BANK REGULATION AND MACROECONOMIC STABILITY

by

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The contents of this paper are solely the responsibility of the authors.

Recent legislative proposals allowing financial institutions to pay interest on deposits, as well as allowing the Federal Reserve to pay interest on bank reserves has again raised the question of the effects of such proposals upon the stability of the macro economy.[1] In the early 1960's, when these issues were previously discussed, the work of William Brainard (1965) and James Tobin and William Brainard (1963) were significant contributions to the area. These authors determined the conditions under which changes in banking regulation would be expansionary or contractionary for the economy as a whole. However, Brainard himself correctly noted that the differential response to exogenous variables induced by regulatory changes in the structure of the banking system cannot be used to assess the desirability of such a shift. If the system is non-stochastic, the monetary authority can often costlessly alter the size of the policy variables so as to compensate for any change in the response of the target variables to autonomous shifts.

The responsiveness of the system to exogenous shocks becomes most important in a stochastic environment. As Poole (1970) has shown in an ISLM framework, the failure of the monetary authority to accurately assess the current values of all endogenous variables indicates that alterations in the financial structure may have important implications for the success of the central bank stabilization policy.

This paper considers the effect of recently proposed policy recommendations on the monetary authority's ability to control its target variables in a stochastic environment. It indicates that some policy proposals would categorically worsen stochastic control, while other seemingly similar proposals would have the opposite effect. The optimal movement in the structure will depend, as in the Poole work, upon the assumed characteristics of the stochastic nature of the system. It should be noted that while the motivating issue of the present study is the U.S. debate on financial structure, the techniques proposed to evaluate the changes are most general. They can be employed to address a whole range of structural changes in the financial system in an analogous manner to the present work. The contribution here should be viewed as the development of techniques to evaluate other more general debates on the optimality of financial structure.

The paper will proceed as follows. Section I will outline the general equilibrium model employed in the study, as well as its stochastic behavior. Section II outlines the proposed regulatory changes and integrates them into the financial market model developed in the previous section. Here the impact of regulatory change on the variance of the target variable, the price level will be considered explicitly. Section III introduces the real sector into the model and evaluates the effect of financial change upon the system's response to real sector disturbances that are stochastic in nature. Section IV integrates the real and financial sectors, demonstrating which policy shifts are appropriate under differing origins of the stochastic disturbances. Section V is devoted to summary remarks.

1. THE MODEL OF FINANCIAL EQUILIBRIUM

A. A Description of the Static Model

The basic framework employed in the analysis is similar to the general equilibrium framework of the financial markets first presented by Brainard and Tobin (1963). Three sectors exist in the economy : the household or public sector, h, the banking or financial institution sector, B, and the firm sector, F. Each sector's demands and supplies satisfy balance sheet constraints and substitution properties that are characterized by gross substitutability and normality.[2] There are four assets in the economy: high powered or base money, H, which also serves as currency ; deposits at financial institutions, D ; bonds issued by the firm sector, B ; and equity, E.

Within the four markets each sector is constrained by a budget constraint limiting asset purchases. For the household, real asset demand is constrained by wealth, so that :

$$H_h^d + D_B^d + B_h^d + E_h^d = W \equiv K + H/P$$

where wealth has been defined as total firm capital plus high powered money in real terms.[3] The financial institution, as an internal financial entity, must sum to zero in real value so that its budget constraint may be written as :

$$H_B^d + B_B^d = D_B^s$$

where, superscript s indicates supply and, following U.S. regulation, these institutions are excluded from owning equity. Finally the firm sector obtains funds from debt and equity to maintain its fixed capital stock; therefore, its constraint is :

$$B_F^s + E_F^s = K.$$

Formally, the model containing these constraints and the conditions of gross substitution and normal goods may be constructed as the following four equation system of equilibrium conditions :

$$(1) \quad H_h^d\,(\bar{r}_D, \bar{r}_B, \bar{r}_E, \overset{+}{W}) + H_B^d\,(\bar{r}_B, \bar{r}_D) = \frac{H^s}{P}\ ,$$

(2) $$D_h^d\,(\overset{+}{r}_D\,,\ \overset{-}{r}_B\,,\ \overset{-}{r}_E\,,\ \overset{+}{W}) = D_B^s\,(\overset{-}{r}_D\,,\ \overset{+}{r}_B),$$

(3) $$B_h^d\,(\overset{-}{r}_D\,,\ \overset{+}{r}_B\,,\ \overset{-}{r}_E\,,\ \overset{+}{W}) + B_B^d\,(\overset{-}{r}_D\,,\ \overset{+}{r}_B) = B_F^s\,(\overset{-}{r}_B\,,\ \overset{+}{r}_E,\ \overset{+}{K}),$$

(4) $$E_h\,(\overset{-}{r}_D\,,\ \overset{-}{r}_B\,,\ \overset{+}{r}_E\,,\ \overset{+}{W}) = E_F\,(\overset{+}{r}_B\,,\ \overset{-}{r}_E,\ \overset{+}{K}),$$

where r_i is the rate of return on asset i, and the signs above the arguments in the demand and supply functions refer to the signs of the partial derivatives.

This general system may be simplified considerably if two assumptions are made concerning the commercial banking sector. First, it will be supposed that the demand for high powered money centers around the required ratio, denoted as ρ_o, and is affected inversely by the opportunity cost of reserve assets, i.e. r_B. Therefore H_B^d is replaced by the multiplicative expression $\rho . D_B^s$ in the market for high powered money.[4] Second, it will be supposed that the deposit rate, r_D, is fixed below the equilibrium value in that market,[5] so that the quantity of deposits supplied by the bank, and affecting its budget constraint, is solely determined by the quantity demanded. The effect of the assumptions is to contract the four equation system above to the following three :

(5) $$H_h^d\,(r_D\,,\ r_B\,,\ r_E\,,\ W) + \rho(r_B\,,\ \rho_o)\ D_h^d\,(r_D\,,\ r_B\,,\ r_E\,,\ W) = \frac{H^s}{P}\,,$$

(6) $$B_h^d\,(r_D\,,\ r_B\,,\ r_E\,,\ W) + \left[1 - \rho(r_B\,,\ \rho_o)\right]\ D_h^d\,(r_D\,,\ r_B\,,\ r_E\,,\ W) = B_F^s\,(r_B\,,\ r_E),$$

(7) $$E_h^d\,(r_D\,,\ r_B\,,\ r_E\,,\ W) = K - B_F^s\,(r_B\,,\ r_E,\ K).$$

There are three unknowns in the system, viz., r_B, r_E and P. As the model is a comparative static full employment framework, one may evaluate the solution of the model at equilibrium in the real sector such that the marginal product of capital is equated to the cost of new equity.[6] Accordingly the system may be solved conditional upon the equilibrium value of r_E.[7] This further reduces the analysis to two equations in two unknowns. It will prove convenient to consider equation (5), the high powered money equation, and the sum of equations (5) and (6), which may be denoted the liquid asset equation because the addition obtains an equilibrium condition of the nature

$$(8) \quad H_h^d(r_D, r_B, r_E, W) + D_h^d(r_D, r_B, r_E, W) + B_h^d(r_D, r_B, r_E, W) = B_F^s(r_B, r_E, K) + \frac{H^s}{P}.$$

Converting equations (5) and (8) to excess demand notation, i.e. let $H = \sum H_i^d - H^s$ and $A = \sum A_i^d - \sum A_i^s$; **denoting the liquid** asset market as A, the model may be written in reduced form as :

$$(9) \quad H(\bar{r}_B, \bar{r}_E, \overset{?}{r}_D, \overset{+}{\rho}_o, \bar{H}^s, \overset{+}{P}) = 0$$

$$(10) \quad A(\overset{+}{r}_B, \bar{r}_E, \overset{+}{r}_D, \bar{H}^s, \overset{+}{P}) = 0,$$

The assumption of gross substitutes accounts for the deterministic signs on r_B, and r_E. The ambiguity of $\frac{\partial H}{\partial r_D}$, denoted henceforth as H_D, results from the offsetting effect of r_D increases on the household's and bank's demand for high powered money. If high-powered money and deposits are net substitutes the sign of H_D is unambiguously negative. If they are complements the opposite is implied. The signs of both H^s and P in equations (9) and (10) follow directly from the normality assumptions above, and both these equations are homogeneous of degree zero in H^s and P. This system of equations can be represented in two-dimensional space for a given value of r_E. As indicated in Figure 1, HH represents the locus of points where the market for high powered money is in equilibrium and AA where the market for liquid assets is in equilibrium. As shown by Siegel (1977) equilibrium in the system is obtained for a unique set of r_B^* and P^*.

B. The Stochastic Behavior of the Model

As noted at the outset, attention will center upon the stochastic characteristics of the model of section A. Two types of random disturbances can be considered. First, there may be a randomness associated with the market for high powered money. Here one may consider uncertainty in the demand for money function, as Goldfeld (1976) has recently suggested, or uncertainty on the supply side, as critics of the Federal Reserve often charge.[8] In Figure 1 this is indicated by shifts in the HH curve. Second, there may be randomness of the demand for liquid assets in general. Shifts in the fraction of wealth devoted to equity are captured by this sort of disturbance. This would be represented by shifts in the AA curve. In general the shocks to these two markets will be correlated.

If the Central Bank had perfect knowledge of the excess demand functions (9) and (10), and the bond rate and price level without a lag, it can offset any shifts in the HH or AA curves by appropriate changes in high-powered money, the deposit rate or the reserve ratio. It can be easily shown that the monetary authority has sufficient instruments to achieve any equilibrium. When the target variable, the price level, is only known with a lag, and the sources of the disturbances are not known, complete control is foregone. In this case, the central bank can only operate to minimize the fluctations in the price level by structuring the financial environment so as to minimize the effect of such disturbances on the economy. Such policy changes affect the <u>responsiveness</u> of the base money market to disturbances that alter interest rates. Hence they affect the slopes of the HH, and as shown below, leave the AA locus unaffected. This slope change can be seen with reference to Figures 2 and 3. Since the slope of HH equals $-H_p/H_B$, a policy change which makes the market for high-powered money more sensitive to the interest rate will flatten the HH curve to H'H'. A given disturbance to the market for high-powered money (ε_H), will result in a smaller increase in the price level (Q_1') after the policy change than before (Q_2'). Hence such a policy shift is termed stabilizing with respect to disturbances in the market for high-powered money. On the contrary, as indicated in Figure 3, disturbances arising in the market for liquid assets (ε_A) will result in a greater change in the price level (Q_2') after the structural shift than before (Q_2). Hence such a policy is destabilizing with respect to disturbances in the market for liquid assets.

To consider the impact of stochastic disturbances analytically, the model is linearized around its equilibrium values of equations (9) and (10). The result is :

$$(11)\quad H_p \tilde{p} + H_B \tilde{r}_B = - H_D \tilde{r}_D - H_E \tilde{r}_E - H_\rho \tilde{\rho}_o + H_p \log \tilde{H} + \varepsilon_H ,$$

$$(12)\quad A_p \tilde{p} + A_B \tilde{r}_B = - A_D \tilde{r}_D - A_E \tilde{r}_E + A_p \log \tilde{H} + \varepsilon_A ,$$

where p represents the log of the price level, tilda ($\sim$) represents deviations from the equilibrium values, and ε_H and ε_A are the random disturbances outlined above.[9] It will be assumed the expected value of both disturbances are zero, $E(\varepsilon_H) = E(\varepsilon_A) = 0$, and $E(\varepsilon_H \varepsilon_A) = \sigma_{AH}$, $E(\varepsilon_H^2) = \sigma_H^2$, $E(\varepsilon_A^2) = \sigma_A^2$. Further, it will be assumed that the random disturbance terms are drawn from a distribution that is fixed in real terms, so that a comparative static shift in the price level do not alter the relative importance of the potential disturbance term.[10]

For any given value of the disturbance terms ε_H and ε_A, the equilibrium price level, from equations (11) and (12) becomes,

$$(13) \quad p = \frac{(A_B \varepsilon_H - H_B \varepsilon_A)}{(H_p A_B - H_B A_p)},$$

and hence the variance of the log of the price level becomes,

$$(14) \quad \mathrm{var}(\tilde{p}) \equiv \sigma_p^2 = \frac{A_B^2 \sigma_H^2 + H_B^2 \sigma_A^2 - 2\sigma_{AH} A_B H_B}{(H_p A_B - H_B A_p)^2}.$$

The focal point of the analysis will be the effect of the proposed regulatory changes on the variance term of equation (14). If the effect of regulatory change is an increase in the variance of p, then structural change reduces effective control of the economy by the monetary authority, and in this sense is a detrimental shift. Of course a decrease in the variance of p is salutary. It is clear from this equation that an increase in H_B, which indicates a flattening of the HH curve will decrease the variance of the price level in the case of H-market disturbances (σ_H^2) and increase the variance for A-market disturbances (σ_A^2). It remains to outline these proposed shifts and their effect on the variance term.

2. THE EFFECT OF PROPOSED POLICY CHANGES

The method of analysis in this study is to determine how several regulatory changes affect the slope of the equilibrium curves and hence the variance of the price level. Three potential changes in the structural environment of the banking system are possible. As indicated previously, all are now being discussed both by Congress and the Federal Reserve System. These are:

(1) a change in required reserve ratio on member banks,

(2) interest payment on required reserves, and

(3) interest payment on demand deposits.

The first two are meant to address the rapidly declining membership in the Federal Reserve while the third is in response to competitive pressures from savings banks and selective commercial banks issuing interest-bearing checking accounts. This study will analyze how such policy proposals affect macroeconomic control and how they may be used in combination to improve macro stability.

The procedure used to evaluate the effect of the three policy changes will be the same. In each case the total differential of equation (14) with respect to the proposed policy change is taken. The result will be a change of the slope of the HH curve, whose graphical interpretation was presented in the last section. For instance, if it can be shown that the proposed structural change reduces the slope of the HH locus, this demonstrates that the structural shift reduces the variance of prices if the disturbances originate in the market for high powered money, while increasing the variance if disturbances affect liquid assets.

A. Changes in Reserve Ratios

The first change to be considered is the effect of a change in required reserve ratios. Above it was assumed that the reserve function was dependent upon the rate of return on bonds and the required ratio. If it is further assumed that required reserves, *ceteris paribus*, increase actual reserves by an equal amount, at least on the margin, then the reserve function may be written as :

$$(15) \quad \rho = \rho(\rho_o , r_B) = \rho_o + \rho(r_B).$$

The effect of a small change in the required reserve ratio, ρ_o, on the variance of the log of price is formally equal to $\frac{\partial \sigma_p^2}{\partial \rho_o}$. In order to evaluate this expression some simplification is necessary. If the demand functions are assumed linear so that second derivatives are zero, the expression becomes[11]:

$$(16) \quad \frac{\partial \sigma_p^2}{\partial \rho_o} = \frac{2\left[A_B \frac{\partial H_B}{\partial \rho}\right]\left[\sigma_H^2 A_B A_p + \sigma_A^2 H_B H_p - \sigma_{AH}(A_B H_p + H_B A_p)\right]}{(H_p A_B - H_B A_p)^3}$$

where

$$(17) \quad \frac{\partial H_B}{\partial \rho} = \frac{\partial D_H^d}{\partial r_B} + \frac{\partial \rho}{\partial r_B}\left[2\frac{\partial D_H^d}{\partial r_B}\frac{dr_B}{d\rho} + \frac{\partial D_H^d}{\partial W}\frac{dW}{d\rho}\right]$$

The first term of equation (17) is negative, whereas the second term is unclear since the bond rate rises and real wealth increases in response to an increase in ρ_o. The first term is the direct effect of an increase in ρ_o on the sensitivity of high powered money to the bond rate. An increase in ρ_o causes a rise in the real amount of reserves. For a given interest sensitivity of deposits, the interest sensitivity of total reserves increases, and hence the direct effect of a rise in ρ_o is negative.[12] The second term captures the indirect effects of a shift in ρ on the bond rate and overall wealth. The first of these is an offsetting effect, as the bond rate will rise with ρ. On the other hand, real wealth will increase as a price decline is associated with an increase in ρ. These two indirect effects are contradictory and will be assumed secondary. $\frac{\partial H_B}{\partial \rho}$ will, therefore, be evaluated as negative, resulting in a flatter HH curve. The AA curve is unaffected since the reserve requirement does not appear in the liquid asset equation. The sign of equation (16), then, is opposite in direction to the sign of the second bracketed term in the numerator, which may now be analyzed.

Consider the case of a disturbance in each market alone. If $\sigma_A^2 = 0$, the expression reduces to

$$(18) \quad \frac{\partial \sigma_p^2}{\partial \rho_o} = \frac{2\left[A_B \frac{\partial H_B}{\partial \rho}\right]\left[A_B A_p \sigma_H^2\right]}{(H_p A_B - H_B A_p)^3} < 0.$$

<u>Ceteris paribus</u>, <u>an increase</u> in the reserve ratio tends to <u>decrease</u> the variance of prices. This is the case we have already analyzed graphically in Figure 2. In the case where only the liquid asset market is subject to disturbances, i.e. where $\sigma_H^2 = 0$, equation (16) becomes :

$$(19) \quad \frac{\partial \sigma_p^2}{\partial \rho_o} = \frac{2\left[A_B \frac{\partial H_B}{\partial \rho} \quad \sigma_H^2 H_p H_B\right]}{(H_p A_B - H_B A_p)^3} > 0,$$

the opposite result to equation (18). The reason for this reversal has been analyzed graphically in Figure 3. Finally in the general case with both variances are non-zero and the covariance terms of equation (16) become relevant, the effect of a shift in ρ is ambiguous. The larger the σ_H^2 term the more likely a positive shift in ρ will reduce overall variance in log-price.[13]

Generalizing from above one may now summarize the result of a (positive) shift in ρ_o, as captured in equation (16). If disturbances prevail primarily in the market for high powered money, the effect of a rise in a reserve requirement is to reduce the logarithmic variance of the price level. On the other hand, if the disturbances are primarily in the market for liquid assets, the effect of a rise in ρ is reversed as the structural shift causes greater price variance for a given disturbance in this market.

B. Interest Payments on Required Reserves

The proposal for the payment of interest on reserves can be easily analyzed in the framework developed above. The payment of interest should be expected to increase the average reserve requirement on demand deposits for two reasons. First, the number of banks belonging to the Federal Reserve System would increase, as membership is a decreasing function of the opportunity cost of holding the higher reserves required of members. Thus an increase in average reserves held by the financial institution sector as a whole, especially in the long run,[14] should be expected from a payment of interest of reserves. The second effect of interest payments would be the greater reluctance of existing member banks to have a negative free reserve position, with its system penalties, and a smaller cost for possessing a free reserve position. If payment of interest is made on required reserves only, there would be no smaller incentives for banks to avoid excess reserves, but greater incentives to avoid a deficiency.

The effect of increasing interest returns to reserves, denoted r_H, may be written formally as :

$$(20) \quad \frac{\partial \sigma_p^2}{\partial \hat{r}_H} = \frac{\partial \sigma_p^2}{\partial \rho} \frac{d\rho}{dr_H} ,$$

with the first term equal to equation (16) above, and $\frac{d\rho}{dr_H} > 0$. Hence, the institution of interest payment on reserves leads to smaller fluctuations in the price level if disturbances occur primarily in the market for currency and reserves, but the reverse effect if disturbances are primarily in the market for liquid assets.

C. Interest Payments on Demand Deposits

The proposal to allow interest payments, at some government administered rate,[15] on demand deposits is different than the two proposals previously considered. It impacts directly upon the deposit market, and the household, whereas the other proposals affected the financial institutions first. However, the method of analysis proceeds in a similar fashion.

The effect of this proposal on the variance is given by

$$(21)\quad \frac{\partial \sigma_p^2}{\partial r_D} = \frac{\left[2\, A_B \frac{\partial H_B}{\partial r_D}\right]\left[\sigma_H^2 A_B A_p + \sigma_H^2 H_p H_B - \sigma_{AH}(A_B H_p + H_B A_p)\right]}{(H_p A_B - H_B A_p)^3}$$

where

$$(22)\quad \frac{\partial H_B}{\partial r_D} = \frac{\partial \rho}{\partial r_B}\left[\frac{\partial D_H^d}{\partial r_B} + 2\,\frac{\partial D_h^d}{\partial r_B}\frac{dr_B}{dr_D} + \frac{\partial d_H^d}{\partial W}\frac{dW}{dr_D}\right]$$

The first term in equation (22) represents the sensitivity of the average reserve ratio to the bond rate times the shift in deposits due to a change in the deposit rate. This is unambiguously negative. The second and third terms capture the indirect effects, as was the case in equation (17) above. The second term depends upon the sign of $\frac{dr_B}{dr_D}$, while the third is determined by $\frac{dW}{dr_D}$. Unless high powered money and deposits are extreme complements,[16] both the bond rate will fall in response to a rise in the deposit rate and wealth declines. As before these terms are of opposite signs and will be assumed to be a secondary order of importance. Therefore, equation (22) will be negative and the HH curve becomes flatter when deposit rates rise. Under the linearity assumptions, the slope of AA is unaffected by a rise in r_D. The effect of r_D on the variance of log-price is, again, dependent upon the nature of the disturbances facing the financial structure.

Hence, the analysis of the change in the deposit rate is qualitatively identical to that of a change in the reserve requirement. A rise in deposit rates will lead to smaller fluctuations of the price level for disturbances in the high powered money market and greater fluctuations if the disturbances center in the market for liquid assets.

3. FINANCIAL INTERACTION WITH THE REAL SECTOR

Thus far the analysis has examined the effect of regulatory reforms on the system with financial disturbances only. This section expands the focus of the analysis by considering the impact of financial reforms on the system's behavior when faced with real shocks.

Assume that the commodity or output demand is a function of the equity rate, which determines the rate of investment, and the price level,[17] which determines the level of real balances. The equilibrium output level is fixed at C^s in real terms so that the equilibrium condition for commodity market full employment is :

$$(23) \quad C^s = C^D(p, r_E), \ \frac{\partial C^D}{\partial p} < 0, \ \frac{\partial C}{\partial r_E} < 0.$$

The locus of points (p, r_E) such that the commodity market is in equilibrium has the slope

$$(24)\quad \left.\frac{dp}{dr_E}\right|_{CC} = \frac{\frac{\partial C^D}{\partial r_E}}{\frac{\partial C^D}{\partial p}} < 0.$$

In a similar fashion the locus of price levels and equity rates which equilibrate the financial markets, equations (9) and (10), can be derived. The counterpart of the commodity locus, denoted CC, is the financial market equilibrium locus, FF, represented in Figure 4.

$$(25)\quad \left.\frac{dp}{dr_E}\right|_{FF} = \frac{H_B A_E - A_B H_E}{H_p A_B - H_B A_p} > 0.$$

The simultaneous solution of the CC and FF locus represents equilibrium in the commodity, liquid asset, and high powered money markets. It is general equilibrium of the expanded system. Now consider a situation where the commodity market itself is subject to stochastic shocks of either a supply or demand nature. It should be clear from the inspection of Figure 4 that disturbances originating in the real sector have a greater impact on the price level when the FF locus is steepest. Therefore, the impact of the proposed regulatory changes can be evaluated by analyzing their effect upon the slope of the FF curve, equation (25). It is assumed that the government, through its influence on commodity demand, stabilizes the mean of the price level when changes in the financial structure cause a once-and-for-all shift in the economic environment.[18]

The result of a change in ρ_o on the slope of the financial market locus can be derived as[19]

$$(26)\quad \frac{\partial\left(\frac{\partial p}{\partial r_E}\right)_{FF}}{\partial \rho_o} = \frac{A_B\left[\frac{\partial D_H^d}{\partial r_B}(H_p A_E - H_E A_p) - \frac{\partial D_H^d}{\partial r_E} A_B (H_p A_B - H_B A_p)\right]}{(H_p A_B - H_B A_p)^2} > 0.$$

The sign of equation (26) is unambiguously positive. Hence the slope of the FF curve rises in the case of an increase in ρ_o and, for a given disturbance in the real sector, the variance of the price level will increase. As noted above in Section 2B an increase in the interest paid on reserves will have identical qualitative effects as an increase in reserve requirements.

An increase in the deposit rate, the third structural change, can be analyzed in a similar fashion to ρ_o above. Taking the derivative of the FF locus with respect to r_D under the assumptions that obtained above results in :

$$(27)\quad \frac{\partial\left(\frac{\partial p}{\partial r_E}\right)_{FF}}{\partial r_D} = \frac{A_B(H_pA_E - H_EA_p)\dfrac{\partial\rho}{\partial r_B}\cdot\dfrac{\partial D_h^d}{\partial r_D}}{(H_pA_B - H_BA_p)^2} > 0$$

As in the case of reserve requirements, a rise in the deposit rate unambiguously increases the variance of the price level for any given disturbance in the real sector.

4. INTEGRATION OF REAL AND MONETARY DISTURBANCES

Section 2 above indicated the results of regulatory change on the overall variance of prices associated with stochastic disturbances in the monetary sector. It indicated that the effect on the variance of the price level of shocks to base money are decreased by positive changes in ρ_o and r_D. Also, because payment on reserves increases the reserve ratio, an increase in this rate, r_H, also decreases overall variance. However the effect of shocks to the liquid asset market is definitive but opposite in sign to that of the base money disturbances. It is straightforward to analyze the set of both reserve requirement changes and deposit rate changes that could be combined so that the variance of the price level remains constant for any set of disturbances. The slope of this isovariance curve, which shall be termed MM, is :

$$(28) \quad \left.\frac{\delta \rho_o}{\delta r_D}\right|_{MM} = \frac{\dfrac{\partial \sigma_p^2}{\partial r_D}}{\dfrac{\partial \sigma_p^2}{\partial \rho_o}}$$

Substituting into equation (28) and ignoring secondary effects of r_B and p changes yields the simple form :

$$(28') \quad \left.\frac{\delta \rho_o}{\delta r_D}\right|_{MM} = \frac{\dfrac{\partial \rho}{\partial r_B}\dfrac{\partial D_h^d}{\partial r_D}}{\dfrac{\partial D_h^d}{\partial r_B}}$$

Further, if it is assumed that deposit demand may be regarded as primarily a function of the difference between r_B and r_D, so that $\frac{\partial D_h^d}{\partial r_D} \simeq \frac{\partial D_h^d}{\partial r_B}$, then equation (28) reduces to :

$$(28'') \quad \left.\frac{\delta \rho_o}{\delta r_D}\right|_{MM} = \frac{\partial \rho}{\delta r_B} .$$

This indicates that if the monetary authority were to change the average reserve ratio and the deposit rate in the same ratio as the rate of responsiveness of the average reserve ratio to a change in the market interest rate, then fluctuations in the price level in the economy would neither increase nor decrease due to disturbances in the monetary sector.

Just as in the case of the financial market, Section 3 implies that a locus of isovariance for real disturbances can be traced for different values of the policy instruments ρ_o and r_D. The slope of this locus, denoted RR, is :

$$(29) \quad \left.\frac{\delta \rho_o}{\delta r_D}\right|_{RR} = - \frac{\dfrac{\partial\left(\dfrac{\partial p}{\partial r_E}\right)}{\partial r_D}}{\dfrac{\partial\left(\dfrac{\partial p}{\partial r_E}\right)}{\partial \rho_o}} = \frac{\dfrac{\partial \rho}{\partial r_B}\,\dfrac{\partial D_h^d}{\partial r_D}}{\dfrac{\partial D}{\partial r_B} - q} < 0$$

$$\text{where } q = \frac{\dfrac{\partial D_h^d}{\partial r_E}\,(H_p A_B - H_B A_p)}{(H_p A_E - H_E A_p)} > 0.$$

As displayed in Figure 5, it can be easily seen that the isovariance locus for disturbances in the commodity market is shallower than the MM locus, in

$(\rho_o\ ,\ r_D)$ space.

As indicated, the $(\rho_o\ ,\ r_D)$ plane is divided into four quadrants. Starting from the existing regulatory structure of point A the monetary authority can move in any direction. If it believes that stochastic shocks arise primarily in the currency or base money market the effect of these disturbances on the price level can be mitigated, compared to point A, by moving into quadrants I or II. However, the effect of disturbances in the real sector are increased in quadrant I, and decreased in II and III only. Therefore, the movement of the instrument ρ_o and r_D to the second quadrant decreases both real and monetary disturbances. If, on the other hand, financial disturbances arise primarily from liquid asset shifts then the direction of movement of σ_A would favor quadrant III over quadrant II.

It should be noted that one cannot say that all points in a particular quadrant dominate all points in another. For instance, if monetary disturbances overwhelm all other sources of variance, the true optimum may be in quadrant I where the effect of monetary disturbances may be greatly mitigated at the cost of a slight worsening of the effect of real disturbances. However, quadrant II does represent a conservative policy posture area if the Federal Reserve perceives both base money and real disturbances to be important but has limited knowledge as to the relative weights.

The forgoing analysis also reflects upon the debate over the appropriate way to induce or at least retain membership in the Federal Reserve System. Two proposals have been suggested. One would reduce the reserve ratio of members directly, while the second, espoused by the Federal Reserve, would indirectly increase it by paying interest on reserves and requiring broader membership. The first of these proposals would exacerbate monetary disturbances, while reducing real shock effects, as it would move the economy into quadrant III. On the other hand, the other would have exactly the opposite effect, by moving the system into quadrant I. If the reduction in the reserve requirement is coupled with interest on demand deposits, the proposal to reduce ρ_0 has the potential of moving into quadrant II, while the Reserve Board proposal keeps the system in I. Therefore, if one views the real sector as a major source of disturbances, proposals reducing reserve levels dominate those that would increase reserves for the purpose of economic stabilization.

4. SUMMARY AND CONCLUSIONS

This paper analyzed the impact of various regulatory changes in the banking area on the stochastic behavior of prices in an macroeconomic framework. It indicated that, on the financial side, regulations such as an increase in required reserve or interest on demand deposits reduce the impact of base money on the disturbances price level, while increasing the response of the price level to liquid asset shocks.

The study also investigated the impact of such regulation on the system's response of real or commodity market shifts. Here it was found that increases in required reserves and interest paid on demand deposits generally increased the fluctuations of the price level caused by shocks to the real sector. It was concluded that unless shocks to the liquid asset market predominate, selective lowering of reserve requirements and raising of deposit rates would be beneficial for economic stabilization.

APPENDIX

I The basic structure of the model indicated in equations (9) and (10) is :

$$(A.1)\quad \begin{bmatrix} \frac{\partial H_h^d}{\partial r_B} + \frac{\partial \rho}{\partial r_B} D_h^d + \rho \frac{\partial D_h^d}{\partial r_B} - \left[\frac{\partial H_h^d}{\partial W} + \rho \frac{\partial D_h^d}{\partial W}\right] \frac{H}{P} + \frac{H}{P} \\ \frac{\partial H_h^d}{\partial r_B} + \frac{\partial D_h^d}{\partial r_B} + \frac{\partial B_h^d}{\partial r_B} - \frac{\partial B_F^S}{\partial r_B} - \left[\frac{\partial H_h^d}{\partial W} + \frac{\partial D_h^d}{\partial W} + \frac{\partial B_h^d}{\partial W}\right] \frac{H}{P} + \frac{H}{P} \end{bmatrix} \begin{bmatrix} r_B \\ \log P \end{bmatrix} =$$

$$\begin{bmatrix} H_B & H_P \\ A_B & A_P \end{bmatrix} \begin{bmatrix} r_B \\ \log P \end{bmatrix}$$

II The general form of the effect of exogenous structural shifts on the variance of log p is :

$$(4.2)\quad \frac{\partial \operatorname{var}(\tilde{p})}{\partial x_0} = \frac{2\left[A_B \frac{\partial H_B}{\partial x_0} - H_B \frac{\partial A_B}{\partial x_0}\right]\left[\sigma_H^2 A_B A_p + \sigma_A^2 H_p H_B - \sigma_{AH}(A_B H_p + H_B A_p)\right]}{(H_p A_B - H_B A_p)^3}$$

$$- \frac{2 \operatorname{var}(\tilde{p}) \left[A_B \frac{\partial H_p}{\partial x_0} - H_B \frac{\partial A_p}{\partial x_0}\right]}{(H_p A_B - H_B A_p)}$$

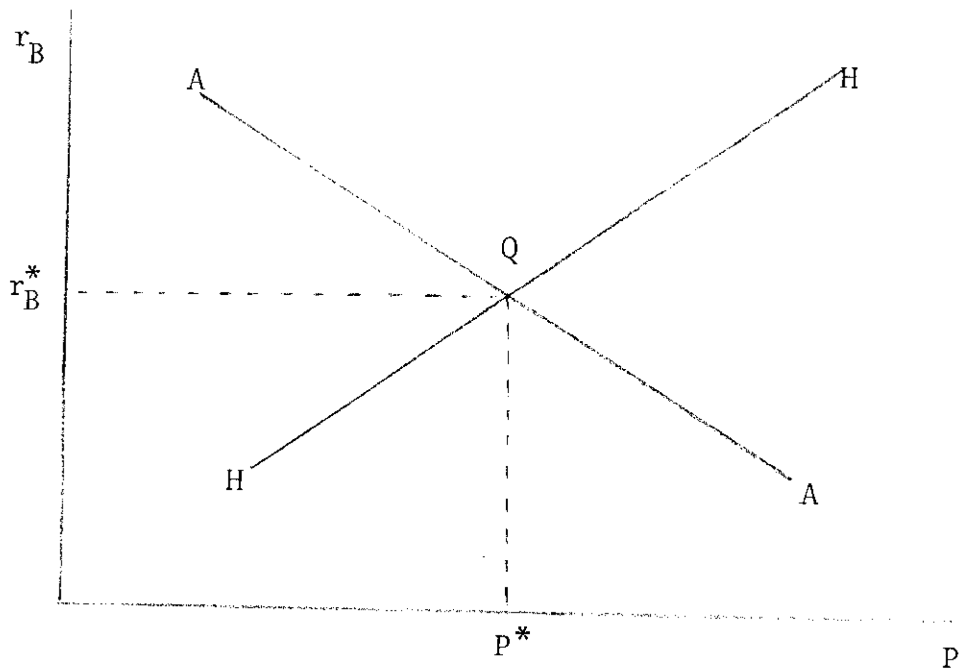
Equations (16) and 20 are special cases of this general form.

III The result of an increase in r_D on r_B, from I above is :

$$(A.3)\quad \frac{dr_B}{dr_D} = \frac{H_D A_p - H_p A_D}{H_p A_B - A_p H_B} < 0 .$$

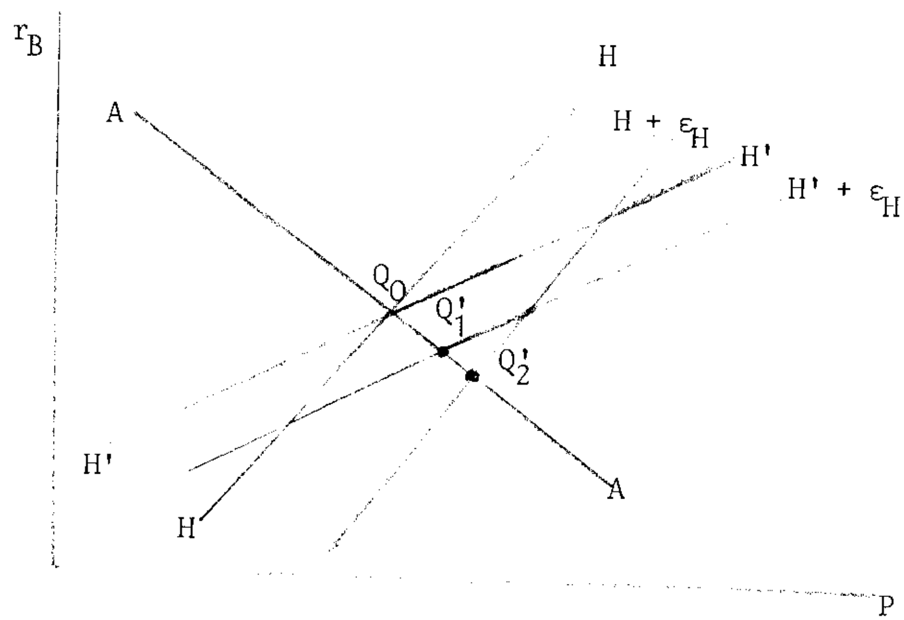
A sufficient, but not necessary, condition for this to hold is $|H_D| < |A_D|$.

Figure 1



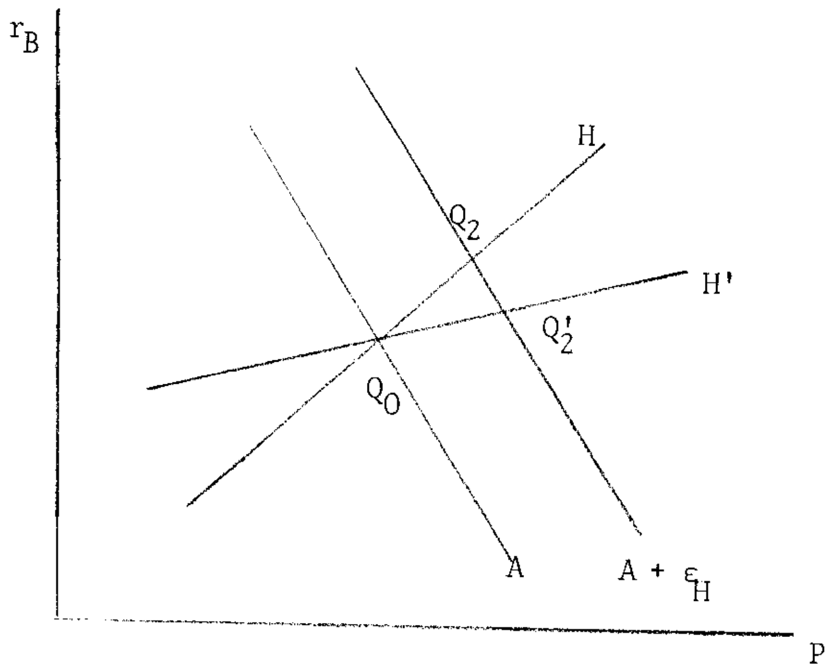
The equilibrium solution for the deterministic model.

Figure 2



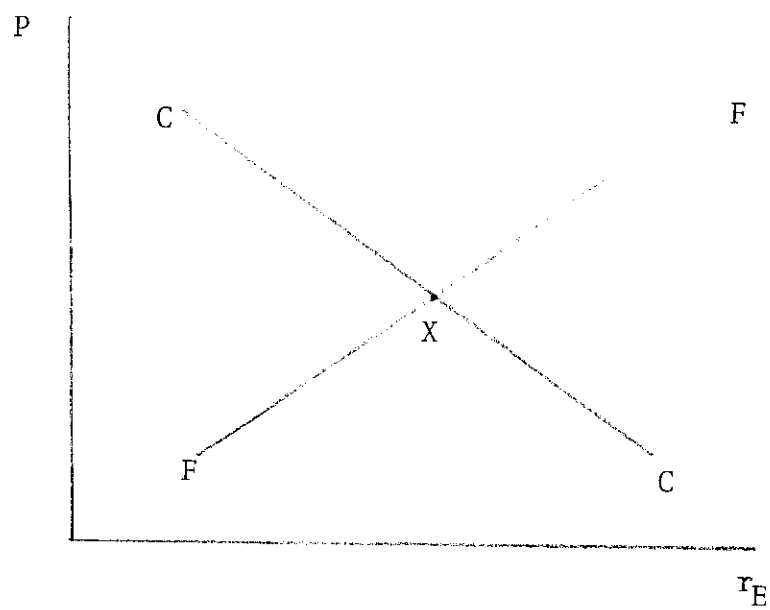
Graphical exposition of disturbance in the high powered money market under two financial structures.

Figure 3



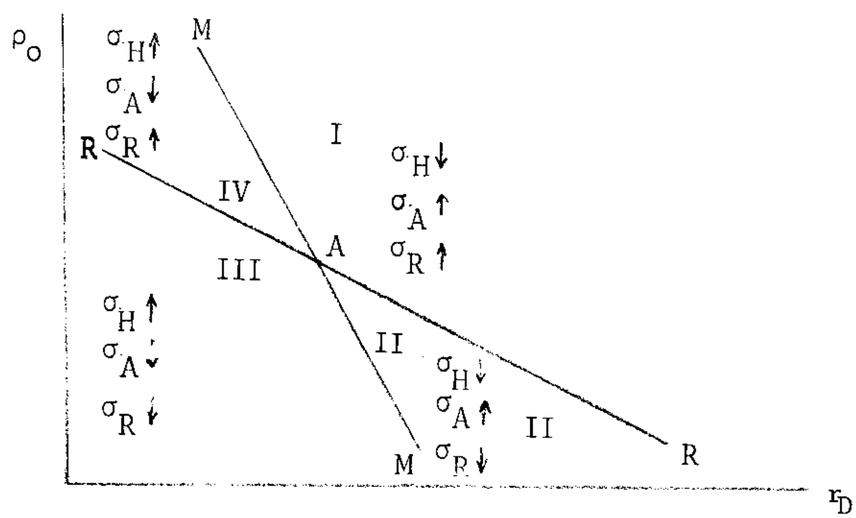
Graphical exposition of disturbance of the demand for liquid assets under two different financial structures.

Figure 4



General equilibrium solution of the model.

Figure 5



The Effect of Regulatory Change on Overall Price Variance

σ_H is the variance due to monetary disturbances

σ_A is the variance due to liquid asset disturbances

σ_R is the variance due to real or commodity market disturbances.

FOOTNOTES

1. The most recent proposals are outlined in the Open Letter from Federal Reserve Chairman William Miller to Henry Reuss, Chairman of the House Banking Committee dated, June 26, 1978. Other discussion of interest on reserves can be found in the study by Ira Kaminow (1975) "Why Not Pay Interest on Member Bank Reserves?" Proposals and analysis of interest on deposits are detailed in the Board of Governors study (1977) "The Impact of the Payment of Interest on Demand Deposits," and R. Alton Gilbert (1977), "Effects on Interest on Demand Deposits: Implications of Compensating Balances."

2. For exact signification of these conditions see Brainard and Tobin (1963) or, more recently, Santomero and Watson (1977).

3. The analysis below evaluates capital value at r_E equal to the marginal product of capital, as Tobin (1969), see footnote 6 below. Accordingly P represents the price of money in terms of current production of either commodities or capital.

4. ρ being a negative function of r_B can be interpreted as either the reserve function of an individual bank or the entire system where the number of banks under high reserve requirements are negatively related to the bond rate.

5. The analysis still holds if r_D is competitively set as long as there are constant returns in the banking sector. See Barro and Santomero (1972), Becker (1975) and Klein (1974) for a discussion of interest on demand deposits.

6. This is consistent with evaluating the system at Tobin's "q" equal to one. As a full employment model, this appears appropriate.

7. In Section 3 below the implications of shifts in r_E are explicitly considered.

8. See, for example, Frost (1977), Burger, Kalish and Babb (1971), and Bomhoff (1977).

9. The text deals with additive disturbances only. However, it should be

13. The effect of the covariance between the shocks depends upon the sign of $(A_B H_p + H_B A_p)$. If the absolute value of the slope of HH is greater than that of the AA locus, then $(A_B H_p + H_B A_p)$ is positive. The effect of a positive covariance between the disturbances is, in this case, to increase the anticipated variance of the price level associated with the structural change under consideration.

14. There will, in all probability, be an change in membership when ρ shifts, as considered in the previous section. However, it is highly unlikely that a change in ρ would cause a sufficient number of members changes to result in an reversal of the movement in ρ for the entire industry.

15. For the present framework it is required that the increase in r_D is insufficient to free the market for demand deposits from the government ceiling regulation. The model in the text assumes that the r_D constraint is binding in the deposit market throughout the experiment. If, however, the market became free from constraint as r_D increased, the sign but not the magnitude of the effect would still be the same.

16. See the Appendix for the exact condition.

17. For consistency with sections 1 and 2, the present analysis will use the log of price, p, with no loss of generality to the results below.

18. The choice of fiscal policy over monetary policy is for computational ease. Attempts to stabilize the price level using monetary instruments will result in complicating all former equations which involve a constant level of high powered money.

19. The specification of equations (26) and (27) below ignores the second order effects of the change in ρ on r_B and continues to assume linearity.

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