



American Finance Association

A Microeconomic Model of Federal Home Loan Mortgage Corporation Activity

Author(s): Kenneth T. Rosen and David E. Bloom

Source: *The Journal of Finance*, Vol. 35, No. 4 (Sep., 1980), pp. 959-971

Published by: Blackwell Publishing for the American Finance Association

Stable URL: <http://www.jstor.org/stable/2327213>

Accessed: 28/11/2009 08:18

Your use of the JSTOR archive indicates your acceptance of JSTOR's Terms and Conditions of Use, available at <http://www.jstor.org/page/info/about/policies/terms.jsp>. JSTOR's Terms and Conditions of Use provides, in part, that unless you have obtained prior permission, you may not download an entire issue of a journal or multiple copies of articles, and you may use content in the JSTOR archive only for your personal, non-commercial use.

Please contact the publisher regarding any further use of this work. Publisher contact information may be obtained at <http://www.jstor.org/action/showPublisher?publisherCode=black>.

Each copy of any part of a JSTOR transmission must contain the same copyright notice that appears on the screen or printed page of such transmission.

JSTOR is a not-for-profit service that helps scholars, researchers, and students discover, use, and build upon a wide range of content in a trusted digital archive. We use information technology and tools to increase productivity and facilitate new forms of scholarship. For more information about JSTOR, please contact support@jstor.org.



Blackwell Publishing and American Finance Association are collaborating with JSTOR to digitize, preserve and extend access to *The Journal of Finance*.

<http://www.jstor.org>

A Microeconomic Model of Federal Home Loan Mortgage Corporation Activity

KENNETH T. ROSEN and DAVID E. BLOOM*

I. Introduction

THE PURPOSE OF THE Federal Credit Agencies (FCA's) is to help stabilize the residential construction sector of the U.S. economy.¹ However, instability of residential construction seems to have worsened in recent years despite rapid growth of the FCA's, which have at times accounted for over one-third of all Federal borrowing activity.² This situation has generated substantial concern among public policymakers and academic researchers over the behavior of the FCA's and over their effectiveness in meeting their public policy goals (see Goldfeld, Jaffee, and Quandt [2], Grebler [3], Hearings [5], Hendershott and Villani [6], Jaffee and Rosen [7], Kaufman [8], Rosen [10], Rosen and Kearl [11], and Silber [12]). However, there has not yet been any systematic attempt to evaluate the behavior and effectiveness of the most recently created and most rapidly growing of the FCA's—the Federal Home Loan Mortgage Corporation (FHLMC).

The objective of this paper is to provide a microeconomic analysis of the FHLMC. Section II presents a brief institutional background on the FHLMC. Section III sets out a demand-supply model of FHLMC mortgage purchase activities. Section IV presents and discusses estimates of several versions of the model developed in Section III, and Section V summarizes and presents the conclusion of the paper.

II. Institutional Background

The Federal Home Loan Mortgage Corporation was created by Title III of the Emergency Home Finance Act of 1970 in an attempt to expand the secondary market for conventional residential mortgages (CRM's) to a national level. Such a market was not viable prior to creation of the FHLMC because lending requirements and loan documents for CRM's varied greatly from lender to lender and from state to state, forcing these instruments to be highly localized. Never-

* University of California at Berkeley and Princeton University. The authors are indebted to Marilyn Reardon and Daniel Measall of the Federal Home Loan Mortgage Corporation for providing much of the data used in this study, to Bryan Boulier, Gilles Grenier and Dwight Jaffee for their valuable comments on this paper, and to the Twentieth Century Fund for financial support.

¹ The Federal Credit Agencies include the Federal National Mortgage Association (FNMA), the Government National Mortgage Association (GNMA), the Federal Home Loan Banks (FHLB's), and the Federal Home Loan Mortgage Corporation (FHLMC).

² Much of the borrowing, however is off-budget.

theless, CRM's comprised over two-thirds of the total assets of the average savings and loan association (SLA) in 1970 and the absence of a national market for these mortgages was a major hindrance to SLA's in the management of their assets. From the standpoint of public policy, this asset management problem aggravated the impact of interest rate changes on mortgage availability and housing production and justified creating a mortgage market mechanism—the FHLMC—which would enhance the liquidity of CRM's and thereby help to stabilize mortgage and housing market fluctuations.

The FHLMC was capitalized in September, 1970 by the issue of \$100 million of non-voting common stock to the twelve Federal Home Loan Banks (FHLB's), which are themselves owned by member SLA's of the FHLB System. Consequently, the FHLMC has some obligation to earn a return that is sufficient to cover the opportunity cost of its contributed capital although this does not necessarily imply profit maximization. In addition, as a subsidiary of the FHLB System, the FHLMC's operations are, 1) under the direction of the FHLB Board, 2) not restricted by Federal debt ceilings, 3) exempt from all Federal, state and local taxes (except those on its real estate holdings), and 4) limited (with regard to its mortgage purchases) to dealings with FHLB System members, the Federal Savings and Loan Insurance Corporation, and institutions whose deposits are insured by an agency of the Federal Government.³

In its operations, the FHLMC endeavors to function as a mortgage trading corporation seeking to purchase and sell mortgages in various forms and markets on a regular basis. Until April, 1977, all of the FHLMC's purchase programs were conducted according to an Administered Price System under which a pricing committee composed of top management of the FHLMC met at least once a week to determine the effective yields the FHLMC required in order to purchase the mortgages it was offered in each of five over-the-counter programs.⁴ Among the factors considered by the pricing committee were current yields on new mort-

³ In May, 1979 the Act establishing the FHLMC was amended to include mortgage bankers, mortgage corporations, investment companies, and other Department of Housing and Urban Development approved mortgagees on the list of eligible sellers to the FHLMC. In order to actually sell mortgages to the FHLMC, though, these organizations—all of whom are nonmembers of the FHLB system—must be approved by the FHLMC by giving evidence of their ability to originate and service mortgages. Furthermore, in lieu of their non-contribution of capital to the FHLMC, nonmembers are also charged a fee of one-half of one percent of the value of mortgages sold to the FHLMC. Note, in addition, that these latter two requirements also applied to eligible nonmember organizations who desired to sell mortgages to the FHLMC prior to the 1979 amendment.

⁴ Since 1971, the FHLMC has regularly conducted four separate programs for making commitments to purchase single-family and multifamily conventional mortgages on whole and participatory bases. It has also conducted a program, which it has gradually been phasing out, for purchasing FHA-VA mortgages.

In addition to its regular purchase programs, the FHLMC has also been involved in several special purchase programs. For example, from October, 1973 to May, 1974, the FHLMC offered six to twenty-four month commitments to purchase mortgages at market interest rates on an optional delivery basis. Also, through a special financing arrangement with the Treasury, the FHLMC offered in 1974, six and twelve month forward commitments to purchase conventional mortgages at rates below those available in the private sector. Finally, in 1975 the FHLMC participated with FNMA as agents for the Government National Mortgage Association (GNMA) in a special mortgage assistance program in which over \$3 billion in mortgages were purchased.

gages, FNMA purchase yields, savings flows and trends, and the cost of funds to the FHLMC.⁵ A formal model of the process by which the FHLMC sets its required yields is presented in the following section. The FHLMC's goal was, and still is, the maintenance of a long and short-run balance between purchases and sales. Yields set by the pricing committee were continuously posted in each of the FHLMC's five regional offices where eligible institutions were able to register the dollar volume of mortgages they wished to sell at the required yield. The FHLMC then had ten days to accept or reject an offer.⁶ Upon acceptance, an offer became a commitment (contract) and delivery of the mortgages to the FHLMC was required within sixty days. There were no offer or contract fees.

In April, 1977, the largest of the five purchase programs, the Class B Participation Program, was changed to an auction system which determined the effective yield and quantity of mortgage loans that the FHLMC would purchase. Since this program has so recently been initiated, no attempt will be made to analyze it in this paper. [See Rosen [10] for an analysis of the FNMA auction system.]

To finance its mortgage purchases, the FHLMC has raised funds by five different methods: 1) borrowing from the FHLB's, 2) issuing GNMA guaranteed mortgage-backed bonds, 3) direct sale of mortgage holdings, 4) sale of Mortgage Participation Certificates (MPC's) and, 5) sale of Guaranteed Mortgage Certificates (GMC's). While all financing methods have been used to some extent in the past, the sale of MPC's and GMC's are presently the major sources of financing for FHLMC purchase activities.

MPC's represent undivided interests in specific pools of mortgages held by the FHLMC. They are designed to appeal primarily to traditional mortgage lenders (especially SLA's in capital surplus areas) and feature classification as a mortgage investment for regulatory and tax purposes, guaranteed timely payment of interest and principal, and performance of the FHLMC as an intermediate servicer, transfer agent, and registrar. MPC's were first sold in September, 1971, and since then have been used to generate over \$2 billion for the FHLMC.

GMC's are similar to MPC's insofar as they also represent undivided interests in specific mortgage pools. But unlike MPC's, GMC's are designed for sale to nontraditional lenders (especially institutional investors such as trust and pension funds). They exhibit bond-like characteristics such as semi-annual payment of interest and an unconditional FHLMC guarantee of interest and principal pay-

⁵ FHLMC required yields and current yields on new mortgages differ systematically because of the seller's charge (approximately .25 percent) for servicing the mortgages sold (sellers to the FHLMC must either retain servicing or contract it out). In fact, over the period July, 1972 to June, 1977 the average monthly difference between FHLMC required yields (for its three largest purchase programs) and current yields on new mortgages was .24 percent. Required and current yields also differ, though, depending on the economic conditions prevailing in the primary and secondary mortgage markets and the FHLMC's resources and policy goals.

⁶ Note that once the FHLMC issues a commitment to purchase a seller's mortgages, delivery of those mortgages by the seller to the FHLMC is mandatory as is their purchase by the FHLMC, providing they satisfy certain underwriting standards. Since only 10% of delivered mortgages fail to pass these standards, commitments and purchases are nearly synonymous and they are used interchangeably in this paper.

ments. GMC's were first sold in February, 1975, and have generated over \$1 billion since that time.

III. Microeconomic Model of FHLMC Mortgage Commitment Mechanisms

The details of the institutional background of the FHLMC suggest modeling its mortgage commitment mechanisms in a supply-demand framework in which member banks of the FHLB system (primarily SLA's) demand loanable funds from the FHLMC in exchange for CRM's. Formally, the SLA demand for FHLMC commitments may be derived as an application of the theory of the firm. However, it should first be pointed out that FHLMC commitments are only one of several potential sources of loanable funds for an SLA. Other sources include net deposit inflows, current period revenue on outstanding loans (repayments), loans from commercial banks, retained earnings, existing liquidity over and above legal liquidity requirements, FHLB advances, and mortgage sales to other agencies. Consequently, a realistic model of SLA demand for FHLMC commitments must be nested in a much broader model of optimal SLA behavior.

The model of SLA behavior developed in this section, from which the demand for FHLMC commitments is derived, is based on the notion that individual SLA's attempt to minimize the cost of raising enough funds from available sources to originate a fixed amount of mortgages.⁷ As a result, SLA's are essentially faced with the problem of choosing a vector of loanable funds from available sources which minimizes their costs (C) of originating a given volume of mortgages. Mathematically, this problem may be represented as follows:

$$\text{MIN } C = \sum_{i=1}^N r_i K_i + FC \quad (1)$$

$$\text{s.t. } M(K_i, X_j) = M^* \quad (i = 1, \dots, N)$$

$$(j = 1, \dots, Z)$$

where r_i is the yield on the i th source of loanable funds, K_i is the quantity of loanable funds from source i , FC are fixed costs of operation, X_j is the j th non-capital factor of production, and M^* is the fixed volume of mortgage originations. The constraint in (1) may be regarded as a mortgage production function which relates financial capital inputs from various sources and other inputs such as land and labor to mortgage originations. Note that the production coefficients implicit in the constraint capture the differences in riskiness, liquidity, and maturity that characterize the various financial capital inputs.

In this problem, r_i ($i = 1, \dots, N$), FC , X_j ($j = 1, Z$), K_N (= net deposit inflows), and M^* are considered exogenous while the K_i ($i = 1, \dots, N - 1$) are the choice

⁷ The notion that SLA's attempt to minimize the cost of originating a fixed amount of mortgages seems more compatible with actual SLA commitment processes than does a profit maximizing framework.

variables.⁸ The lagrangean for this problem is therefore

$$L = \sum_{i=1}^{N-1} r_i K_i + r_N K_N + FC + \lambda (M^* - M(K_i, X_j)) \quad (2)$$

and maximization of (2) requires that the following conditions be satisfied:

$$\begin{aligned} \frac{\partial L}{\partial K_i} = r_i + \lambda \left(\frac{\partial M(K_i, X_j)}{\partial K_i} \right) &= 0 \quad i = (1, \dots, N-1) \\ \frac{\partial L}{\partial \lambda} = M^* - M(K_i, X_j) &= 0 \end{aligned} \quad (3)$$

These N necessary conditions— $N-1$ marginal conditions and one production constraint—can be used to derive a demand equation for each of the $N-1$ endogenous variables in terms of all of the exogenous variables.⁹ Denoting K_1 , as the demand for FHLMC commitments (r_1 therefore being the FHLMC required yield), the SLA demand equation for FHLMC commitments which is implied by this model is

$$K_1 = K_1(r_1, \dots, r_N, K_N, FC, X_j, M^*) \quad (4)$$

Equation (4) is the underlying form of the demand equation for FHLMC commitments estimated and discussed in Section IV. Basically, (4) suggests that the dollar value of SLA offers to sell mortgages to the FHLMC is a function of the cost of raising loanable funds through the FHLMC, the costs of alternative methods of raising loanable funds, the amount of loanable funds needed, funds available from net deposit inflows, and a vector of fixed costs and factors. On an a priori basis, one would expect a negative association between the volume of FHLMC commitments and the cost of those commitments (i.e., FHLMC required yield), and positive associations between FHLMC commitments and the costs of loanable funds raised from substitute sources. In addition, one should expect a positive association between FHLMC commitments and the need for SLA's to increase their stock of loanable funds. Hopefully, the magnitude and significance of this last association will shed light on the consistency of the FHLMC's actual operations relative to its public purpose.

Unlike the behavior of commitment demanders, modeled using conventional demand analysis, the behavior of the FHLMC as a commitment supplier is not entirely motivated by profit considerations and therefore cannot be analyzed with a standard supply-side model. As pointed out in Section II, the FHLMC is owned by member banks of the FHLB system, and must maintain its solvency by earning a sufficient return to cover the opportunity cost of its contributed capital. However, the primary purpose of the FHLMC, as prescribed by Congress, is to ease the liquidity problems of SLA's without concern for profit. Furthermore, it would be incongruous to model the FHLMC's supply function, for the FHLMC is not a perfect competitor. Rather, it dominates the secondary market for CRM's and does not take prices in that market as given. Consequently, this analysis will adopt the approach taken by Silber in his work on the FNMA and the FHLBB.

⁸ The assumption that K_N is exogenous is discussed in Section IV A.

⁹ It is assumed that the cost function is globally convex.

Silber [12] shows that one may successfully model the behavior of quasi-public agencies like the FHLMC by maximizing a weighted objective function constructed to reflect the agencies' goals. His model, however, suggested that conditions in the housing market directly affect the agencies' behavior, whereas the model developed in this section reflects the view that mortgage market conditions—and not housing market conditions—are the direct determinants of agency behavior.

We postulate that three factors crucially influence FHLMC behavior. First, is the non-profit nature of its activities which implies that everything else equal, FHLMC will try to just cover its borrowing and operating costs. In the objective function that follows this goal is proxied by $(r_1 - \alpha r_b)^2$. The second goal of the FHLMC is to help stabilize the mortgage market by offsetting a short-fall or an excess of funds in this market. There are a number of different measures one might use to quantify this goal, such as deviations from target levels of mortgage flows, housing starts, or mortgage interest rates. Alternatively one could proxy this countercyclical activity by a measure of the need of SLA's for funds, where need is defined as we have earlier in the paper, as the difference between mortgage loans made and net deposit inflows. While we have experimented with all these measures of countercyclical need, we have adopted the latter measure $(M - K)$, as this term will be most sensitive to cyclical distress faced by SLA's.

The final agency goal recognizes that FHLMC is not the only secondary market purchaser of mortgages. Thus we incorporate the FHLMC's desire to be competitive with its major rival the FNMA. This is measured in the objective function by $(r_1 - r_{fn})^2$.

Equation (5) is the objective function that the FHLMC is viewed as seeking to minimize

$$\Omega = \omega_1(M - K)^2 + \omega_2(r_1 - \alpha r_b)^2 + \omega_3(r_1 - r_{fn})^2 \quad (5)$$

where

Ω is scaled in units of FHLMC disutility,

$\omega_1, \omega_2, \omega_3$ are positive weighting factors which convert the squared differences between a) M and K , b) r_1 and αr_b , and c) r_1 and r_{fn} to units of FHLMC disutility.

$M - K$, is mortgages created minus deposit flows, which approximates SLA need for loanable funds,

r_b is the FHLMC exogenous weighted average cost of capital,

r_{fn} is the required yield on FNMA commitments to purchase mortgages,

α is a scalar, the value of which depends on such factors as the riskiness and time to maturity of the average dollar of capital raised by the FHLMC relative to the average dollar of mortgages purchased by the FHLMC.

It should be noted that having squared terms on the right hand side of (5) guarantees that the FHLMC bears disutility from positive as well as negative deviations of M from K , of r_1 from αr_b , and of r_1 from r_{fn} . The rationale for having the FHLMC bear disutility in these cases follows from their public purpose of acting as a mortgage market stabilizer, from the notion that the return on the capital of a public agency should be minimal, and from the importance of the

FNMA rate as an indicator of competitive conditions in the secondary mortgage market.

Assuming the second order conditions for a minimum of Ω with respect to r_1 are globally satisfied, the following condition will hold at the minimum point:

$$2\omega_1(M - K) \left(\frac{\partial M}{\partial r_1} \right) + 2\omega_2(r_1 - \alpha r_b) + 2\omega_3(r_1 - r_{fn}) = 0 \quad (6)$$

Assuming M is linear in r_1 and that the partial derivative $\frac{\partial M}{\partial r_1}$ in (6) is a constant (Co), (6) may be rewritten as:

$$\omega_1(M - K)Co + \omega_2(r_1 - \alpha r_b) + \omega_3(r_1 - r_{fn}) = 0 \quad (7)$$

Solving explicitly for r_1 (the FHLMC required yield) yields:

$$r_1 = \frac{1}{\omega_2 + \omega_3} [-\omega_1 Co(M - K) + \omega_2 \alpha r_b + \omega_3 r_{fn}] \quad (8)$$

This equation, which is the basis of the empirical supply-side equations estimated in the following section, suggests that the FHLMC's required yield on mortgage purchases is a function of its own cost of capital (r_b), the yield on FNMA commitments, and the difference between actual mortgage originations and the flow of deposit to SLA's. Furthermore, since ω_1 , ω_2 , and ω_3 are presumed positive, it follows that r_1 is expected to be positively related to r_b and r_{fn} . The relationship between r_1 and $(M - K)$ depends, however, on the sign of $\frac{\partial M}{\partial r_1}$ which we have assumed to be constant. Clearly, however, because of the downward sloping demand for FHLMC commitments, $\frac{\partial M}{\partial r_1}$ must be negative. Thus if FHLMC is reacting in a counter-cyclical fashion r_1 should be negatively related to the $(M - K)$ term. It should be noted that while M can be treated as fixed from the point of view of the individual institution and thus is treated as M^* on the demand side, in a macroeconomic sense M is a function of r_1 (among other variables). Thus $\sum M^* = M$. This interdependency will of course have to be handled with a consistent estimation technique.

A. Demand for FHLMC Commitments

Equation (4) provides the general form of the demand equations to be estimated. As given by (9) these equations are specified in linear form with the coefficients of M^* and K_N constrained to be equal. The rationale for this constraint is that during the period under consideration (1972-1977), the nature of Regulation Q ceilings made deposit inflows a preferred and exogenous, but fairly unpredictable, source of funds to SLA's. As a result, SLA's generally increased their mortgage holdings in tandem with their deposit growth in the long run, while in the short run they sometimes faced shortfalls and excesses of deposit flows relative to mortgage commitments. In these short run situations they were often forced to borrow funds from the FHLBB or commercial banks, sell mort-

gages to FNMA or the FHLMC, buy mortgages or mortgage-like instruments from other originators, or vary their holdings of liquid assets. In view of this scenario, constraining the coefficients of M^* and K_N to be equal seems reasonable.

The demand equations are therefore specified as follows:

$$\text{COMTS} = \beta_0 + \beta_1 r_y + \beta_2 r_{tb} + \beta_3 r_{fn} + \beta_4 r_{fl} + \beta_5 (M^* - K_N) + \epsilon_D \quad (9)$$

where COMTS = FHLMC dollar commitments, r_y = the required yield on FHLMC commitments, r_{tb} = the treasury bill yield (a proxy for the opportunity cost of own liquidity), r_{fn} = the required yield on FNMA commitments, r_{fl} = the interest rate on FHLBB advances, M^* and K_N are as before, and ϵ_D is a random error.¹⁰ In line with the discussion of the demand equation in the previous section, β_1 is expected to be negative and $\beta_2, \beta_3, \beta_4, \beta_5$ are expected to be positive. Note that the fixed costs and factors are subsumed in the constant term.¹¹

B. Supply of FHLMC Commitments

The empirical specification of the supply (required yield) equation is suggested by equation (8).

$$r_y = \alpha_0 + \alpha_1 r_b + \alpha_2 r_{fn} + \alpha_3 (M - K_N) + \epsilon_S \quad (10)$$

All variables in (10) are defined as before.

It is expected that α_1 and α_2 will be positive. In addition, the sign and significance of α_3 will provide evidence on the counter-cyclical nature of FHLMC activities.

C. Results

Taken together, (9) and (10) constitute a two equation model in which FHLMC commitments (COMTS) and required yield (r_y) are endogenously determined. The commitment demand equation (9) constitutes a recursive block and may therefore be estimated with an ordinary least squares estimator. However, the required yield equation (10) must be estimated by two stage least squares due to the presence of M (which is presumably a function of r_1) on the right hand side. Estimation results for the three largest FHLMC purchase program for the period July, 1972 through June, 1977 are presented in Tables I and II. Also presented in

¹⁰ It may be argued that the commitment demand equations have a drawback since they constrain a dollar denominated value to be influenced linearly by interest rate variables. To remedy this problem, the commitment demand equations were respecified so that each interest rate variable was scaled by the $(M^* - K_N)$ variable. The results of estimating with this specification were, however, identical with regard to signs of the estimated coefficients though somewhat less significant than the results obtained using the unscaled specification. As a result, we have only reported the unscaled estimates.

¹¹ Although not reflected in our notation, the M^* variable actually used for the empirical results of this section equals mortgage originations less mortgage repayments. Note that this specification implies that repayments are exogenous and have the same coefficient (in absolute value) as mortgage originations. *F*-tests for the equality (in absolute value) of the coefficients of mortgage originations, mortgage repayments, and deposit inflows provide support for this joint set of constraints in all demand equations reported below.

these tables are the results of estimation when certain insignificant and incorrectly signed variables are dropped from the demand equations.¹²

The results of estimating the commitment demand equations are supportive of the model developed above. The sign of the coefficient on the FHLMC required yield variable is negative in all equations and is statistically significant (at the 5 percent level) in four of the six equations. In addition, the coefficient of the FNMA required yield variable is positive in all cases and statistically significant in most cases. These two results provide strong evidence that SLA's respond to relative cost considerations, particularly when they decide to sell some of their mortgages. Note also that the coefficient of the treasury bill yield, though not statistically significant, is positive as expected while the coefficient of the FHLBB advance rate is consistently negative and is significant in two cases, contrary to expectations. This latter result is somewhat puzzling although it may involve the close institutional relationship between the FHLMC and the FHLBB which conceivably makes it difficult to isolate the theoretical effect of the FHLBB advance rate on FHLMC commitment demand. Both the advance rate and the treasury bill yield have been dropped from the final regression. Finally, note that the coefficient of the need-for-funds variable ($M^* - K_N$) is positive in all regressions and is statistically significant in four of the six regressions. This confirms the hypothesis that the FHLMC commitment mechanisms are utilized more heavily in tight credit periods than in periods of relatively abundant liquid resources.¹³

The supply equations were estimated by two stage least squares with an iterative technique (like Cochrane-Orcutt) used to correct for the substantial autocorrelation discovered in the residuals.¹⁴ Regarding these equations, the estimation results are strongly consistent with the model developed above. First, the coefficient of the FHLMC cost of capital (r_b) is estimated to be positive in all regressions and statistically different from zero in all but one case. Second, the coefficient of the FNMA yield is estimated to be positive and statistically significant in all cases. Finally, the coefficient of the need-for-funds variable ($M - K_N$) is estimated to be negative in four of the six regressions and significantly different from zero in two of those regressions. This is an interesting result from

¹² *F*-tests of the hypothesis that the coefficients of the variables r_{tb} and r_{fl} are jointly zero could be accepted in only one of the three cases (Program 3). Nevertheless, we report, for all cases, regression results for which these variables are excluded since 1) the initial results suggest that the treasury bill rate is either a poor or unnecessary proxy for the opportunity cost of own liquidity and that the model presented in Section III has incorrectly captured the relationship between the demand for FHLMC commitments and the FHLBB advance rate, and 2) the final results can be interpreted as the unconstrained estimates of a model of FHLMC activity in which SLA demands for FHLMC commitments are conditioned on the prior decision to raise funds by selling mortgages.

¹³ The low R^2 values reported in Table 1 appear, at least partly, to be the consequence of using monthly data to estimate the demand equations. When quarterly data is used the R^2 values for the three initial specifications jump to .56, .56, and .53 respectively. Note, also, that the point estimates generated from the quarterly data, although imprecise, are quite similar to those obtained from the monthly data.

¹⁴ For a full description of the iterative procedure used see Fair (1) (1970).

Table I
Federal Home Loan Mortgage Corporation Commitment Demand Equations Ordinary Least Squares Estimates*

Dependent Variable	Constant	r_y	r_{ib}	r_{in}	r_{il}	$(M^* - K_N)$	R^2	D.W.
Program 1 Commitments (Final Regression)	18839.00	-19813.07		19326.10		2158.26	.22	1.51
Program 1 Commitments (Initial specification)	(23089.65) -2700.59	(7680.20) -7503.49	6721.49	(8245.05) 21958.83	-19924.57	(1027.60) 972.91	.35	1.49
Program 2 Commitments (Final Regression)	(23483.34)	(8101.20)	(3005.32)	(7772.31)	(6368.50)	(1029.10)		
Program 2 Commitments (Initial specification)	301142.94	-58013.24		27484.79		8114.33	.30	1.60
Program 3 Commitments (Final Regression)	(115481.38) 199018.56	(23880.18) -42301.87	13022.57	(26376.41) 58532.95	-51432.11	(3355.15) 4480.51	.45	1.78
Program 3 Commitments (Initial specification)	(108880.69)	(25868.52)	(11162.59)	(26505.47)	(21029.51)	(3346.04)		
Program 3 Commitments (Final Regression)	15459.87	-4158.45		2569.57		475.94	.37	1.46
Program 3 Commitments (Initial specification)	(4351.96) 15650.64	(936.85) -3138.13	730.95	(960.60) 1730.99	-854.13	(177.01) 446.15	.38	1.53
	(4625.15)	(1460.14)	(746.89)	(1768.13)	(1185.77)	(202.19)		

* For Tables I and II:

Program 1—Conventional single family whole mortgages.

Program 2—Class B participation in conventional single and single-multifamily mortgage pools (the largest FHLMC program).

Program 3—Conventional multifamily mortgage pools.

Standard errors are reported in parentheses below estimated coefficients.

For Table II only: RHO is the estimated first order serial correlation coefficient.

Table II

Federal Home Loan Mortgage Corporation Required Yield Equations Two Stage Least Squares Estimates With and Without Correction for First-Order Serially Correlated Errors

Dependent Variable	C	BC	FNMA	M - K _N	RHO	R ²	D.W.
Program I	-.171	.023	.997	-.065		.90	.89
Required Yield	(.494)	(.086)	(.120)	(.019)			
Program I	1.650	.210	.616	-.025	.691	.94	1.90
Required Yield	(.824)	(.095)	(.138)	(.020)	(.092)		
Program II	.549	.231	.702	-.030		.91	1.03
Required Yield	(.450)	(.079)	(.109)	(.017)			
Program II	1.412	.312	.528	-.007	.542	.93	1.95
Required Yield	(.692)	(.094)	(.135)	(.021)	(.107)		
Program III	2.323	.319	.475	.007		.78	.34
Required Yield	(.700)	(.122)	(.170)	(.027)			
Program III	3.945	.212	.394	.008	.860	.93	1.68
Required Yield	(1.123)	(.100)	(.148)	(.020)	(.065)		

a policy viewpoint since it provides some evidence that the FHLMC is willing to sacrifice profitability in order to fulfill its public policy goals.¹⁵

As an aid in the interpretation of the results in Tables I and II, selected partial and total elasticities have been calculated and are presented in Table III. On the demand side of the model, both the partial and total elasticity of COMTS with respect to $(M^* - K_N)$ is positive and less than unity for all three programs. On the supply side of the model, the elasticities of r_1 with respect to $(M - K_N)$ are negative for two of the three programs, but are strikingly close to zero in all cases.

The inelasticity (total) of COMTS with respect to $(M^* - K_N)$ seems to indicate that SLA's increase and decrease their reliance on the FHLMC less than proportionately in response to changes in their need for loanable funds. Interestingly, this somewhat disturbing result is also explained in part by the inelasticity of required yield with respect to $(M - K_N)$, suggesting that the FHLMC should consider making its required yields more responsive to the liquidity needs of SLA's if it desires to increase its countercyclical activities. Thus, the main finding of this section is that while the FHLMC seems to be responding correctly to the working capital needs of SLA's it may be advisable from the standpoint of public

¹⁵ Although not discussed above, estimates were also generated for supply equations which were respecified to include lagged exogenous variables and thereby allow for the possibility of partial adjustments in the FHLMC rate setting process. As pointed out by this paper's referee: "this would be likely since rate-setting is a bureaucratic/administrative procedure, and thus delays are common, compared with market rate-setting." Although a wide variety of distributed lag models were estimated, the only lag model which seemed to receive any empirical support was one in which the supply equation was augmented with either a one period lagged FHLMC cost of capital variable. In these cases, the coefficient of the lagged variable was uniformly positive and generally statistically significant. This provides some evidence for the hypothesis that delays characterize the FHLMC rate setting process. However, in almost every case in which lagged exogenous variables were added to a supply equation, the coefficients of the unlagged variables and the other interest rate variables were rendered statistically insignificant.

Table III
Selected Elasticities^a

	Partial Elasticities		$\frac{\partial \log \text{COMTS}^b}{\partial \log \text{NEED}}$
	$\frac{\partial \log \text{COMTS}}{\partial \log \text{NEED}} \Big _{\bar{r}_y}$	$\frac{\partial \log r_y}{\partial \log \text{NEED}}$	
Program 1	.271	-.024	.433
Program 2	.317	-.011	.385
Program 3	.766	.002	.719

^a The partial elasticities are evaluated at the sample means using the ordinary least squared estimates of the final specifications of Table I and the serially unadjusted two-stage least squares estimates of Table II.

^b Calculated as follows:

$$\frac{\partial \log \text{COMTS}}{\partial \log \text{NEED}} = \left[\frac{\partial \log \text{COMTS}}{\partial \log \text{NEED}} \Big|_{\bar{r}_y} + \frac{\partial \text{COMTS}}{\partial r_y} \frac{\partial r_y}{\partial \text{NEED}} \right] \frac{\overline{\text{NEED}}}{\overline{\text{COMTS}}}$$

where

$$\text{NEED} = (M^* - K_N) = (M - K_N)$$

$$\bar{r}_y = r_y \text{ fixed,}$$

$$\overline{\text{NEED}} = \text{sample average of NEED over the entire sample period, and}$$

$$\overline{\text{COMTS}} = \text{sample average of COMTS over the entire sample period.}$$

policy to have it sacrifice additional profitability in order to increase the FHLMC's supply of loanable funds to SLA's in periods of tight credit.

V. Summary and Conclusion

This paper has presented and estimated a microeconomic model of FHLMC mortgage commitment activities in which commitment volume and required yield are endogenously determined. Findings on the demand side of the model strongly support the view that the SLA demand for FHLMC commitments is responsive to relative cost considerations and that SLA's rely on the FHLMC to increase their loanable funds more heavily when mortgage credit markets are tight. On the supply side of the model, the findings indicate that the FHLMC's cost of capital is an important determinant of its required yields and that these required yields are affected, though not substantially, by the liquidity needs of SLA's.

In conclusion, it appears that the FHLMC has designed a mortgage commitment mechanism which does respond in a countercyclical fashion to the credit demands of mortgage market participants. Most of this sensitivity, however, arises from the response of demanders to relative cost considerations rather than from active policy responses by the FHLMC. Thus, it appears that much room remains for the FHLMC to increase its countercyclical weight by altering its pricing behavior.

REFERENCES

1. Ray C. Fair. "The Estimation of Simultaneous Equation Models with Lagged Endogenous Variables and First Order Serially Correlated Errors," *Econometrica*, (May, 1970).
2. Stephen M. Goldfeld, Dwight M. Jaffee and Richard E. Quandt. "A Rationing Model of FHLBB Advances," Princeton University Financial Research Center, Memo #26, (November, 1978).
3. Leo Grebler. "An Assessment of the Performance of the Public Sector in the Residential Housing Market: 1955-1974," in *Capital Markets and the Housing Sector*, edited by Robert M. Buckley, John A. Tuccillo, and Kevin E. Villani (Cambridge, Massachusetts, (Ballinger Publishing Company, 1977).
4. J. M. Guttentag. "The Short Cycle in Residential Construction," *The American Economic Review*, Volume LI, Number 3 (June, 1961).
5. *Hearings before the Committee on Banking, Housing, and Urban Affairs*, United States Senate, 94th Congress, Second Session, Washington, D.C., (December 13, 1976).
6. Patrick H. Hendershott, and Kevin Villani. "The Federally Sponsored Credit Agencies: Their Behavior and Impact," in *Capital Markets and the Housing Sector*, edited by Robert M. Buckley, John A. Tuccillo and Kevin E. Villani Cambridge, Massachusetts, (Ballinger Publishing Company, 1977).
7. Dwight M. Jaffee and Kenneth T. Rosen. "Estimation of the Effectiveness of Stabilization Policies for the Mortgage and Housing Markets," *Journal of Finance*, (June, 1978).
8. Herbert M. Kaufman. "An Analysis of the Behavior of Federal Mortgage Market Agencies," *Journal of Money, Credit, and Banking* (1975).
9. Sherman, Maisel. "Fluctuations in Residential Construction Starts," *The American Economic Review*, Volume LIII, Number 3 (June 1963).
10. Kenneth T. Rosen. "The Federal National Mortgage Association, Residential Construction, and Mortgage Lending," (unpublished manuscript, August, 1978).
11. Kenneth Rosen and James Kearl. "A Model of Housing Starts, Mortgage Flows, and the Behavior of the Federal Home Loan Bank Board and the Federal National Mortgage Association," Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University, Working Paper No. 27.
12. William L. Silber. "A Model of Federal Home Loan Bank System and Federal National Mortgage Association Behavior," *The Review of Economics and Statistics*, Volume LV, Number 3 (August 1973).