COWLES FOUNDATION FOR RESEARCH IN ECONOMICS

AT YALE UNIVERSITY

Box 2125, Yale Station
New Haven, Connecticut 06520

COWLES FOUNDATION DISCUSSION PAPER NO. 535

Note: Cowles Foundation Discussion Papers are preliminary materials circulated to stimulate discussion and critical comment. Requests for single copies of a Paper will be filled by the Cowles Foundation within the limits of the supply. References in publications to Discussion Papers (other than mere acknowledgment by a writer that he has access to such unpublished material) should be cleared with the author to protect the tentative character of these papers.

DISEQUILIBRIUM MODELS OF FINANCIAL INSTITUTIONS

Gary Smith and William Brainard

DISEQUILIBRIUM MODELS OF FINANCIAL INSTITUTIONS*

by

Gary Smith and William Brainard

I. INTRODUCTION

The purpose of this paper is two-fold; to specify a consistent general disequilibrium model of financial markets which can be estimated and to estimate that portion of the model relating to savings and loan associations. Disequilibrium macro models have been a center of discussion in recent years. Analysis of these models has focused on theoretical issues--exploration of rational consumer and firm behavior in a world of market disequilibria and investigation of the possibility of quantity equilibria at "disequilibrium" prices. To our knowledge, none of these general models have concerned themselves with the problems of empirical estimation. Concurrently, there has been a substantial amount of empirical work concerned with estimation of disequilibrium, or credit rationing, in particular financial markets. This work has been motivated by a common belief that in mortgage, consumer and possibly even business loan markets rationing is not an infrequent occurrence. These studies have taken a partial equilibrium or single market view of the problem. Typically, the implications of rationing in one market for other asset demands and markets are ignored. Even if this approach were satisfactory for studying an isolated market, it creates problems of consistency when

---

*The research described in this paper was undertaken by a grant from the National Science Foundation.

the results of these studies are embedded in larger models of financial markets. In Sections II, III, and IV of this paper, we discuss the consistent specification and estimation of a disequilibrium model of financial markets and of the behavior of the economic agents who meet in them. The emphasis in this discussion is on the implied restrictions on coefficients which should be enforced in estimation. Although some completely specified models of financial markets, incorporating disequilibrium in some markets, have been constructed [2], with the exception of Jaffee [8] none have focused on these econometric issues. A related, and complementary, approach is being followed by Ray Fair [4].

Recognition of the possibility of rationing in financial markets, with the resulting need to distinguish econometrically between notional and effective demands, places one more burden on an already over-worked data base. Elsewhere [12] we have argued that a sensible alternative to the common practice of simplification of structure and deletion of variables in this situation is the explicit use of *a priori* information. In Section V, we report the result of following this alternative. A model of Savings and Loan Associations previously estimated under the assumption that these institutions are always on their notional (short run) demand and supply equations, is respecified so as to incorporate rationing in the mortgage market. Prior means and a variance covariance matrix of parameters are specified for both the demand and rationing equations. A Theil-Goldberger mixed estimation technique is then used to combine this *a priori* information with the data. The performance of these equations in predicting out of sample is then compared with performance of a naive model, the equilibrium model, and equations estimated by ordinary least squares.

II. A Two-Sector, Two-Good Example

The notion disequilibria is not unambiguous. *Ex post* markets always clear. One reasonable definition of disequilibrium is a situation in which at well specified terms some traders are satisfied while others are turned away. In practice, it is difficult to distinguish this situation from one in which unobserved terms are adjusted so that all traders are satisfied. Some mechanisms may approximate prices, for example mortgage points or a well functioning system of bribery. Others are more arbitrary and likely to be less efficient, such as gasoline queues or what are effectively lotteries. Ideally estimation of supply and demand relations would include measurement of such variables. In our following discussion, nonprice factors are omitted and an essentially arbitrary rule is assumed to reconcile demand and supply. Our specification is also consistent with the view that variations in some unobserved variables do the allocation. With this interpretation, apparent discrepancies between notional and effective demands simply reflect changes in the unobserved variables.

Some of the problems of specification of disequilibrium models are most clearly illustrated in a simple model in which there are only two sectors and two traded goods (which can be interpreted as two commodities, or one commodity and money). Let the sectors (a and b) have notional excess demands (expenditures) for the two goods (1 and 2) which depend upon a variety of factors including P_1 ,[1] the price of the first good in terms of the second:

---

[1] In the remainder of the paper, we will reserve the use of the word excess to refer to market, rather than individual (excess) demand.

$$N_1^a = N_1^a(P_1, \ldots) \qquad N_1^b = N_1^b(P_1, \ldots)$$

$$N_2^a = N_2^a(P_1, \ldots) \qquad N_2^b = N_2^b(P_1, \ldots)$$

where

$$\frac{\partial N_1^a}{\partial P_1}, \frac{\partial N_1^b}{\partial P_1} < 0 \qquad \frac{\partial N_2^a}{\partial P_1}, \frac{\partial N_2^b}{\partial P_1} > 0 \ .$$

If the demands are consistent with the budget constraints

$$N_1^a + N_2^a = N_1^b + N_2^b = 0$$

for all values of P_1 , then

$$\frac{\partial N_1^a}{\partial P_1} + \frac{\partial N_2^a}{\partial P_1} = \frac{\partial N_1^b}{\partial P_1} + \frac{\partial N_2^b}{\partial P_1} = 0 \ .$$

Graphically,

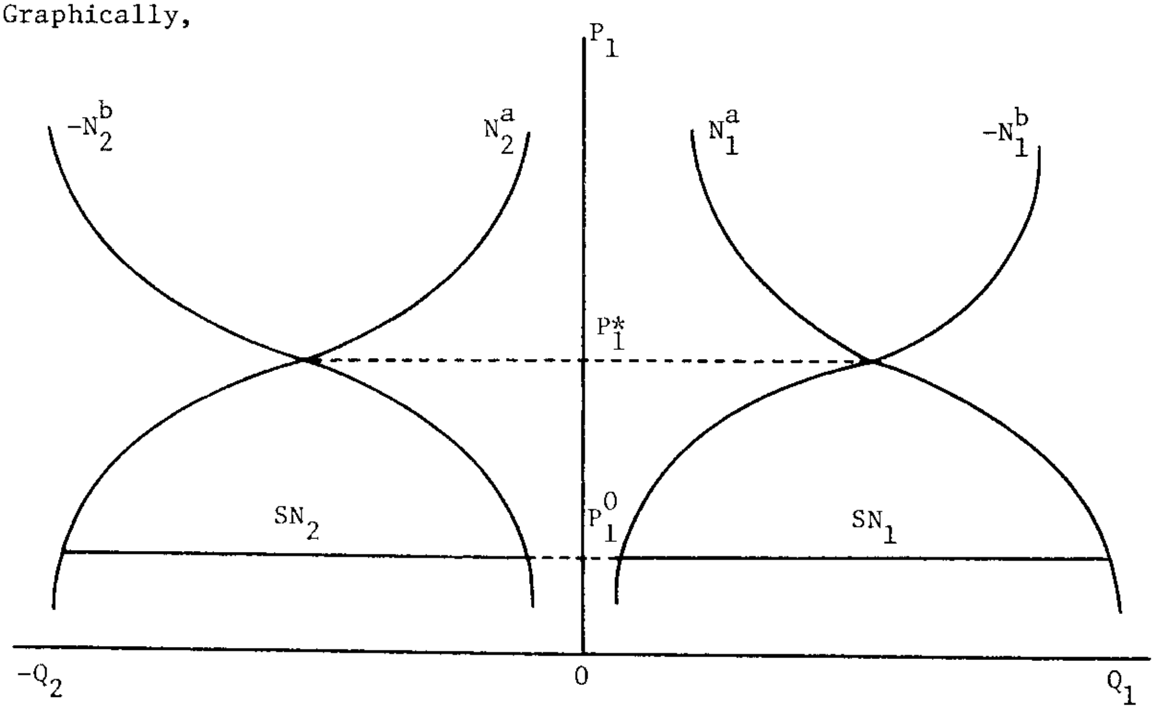


FIGURE 1

The excess notional demands in the two markets are given by

$$SN_1 = N_1^a + N_1^b$$

$$SN_2 = N_2^a + N_2^b \ .$$

Society's budget constraint

$$(N_1^a + N_2^a) + (N_1^b + N_2^b) = 0$$

insures that the excess demands sum to zero

$$SN_1 + SN_2 = 0 \ .$$

Thus, if one market clears, the sectoral budget constraints insures that the other market will also clear. It consequently takes only one variable, such as P_1, to clear both markets, and it is misleading to identify governments of such an equilibrating variable with a particular excess demand. At P_1^0 in Figure 1, for example, both sectors would want to trade some of good 2 for good 1. If P_1 increases, we could as reasonably say that it was the unattractiveness of 2 as the attractiveness of 1 which was responsible.

Now consider the case where P_1 is at a nonmarket clearing level such as P_1^0 : a wants to buy more of 1 than b wants to sell and sell more of 2 than b wants to buy. What will be the actual quantities transacted? It seems sensible to rule out transactions that neither sector wants to make--i.e., quantities outside the gap between demand and supply. Subject to this restriction, we will allow both sectors to be off their notional demand curves.

Assume, for example, that the first market is rationed at P_1^0 and that sector a absorbs a fraction α and sector b a fraction $1-\alpha$ of the excess demand in that market. Given its "ration," each sector must adjust its demand for the second good in accordance with its budget constraint. Using A for actual transactions and E for effective demands,

$$A_1^a = N_1^a - \alpha SN_1 \qquad A_1^b = N_1^b - (1-\alpha)SN_1$$

$$E_2^a = N_2^a + \alpha SN_1 \qquad E_2^b = N_2^b + (1-\alpha)SN_1 \ .$$

The budget constraints insure, in this two good example, that the effective demands reflecting "spillovers," exactly clear the second market

$$\begin{aligned} E_2^a + E_2^b &= N_2^a + N_2^b + SN_1 \\ &= N_2^a + N_2^b - SN_2 = 0 \end{aligned}$$

In Figure 2, the dotted line giving the effective demands assumes that at any disequilibrium price the fraction α absorbed by sector a is the same. It might be more realistic to have α vary so that actual transactions stay closer to the minimum of supply and demand

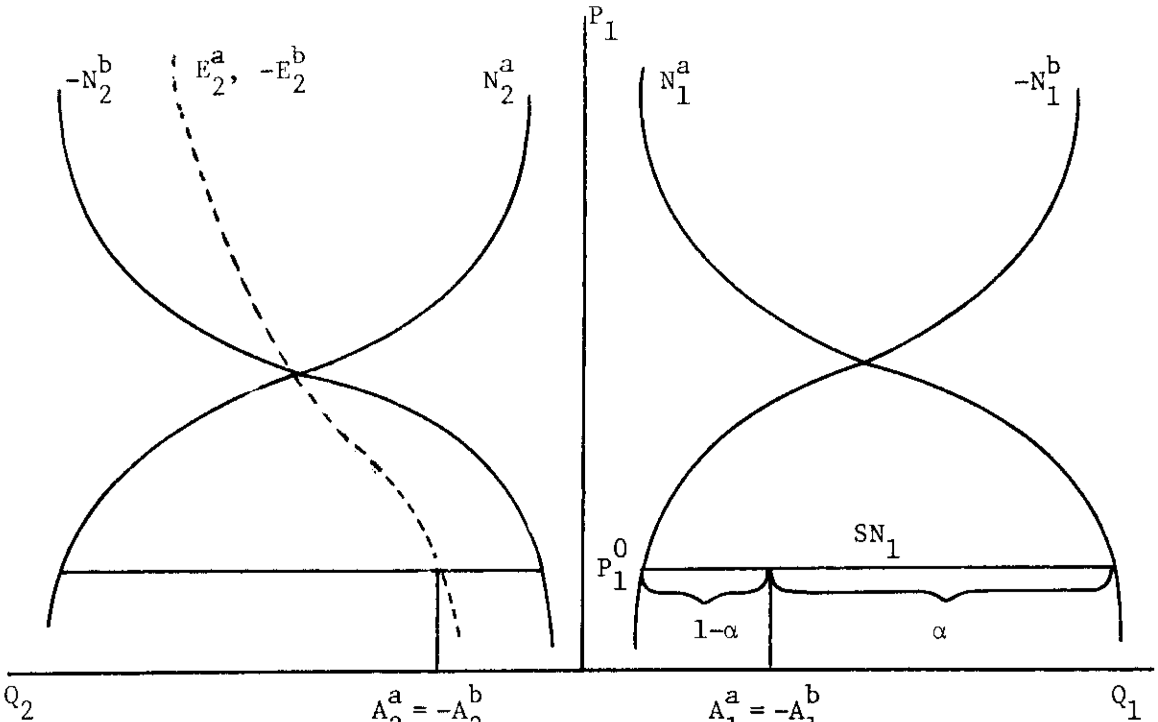


FIGURE 2

Although this example is too simple to provide individuals with a choice in the way they modify their notional demands in response to rationing in a particular market, it does make clear what is required to completely specify a disequilibrium model. A disequilibrium model with n commodities and markets requires specification of the following:

(1) Notional demands for the agents.

(2) Which k markets are rationed and which $n-k$ markets are cleared by freely moving variables (such as prices).

(3) Which sectors absorb the market disequilibria in the k rationed markets.

(4) How these absorptions are financed, i.e., how effective demands for other commodities are influenced by the quantity restrictions from rationed markets.

(5) Which $n-k-1$ variables adjust to clear the $n-k$ equilibrium markets, and how any remaining explanatory variables are determined.

III. Two Sectors, Two Rationed Markets, and Two Competitive Markets

In the previous section, we discussed a disequilibrium model with two assets or commodities and two sectors. This model was limited in several respects. Spillover demands were completely determined by budget constraints. A disequilibrium in one market necessarily implied an equal and offsetting disequilibrium in the other market. Consequently a rationing mechanism which "cleared" one disequilibrium market automatically cleared the other, and there was no room for a market cleared by complete price or rate adjustment. In addition, there was no distinction between effective and actual or realized demands. In this section the simplest model which illustrates the complexities which arise in a general model **is** investigated. In the model two markets are rationed, and two markets are cleared by the adjustment of prices (a single price ratio). A disequilibrium arising in one rationed market may spill over to either a rationed or an unrationed market. Since there are two unrationed markets, clearing the rationed markets does not necessarily clear the nonrationed markets.

Extending the previous notation, with the first two markets rationing excess effective demands, SE_i ,

$$A_1^a = E_1^a + \alpha_{11}SE_1 = N_1^a + \alpha_{11}SE_1 + \alpha_{21}SE_2$$

$$A_2^a = E_2^a + \alpha_{22}SE_2 = N_2^a + \alpha_{12}SE_1 + \alpha_{22}SE_2$$

$$A_3^a = E_3^a \qquad = N_3^a + \alpha_{13}SE_1 + \alpha_{23}SE_2$$

$$A_4^a = E_4^a \qquad = N_4^a + \alpha_{14}SE_1 + \alpha_{21}SE_2$$

$$A_1^b = E_1^b + \beta_{11}SE_1 = N_1^b + \beta_{11}SE_1 + \beta_{21}SE_2$$

$$A_2^b = E_2^b + \beta_{22}SE_2 = N_2^b + \beta_{12}SE_1 + \beta_{22}SE_2$$

$$A_3^b = E_3^b \qquad = N_3^b + \beta_{13}SE_1 + \beta_{23}SE_2$$

$$A_4^b = E_4^b \qquad = N_4^b + \beta_{14}SE_1 + \beta_{24}SE_2$$

where from the budget constraint

$$\sum_{i=1}^{4} N_i^a = \sum_{i=1}^{4} N_i^b = 0$$

and

$$SE_i = E_i^a + E_i^b \, , \quad i = 1, 2 \, .$$

It would be possible to specify the effective demands and realized transactions as general functions of prices and market disequilibria. We restrict ourselves to the case where only two markets are rationed and assume a linear structure to the notional, effective, and actual demands. Each agent's realized transaction differ from effective demands by a fixed share of the market excess effective demand. For example, agent a is rationed by an amount $\alpha_{11}SE_1$ in market 1. Effective demands in both rationed and unrationed markets reflect such rationing. For example, agent a's effective demand for the first good is altered by $a_{21}SE_1$.

The sectoral budget constraints on the α_{ij} and β_{ij} reflect the fact that an individual must make financial accommodation of whatever market frustrations he encounters,

$$\sum_{j=1}^{4} \alpha_{ij} = \sum_{j=1}^{4} \beta_{ij} = 0 \ .$$

Since markets must actually "clear," ex post, a market disequilibria is always absorbed by someone. In our specification, rationing clears the first two markets:

$$0 = A_1^a + A_1^b = (E_1^a + E_1^b)(1 + \alpha_{11} + \beta_{11})$$

$$0 = A_2^a + A_2^b = (E_2^a + E_2^b)(1 + \alpha_{22} + \beta_{22}) \ .$$

This will be so if and only if

$$\alpha_{11} + \beta_{11} = \alpha_{22} + \beta_{22} = -1 \ .$$

The surplus effective demands are related to the surplus notional demands by the following equations:

$$SE_1 = SN_1 + (\alpha_{21} + \beta_{21})SE_2$$

$$SE_2 = SN_2 + (\alpha_{12} + \beta_{12})SE_1 \ .$$

Hence, the actual transactions given above can be rewritten as follows:[1]

---

[1]Unless $(\alpha_{21} + \beta_{21})(\alpha_{12} + \beta_{12}) = 1$. In the most plausible situation where α_{11} , α_{11} , β_{22} , β_{22} are nonpositive and the remaining coefficients nonnegative, the exception requires that there be no spillovers into the competitive markets.

$$A_i^a = N_i^a + \theta_{1i} SN_1 + \theta_{2i} SN_2$$

$$A_i^b = N_i^b + \phi_{1i} SN_1 + \phi_{2i} SN_2$$

where $\quad SN_i = N_i^a + N_i^b$.

When written in this form, our rationing and sectoral adding up constraints imply:

$$\theta_{11} + \phi_{11} = \theta_{22} + \phi_{22} = -1$$

$$\theta_{12} + \phi_{12} = \theta_{15} + \phi_{15} = 0$$

$$\sum_{j=1}^{4} \theta_{ij} = \sum_{j=1}^{4} \phi_{ij} = 0 \ .$$

In whichever form the system is written, the effective demands in unrationed markets are not independent. In the first form, for example, we have:

$$SE_3 + SE_4 = E_3^a + E_3^b + E_4^a + E_4^b$$
$$= (-A_1^a - A_2^a) + (-A_1^a - A_2^b) = 0$$

so that it only takes one freely moving variable to equilibrate the two nonrationed markets. Thus, to complete this model we need to specify what this equilibrating variable is and how the other arguments of the demand equations are determined. In general Walras' law implies that effective demand equilibrium in all but one nonrationed market insures equilibrium in that final market. Since realized demands differ from effective demands in rationed markets, the summation of excess effective demands across all markets is not zero.

A theoretical application of this framework is provided by Smith's [11] analysis of an IS-LM model with disequilibrium in the labor and commodity markets and a freely moving interest rate which clears financial markets. In this model there are spillovers within the "real" markets and from real markets to financial markets. In the present paper we are concerned with credit rationing in financial markets, which may have significant spillover effects on employment and production.

The remainder of this paper is concerned with the application of this approach to the estimation of Savings and Loan Association asset demands when it is assumed that the mortgage market is not always in equilibrium. Restricting ourselves to S&L's will enable us to investigate the importance of spillover effects within the sector, but obviously precludes study of the allocation of any market disequilibrium among other sectors. It should be noted that other sectors may well be rationed even if savings and loans are always on their notional demand curves.

IV. Specification and Estimation of Effective Demands for Savings and Loan Associations

The specification that we will use for the notional demands is identical to that used in our earlier paper which assumed S&L's are always in equilibrium. This specification does allow short run portfolio adjustment towards long run asset demands, but S&L's were assumed to always realize their short run notional demands. The long run asset demands are of the form:

$$a_i^*/w^e = \alpha_{i0} + \sum_{j=1}^{n} \alpha_{ij}/r_i \ ,$$

where a_i^* is the long run desired holding of the i^{th} asset, r_j is the yield on the j^{th} asset and w^e is anticipated disposable funds, chiefly deposits and Federal Home Loan Bank Board borrowings. The short run adjustment model is given by

$$\Delta a_i = \sum_{j=1}^{n} \varepsilon_{ij}(a_j^* - a_j(-1)) + f_{ij}(S - S^e) + g_{ij}\Delta FHLB$$

where $\Delta FHLB$ is the change in FHLB borrowing and $S - S^e$ is the unanticipated change in other disposable funds.

Recognition of the possibility of market disequilibria requires the specification of effective as well as notional demands. There is some choice in the specification of how institutions adjust to being rationed. If the "ration" is not responsive to their actions, they could treat the ration simply as a redefinition of disposable funds (i.e., they could regard mortgages as predetermined in their portfolio decision). The allocation of this portion of disposable funds amoung other assets could be the same for any other source of funds. The market rationing equations we have specified, however, probably only make sense if rationing is not expected as a permanent condition. If this is the case, then it seems more sensible to have rationing in one market shift the short-run demand equations for other assets. We have followed this procedure, in that the effective demand equations are simply short-run equations shifted in the additive way described in Sections II and III above.

In the absence of direct information, proxies must be used to represent excess notional or excess effective demands in estimation of the model. Natural candidates for proxies are variables such as prices which are thought to respond to disequilibrium pressures. There are, of course, markets where prices are administratively or legally set with little or haphazard regard for market pressures and for which the use of price changes would be inappropriate. Suppose, however (continuing with our 2-sector, 4-market example), that "prices" can be found for the rationed markets which respond to excess demand, possibly with error:

$$\Delta P_i = \lambda_i SE_i + V_i \ .$$

In principle, there could be a quite complex relationship between all market disequilibria and all prices. In practice, however, we have used only the own rate as the proxy for a particular excess demand. In particular, introducing disturbance terms in the demand equations,

$$A_i^a = N_i^a + \frac{\alpha_{1i}}{\lambda_1}\Delta P_1 + \frac{\beta_{2i}}{\lambda_2}\Delta P_2 + \left[\varepsilon_i^a - \frac{\alpha_{1i}}{\lambda_1}V_1 - \frac{\alpha_{2i}}{\lambda_2}V_2\right]$$

$$A_i^b = N_i^b + \frac{\alpha_{1i}}{\lambda_1}\Delta P_1 + \frac{\beta_{2i}}{\lambda_2}\Delta P_2 + \left[\varepsilon_i^b - \frac{\beta_{1i}}{\lambda_1}V_1 - \frac{\beta_{2i}}{\lambda_2}V_2\right] .$$

The use of such endogenous variables as proxies creates simultaneity problems in the estimation of the model. The measurement errors in the ΔP_i will bias their coefficients towards zero, while the positive correlation of ΔP_i and ε_i (through SE) will bias the coefficients away from zero. An instrumental variables procedure was consequently used for some of the estimates. The endogenity of ΔP_i also creates problems about the division of the sample period into rationed and unrationed sub-periods, and in the specification of priors, which we will return to later in this section.

Single equation estimation techniques will automatically enforce the balance sheet restrictions since the RHS variables do not vary across equations. These estimates are not efficient since the explanatory variables presumably vary across sectors and since the disequilibrium proxies create correlations in the errors across sectors.

Enforcement of the rationing constraints

$$\alpha_{11} + \beta_{11} = \alpha_{22} + \beta_{22} = -1$$

yields unique estimates of $\hat{\lambda}_1$ and $\hat{\lambda}_2$

$$\hat{\lambda}_1 = \frac{-1}{\left(\frac{\hat{\alpha}_{11}}{\lambda_1}\right) + \left(\frac{\hat{\beta}_{11}}{\lambda_1}\right)} \qquad \hat{\lambda}_2 = \frac{-1}{\left(\frac{\hat{\alpha}_{22}}{\lambda_2}\right) + \left(\frac{\hat{\beta}_{22}}{\lambda_2}\right)}$$

which can then be used to computed unique estimates of all the α_i and β_i .

A simple extension of the analysis is to permit different rationing rules for periods of excess demand and excess supply, distinguished, for example, by whether prices are rising or falling, or to allow different rationing rules depending upon whether markets are "near" or "far" from equilibrium.

$$\alpha_{ij} = \alpha^+_{ij}D^+_i + \alpha^-_{ij}D^-_i$$

$$\beta_{ij} = \beta^+_{ij}D^+_i + \beta^-_{ij}D^-_i$$

where

$$D^+_i = \begin{matrix}0\\1\end{matrix}\ , \quad D^-_i = \begin{matrix}0\\1\end{matrix} \quad \text{as, for example,} \quad \Delta P_i \begin{matrix}>\\<\end{matrix} 0 \ .$$

The actual transactions (omitting the disturbances) are now

$$A^1_i = N^1_i + \frac{\alpha^+_{1i}}{\lambda_1}D^+_1\Delta P_1 + \frac{\alpha^-_{1i}}{\lambda_1}D^-_1\Delta P_1 + \frac{\alpha^+_{2i}}{\lambda_2}D^+_2\Delta P_2 + \frac{\alpha^-_{2i}}{\lambda_2}D^-_2\Delta P_2$$

$$A^2_i = N^2_i + \frac{\beta^+_{1i}}{\lambda_1}D^+_1\Delta P_1 + \frac{\beta^-_{1i}}{\lambda_1}D^-_1\Delta P_1 + \frac{\beta^+_{2i}}{\lambda_2}D^+_2\Delta P_2 + \frac{\beta^-_{2i}}{\lambda_2}D^-_2\Delta P_2 \ .$$

with the adding up restrictions across sectors:

$$\alpha^+_{11} + \beta^+_{11} = \alpha^-_{11} + \beta^-_{11} = \alpha^+_{22} + \beta^+_{22} + \alpha^-_{22} + \beta^-_{22} = -1$$

In the empirical work reported in Section II, we distinguished between periods of mortgage market excess demand, excess supply, and "near equilibrium."

The α's and β's could differ in different conditions of market disequilibrium in a variety of ways. One plausible though extreme assumption is that sectors may be frustrated in attempts to make purchases or sales, but that they can never be forced to make unwanted transactions. By this reasoning, the actual quantities transacted will equal the lesser (in absolute value) of effective supply of demand. Demanders will fully absorb the market disequilibrium in an excess demand environment, while supplies will fully absorb any excess supply. Fair-Jaffee [5] emphasize this approach and most subsequent work has been concerned with the maximum likelihood identification of excess demand and supply regimes and has made this assumption. Most of this work is concerned only with the two aggregate sides of a market. In a multiagent environment, the specification of spillover demands generally requires knowledge of how the long side of the market is rationed.

While this "minimum quantity" scheme has some appeal, it is sometimes argued that financial institutions make more credit available during crunches than can be explained by simple yield comparisons because they feel compelled to do so by loyalty to their customers, or concern about the future of their customer relations. Indeed, a "maximum quantity" model might be used to depict the willingness of firms to retain personnel who would otherwise be unemployed.

Our priors on the α's for the mortgage market are actually not far from the "minimum quantity" assumption. Our prior means were that Savings and Loan Associations and Mutual Savings Banks absorb .8 of an excess demand for mortgages, but only .08 of an excess supply. In the periods where the mortgage market is regarded as near equilibrium, they are assumed to absorb .4 of whatever disequilibrium exists. These rations were assumed to be split evenly between these two sectors. The differences between these fractions and 1 are absorbed by other financial institutions (banks and insurance companies) and borrowers.

If different rationing rules for periods of excess demand and supply are permitted, it would be possible to estimate the α's , β's and λ's for each type of period by using information for both sectors. However, if the speeds of adjustment, λ , are assumed to be the same in periods of excess demand and supply then the system would be overidentified. The importance of this overidentification cannot be assessed unless all sectors are estimated. The difficulty could be handled by using a system estimator in which the estimates are constrained to agree. We however thought it plausible that the speeds of adjustment differ in periods of excess demand and supply.

Allowing the speeds of adjustment to differ makes explicit an ambiguity which may have already worried the reader. Should one interpret a large rate change as evidence of a large disequilibrium, or as evidence that a potential disequilibrium has been eliminated by rapid rate adjustment? It could be argued that rapidly moving rates are associated with periods of market clearing and sticky rates with persistent disequilibrium. An extreme example is the case where a rate is against a legal barrier. In addition to the simultaneity and measurement problems discussed above, this ambiguity makes it difficult to qualitatively identify periods of excess demand and supply.

In light of this difficulty, we attempted to use subjective non-rate information as the basis for partitioning the sample into periods of excess demand, excess supply and near equilibrium for mortgages. Specifically we made use of a characterization of mortgage market conditions (based upon information about a number of factors in addition to price changes) which the Economics and Research Department of the Mortgage Bankers Association of America was kind enough to provide us. This information is reproduced in Table II, and is referred to in our empirical work as the MBA classification of SE . We have used the convention of labelling as "excess demand" a situation in which there is an excess demand for mortgage notes and an excess supply of mortgage money. For the purpose of comparison, we also use changes in the mortgage rate as a criteria for classification. Quarters in which

$$-.05 \leq \Delta r_M \leq .10$$

were classified as market balance; quarters for which Δr_M was less (greater) than that range were classified as excess demand (supply). The results which use the change in interest rate to classify disequilibrium periods are labelled Δr . As Table II shows, there is only a rough correspondence between these two classification methods. One qualitative difference is that the Δr method gives a suspiciously erratic picture of a market swinging in and out of disequilibrium.

However, formal statistical tests show they are far from independent. Table III provides a contingency table comparison of the two classifications for the sample period 1952.III through 1974.IV used in this paper. The usual Pearson chi-squared statistic of 18.71 is highly significant.

The alternative likelihood ratio and Freeman-Tukey statistics are respectively 19.08 and 16.10. In each case, if the classifications were independent, the chances of accidentally observing such a high statistic is less than .005.

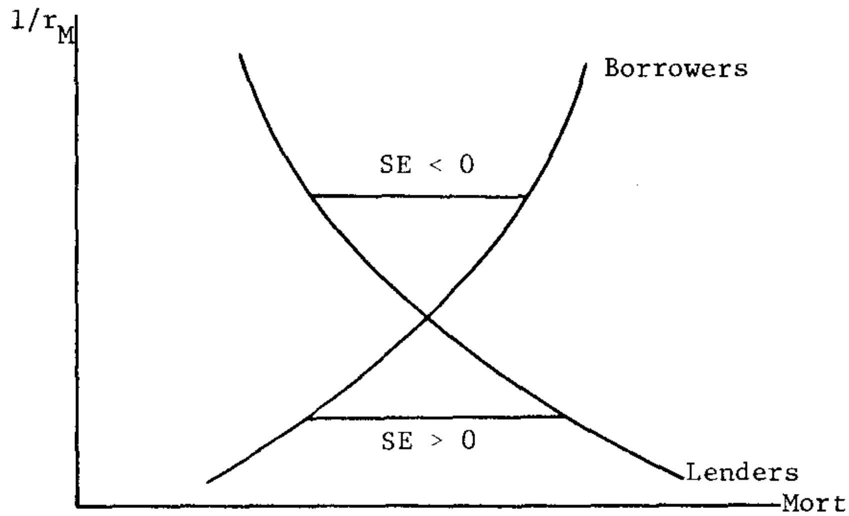
The MBA classification rationale makes frequent reference to the spread between mortgage and corporate bond rates. One could imagine the yields moving roughly together in the long run but diverging in the short run because of institutional stickiness in changing the mortgage rate. The third column of Table II displays the time path of the yield spread. It is apparent that the MBA classification is a complex judgmental procedure which bears no simple relationship to the yield spread.

If the minimum of supply and demand were assumed to prevail and there were no spillovers from other markets, mortgage note demand equations could simply be estimated using the periods here classified as equilibrium or excess supply. However, to use data from excess demand periods or to allow the possibility that more than the minimum of supply and demand is traded requires a quantitative measure of market disequilibrium.

One measure that we used was provided by explicitly assuming a mortgage rate adjustment based upon the amount of excess effective demand

$$\Delta\left(\frac{1}{r_M}\right) = \lambda SE \ .$$

As indicated above, we will allow the speed of rate adjustment to differ in different market conditions. Unfortunately, it is not obvious how these speeds vary. It might plausibly be argued, for example, that the responsiveness of rates will depend upon the pressures which impinge directly on the "price setter" or upon how much the "price setter" expects to benefit from a rate change. If borrowers absorb most of the disequilibrium when $SE < 0$ and lenders absorb most of it when $SE > 0$, then the direct



pressure argument would suggest that if lenders set rates, they will lower them faster than they raise them (since the discrepancy between desired and actual holdings is greater in the former case). On the other hand, the prospective benefits argument would suggest the opposite, since when $SE > 0$ more mortgages can be made at higher rates. We assumed means for $1/\lambda$ of 500 when $SE < 0$, 1000 when SE is near zero, and 2000 when $SE > 0$. These figures imply that, for a 5% mortgage rate, an excess demand of \$4 billion will lower the mortgage rate 5 basis points while a \$1 billion excess supply will raise it five basis points. Although (as revealed by the relatively large variances we associated with our prior means) we were not confident about our priors, we leaned toward the prospective benefits view by specifying an expectation that the speed of adjustment is twice as fast when $SE < 0$ as when $SE \simeq 0$, and four times as fast as when $SE > 0$.

Another inadequacy of the simple rate adjustment mechanism which we have assumed is that it neglects other explanatory variables which in principle seem likely to affect a rate setter's behavior. For example, anticipated changes in a market, either because of anticipated changes in other rates, or changes in disequilibria in other markets, may motivate rate adjustments. For example, an institution may cut its own rate in order to avoid a potential loss of customers (potential excess demand) because of a decline in other rates. Similarly, it seems likely that a controlled rate would be increased more rapidly when alternative sources of funds for customers are being rationed.

The assumed relationship between SE and $\Delta(1/r_M)$ would seem appropriate for the sample classification based upon the observed changes in the mortgage rate. For the MBA classification, this quantitative measure does not always agree with the qualitative label. For example, in 16 of the 28 periods labelled excess demand by the MBA, the quantitative measure $\Delta(1/r_M)$ is negative.

We consequently constructed two simple alternative excess demand proxies. One assumes a constant level of excess demand or supply in each period so classified by the MBA. The second assumes excess demand (supply) grows at a constant rate until the middle of each classified interval and then declines at a constant rate, giving a triangular pattern.

V. Estimation Results

As we have argued elsewhere a detailed structural model such as the one we are using to describe S&L behavior cannot be reliably estimated by time series data alone. We have used the Theil-Goldberger mixed estimation procedure to combine the time series data with explicit a priori information about the model's parameters. For the notional demands the prior means and covariances were taken to be identical with those in our previous equilibrium study. For comparative purposes, we also report least squares estimates of the model using only time series data. The only specification searches that we indulged in were concerned specifically with the qualitative and quantitative descriptions of mortgage market disequilibria which were discussed above.

Table IV contains the prior covariance matrix and Tables V-VIII display the various estimates. For comparative purposes each table also contains the estimates for the equilibrium model, labelled with an "e" superscript. In our previous papers, we emphasized the usefulness of a priori information in obtaining reliable parameter estimates. A great deal of attention was consequently paid out of sample forecasting tests. In the present paper almost all of the available data was used for estimation since our primary concern was the extent to which allowance for disequilibria would affect the parameter estimates. For completeness, however, Tables IX and X contain the in-sample and out-of-sample root mean squared errors (RMSE's).

In our earlier work, we also estimated asset demand equations for mutual savings banks as well as savings and loan associations. However, as we explained in the 1976 paper, there are two distinct regimes to mutual savings bank behavior. In the 1950's and early 1960's, they held many more long term bonds than desired but were reluctant to realize the capital losses that they had incurred. By the mid-1960's, their total portfolios had grown and enough of their bonds had matured for the portfolio adjustment model to become appropriate. We did not reestimate the mutual savings bank equations here because the scarcity of relevant data precluded our desired tests of the sensitivity of the estimates to mortgage market disequilibria.

Table V contains the estimated parameters under the presumption that savings and loans realize their notional demands except in excess demand situations. Following the MBA classification, 26 of the 90 quarters from 1953.III-1974.IV were omitted; with the Δr rule, 13 quarters were deleted. The least squares estimates, and particularly the adjustment parameters, were fairly sensitive to the choice of data period.

One interpretation of this result is that indeed rationing is important in explaining S&L portfolios, and that the previous estimates were contaminated by the inclusion of the "disequilibrium" observations. However it is also consistent with our finding in [13] that the least squares estimates were significantly altered by other minor changes in the data base. One indication that the latter interpretation is more likely to be correct is the fact that the "disequilibrium" parameters indicate an excess demand during only 6 of 26 periods classified as such in the case of MBA and 9 of 13 in the case of Δr, and never more than $5 billion.

The Δr mixed estimates are little affected by the exclusion of "excess demand" periods. There are some modest changes in the MBA estimates. One change is a reduction in the fractions of an unexpected increase in wealth allocated to long term bonds and mortgages and an increase in the amount put into short term bonds. These shifts put the mixed estimates closer to our priors than in the equilibrium case. There is also a decrease in the estimated fraction going into mortgages of an anticipated increase in funds, accompanied by an equal increase in desired holdings of mortgages. Forecasting errors were not calculated since the sample periods for the MBA and Δr classifications did not coincide with each other or with those used for the other estimates reported here. The mixed Δr estimates do suggest that the omitted disequilibrium periods were cases of excess demand (10/13) cases), whereas the MBA estimates indicate that they were typically excess supply (only 8/26 excess demand).

Table VI contains the estimated coefficients when $\Delta(1/r_M)$ is used as a proxy for the amount of excess effective demand. This time both the least squares and mixed estimates are little affected by the allowance for disequilibria. Again there is a small decrease in the mixed estimates of the fraction going into mortgages of either an unexpected growth in wealth or an anticipated increase accompanied by an increase in desired mortgage holdings. The mixed estimates of the short run interest elasticities are also reduced somewhat.

The "rationing" coefficients are of particular interest. Perhaps not too surprisingly, given the likely entanglement of disequilibrium and partial adjustment, OLS appears to have difficulties. The estimates for α/λ are of the wrong sign as often as not. The mixed estimates, on the other hand, seem quite well behaved. Relative to our priors, the absolute value of α/λ tends to be very low, indicating that either savings and loans do not absorb much of a disequilibrium in mortgage markets, or that the speed of mortgage rate adjustment is quite rapid. Given the small differences in the other coefficients from those of the equilibrium model, this would seem to suggest that the mortgage market adjusts more rapidly than we had expected. As expected in every case, the mixed estimates for $|\alpha/\lambda|$ are smallest for SE < 0 . Although the estimates of $|\alpha/\lambda|$ are generally low, they are unexpectedly largest for SE = 0 . This may be due to an unanticipated willingness of S&L's to absorb small disequilibria.

In Tables IX and X, we have reported the in-sample and out-of-sample root mean squared errors for forecasts 1, 2, 4, 6 and 8 quarters into the future. The tables give a comparison of the various estimates and of naive forecasts made by an eight-quarter autoregressive model, estimated over the same in-sample period. The inclusion of the rate proxy for mortgage market disequilibria had little effect on the within-sample forecasts, and somewhat worsened the out-of-sample forecasts. Here and throughout the paper the least squares estimates generally outforecast the mixed estimates. This may have been due to the short (two year) out-of-sample period used in this paper. The out-of-sample data is not far removed from the in-sample data, and there is for each model only one eight quarter ahead forecast. In our earlier papers, the mixed estimates forecast as well as or better than least squares over three and four year out-of-sample periods for savings and loans, and clearly better over eleven and fourteen year out-of-sample periods for mutual savings banks. It is apparent that the least squares estimates predict quite unlikely responses to many hypothetical changes in the explanatory variables. The longer out-of-sample periods were intended to expose the weakness of least squares forecasts when the in-sample inter-correlations among the explanatory variables break down. It is interesting that even for forecasts so close to the sample period the naive model does very poorly in forecasting mortgages beyond one period ahead.

As indicated in our discussion above the use of the mortgage rate change as a proxy for mortgage market disequilibria creates a simultaneity problem in that the error in the S&L mortgage demand equation will be correlated with the change in rate. Hence we have tried estimation of the demand equations using an instrumental variables technique.

Table VII contains the parameter estimates when per capita disposable income and the change in the number of households were all used as instrumental variables for each rationing proxy $[\Delta(1/r)/W^e]$ in the appropriate periods. These particular instruments were selected because they appear likely to influence the change in the mortgage rate by affecting the supply of mortgage rates but have little direct effect on Savings and Loan Association portfolio management.

Again the disequilibrium estimates are close to the equilibrium estimates. In fact the slight changes identified in Tables V and VI are no longer apparent. However, the use of instrumental variables greatly increased the absolute values of the rationing coefficients. Again the least squares estimates are as often as not implausibly signed. While the magnitudes of the mixed estimates are now not as far from our priors, their relative sizes conform to the pattern noted earlier. The excess supply parameters are the smallest in every case, indicating that savings and loans are willing to raise mortgage rates and/or ration customers. The near equilibrium parameters are almost as large as our priors, suggesting some rate stickiness close to equilibrium and an S&L willingness to absorb small disequilibria. The excess demand rationing parameters are also large, though not as large as our priors. Apparently, mortgage rates are sticky downward and/or, not unexpectedly, borrowers absorb little if any of this type of disequilibrium.

Table VIII contains the estimates with the constant and "triangular" proxies for market disequilibrium using the MBA classification of market conditions. Again the rate and adjustment parameters are strikingly similar to those for the equilibrium model. The rationing coefficients are unfortunately ambiguous because the proxies are consistent with any scale for the market disequilibrium. Due to a reluctance to assign a dollar figure to the amount of disequilibrium we did not use priors here for the rationing coefficients. One consequence is that the estimates are pretty wild. Another is that the interpretations of the magnitudes depend upon the reader's assessment of the average market disequilibrium. The reported estimates correspond to an average one billion dollar level or change in market disequilibrium. A doubling of this figure would halve these estimates. The rationing coefficients consequently appear quite small.

The triangular disequilibrium model does do relatively well forecasting within and outside the sample period, but the difference in RMSE's across models do not really seem important. In addition, the striking similarity of the mixed estimates to the various disequilibrium estimates suggest that little may be lost by the simpler assumption that savings and loans do in fact realize their notional demands.

TABLE 1. Definitions and Data

Interest Rates

RL : Corporate Bond Rate

RM : Mortgage Rate

RS : Treasury Bill Rate

Assets

CDD : Currency, reserve and demand deposits

SHORT : Short-term marketable U.S. government securities, open market paper, and security credit

LONG : U.S. government securities other than short-term marketable, state and local government securities, and corporate and foreign bonds

MORT : Mortgages

FHLB : borrowing from the FHLB

Data: The Federal Reserve Board's quarterly flow of funds data was used for all financial quantities. All interest rate data was taken from the MPS data bank.

TABLE II. Classification of Mortgage Market Disequilibria

	Δr_M	$r_M - r_B$	Market Condition + : Excess Demand − : Excess Supply $-.05 \leq \Delta r_M \leq .10$	MBA	Mortgage Bankers Association Description of Market
1952.I		1.93			
II	.00	1.96			Mortgage yields steady / record-
III	.01	1.95			ings steady / percentage of in-
IV	.01	1.92			stitutional inflows invested in
1953.I	.03	1.87			mortgages remains steady
II	.21	1.83	−		
III	.22	2.10	−	+	
IV	.05	2.29		+	
1954.I	−.14	2.32	+	+	Spreads between mortgage and cor-
II	−.08	2.32	+	+	porate bond rates high / life
III	.00	2.32		+	insurance commitments at high
IV	−.05	2.26		+	levels / percentage of institu-
1955.I	.00	2.19		+	tional inflows in home mortgages
II	.00	2.12		+	high
III	.02	2.07		+	
IV	.03	2.08		+	
1956.I	.02	2.12			Saving inflows to mortgages level
II	.06	2.02			off / FHA falls off from peak
III	.12	1.98	−		levels / mortgage yields increase
IV	.20	1.92	−		somewhat but yield spreads fall
1957.I	.15	2.05	−	−	
II	.02	2.00		−	Mortgage yield jumps / yield spread
III	.13	1.83	−	−	falls off before large increase in
IV	.10	2.00		−	'58 / downpayments stay high /
1958.I	−.15	2.24	+	−	housing sales plummet
					Mortgage yield and yield spread
II	−.23	2.04	+		begin to move up / life insurance
III	−.04	1.71			commitments and saving inflows to
IV	.19	1.68	−		mortgage market begin to pick up /
					downpayments fall
1959.I	.03	1.67		+	
II	.03	1.48		+	Mortgage yields fall / activity
III	.19	1.55	−	+	up / life insurance and institu-
IV	.23	1.68	−	+	tional activity remains high
1960.I	.05	1.75		+	

TABLE 11 (continued)

	Δr_M	$r_M - r_B$	Market Condition + : Excess Demand - : Excess Supply $-.05 \leq \Delta r_M \leq .10$	MBA	Mortgage Bankers Association Description of Market
1960.II	-.02	1.83			
III	-.02	1.95			
IV	-.08	1.86	+		
1961.I	-.07	1.84	+		
II	-.12	1.71	+		
III	-.01	1.54			
IV	.00	1.57			
1962.I	.00	1.57			
II	.00	1.68			
III	-.01	1.63			
IV	-.04	1.67			
1963.I	-.04	1.69			
II	-.05	1.62			All types of money market rates stable
III	-.01	1.54			
IV	.00	1.50			
1964.I	.00	1.46			
II	.01	1.43			
III	-.01	1.42			
IV	.00	1.40			
1965.I	.00	1.41			
II	.00	1.39			
III	.03	1.36			
IV	.09	1.34			
1966.I	.15	1.29	-	-	Mortgage yields climb / yield spread between FHA secondary market rate and Aaa bonds falls below 100 basis points for first time / massive outflows of savings--first major bout of disintermediation / housing starts to fall off
II	.26	1.36	-	-	
III	.25	1.29	-	-	
IV	.11	1.34	-	-	
1967.I	-.17	1.43	+	+	Sharp turnaround in savings flows / mortgage rates dip / starts to jump
II	-.08	1.21	+	+	
III	.09	.96		+	
IV	.10	.62			Widely fluctuating month to month changes in money market rates / housing starts to move up consistently but not nearly as rapidly as in the early quarters of 1967
1968.I	.13	.66	-		
II	.34	.88	-		
III	.20	1.25	-		
IV	.02	1.11			
1969.I	.26	.91	-		
II	.25	.97	-	-	Savings flows fall off / housing starts drop sharply / yield spread between mortgages and corporate bonds vanishes / average downpayments on conventional loans rise
III	.36	1.16	-	-	
IV	.16	.91	-	-	
1970.I	.20	.69	-	-	
II	.01	.45		-	

TABLE II (continued)

	Δr_M	$r_M - r_B$	Market Condition + : Excess Demand − : Excess Supply $-.05 \leq \Delta r_M \leq .10$	MBA	Mortgage Bankers Association Description of Market
1970.III	.01	.38			A period of transition from shortage to surplus of funds
IV	−.16	.53	+		
1971.I	−.63	.59	+	+	Savings flows build up through most of period / starts sales rise consistently / average downpayment on conventional homes fall while prices rise
II	−.12	.22	+	+	
III	.15	.28	−	+	
IV	−.02	.52		+	
1972.I	−.20	.39	+	+	
II	.04	.38		+	
III	.04	.49		+	
IV	.03	.59		+	
1973.I	.05	.56	0	+	
II	.21	.68	−	+	
III	.74	1.14	−	−	
IV	.05	1.13	0	−	
1974.I	−.17	.71	+	−	
II	.49	.74	−	−	
III	.50	.61	−	−	
IV	−.04	.54	0	−	

TABLE III. Contingency Table for Disequilibrium Classification Methods

		MBA Classification			
		–	0	+	
Δr_M Classification	–	13 (5.78)	8 (12.13)	5 (8.09)	26
	0	5 (11.11)	29 (23.33)	16 (15.56)	50
	+	2 (3.11)	5 (6.53)	7 (4.36)	14
		20	42	28	90

( ) : Expected number with independence

$p(\chi^2_4 \geq 18.71) < .005$

TABLE V. Short Run Coefficients, Minimum of Demand and Supply

		Rate Responses				Adjustment Coefficients					
		1	$\frac{1}{r_S}$	$\frac{1}{r_L}$	$\frac{1}{r_M}$	$\frac{\phi CDD}{W^e}$	$\frac{\phi SHORT}{W^e}$	$\frac{\phi LONG}{W^e}$	$\frac{\phi MORT}{W^e}$	$\frac{S - S^e}{W^e}$	$\frac{\Delta FHLB}{W^e}$
$\frac{\Delta CDD}{W^e}$	Priors	none	.021	.064	-.072	1.0	.0	.1	.2	.3	.1
	OLS^e	-.228	-.004	.090	.089	.447	-.177	-.453	-.199	.166	.258
	OLS (MBA)	.087	-.001	.078	.117	1.073	.332	-.070	.112	.224	.222
	OLS (Δr)	-.179	-.008	.099	.089	.518	-.157	-.356	-.151	.227	.281
	$Mixed^e$	.028	-.005	.127	.095	.976	-.014	.083	.050	.177	.210
	Mixed (MBA)	.074	.003	.109	.043	.991	-.004	.090	.089	.286	.199
	Mixed (Δr)	.040	-.011	.132	.085	.979	-.015	.084	.061	.261	.191
$\frac{\Delta SHORT}{W^e}$	Priors	none	-.028	.058	-.074	.0	1.0	.2	.3	.4	.1
	OLS^e	.033	.001	-.064	.096	-.130	.198	.068	.035	.020	-.084
	OLS (MBA)	.070	.001	-.046	.116	.152	.209	.074	.074	.052	-.166
	OLS (Δr)	.007	.002	-.060	.104	-.091	.145	.005	.012	.044	-.180
	$Mixed^e$	.221	-.008	-.043	-.001	-.005	.980	.203	.209	.060	.023
	Mixed (MBA)	.333	-.010	-.078	-.026	.013	.982	.211	.321	.158	.048
	Mixed (Δr)	.247	-.010	-.040	-.028	-.003	.982	.203	.233	.119	.006
$\frac{\Delta LONG}{W^e}$	Priors	none	.007	-.322	.546	.0	.0	.7	.0	.0	.0
	OLS^e	.149	-.001	.012	-.103	-.073	-.030	.328	.131	.251	-.012
	OLS (MBA)	.119	-.000	.017	-.140	-.238	-.062	.303	.097	.163	.020
	OLS (Δr)	.155	-.004	.026	-.128	-.113	-.017	.367	.134	.203	.044
	$Mixed^e$	.239	.007	-.081	.118	.013	.015	.706	.224	.156	-.033
	Mixed (MBA)	.214	.010	-.079	.129	.013	.016	.708	.198	.059	-.044
	Mixed (Δr)	.222	.005	-.075	.132	.013	.014	.707	.209	.100	.011
$\frac{\Delta MORT}{W^e}$	Priors	none	.0	.200	-.400	.0	.0	.0	.5	.3	.8
	OLS^e	1.046	.004	-.039	-.082	.757	1.009	1.056	1.033	.564	.839
	OLS (MBA)	.727	.000	-.049	-.093	.013	.522	.692	.717	.561	.924
	OLS (Δr)	1.016	.010	-.065	-.066	.687	1.030	.984	1.004	.526	.855
	$Mixed^e$	.514	.007	-.004	-.211	.017	.020	.009	.520	.607	.800
	Mixed (MBA)	.380	-.003	.047	-.145	-.017	-.010	-.009	.392	.497	.796
	Mixed (Δr)	.491	.016	-.019	-.187	.012	.018	.005	.496	.519	.792

TABLE VI. Short Run Coefficients, $\Delta(1/r_M) = \lambda SE$

		Rate Responses				Adjustment Coefficients						Disequilibrium		
		1	$\frac{1}{r_S}$	$\frac{1}{r_L}$	$\frac{1}{r_M}$	$\frac{\phi CDD}{W^e}$	$\frac{\phi SHORT}{W^e}$	$\frac{\phi LONG}{W^e}$	$\frac{\phi MORT}{W^e}$	$\frac{S - S^e}{W^e}$	$\frac{\Delta FHLB}{W^e}$	$\frac{(\Delta \frac{1}{r})^+}{W^e}$	$\frac{(\Delta \frac{1}{r})^0}{W^e}$	$\frac{(\Delta \frac{1}{r})^-}{W^e}$
$\frac{\Delta CDD}{W^e}$	Priors	none	.021	.064	-.072	1.0	.0	.1	.2	.3	.1	100	20	2
	OLS^e	-.228	-.004	.090	.089	.447	-.177	-.453	-.199	.166	.258			
	OLS (MBA)	-.215	-.005	.095	.069	.424	-.170	-.444	-.187	.158	.278	7.62	-1.25	15.10
	OLS (Δr)	-.195	-.007	.095	.081	.455	-.151	-.385	-.167	.183	.303	22.2	-2.47	1.41
	$Mixed^e$	.028	-.005	.127	.095	.976	-.014	.083	.050	.177	.210			
	Mixed (MBA)	.052	-.009	.134	.084	.978	-.013	.085	.075	.179	.227	11.1	11.0	1.52
	Mixed (Δr)	.038	-.011	.139	.090	.978	-.013	.084	.060	.190	.249	34.53	16.71	1.84
$\frac{\Delta SHORT}{W^e}$	Priors	none	-.028	.058	-.074	.0	1.0	.2	.3	.4	.1	100	30	3
	OLS^e	.033	.001	-.064	.096	-.130	.198	.068	.035	-.020	-.084			
	OLS (MBA)	.027	.002	-.069	.108	-.126	.201	.058	.030	.019	-.091	.001	-4.87	-12.0
	OLS (Δr)	.011	.004	-.074	.106	-.152	.194	.032	.014	.008	-.110	-15.8	-12.0	-1.9
	$Mixed^e$	.221	-.008	-.043	-.001	-.005	.980	.203	.209	.060	.023			
	Mixed (MBA)	.228	-.009	-.040	-.005	-.004	.980	.203	.216	.061	.028	2.67	4.54	1.73
	Mixed (Δr)	.228	-.010	-.035	-.010	-.004	.980	.204	.217	.063	.033	9.80	18.7	2.27
$\frac{\Delta LONG}{W^e}$	Priors	none	.007	-.322	.546	.0	.0	.7	.0	.0	.0	600	150	15
	OLS^e	.149	-.001	.012	-.103	-.073	-.030	.328	.131	.251	-.012			
	OLS (MBA)	.164	-.001	.014	-.095	-.040	-.049	.353	.148	.269	-.014	1.03	6.15	-17.0
	OLS (Δr)	.167	-.002	.015	-.107	-.069	-.015	.365	.148	.260	.013	12.1	-1.41	.648
	$Mixed^e$	.239	.007	-.081	.118	.013	.015	.706	.224	.156	-.033			
	Mixed (MBA)	.291	-.002	-.057	.090	.019	.015	.712	.280	.182	-.002	11.0	50.4	9.90
	Mixed (Δr)	.278	-.003	-.044	.071	.019	.016	.709	.264	.164	-.006	29.0	100.8	12.2
$\frac{\Delta MORT}{W^e}$	Prior	none	.0	.200	-.400	.0	.0	.0	.5	.3	.8	-800	-200	-20
	OLS^e	1.046	.004	-.039	-.082	.757	1.009	1.056	1.033	.564	.839			
	OLS (MBA)	1.023	.004	-.039	-.081	.741	1.018	1.032	1.009	.554	.827	-8.65	-1.16	13.88
	OLS (Δr)	1.017	.005	-.035	-.080	.766	.971	.987	1.006	.549	.794	-18.4	15.8	-.130
	$Mixed^e$	.514	.007	-.004	-.211	.017	.020	.009	.520	.607	.800			
	Mixed (MBA)	.431	.019	-.036	-.169	.007	.018	.000	.431	.577	.747	-24.2	-65.9	-13.1
	Mixed (Δr)	.457	.025	-.060	-.152	.009	.018	.003	.460	.582	.724	-73.3	-136.2	-16.3

TABLE VII. Short Run Coefficients with Instruments for $\left(\Delta\frac{1}{r}\right)/W^e$

		Rate Responses				Adjustment Coefficients						Disequilibrium		
		1	$\frac{1}{r_S}$	$\frac{1}{r_L}$	$\frac{1}{r_M}$	$\frac{\phi CDD}{W^e}$	$\frac{\phi SHORT}{W^e}$	$\frac{\phi LONG}{W^e}$	$\frac{\phi MORT}{W^e}$	$\frac{S - S^e}{W^e}$	$\frac{\Delta FHLB}{W^e}$	$\frac{\left(\Delta\frac{1}{r}\right)^+}{W^e}$	$\frac{\left(\Delta\frac{1}{r}\right)^0}{W^e}$	$\frac{\left(\Delta\frac{1}{r}\right)^-}{W^e}$
$\frac{\Delta CDD}{W^e}$	Priors	none	.021	.064	−.072	1.0	.0	.1	.2	.3	.1	100	20	2
	OLS^e	−.228	−.004	.090	.089	.447	−.177	−.453	−.199	.166	.258			
	OLS (MBA)	−.186	−.003	.094	.071	.536	.536	−.149	−.341	−.162	.174	-68.9	-91.7	-50.1
	OLS (Δr)	−.183	−.007	.096	.070	.459	−.141	−.344	−.159	.180	.311	38.5	-75.7	-1.3
	$Mixed^e$	.028	−.005	.127	.095	.976	−.014	.083	.050	.177	.210			
	Mixed (MBA)	.037	−.005	.132	.086	.977	−.014	.083	.059	.180	.215	90.3	15.9	1.7
	Mixed (Δr)	.031	−.010	.135	.096	.977	−.013	.084	.054	.187	.251	38.9	15.9	1.7
$\frac{\Delta SHORT}{W^e}$	Priors	none	−.028	.058	−.074	.0	1.0	.2	.3	.4	.1	100	30	3
	OLS^e	.033	.001	−.064	.096	−.130	.198	.068	.035	.020	−.084			
	OLS (MBA)	.018	.000	−.059	.085	−.154	.192	.034	.020	.010	−.086	13.1	8.0	20.3
	OLS (Δr)	.025	.002	−.070	.105	−.088	.205	.086	.025	.006	−.115	6.6	-195.2	-14.6
	$Mixed^e$	.221	−.008	−.043	−.001	−.005	.980	.203	.209	.060	.023			
	Mixed (MBA)	.223	−.008	−.045	.008	−.005	.980	.203	.213	.062	.027	20.4	24.6	2.7
	Mixed (Δr)	.224	−.009	−.041	−.002	−.005	.980	.203	.212	.061	.030	4.2	24.8	2.6
$\frac{\Delta LONG}{W^e}$	Priors	none	.007	−.322	.546	.0	.0	.7	.0	.0	.0	600	150	15
	OLS^e	.149	−.001	.012	−.103	−.073	−.030	.328	.131	.251	−.012			
	OLS (MBA)	.177	.001	−.000	−.069	−.052	−.038	.375	.163	.284	.008	47.1	34.6	-33.2
	OLS (Δr)	.157	−.002	.014	−.098	−.023	−.019	.347	.139	.265	.009	4.1	87.3	.6
	$Mixed^e$	.239	.007	−.081	.118	.013	.015	.706	.224	.156	−.033			
	Mixed (MBA)	.264	.008	−.081	.145	.014	.015	.707	.256	.171	−.007	231.5	133.2	13.9
	Mixed (Δr)	.253	.003	−.072	.116	.014	.016	.707	.240	.159	−.001	17.9	120.1	13.0
$\frac{\Delta MORT}{W^e}$	Priors	none	.0	.200	−.400	.0	.0	.0	.5	.3	.8	-800	-200	-20
	OLS^e	1.046	.004	−.039	−.082	.757	1.009	1.056	1.033	.564	.839			
	OLS (MBA)	.991	.002	−.035	−.087	.671	.995	.932	.980	.532	.834	8.8	49.1	63.0
	OLS (Δr)	1.001	.007	−.041	−.076	.703	.955	.911	.994	.549	.796	-49.3	183.6	15.2
	$Mixed^e$	.514	.007	−.004	−.211	.017	.020	.009	.520	.607	.800			
	Mixed (MBA)	.477	.004	−.008	−.239	.016	.019	.008	.474	.586	.765	-341.8	-173.7	-18.3
	Mixed (Δr)	.494	.015	−.024	−.211	.016	.018	.006	.496	.593	.717	-60.9	-160.8	-17.3

TABLE VIII. Short Run Coefficients, Constant and Triangular Proxies for MBA SE

		Rate Responses				Adjustment Coefficients							
		1	$\frac{1}{r_S}$	$\frac{1}{r_L}$	$\frac{1}{r_M}$	$\frac{\phi CDD}{W^e}$	$\frac{\phi SHORT}{W^e}$	$\frac{\phi LONG}{W^e}$	$\frac{\phi MORT}{W^e}$	$\frac{S - S^e}{W^e}$	$\frac{\Delta FHLB}{W^e}$	$\frac{SE^+}{W^e}$	$\frac{SE^-}{W^e}$
$\frac{\Delta CDD}{W^e}$	Priors	none	.021	.064	-.072	1.0	.0	.1	.2	.3	.1	none	none
	OLS^e	-.228	-.004	.090	.089	.447	-.177	-.453	-.199	.166	.258		
	OLS (CON)	-.194	-.002	.097	.083	.507	-.177	-.371	-.166	.178	.265	-.048	-.046
	OLS (Tri)	-.194	-.000	.102	.066	.512	-.160	-.358	-.169	.174	.265	-.025	-.012
	$Mixed^e$	.028	-.005	.127	.095	.976	-.014	.083	.050	.177	.210		
	Mixed (CON)	.035	-.001	.125	.091	.980	-.014	.086	.058	.199	.228	-.104	-.141
	Mixed (Tri)	.019	.003	.129	.077	.979	-.015	.085	.039	.199	.224	-.049	-.064
$\frac{\Delta SHORT}{W^e}$	Priors	none	-.028	.058	-.074	.0	1.0	.2	.3	.4	.1	none	none
	OLS^e	.033	.001	-.064	.096	-.130	.198	.068	.035	.020	-.084		
	OLS (CON)	.025	.000	-.055	.073	-.149	.200	.041	.026	.012	-.089	-.009	.047
	OLS (Tri)	.018	-.000	-.057	.076	-.161	.197	.021	.019	.011	-.087	.001	.031
	$Mixed^e$	.221	-.008	-.043	-.001	-.005	.980	.203	.209	.060	.023		
	Mixed (CON)	.223	-.009	-.030	-.031	-.006	.980	.203	.209	.049	.015	-.017	.090
	Mixed (Tri)	.223	-.008	-.031	-.028	-.006	.980	.203	.209	.050	.022	-.007	.048
$\frac{\Delta LONG}{W^e}$	Priors	none	.007	-.322	.546	.0	.0	.7	.0	.0	.0	none	none
	OLS^e	.149	-.001	.012	-.103	-.073	-.030	.328	.131	.251	-.012		
	OLS (CON)	.176	.001	-.001	-.063	-.017	-.034	.407	.160	.270	.001	-.003	-.103
	OLS (Tri)	.183	.002	.005	-.077	-.004	-.024	.432	.165	.269	-.006	-.008	-.053
	$Mixed^e$	.239	.007	-.081	.118	.013	.015	.706	.224	.156	-.033		
	Mixed (CON)	.232	.008	-.115	.193	.014	.013	.707	.222	.184	-.012	.043	-.229
	Mixed (Tri)	.233	.009	-.102	.163	.014	.013	.707	.221	.180	-.027	-.000	-.104
$\frac{\Delta MORT}{W^e}$	Priors	none	.0	.200	-.400	.0	.0	.0	.5	.3	.8	none	none
	OLS^e	1.046	.004	-.039	-.082	.757	1.009	1.056	1.033	.564	.839		
	OLS (CON)	.993	.001	-.041	-.092	.659	1.011	.922	.981	.540	.823	.060	.101
	OLS (Tri)	.993	-.001	-.050	-.065	.653	.986	.905	.985	.546	.827	.033	.034
	$Mixed^e$	.514	.007	-.004	-.211	.017	.020	.009	.520	.607	.800		
	Mixed (CON)	.510	.002	.018	-.252	.013	.021	.005	.512	.568	.769	.079	.279
	Mixed (Tri)	.527	-.004	.002	-.211	.013	.022	.005	.532	.571	.781	.057	.120

TABLE IX. RMSE's for In-Sample Forecasts 1954-1972

Variable	Method	Number of Quarters Ahead 1	2	4	6	8
CDD	OLS[e]	.248	.257	.273	.276	.254
	OLS (MBA)	.240	.252	.267	.274	.250
	OLS (Δr)	.245	.255	.265	.273	.257
	OLS (MBA, INST)	.244	.250	.256	.259	.247
	OLS (Δr, INST)	.235	.242	.252	.256	.242
	OLS (MBA, CON)	.247	.259	.268	.277	.263
	OLS (MBA, TRI)	.243	.250	.257	.264	.253
	Mixed[e]	.377	.409	.419	.424	.428
	Mixed (MBA)	.374	.419	.437	.443	.447
	Mixed (Δr)	.364	.399	.412	.418	.421
	Mixed (MBA, INST)	.394	.432	.444	.450	.455
	Mixed (Δr, INST)	.363	.397	.408	.413	.416
	Mixed (MBA, CON)	.353	.387	.399	.405	.409
	Mixed (MBA, TRI)	.342	.367	.374	.378	3.82
	Naive	.110	.166	.237	.332	.404
SHORT	OLS[e]	.223	.288	.340	.415	.444
	OLS (MBA)	.223	.287	.333	.406	.431
	OLS (Δr)	.221	.281	.328	.397	.423
	OLS (MBA, INST)	.220	.284	.335	.410	.439
	OLS (Δr, INST)	.220	.279	.334	.397	.410
	OLS (MBA, CON)	.221	.285	.337	.412	.442
	OLS (MBA, TRI)	.220	.282	.333	.407	.439
	Mixed[e]	.453	.576	.621	.631	.640
	Mixed (MBA)	.455	.586	.639	.652	.661
	Mixed (Δr)	.452	.578	.627	.639	.648
	Mixed (MBA, INST)	.456	.586	.634	.646	.655
	Mixed (Δr, INST)	.454	.578	.624	.635	.644
	Mixed (MBA, CON)	.452	.576	.622	.633	.642
	Mixed (MBA, TRI)	.451	.571	.613	.623	.632
	Naive	.219	.321	.423	.548	.641

TABLE IX (continued)

Variable	Method	Number of Quarters Ahead 1	2	4	6	8
	OLS[e]	.209	.295	.350	.331	.347
	OLS (MBA)	.199	.280	.348	.339	.363
	OLS (Δr)	.204	.281	.329	.313	.331
	OLS (MBA, INST)	.199	.285	.360	.358	.383
	OLS (Δr, INST)	.200	.281	.330	.317	.333
	OLS (MBA, CON)	.201	.276	.333	.321	.353
	OLS (MBA, TRI)	.199	.271	.320	.308	.338
LONG	Mixed[e]	.253	.334	.431	.461	.473
	Mixed (MBA)	.278	.396	.568	.634	
	Mixed (Δr)	.266	.347	.482	.532	.550
	Mixed (MBA, INST)	.288	.427	.581	.629	.646
	Mixed (Δr, INST)	.258	.346	.463	.500	.514
	Mixed (MBA, CON)	.246	.328	.430	.461	.474
	Mixed (MBA, TRI)	.242	-316	.404	.432	.443
	Naive	.351	.511	.678	.766	.833
	OLS[e]	.309	.437	.560	.646	.691
	OLS (MBA)	.308	.439	.570	.674	.715
	OLS (Δr)	.299	.426	.541	.632	.674
	OLS (MBA, INST)	.314	.443	.575	.685	.739
	OLS (Δr, INST)	.296	.402	.501	.580	.619
	OLS (MBA, CON)	.309	.437	.563	.676	.735
	OLS (MBA, TRI)	.301	.422	.534	.641	.699
MORT	Mixed[e]	.665	.954	1.131	1.174	1.191
	Mixed (MBA)	.716	1.073	1.339	1.417	.656
	Mixed (Δr)	.653	.960	1.180	1.243	1.264
	Mixed (MBA, INST)	.775	1.130	1.356	1.414	1.436
	Mixed (Δr, INST)	.681	.982	1.171	1.219	1.238
	Mixed (MBA, CON)	.666	.957	1.138	1.182	1.200
	Mixed (MBA, TRI)	.616	.879	1.036	1.075	1.092
	Naive	.359	.958	2.498	4.491	6.607
	OLS[e]	.250	.327	.395	.440	.463
	OLS (MBA)	.246	.323	.396	.450	.472
	OLS (Δr)	.245	.318	.380	.427	.450
	OLS (MBA, INST)	.248	.324	.399	.456	.487
	OLS (Δr, INST)	.241	.307	.365	.406	.425
	OLS (MBA, CON)	.248	.322	.391	.449	.482
	OLS (MBA, TRI)	.244	.314	.376	.430	.464
$(\sum RMSE^2/4)^{.5}$	Mixed[e]	.462	.617	.712	.737	.747
	Mixed (MBA)	.483	.676	.824	.871	.610
	Mixed (Δr)	.457	.620	.740	.776	.790
	Mixed (MBA, INST)	.512	.705	.833	.868	.883
	Mixed (Δr, INST)	.466	.627	.731	.760	.772
	Mixed (MBA, CON)	.456	.614	.712	.737	.749
	Mixed (MBA, TRI)	.436	.577	.662	.685	.695
	Naive	.279	.572	1.317	2.300	3.351

TABLE X. S&L RMSE's for Out-of-Sample Forecasts (1973.I-1974.IV)

Variable	Method	Number of Quarters Ahead 1	2	4	6	8
CDD	OLS[e]	.649	.783	.619	.590	.408
	OLS (MBA)	.688	.833	.663	.612	.422
	OLS (Δr)	.687	.870	.729	.737	.517
	OLS (MBA, INST)	.712	.851	.771	.846	.779
	OLS (Δr, INST)	.658	.837	.659	.675	.369
	OLS (MBA, CON)	.610	.717	.504	.461	.234
	OLS (MBA, TRI)	.681	.824	.668	.670	.523
	Mixed[e]	.790	.908	.628	.608	.266
	Mixed (MBA)	.789	.934	.639	.629	.194
	Mixed (Δr)	.808	.947	.641	.614	.183
	Mixed (MBA, INST)	.873	.973	.612	.591	.219
	Mixed (Δr, INST)	.799	.929	.598	.605	.196
	Mixed (MBA, CON)	.728	.885	.663	.629	.292
	Mixed (MBA, TRI)	.774	.918	.742	.721	.385
	Naive	.544	.258	.327	.515	.690
SHORT	OLS[e]	.200	.254	.247	.340	.012
	OLS (MBA)	.204	.251	.245	.347	.013
	OLS (Δr)	.175	.201	.214	.317	.077
	OLS (MBA, INST)	.204	.264	.317	.385	.094
	OLS (Δr, INST)	.314	.424	.454	.567	.772
	OLS (MBA, CON)	.163	.237	.351	.488	.262
	OLS (MBA, TRI)	.162	.238	.348	.453	.254
	Mixed[e]	1.657	2.202	2.417	2.581	2.229
	Mixed (MBA)	1.641	2.225	2.464	2.628	2.266
	Mixed (Δr)	1.650	2.228	2.458	2.620	2.242
	Mixed (MBA, INST)	1.629	2.193	2.378	2.522	2.144
	Mixed (Δr, INST)	1.679	2.259	2.480	2.640	2.304
	Mixed (MBA, CON)	1.709	2.293	2.540	2.723	2.383
	Mixed (MBA, TRI)	1.688	2.223	2.421	2.598	2.309
	Naive	.316	.419	.667	1.103	1.257

TABLE X (continued)

Variable	Method	Number of Quarters Ahead 1	2	4	6	8
LONG	OLS[e]	.549	.677	.855	1.002	1.398
	OLS (MBA)	.648	.871	1.173	1.376	1.882
	OLS (Δr)	.540	.638	.753	.837	1.169
	OLS (MBA, INST)	.660	.885	1.207	1.403	1.767
	OLS (Δr, INST)	.525	.654	.872	1.093	1.495
	OLS (MBA, CON)	.667	.909	1.207	1.422	1.847
	OLS (MBA, TRI)	.613	.781	.950	1.082	1.452
	Mixed[e]	1.202	1.360	1.340	1.440	1.851
	Mixed (MBA)	1.399	1.582	1.498	1.585	2.093
	Mixed (Δr)	1.266	1.402	1.296	1.368	1.827
	Mixed (MBA, INST)	1.428	1.732	1.762	1.947	2.514
	Mixed (Δr, INST)	1.118	1.202	1.097	1.134	1.507
	Mixed (MBA, CON)	1.346	1.532	1.507	1.629	2.069
	Mixed (MBA, TRI)	1.233	1.386	1.330	1.418	1.896
	Naive	.674	.744	.701	1.199	.721
MORT	OLS[e]	.542	.654	.706	.733	1.000
	OLS (MBA)	.587	.742	.881	.952	1.472
	OLS (Δr)	.571	.715	.724	.759	.573
	OLS (MBA, INST)	.490	.562	.555	.708	.894
	OLS (Δr, INST)	.594	.712	.871	1.169	1.896
	OLS (MBA, CON)	.561	.726	.851	.959	1.350
	OLS (MBA, TRI)	.536	.652	.662	.722	.675
	Mixed[e]	1.318	1.893	1.761	1.796	.550
	Mixed (MBA)	1.415	2.107	2.009	2.039	.482
	Mixed (Δr)	1.428	2.127	2.050	2.088	.619
	Mixed (MBA, INST)	1.676	2.344	1.690	1.566	.160
	Mixed (Δr, INST)	1.581	2.317	2.217	2.256	1.038
	Mixed (MBA, CON)	1.325	1.942	1.923	1.956	.700
	Mixed (MBA, TRI)	1.202	1.736	1.748	1.867	.578
	Naive	1.634	3.987	6.925	15.666	16.458
$(\sum RMSE^2/4)^{.5}$	OLS[e]	.514	.625	.647	.708	.883
	OLS (MBA)	.565	.719	.814	.907	1.213
	OLS (Δr)	.529	.654	.646	.692	.702
	OLS (MBA, INST)	.553	.688	.784	.913	1.065
	OLS (Δr, INST)	.538	.673	.734	.913	1.281
	OLS (MBA, CON)	.538	.694	.799	.921	1.158
	OLS (MBA, TRI)	.537	.665	.691	.766	.852
	Mixed[e]	1.280	1.667	1.669	1.756	1.481
	Mixed (MBA)	1.349	1.786	1.786	1.869	1.562
	Mixed (Δr)	1.324	1.757	1.756	1.835	1.482
	Mixed (MBA, INST)	1.437	1.887	1.732	1.799	1.658
	Mixed (Δ, INST)	1.342	1.787	1.774	1.851	1.474
	Mixed (MBA, CON)	1.325	1.743	1.793	1.890	1.623
	Mixed (MBA, TRI)	1.266	1.637	1.676	1.786	1.534
	Naive	.938	2.043	3.500	7.879	8.268

REFERENCES

[1] Amemiya, T. "A Note on a Fair and Jaffee Model," Econometrica, 42 (1974), 759-762.

[2] Brainard, W. and J. Tobin. "Pitfalls in Financial Model Building," American Economic Review (May 1968).

[3] Clower, R. "The Keynesian Counterrevolution: A Theoretical Appraisal," in F. Hahn and F. Brechling, The Theory of Interest Rates. London: Macmillan, 1965.

[4] Fair, Ray. A Model of Macroeconomic Activity. Cambridge: Ballinger, 1974.

[5] Fair, R. and D. Jaffee. "Methods of Estimation for Markets in Disequilibrium," Econometrica (May 1972).

[6] Fair, R. C. and H. Kelejian. "Methods of Estimation for Markets in Disequilibrium--A Further Study," Econometrica, 42 (1974), 177-190.

[7] Grossman, H. "Money, Interest, and Prices in Market Disequwlibrium," Journal of Political Economy (September/October, 1971).

[8] Jaffee, D. "On the Specification and Estimation of a Disequilibrium Market," mimeo, March 1974.

[9] Jaffee, D. "The Specification of Disequilibrium Flow of Dunds Models,"

[10] Maddala, G. S. and F. D. Nelson. "Maximum Likelihood Methods for Models of Markets in Disequilibrium," Econometrica, 42 (1974), 1013-1030.

[11] Smith, G. "Equilibrium and Disequilibrium Interpretations of the IS-LM Model," Cowles Foundation Discussion Paper No. 461, revised January 1978.

[12] Smith, G. and W. Brainard. "The Value of a priori Information in Estimating a Financial Model," Journal of Finance (December 1976, 1299-1322.

[13] Smith, G. "Further Evidence on the Value of a priori Information," Journal of Finance, forthcoming.

[14] Tucker, D. "Macroeconomic Models and the Demand for Money under Current Market Disequilibrium," Journal of Money, Credit and Banking (February 1971).