COMPETITION AND INTEREST RATE CEILINGS IN COMMERCIAL BANKING

by

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I. Introduction

The business of offering demand deposits is conducted subject to two forms of government regulation. Only commercial banks may offer such accounts (with some recent important exceptions) and entry into the commercial banking business is strictly limited by the necessity of obtaining a bank charter. Banks are forbidden, by Federal law, from competing for deposits by offering interest. Several proposed policy changes would effectively modify or eliminate the prohibition on demand deposit interest.

In this paper I consider the behavior of the deposit interest rate if the legal ceiling is raised or removed. The behavior of the deposit rate depends on the market structure in which demand deposits are offered. I argue here that market is best described by imperfect competition.

The *raison d'être* of the current paper is the need for a unified model to include both bank practice in regard to the payment of implicit interest when explicit interest is prohibited and also the extent of explicit interest when the prohibition is removed. If banks presently competed away all excess profit through the payment of implicit interest, it would be reasonable to think that explicit interest, when permitted, would also be paid at the competitive rate. The total legal restriction on demand deposit interest has resulted in a partially effective economic restriction. (See [Barro and Santomero], [Becker], [Keen], [Santomero], and [Startz].) Other empirical evidence on the extent of bank monopoly power can be found in [Heggestad and Mingo, 1976] and [Heggestad and Mingo, 1977].) The central conclusion of this paper is that removal of the explicit interest prohibition will, as desired, force the banking industry closer to fully competitive behavior.

The classical analysis of price controls fails to recognize the power of competition to enforce a market determined solution. Price controls are evaded fully or in part as agents substitute quality, advertising, or other forms of non-price competition in place of forbidden, open price competition. Below, I model such "evasion" in the banking industry. (By substituting "price" for "interest rate" and "output" for "deposits", most of the analytic framework developed will readily apply to other industries.) Price controls have major macroeconomic effects when applied to banks. A large part of the analysis in this paper is focused on the position and slope of the money demand schedule. I begin by applying the classical analysis of price controls to banking.

The monetary authority is interested in both the level of money demand and the marginal relation between money demand and market interest rates. $M(r,r_D)$ is the public demand for money; where r is a typical short nominal interest rate and r_D is the nominal interest rate paid by banks on demand deposits. (Throughout the paper, extraneous arguments, such as income, are omitted). The partial derivatives of the money demand function are $M_r < 0$ and $M_{r_D} > 0$. Existing law fixes r_D at zero.[1] Money demand is $M(r,0)$ and dM/dr is just M_r. Suppose that the deposit rate ceiling is raised a small amount, dr_D. Assuming that banks continue to earn more from loaning out deposits than the new ceiling allows depositors to be paid, perfect competition requires that banks pay the new, higher rate. Money demand will rise by $M_{r_D} \cdot dr_D$. The marginal relation between the level of money demand and the market rate will be unchanged (assuming the partial

[1] The institution of NOW and "automatic transfer" accounts has increased the number of institutions which effectively have checking account authority and has raised the interest ceiling on some checkable accounts from zero to five percent. The five percent ceiling remains a binding constraint.

are constant over the relevant range).

Now suppose that the authorities either eliminate the deposit rate ceiling or raise it to the point where it no longer binds. Perfect competition requires zero profits, or, equivalently, that banks pay out all their investment earnings to depositors. Let δ be the fraction of deposits that banks are able to invest. Abstracting from risk (and the multiplicity of market interest rates), the competitive deposit rate must be $r_D = \delta r$.

Compare now a zero deposit rate ceiling with a competitively set rate. Money demand will increase by $M_{r_D} \cdot \delta r$. The relation between money demand and the market rate will be less negative. The total derivative will increase to

$$dM/dr = \underset{(-)}{M_r} + \underset{(+)}{\delta M_{r_D}}$$

The questions of interest to the monetary authority can be restated with a more general formulation of the deposit rate equation. Suppose we have

$$r_D = \alpha + \beta\delta r$$

A change in regulatory policy changes α and β. The resulting change in the demand for money is

$$\Delta M = M_R \cdot (\Delta\alpha + \Delta\beta\delta r)$$

The change in the relation between the money stock and the market interest rate is

$$\Delta(dM/dr) = \Delta\beta\delta M_{r_D}$$

The monetary authority must be concerned with both the change in the level of money demand and the change in the marginal relation between money demand and the market interest rate. An increase in the level of money demand which is not accommodated will induce either a deflation or a drop in real aggregate demand. An increase in the money supply solely to accommodate a higher level of money demand may be misinterpreted as an inflationary excess growth if the impact of the regulatory change is not properly taken into account. The change in the marginal relation between money demand and the market interest rate means, in this case, that the LM curve will be steeper. The monetary authority will need smaller changes in money supply to produce a given change in market interest rates and real aggregate demand.

The principle objective of this paper is to examine the effect on α and β, and therefore on the level and interest sensitivity of money demand, of changes in regulations, most especially a modification or elimination of the ban on explicit interest.

II. Motivating the model

Four "stylized facts" about banking, taken jointly, suggest a monopolistically competitive model of the bank deposit market.

i) The imposition by law of an effective deposit rate ceiling creates an excess unit profit on deposits, and therefore an incentive for each bank to expand its deposit liabilities.

ii) Banks are able to attract deposits through nonprice competition, that is through the payment of "implicit" interest.

iii) Banks do not compete away all potential excess profits. Charter requirements limit free entry.

iv) As market interest rates rise, and the profit margin on deposits increases, banks engage in more active nonprice competition.

Might perfect competition serve as an adequate description of the bank deposit market? Perfect competition implies zero economic profit. (I abstract from risk; see [Klein] for a bank model with risk.) The legal prohibition of deposit interest would create profits, except that banks can compete away profits through nonprice competition. In our banking system, the cost of providing implicit interest is consistently below the revenue from investing deposits; therefore, the market must be only imperfectly competitive.[2] The assertion that the implicit interest rate is below the competitive level, which I treat as a given, has been shown econometrically in [Startz], and can also be seen in the implicit interest measures in [Barro and Santomero], [Becker], and [Santomero].

Similar market behavior has been noted in other industries, most especially airlines. The model developed here draws heavily on models presented in [Douglas and Miller], [Schmalensee 76], [Schmalensee 77], [Stigler], and [White].

III. Monopolistic Competition for Demand Deposits

I develop here a model of bank behavior in the demand deposit market. The model is Chamberlin's system of monopolistic competition [Chamberlin] slightly extended to meet the present need. The notion of modeling bank behavior by monopolistic competition appeared at least as early as 1938 [Chandler] and much of the work since then is summarized by Alhadeff in

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[2] Point iv) rules out one final possibility favoring a competitive model. Suppose that only limited implicit payments are possible, though the market is perfectly competitive; for example, that the only avenue of nonprice competition is through the provision of flowered checks and consumers have satiated their desires along this dimension. We would see some implicit interest being paid, but less than a competitive amount. We observe that banks increase the level of implicit payments when market interest rates rise. If the banks can increase the implicit rate, they could have done so previously, proving that implicit payments had not reached a limiting point and that the market must be imperfectly competitive.

Chamberlin's Festschrift [Alhadeff]. It is convenient to define several symbols.

r	the market interest rate
r_x	explicit interest rate on demand deposits
r_m	implicit interest rate on demand deposits
n	number of banks
D	total demand deposits
D^i	deposits of bank i
r_x^i, r_m^i	deposit rates offered by bank i

The demand faced by bank k is positively related to the rates it offers, positively related to the differences between its rates and those offered by competitors, and negatively related to the market interest rate. All the coefficients, including the intercept, are positive. Arguments which are not relevant to the problem, such as income, are subsumed in the intercept.

I make the usual assumption of symmetry. All banks face identical demands (and will also have identical costs). Let r_x^i and r_m^i represent rates offered by a typical competitor bank. It will be helpful to have the number of banks enter explicitly and to keep the parameters constant.

$$(1)\quad D^k = \frac{A}{n} + \frac{a_x}{n-1}\sum_{i\neq k}(r_x^k - r_x^i) + \frac{A_x}{n} r_x + \frac{a_m}{n-1}\sum_{i\neq k}(r_m^k - r_m^i) + \frac{A_m}{n} r_m - \frac{A_r}{n} r$$

The parameters a_x and a_m represent the ability of the k^{th} bank to attract deposits from the entire market or increase its market share by offering higher deposit rates than its competitors. The parameters A_x, A_m, and A_r represent the change in market demand for a change in the respective average interest rates. I make the usual assumption that $A_x > A_r$.

Summation of the n bank demand curves (1) yields (2).

(2) $D = A + A_x r_x + A_m r_m - A_r r$

The revenue and cost functions for the k^{th} bank are

$\delta r D^k$ (revenue)

$r_x^k D^k + C(r_m^k D^k)$ (cost)

Because it permits vast analytic simplification, I make the (untrue) assumption that implicit interest is paid in strict proportion to the size of the demand deposit.

Services provided through nonprice competition are almost certainly less valuable to the consumer than would be an equivalent payment in dollars.[3] The money demand function takes as its argument the implicit interest rate as valued by the consumer, whatever providing such a rate may cost banks. I measure the implicit rate from the consumer's vantage. Specifically, I choose as a normalization rule that implicit interest is measured so that is has the same effect on a consumer's money demand as does explicit interest. To restate this point, I choose to measure r_m such that $A_x = A_m$. Together with the normalization in the demand equation goes the implication that $C(r_m D) > r_x D$ when $r_m = r_x$. (See appendix). I further simplify the cost function by assuming constant returns to scale. The cost of implicit interest can now be rewritten as $cr_m D$, with $c > 1$.

The profit of the k^{th} bank is

(3) $\pi^k = \delta r D^k - r_x^k D^k - cr_m^k D^k$

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[3]Keen estimated, for special checking accounts, that services costing a bank one dollar were worth 59 cents to the consumer. See [Keen, p. 132].

Each bank attempts to maximize profits. This requires the bank to make some sort of assumption about the oligopolistic behavior of its competitors. I will adopt the Chamberlinian "large group" assumption. Each bank is small in the market of any given competitor; in the absence of overt or tacit collusion, bank k assumes that the other r_x^i and r_m^i are determined exogenously with respect to its own actions.

Consider now the profit maximization problem for bank k when there is an effective ceiling on the explicit interest it may offer. It maximizes profit over r_m^k taking r, r_x, and r_m^i all to be exogenous.

$$(4) \qquad d\pi^k/dr_m^k = (\delta r - r_x - cr_m^k)[a_m + \frac{A_m}{n^2}] - cD^k$$

The optimum is further restricted by the side condition that r_m^k be non-negative.

IV. Operation of the Banking System With an Effective Explicit Interest Rate Ceiling

The assumption of symmetry allows us to reduce the problem to two equations in r_m and D, plus the side condition that $r_m \geq 0$. The market demand schedule appears above as equation (2). The bank offer curve is obtained by setting marginal profit, (4), equal to zero, and summing the equations over all n banks. (In the appendix, I consider the stability of this equilibrium). The solution for the implicit interest rate is given in (5), if the side condition in (6) holds; if not, $r_m = 0$.

$$(5) \qquad r_m = \left[\frac{-A}{a_m n + A_m + A_m/n}\right] - \left[\frac{cA_x + a_m n + A_m/n}{c[a_m n + A_m + A_m/n]}\right] r_x + \left[\frac{cA_r + \delta a_m n + \delta A_m/n}{c[a_m n + A_m + A_m/n]}\right] r$$

$$(6) \qquad [cA] + [cA_x + a_m n + A_m/n] r_x \leq [cA_r + \delta a_m n + \delta A_m/n] r$$

Before examining the general implications of (5) and (6), it is useful to first consider the special case of a perfectly competitive market structure. The monopolistically competitive solution approaches pure competition under either of two conditions.[4] If there is unlimited entry, i.e., as n goes to infinity, the limits of (5) and (6) are the solution under perfect competition. Alternatively, if each bank faces a perfectly elastic demand with respect to its provision of implicit services over and above those provided by competitors, i.e., a_m goes to infinity, the competitive solution is again approached. In either case, equations (7) and (8) give the limiting formulae for r_m and the non-negativity condition.

(7) $$r_m = (\delta r - r_x)/c$$

(8) $$r_x \leq \delta r$$

Consider how the monetary authority would see a change from the competitive implicit interest regime (say with $r_x=0$) to a regime with competitive explicit payments. At the going market interest rate, deposit demand will increase by $A_x\delta r(c-1)/c$. The relation between deposit demand and the market interest rate will increase (become less negative) from $dD/dr = (A_x\delta/c) - A_r$ to $dD/dr = (A_x\delta) - A_r$.

In general, (5) can be written

$$r_m = \alpha - \gamma r_x + \beta\delta r$$

[4]The limiting properties of the model depend on the assumption of constant returns to scale and on the particular form of the demand schedule. The former assumption is reconsidered below. For a model of a similar formal nature see [Schmalensee, 1976]. The limit of a Chamberlinian model always has price go to average cost, but does not in general have price driven to marginal cost.

At the competitive limit $\alpha=0$ and $\beta=1/c$. Take r_x to be zero, since this is true in practice. The equivalent formula for competitive explicit interest would have $\alpha=0$ and $\beta=1$. The "spirit of the law", of course, has both α and β equal zero. We can use these three as standards of comparision for the operation of the system with the implicit interest rate determined by monopolistic competition.

In the competitive case, $r_x=0$ is sufficient to guarantee the validity of the non-negativity condition. However, this is not true in the more general setting (6). At very low market interest rates, r_m will be zero, because increased implicit interest must be paid on every deposit dollar, while revenue is increased only by the investment of the marginal increase in deposits. There is a kink in the function describing r_m at the point where (6) holds with exact equality after which (5) holds.

Examination of (5) establishes the following properties for the case of monopolistic competition. The intercept, α, is negative. γ is greater than $1/c$, but less than 1. In addition, γ is greater than $\beta\delta$. β is less than $1/\delta$. A sufficient, but not necessary, condition for β to be less than 1 is for A_r to be less than δA_m. A necessary and sufficient condition for β to be less than $1/c$ is $cA_r < \delta A_m$.

The theoretical uncertainty as to the value of β points to a useful difference between the theory of monopoly and the theory of monopolistic competition. The previous paragraph shows that depending on the values of various parameters β may be greater than 1; or, in other words, implicit interest payments might be more responsive to the market interest rate than competitive explicit payments would be. In the case of pure monopoly nothing more could be said. However, if the monopolistic competition is sufficiently competitive, in the well defined sense of there being a large number of firms (large n) or an attractive method of nonprice competition (large a_m), then a little algebra shows that β will be less than 1; that implicit interest will be less responsive to the market rate than would be competitive explicit interest.

r_m is unobservable. However, $C(r_m D)$, the cost to banks of paying implicit interest, is measurable, albeit with some difficulty. [Startz] reports regressions of cr_m on δr and a constant. While the regressions do not control for variations in n or the demand parameters, the results can nonetheless be interpreted as reasonably good estimates of $c\alpha$ and $c\beta$. The value of $c\beta$ is found to be between one-third and one-half. [Santomero] independently shows the same result in his Figure 2. In the present model, this implies $cA_r < \delta A_m$. It also has some important implications, discussed below, about the impact of a policy change which increases the number of banks competing in the demand deposit market.

Before considering various policy changes, it may be useful to briefly summarize the impact of nonprice competition on the operation of the banking system, as seen by the central bank. The demand for deposits is greater than it would be in the absence of nonprice competition and is less responsive, that is it responds less negatively, to changes in the market interest rate. The demand for deposits is less than it would be if competitive explicit interest were being paid and, assuming "sufficient competition", demand is more (negatively) responsive to the market interest rate.

V. The Effect of Policy Changes on the Operation of the Banking System

In the previous section, a baseline was established for the operation of the banking system given current regulations. Most of the reform proposals put forth or implemented in recent years have included three suggestions. The reserve requirement would be substantially lowered (especially by relabeling certain demand balances as savings deposits). The ceiling rate on explicit interest would be increased, but not eliminated. The number of competitors in the demand deposit market would be increased by allowing thrift institutions to offer checkable accounts. The effect of increasing δ by lowering the reserve requirement needs little explanation, so I will consider only the latter two changes in policy.

Consider an increase in the ceiling on r_x to $r_x + \Delta r_x$ with the assumption that the new ceiling continues to bind. If the nonnegativity constraint (6) is non-binding, then the implicit interest rate will fall by $\gamma\Delta r_x$. Deposit demand will increase by $A_x(-\gamma + 1)\Delta r_x$, which is positive since γ is less than one. The responsiveness of deposit demand to the market interest rate is unaffected.

As r_x is raised, (6) may at some point become binding. The implicit rate will remain at zero as the explicit rate continues to rise. Deposit demand will increase by more than is indicated above. In the region in which both the non-negativity constraint and the explicit interest ceiling are binding, the responsiveness of deposit demand to the market rate will be the same as in the absence of nonprice competition.

Permitting thrift institutions to offer checkable accounts will, in most geographic areas, greatly increase the number of participants in the demand deposit market. Examination of (5) shows that the implicit interest rate increases monotonically with n, so long as the pure monopoly effect is small (i.e., $a_m n > A_m/n$). Increasing the number of banks may either increase or decrease the responsiveness of r_m to r. $\beta\delta$ increases monotonically with n if $cA_r < \delta A_m$ (and $a_m n > A_m/n$) and decreases monotonically if the reserve is true. The empirical evidence quoted above bears directly on this question and indicates that increasing the number of banks will indeed lead to increased responsiveness of r_m to r.

Since proposed reforms suggest raising both r_x and n, the "cross partial" of r_m is also of interest. γ declines as n increases. Increasing the explicit interest ceiling while increasing the number of competitors generates a higher implicit interest rate than if the two changes acted independently.

The impact of policy changes on commercial banks differs from the effect seen by the monetary authority and the public because of the expense of providing implicit interest, $c > 1$. For an increase in the number of banks, the rate of profit (per dollar of deposit) simply varies inversely with the change in r_m. The change in spending per dollar deposit when r_x is increased (assuming that the ceiling remains binding and (6) does not) is $(-c\gamma + 1)\Delta r_x$. Since γ is greater than $1/c$, total spending falls. If (6) becomes binding as r_x increases, then the explicit interest expense continues to increase but the cost of implicit interest ceases to fall. Some caution is necessary in the precise predictions about the change in costs, since these predictions are particularly sensitive to the simplifying assumption of constant returns to scale. (See appendix).

VI. Elimination of the Ceiling on Explicit Interest

The behavior of the banking system in the absence of a binding ceiling on explicit interest will be quite different from the behavior of the system with a high, but effective, limit on r_x. Elimination of the binding ceiling could occur in any of three ways. The current prohibition could simply be repealed by legislative action, though this seems unlikely at present. A drop in the market interest rate in combination with national adoption of NOW accounts or their equivalent might drop the market determined level of r_x below the present Regulation Q ceiling. Finally, the regulatory authorities might raise the pro forma ceiling to a level they knew to be non-binding.

If permitted to pay explicit interest, will banks necessarily find it advantageous to do so? Will they choose to offer a mix of implicit and explicit payments? Given the special assumptions of this model, a very strong result can be derived. In the appendix, I present modifications required with weaker assumptions.

Suppose a tentatively optimal mix of implicit and explicit interest is proposed in which both r_m^k and r_x^k are positive. The marginal profit generated by raising r_m^k is given by (4), above. The marginal profit generated by raising r_x^k is given in (9).

$$(9) \qquad d\pi^k/dr_x^k = (\delta r - r_x^k - cr_m^k)[a_x + \frac{A_x}{n^2}] - D^k$$

Since this has been suggested as an optimal mix, both marginal profit conditions must equal zero, which in turn implies $a_m = ca_x$. Since this will occur only by improbable coincidence, we should not observe mixed explicit and implicit interest.

A simple empirical observation suggests that $a_m < ca_x$. If $a_m > ca_x$, then explicit payments will never be offered. In the New England NOW account experiment, banks more or less unanimously pay explicit interest and pay it at the legal ceiling rate. This suggests that as an empirical fact, if the legal prohibition on explicit interest payments were abolished, explicit interest would displace implicit interest as the form of payment.

We turn now to an examination of the market determined r_x. Setting marginal profit equal to zero in (9) and using the market demand curve (2) allows us to determine r_x.

$$(10) \qquad r_x = \left[\frac{-A}{a_x n + A_x + A_x/n}\right] + \left[\frac{A_r + \delta a_x n + \delta A_x/n}{a_x n + A_x + A_x/n}\right] r$$

The monopolistically competitive solution approaches pure competition when either n or a_x grows large without limit. As asserted in Section I, the competitive explicit interest rate is $r_x = \delta r$. For convenience, (10) can be rewritten

$$r_x = \alpha + \beta\delta r$$

β is less than $1/\delta$. Depending on the parameters, β may be either greater or less than one. Non-negative total profit puts a constraint on (10) which may be binding at high market interest rates if $\beta > 1$; $r_x \leq \delta r$. A necessary and sufficient condition for $\beta < 1$ is $A_r < \delta A_x$. The empirical claim, presented in Section IV, that $cA_r < \delta A_m$, is a more than sufficient condition for $\beta < 1$. The competitive limit of (10) has $\alpha = 0$ and $\beta = 1$.

Increasing the number of banks makes α less negative and drives β toward one. Increasing the number of banks makes the deposit rate more or less responsive to the market rate according to whether β is below or above one. If, as suggested above, β is less than one, then increasing the number of banks both increases the deposit rate and increases its responsiveness to the market rate.

Suppose the current zero ceiling on explicit interest were abolished. The behavior of the banking system would change from that predicted by equations (2) and (5) to that predicted by equations (2) and (10), as banks switched from implicit to explicit interest. Suppose the reserve requirement and the number of banks were left unchanged. The actual change in the behavior of the system depends in general on all the prameters, in particular on the relative size of a_x versus a_m. The most interesting case to consider is $a_x = a_m$. The increase in deposit demand is given in (11).

$$\Delta D = A_x \delta r \left[\frac{c-1}{c} \cdot \frac{a_x n + A_x/n}{a_x n + A_x + A_x/n}\right] \tag{11}$$

Deposit demand will be less responsive (less negatively responsive) to the market rate after the ceiling is abolished. The term in brackets in (11) is $\beta_{explicit} - \beta_{implicit}$.

The impact on profitability of commercial banks is, of course, different from the effect seen by the monetary authority and the public. The decrease in the excess return per dollar of deposit is given in (12).

$$\frac{c-1}{a_x n + A_x + A_x/n} \; [A - A_r r] \tag{12}$$

This answer is again dependent on the precise form of the cost function. Excess return falls unless the market interest rate is extremely high, so high that no deposits would be held in the absence of deposit interest.

VII. Summary

If the market for demand deposits was inherently perfectly competitive, and if the formal regulation against the payment of interest could not be evaded through methods of nonprice competition, then the impact of abolition of the deposit interest prohibition would be easy to understand. *Ceteris paribus*, demand for money would increase and the demand for money would become less (negatively) responsive to the market interest rate. Recognition of the practice of paying interest implicitly suggests that the effect of the change will be much less dramatic than a simple picture of pure competition might suggest. Further, the very same empirical evidence argues that current operation of the market is incompatible with perfect competition.

In this paper I have developed a simple model of Chamberlinian monopolistic competition. This model can account for the observed practices of nonprice competition and yields predictions for market behavior if explicit price competition were to be allowed. Specifically, the effect of increasing the number of banks competing in a market, the effect of raising, but not eliminating, the ceiling rate on explicit interest, and the effect of eliminating the ceiling rate on explicit interest, can all be predicted. Especially strong results can be used by using previous empirical estimates to put constraints on the possible range of various theoretical parameters. The combination of the theoretical model and the empirical observation of observable behavior allows prediction about policy changes prior to their institution.

The discussion in this paper has focused on the two related questions of how various policies determine the level of the deposit interest rate and determine the relation between the deposit rate and market interest rates. By immediate extension, the effect of these policies on the level of deposit demand and on the relation between deposit demand and the market interest rate is also determined.

With a binding ceiling on explicit interest the implicit interest rate will be positive but below the competitive explicit rate. The implicit rate increases with the market interest rate, but by less than a competitive explicit rate would. An increase in the legal ceiling on explicit interest leads to a partially offsetting drop in the implicit rate, but the net result will be an increased total deposit rate. An increase in the number of banks competing in a market will increase both the implicit interest rate and its responsiveness to the market rate.

Abolition of the ceiling on explicit interest will result in explicit interest being offered rather than implicit interest, as opposed to inducing a mixture of the two. This strong result depends on the assumption that the marginal cost of implicit interest payment is everywhere greater than the marginal cost of explicit interest payment. In the absence of an effective ceiling on explicit interest, the deposit rate will be positively related to the market rate, but will reflect changes in the market rate less fully than the deposit rate would if perfect competition prevailed. Increases in the number of banks will increase both the deposit rate and its responsiveness to the market rate.

Changing from our current system of no explicit interest to one in which the market determines the deposit interest rate will result in increased deposit demand, increased responsiveness of the deposit rate to the market rate, and lower profit margins for commercial banks. The magnitude of these changes will be far less than that suggested by a simple change from a world of no interest to a world of payment determined by perfect competition.

Appendix

A1. Proof of the normalization assumption

I prove here the assertion made in section III that normalizing the measurement of implicit interest so that $A_x = A_m$, so that implicit and explicit payments have the same marginal effect on deposit demand, implies that the marginal cost of providing implicit interest is greater than the marginal cost of explicit interest. Sufficient assumptions are that deposits are not a Giffen good and that the payment of implicit interest is meaningful, in the sense that the consumer receives more of the auxiliary good than he would freely consume and that the auxiliary good cannot be resold.

I first show the usual characterization of the optimal consumption bundle when the provision of implicit interest is not binding. I then solve the constrained optimization and show that the demand schedule for deposits has the property claimed above. (For simplicity, I actually prove the equivalent assertion that for equal interest costs deposit demand is less responsive to changes in the implicit rate.)

The representative consumer has a well behaved utility function defined over deposits, the auxiliary service, and an additional commodity (D,M,Y). The prices are P_D, P_M, and 1. W is wealth. The consumer receives r_xD explicit interest in the form of general purchasing power and r_mD/P_M units of the auxiliary service as implicit interest. The unconstrained optimization problem and its solution, where λ is the marginal utility of income, are:

$$\max_{D,M,Y} \quad U(D,M,Y)$$

$$\text{S.t.} \quad W = (P_D - r_x)D + P_M(M - r_m D/P_M) + Y$$

$$U_D = \lambda(P_D - r_x - r_m)$$

$$U_M = \lambda P_M$$

$$U_y = \lambda$$

Note that the solution is characterized by $U_M = U_Y P_M$.

In the constrained optimization, the consumer is forced to accept more of the auxiliary service than he would freely buy. As a result, $U_M < U_Y P_M$. The constrained optimization problem is

$$\max_{D,Y} \quad U(D,M,Y)$$

$$\text{S.t.} \quad W = (P_D - r_x)D + Y$$

$$M = r_m D/P_M$$

The optimum is characterized by

$$U_D + \frac{r_m}{P_M} U_M = U_y(P_D - r_x)$$

The properties of the deposit demand schedule can be found by totally differentiating this condition with respect to D, M, Y, r_x, and r_m. This yields

$$[\cdot]dD = U_y dr_x + (U_M/P_M)dr_m$$

The term in brackets is a complicated expression which is positive iff deposits are not a Giffen good. Note that the coefficient of dr_m is less than the coefficient of dr_x, proving the original claim.

A2. Stability and character of the equilibrium

The simple forms chosen for the demand and cost functions in conjunction with the symmetry assumptions allow for simple characterizations of the equilibrium derived in equation (5).

The implicit interest rate in (5) is calculated as the mean r_m. Actually, every bank will offer this rate. Consider two banks, both allegedly maximizing profit, with different r_m. The bank with the higher r_m has lower marginal profit since in (4) both r_m^k and D^k will be larger. At least one bank does not have zero marginal profit.

It is easily seen that the system is stable with respect to perturbances of the exogenous variables A, r, and r_x. In each case the implicit rate moves in the opposite direction of the disturbance in the demand equation.

Suppose bank k raises r_m^k above the equilibrium by dr_m^k. Every other bank will raise its rate by (A2).

$$\text{(A2)} \quad \left. \frac{dr_m^k}{dr_m^i} \right|_{\pi^{k'}=0} = \frac{(a_m/(n-1)) - A_m/n^2}{2[a_m+A_m/n^2]}$$

Bank k will lower its rate by dr_m^k minus (n-1) times (A2), or a little more than halfway back toward equilibrium. This demonstrates, somewhat informally, that the system is stable.

Since the system is linear, all the claims above hold globally.

A3. The Cost of Implicit Interest

The central assumption of this paper is that it is more expensive for banks to provide implicit interest than it would be to provide an equivalent amount of explicit interest; where "equivalent" was defined in terms of having the same effect on the market demand curve. The analysis was greatly simplified by making the strong assumption of constant costs. However, this involved some loss of realism and generated a narrow set of implications. Here, I drop the assumption of constant costs and reconsider some of the results.

One expects the marginal cost of providing implicit interest to increase with r_m (the implicit interest rate as measured from the customer's viewpoint). Total implicit interest is actually a package of services. Some services--a service charge rebate--are of about equal value with an explicit cash payment. Other services--flowered checks--are worth far less to the consumer. At low implicit interest rates, the bank can form the entire service package with valuable services. At higher rates, more services of less value must be added. As a result, higher levels of implicit interest require increased marginal expenditure by the bank.

I now write the cost of providing implicit interest as $C(r_m)\cdot D$. It is helpful to have the cost function separable in the interest rate and the level of deposits both because the mathematics is slightly simplified and because it contains the implicit assumption that costs do not directly depend on the number of competitors splitting the market, aside from the effect on the interest rate and level of total deposits. The first and second derivatives are $c'>0$ and $c''>0$. For the time being also assume $c'>1$.

The cost function, as stated in the body of the essay, is

$$\pi^k = \delta r D^k - r_x D^k - C(r_m^k)D^k$$

The first order condition for profit maximization is

$$d\pi^k/dr_m^k = 0 = (\delta r - r_x - C(r_m))[a_m + \frac{A_m}{n^2}] - c'D/n$$

where I have made use of the appropriate symmetry assumptions.

Since this equation is nonlinear, graphical solution is convenient. The slope of the first order condition, in r_m,D space, is given by

$$\left.\frac{dr_m}{dD}\right|_{\pi^{k'} = 0} = - \frac{c'}{c'[a_m n+A_m/n]+c''D}$$

The market demand equation is

$$D = A + A_x r_x + A_m r_m - A_r r$$

The effect of an increase in the market interest rate is demonstrated in Figures 1a and 1b. Figure 1a shows constant marginal cost. An increase in the market interest rate increases the implicit interest rate. Figure 1b is drawn based on increasing marginal cost. For reference, the constant cost lines from 1a are repeated (thin lines). The intersection of demand and the zero profit line (heavy solid lines) is at the same position as in the previous figure. The zero profit line is flatter than in the constant marginal cost case due to the presence of c''D in the denominator. (N.B., in the constant cost case the zero profit line is in fact a line. In the present case, the schedule is nonlinear.)

An increase in the market rate shifts the zero profit line to the right; the shift is greater at lower implicit interest rates. (In the constant cost case, the new line is parallel to the old.) An increased market rate results in a higher implicit interest rate. Comparative statics may be seen by comparing the intersection of the heavy dashed lines to the intersection of the light dashed line and the dashed demand schedule. In the case of increasing marginal cost, the increase in r_m is less and the fall in deposit demand is greater.

Figure 2 illustrates the comparative statics of an increase in the explicit interest ceiling (in the region in which the ceiling remains binding). As before, the thin lines show the constant cost case. In the increasing marginal cost case, the implicit interest rate falls less, and deposit demand increases by more, than for constant marginal cost. Algebraically, the result is

$$\frac{dr_m}{dr_x} = - \frac{a_m n + A_x/n + c'A_x}{c'a_m n + c'A_x/n + c'A_x + c''D}$$

The increasing marginal cost case differs from the constant cost case by the presence of the $c''D$ term in the denominator.

The change in the cost of implicit interest for a small increase in the (binding) explicit interest ceiling is

$$\frac{dC(r_m)}{dr_x} = - \frac{a_m n + A_x/n + c'A_x}{a_m n + A_x/n + A_x + \frac{c''D}{c'}}$$

Bank profit margins improve if and only the fraction is greater than one (in absolute value). In the constant cost case, $c'' = 0$, there is a net savings since $c' > 1$. In the more general case, the fraction may be either more or less than one. The total cost of deposit interest may either rise or fall following an increase in the explicit ceiling.

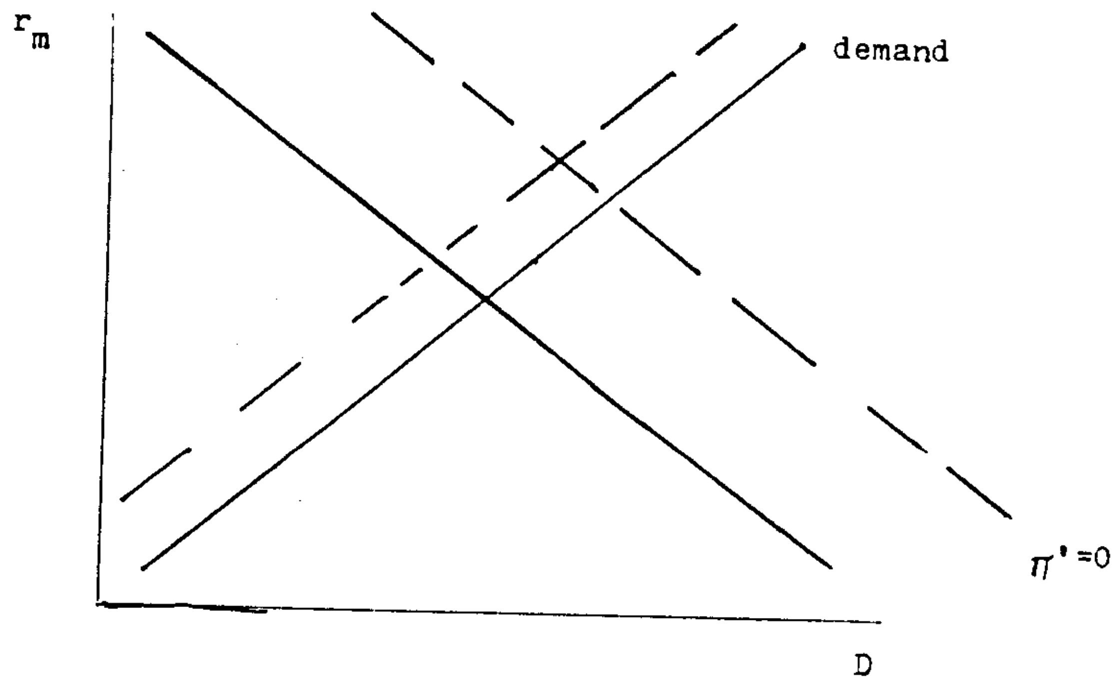

Figure 1a

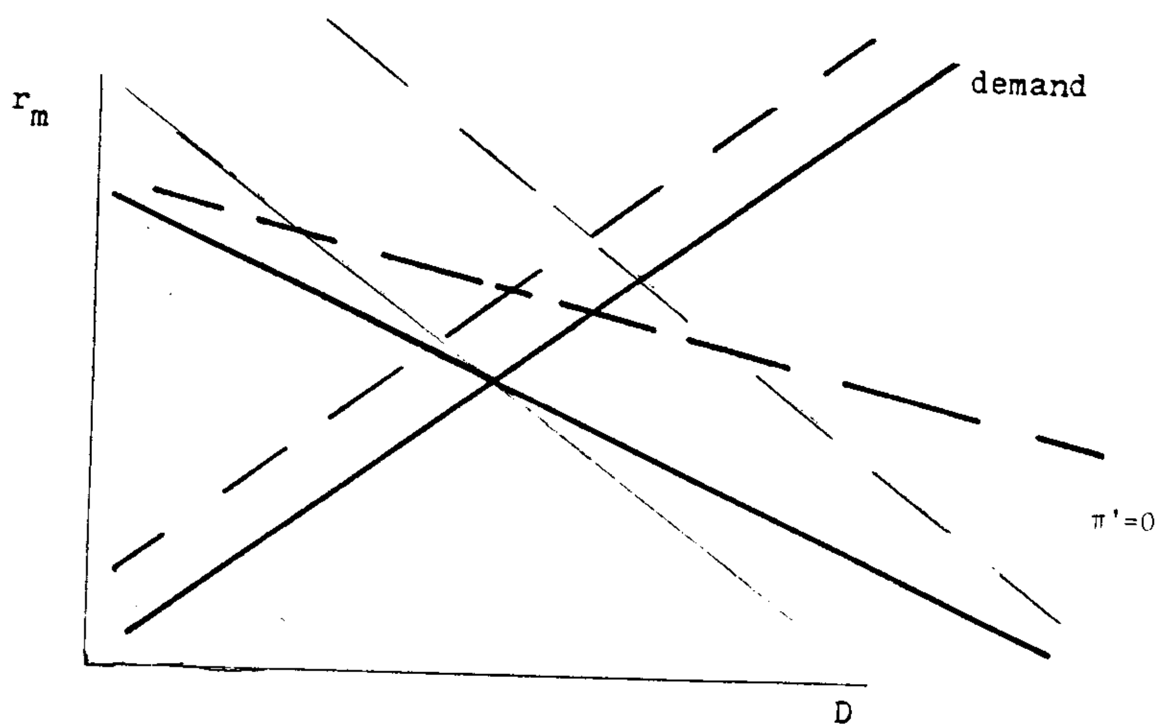

Figure 1b

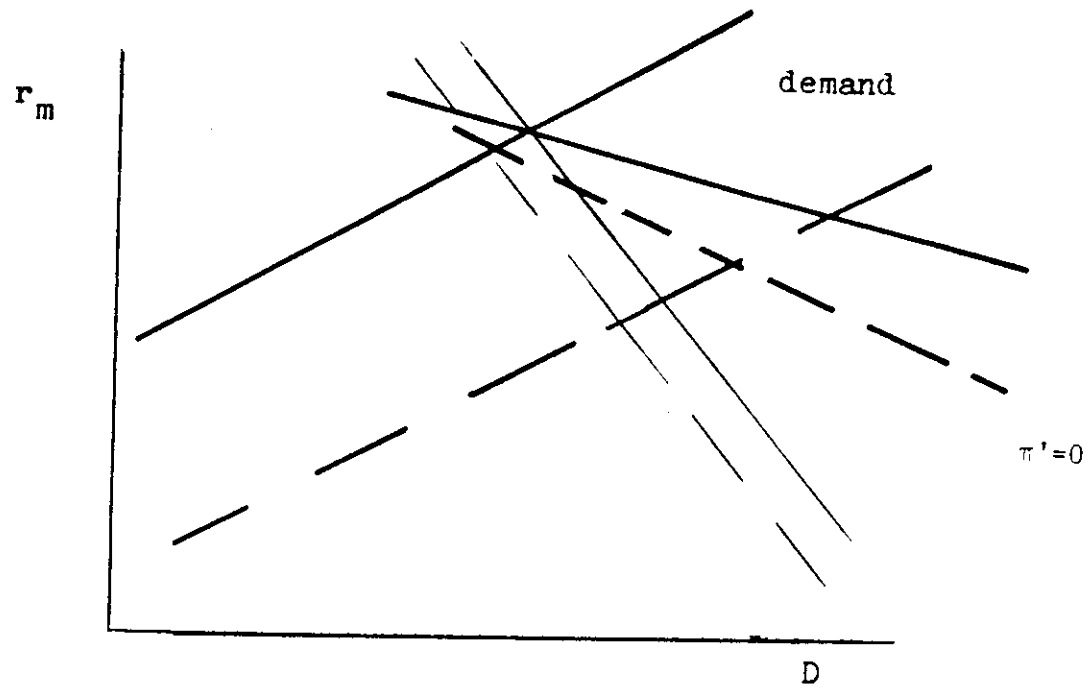

Figure 2

Under current law, explicit interest is subject to the personal income tax while implicit interest is not. This creates an incentive to partially substitute implicit for explicit payment. The model is easily modified to deal with the tax wedge. Further discussions of some of the issues here can be found in [Kimball] and [Higgins].

Assume deposits are held by individuals who face a uniform proportional tax rate and that deposit demand depends only on the after-tax value of interest. The model should be modified by decreasing all the deposit demand parameters, except those on the implicit interest rate, by (1-t), where t is the tax rate. In the constant cost model the knife-edge property persists, so that in the absence of an explicit interest rate ceiling banks will still pay either explicit interest or implicit interest, but never a mix. For a given set of parameters, the existence of the tax wedge makes it more likely that will choose to pay implicit interest. If the banks pay explicit interest, then the tax has relatively little impact on the predictions of the model. The change from implicit to explicit interest will be less dramatic than in the absence of the tax. The explicit interest rate (pre-tax) will be slightly less than it would be in the absence of taxes but the responsiveness of the explicit rate to the market rate will be unaffected (see equation (10)). With a variable marginal cost of implicit interest, the implicit interest rate would be reduced until $[a_m+A_m/n^2] = (1-t)c'(r_m)[a_x+A_x/n^2]$. More simply, banks will adjust the payment schedule until the implicit interest rate is low enough that a (tax-free) dollar of implicit interest attracts deposits equally as well as a post-tax dollar of explicit interest.

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