EUROPEAN COMMISSION

Brussels, 28.9.2011
SEC(2011) 1102 final

Vol. 11

COMMISSION STAFF WORKING PAPER

IMPACT ASSESSMENT

Accompanying the document

Proposal for a Council Directive

on a common system of financial transaction tax and amending Directive 2008/7/EC

{COM(2011) 594 final}
{SEC(2011) 1103 final}

ANNEX 10

IMPACTS ON EFFECTIVE TAX RATES, THE COST OF CAPITAL AND INTEREST RATE SPREADS

This Annex illustrates the effects of the tax instruments discussed in the main document on the behaviour of banking and financial intermediaries. In particular, consistent with the traditional framework to assess the impacts of taxation on the incentives to accumulate capital, the effects on the user cost of capital, and the related concepts of effective tax rates, will be reviewed. Given the crucial functions performed by banks in the economy, investigating the potential effects of taxation on the rates and the credit market is also of particular interest. In this context, as the literature on banking regulation has highlighted the existence of a link between lending and capital requirements, in investigating the impacts of bank taxes on lending rates and volumes the interaction with regulatory provisions on equity capital is explicitly taken into account.

1. FINANCIAL TRANSACTION TAXES

The effects of transaction taxes on firms' behaviour have been investigated particularly for the case of securities. A general theoretical result is that that higher transactions costs, including those imposed by transaction taxes, are associated with lower asset prices (Kupiecs, 1996). Investors facing higher costs to acquire a security require a higher return from holding it, and thus bid the price down. This may increase the cost of capital faced by firms, which in turn would translate into lower investment at the macroeconomic level.

In a simple framework for the valuation of the firm, Matheson (2011) analyses the effects of a securities transactions tax (STT) on share prices and on the cost of capital, and finds that a STT is akin to a permanent increase in the firm's discount rate[1]. While the effect on the cost of capital is derived in Box 9.1, considering the case of a transactions tax levied once per transaction at the ad valorem rate T, the proportional reduction in the value of a security (Δ) following the STT is, under simplifying assumptions:

$$\Delta = 1 - \frac{1 - e^{-RN}}{1 - (1 - T)e^{-RN}},$$

with $R = r - g$, where r is the discount rate and g the growth rate of dividends, and N is the holding period.

Box 9.1. STTs and the cost of capital (Matheson, 2011)

Consider a firm that maximizes the dividend stream, given by:

$$\sum_t (1 - \vartheta_t) D_t (1 + r)^{-t},$$

[1] A STT is defined as a tax on trades in all or certain types of securities (equity, debt and their derivatives). It may include original issuance (similar to a capital levy), or be restricted to secondary market trades.

where ϑ_t is the dividend tax rate at *t*. in the absence of equity finance, dividends are given by $D_t = F(K_t) - I_t$, with $K_t = I_t + (1-\delta)K_{t-1}$, where, as usual, K indicates the capital stock, I is investment and δ is the economic depreciation rate. After substituting, the maximand becomes:

$$\sum_t (1-\vartheta_t)\left[F(K_t) - K_t + (1-\delta)K_{t-1}\right](1+r)^{-t} .$$

Differentiating with respect to K_t and setting equality to zero gives:

$$(1-\vartheta_t)\left(F'(K_t) - 1\right) + (1-\vartheta_{t+1})(1+r)^{-t}(1-\delta)(1+r)^{-1} = 0$$

Rearranging, the value-maximizing marginal product of capital can be expressed as:

$$F'(K_t) = 1 - (1-\vartheta_{t+1})(1-\vartheta_t)^{-1}(1-\delta)(1+r)^{-1} .$$

Imposing $\vartheta_t = 0$ and $\vartheta_{t+1} = (1/N)T$, with 1/N the probability of selling the share at t+1 and T the ad valorem transaction tax rate, the expression becomes:

$$F'(K_t) = \left[(r+\delta) + (1-\delta)T/N\right](1+r)^{-1} .$$

Hence, the STT increases the cost of capital by the second term on the right hand side of the equation, and is roughly equivalent to an increase in the firm's discount rate by *T/N*.

The table shows that the effects on the security prices and on the cost of capital increase in the tax rate and are dampened with longer holding periods (see Table 9.1). By raising transactions costs, a STT would also increase the average holding period of securities, particularly for securities with initially narrow bid-ask spreads. In turn, this would reduce the impact of the tax on securities values and capital costs. As corporate bonds are generally traded less frequently than stocks, a given STT would likely impact corporate borrowing costs less heavily then stocks.

Empirical studies of the impact of STTs on financial markets generally confirm the theoretical proposition that they reduce asset prices (Umlauf, 1993; Hu, 1998). Bond, Hawkins and Klemm (2005) find that the 50 % cut in the UK stamp duty enacted in 1986 increased share prices, particularly for shares with high turnover rates. They predict that eliminating the remaining 50 basis point stamp duty would increase share prices between 2.5 and 6.3 percent, with the size of the effects depending negatively on dividend yield and positively on market turnover. STTs are therefore capitalized more heavily into the prices of assets with high turnover, such as large-capitalization stocks. Schwert and Seguin (1993) estimate that the increase in the cost of capital following a 0.5% STT in the US would be between 10 and 180 basis points. Oxera (2007) estimates that abolition of the 0.5% UK stamp duty would increase share prices by 7.2% and reduce the cost of capital by between 66 and 80 basis points. The magnitude of the impacts of STTs depends positively on the frequency with which shares are traded.

The negative impact of transaction taxes on investment is not confined to taxes applicable to securities. Albuquerque (2006) builds a dynamic general equilibrium (DGE) to analyse different bank account debits (BAD) taxes, of the type of the Provisional Contribution on Financial Transactions (CMPF) implemented in Brazil (see Annex 8). In a framework of utility-maximising households, BAD taxes introduce a distortionary effect on the interest and dividend rates (through the Euler equations). The steady-state interest and dividend rates are found to increase with the tax rate and the turnover. The effect on the dividend rate implies that even with a small rate the tax can cause disinvestment and thus be detrimental to capital accumulation.

In general, bank transaction taxes (BTTs) can have detrimental effects on the functioning of both financial markets and the real economy. Since banks collecting BTTs usually charge higher interest rate spreads to recoup profitability, investment is discouraged. Likewise, BTTs also tend to encourage vertical integration of production processes, regardless of efficiency, as following the cascading effect through the production chain which results in multiple layers of tax on goods and services produced using bank-mediated transfers. Kirilenko and Summers (2004) have stressed that the erosion of the tax base taking place by removing funds from financial intermediaries has effects that go well beyond the revenue shortfall, given the role of the banking sector in the economy. A consequence of disintermediation would be the misallocation of financial funds, with a far reaching potential impact on the financing of investment projects. In fact, the experience with BTTs in Latin America has shown that this type of taxes, in addition to generating revenues which are substantially declining over time (Coelho, 2009; Baca-Campodónico, de Mello and Kirilenko, 2006), tend to be associated with significant substitution into cash, relocation of bank transactions into off-shore centres, development and adoption of new financial instruments and practices.

Table 9.1

Percentage Reduction in Security Valuation due to an STT

Tax Rate (T), Basis Points	Average Holding Period (Years) 0.10	0.25	0.5	1	2	3	3.7	10
1	3.2%	1.3%	0.7%	0.3%	0.2%	0.1%	0.1%	0.0%
5	14.3%	6.2%	3.2%	1.6%	0.8%	0.5%	0.4%	0.1%
10	25.0%	11.7%	6.2%	3.2%	1.6%	1.1%	0.8%	0.3%
50	62.5%	39.9%	24.9%	14.1%	7.5%	5.0%	4.1%	1.4%

Discount rate less dividend growth rate: R = 0.03

Increase in Cost of Capital - Percentage Points

Tax Rate (T), Basis Points	Average Holding Period (Years) 0.10	0.25	0.5	1	2	3	3.7	10
1	0.10	0.04	0.02	0.01	0.01	0.00	0.00	0.00
5	0.50	0.20	0.10	0.05	0.03	0.02	0.01	0.01
10	1.00	0.40	0.20	0.10	0.05	0.03	0.03	0.01
50	5.00	2.00	1.00	0.50	0.25	0.17	0.14	0.05

Source: Matheson (2011)

2. TAXES ON BANK PROFITS AND REMUNERATIONS

Taxation of income from capital is traditionally analysed using the concepts of effective tax rates. While the standard approach has focused on marginal investment decisions, leading to the formulation of effective marginal tax rates (EMTR) based on the cost of capital, a complementary approach looks at discrete choices among alternative investment projects, for which the relevant measure is the effective average tax rate (EATR). As the EATR encompasses the EMTR for marginal projects, it is reviewed here in its general formulation, and then the measures for a cash-flow type of profit tax are derived. Subsequently, an alternative EMTR which takes into account all the inputs (i.e. labour in addition to capital) is presented, alongside the implications for a cash-flow type of profit tax.

2.1. The EATR methodology

The effective average tax rate (EATR) developed by Devereux and Griffith (2003) provides a popular forward-looking measure of capital taxation considering a one-period perturbation of the capital stock of a firm. It is defined as follows:

$$EATR = \frac{R^* - R}{p/(1+r)}, \qquad (1)$$

where R^* is the present discounted value of the economic rents earned from the investment project in the absence of taxes, R is the same with taxation, *p* is the pre-tax net income stream discounted using the real interest rate *r*.

It is possible to show that, in the absence of taxes, the economic rent generated by an investment is:

$$R^* = -1 + \frac{(1+\pi)(p+\delta) + (1+\pi)(1-\delta)}{(1+i)} = \frac{p-r}{1+r}, \qquad (2)$$

with *I* the nominal interest rate, π the inflation rate, δ the economic depreciation rate of the capital stock.

When taxes are introduced, the source of financing also affects the rents. In particular, if the investment is financed with retained earnings, the rents are:

$$R^{RE} = -\gamma(1-A) + \frac{\gamma}{1+\rho}\left[(1+\pi)(p+\delta)(1-t) + (1+\pi)(1-\delta)(1-A)\right], \qquad (3)$$

where *t* is the rate of taxation of corporate income, A is the present discounted value of tax allowances per unit of investment (with a rate of fiscal depreciation per period equal to φ), *ρ* is the investor discount rate, $\rho=(1-m^i)i/(1-z)$, with m^i being the shareholder's marginal personal income tax rate on interest income and *z* the tax on capital gains, and $\gamma=(1-m^d)/(1-z)$ is a factor measuring the difference in treatment of new equity and distributions with m^d the personal tax rate on dividends. In the case of alternative sources of finance, additional financing cost needs to be added to this equation, or $R=R^{RE}+F$. In the case of finance by new equity (NE) and debt (D), the addendums are, respectively, $F^{NE} = -\rho(1-\gamma)(1-\varphi t)/(1+\rho)$ and $F^D = \gamma(1-\varphi t)(\rho - i(1-t))/(1+\rho)$.

As shown by Devereux and Griffith (2003), in the absence of personal taxes on interest income and capital gains, the EATR on a marginal project is equal to the EMTR, which can then be expressed as:

$$EMTR = \frac{\tilde{p} - r}{\tilde{p}} \qquad (4)$$

where $\tilde{p}$ is the cost of capital, i.e. the solution to $R=0$, as required in the case of a marginal investment.

In this general setting it is possible to verify the result that a cash-flow type of taxation for corporate income which allows immediate expensing of investment and no deductions for interest payments does not affect the cost of capital, and hence leads to a null EMTR (see, for instance, King (1987)). Consider the case of retained earnings financing as in (3), which gives the following expression for the cost of capital:

$$\tilde{p} = \frac{(1-A)[\rho + \delta(1+\pi) - \pi]}{(1-t)(1+\pi)} - \delta \,. \qquad (5)$$

Recalling that if the investment cost is fully expensed when it is incurred, then *A=t*, and substituting gives: $\tilde{p}^{cf} = (\rho - \pi)/(1+\pi)$. Substituting into equation (4), the numerator of the EMTR simplifies to $\rho - \pi - r(1+\pi) = 0$, since $(1+r)(1+\pi)=1+I$ and $\rho=I$ without personal taxes.

The cash-flow type of taxes however will still lead to positive EATRs. Recalling that $\varphi =1$, $A=t$ and no deduction is allowed for interest payments, it is possible to show that the EATRs are:

$$EATR^{RE} = \frac{\frac{(p-r)}{1+r} - (1-t)\gamma[-1 + (1+\pi)(1+p)/(1+\rho)]}{\frac{p}{1+r}} \,, \qquad (6)$$

$$EATR^{NE} = EATR^{RE} + \frac{(1-t)(1+\gamma)\rho/(1+\rho)}{\frac{p}{1+r}} \text{, and} \qquad (7)$$

$$EATR^{D} = EATR^{RE} + \frac{(1-t)\gamma(\rho - i)/(1+\rho)]}{\frac{p}{1+r}} \,. \qquad (8)$$

Consider a tax levied at 5% rate on cash-flow profits. Abstracting from capital gain and personal taxes, if one assumes a pre-tax rate of return of 20%, in the presence of a 5% real interest rate and 2% inflation, the EATR is 3.75%[2]. Of course, having in mind the design of the FAT, one should take into account that the same statutory rate falls on the labour compensation. The next section illustrates an alternative methodology that explicitly incorporates the labour input into the calculation of the effective tax burden.

2.2. A PRODUCTION BASED APPROACH TO MEASURE MARGINAL EFFECTIVE TAX RATES

McKenzie, Mintz and Scharf (1997) have proposed a 'production approach', as opposed to the traditional 'investment approach' to derive effective marginal tax rates which take into

[2] Absent personal taxation and levies on capital gains, the way of financing the investment (whether through retained earnings or through debt) does not affect the average tax burden.

account taxes levied on all inputs. As such, this approach seems particularly promising to analyse a financial activities tax levied on profits and remunerations, hence on the capital and labour factors. The sketch of the methodology provided here follows strictly the adapted model proposed by McKenzie (2000) to calculate effective taxes on banks. The methodology can be implemented in three steps, which allow the calculation of the effective tax rates on: i) each of the inputs; ii) the marginal cost function; iii) output.

i) The effective tax rate on capital is given by the effective marginal tax rate, obtainable using the methodology of King and Fullerton (1984) and Devereux and Griffith (2003). As shown above, the marginal rate for a cash flow profit tax is zero. As far as the marginal rate on labour is concerned, the key issue is to identify the 'marginal' worker. In the presence of a flat rate applicable to payroll the marginal rate would be given by the rate itself.

ii) The rates on the inputs are aggregated to obtain the rate on the marginal cost function (MC), T^i, which solves $(1+T^i)\, MC(q; p^0) = MC(q; p')$, where q denotes the output and W^0 (W') is a vector of input prices before (after) taxation. Assuming a bank that 'produces' loans (L) using capital (K) and labour (N), $MC(q; p')=MC(L; p^K(1+\beta^K t^K), p^N (1+\beta^N t^N))$, where t^i are the marginal tax rates and β^i the tax shifting factors, $0 \leq \beta^i \leq 1$[3]. In particular, when $\beta^i = 1$ the tax is fully shifted forward to the demand side for the input, and the user cost changes by the full amount of the tax. On the other hand, when $\beta^i = 0$ the tax is fully borne by the supply side, hence the user cost is unaffected by it. In the intermediate case, the user cost increase by some fraction of the tax. Finally, aggregating the effective marginal tax rates requires the choice of a functional form for the production function. Two commonly used forms are:

a. the Cobb-Douglas (with elasticity of substitution among the inputs equal to 1) leads to $T^i = \left(1+\beta^K t^K\right)^{A^K} \left(1+\beta^N t^N\right)^{A^N} - 1$

b. the Leontief, or fixed proportions (with elasticity of substitution among the inputs equal to 0) leads to $T^i = A^K\left(1+\beta^K t^K\right) + A^N\left(1+\beta^N t^N\right) - 1$,

where the A^i are the factors shares.

iii) The effect of taxes on the marginal revenues needs to be taken into account. Following the tax, one should observe an upward shift of the marginal cost curve, together with a downward shift of the marginal revenue schedule. In the model of McKenzie (2000), banks are price takers in the loan market. The net effect is a reduction in the number of loans. The equilibrium condition for profit maximisation without taxes is:

$$r^l{}_l = MC(.)(\rho + f) \qquad \Leftrightarrow \qquad r^n \equiv r^l / MC(.) - f = \rho \qquad (9)$$

where r^l is the loan rate, assumed as given, and f is the loans loss rate. Finally, ρ is the opportunity cost of finance, or $\rho = \sigma r^e + (1-\sigma) r^d$ where r^e (r^d) is the rate of return required by equity owners (depositors), and σ the proportion of the marginal loan financed by retained earnings[4]. In the equilibrium condition above, r_n is defined as the net rate of return on a marginal loan net of default risk.

The equilibrium condition for profit maximisation in the presence of taxes is:

---

[3] $\beta^i = (\varepsilon^i{}_s)/(\varepsilon^i{}_s + \varepsilon^i{}_d)$, with $\varepsilon^i{}_s$ ($\varepsilon^i{}_d$) the elasticity of supply (demand).

[4] In the model, only retained earnings and deposits are the two sources of finance for the bank.

$$r^l(1-t) = (1+T^i)MC(.)(\rho+f) \quad (10)$$

which, combined with the condition (9), gives the gross-of-tax return r_g on issuing an additional loan leading to the net-of-tax return r_n :

$$r^g = r^l(1+T^i)(\rho+f)/r^l(1-t)-f \quad (11)$$

Combining the net and the gross rates, one can obtain the effective marginal tax rate on bank loans as: $t^l=(r^g - r^n)/r^g$.

To fix ideas, a simple numerical example can be worked out as follows. Suppose a 5% tax is levied on cash-flow profits and remunerations. As clarified above under i), in the absence of other taxes the marginal rate on capital will be zero, whereas that on labour is 5%. Consider further the aggregation under ii), and a pass-though of the labour tax of 50%. Using a value for the labour share equal to 52%, the Cobb-Douglas production function gives an effective rate on intermediation costs of 1.29%, while the fixed proportions function leads to a marginal effective rate of 1.3%[5]. Finally, applying the steps under iii) one obtains a marginal effective rate on loans in the range of 29%[6]. The rather high order of magnitude, broadly consistent with the evidence for the US and Canada calculated in McKenzie (2000), is indeed a result of the combined effect of taxes on the cost of intermediating bank loans, which arise from the taxation of bank inputs, and the reduction in the marginal revenue from issuing the loan.

3. EFFECTS ON BANKS ASSET GROWTH AND RISK: EMPIRICS

Since a reduction of after-tax returns discourages expansion of investment, an increase in bank taxes is likely to impact negatively on bank asset growth. In addition, reduced after-tax earnings make retaining earnings more costly, adversely affecting capital formation, which in turn discourages asset growth. Moreover, a reduction in asset growth and (after-tax) profitability, coupled with more costly capital formation, can also translate into higher bank risk. De Nicolò (2010) quantifies those potential impacts with respect to two specific tax instruments: a Financial Stability Contribution (FSC) and a FAT[7].

First, using a large unbalanced panel of US banks during 1995-2009, the author estimates forecasting models of equity formation, bank assets growth and the probability of default. As expected, a lower return on assets due to an increase in corporate taxation has a negative impact on capital formation, asset growth, and translates in an increase in the probability of default. In addition, a higher effective tax rate reduces asset growth, while higher asset growth also reduces the probability of default.

From the equations in the levels, first difference equilibrium relationships are obtained relating the change in taxation to the change in asset growth and probability of default. The hypothetical cases considered are:

---

[5] The share of labour compensation over gross value added for financial corporations is obtained using the Annual Sectoral Accounts from Eurostat.

[6] The calculations assume a ROE of 10%; a rate on deposits of 2.06% and a loan loss rate of 4.2%. These values are obtained from the ECB Statistical Warehouse and ECB (2010). The share of equity financing for the marginal loan is assumed equal to 5.05%.

[7] See IMF (2010) for the definitions.

- FSC taxes of 10, 50 and 100 basis points applied to total debt and to total liabilities net of equity capital;
- a Financial Activity Tax (FAT) assumed to be 2 percent (200 basis points) of profits before taxes.

The results show a limited median impact of FSC and FAT on asset growth (the point estimates do not exceed a decline of 0.07% under the highest FSC tax rate and base), with extreme values of sizable magnitude, however. By contrast, the impact of FSC and FAT on the probability of default is very small, with the maximum over all banks reaching 0.12 %.

In the second step of the analysis, the impact on real activity is derived using an estimated elasticity for GDP growth to bank assets growth of 0.07%, obtained from a panel of 48 countries in the period 1980-2007. The FSC and the FAT have a very limited median impact on GDP growth. However, the impact of these taxes could have more significant adverse real effects in the worst case scenario in which most banks would implement a contraction in asset growth closer to the estimated maximum for large banks.

4. BANK TAXES IN THE PRESENCE OF CAPITAL REQUIREMENTS: A THEORETICAL FRAMEWORK

In this section the effects of bank taxes is analyzed using an adapted version of the basic Monti-Klein model (Freixas and Rochet, 2007). In particular, the model allows one to study the effects of a tax on profits (and of a bank levy) on banks' behaviour and profitability, as well as the combined effect of regulation, in a very stylized setting.

The bank is a monopolist facing a downward-sloping demand for loans $L(r_L)$ and an upward-sloping supply of deposits, $D(r_D)$. In what follows, it is more convenient to work with the inverse demand functions, as follows: $r_L(L)$ and $r_D(D)$. Likewise, it is useful to define the effect of taxes on the relevant functions. Consider a generic profit tax of h_L. The (inverse) demand function for loans now becomes $r_L(\overset{-}{L},\overset{-}{h_L})$, where the superscripts indicate the sign of the partial derivatives. The conditions in the demand for loans reflect the fact that higher interest rates or higher taxes reduce the number of investment projects with positive net present value. In particular, an increase in the tax rate h_L, keeping the amount of demanded loans unchanged, reduces the level of r_L. By the same token, consider a tax on deposits h_D on deposits. The inverse supply schedule denotes the interest rate required by depositors in order to supply resources equal to D. A tax falling on deposits implies that for given D, depositors increase the required rate r_D. Hence, $r_D(\overset{+}{D},\overset{+}{h_D})$, where the superscripts indicate the sign of the partial derivative as before.

The bank's cost function is assumed to be linear and separable:

$$C = \gamma_D D + \gamma_L L\,, \tag{12}$$

with γ's positive cost parameters. The profit function looks like:

$$\Pi = r_L(L)L - r_D(D)D - rI - pL - C \tag{13}$$

where I denotes the net interbank liabilities, on which the bank pays the money market rate of r, exogenously given, and provisions are assumed to be a constant fraction p of loans.

Banks are subject to capital requirements, which, following the literature, are assumed to be always binding. This implies that the amount of equity is a given fraction $0<k<1$ of loans, or $E=kL$. Taking into account all the elements above, the balance sheet constraint is:

$$L = D + E + I \,, \tag{14}$$

Finally, in the spirit of Caminal (2003), it is assumed that the bank is a licence holder, with no private wealth, so that equity needs to be raised on the market. Denoting v the value of the licence, η the net rate of return required by outside investors and φ the proportion of the bank owned by them, then φ is determined by the following no arbitrage condition:

$$\frac{\varphi\Pi}{E-v} = 1+\eta \,. \tag{15}$$

The left hand side is the amount of profits accruing to outside investors expressed as a ratio of their disbursement. Such return is assumed to be equal to $1+\eta$, the return to outside investors on their alternative option.

A tax on bank profits

The analysis builds upon Albertazzi and Gambacorta (2007). In the basic framework outlined above, a tax at rate τ on profits generates a fiscal effect on the cost of equity. Profits in equation (15) have to be netted of the tax, yielding the following:

$$\frac{\varphi\Pi(1-\tau)}{E-v} = 1+\eta \,. \tag{16}$$

Rearranging, one can express the fraction of profits accruing to the licence holder as:

$$(1-\varphi)\Pi = \Pi - \frac{1+\eta}{1-\tau}E + \frac{1+\eta}{1-\tau}v \,. \tag{17}$$

Taking into account equations (12)-(16), the maximization problem can then be written as:

$$\underset{L,D}{\mathrm{Max}}\,(1\text{-}\tau)\left[r_L L - \tilde{\gamma}_L L - r_D D + \gamma_D D + rD + \frac{1+\eta}{1-\tau}v\right],$$

with $\tilde{\gamma}_L = \gamma_L + p + k\frac{1+\eta}{1-\tau} + (1-k)r,$ a term akin to an adjusted marginal cost which indicates that, in addition to operational expenses, loans involve costs in terms of provisions, capital requirements and money market interest rate, for non-equity finance. As a result of full separability, a tax on profits has no effect on the equilibrium on the deposits market. It affects the lending side through two channels: the marginal cost of outside equity $(1+\eta)/(1-\tau)$ and the demand for loans. Formally, this can be seen first by deriving the first order conditions (FOCs), as follows:

$$\begin{cases} \dfrac{d\Pi}{dL} = (r_L)_L L + r_L - \tilde{\gamma}_L = 0 & \Leftrightarrow r_L^{\ *} = \tilde{\gamma}_L / (1 - 1/\varepsilon_L) \\ \dfrac{d\Pi}{dD} = r - (r_D)_D D - r_D - \gamma_D = 0 & \Leftrightarrow r_D^{\ *} = (r - \gamma_D)/(1 + 1/\varepsilon_D) \end{cases}$$

where $(r_L)_L \equiv dr_L/dL (< 0)$ and $(r_D)_D \equiv dr_D/dD (> 0)$, while ε_L and ε_D are the elasticities of the demand for loans and of the supply of deposits, henceforth assumed constant[8].

Simple comparative statics shows the effect of the variables of interest on the equilibrium. In particular, the effects of the profit tax on quantities can be examined by totally differentiating the FOCs, yielding:

$$\frac{dL^*}{d\tau} = -\frac{(r_L)_\tau - (1 - 1/\varepsilon_L)^{-1} (\tilde{\gamma}_L)_\tau}{(r_L)_L} = -\frac{(r_L)_\tau - (1 - 1/\varepsilon_L)^{-1} k(1+\eta)(1-\tau)^{-2}}{(r_L)_L} < 0, \text{ and}$$

$$\frac{dD^*}{d\tau} = 0,$$

where $(r_L)_\tau \equiv dr_L/d\tau < 0$ denotes the partial derivative of the inverse demand function with respect to the tax rate. The null effect of the tax on deposits is because the rate and the cost for deposits are not affected by the tax. We concentrate on the loans market.

In a similar way, the effect of tighter regulation for bank capital on lending volumes can be analysed using comparative statics for the parameter *k*, as follows:

$$\frac{dL^*}{dk} = -\frac{-(1 - 1/\varepsilon_L)^{-1} (\tilde{\gamma}_L)_k}{(r_L)_L} = -\frac{-(1 - 1/\varepsilon_L)^{-1} (1+\eta)(1-\tau)^{-1}}{(r_L)_L} < 0 .$$

Hence, both a tax on profits and tighter regulatory requirements will decrease lending volumes. The latter effect is the so-called "bank capital channel", which captures how shocks to a bank's capital affect the level and composition of its assets. As highlighted in FSA (2009), such channel operates under the conditions that: (i) banks do not hold excess capital with which to isolate credit supply form regulatory changes; (ii) raising capital is costly for banks; (iii) there is positive demand for bank credit.

What happens to equilibrium rates? It is easy to verify that

$$\frac{dr_L^{\ *}}{d\tau} = (1 - 1/\varepsilon_L)^{-1} (\tilde{\gamma}_L)_\tau > 0, \text{ and}$$

$$\frac{dr_L^{\ *}}{dk} = (1 - 1/\varepsilon_L)^{-1} (\tilde{\gamma}_L)_k > 0.$$

[8] In formulas: $\varepsilon_L \equiv -(dL/dr_L)(r_L/L) > 0$ and $\varepsilon_D \equiv (dD/dr_D)(r_D/D) > 0$. Other standard assumptions on the size of the elasticities as well as on the second order conditions are satisfied.

Again, both an increase in the tax rate and tighter capital requirements operate in the same direction of increasing the cost of credit. The cross-derivative that captures the combined effect of taxation and regulation on the loan rate is: $\frac{dr_L^*}{dkd\tau} = (1 - 1/\varepsilon_L)^{-1} (\tilde{\gamma}_L)_{k\tau} > 0$.

It bears a positive sign like the cross-derivative of the marginal cost function. Hence, each of the instrument considered (tax rate and regulatory requirement) reinforces the marginal effect of the other on the cost of credit.

Bank levies

Following the recent experience with the implementation of this type of instrument, we analyse a bank levy impacting on the liabilities side of the bank balance sheet. In particular, in the in the stylized framework presented above two alternative bases for a bank levy – with a rate of λ – will be introduced: *i*) deposits not falling under a guarantee scheme; *ii*) total liabilities excluding equity capital and insured deposits. The choice of the base is shown to have significant effects on the equilibrium and its comparative statistics properties.

i) A levy on uninsured deposits

Defining *g* the fraction of insured deposits, the base for the levy is $(1-g)D$.

Taking into account the arbitrage condition under (15), the maximisation problem for the licence-holder bank becomes:

$$\underset{L,D}{\text{Max}} \left[r_L L - \hat{\gamma}_L L - r_D D + \hat{\gamma}_D D + rD + (1+\eta)v \right]$$

with $\hat{\gamma}_L = \gamma_L + p + k(1+\eta) + (1-k)r$, and $\hat{\gamma}_D = \gamma_D + \lambda(1-g)$. As before $\hat{\gamma}_L$ is an adjusted marginal cost on loans which indicates that, in addition to operational expenses, loans involve costs in terms of provisions, capital requirements and money market interest payments. It is easy to verify that $\hat{\gamma}_L < \tilde{\gamma}_L$, since the marginal cost of outside equity is lower, absent the tax on profits, ceteris paribus. On the other hand, the marginal cost of deposits needs to be adjusted for the levy, which de facto becomes an additional cost component proportional to the fraction of uninsured deposits. Thus, deposit insurance acts like a subsidy that affects banks' marginal cost proportionally to the rate of the levy.

The FOCs from profits maximisation are:

$$\begin{cases} \frac{d\Pi}{dL} = (r_L)_L L + r_L - \hat{\gamma}_\mathrm{L} = 0 & \Leftrightarrow r_L^* = \hat{\gamma}_\mathrm{L} / (1 - 1/\varepsilon_L) \\ \frac{d\Pi}{dD} = r - (r_D)_D D - r_D - \hat{\gamma}_\mathrm{D} = 0 & \Leftrightarrow r_D^* = (r - \hat{\gamma}_\mathrm{D}) / (1 + 1/\varepsilon_D) \end{cases}$$

As before, comparative statics can be used to assess the effect on the equilibrium of changes in the levy rate as well as the impacts of tighter regulatory requirements on capital. From the discussion above it is clear that while the levy will impact on the market for deposits, the regulatory requirements affect uniquely the loans market. In particular, when it comes to equilibrium quantities, the effects of the levy are:

$$\frac{dD^*}{d\lambda} = -\frac{(r_D)_\lambda - (1 + 1/\varepsilon_D)^{-1}(\hat{\gamma}_D)_\lambda}{(r_D)_D} = -\frac{(r_D)_\lambda + (1 + 1/\varepsilon_D)^{-1}(1 - g)}{(r_D)_D} < 0, \text{ and}$$

$$\frac{dL^*}{d\lambda} = 0.$$

As before, the adjustments following tighter regulation, that is an increase in the parameter k denoting the fraction of loans to be covered by equity, will take place on the loans market. In particular:

$$\frac{dL^*}{dk} = -\frac{-(1 - 1/\varepsilon_L)^{-1}(\hat{\gamma}_L)_k}{(r_L)_L} = -\frac{-(1 - 1/\varepsilon_L)^{-1}(1 + \eta)}{(r_L)_L} < 0$$

Comparative statics on the equilibrium rates gives:

$$\frac{dr_D^{\ *}}{d\lambda} = -(1 + 1/\varepsilon_D)^{-1}(\hat{\gamma}_D)_\lambda < 0, \text{ and}$$

$$\frac{dr_L^{\ *}}{dk} = (1 - 1/\varepsilon_L)^{-1}(\hat{\gamma}_L)_k > 0.$$

Hence, while the levy affects only the deposits market, capital requirements still act through the credit channel. As a result of separability between deposits and loans, the cross-effects of regulation and taxes are nil:

$$\frac{dr_L^{\ *}}{dk d\lambda} = 0; \frac{dr_D^{\ *}}{dk d\lambda} = 0.$$

ii) A levy on liabilities

The second type of bank levy considers total liabilities excluding equity capital and insured deposits as a base, or:

$E + D + I - (E + gD) = I + (1 - g)D$,

where, as before, *g* is the fraction of deposits falling under a guarantee scheme. Compared to the previous case, now the base for the levy is broader as it includes also the net interbank liabilities.

Taking into account the arbitrage condition under (15), the maximisation problem for the licence-holder bank becomes:

$$\underset{L,D}{\text{Max}} \left[r_L L - \bar{\gamma}_L L - r_D D + \bar{\gamma}_D D + rD + (1+\eta)v \right]$$

with $\bar{\gamma}_L = \gamma_L + p + k(1+\eta) + (1-k)(r+\lambda)$, and $\bar{\gamma}_D = \gamma_D - g$. As before $\bar{\gamma}_L$ is an adjusted marginal cost on loans, including operational expenses, provisions, capital requirements and money market interest payments. Interestingly, compared to the previous case, now the levy becomes an additional cost component associated with loans through the money market channel. Indeed, it is easy to verify that $\bar{\gamma}_L > \hat{\gamma}_L$. On the other hand, the marginal cost of deposits needs to be adjusted downwards due the presence of the guarantee scheme, implying $\bar{\gamma}_D < \hat{\gamma}_D$.

The FOCs from profits maximisation are:

$$\begin{cases} \dfrac{d\Pi}{dL} = (r_L)_L L + r_L - \bar{\gamma}_\mathrm{L} = 0 & \Leftrightarrow r_L^* = \bar{\gamma}_L / (1 - 1/\varepsilon_L) \\ \dfrac{d\Pi}{dD} = r - (r_D)_D D - r_D - \bar{\gamma}_\mathrm{D} = 0 & \Leftrightarrow r_D^* = (r - \bar{\gamma}_\mathrm{D}) / (1 + 1/\varepsilon_D) \end{cases}$$

As before, comparative statics can be used to assess the effect on the equilibrium of changes in the levy rate as well as the impacts of tighter regulatory requirements on capital. From the discussion above it is clear that in this case the levy will impact on the loans market through its effects on interbank financing. In particular, when it comes to equilibrium quantities, the effects of the levy are:

$$\frac{dD^*}{d\lambda} = 0, \text{ and}$$

$$\frac{dL^*}{d\lambda} = \frac{(r_L)_\lambda - (1 + 1/\varepsilon_D)^{-1} (\bar{\gamma}_L)_\lambda}{(r_L)_L} < 0.$$

As before, the regulatory requirements affect uniquely the loans market. The effect of tighter regulation is then:

$$\frac{dL^*}{dk} = -\frac{-\left(1-1/\varepsilon_L\right)^{-1}\left(\bar{\gamma}_L\right)_k}{\left(r_L\right)_L} < 0\,.$$

Comparative statics on the equilibrium rates gives:

$$\frac{dr_L^{\ *}}{d\lambda} = \left(1 - 1/\varepsilon_L\right)^{-1}\left(\bar{\gamma}_L\right)_\lambda > 0, \text{ and}$$

$$\frac{dr_L^{\ *}}{dk} = \left(1 - 1/\varepsilon_L\right)^{-1}\left(\bar{\gamma}_L\right)_k > 0.$$

The cross-effects of regulation and taxes on the equilibrium loan rate are:

$$\frac{d^2 r_L^{\ *}}{dkd\lambda} = -\left(1 - 1/\varepsilon_L\right)^{-1} < 0.$$

Hence, a higher levy on liabilities (excluding equity capital) counteracts the effects of tighter regulation on the loans rate, which increases now at a decreasing rate.

5. COMPARISON AND CONCLUSIONS

The partial equilibrium analysis above illustrates the different impacts of taxes on profits and bank levies on the behaviour of a monopolist bank in a Monti-Klein type of model. The comparative statics results show that tighter prudential regulation increases the interest rate charged on loans and reduces credit ("bank capital channel"). While a tax on profits has similar effects on the equilibrium in the loans market, the impacts of a bank levy depend on the definition of the base. On the one hand, at the margin, a levy on deposits only – with the exclusion of those covered by insurance schemes – decreases both quantities and rates on the market for such liability. On the other hand, when the base is extended to all liabilities – with the exclusion of insured deposits and capital – the adjustments take place again on the loan market, where quantities decrease and rate are higher.

Finally, it is interesting to compare the effects of regulation on rates in the presence of different tax instruments, as follows:

$$\left.\frac{dr_L^{\ *}}{dk}\right|_\lambda^{I+(1-g)D} < \left.\frac{dr_L^{\ *}}{dk}\right|_\lambda^{(1-g)D} < \left.\frac{dr_L^{\ *}}{dk}\right|_\tau^{\Pi},$$

where the subscript indicates the case of levies (λ) or taxes (τ), while the superscript indicates the relevant base, as defined above. Thus, the increase in the cost of credit following tighter capital requirements is lower under a bank levy on riskier liabilities, whereas it is the highest in the case of a profit tax.

References

Albertazzi, Ugo and Leonardo Gambacorta (2007), “Bank Profitability and Taxation”, *mimeo,* Banca d'Italia.

Amihud Yakov, Haim Mendelson, and Lasse H. Pedersen, 2005, “Liquidity and Asset Prices,” *Foundation and Trends in Finance*, 1(4): pp. 1–96.

Baca-Campodonico, Jorge, Luiz de Mello and Andrei Kirilenko (2006), “The Rates and Revenue of Bank Transaction Taxes”, OECD Economics Department Working Paper 494.

Bond, Steve, Mike Hawkins and Alexander Klemm (2005), "Stamp Duty on Shares and Its Effect on Share Prices", *FinanzArchiv: Public Finance Analysis*, 61 (3), pp. 275-297.

Caminal, Ramon (2003), "Taxation of Banks: a Theoretical Framework", in P. Phonohan (ed.), "*Taxation of Financial Intermediation: Theory and Practice for Emerging Economies*", pp. 31-80, The World Bank and Oxford University Press.

Coelho, Isaias (2009), “Taxing Bank Transactions – the Experience in Latin America and Elsewhere”, mimeo.

De Nicolò, Gianni (2010), "The Potential Impact of FSC and FAT On Bank Asset Growth, Risk, and Real Activity", in Claessens, S., M. Keen and C. Pazarbasioglu, "*Financial Sector Taxation The IMF's Report to the G-20 and Background Material*", IMF, pp. 188-191.

Devereux Michael and Rachel Griffith (1998), "The taxation of discrete investment choices", IFS Working Paper W98/16.

ECB (2010), "EU Banking Sector Stability", Report of September 2010.

Freixas, Xavier and Jean-Charles Rochet (2007), "*The Microeconomics of Banking*", M.I.T. Press.

FSA (2009), "Bank regulation, capital and credit supply: Measuring the impact of prudential standards", Occasional Papers in Financial Regulation.

Hu, Shing-yang (1998), “The Effects of the Stock Transaction Tax on the Stock Market—Experience from Asian Markets,” *Pacific Basin Finance Journal*, 6, pp. 347–364.

King, Mervyn A. (1987), "The cash-flow corporate income tax", in Feldstein, M. (ed.) *The Effects of Taxation on Capital Accumulation*, NBER, pp. 377-400.

King, Mervyn A. and Dan Fullerton (1984), "*The Taxation of Income from Capital*", Chicago: University of Chicago Press.

Kupiec, Paul (1996), “Noise Traders, Excess Volatility, and a Securities Transaction Tax,” *Journal of Financial Services Research*, 10, pp. 115–129.

Matheson, Thornton (2011), "Taxing Financial Transactions: Issues and Evidence", IMF Working Paper 11/54.

McKenzie, Kenneth J. (2000), "Taxing Banks", Taxation Discussion Paper 1, ATAX, University of New South Wales.

McKenzie, Kenneth, Jack Mintz and Kimberly Scharf (1997), "Measuring Effective Tax Rates in the Presence of Multiple Inputs: A Production Based Approach," *International Tax and Public Finance*, 4 (3), pp. 337-359.

Oxera (2007), "*Stamp Duty: Its Impact and the benefits of its Abolition*," Report prepared for Association of British Insurers, City of London Corporation, Investment Management Association and London Stock Exchange (London).

Schwert, G. William., and Paul Seguin (1993), "Securities Transaction Taxes: an Overview of Costs, Benefits and Unresolved Questions," *Financial Analysts Journal,* pp. 27–35.

Umlauf, Steven R. (1993), "Transaction Taxes and the Behaviour of the Swedish Stock Market," *Journal of Financial Economics*, 33, pp. 227–240.