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Tax on Interest and the Pricing of Personal Demand Deposits*

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Abstract

The paper analyzes the effects of taxation on the pricing of personal transactions deposits such as chequing accounts. In many fiscal systems, explicit interest on deposits is taxable while "implicit interest" in the form of underpriced bank services for depositors is not. Conditions are developed under which this asymmetry leads to zero deposit rates, zero service charges, or both. Minimum balance requirements are also explained. It is found that the asymmetric tax system generally involves an implicit subsidy to the service production activities of banks. The subsidy to banking is increases when the tax rate on interest income is increased. The analysis is extended to the Finnish system of tax exempt regulated deposit rates. The implicit subsidy to the real activities of banks is shown to be even larger in this system.

Tiivistelmä

Tutkimuksessa tarkastellaan verotuksen vaikutuksia käyttelytilien kilpailulliseen hinnoitteluun. Useissa verojärjestelmissä korkotulo on pääsääntöisesti verollista, mutta tallettajille tarjottuja alihinnoiteltuja pankkipalveluja ei veroteta. Tutkimuksessa osoitetaan, että tiettyjen ehtojen ollessa voimassa tämä verojärjestelmä tuottaa kilpailullisen tasapainon, jossa talletuskorko on nolla, ja pankkipalvelut ovat ilmaisia, jos tallettaja pitää tilillään tietyn minimisaldon. Voidaan osoittaa, että kyseinen verojärjestelmä sisältää kätketyn subvention pankkipalvelujen tuotannolle. Subventio on sitä suurempi, mitä korkeampi on korkotulojen veroaste. Suomalaistyyppisessä verojärjestelmässä, jossa sallitaan verottomia talletuskorkoja, subventio muodostuu vielä suuremmaksi.

Contents

1 Introduction

The fact that most of the services provided by banks are paid indirectly through the interest margin on deposits and not by direct service charges must be regarded as a kind of anomaly from the point of view of standard microeconomic theory. The anomaly is, of course, really visible only when banks can use market-based pricing of deposits. Before, when interest rate ceilings on deposits existed in many countries, one could often appeal to that kind of legal restrictions when seeking to explain the phenomenon of "implicit interest", as the cross-subsidization of transactions services with profits from deposit-taking activities is often called. After the recent advances in deposit rate deregulation and financial innovation, the legal restrictions argument has now lost force, however, and genuinely economic explanations must be found.

Some authors have noted that a tax asymmetry found in many fiscal systems may provide at least one explanation for the phenomenon (see Walsh, 1983; and also Mitchell, 1988, and Goodhart, 1989 p. 227). The tax argument goes as follows. If explicit interest income of depositors is taxable, but the benefits from subsidized transaction services are not, banks may be induced to reward depositors with free services instead of explicit interest even though individuals generally prefer money payments to grants in kind. These authors have not, however, provided a complete analysis of how the costs of using transaction services and the demand for deposits are determined when deposit pricing is distorted by asymmetric taxation.

In this paper, I study the effects of the aforesaid tax asymmetry with a "production model" of banking which makes it possible to apply standard microeconomic tools to the problem. The analysis shows that both the demand deposit rate and the service charge may be zero in a competitive equilibrium; and if this is the case, the remission of service charges is conditional on a minimum balance requirement, which dictates the velocity of deposits. The emergence of the cross-subsidizing equilibrium depends on the tax rate on interest income. Formulas are developed for the "effective marginal price" the depositors pay for bank services in the competitive equilibrium. These formulas indicate that the tax-free status of "implicit interest" on deposits creates a subsidy on the provision of transaction services by banks.

In Finland, interest on personal transactions deposits (used mainly by giro and debit cards) has traditionally been tax exempt, if the interest rate is below a ceiling stipulated by tax laws. The ceiling has been low in relation to money market rates, however. Analysis of the Finnish type tax system (in section 5) reveals that it involves an even more extensive tax subsidy to banking than the standard system of deposit interest taxation which was outlined above.

There exist in the literature also other explanations than the tax effect for the cross-subsidization of deposit-taking and service production. Baxter, Cootner and Scott (1977, in ch. 2) present a model in which the cross-subsidization is used by the banks as a device for price discrimination among customers with varying "access costs" to bank services. In their model, banks operate on the declining part of their average cost curve, so that marginal cost prices would not be financially viable.

More recently, Whitesell (1988) has presented a model in which a monopolistic bank has an incentive to cross-subsidize transaction services in order to induce its customers to use less cash and more deposits as means of payment. Finally, Tarkka (1989) has noted that in a world with risk aversion, uncertainty with respect to the volume of transactions may lead to underpricing of money transfer services and consequently to the existence of excess interest margins on demand deposits.

Since the purpose of this paper is to pinpoint just the implications of the tax asymmetry for deposit pricing, the model presented below does not contain other features which might explain the existence of excess interest margins on demand deposits and the underpricing of transaction services. Such complications as imperfect competition, customer access costs and imperfect information are therefore deliberately excluded from consideration.

2 Some Stylized Facts of Deposit Pricing

The following comments are an attempt to establish some "stylized facts" of bank pricing behaviour, especially in deregulated markets. Unfortunately, comparable information on the terms of transactions accounts applied in different countries is very scarce, especially if one tries to advance beyond casual observation. This is actually quite understandable, taking into account the multiplicity of parameters which may be used in pricing demand deposits: apart from straight interest rates and service charges, the banks may use nonlinear pricing by making interest rates or fees conditional on the amount of deposited funds, the number of payments processed, etc. These issues are lucidly surveyed in the U.S. context by Davis and Korobow (1987). Reviews on other countries include Baltensberger and Dermine (1987), Vittas et al. (1988) and SOU (1989).

The freedom of price competition in the deposit market varies considerably in an international comparison. In many countries, the interest paid on chequing accounts or other similar transactions deposits was still in the late 1980's restricted by law or cartel (sometimes sponsored by authorities; see Bingham, 1985). There are, however, also several major countries where no obvious barriers to price competition exist and the existing structure of deposit interest rates and service charges should therefore reflect "market forces". Examples of countries in this group include, Germany, Sweden, the United Kingdom and, after the recent deregulation of deposit rates, also the United States.

The principles of pricing the demand deposits seem to differ considerably across these "deregulated" countries. For example, most German banks offer only a nominal 0.5 per cent per annum of interest on cheque accounts, whereas the interest-bearing U.S. checking accounts offer high, money-market related interest rates. Between these extremes is the Swedish practice of offering graduated interest rates conditioned on the balance on the account. This is also the typical strategy for the U.K. building societies, while the zero-interest current account still survives in the clearing banks of that country.

Turning to service charges, most U.K. and Swedish banks offer free banking, sometimes conditional on the balance on the account. In the United States, it is common for banks to determine their service charges on the basis of the customer's deposit balances. Most banks in the U.S. offer free service if the minimum balance on the account is high enough. In Germany, by contrast, some service charges are typically instituted, at least for transactions in excess of a set quota.

What is common to these different price structures is that the combination of market-related interest rates on chequing account balances and cost-related fees for transactions does not seem to be prevalent. Instead, a tendency towards product cross-subsidization (in favour of transactions) is visible in the pricing of personal transactions accounts in all of the countries reviewed. This is in contrast with predictions by a number of economists, who have assumed that cross-subsidization of transactions services would disappear in deregulated markets (see Black, 1970; Fama, 1980; Fischer, 1983; and Saving, 1979).

In Finland, market-determined deposit terms are a relatively recent development. In the Finnish tax system, personal interest income from bank deposits is tax free if the deposit terms satisfy certain conditions stipulated by the tax laws. The rules include interest rate ceilings for tax free accounts. At present, for example, interest on transactions deposits is not taxable if the interest rate is not higher than 4.5 per cent.

Until recently, the exemption effectively prevented the banks from offering deposit accounts with a higher, and consequently taxable, rate of interest. In 1990, however, the general rules of interest income taxation were changed. Interest income was no longer included to the income tax base, and a final tax at source (first 10 per cent, and now 15 per cent) was instituted instead. After this easing of interest taxation, taxable "high-yield" transactions accounts were introduced by banks. These new products have not, however, been particularly successful in attracting business away from the old style tax free transactions accounts.

As regards service charges on depositors, banks have made an attempt to move towards at least approximately cost-based pricing. The general practice seems to be, however, that service charges are waived if the depositor keeps a prescribed minimum balance on her account.[1] The experience suggests that, even with the current low tax rates on interest income, the combination of tax free interest and no service charges for "good" depositors is quite viable in the competition for deposits.

3 The Model

In the following, the equilibrium deposit price structures are analyzed with the help of a simple model. The model consists of a representative consumer-depositor and a representative bank interacting in a competitive setting. The model is static and perfect information is assumed.

The bank produces "transfer services" which yield utility for the consumer-depositor. These services could consist of, for example, effecting payments through a money transfer system such as check clearing, giro or EFTPOS. The consumer-depositor may pay for these services with direct service charges, or by keeping deposit balances at the bank with a low rate of interest, or both. The customer relationship of the consumer-depositor with the bank may thus consist of purchases of transfer services, and the holding of deposits in the bank.

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[1] Cf. Finnish Bankers Association (1991).

The bank places the deposited funds in "bonds", in a perfect capital market where an interest rate r prevails. It is, however, required to keep a fraction q of deposits in the form of required reserves. For simplicity, these reserves are assumed to earn no interest.

The costs of producing transfer services are assumed to be separable with respect to the different customers. We can therefore speak meaningfully of the costs and profits arising from a given customer relationship of the bank. The average (unit) cost of producing a quantity N of transfer services for the representative customer is assumed to be

$$c = c(N). \tag{1}$$

The model and the results derived below are not very sensitive to the shape of the average cost function c(N). To improve tractability, it is assumed to be continuously differentiable. Also, the marginal costs implied by c(N) must be positive, requiring $N\ c_N > -c(N)$ for all N. As long as these conditions are satisfied, the average cost function may be increasing, constant, U-shaped, or decreasing. The last possibility is particularly interesting because it seems plausible that the maintenance of bank accounts involves significant, customer-specific fixed costs which are independent of the use of the account. In most of the mathematics that follows, the unit cost is simply denoted by c, even though it is not a constant but a function of N.

The profit π of the bank from a representative deposit relationship can now be defined as follows:

$$\pi = [r(1-q) - i]D + (s - c)N, \tag{2}$$

where D is the deposit balance, i is the deposit rate and s is the service charge for one unit of transfer services.

The only tax considered in the model is the tax on interest income, which is assumed to be asymmetric in the typical way: pecuniary interest income is taxable, but implicit interest on deposits in the form of underpriced services is tax free. Depositors are not able to deduct service charges paid to banks from their taxable income. For simplicity, the tax rate on interest income is assumed to be flat.

Let us now turn to the budget constraint of the depositor. For the present purposes, there is no need to consider other than interest income. So, the consumer-depositor is assumed to have a given wealth W which he may invest in "bonds" earning the rate of interest r, or in deposits earning the deposit rate i. The tax rate on interest income is t. The after-tax income of the consumer-depositor may thus be defined as $(1 - t)[r(W - D) + iD]$.

The expenditures of the consumer-depositor consist of the purchases of a consumption good, and bank service charges. Normalizing the price of the consumption good to unity, the budget constraint of the consumer-depositor may now be written as follows:

$$G+sN \le (1-t)[rW-(r-i)D], \tag{3}$$

where G is consumption of the consumption good.

The utility of the consumer-depositor is assumed to be a function of the consumption of the consumption good and the transfer services:

$$U=U(G,N) \tag{4}$$

The utility function is assumed to be convex and increasing in its arguments. It is further assumed that the lim $U_G = \infty$ as $G \rightarrow 0$ and lim $U_N = \infty$ as $N \rightarrow 0$. These properties are used below to ensure positive demands for both N and G.

Under perfect competition, separability of costs and revenues by customer, and perfect information, the bank cannot earn positive profits from any customer relationship. Further, the perfect information assumption implies that the banks knows the customer's characteristics and thus "prices" (i.e. the service charge s and the deposit rate i) can be made conditional on the behaviour of the customer. Consequently, the consumer-depositor does not in fact optimize subject to given prices, but is able to obtain any terms for the customer relationship which are allowed by the "feasibility constraint" of nonnegative profits to the bank. Using the profit function (2), the assumption of zero profits in equilibrium implies

$$(r-i)D=(c-s)N+rqD \tag{5}$$

so that any interest lost by the depositor is used by the bank for subsidizing her use of transfer services and to cover costs caused by the reserve requirement. Substitution of the zero-profit constraint (5) in the budget constraint of the representative consumer-depositor yields

$$(1-t)rW-G-sN-(1-t)(c-s)N-(1-t)rqD \ge 0. \tag{6}$$

The consumer-depositor's decision problem is obviously to maximize utility (4) subject to the "augmented" budget constraint (6). The consumer-depositor does not only maximize with respect to the demands G, N and D; she may also select the service charge s and deposit rate i so as to maximize her attainable utility level. Whatever the chosen prices, the solution is financially feasible from the bank's point of view as long as the constraint (6) is satisfied.

Finally, we require that the solution must also satisfy nonnegativity constraints $D \ge 0$, $i \ge 0$ and $s \ge 0$. These constraints are due to the discontinuities which occur in typical tax systems when prices turn negative. For example, even though positive service charges are typically not deductible in personal taxation, negative service charges (which would imply paying bonus to depositors for transactions on the account) would be taxable. Similarly, negative interest rates are assumed to be not neductible in income taxation. Finally, the nonlinearity with respect to D arises from the fact that negative deposits do not allow the bank to have negative interest-free reserves at the central bank.

Formally, the problem of the customer-depositor may be solved by maximizing the following Lagrangean:

$$\max\ \pounds = U(N,G) + k[(1-t)rW - G - sN - (1-t)(c(N)-s)N - (1-t)rqD] + h[r(1-q)D + (s-c(N))N] \tag{7}$$

so that $D \geq 0$, $s \geq 0$.

Besides the utility function, the Lagrangean consists of two constraints. The first, multiplied by the Lagrange multiplier k, is the budget constraint (6). The second, multiplied by another Lagrange multiplier h, is needed to ensure the non-negativity of the deposit rate i. The constraint is derived from the zero-profit condition (5), which may be written as $iD = r(1-q)D + (s-c)N$. Since $iD \geq 0$ is implied by the non-negativity constraints discussed above, one may use the condition $r(1-q)D + (s-c)N \geq 0$ together with $s \geq 0$ and $D \geq 0$ to ensure that the original set of nonnegativity constraints holds.

The Kuhn-Tucker conditions for a maximum are as follows:

$$\pounds_G = U_G - k \leq 0 \tag{8}$$

$$G\pounds_G = G(U_G - k) = 0 \tag{9}$$

$$\pounds_N = U_N - k[(1-t)(c + Nc_N) + ts] + h(s - c - Nc_N) \leq 0 \tag{10}$$

$$N\pounds_N = N\{U_N - k[(1-t)(c + Nc_N) + ts] + h(s - c - Nc_N)\} = 0 \tag{11}$$

$$\pounds_D = -k(1-t)rq + hr(1-q) \leq 0 \tag{12}$$

$$D\pounds_D = D[k(1-t)rq - hr(1-q)] = 0 \tag{13}$$

$$\pounds_s = -kNt + hN \leq 0 \tag{14}$$

$$s\pounds_s = s[kNt - hN] = 0 \tag{15}$$

$$\pounds_h = (1-q)rD + (s-c)N \geq 0 \tag{16}$$

$$h\pounds_h = h[(1-q)rD + (s-c)N = 0 \tag{17}$$

$$\pounds_k = (1-t)rW - G - sN - (1-t)(c-s)N - (1-t)rqD \geq 0 \tag{18}$$

$$k\pounds_k = k[(1-t)rW - G - sN - (1-t)(c-s)N - (1-t)rqD] = 0 \tag{19}$$

Different kinds of equilibria can emerge in the model, depending on the tax rate t and the reserve requirement q. The different possibilities are discussed below (however, only cases with $1 > t \geq 0$ and $1 > q \geq 0$ are scrutinized).

4 The Analysis of Different Market Equilibria

Before starting the analysis of the different types of equilibria, it is useful to note that the consumption of transfer services N and the consumption good G must be strictly positive in equilibrium due to the assumptions concerning the shape of the utility function as $G \rightarrow 0$ or $N \rightarrow 0$. Similarly, the assumption that the utility function is strictly increasing for all N and G means that the Lagrange multiplier k for the consumer-depositor's budget constraint must always be positive.

4.1 The Case With Dominating Taxes

Let us consider a system in which the tax rate on interest income is greater than the reserve requirement. More precisely, assume that $1 > t > q > 0$. In this case, which is presumably the most common or "realistic" one, the equilibrium amount of deposits is strictly positive. This may be demonstrated by contradiction as follows.

Assume for a moment that $D = 0$. From condition (17) we know that s must be positive whenever $D = 0$ (since N and c are assumed positive). With positive s and N we can then divide the condition (15) through by Ns to obtain $h = kt$. Substituting $h = kt$ to (12) gives $ktr(1-q) - krq(1-t) \leq 0$. Dividing this by the positive factor kr yields $t(1-q) - q(1-t) \leq 0$, or equivalently, $t \leq q$. This is in contradiction with the assumption of $t > q$. Therefore, $D = 0$ is not optimal whenever $t > q$.

Knowing that D must be positive in this case, we can derive from condition (13) the result

$$h = kq(1-t)/(1-q). \tag{20}$$

Substituting this in (15) yields after some manipulation

$$Nsk[q(1-t) - t(1-q)] = 0. \tag{21}$$

With positive N and k, this can hold only if $s = 0$. This is another important result. It means that when $t > q$, transfer services are provided free of charge in equilibrium.

Now it is obvious that if services are not paid directly, the bank must have a positive interest margin to cover its costs. With positive deposits, and zero service charges, the zero-profit constraint allows us to write

$$i = r(1 - q) - cN/D. \tag{22}$$

But, with $h > 0$, $N > 0$ and $s = 0$, we can derive from the condition (17) the result

$$r(1 - q) - cN/D = 0 \tag{23}$$

Which, taken together with (22) implies $i = 0$. The optimal deposit rate is thus shown to be zero in this case.

We can now substitute the results on s and h to the original set of Kuhn-Tucker conditions, which under the assumption of an interior maximum for G and N simplifies to

$$U_G = k \tag{24}$$

$$U_N = k(c + Nc_N)(1 - t)/(1 - q) \tag{25}$$

$$(1 - t)rW = G + cN(1 - t)/(1 - q) \tag{26}$$

$$D = cN/r(1 - q) \tag{27}$$

From the second first-order condition (25) we see that the effective marginal price paid by consumers on the transfer services in this case is $(c + Nc_N)(1-t)/(1-q)$. Note that the expression $(c + Nc_N)$ defines the marginal cost of production of transfer services. Note also that in the present case, the effective marginal price paid by consumers is lower than the marginal cost of producing these services. This distortion, which is due to the tax asymmetry, is partly compensated by the reserve requirements. With $t > q$, the "reserve requirement tax" is not, however, sufficient to restore complete neutrality and an effective subsidy on N is inherent to the asymmetric tax system.

Note that equations (24), (25), and (26) are constitute a set of first-order conditions and a budget constraint, which are sufficient to determine consumption G of the ordinary consumption good as well as the amount N of transfer services. Given N, the condition (26) reveals how the stock of deposits held by the representative consumer-depositor is determined simply from the bank's zero-profit condition. With zero interest and zero service charges, the customer is required to keep at least such balances at the bank that the generated interest margin is sufficient to cover the cost of producing the transfer services used by the customer.

In sum, the case $1 > t > q > 0$ leads to the classic deposit pricing system: zero interest on demand deposits, "free" service and minimum average balance requirements. Since the minimum balance requirement is proportional to the volume of transfer services, the deposit terms define an implicit price for these services. Since the minimum balances required are inversely proportional to the interest rate on bonds, the model incidentally provides a novel explanation for the negative interest elasticity of demand deposits.

4.2 The Case With Dominating Reserve Costs

Consider next the case $1 > q > t \geq 0$. The reserve requirement tax is now heavier than the tax on interest income and the equilibrium amount of deposits are zero in this model. This can again be demonstrated by contradiction. From (13) we see that in an equilibrium with positive amount of deposits, $h = kq(1-t)/(1-q)$. When $1 > q > t \geq 0$, this is in contradiction with condition (14) which requires $h \leq kt$.

The principles of deposit pricing are very simple in this case. First, deposit interest rates have no meaning or significance as deposits do not exist. Further, with $D = 0$, the zero-profit condition requires $s = c$. This equilibrium thus involves full-cost pricing of transaction services. Since we have allowed for non-linear price schedules in the model by inserting the zero profit condition directly into the consumer-depostior's budget constraint, the marginal price of services equals the marginal cost of service production in this case.

Obviously, positive deposits could be explained also in this case when tax incentives for deposit-taking do not exist, by assuming "economies of scope" so that keeping deposits would lower the cost of providing transfer services. This possibility is not, however, explored here.

4.3 Some Special Cases

When $q = t$ or $q = 0$ or both hold, the model is not capable of producing a fully determinated solution. Some of the variables D, s, and i are left indeterminate in these border cases, meaning that the consumer-depositor is indifferent with respect to the value given to the indeterminate variables. These cases are briefly commented below.

4.3.1 A Neutral System

In the special case when the reserve requirement rate and the tax rate on interest income are both positive but equal, or $1 > q = t > 0$, the condition (13) may be simplified to

$$D(h - kt) = 0. \tag{28}$$

Thus, if D is not zero in equilibrium, then $h = kt$. It is easy to check that $h = kt$ holds also if D were zero. For when $D = 0$, then $s > 0$ by the condition (16); and with a positive s, the $h = kt$ is implied by condition (15).

Using the information that h is positive, we can derive from (17) the result

$$(1-q)rD+(s-c)N=0, \tag{29}$$

which, substituted in the zero-profit constraint gives $Di = 0$. This means that the deposit rate i is zero, if deposits are positive; this is also quite as well if $D = 0$, for then the deposit rate has no role in the model.

But is the stock of deposits positive or not? It turns out that the model has no unique solution with respect to D and s. This happens because the Kuhn-Tucker conditions (12) to (15) vanish when $1 > q = t > 0$. The variables D and s are thus left indeterminate, restricted only by the zero-profit constraint taking now the form

$$s=c-r(1-q)D/N \tag{30}$$

and the nonnegativity constraints $D \geq 0$ and $s \geq 0$. The interpretation is that the consumer-depositor is indifferent about the combinations of D and s allowed by the bank's zero profit condition. The result that the optimal deposit rate is zero thus remains the only precise implication of the model on deposit pricing in this case.

4.3.2 Zero Reserve Costs

Consider the case in which $1 > t > q = 0$. When the burden caused by the reserve requirement is zero, but the tax on interest is positive, the model is able to precisely determine only one of the terms of the customer relationship. This is the service charge, which turns out to be zero in this case.

That $s = 0$ may be demonstrated as follows. When $q = 0$, the condition (12) simplifies to $hr \leq 0$. With a positive r, this implies $h = 0$. Using $h = 0$, the condition (15) may be written in the form $-sktN = 0$, which implies $s = 0$ (k, t, and N are all positive). With $s = 0$ and $q = 0$ the condition (16) implies

$$D \geq c(N)N/r \tag{31}$$

so that a minimum balance requirement is clearly present in this equilibrium. However, D is not uniquely determined, since all other conditions containing D vanish when $q = s = h = 0$. The interpretation becomes clear when we combine (31) with the zero-profit constraint of the bank, which in this case takes the following form:

$$i=r-c(N)N/D. \tag{32}$$

The interpretation is that the consumer-depositor is indifferent with respect to the different combinations of D and i offered by the bank, as defined by (32); the choice is, however, restricted by the requirement that the resulting $i \geq 0$ is positive, which implies the lower bound for the deposit balance defined by (31).

4.3.3 The Case Without Taxes or Reserve Costs

Finally, when neither income tax nor the reserve requirement are present, it is easy to show that the model is totally indeterminate with respect to i, D and s. The reason is of course that all methods of paying for the transfer services are financially equivalent in this case.

5 A Finnish Extension: The Regulated Tax Free Deposit Rate

The model is now extended for application to the Finnish deposit market. In particular, we wish to analyze the case in which the banks are allowed to take taxfree deposits at some regulated interest rate. In the following, this legally determined deposit rate is denoted by ρ. This rate is assumed to be set below the after-tax capital market rate, i.e. $\rho < (1-t)r$. Further, the analysis is restricted to the most realistic case of $t > q$, which also produces the most interesting results.

These assumptions simplify the analysis of the competitive equilibrium considerably. Firstly, we can now take for granted that the interest margin $r-\rho$ is positive. This means that the zero-profit condition of competitive equilibrium (analogous to equation 5 above) can be used to solve for the amount of deposits the bank requires to break even at given transaction volumes and service charges:

$$D = [(c-s)/(r(1-q)-\rho)]N \tag{33}$$

Another modification is that the budget constraint of the consumer-depositor must be rewritten to take into account the tax exemption of deposit interest:

$$G + sN \leq (1-t)rW - [r(1-t)-\rho]D \tag{34}$$

As above, the budget constraint may be developed to take into account the zero-profit constraint. Subsituting (33) for D in (35) yields

$$(1-t)rW - G - \{(c-s)[r(1-t)-\rho]/[r(1-q)-\rho] + s\}N \geq 0. \tag{35}$$

The optimization problem of the depositor can now be characterized with the following Lagrangean, which is somewhat simpler than (7) above:

$$\max\ \pounds = U(N,G) + k\{(1-t)rW - G - \{(c-s)[r(1-t)-\rho]/[r(1-q)-\rho] + s\}N\} \tag{36}$$

so that $s \geq 0$.

The conditions for a restricted maximum are now developed with respect to the volumes G and N, as well as the service charge s. Recall that, since the zero-profit condition was taken into account in deriving the above Lagrangean, the depositor is able to select the service charge which maximizes (36). The amount of deposits required by the bank will vary according to the selected charge, however, as indicated in (33). The Kuhn-Tucker conditions are now as follows (taking it for granted that an interior solution for G and N is obtained):

$$£_G = U_G - k = 0 \tag{37}$$

$$£_N = U_N - k\{(c + Nc_N - s)[r(1-t) - \rho]/[r(1-q) - \rho] + s\} = 0 \tag{38}$$

$$£_s = k\{[r(1-t) - \rho]/[r(1-q) - \rho] - 1\} \leq 0 \tag{39}$$

$$s£_s = sk\{[r(1-t) - \rho]/[r(1-q) - \rho] - 1\} = 0 \tag{40}$$

$$£_k = \{(1-t)rW - G - \{(c-s)[r(1-t) - \rho]/[r(1-q) - \rho] + s\}N\} \geq 0 \tag{41}$$

$$k£_k = k\{(1-t)rW - G - \{(c-s)[r(1-t) - \rho]/[r(1-q) - \rho] + s\}N\} = 0 \tag{42}$$

Under the assumption that the tax rate t is higher than the reserve requirement rate q, the condition (39) holds as an inequality. This is because the term $[r(1-t)-\rho]/[r(1-q)-\rho]$ in the expression is smaller than one. By (40), this implies that the optimal service charge must be zero. As above, the intuition is that, when the reserve requirement tax is lighter than the marginal tax rate, taxes are minimized when services are paid through keeping deposits at the bank.

Subsituting this result ($s = 0$) into the condition (38) yields the following expression for the optimal use of transactions services N:

$$£_N = U_N - k(c + Nc_N)[r(1-t) - \rho]/[r(1-q) - \rho] = 0 \tag{43}$$

Now inspection of this expression reveals that the effective marginal price, paid by the depositor-customer on transaction services is given by $(c + Nc_N)[r(1-t)-\rho]/[r(1-q)-\rho]$. This is a generalization of the previous result (25), which described the situation prevailing when the maximum tax free interest was zero. As in that case, the effective marginal price is again lower than the marginal cost $c + Nc_N$.

Further, it can be shown that, under the assumption $t > q$, the effective marginal price paid by the depositor is the lower, the higher is the tax free deposit rate. An extreme case is reached as ρ approaches $r(1-t)$, the after-tax capital or money market rate. Then the effective price on transactions services approaches zero. Of course, the same results apply for changes in the tax rate on personal interest income. If the tax rate is raised, while keeping the tax-free deposit rate constant, the effective price on transactions services is lowered – and the implicit tax subsidy on the banks' real activities is increased.

A peculiar feature of the Finnish type of deposit tax system is that the effective marginal price of transactions services is a function of the market rate of interest. Assuming that the tax- free deposit rate is not adjusted by the authorities according to the changes in the market rate, the effective price on bank services will decline when the market rate of interest declines and vice versa. When the maximum allowed tax-free rate is strictly positive, the changes in the effective price are more than proportional to the changes in the market rate of interest. The analysis of the tax free regulated deposit rate regime may be concluded by noting that (33) may be simplified to give the following result on the minimum balance requirement:

$$D = cN/[r(1-q)-\rho] \tag{44}$$

As before, the minimum balances required by the bank at the customer's optimum can again be calculated simply by dividing the total cost of servicing deposits cN by the interest margin. The minimum balance requirement should increase as the regulated tax free deposit rate is increased – or when the net interest rate on bank assets decreases.

6 Discussion

We have analyzed the effects of taxation on the pricing of personal transactions deposits. More specifically, the analysis was focused on the competitive price structure which emerges if interest on deposits is taxable while "implicit interest" in the form of underpriced bank services for depositors is not. It was shown that, if the tax rate on interest income is high enough, this asymmetry may lead to zero deposit rates and zero service charges. Minimum balance requirements also emerge.

The tax-based model of deposit pricing has a number of attractive features. First of all, it explains the classical system of demand deposit pricing. Secondly, the model gives an explanation for the demand for money which does not rely on putting (deposit) money directly in the utility function of the consumers, nor on imposing an ad hoc cash-in-advance constraint on transactions. In this model, deposits are simply a device for paying for transaction services in a way which avoids some taxes. Moreover, the model predicts the velocity of deposits, defined as N/D, to be an increasing function of the rate of interest.

Is the tax explanation a serious candidate as "the" explanation for the observed peculiarities of deposit pricing? This is not clear despite the above mentioned merits of the model. A serious problem with the tax argument is that the required asymmetry does not exist in the corporate taxation, since corporations can deduct the service charges as expenses in taxation (unlike households in most countries). Therefore, the tax-based model can probably be applied only in the case of household deposits.

An important empirically refutable implication of the tax-based model of deposit pricing is that explicit service charges should never coexist with explicit, taxable interest, at least not within a single deposit relationship. This has the intuitive explanation that under perfect information it is financially irrational to pay taxable interest to depositors if the depositors in turn pay service charges to the bank which are not deductible in taxation. If service charges were widely paid by holders of taxable interest-bearing demand deposits, this would probably indicate the presence of market imperfections which would in some way prevent the complete tax arbitrage. That would also call for the development of other, more complicated models of deposit pricing than the simple tax-avoidance model.

Anyhow, the above analysis leads to several important conclusions regarding the distortionary effects on banking of existing tax systems. From the policy point of view, the most important result of the analysis was that the model clearly demonstrates that the tax free status of "implicit interest" is a subsidy for the production of banking services. Reserve requirements can be used to reduce this distortion, however. The present model is interesting, and perhaps even unique in that the reserve requirement "tax" presents itself as neutrality improving, rather than distortionary as is usually argued.

In the Finnish case, the distortionary effects are amplified by the tax exemption of deposit interest on low-yielding accounts. The implicit subsidy to banks' real activities approaches 100 per cent of costs when the after-tax market rate approaches (from above) the regulated tax-free deposit rate. Thus, the impact of the tax system on the banking industry is variable, and may occasionally be very great, depending of course on the price elasticity of demand for liquidity services provided by banks.

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