

## Interest Rates, Forward Commitments, and Life Insurance Company Demand for Mortgages

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### I. Purpose

Periodic flows of life insurance company (LIC) funds into the mortgage market result almost entirely from acceptances of forward commitment contracts negotiated months, and often years, earlier. Thus, Jaffee (1972) and others (Bisignano, 1971; Lintner, 1976; Lintner et al., 1978; Pesando, 1974; Ribble, 1973; and Smith and Sparks, 1971) have considered forward commitment behavior as the appropriate foundation for developing supply-of-mortgage-fund equations in large-scale econometric models and for analyzing the portfolio behavior of LICs and other financial institutions involved in issuing mortgage commitments. [1]

While the mechanics of the mortgage commitment-dispersement process are well understood from the institutional literature (see, for example, Brimmer, 1962; Fisher and Opper, 1971; Jones, 1968; Klamann, 1961; and Walter, 1962), fundamental differences have appeared in formulations of the underlying rationale for acquiring mortgages via forward commitments. The central theoretic issue is whether LICs simply utilize commitments in portfolio balancing, given the formalized dual-loan arrangement in mortgage markets, [2] or whether LICs utilize commitments as a means of risk avoidance given a known negative covariance between future interest rates and expected investible fund inflows being committed in the present. The former view is mainly attributable to Klamann (1961) and Jaffee (1972) while the latter view is a recent development of Lintner (1976) and Lintner et al. (1978).

The purpose of this article is to contrast these alternative views and empirically test models based upon their theoretical equations. As is so often the case, the main point of dissonance is with the specification of interest rates. In Jaffee's model, interest rate effects are incorporated through mortgage and competing asset yield spreads which are strictly contemporaneous. The relevant opportunity rate in the Lintner et al. model is the expected rate on a competing asset or expected commitment rate in future periods. The available empirical evidence leads to ambiguous conclusions suggesting that perhaps both specifications are correct. Empirical results from this study, however, lend convincing support to the Jaffee view.

This article also has a secondary purpose with somewhat broader limits. Specifically, the estimation of an aggregate supply equation for LIC mortgage commitments provides an opportunity

to reexamine some troublesome empirical questions. First, evidence from Bisignano (1971), Cummins (1975), and Pesando (1974) indicates that residential and nonresidential mortgage commitments follow different regression regimes. Performing a disaggregate analysis of LIC mortgage commitment behavior, therefore, is a tenable exercise for two reasons: 1) as an inquiry into the possibility of bias due to aggregation; and 2) to assess the effects of disaggregating commitments for the comparison of alternative mortgage commitment formulations. A second, and possibly more important major empirical question concerns the substitutability of competing assets for mortgage in LIC portfolios. A discussion of this issue accompanies the analysis presented in a later section.

The remainder of the article is comprised of four sections. Section II establishes a common foundation for modeling forward commitment behavior and considers the rationale of LICs in following this approach in making mortgage investments. In Section III, the Jaffee and Lintner et al. models are developed. Section IV presents empirical results of comparing the two models on both an aggregate and a disaggregate basis. The models are also used to reexamine the substitutability question. Some conclusions and a discussion of the significance of the results are presented in the final section.

## II. Prior Considerations

A conventional starting point in the development of financial models is the presumption that relationships underlying institutional demand for financial assets follow a partial or stock adjustment mechanism based upon a notion of disequilibrium cost and adjustment from an actual to some desired position. [3] Accordingly, prior investigations of LIC mortgage commitment behavior and studies of changes in the stock of mortgages in LIC portfolios have relied extensively on this partial adjustment precept.[4] The desired level of new commitments is considered a function of interest rates, long-term and short-term wealth constraints, and the level of mortgage commitments issued in previous periods but not yet dispersed.[5] Portfolio theory explicitly requires including the own interest rate, rates on alternative financial assets, the variances of these rates, and the covariances between rates. A common practice in empirical studies, however, is to assume constant variances and covariances and to specify only the differential between the own rate and the rate on a competing asset in an effort to avoid excessive multicollinearity.

A substantial and growing body of evidence exists to suggest that highly organized capital markets exhibit allocational efficiency regarding newly available information (see, for example, Fama, 1970). If capital markets are operationally efficient, long-term and short-term interest rates and

current prices fully reflect all relevant information in the market. That is, investors acting as arbitrageurs insure that all opportunities to increase returns or avoid losses arising from newly available information are efficaciously acted upon.

The arbitrage process extends to trading securities with different maturities to increase returns and decrease losses in accordance with the main premise of the expectation hypothesis (see Fama and Miller, 1972). If capital markets are efficient and all available information is impounded into current prices and prevailing interest rates, then long-term and short-term rates essentially perform random walks. Then implicitly, expected long-term and short-term rates cannot be meaningfully derived from any distributed lag scheme using past interest rates. [6]

The comparative analysis of the Jaffee and Lintner et al. views of LIC forward commitment behavior, then, may be regarded as a test of this current-rate hypothesis. The implication of the hypothesis is that current forward commitment rates (and commitment fees) fully compensate LICs for the risks inherent in the dispersement lag. These risks include: 1) the risk of extraordinarily high rates of attrition in commitments; 2) interest rate risk and possible opportunity loss during the period between commitment and dispersement of funds; and 3) the risk of involuntary asset sales resulting from overcommitment. The current-rate hypothesis is consistent with the notion that LICs use forward commitments for portfolio balancing to satisfy the fully invested objective.

### III. Alternative Models

#### A. *Jaffee (1972)*

Life companies are assumed by Jaffee to be price takers in the mortgage markets, but set premium rates and the composition of their portfolios so as to induce profit maximizing levels of deposits. The mortgage investment model depicts the determinants of forward commitments as essential antecedents of changes in residential mortgage stocks within a conventional stock adjustment framework. The equation for *desired* stock is assumed to have the forms

$$\frac{M^*}{D} = a_0 + a_1(RM - RC) \quad (1)$$

or

$$M^* = [a_0 + a_1(RM - RC)]D \quad (2)$$

where  $M^*$  is desired mortgage stock,  $RM$  is the mortgage interest rate,  $RC$  is the rate on a competing asset or the opportunity rate,  $D$  is the level of deposits, and  $a_i$  ( $i = 0, 1$ ) are parameters. [7]

The equation for *intended* changes in mortgage stocks,  $(M - M_{-1})'$ , incorporates the influence of changes in deposits,  $\Delta D$ , as a short-run wealth constraint:

$$(M - M_{-1})' = g_0(M^* - M_{-1}) + g_1 \Delta D \quad (3)$$

where  $g_i$  ( $i = 0, 1$ ) are parameters of the adjustment mechanism, and after correcting for mortgage repayments,  $R$ , Eq. (3), becomes

$$(M - M_{-1})' = g_0(M^* - M_{-1}) + g_1 \Delta D + R. \quad (4)$$

Assuming that over a long-term investment horizon life companies fully adjust to desired levels of mortgage stocks,  $g_0$  can be set to unity and Eq. (4) becomes

$$(M - M_{-1})' = M^* - M_{-1} + g_1 \Delta D + R. \quad (5)$$

In its present form, the model is a close rendition of the familiar de Leeuw-Goldfield financial stock adjustment formulation. The distinguishing feature of this version is the specification of *intended* apart from *desired* changes in mortgage stocks—a modification necessitated by the extraordinary manner in which life companies accumulate mortgages in their portfolios. Mortgages are accumulated periodically as a result of 1) direct acquisition,  $MM'$ ; 2) "takedowns" of outstanding commitments issued in prior periods,  $MOC'$ ; and 3) issuing new commitments,  $MNC'$ . This implies the identity

$$(M - M_{-1})'' \equiv MM' + MOC' + MNC' \quad (6)$$

The components are assumed to have the following properties:

$$MNC' = aNC, \quad a < 1 \quad (7)$$

and

$$MOC' = bOC_{-1}, \quad b < 1 \quad (8)$$

where NC and OC<sub>-1</sub> are actual levels of new and outstanding commitments. The parameters a and b are less than unity to account for takedowns of new and outstanding commitments during the current period.

Using Eqs. (3), (7), and (8) in equating actual and intended stocks, the supply of new commitments equation can be written

$$NC = \left(\frac{1}{a}\right)[(M - M_{-1})' - MM'] - \frac{b}{a}OC_{-1} \quad (9)$$

Finally, if MM' is assumed to be a constant function of (M - M<sub>-1</sub>)' such that

$$MM' = c(M - M_{-1})', \quad c < 1 \quad (10)$$

a complete specification for the optimal stock of new commitments can be obtained by substituting Eq. (10) into Eq. (9) and using Eqs. (2) and (4)

$$NC^* = a_0d_0D + a_1d_0(RM - RC)D + g_1d_0 \Delta D - d_0M_{-1} + d_0R - d_1OC_{-1} \quad (11)$$

with  $d_0 = 1 - c/a$  and  $d_1 = b/a$ .

*B. Lintner et al. (1976, 1978) [8]*

The Lintner consortium focus on the problem of deriving a supply equation for advanced mortgage commitments via a straightforward determination of an optimal stock of commitments equation. The model is built on a unique theoretic foundation which characterizes LIC demand for forward mortgage commitments as an expression of risk-averse behavior. Specifically, LICs are presumed to exhibit a strong preference for the "known rate" available on funds committed for future delivery in the present vis-a-vis an "uncertain rate" alternatively available in the period when funds are received and dispersed. Moreover, LIC mortgage investment is undertaken with a priori knowledge of a negative covariance between future flows of investible funds and changes in interest rates. Even if the own interest rate is expected to rise, LICs will not respond directly by increasing commitment levels because of their aversion to overcommitment risk resulting from the accompanying reduction in investible funds.

In terms of the model, LICs are assumed to adjust commitment levels on the basis of differentials between forward commitment rates and expected rates on competing assets since "Comparisons of the forward commitment rate and current spot rates are not directly relevant" (emphasis added) (Lintner et al., 1978:603).

The structural equation for optimal forward commitment stocks is derived from standard mean-variance portfolio theory

$$FC^* = \bar{F} + \frac{RM - \overline{RC}}{\lambda V_{\overline{RC}}} + \beta \overline{RC} \quad (12)$$

where  $FC^*$  is the optimal forward commitment level,  $F$  is the expected value of investible funds available at the end of the period,  $\overline{RC}$  is the expected opportunity rate,  $\lambda$  is the Pratt-Arrow coefficient of absolute risk aversion,  $V_{\overline{RC}}$  is the variance of  $\overline{RC}$ , and  $\beta$  is the slope coefficient from a regression of  $F$  on  $RM$ . As a ratio of the covariance between  $F$  and  $RM$  over the variance of  $RM$ ,  $\beta$  implicitly carries a negative sign. Equation (12) is linearized to

$$\frac{FC^*}{\bar{F}} = 1 + \frac{RM - \overline{RC}}{\lambda V_{\overline{RC}}} + \beta \overline{RC} \quad (13)$$

The influence of outstanding commitments is added using an identity similar to that introduced by Jaffee as Eq. (6). The identity

$$FC^* \equiv OC_{-1} + NC \quad (14)$$

is used to convert Eq. (13) into an equation for optimal new commitments

$$\frac{NC^*}{\bar{F}} = \frac{FC^*}{\bar{F}} - \frac{OC_{-1}}{\bar{F}} = 1 - \frac{OC_{-1}}{\bar{F}} + \frac{RM - \overline{RC}}{\lambda V_{\overline{RC}}} + \beta \overline{RC}. \quad (15)$$

Using a set of equations for determining the desired proportion of total assets held in a particular asset (e.g., mortgages), the desired ratio of new commitments to investible funds is inferred to be inversely related to the stock of outstanding commitments and directly related to the expected growth rate of investible funds.[9]

$$\frac{NC^*}{F} = \overline{f}(\overline{GR}, OC, X) \quad (16)$$

where  $\overline{GR}$  is the expected growth rate of investible funds and X refers to other relevant determinants.

Finally, the actual pace of new commitment activity is specified as a weighted average of the desired level and the pace of new commitment activity over the previous 6-month or 12-month period

$$\frac{NC}{F} = \alpha \left( \frac{NC^*}{F} \right) + (1 - \alpha) \left( \frac{NC}{F} \right) \quad (17)$$

where NC is the average of new commitment issuances over previous periods.

The complete empirical specification for new commitments is obtained by substituting Eqs. (15) and (16) into (17) and takes two forms:

$$\begin{aligned} \frac{NC}{F} = a_0 + a_1 \left( \frac{RM - \overline{RC}}{V_{\overline{RC}}} \right) + a_2 \frac{OC_{-1}}{F} \\ + a_3 \overline{GR} + a_4 \overline{RC} + a_5 \left( \frac{NC_{-n}}{F} \right) + w \quad (18) \end{aligned}$$

and

$$\begin{aligned} NC = b_6 + b_0 F + b_1 \left( \frac{RM - \overline{RC}}{V_{\overline{RC}}} \right) + b_2 OC_{-1} \\ + b_3 (\overline{GR}) F + b_4 (\overline{RC}) F + b_5 NC_{-n} + u. \quad (19) \end{aligned}$$

Since Lintner et al. use Eq. (19) with quarterly data, the empirical analysis which follows compares estimates of Eq. (11), with a lagged dependent variable added, and Eq. (19).

#### IV. Empirical Results

The forward commitment and other financial data used in estimating the forward commitment equations are quarterly and span the interval 1959-1 through 1977-IV. An appendix to this chapter provides the necessary descriptions and sources of these data in the form of a glossary of variables. The comparison of the two forward commitment models relies upon a replication of estimation procedures followed by Jaffee using Eq. (11) and Lintner et al. using Eq. (19) with

equivalent data series. The specific course followed here is to estimate these equations for aggregate commitments then repeat the comparative analysis for both residential and business-industrial mortgage commitments. The effect of short-term, vis-a-vis long-term, interest rates is also considered in determining substitutability of competing assets for mortgages in LIC portfolios.

#### A. Aggregate Commitments

While estimating Jaffee's equation for aggregate commitments is fairly straightforward, several variables needed to be constructed prior to using the Lintner et al. model. Most importantly, three interest rate variables are formed. First, an expected rate on the competing asset is computed as a three-quarter moving average of lagged values of the current rate on corporate bonds, RCB. This expected rate,  $\overline{RCB}$ , is subtracted from the forward rate on mortgage commitments, FRT, forming a yield spread and then divided by the variance of  $\overline{RCB}$ . Estimates of  $V_{\overline{RCB}}$  are obtained by exponentially smoothing the lagged error variance around prior estimates of RCB

$$V_{RCB} = \alpha V_{RCB} + (1 - \alpha) V_{RCB-1} \quad (20)$$

with

$$V_{RCB} = \sum_{i=1}^3 w_i \frac{(RCB_{-i} - \overline{RCB}_{-i})^2}{3}. \quad (21)$$

Secondly, an expected rate on the competing asset is computed as an autoregressive expectation based upon a third-degree polynomial distributed lag on the past four quarterly values of RCB. The same procedures as before are used in estimating the variances, i.e., Eqs. (20) and (21), and constructing the variable. Finally, the opportunity rate is taken as a three-quarter moving average of past values of FRT. Again, the identical procedures are used in estimating the variance and constructing the variable.

The growth rate of investible funds, GR, is approximated by the exponentially smooth rate of growth ( $\alpha = .01$ ) of

$$\frac{2(ALIV - ALIV_{-3})}{ALIV + ALIV_{-3}} \quad (22)$$

where ALIV is a two-quarter average of past values of investible funds, LIV. Also, the lagged dependent variable in the Lintner et al. model is treated as an average of the past two quarterly values.

[10]



Estimates of the aggregate commitment equation using Jaffee's model regression (I) and the three interest rate variants of the Lintner et al. model (regression 2, 3, and 4) are presented in Table 1. Estimation is performed under the assumption that disturbances follow a first-order autoregressive scheme with the Cochrane-Orcutt procedure implemented to estimate the autoregressive parameter. Overall, the relative performance of the Jaffee model is noticeably superior in a minimum standard error sense. The standard error differs by nearly one-third when comparing estimates of Jaffee's equation with estimates of the variant preferred by Lintner et al. (regression 4).

Turning to the essential issue of current versus expected interest rates, the evidence here strongly suggests that LICs adjust their forward commitment behavior in accordance with prevailing interest rate differentials. While the coefficient on the interest rate variable in the Jaffee equation is 3 times its standard error, all expected interest rate variables in the Lintner et al. models have an incorrect negative sign. When the current interest rate differential is entered in the Lintner et al. model (regression 5) its coefficient is correctly signed and significantly different from zero at the .05 level. There is, however, some indication from the estimates using the Lintner et al. models that a negative covariance between expected interest rates and investible funds exists and influences LIC mortgage investment decisions.

#### *B. Residential and Business-Industrial Commitments*

The notion that LIC forward commitment behavior differs with respect to the major categories of mortgages is based in part upon information directly observable in the data and partially upon results reported in recent econometric investigations (Bisignano, 1971; Cummings, 1975; and Pesando, 1974). [11] Important dissimilarities between the two major categories, residential mortgages and business-industrial mortgages, may be summarized as follows:

1. The composition of LIC mortgage holdings has undergone a dramatic transformation in favor of nonresidential mortgages during the past three decades. In the first quarter of 1953, residential mortgage commitments were over 60% of total LIC mortgage commitments. This proportion steadily decreased to 35% by the first quarter of 1965, and finally, to less than 10% in the fourth quarter of 1977. Conversely, business industrial commitments continually increased leaving the long-run proportion of total mortgages in LIC portfolios relatively unchanged.

2. Pesando (1974) and Bisignano (1971) have shown that dispersement lags, i.e., the period(s) between the point of commitment and the point at which funds are actually loaned, for residential and nonresidential mortgages are markedly different in both form and duration. The pattern of residential mortgage commitment takedowns is characterized by large dispersements in the commitment period

and a rapid completion while business-industrial commitments are dispersed along a function which is humped in the first year and flattens to a much longer completion. These lag patterns are reaffirmed from estimates obtained for the period covered in this study. Cumulative Jags for aggregate and disaggregate LIC mortgage commitments are provided in Table 2.

Given the likelihood of aggregation bias when combining residential and business-industrial commitments and the potential problem this could cause in comparing the two models, regressions are rerun for both types of commitments. These results are presented in Table 3. Estimates using business-industrial commitment data offer no real surprise. The performance of the interest rate variable in the Jaffee model is noticeably improved from estimates in the aggregate model, although the expected rate variable in the Lintner et al. model showed little change. Most noteworthy among the results obtained when using residential commitment data is the incorrectly signed coefficient on the current rate variable and the strength of the estimated coefficient on the investible funds expected rate variable. [12] While opposing signs for the interest rate coefficient for the individual components of total LIC commitments suggest that aggregation is a problem, the effects are negligible insofar as the model comparisons are concerned.

### *C. Substitutability*

Standard mean-variance portfolio theory states that the degree of substitutability between two assets is proportional to the degree of positive correlation in the assets' returns (Royama and Hamada, 1967; Silber, 1970; and Walter, 1962). That is, assets with similar risk characteristics tend to be substitutes in portfolios, or conversely, complements used in diversification. For these reasons the rate on AAA corporate bonds is considered an appropriate opportunity rate for LIC mortgage investment. Nevertheless, the expectation hypotheses of the term structure of interest rates and the efficient markets thesis suggest that short-term opportunity rates provide equally strong, or stronger, substitutability signals. The behavioral justification is that LICs delay long-term investments when short-term securities offer more favorable returns.[13] In an application of Jaffee's model, substitutability tests are conducted using two short-term rates, the Treasury bill rate, RTB, and the commercial paper rate, RCP. Results of the tests are presented in Table 4 along with the results obtained when using the corporate bond rate from the earlier analysis and when including the differential between business-industrial and residential mortgage rates.

The substitutability tests confirm the notion that short-term securities and mortgages are close substitutes in LIC portfolios. Particularly, the inclusion of the commercial paper rate results in estimated coefficient which is nearly 4 times its standard error. The findings reported here (regression

4) indicate little substitution between business-industrial and residential mortgages. Regressions using only business-industrial and only residential mortgage commitment data lead to essentially the same conclusion.

## V. Conclusion

Forward commitments pose a unique set of problems for conceptualizing institutional investment behavior. One solution is to posit an expectational decision framework for selecting the most favorable investment option from an extensive intertemporal opportunity set. Alternatively, it may be viewed that financial institutions recognize the inherent randomness of risks and returns for future investments and choose a decision framework which is confined to current prices and interest rates. The tests performed in this chapter give no evidence that the former view is a correct representation of institutional investment behavior. In the case of LIC forward commitments for mortgages, current interest rate variables consistently outperformed variables based upon econometric expressions of interest rate expectations. This evidence supports an efficient-markets view of future interest rates and casts doubts about the propriety of an adaptive or rational expectations formulation. Further, the most precise estimates are obtained when short-term rates are included as the appropriate opportunity rate.

## Appendix Data Sources and Glossary of Variables

Data for the study are quarterly, cover the period 1959-I through 1977-IV, and are obtained from the following sources:

- A. Board of Governors of the Federal Reserve System. Econometric Model Data Base (See Board of Governors, 1975).
- B. Board of Governors of the Federal Reserve System, Flow of Funds Accounts (See Board of Governors, 1978).
- C. American Council of Life Insurance, Forward Commitment Survey (See American Council, 1978b).
- D. American Council of Life Insurance, Cash Flow Survey (See American Council, 1978a).

### *Interest Rates*

- FRT— rate on LIC forward commitments for business-industrial and multifamily mortgages (C)  
FRB— RCB- weighted average rate on LIC forward commitments for reported types of business-industrial mortgages (C)  
FRM— weighted average rate on LIC forward commitments for reported types of multifamily residential mortgages (C)  
RCB— corporate bond rate (A)  
RCP— commercial paper rate (A)  
RM— mortgage rate, 1-4-family residential (A)  
RTB— treasury bill rate (A)

### *Commitments*

- MCNI— total new mortgage commitments of LICs (A)  
MCOI— total outstanding mortgage commitments of LICs (A)  
FCNB— new business-industrial mortgage commitments of LICs (A)  
FCOB— outstanding business-industrial mortgage commitments of LICs (A)  
FCNR— new residential mortgage commitments of LICs (A)  
FCOR— outstanding residential mortgage commitments of LICs (A)

### *Mortgage Stocks and Repayments*

- MKIS— total mortgage stocks of LICs (A)  
GSB— business-industrial mortgage stocks of LICs (B)  
GSR— sum of 1-4-family and multifamily residential mortgage stocks of LICs (B)  
MRIS— total mortgage repayments of LICs (A)

### *Wealth Constraints*

- MIS— total deposits of LICs--policy reserves less policy loans (A)  
LIV— flow of LIC investible funds (D)

### *Other*

- $\bar{FRT}$ ,  $\bar{RCB}$ — expected rates on total forward commitments of LICs and corporate bonds computed from past FRT and RCB data as described in the text  
 $V_{FRT}$ ,  $V_{RCB}$ — variances of expected rates on total forward commitments and corporate bonds-see descriptions provided in the text  
GR— growth rate in LIC investible funds from past LIV data as described in the text

## Notes

- [1] Notwithstanding, mortgage stock adjustment equations have also been estimated straightforwardly in recent econometric studies; see, for example, Bosworth and Duesenberry (1973), and Cassidy and Valentini (1972).
- [2] The forward commitment process is structured around an agreement negotiated between a borrower and the LIC for the delivery of a set amount of funds at some future period under specified terms of credit. The agreement, which is only legally binding on the UC, establishes the conditions for the "permanent" loan. The usual procedure is for the borrower to show proof of securing a commitment for permanent financing to a second lender who makes a short-term loan under a construction financing agreement. Once construction is completed, the borrower either accepts the commitment from the LIC or negotiates a new permanent loan to satisfy his financial obligation to the construction lender (see Klamann, 1961, Chapter 7).
- [3] Early applications of partial adjustment models for analyzing financial asset demand are found in the works of Meigs (1962), Goldfield (1966), and de Leeuw (1965). The concept evolved out of the fixed capital investment literature (see Jorgenson (1971) for a review), and is currently used in a variety of related research (see, for example, Kearl and Mishkin (1977) for a recent adaptation in the housing demand literature).
- [4] An exception is the mortgage commitment model developed by Pesando (1974).
- [5] Changes in mortgage commitments may be viewed as the difference between desired and actual commitments  $(MC - MC_{t-1}) = A \cdot (MC^* - MC_{t-1}) + u$ , where  $MC$  is the end of period level of new mortgage commitments,  $MC^*$  is a desired level of new commitments,  $\lambda$  is the periodic adjustment rate,  $u$  is an additive error term, and the numbered subscripts refer to time periods.
- [6] See (Bierwag and Grove, 1971; Brick and Thompson, 1978; Pippenger, 1974; and Roll, 1970) for evidence that current and past changes in interest rates are uncorrelated. Expectations may still be rational (see Muth, 1961), but are simply not represented in empirical analyses by past observations.
- [7] Three restrictive assumptions accompany Eq. (I). First, a single yield is used to measure returns on competing assets so as to avoid excessive multicollinearity. Second, the own rate and the opportunity rate are assumed to have opposite signs, but not equal in absolute value. Third, the scaling of mortgages by deposits excludes the equity base and other liabilities are long-run wealth constraints.
- [8] The model development that follows is largely abstracted from the Lintner et al. (1978) paper.
- [9] See Lintner et al. (1978:613-619).
- [10] See Lintner et al. (1978:624-617).
- [11] See Theil (1971: 556-562).
- [12] A comparison with Jaffee's (1962: 181) original estimates indicates that interest rates virtually disappear as a determinant of LIC demand for residential mortgages when data for the 1970s is included.
- [13] Cummins (1975:94) found some evidence of this type of substitution for LIC corporate bond acquisitions, but did not undertake a similar analysis for mortgages.

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Table 1. Comparison of Forward Commitment Models from Regressions Using Aggregate Mortgage Commitments

Dependent Variable: Aggregate LIC Mortgage Commitments (MCNI)\*

Regression Number	Coefficients <sup>b</sup>							
	Constnat	$(FRT_{-1} - RCB_{-1})MIS$	$\frac{FRT - \overline{RCB}}{V_{RCB}} \cdot LIV$	$\frac{FRT - \overline{FRT}}{V_{FRT}} \cdot LIV$	$(FRT_{-1} - RCB_{-1})LIV$	MIS	$\Delta MIS$	MRIS
1	-433.94 (-1.12)	.0023 (3.00)				.0048 (.60)	-.0291 (-.18)	.4512 (1.92)
2	287.68 (.97)		-.1205 (-2.19)					
3	297.86 (1.19)		-.0001 (-.12)					
4	204.77 (.59)			-.0003 (-1.48)				
5	-74.10 (-.26)				.0589 (1.81)			

  

$MKIS_{-1}$	LIV	$(\overline{GR})LIV$	$(\overline{RCB})LIV$	$MCOI_{-1}$	$MCNI_{-1}$	$R^2$	Regression Statistics		
							D.W.	Rho	SE
-.0113 (-.88)				-.0503 (-1.30)	.8965 (11.08)	.8752	1.69	.1369	270.47
	-1.8441 (-.59)	1.1693 (.72)	-5.9314 (-2.20)	.0180 (.49)	.5657 (4.16)	.7544	1.76	.4868	347.91
	-2.9595 (-1.02)	1.5625 (1.05)	.0017 (.30)	-.0298 (-.98)	.7203 (5.82)	.7622	1.61	.5383	373.37
	-3.7575 (-1.30)	2.0479 (1.37)	-.0197 (-1.30)	.0186 (.42)	.5586 (3.89)	.7256	1.74	.6317	401.09
	-4.5303 (-1.64)	2.3801 (1.67)	-.0119 (.89)	-.0019 (-.05)	.7252 (5.45)	.7961	1.78	.4448	345.77

Notes:

\* Other symbols are defined in the Appendix.

<sup>b</sup> Figures in parentheses are asymptotic t-statistics.

*Table 2. Cumulative Dispersement Lags for Aggregate and Disaggregate Mortgage Commitments<sup>a</sup>*

<i>Quarterly lag from commitment</i>	<i>Commitment category</i>		
	<i>Aggregate</i>	<i>Residential</i>	<i>Business-industrial</i>
0	.007	.220	.000
1	.148	.220	.088
2	.290	.269	.193
3	.429	.368	.306
4	.558	.513	.419
5	.674	.699	.524
6	.771	.921	.612
7	.843	—	.675
8	.886	—	.704

*Note:* <sup>a</sup> From regressions of mortgage flows and an eight-quarter distributed lag on commitments. The lag is constrained to a second-degree polynomial with no end point constraints. Regressions run with an intercept term, seasonal dummies, and the Cochrane-Orcutt technique in effect.

**Table 3. Comparison of Forward Commitment Models from Regressions Using Business-Industrial and Residential Mortgage Commitments**

Dependent Variables: A. Business-Industrial Commitments (FCNB)<sup>a</sup>  
 B. Residential Commitments (FCNR)

Regression Number	Coefficients <sup>b</sup>		A. $(FRB - \overline{FRT}/V_{FRT})LIV$				Regression Statistics		
	Constant	A. $(FRB_{-1} - RCB_{-1})MIS$ B. $(RM_{-1} - RCB_{-1})MIS$	B. $\left(\frac{RM - \overline{FRT}}{V_{FRT}}\right)LIV$	MIS	$\Delta MIS$	MRIS	D.W.	Rho	SE
1A	-509.83 (-2.11)	.0017 (3.84)		.0046 (.82)	-.0123 (-.14)	.1816 (1.48)			
1B	274.50 (1.19)	-.0001 (-.10)		-.0054 (-2.93)	.1018 (1.88)	.2702 (2.77)			
2A	-128.99 (-.81)		-.0001 (-.22)						
2B	190.11 (1.84)		-.0001 (-.31)						
A. $GSB_{-1}$ B. $GSR_{-1}$	LIV	$(\overline{GR})LIV$	$(\overline{RCB})LIV$	A. $FCOB_{-1}$ B. $FCOR_{-1}$	A. $FCNR_{-1}$ B. $FCNB_{-1}$	$R^2$			
				-.0158 (-1.60)	.9592 (14.16)	.9413	1.97	-.1475	167.60
				.0091 (.87)	.6198 (6.30)	.7891	1.96	-.0363	124.88
	-2.3328 (-1.32)	1.1635 (1.33)	.0036 (.44)	-.0071 (-.61)	.9290 (7.07)	.9094	1.87	.2848	210.35
	-1.8818 (-1.79)	1.0611 (1.96)	.0235 (4.38)	.0094 (.89)	.2348 (1.54)	.7933	2.11	.4924	139.57

Notes:

<sup>a</sup> Other symbols are defined in the Appendix.

<sup>b</sup> Figures in parentheses are asymptotic t-statistics.

Table 4. Substitutability Tests for Aggregate Mortgage Commitments.

Dependent Variable: Aggregate LIC Mortgage Commitments (MCNI)<sup>a</sup>

Regression Number	Coefficients <sup>b</sup>					Regression Statistics			
	Constant	$(FRT_{-1} - RCB_{-1})MIS$	$(FRT_{-1} - RTB_{-1})MIS$	$(FRT_{-1} - RCP_{-1})MIS$	$(FRB_{-1} - RM_{-1})MIS$	$R^2$	D.W.	Rho	SE
1	-433.94 (-1.12)	.0023 (3.00)							
2	243.01 (.57)		.0009 (3.02)						
3	388.42 (.92)			.0009 (3.94)					
4	-38.61 (-.08)				.0009 (1.19)				
<i>MIS</i>	$\Delta MIS$	<i>MRIS</i>	<i>MKIS</i> <sub>-1</sub>	<i>MCOI</i> <sub>-1</sub>	<i>MCNI</i> <sub>-1</sub>				
.0048 (.60)	-.0291 (-.18)	4512 (1.92)	-.0113 (-.88)	-.0503 (-1.30)	.8965 (11.08)	.8752	1.69	.1369	270.47
.0001 (.02)	.0111 (.07)	.2585 (1.09)	-.0121 (-.87)	.0088 (.19)	.8490 (9.97)	.8705	1.85	.2420	275.01
.0032 (.38)	-.0190 (-.12)	.1955 (.86)	-.0187 (-1.32)	.0387 (.81)	.7774 (9.08)	.8769	1.85	.2891	268.60
.0078 (.87)	-.0079 (-.04)	.3497 (1.41)	-.0157 (-.96)	-.0550 (-1.26)	.8987 (9.37)	.8669	1.87	.2385	289.89

Notes:

<sup>a</sup> Other symbols are defined in the Appendix.

<sup>b</sup> Figures in parentheses are asymptotic t-statistics.