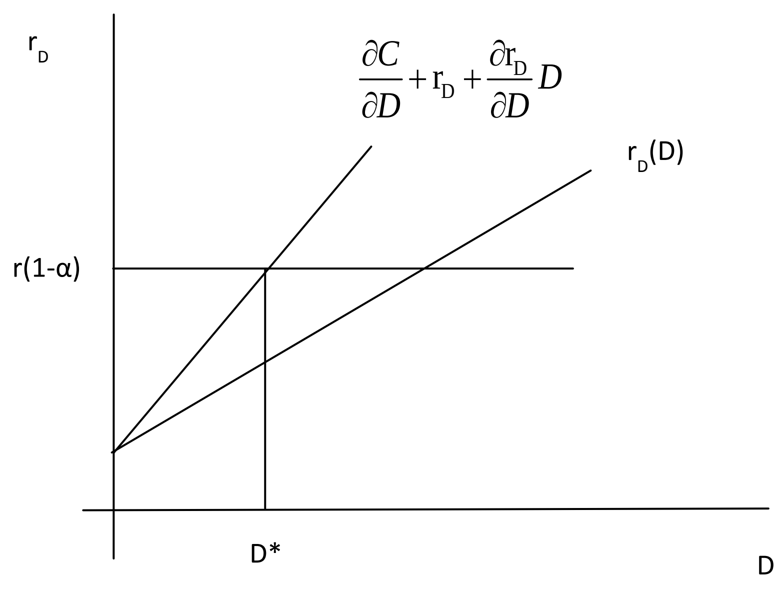
where ε is the elasticity. Written in this way, the bank monopoly sets the percentage mark-up (the Lerner indices) inversely to the elasticity.

Figure 5: The monopolistic banking equilibrium

The market for loans



The market for deposits



The monopoly solution is illustrated in Figure 5. The upper diagram shows the equilibrium in the market for loans while the lower diagram shows the equilibrium in the market for deposits. The monopoly bank pushes the interest rate on loans above the competitive rate and the equilibrium market volume of loans is lower. In the market for deposits the bank is a monopsony, being the only buyer of deposits and the volume of deposits is lower than in the competitive equilibrium.

Net borrowing of banks may be higher or lower than in the competitive case. Both loans and deposits are lower than in the competitive case, but which is relatively lower depends on the relative elasticities. If the ratio of loans to deposits is less in the monopoly case, net borrowing will be lower. If the ratio is higher in the monopoly case, net borrowing will be higher.

V. Analysis of Taxes on Banks with Monopoly Power

A. A Tax on Bank Assets

We consider first a tax on bank assets assuming reserves are exempt as considered previously for the competitive model. Profits for the monopoly bank with a tax on assets are:

$$\pi = (r_L(L) - r - t_A)L + [r(1-\alpha) - r_D(D)]D - C(D,L) \tag{16}$$

First order conditions are:

$$\begin{aligned} \phi_l &= \frac{\partial \pi}{\partial L} = \frac{\partial r_L}{\partial L}L + (r_L - r - t_A) - \frac{\partial C}{\partial L} = 0 \\ \phi_d &= \frac{\partial \pi}{\partial D} = -\frac{\partial r_D}{\partial D}D + r(1-\alpha) - r_D - \frac{\partial C}{\partial D} = 0 \end{aligned} \tag{17}$$

These can be re-written as

(18)
$$\frac{(r_L - r - t_A) - \frac{\partial C}{\partial L}}{r_L} = \frac{1}{\varepsilon_L(r_L)}$$
$$\frac{r(1-\alpha) - r_D - \frac{\partial C}{\partial D}}{r_D} = \frac{1}{\varepsilon_D(r_D)}$$

Proposition 10: A tax on assets lowers the monopolist bank's supply of loans and has no effect on its demand for deposits if management costs are separable.

Proof: Using the implicit function theorem on the first order conditions yields:

(19)
$$\frac{\partial L}{\partial t_A} = -\frac{\partial \phi_l / \partial t_A}{\partial \phi_l / \partial L} = -\frac{-1}{L(\partial^2 r_L / \partial L^2) + 2\partial r_L / \partial L - \partial^2 C / \partial L^2} < 0$$
$$\frac{\partial D}{\partial t_A} = -\frac{\partial \phi_d / \partial t_A}{\partial \phi_d / \partial D} = -\frac{0}{-(2\partial r_D / \partial D + D(\partial^2 r_D / \partial D^2)) - \partial^2 C / \partial D^2} = 0$$

In the monopoly case, the tax increases the marginal cost of managing loans and hence reduces the supply of loans. Deposits are unaffected by the tax.

These results are illustrated in Figure 6. In the market for loans in the upper diagram, the tax on assets increases the marginal cost of loans while also increasing the interest rate on loans charged to consumers. In the market for deposits, the tax has no effect.

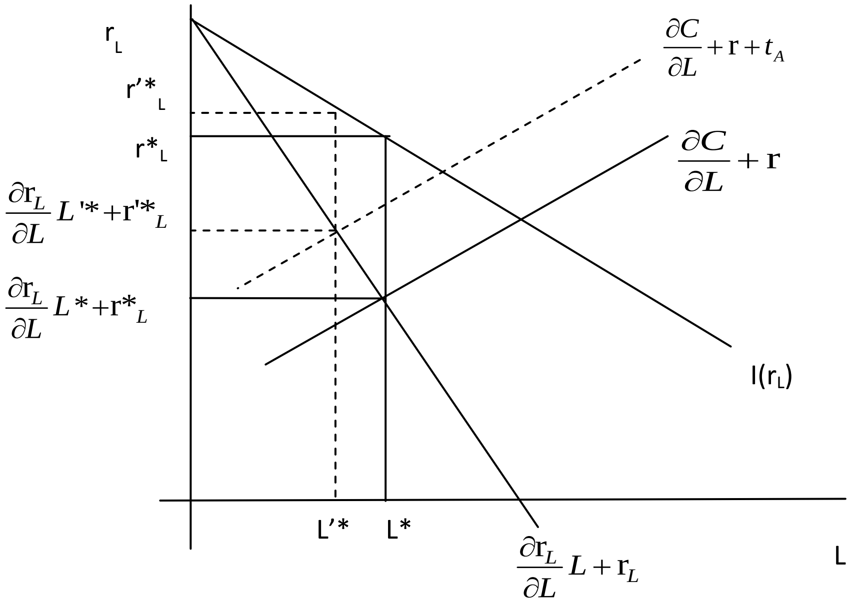
B. A Tax on Bank Deposits

Profits for the monopoly bank with a tax on deposits are:

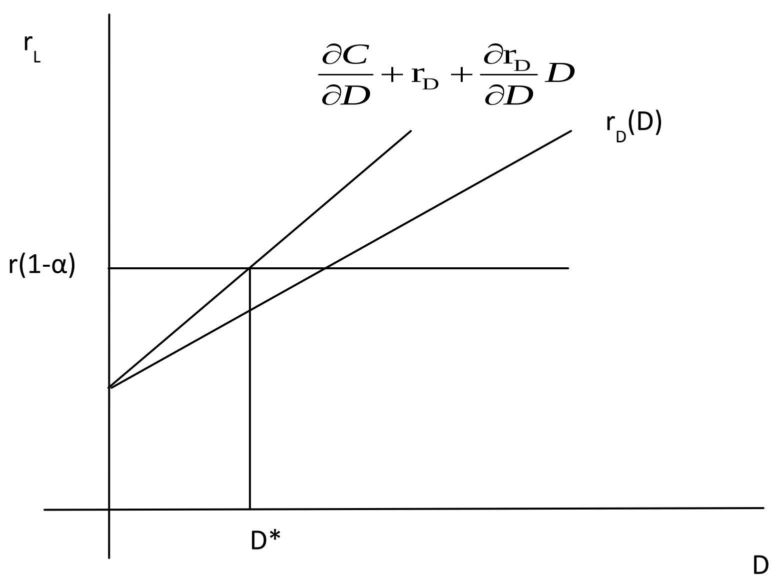
(24)
$$\pi = (r_L(L) - r)L + [r(1-\alpha) - r_D(D) - t_D]D - C(D, L)$$

Figure 6: A tax on bank assets in a monopolistic banking market, holding the interbank rate fixed

The market for loans



The market for deposits



First order conditions are:

(25)
$$\phi_l = \frac{\partial \pi}{\partial L} = \frac{\partial r_L}{\partial L} L + (r_L - r) - \frac{\partial C}{\partial L} = 0$$
$$\phi_d = \frac{\partial \pi}{\partial D} = -\frac{\partial r_D}{\partial D} D + \left[r(1-\alpha) - r_D - t_D \right] - \frac{\partial C}{\partial D} = 0$$

These can be re-written as

(26)
$$\frac{(r_L - r) - \dfrac{\partial C}{\partial L}}{r_L} = \frac{1}{\varepsilon_L(r_L)}$$
$$\frac{\left[r(1-\alpha) - r_D - t_D \right] - \dfrac{\partial C}{\partial D}}{r_D} = \frac{1}{\varepsilon_D(r_D)}$$

where ε is the elasticity.

Proposition 11: Market power does not alter the fact that if management costs are separable, a higher tax rate on deposits lowers a bank's demand for deposits and has no effect on its supply of loans.

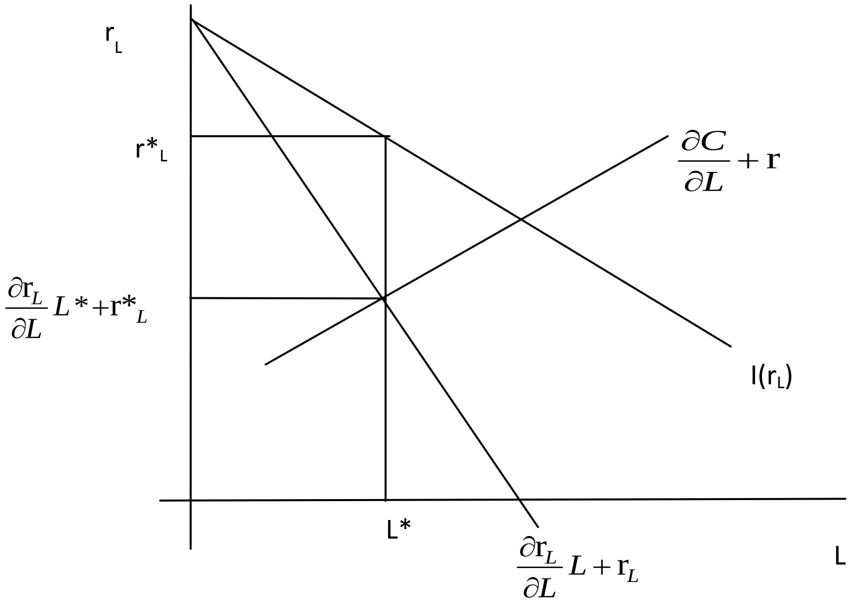
Proof: Applying the implicit function theorem yields:

(27)
$$\frac{\partial L}{\partial t_D} = -\frac{\partial \phi_l / \partial t_D}{\partial \phi_l / \partial L} = -\frac{0}{L(\partial^2 r_L / \partial L^2) + 2\partial r_L / \partial L - \partial^2 C / \partial L^2} = 0$$
$$\frac{\partial D}{\partial t_D} = -\frac{\partial \phi_d / \partial t_D}{\partial \phi_d / \partial D} = -\frac{-1}{-(2\partial r_D / \partial D) - D(\partial^2 r_D / \partial D^2) - \partial^2 C / \partial D^2} < 0$$

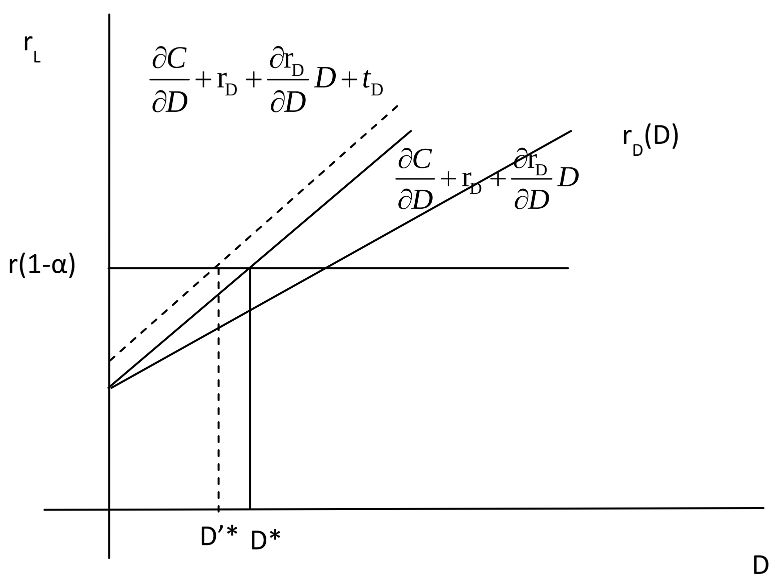
Figure 7 illustrates this result. Again the market for loans is unaffected by the tax on deposits as shown in the upper diagram. In the market for deposits, the marginal cost of deposits is shifted up by the tax, reducing the demand for deposits.

Figure 7: A tax on bank deposits in a monopolistic banking market, interbank rate fixed, separable costs

The market for loans



The market for deposits



Proposition 12: A tax on deposits increases net borrowing when the bank is a monopoly.

Proof: The proof proceeds as in the competitive case. Differentiating the negative of (1) yields:

(1')
$$-\frac{\partial M}{\partial t_D} = -(1-\alpha)\frac{\partial D}{\partial t_D} + \frac{\partial L}{\partial t_D}$$

Substituting from (27):

(1'')
$$-\frac{\partial M}{\partial t_D} = (1-\alpha)\frac{-1}{-(2\partial r_D/\partial D) - D(\partial^2 r_D/\partial D^2) - \partial^2 C/\partial D^2} > 0$$

Since deposits fall but loans do not, borrowing increases.

C. A Tax on Bank Liabilities

As before a tax on bank liabilities amounts to a tax on deposits plus a tax on borrowing which is equivalent to a tax on assets that does not exempt reserves; as net borrowing is –M, this tax is:

(17)
$$(D_n - M_n)(t_B) = (D_n - (1-\alpha)D_n + L_n)(t_B) = (\alpha D_n + L_n)(t_B)$$

After-tax profits are:

(18)
$$\pi = (r_L(L) - r - t_B)L + [r(1-\alpha) - r_D(D) - \alpha t_B]D - C(D,L)$$

Choosing D and L to maximize profits yields:

(19)
$$\phi_l = \frac{\partial \pi}{\partial L} = \frac{\partial r_L}{\partial L}L + (r_L - r - t_B) - \frac{\partial C}{\partial L} = 0$$
$$\phi_d = \frac{\partial \pi}{\partial D} = -\frac{\partial r_D}{\partial D}D + \left[r(1-\alpha) - r_D - \alpha t_B\right] - \frac{\partial C}{\partial D} = 0$$

Proposition 13: If management costs are separable, a tax on liabilities lowers a monopoly bank's demand for deposits and its supply of loans.

Proof: Applying the implicit function theorem yields:

$$\begin{aligned}\frac{\partial L}{\partial t_B} &= -\frac{\partial \phi_L / \partial t_B}{\partial \phi_L / \partial L} = -\frac{-1}{L(\partial^2 r_L / \partial L^2) + 2\partial r_L / \partial L - \partial^2 C / \partial L^2} < 0 \\ \frac{\partial D}{\partial t_B} &= -\frac{\partial \phi_D / \partial t_B}{\partial \phi_D / \partial D} = -\frac{-\alpha}{-(2\partial r_D / \partial D) - D(\partial^2 r_D / \partial D^2) - \partial^2 C / \partial D^2} < 0\end{aligned} \tag{20}$$

Figure 5 illustrates this result. The tax has identical effects in the market for loans as a tax on assets. In the market for deposits, the marginal cost of deposits is shifted up by the fraction α of the tax. Other things equal, this lowers the demand for deposits. In equilibrium, the interest rate paid for deposits also falls; hence the overall effect in equilibrium depends on the degree to which the interest rate falls relative to the required reserve ratio α.

Proposition 14: The effect of a tax on liabilities on a monopoly bank's borrowing is indeterminate and more complicated than the perfectly competitive case. However, it still is the case that net borrowing will decrease if the tax decreases deposits (net of the reserve requirement) by more than loans.

The proof again starts from the definition of net borrowing. Differentiating the negative of (1) yields:

$$-\frac{\partial M}{\partial t_D} = -(1-\alpha)\frac{\partial D}{\partial t_D} + \frac{\partial L}{\partial t_D} \tag{1'}$$

Clearly the first term must increase by more than the second for net borrowing to fall due to the tax.

D. A Tax on Bank Profits

After-tax profits for the monopoly bank with a tax on profits are:

(31) $$\pi = \left[(r_L(L)-r)L+[r(1-\alpha)-r_D(D)]D-\gamma C(D,L)\right](1-t_\pi)$$

First order conditions are:

(32) $$\begin{aligned}\frac{\partial \pi}{\partial L} &= \frac{\partial r_L}{\partial L}L+(r_L-r)-\gamma\frac{\partial C}{\partial L}=0\\ \frac{\partial \pi}{\partial D} &= \frac{\partial r_D}{\partial D}D+\left[r(1-\alpha)-r_D\right]-\gamma\frac{\partial C}{\partial D}=0\end{aligned}$$

These can be re-written as

(33) $$\begin{aligned}\frac{(r_L-r)-\gamma\dfrac{\partial C}{\partial L}}{r_L} &= \frac{1}{\varepsilon_L(r_L)}\\ \frac{\left[r(1-\alpha)-r_D\right]-\gamma\dfrac{\partial C}{\partial D}}{r_D} &= \frac{1}{\varepsilon_D(r_D)}\end{aligned}$$

where ε is the elasticity. As in the competitive case, the effects of the tax depend crucially on the fraction of costs that are deductible.

Proposition 15: As in the perfectly competitive case, if management costs for both loans and deposits are fully deductible, the tax does not change the monopoly bank's demand for deposits or supply of loans.

Proof: If costs are fully deductible, γ = 1. The proposition follows from a comparison of first order conditions.

VI. Conclusion

Taxation of the banking sector is an important but under-researched policy issue. Our goal here is to partially fill this gap by analyzing different ways to tax banks as a corporation. As discussed in Freixas and Rochet (1999) Arrow-Debreu models (with perfect financial markets) are not very useful for analyzing the banking sector as banks become redundant and essentially serve no useful purpose in such models. Two distinct types of models have been developed to explain the usefulness of banks, one relying on incomplete information, and a second that emphasizes the role of banks in providing services such as the management of loans and deposits, associated with Monti (1972) and Klein (1971). This latter model is a general equilibrium one in that the interest rates charged on loans and paid on deposits is endogenous.

Summarizing the main results, we have found that a tax on bank assets decreases loans and net borrowing by banks; a tax on bank deposits decreases the demand for deposits and increases net borrowing by banks; a tax on bank liabilities decreases both loans and deposits and may increase or decrease net borrowing by banks; and the effects of a tax on bank profits depends crucially on the deductibility management costs. We also show that these results extend to the case of monopoly power.

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