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An analysis of the relationship between the mortgage credit supplied by financial intermediaries and residential housing activity

Shelby Joe Smith
Iowa State University

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by

Shelby Joe Smith

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CHAPTER I.

INTRODUCTION

In the past two decades, housing production has served as a balance wheel for the remainder of the economy--booming in periods of general economic stagnation and turning down in periods of economic exhiliration. Downturns in residential mortgage borrowing precede the onset of economic recession, often by many quarters. Mortgage borrowing then turns up again prior to the pick-up in general economic activity.[1] These fluctuations in housing activity have characterized all major classes of permanent dwellings: single-family homes and multi-family dwellings alike, conventionally financed units as well as federally backed ones. Housing production, due to its large size, is very important in the economy. Throughout the 1960s residential construction accounted for twenty-five to thirty percent of gross private domestic investment (44, p. 3). While real gross national product has varied between peak and trough by less than five percent over the past twenty years, residential housing expenditures have varied by twenty to forty percent. This cyclical behavior of the housing sector is not a problem endemic to the United States because similar cycles have been recorded in various nations almost regardless of the prevailing types of institutional arrangements (26, 63).

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[1] For an assessment of the cycles in residential housing construction, see (3, 22, 34, 49).

Going into the decade of the 70's, it seems a slight possibility that the feast-to-famine cyclical undulations will be ameliorated even though a formal national housing policy now exists which opts for a record number of units per year. The policy makers of the U.S. have, on occasion, been criticized for allowing the housing sector to be the sacrificial lamb of the economy. There has been a demand to provide greater stability to the housing sector by implementing more pro-housing fiscal and monetary policy.[1] It should be remembered short-run fluctuations in residential housing have had an important role in overall economic stability, moderating inflationary pressures during periods of excess demand, and aiding in recovery from economic contractions. It appears likely that variations in the rate of home building activity may have reached proportions that are politically and socially unacceptable. If, however, these swings in housing activity are dampened, the goal of overall economic stability will suffer unless this greater housing stability is combined with changes which force other sectors to share a greater portion of the burden. Whether or not the periodic fluctuations in the short-run housing cycle should be ameliorated and the goal of overall economic stability be jeopardized is a value judgement. No attempt will be made to answer this conundrum, but instead, we will simply proceed on the premise that the colossal fluctuations in housing production are inherently undesirable and policies designed to attenuate their magnitudes should be implemented.

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[1] Of course, to the degree this is done, other sectors of the economy may be affected more adversely than before.

There are a substantial number of housing students who believe the home building cycles are primarily caused by the supply of mortgage credit. The belief is based on the results from empirical studies as well as a priori reasoning. The system through which mortgage money is supplied to the housing sector is closely tied to our financial, particularly thrift, institutions. In recent years, excluding U.S. Government agencies, the four types of financial institutions--savings and loan associations (SLAs), mutual savings banks (MSBs), commercial banks (CBs), and life insurance companies (LICs)--have furnished close to ninety-five percent of the net increase in residential mortgage money. This seems to suggest that one way to study the housing construction cycle is to concentrate on mortgage credit flows. This concentration on financial variables has not been the route followed by some researchers; they have tended to focus on what has been referred to as basic demand variables. These variables are such things as population changes, household formations, vacancy rates, cost of housing as opposed to rent levels, etc.

The research undertaken in this exposition will concentrate on financial variables because our main interest is in the short-run cycles of the housing sector. Demographic factors and the relative price of housing, which might be crucially important determinants of housing demand and construction in the long-run, ordinarily do not change very much in the short-run; therefore, they will not be included in the analysis undertaken in this research. Even though the flow of financing through depositary institutions is considered to be the most important factor generating the short-run housing cycle, the basic demand variables will tend to put a floor on cyclical troughs and a ceiling on peaks. The

connection between the supply of mortgage credit and building activity derives from the fact that residential building is heavily dependent upon outside financing and in periods of tight credit conditions the flow of savings through financial intermediaries to the mortgage market dries up. Contrariwise, in periods of easy credit, long-run financing necessary for building activity is readily available.

This focus on the short-term housing cycle and financial variables leads to a separation of the housing sector by credit supplying intermediary. We have chosen to segregate the mortgage market into four subsectors consisting of the four major financial intermediaries outlined above, viz., SLAs, MSBs, CBs, and LICs. An alternative formulation, and one followed by some researchers, would have allowed product differentiation in the home mortgages according to loan type, i.e., FHA, VA, and conventionally financed.[1] The differentiation by financial intermediary is not radically different from differentiation by loan type because the various intermediaries specialize in a particular type of loan. Probably the ideal approach would be to separate by intermediary and loan type, for example, FHA loans from SLAs, etc., but the dearth of good data precludes this approach. The intermediary approach was chosen because we felt the data were more consistent and when employing the loan type method it is necessary to aggregate across institutions whose behavioral relationships vary considerably.

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[1]FHA and VA are Federal Housing Authority and Veterans Administration, respectively.

Up until now we have mentioned the flow or supply of mortgage credit without discussing the demand. Demand for mortgage credit will not play a major role in this research because we feel, along with numerous other housing researchers, the stop-and-go pattern of housing starts is primarily determined on the supply side of the market. It has been argued by many that it has been supply rather than demand which has determined the volume and price in the mortgage market.[1] A basic assumption in such an argument is that supply forces have been more dynamic and easily adjustable in that lenders respond to changed market conditions or to expected changes more readily than do consumers. The supply orientated approach implicitly assumes the demand for mortgage credit is always sufficient to clear the market. By assuming an ever present sufficient demand, we can determine the supply of mortgage credit by looking at financial variables given that demand is adequate at all supply levels and the market will be cleared. The supply approach was also adopted because of the poor results other researchers have obtained when they attempted to estimate demand. Actually, an attempt to estimate the demand for mortgage credit would be very difficult since no actual series exists for ex ante demand, i.e., there is no way to determine what portion of demand goes unsatisfied because of subjective rationing, etc. This probably arises because on the demand side we are confronted with a complex matrix of variables. To most individuals, housing is more than an investment; ownership is customarily intertwined with the objective of occupancy. Various amenities beyond the realm of investment arise,

[1] Supply and demand forces of housing models are discussed in (43).

e.g., social stature, privacy, tax advantages, etc.; thus, demand is influenced by so many diverse and unquantifiable variables that attempts to specify it have failed. Another less important reason why supply is favored over demand is that when supply of loanable funds is inconstant, as it periodically is, intervention to correct imbalances requires an understanding of the supply function, i.e., from a policy standpoint, supply is more easily manipulated than is demand. To the extent that housing activity is not determined by the availability of mortgage credit flows, the analysis undertaken in this study will be in error. If the assumptions concerning supply and demand are unsuitable, they will emerge by generating poor results in our estimation and forecasts.

This paper will be primarily concerned with nonfarm, residential housing. This arises because the financial institutions to be considered land primarily in this market. The inclusion of nonresidential housing would require an analysis of other suppliers of mortgage credit and the data from these sources are not as accessible nor are they as reliable as what we have chosen. Additionally, the federal credit programs have concentrated on the residential sector of the housing market; thus, any assessment of policy tools should focus on the same segment of the market. Furthermore, the bulk of the housing research in the past has been concerned with residential housing and the literature is more developed in this area.

The sample period chosen for analysis is 1964:1 through 1972:2. This relatively short period was chosen solely because of data limitations. It would probably be better to lengthen the sample period but some of the data series simply do not exist before 1964:1 and the

necessary data to estimate them were also unavailable. The primary difficulty associated with a limited sample period is the degree of freedom problem encountered in the statistical analysis. It is felt, however, that the period is sufficiently long to prevent major statistical problems. The sample period contains two substantial downturns in the housing cycle; consequently, the analysis will be put to a strenuous test since the data series are of such short duration.

In addition to the short sample span, another data problem exists in that the mortgage credit market is constantly undergoing structural change which makes it difficult to find a period long enough for statistical analysis. For example, in 1966 the Johnson Administration constrained the Federal Home Loan Bank System (FHLBS) in its efforts to make advances; in 1968 the Federal National Mortgage Association (FNMA) was reorganized into a quasi-governmental organization and removed from the federal budget which in turn altered its modus operandi. A host of federal agencies take concerted and nonconcerted actions in and out of the mortgage market over time so that the magnitudes of economic forces operating within the constantly shifting institutional framework become very difficult to identify. The problem involved is to reduce the host of complex and intricate mechanisms of the mortgage credit market into relationships involving only a manageable number of strategic variables. Hopefully, this reduction process will leave a realistic framework capable of explaining the factors at work in the residential mortgage market.

Quarterly data were chosen because this has been the route taken by other housing research and this data are more plentiful. Additionally,

a quarterly time dimension corresponds to the observed seasonal pattern of variation in many of the relevant flow variables, and the practice of quarterly dividend patterns suggest that the short-term planning horizon could logically focus on this time period. The only other plausible alternative was to use monthly data but it is felt the month is too short a time period for response to rapid, substantial changes in financial variables.[1] There will be no attempt to disaggregate below the national level since appropriate data series are nonexistent.

The most common approach taken by housing researchers has been to employ a stock adjustment mechanism. The research to follow deviates from this precedent because it was felt the stock adjustment approach would not provide the best results, especially vis-à-vis forecasts. The reason for this decision was because a stock adjustment approach has at least three undesirable characteristics: (1) almost invariably too much weight is given to the lagged dependent variable, (2) the turning points in the dependent variable are likely to be missed when forecasts are attempted, and (3) it is necessary to assume the adjustment coefficient remains constant throughout the analysis. We chose the method of determining the independent variables of the system a priori and then testing them for significance with regression analysis. This approach, combined with the exclusion of the demand side of the market, leads to a system of equations that are neither structural nor reduced form but have been referred to in the literature as quasi-reduced form equations.

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[1]Some analysis of monthly data was attempted but the complicated lag structures made this approach unmanageable.

This method of estimation does not lead to a formal model of the mortgage credit market but this is unimportant since the primary concern is the relationship between credit flows and residential housing activity. Many models have not captured in an adequate way the relationship between the housing and mortgage markets; hopefully, this research will not be so afflicted. The accuracy of the approach adopted will be judged by the forecasted results.[1]

An assessment of the residential housing and mortgage credit markets requires an examination of the supplying intermediaries because it is here that the disturbance is first generated. For example, when money becomes tighter, institutions that have a wide latitude in investment choices, e.g., CBs and LICs, put fewer funds into residential mortgages. Furthermore, other institutions, e.g., SLAs and MSBs, have an asset structure which makes it difficult to compete for funds when short-term market rates rise rapidly. We see then that the four principal mortgage lending intermediaries are either shunning residential mortgages for more profitable investments or are the victims of disintermediation which leaves fewer funds for housing purposes. During periods of credit restraint, further instability is injected into the housing sector as businesses enlarge their command over financial resources, labor, and capital, thereby increasing their real output at the expense of housing construction. As a result it is no surprise that changes in the cost and availability of credit in general have acute and substantial impacts in the housing sector. Fluctuations in the availability of mortgage

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[1]This ad hoc approach is similar to Brady's (8).

credit have increased the basic instability of house building. Many recommendations—both good and bad—have been made to improve the mortgage credit cycle and thus facilitate a moderated house building cycle. The purpose here is not to judge these various proposals but to analyze the role of mortgage credit in the existing economic atmosphere. Admittedly, such institutional and political caveats that may exist should be taken into account in any analysis.

The general plan of this paper is to determine and specify the variables that influence mortgage credit flow through the major financial institutions serving the housing sector. Each intermediary will be considered separately but as much symmetry as possible will be maintained. Since each intermediary acts somewhat independently in the market, there is no a priori reason to assume they will all be influenced by the same variables. In fact, just the antithesis is expected. Once the individual intermediary flows are analyzed, they will be combined into one composite series and employed in the analysis of the residential home building activity. This indirect approach to the housing sector should yield reasonably good results because the demand for mortgage credit is derived from the demand for housing stock.[1]

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[1]We are implicitly assuming, as other researchers have done, the factors of input—land, materials, labor, etc.—are in perfectly elastic supply and no bottlenecks are forthcoming in these areas.

CHAPTER II.

SELECTED REVIEW OF THE LITERATURE

Concern about the cyclical swings in the housing sector, and a growing discrepancy between privately and socially desired and actual housing stocks has spawned a substantial amount of research investigating this sector of the economy.[1] In a study of the sort undertaken here, it would be impossible to review all the research accomplished in the past two decades; consequently, the review of the literature will be limited to selected models which have similarities of the analysis to be undertaken in this paper. On theoretical grounds, no model clearly is preferred; each has a unique rationale and advantages. On empirical grounds such as goodness of fit or ex post prediction accuracy, it is difficult to make an assessment. The models are estimated over different periods and seek to accomplish different objectives; therefore, it is hazardous to make comparisons. All the models to be reviewed are short-run in nature and the authors have largely ignored long-run influences on mortgage credit flows and housing. Some of the models of the housing sector are relatively undeveloped and have performed rather poorly for forecasting purposes. This is not to say considerable progress has not been made. Both in terms of specification and prediction, improvements

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[1]For a partial list of the research completed in the housing and mortgage credit sectors, see (30, 68). Recent empirical models are discussed at some length in (43).

have been realized and inaccuracies reduced. Hopefully, continued progress will be forthcoming in the future as better data become available.

The four models selected for review are all of recent vintage but each uses a different technique. Brady's work will be reviewed because he deals specifically with housing starts according to the type of financing. This model is straightforward and not cluttered with side issues as is some of the research reviewed. Huang's model is of special interest because he deals with mortgage credit flows as well as housing starts; additionally, Huang's research has been widely accepted as one of the more important pioneer works. Jaffee's simulation model was selected primarily because of his treatment of advance mortgage commitments. Also he segregated his analysis by intermediary which is the procedure to be followed in this research. Furthermore, Jaffee's model is one of the few simulation approaches designed to evaluate alternative policy prescriptions. Silber's work was chosen for review because he concentrated strictly on mortgage credit supplied by intermediary. Even though Silber did not extend his research to include actual housing activity, it might be so extended since starts and mortgage credit flows are thought to be positively related. Two of the models chosen for review are segregated along intermediary lines whereas the remaining two concentrate on the type of financing. Two deal with starts, either directly or by value, and two are concerned with mortgage credit flows. Even though these four models represent only a small portion of the total research in this area, we feel they are a fairly accurate cross section of the research undertaken to date.

Brady's Model

Brady[1] develops a short-run econometric model of the U.S. residential housing market utilizing quarterly data, seasonally adjusted at annual rates, and concentrating on financial variables.[2] The sample period is 1960:3 through 1970:2 and the modes of analysis are ordinary and two-stage least squares. The housing market is divided into single-family dwellings which are conventionally financed, FHA-insured, and VA-guaranteed, multiple-family dwellings, and mobile homes. This division is based on the results of a correlation matrix of the different sectors and on the outcome of previous analysis (10, 11). Brady uses three starts series the first of which corresponds to all the above five types (HTTT series), the second is all starts minus mobile homes (HTT series), and the last is all single-family starts (HTUS series). Brady reasons that a separation of the overall market into its major components will lead to better structural fits and forecasting results. Our review will concentrate on the HTT series since it is the series to be analyzed and estimated in this paper. Brady also has a value-of-starts series which corresponds to his HTT series and is analogous to the value series to be analyzed in this paper. The actual equations formulated by Brady appear

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[1]The primary model is given in (8), however, additional research which is related is (10, 11, 12, 13).

[2]The analysis used explanatory equations based on a priori specifications. Brady finds that basic demand variables do not influence the short-run movements in the housing sector even though they may affect the long-run behavior. He contributes their insignificance to the generally poor quality of the data and/or the fact that supply factors are more important in explaining the quarterly variation in housing starts than are demand variables (8, p. 17).

in Appendix A along with a brief explanation of his variables.

Brady begins by estimating the HTT series and also its value. The basic criticism of these estimates is the mixture of supply and demand variables in the same equation. For example, the HTT and the ICNFR58 equations contain as predetermined variables both the Boeckh index and the net change in FHLBS advances. The Boeckh index is a variable associated with the demand for housing whereas advances are aligned with the supply of mortgage credit. The admixture of variables is also a basic weakness of the other estimation equations derived by Brady and could account for the unusual sign obtained for the Boeckh index variable. There also appears to be a conspicious lack of federally underwritten mortgage variables in the aggregate starts and the value-of-starts equation. It appears, by observing Brady's results, the federally underwritten sector is unimportant in explaining either value or volume of residential housing starts. This is an unexpected outcome since approximately twenty-five percent of all residential starts are either FHA or VA financed.

Brady next estimates the various subsectors of the housing market.[1] Due to the similarity of the cyclical movements in FHA-insured and VA-guaranteed starts during the 1960's, these two series are combined and estimated as one. The only additional criticism of these equations is the low D-W statistic of 0.79 and possible positive serial correlation or misspecification associated with the federally underwritten starts

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[1] His mobile homes equation will not be reviewed because this research is not concerned with this series.

equation and the low significance level of the FNMA-GNMA[1] variable (t-statistic of 1.7) in the same equation. Both of these shortcomings are important: the former because it violates one of the basic assumptions of least squares analysis and may lead to biased results[2] and the latter because Brady later employs this variable as a policy instrument. The negative time trend obtained by Brady for all series except HM, has been referred to as an anomaly probably arising from misspecification of the equations. This is probably a correct assessment, especially for the aggregate equations.

Brady's summary statistics are reasonable and the equations, with the exception of the multiple-family dwellings one, track the actual series over the sample period. The equations capture the downturns in housing activity without a substantial delay and this is the strong point of the analysis. To verify the independence of the various subsectors of the model, Brady reestimated the equations using two-stage least squares. Based on low t-statistics of the exogenously entered dependent variables, he concluded the simultaneous equation bias was of a negligible magnitude.[3]

Brady's equations allow him to predict any of his starts series or the magnitudes of the various subsectors. However, our interest is

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[1]GNMA is the acronym for Government National Mortgage Association.

[2]For the consequences of autocorrelated disturbances, refer to (42, pp. 179-88).

[3]In (11) Brady also concluded the two-stage results were not superior to the ordinary least squares analysis.

confined to the HIT series. Brady's predictions of this series along with the actual values and percent error appear in Table 2.1 below. With the exception of 1970:4, these forecasted results are reasonably accurate, especially if we consider that exogenous variables also had to be estimated. Brady's estimates are too low in all instances except 1971:3 when it is marginally above the actual value. This underestimation could be rooted in positive serial correlation of the residuals in the HIT equation since the D-W statistic is in the indeterminate zone.[1]

TABLE 2.1

Brady's estimates of housing starts, actual values, and percent error (In thousands, seasonally adjusted, annual rates)

Quarter	Actual	Estimated	Percent error
1970:4	2054	1577	23
1971:1	1938	1777	8
1971:2	2008	1868	7
1971:3	2029	2071	2
1971:4	2457	2207	10

Brady also made estimates of the various demand elasticities for subsectors of his housing market. Additionally, he converted the forecasting model into a policy model. These ancillary aspects of the research are interesting but are not pertinent to the current undertaking and consequently will not be reviewed.

[1]For a list of the D-W values needed to prevent serial correlation, see (21).

Huang's Model

Huang's model (35, 36, 37, 38) can be broken into three distinct parts consisting of the demand side of the market, supply of mortgage credit, and mortgage yield adjustments and relations. This latter subsector of Huang's model has remained relatively undeveloped due to difficulties in specifying excess supply and demand in the model. Since this portion of the model lacks good empirical verification, it will not be reviewed. The demand side of the model will also not be analyzed since the nature of this exposition will be supply oriented. No damage is done by segregating the model and analyzing only the mortgage credit supply component since the subsectors of Huang's model are developed and tested separately. Huang concurs with other researchers that the supply of mortgage credit has a controlling influence over housing starts and has determined the volume and price in the postwar mortgage market (35, p. 1225); thus, the supply portion of the model is the best developed and could probably be referred to as the heart of the model. Huang's model has evolved over time, gradually becoming more complete as it incorporates better data and undergoes additional scrutiny. The last work cited is doubtless the most complete to date and will be the subject of this review, but it will sometimes be necessary to make references to the earlier research.

Huang's division of the mortgage credit market is by type of loan instead of intermediary. This alternative is chosen because according to Huang (37, p. 442) federal participation in the postwar mortgage market has been an important factor in shaping the mortgage and housing

market as a whole so that for policy purposes it is desirable to see how each type of mortgage activity takes place in response to changing money and capital market conditions. His model uses seasonally unadjusted quarterly data for the period 1953:4 through 1970:2. The analytical mode is ordinary least squares. Huang first estimates the total mortgage credit supplied.[1] His equation explains about ninety-three percent of the variation in the dependent variable but the low D-W statistic indicates some minor problems. Huang included in this aggregate supply all variables which achieved significance in the disaggregated equations for the subsectors. This procedure results in four of his independent variables having a questionable significance level, viz., mortgage rate and short-term market rate lagged one quarter, long-term corporate bond rates lagged two quarters, and the new purchases of FNMA. No doubt the problem associated with the interest rates can be traced to the multicollinearity of these terms. Even though the FNMA variable is insignificant, it is interesting to note the apparent inverse relationship it has with total mortgage credit supplied. Commitments are not included and are never discussed as a possible candidate for inclusion. It would be difficult to include commitments in an aggregate equation because of the varied commitment structures of the supplying intermediaries. It is puzzling, however, how commitments have been important in other research efforts, especially disaggregated approaches, and yet not incorporated into Huang's analysis. The long lag associated with net increases in saving deposits at selected institutions is unique

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[1]This equation and others formulated by Huang appear in Appendix A along with an explanation of the variables.

to Huang's analysis and has not been duplicated elsewhere. Most would argue the lag structure is shorter and, in fact, Huang himself finds the unlagged version of this variable to be significant in explaining supply in his earlier work (37). The unlagged version of the monetary base variable is somewhat surprising in light of the fact that a lag is usually associated with the transmission of monetary policy to the capital and mortgage markets. This immediate impact of monetary policy could be a reflection of advance commitments activity but its high level of significance all but rules out this possibility. It could be that the historical increase in the monetary base variable and the aggregate supply of mortgage credit has been more coincident than causal. Huang's justification for the unlagged version of the monetary base variable is based on an experiment where it proved superior to a one and two period lag. Huang has included only supply related variables in his aggregate supply equation and, in general, his findings parallel those of other researchers.

Huang next disaggregates his model into three subsectors corresponding to loan type. He contends the FHA and VA subsectors of the market indicate a high degree of substitution and can be treated as one government underwritten sector.[1] The subsector equations contain essentially the same variables as the aggregate equation. The mortgage rates associated with the given type of loan is substituted for the general rate used in the overall supply equation. The FNMA variable is excluded from the conventional mortgage equation because it was insignificant and displayed

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[1]He justifies this combination on the basis of elasticity estimates which he derived. Huang (36, pp. 10-12) concurs with Brady that the two markets have moved in unison only since the early 1960's.

a negative sign.

The government underwritten sector explains sixty-five percent of the variation in the dependent variable. The D-W value of 0.87 indicates the existence of positive serial correlation, or left out variables, or wrong functional form, or any combination of these in varying degrees. The problem becomes serious if the estimation equations are to be used for forecasting, and, realistically, makes the results of the regressions less reliable since a basic assumption of the least squares technique has been violated. The three quarter lagged saving inflow coefficient is not significantly different from zero and could have been safely excluded from the equation. Its unimportance is probably rooted in the fact that intermediaries which make FHA and VA loans have some latitude in their portfolio choices; consequently, inflows go to those items which are most profitable and this may or may not be mortgages. The importance of this variable in the aggregate and conventional equation derives from the fact that SLAs are the largest mortgage credit supplying intermediary and they effectively have no portfolio diversity. It is interesting to note that the FHLBS advances achieved significance in the government underwritten equation whereas FNMA did not. This is the exact opposite of what would be anticipated on a priori grounds because FNMA's activity is confined to FHA and VA instruments whereas FHLBS advances go predominately to SLAs which make mostly conventional loans. This is a queer outcome which has not been duplicated by other researchers.

The conventional sector supply equation explains ninety-four percent of the dependent variable's fluctuations. The interest rate terms fail to achieve a reasonable level of significance; this probably results

because the lack of portfolio diversity of SLAs make own and alternative yields unimportant. The one quarter lagged value of FHLBS advances is somewhat of a novelty because during most of the sample period the FHLBS has been characterized as a lender of first resort (7, pp. 160-1 and 58, p. 70). The lagged version of this variable has not been verified by other research and, on a theoretical level, its use is questionable.

No housing starts equations were included in Huang's most recent research because he feels mortgage credit flows stand as proxies for real variables, such as housing starts (36, p. 4). In his 1969 model, the value of housing starts and the supply of mortgage credit was forecasted for 1966. These predicted values along with actual values and percent error are shown in Tables 2.2 and 2.3 below. It is an injustice to take these earlier results as representative of Huang's efforts but he offered no forecasts from his latest work and the exact data to fit his variables were unavailable; thus, no independent predictions were possible from the latest equation.

TABLE 2.2

Huang's estimates of housing starts values, actual values, and percent error (In millions of dollars)

Quarter	Actual	Estimated	Percent error
1966:1	4799	4794	2.02
1966:2	5001	4694	6.32
1966:3	3926	4367	11.23
1966:4	3795	3016	20.55

TABLE 2.3

Huang's estimates of the supply of mortgage credit, actual values, and percent error (In millions of dollars)

Quarter	Actual	Estimated	Percent error
1966:1	3488	3593	3.01
1966:2	3734	4484	20.08
1966:3	3386	4930	45.59
1966:4	3249	4476	37.77

Huang's forecasts are somewhat less than desirable but 1966 witnessed a massive downturn in mortgage credit supply activity. Huang contributes his poor forecasts to structural changes in the mortgage market beginning in 1966. For whatever reason, the quality of the forecasts was low but should improve as the 1971 modifications of his model are included. The main criticism of Huang's research is his consistent tendency to discuss and draw conclusions from variables which failed the usual significance tests. It is hazardous to base policy decisions on variables whose partial regression coefficients are not significantly different from zero. It almost seems he incorporates the variables he needs for policy irrespective of their statistical importance.

Jaffee's Model

Jaffee (41) estimates a structural model explaining mortgage commitments and mortgage credit flows by the major financial institutions in the mortgage market. On the mortgage credit supply side of the model he estimates gross mortgage flows for SLAs, MSBs, and LICs and net change

in mortgage loans outstanding for CBs. Jaffee develops supply, demand, and interest rate equations in his model but since our concern is supply oriented, only the supply part of the model will be reviewed.[1] Jaffee's model was developed as a component sector of a complete model of the economy; consequently, he was constrained to use data endogenous to the larger model whenever possible. Additionally, the model of the mortgage sector was prepared with particular concern for the lags in the affect of variables and the quantitative effects of the available policy instruments. The sample period employed for the estimation was the second half of the 1950s through 1968:4. Seasonally adjusted data were used except the interest rates were unadjusted. Ordinary least squares was used to formulate the equations and all equations displaying serial correlation of the errors were adjusted to compensate for it.[2] Jaffee did not bother to analyze or adjust for simultaneous equation bias by using higher level least squares because the more sophisticated technique did not yield better results for other researchers. The distributed lags estimated by Jaffee were derived by using the Almon technique (4). The final estimation equations and an interpretation of the variables employed by Jaffee may be found in Appendix A.

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[1]The supply side of the model is more developed and disaggregated than is the demand side. The importance of the supply portion is exemplified by Jaffee since his model implicitly assumes the market is never in a situation of excess supply and demand adjusts to an essentially predetermined supply (41, pp. 42-3).

[2]The coefficient of serial correlation, p, for those equations estimated with the iterative procedure of Cochrane and Orcutt appear, along with the summary statistics, in Appendix A.

Jaffee's analysis starts with a modified stock adjustment approach. A variant of a stock adjustment model was needed to take into account the institutional arrangements for advance commitments of mortgage credit. The available data on advance commitments is used to estimate directly an equation for the supply of commitments. For SLAs, MSBs, and LICs, Jaffee derives the gross flows of mortgages as essentially realizations of commitments made earlier. For CBs, the absence of commitments data forces him to estimate the mortgage flow directly. Constants were added in the gross mortgage flow equations, but not the net change equation for CBs, to allow for misspecification and data scaling in the estimated commitments equations. Generally speaking, Jaffee's summary statistics are good and the model tracks the actual values of the endogenous variables quite well. Jaffee made no forecasts because his primary concern was simulation. By "shocking" the model, his simulation approach allows an assessment of the impact of various policy instruments.

Jaffee's use of the stock adjustment approach calls for the inclusion of the lagged dependent variable as an independent variable in the regression equations. In all equations the lagged endogenous variable was statistically significant and displayed the correct sign. The inclusion of this variable is an inherent weakness of the stock adjustment approach because it makes current quarter estimates depend upon past quarter flows; thus, a type of extrapolation is being used and the model may perform poorly at turning points in the series. Jaffee's results are not substantially hobbled by this shortcoming because the

coefficients of the lagged dependent variable are quite small for a stock adjustment approach.[1]

Jaffee's model failed to track the actual dependent variable during 1968 and he attributes this to a structural shift in the mortgage market probably related to the uncertainty of the effects of tight money on deposit flows following the unhappy experiences of 1966. No attempt was made to judge the source or importance of this effect but instead it was neutralized by adding a dummy variable for 1968. The one unique and innovative feature of Jaffee's research is his use of commitments data to estimate mortgage flows. Many researchers have ignored this variable because of data difficulties, collinearity problems, added complexity of the model, etc., but Jaffee shows that commitments are important and their inclusion leads to better estimations. The simulation nature of Jaffee's model may have led to added complications of the commitments variable because he was constrained from eliminating recent commitments from his equations. It seems prudent to assume that for LICs the immediate past commitments do not influence current quarter mortgage credit flows because this intermediary rarely uses short-term commitments; however, Jaffee found that recent commitments of LICs were the most important.[2] On the other hand, he contends that mortgage credit flows of SLAs are influenced by commitments made up to six quarters past.

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[1]The possible exception occurs with the most important credit supplying intermediary, SLAs, where the coefficient is approximately 0.30.

[2]He partially refutes his own finding by showing that the mean length of LIC commitments is 2.7 quarters. Another source (27, p. 2) indicates that this may be an underestimate of the mean length.

In view of the very short-term nature of SLA commitments, this result appears a bit farfetched. In fact, Jaffee's own equation has the six quarter lagged value of commitments inversely influencing current quarter flows. A very curious result which has little intuitive appeal. The MSB equation also appears to stress current and immediate past commitments too heavily. In toto, Jaffee should be commended for his inclusion of commitments even though he seems to become over zealous in estimating the lag structure.

All the usually included financial variables appear in the SLA supply equation with the exception of credit terms. This absence is probably overcome by the distributed lag structure of outstanding commitments which reaches back six quarters. There is no explicit mention of a variable to measure aggregate monetary policy. This lack is doubtless rectified partially by the commitments variable and also by including a unique deposits variable which measured the deposit inflow variation from a four quarter moving average. This deposits deviation variable is indigenous to all the equations except the one associated with CBs. The FHLBS advances variable was not highly significant but it was nevertheless included since it is one of the policy instruments which Jaffee seeks to analyze.

The equation for LICs and MSBs are analogous to the one for SLAs as far as variables are concerned. The repayments variable in the LIC equation was not statistically significant but to keep the equation symmetrical, it was retained as an independent variable. The coefficient attached to repayments in the MSB equation was constrained to be 0.4 on

the grounds that it implied a reasonable coefficient for repayments in the MSB commitments equation and that this magnitude was approximately the mean of the estimated repayments coefficients for LICs and SLAs.[1] This ad hoc approach is questionable and could raise difficulties if the equation is used to estimate flows outside the sample period. The activity of FNMA-GNMA is not included in the intermediary equations but instead enters the model as a separate entity. The rates on substitute portfolio items enter the mortgage flow equations indirectly via the commitments equations.

The CB equation is relatively simple since it includes only deposits and the lagged dependent variable on the right hand of the regression equation. Time deposits are entered once as a distributed lag by themselves and again as a distributed lag but scaled by the interest rate difference of mortgages and the commercial loan rate. Demand deposits have a very small partial regression coefficient which is not significantly different from zero; nevertheless, for completeness it was incorporated into the equation. It is interesting to observe that time deposits reach their apex of importance after a one or two period lag which indicates that CBs may practice a wait and see attitude toward mortgage credit supply activity. The CB equation might be improved if an index of monetary movement were included, especially since no commitments variable appears in the estimation equation.

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[1]The primary reason for fixing this coefficient was the substandard results obtained from the initial regressions.

As previously mentioned, Jaffee made no forecasts of the dependent variables or of housing starts but instead concentrated on simulated shocks to judge the efficiency of policy variables.[1] Even though these are of minor concern to this research, we feel compelled to comment that Jaffee carried his simulations further into the future than could be justified. For example, in many instances he was commenting on the influence of a shock that had occurred some thirty-two quarters previously. This seems particularily irrelevant since his model is primarily short-run and probably not capable of handling such long-run changes. Basically, Jaffee's supply estimation equations are very good and could probably be used to make reasonably accurate forecasts of short-run future activity in mortgage credit flows. The model of the mortgage market developed by Jaffee differs most notably from other studies in its emphasis on the effects of policy controlled variables and the lags in timing introduced by advance commitments for mortgages.

Silber's Model

Silber (59) attempts to specify and estimate an econometric model describing the behavior of the participants in the mortgage credit market. The model is divided into supply and demand forces. Our primary concern is with the mortgage credit supply part of the model which analyzes the four major financial institutions participating in the

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[1]This occurs because Jaffee's mortgage credit model is a subset of a larger model of the entire economy. This larger model, by using Jaffee's results, is designed to make forecasts of credit flows as well as actual housing starts.

mortgage market. This model does not attempt to separate mortgages by type of financing but instead concentrates on the supplying intermediary. Silber uses seasonally unadjusted, quarterly data to analyze the period 1953:1 through 1965:4 and then forecasts the 1966:1 aggregate mortgage credit outstanding by intermediary. He is interested in total mortgage loans outstanding and not the flow of new funds into the mortgage market.

The model includes mostly financial variables; consequently, it can be dubbed a short-term model. A stock adjustment mechanism is employed and all structural equations include the lagged value of the endogenous variable. Silber specified the estimation equations using ordinary and two-stage least squares analysis and he adjusted for serial correlation when it was a serious problem.[1] The summary measures of the equations appear to be very good but this is probably attributable to the stock adjustment structure of the model.[2] Silber analyzes each intermediary in turn and then aggregates them into one mortgage credit supplying entity. It seems appropriate to review his analysis by considering each intermediary separately.[3]

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[1]The final equation for MSBs was estimated by ordinary least squares whereas the final equations of the other three intermediaries were derived by two-stage least squares.

[2]A large importance attached to the lagged dependent variable, which determines the adjustment coefficient in a stock adjustment type model, leads to future predicted values which are linear extrapolations of past movements; thus, the models fails when it is most needed, namely, at turning points in the series.

[3]Silber also estimated a mortgage credit demand equation for the household sector of the economy but this portion of the model is excluded from this review because of the supply determined nature of the research to be formulated in this exposition.

Silber found that the return on other portfolio items, mostly government securities, did not influence SLA credit supply behavior. He chose to use the rate on advances rather than the volume and did find it significant, albeit at a low level. Deposits and lagged credit outstanding were significant and properly signed. The difficulty with the SLA equation is not what was included but rather what was excluded. Conspiciously missing are credit term variables associated with mortgages, i.e., interest rate, loan-to-value ratio, and amortization length. Silber contends these are unimportant because SLAs have no portfolio diversity and they must invest in mortgages or not at all. This may be relevant in the long-run but in a short-term model such as this, credit terms should be important. Also absent from the SLA equation are commitments and repayments; these may be rationalized away in a "levels" concerned stock adjustment model but they are doubtless important in explaining movements in a "change" type model. In summary, Silber's SLA equation is determined by three real variables, one of which has a questionable significance and another which is the lagged dependent variable.[1]

In the LIC equation, mortgage repayments are explicitly excluded but are, no doubt, implicitly included in the total assets variable. Silber claims the signs of the interest rate difference variables indicate mortgages and corporates are substitutes whereas mortgages and

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[1]Silber adjusts for serial correlation among the residuals because the D-W statistic indicated its presence; however, the D-W statistic may be unreliable when the estimation equation contains the lagged dependent variable, see (53, p. 235).

governments are complements. The net coefficient of the differential terms is positive and indicates the coefficient of the mortgage rate. Loan-to-value ratio is included but Silber excluded amortization length on the grounds it is highly collinear with the former. He had a two quarter lag of mortgage commitments which appears short on a priori grounds as well as on evidence of other empirical studies. Even though Silber's equation tracks during the sample period, it is likely to perform awkwardly as a forecasting tool because of the large coefficient associated with the lagged dependent variable. On the basis of the t-statistic, only three of the seven independent variables in the LIC equation are highly significant. The rate differentials and the loan-to-value ratio are probably collinear which accounts for their low significance but it is parlous to base interpretations on a variable whose significance is questionable.

In the MSB equation, there is no explicit mention of forward commitments, repayments, or noninterest credit terms. This equation has the same weaknesses as the previous two even though it tracks rather well. Silber does not attempt to include FNMA-GNMA activity into this equation because he treats government intervention, along with other nonintermediary supply, as a residual.

The CB equation reported by Silber is surprisingly simple for such complicated financial institutions. The equation has only three exogenously determined variables, and the two deposit variables are likely collinear. Missing from the CB equation are credit term variables, rates on alternative portfolio items, and monetary variables. Curiously enough, the coefficient associated with time deposits is roughly twice

that of demand deposits; this, as we shall later see, is approximately the same result obtained from an entirely different approach.

The basic criticism of Silber's approach is the stock adjustment nature of his model. His summary measures of goodness of fit are excellent but these no doubt arise because most of his explanatory power lies in the lagged dependent variable. There is a surprising lack of lagged independent variables. It seems that most decisions of financial intermediaries are based on current quarter magnitudes. This curious outcome conforms neither to observed practices nor to the results of other studies.

To assess Silber's success, let us analyze his forecasted results. He attempted a forecast for 1966:1. The actual and predicted values for this quarter are shown in Table 2.4. A cursory examination of this Table

TABLE 2.4

Silber's estimates of the total mortgage credit outstanding, actual values and percent error (In billions of dollars)

	M^3	M^2	M^c	M^1
Actual	112.00	45.36	50.20	61.26
Estimated	112.23	45.84	50.58	61.60
Percent error	0.2	1.06	0.76	0.55

might lead one to believe Silber's model is near perfect because of the small differences in actual and predicted values. However, if we take the change in the variables during 1966:1 and compare them with the difference in the actual and predicted values for 1966:1, a different

picture emerges. Table 2.5 shows this comparison. It appears that Silber's estimates are good only because he is working with large numbers and if we consider his forecasts in terms of net changes in mortgage credit flows, the model performs rather poorly.[1]

TABLE 2.5

Net change versus the actual-estimated error for 1966:1
(In millions of dollars)

	M^S	M^M	M^C	M^I
Net change during 1966:1	1678	769	435	1124
Difference in estimated and actual from Table 2.4	230	480	380	340
Percent error	13.7	62.5	87.4	30.2

The important variable in predicting short-term housing starts from the supply of mortgage credit is the amount of new funds flowing into the housing sector. Silber's model will yield this variable if we take the predicted value of M^i_{t+n} and subtract from it M^i_t. Table 2.5 shows that such a derivation is likely to yield poor results; therefore, the model is not acceptable for predicting short-run changes in mortgage credit outstanding and assessing the volume of new housing starts. Silber's model, however, predicts rather well what it is designed

[1]The estimates of Tables 2.4 and 2.5 are greater than the actual values for all financial intermediaries. This is no doubt a function of the stock adjustment form of Silber's model because the large weight assigned to the lagged dependent variable had a tendency to propel the estimates along the past trend when in fact housing activity started a decline at this time.

to predict, i.e., outstanding credit. The point is, how could the model miss since he is forecasting a very small change in an exceedingly large number? Especially since his forecasting equations use the last large number in the series as the prime independent variable. Outside of the stock adjustment approach, Silber, like Huang, has erred by including independent variables whose coefficients are not significantly different from zero at a reasonable level of confidence. Furthermore, this error has been compounded since Silber treats the questionable variables as if they are very important from a policy standpoint. This pitfall, when combined with the stock adjustment approach, leaves Silber's analysis less than optimal.

CHAPTER III.

THE SHORT-RUN DETERMINANTS OF MORTGAGE CREDIT SUPPLIED BY SAVINGS AND LOAN ASSOCIATIONS

The housing sector of the economy is inextricably bound up with the financial sector because of the long-term financing requirements of most home buyers. In this chapter, one of the financial intermediaries supplying mortgage credit to the residential mortgage market is considered, viz., savings and loan associations (SLAs). If the mortgage credit supplied by SLAs can be estimated, it should be possible to assess the role these intermediaries play in overall residential construction activity. Furthermore, SLAs supply the bulk of conventional mortgage credit;[1] thus, an estimate of their activity should serve as a proxy for the conventionally financed sector of the mortgage market. The purpose of this section of the paper is to develop an equation whose variables explain the mortgage credit supply behavior of SLAs. In formulating the mortgage credit supply equation, variables thought to be relevant on a priori grounds will be postulated and then accepted

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[1]At year-end 1971, fifty-one percent of all the home loans in the private sector were held by SLAs; eighty-one percent of all the home loans for one-to-four-family units was attributable to SLAs. Throughout the 1960's about ninety-six percent of the loans made by SLAs were conventional but the FHA-VA component has been increasing recently and by year-end 1971, conventional loans accounted for eighty-six percent of the portfolio (57).

or rejected on the basis of ordinary least squares analysis.[1] No attempt has been made to analyze the portfolio mixture, or the balance sheet constraints of the financial intermediaries.[2] The objective here is to estimate the amount of funds flowing into the residential mortgage credit market. Implicitly, we are assuming the individual portfolio is rationally balanced and institutional, legal, and risk constraints of the industry are taken into account when portfolio adjustment occurs.

Supply Variables

In what follows, supply is construed to be the volume of mortgage credit offered to the residential housing sector of the economy in a given time period. For the lack of a better measure, the change in total nonfarm mortgage loans outstanding of all insured SLAs is taken as the measure of net new funds supplied by SLAs during the period. The change in total nonfarm mortgage loans outstanding, the dependent variable to be estimated in this analysis, is a net change variable and was used because the gross change value was not readily obtainable. This form of the dependent variable dictates that the independent variables should also be in a net change form; there is doubtless some question about whether or not this has been achieved. Due to data scarcity and sheer nonavailability, some variables are not true net change values. For example, commitments refer to all new mortgages

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[1] Insured SLAs were used because the data are more accessible and reliable than it is for all operating SLAs. In 1971, seventy-seven percent of all associations were insured by the FSLIC but this group held ninety-seven percent of all the assets of the industry (57, p. 58).

[2] For an analysis of portfolio behavior, see (62, 65).

made and thus have some attributes of a gross change variable. This problem simply could not be avoided and it is recognized as a shortcoming of this analysis; nevertheless, the weakness should not jeopardize the overall results.

It would appear the volume of mortgage backed loans SLAs are willing to make should depend upon the expected inflow of funds, prior commitments, an index of expected mortgage market conditions, and the expected profitability of the loans.[1] Naturally, other minor forces are at work influencing SLA supply behavior but these four broad categories should explain supply reasonably well. Admittedly, the simultaneity of the variables can present problems but their individual interaction simply cannot be evaluated in a generalized study such as this one.[2] To analyze the particular ramifications of each variable would carry us far afield, adding more confusion than clarity. A suggested area for future research is the detailed analysis of the components of the above categories, including their interaction and a postulation of causal orderings.[3]

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[1]The following analysis assumes that mortgage credit lending intermediaries are not constrained by an insufficient demand for mortgage credit, i.e., the mortgage market will absorb all available funds supplied without substantially disrupting the market. For a documentation of the existence of excess demand for mortgage credit during the sample period, see (61, pp. 18-20).

[2]An example of simultaneously determined variables would be commitments and expected mortgage market conditions. No doubt the latter influences the former, but measurement is hazardous.

[3]No complete and detailed study of the variables determining mortgage credit supplied by SLAs has, to the author's knowledge, been undertaken as a fully integrated exposition. The closest substitute for such an exposition is the Friend Study (29). Substantial work in this area has been undertaken by various researchers.

For the purpose of this study, it will be assumed that the simultaneity problem is of second order magnitude, not seriously biasing the results.

Inflow of funds

Inflow of funds come primarily from additions to saving deposits (share accounts), outstanding mortgage loan repayments (scheduled interest and principal payments as well as unscheduled principal payments), and advances from the Federal Home Loan Bank System. Additionally, selling presently held mortgages in the secondary mortgage market is a source of funds. In the time interval spanned by this study, the Federal National Mortgage Association and the Government National Mortgage Association[1] have been the major participants in the secondary mortgage market. Fanny May and Ginny May deal almost exclusively in the FHA-insured and VA-guaranteed mortgages; therefore, an active secondary market existed only for federally underwritten mortgages during the period of this study.[2] In view of the relatively limited volume of FHA and VA mortgages held by SLA's, it would be surprising if secondary market activity has a significant impact on the mortgage credit supply behavior of SLAs.[3] If the secondary mortgage market affects the mortgage

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[1] Known in financial circles as Fanny May and Ginny May, respectively.

[2] Fanny May dealt in conventionals for the first time in March 1972. The newly created Federal Home Loan Mortgage Corporation is designed to establish a secondary market for conventionals but, it too, acted for the first time in March, 1972 (18, 40).

[3] Some of the studies undertaken in the past (e.g., 8, 36, 59) have failed to find Fanny May-Ginny May secondary market activity significant in explaining movements in the conventional mortgage market.

credit supplied by SLAs, we would expect an inverse relationship, i.e., the regression coefficient will have a negative sign. A quid pro quo results when SLAs participate in the secondary market, viz., mortgages are traded for liquid assets, and it seems unreasonable to think that all, or more than all, of the funds obtained from the secondary market transactions would be channeled into new mortgages. However, unless all the funds obtained from the secondary market are reinvested in new mortgages, an inverse relationship between the change in outstanding mortgages and secondary market activity will prevail.

Intuitively, it is expected that all other inflow of funds mentioned previously will have a positive influence upon the mortgage credit supplied by SLAs. The unscheduled prepayment of mortgages should be influenced to some degree by the general monetary conditions of the economy. For example, if mortgage rates are low and credit availability easy, prepayments can be expected to rise because some homeowners may capitalize on the opportunity to refinance their houses at a lower interest rate. Furthermore, some individuals will use these favorable financing terms to change residences. In general, however, expected mortgage repayments should be relatively stable as well as having a preponderant and positive influence upon the credit supply activity of SLAs.

Historically, saving inflows have been volatile and the least predictable of the above. It is reasonable to surmise that SLA managers will base their estimates of future saving inflows upon the trend of the recent past; consequently, a lagged saving inflow variable is hypothesized to have the most influence. In fact, some of the studies reviewed have documented the importance of lagged saving inflows.

The FHLBS advances are usually available to associations in need and serve to buttress mortgage lending activity. Advances could be segregated as to maturity but to do so seems unnecessary since all maturities should positively influence mortgage credit supplied and the maturity structure did not change appreciably during the time interval being considered. Of the inflow variables, advances should have the least influence on mortgage credit supplied because their predominant role is to provide liquidity and facilitate other short-term adjustments. If the present trend of longer term advances continue, their importance vis-à-vis mortgage credit supplied could be enhanced; however, advances have been treated as homogenous here on the assumption their maturity structure will remain materially unaltered in the immediate future.

Commitments

The second general determinant of mortgage credit supplied by SLAs is the volume of advance commitments made by these institutions. Loan commitments made by SLAs are not binding upon the potential mortgagor but are, as a matter of policy, upon the association. The sequel of this phenomenon is that once commitments are made, SLAs will honor them at some future date; therefore, past commitments must influence future mortgage credit supplied. Naturally, the proportion of commitments taken down depends upon the mortgagors and their expectations regarding future mortgage market developments. For example, if easy mortgage credit is expected, the potential borrowers may not utilize the commitments but instead opt for lower rates and/or other favorable

terms at inter- or intraindustry competitors. Generally, it could be argued that the expected trend of the mortgage credit market is reflected in the present commitment take-down ratio. If commitment take-down is relatively high, this is indicative of an expected tight mortgage market and rising interest rates whereas a low take-down ratio implies the antithesis.

One might argue that advance commitments should not be used as an explanatory variable in an equation containing interest rates and other supply variables because these are the factors determining advance commitments. Such an argument, however, doubtless overstates the case since advance commitments are made basically to coordinate the future inflow of funds, viz., savings deposits and repayments, with future outflow of funds to facilitate the mortgage portfolio maintenance. This inflow-outflow coordination management via advance commitments is relatively independent of supply variables; therefore, it can be cogently argued that the simultaneity implied above is not as serious as might initially be thought (12, p. 277).

Some argue that advance commitments by SLAs simply set a floor for the volume of mortgage credit supplied. This argument usually runs as follows: the majority of SLA mortgage loans are uncommited, i.e., over-the-counter, and consequently highly susceptible to rapid adjustment. When associations over or under commit due to unrealized expectations, the error is rectified by altering the volume of over-the-counter loans. The hypothesized floor materializes since over-the-counter loans can never be less than zero; therefore, when SLAs seriously over commit and outstanding commitments exceed the level of total desired

loans, the commitments must be honored. This causes the associations to make more loans than actually desired and the floor mentioned above becomes operational.

Granted, this floor phenomenon may be a real possibility but when would advance commitments greatly exceed desired loans SLAs wish to make? Indubitably, only in uncommon times such as the credit crunch of 1966. Even in dire times, the floor may be short-lived because advance commitments by SLAs are mostly for the immediate future and adjustment to over commitments should occur rapidly. On the basis of the maturity structure of advance commitments of SLAs, equilibrium between actual and desired loans should be established in one quarter (24).

In general, advance commitments have not been seriously considered by most researchers[1] due to one or both of the reasons cited above. It is contended here that commitments are important and must be included as an explanatory variable in the SLA residential mortgage credit supply equation. It is left to the regression results to furnish the evidence. A priori it is anticipated that commitments will have a positive influence upon the supply of mortgage credit but the relationship should be such that commitments made at time period t will affect mortgage credit supplied at t+n.

Expected mortgage market conditions

The third major determinant of mortgage credit supplied by SLAs, expected mortgage market conditions, is not directly observable. Since the housing cycle (and consequently the mortgage credit cycle) moves

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[1]For exceptions, see (41, 48).

countercyclically to the general business cycle, an indicator of business conditions should serve as a proxy for expected mortgage market conditions. Interest rates, excess reserves, the size of the money stock, or some index based on these has ordinarily been used in housing studies. Interest rate indices have especially been incorporated because the general consensus among housing researchers seems to be that interest rates are the prime movers due to the long-term nature of mortgages. Both the Meltzer index,[1] which is based on excess reserves and interest rates, and the Saint Louis Fed monetary base, a measure of the money stock magnitude, will be tried in the regression analysis.

If the Meltzer index of monetary stringency is used, one might expect a positive regression coefficient. This follows if as monetary conditions become tight, the Meltzer index rises due to increasing interest rates and/or falling free reserves. The rising interest rates should indicate a more profitable mortgage loan; thus, a positive relationship between the Meltzer index and mortgage credit supplied. On the other hand, if net free reserve are allowed to rise, ceteris paribus, this is indicative of excess liquidity and should imply a greater willingness to supply additional funds to the mortgage market. Note, however, when net free reserves increase the index decreases; therefore, a negative relationship between supply and the index is possible, albeit, somewhat remote. There are some researchers, especially monetarists, who would argue interest rates do not measure monetary movements and consequently should not be used to indicate ease or stringency. This

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[1] See Appendix B.

question, however, is not an issue in the present exposition.

If the change in the Saint Louis Fed monetary base index is utilized, the sign of the coefficient is also difficult to predict. This arises because of the variability in the lag and affect of monetary policy. Supposedly, an increase in the rate of change of the monetary base measure is indicative of easier monetary conditions and easing credit conditions. Easier credit for the borrower implies less profitability, ceteris paribus, for the lender; therefore, as the monetary conditions ease a la the monetary base index, SLAs may be more reluctant to make mortgage backed loans. Unfortunately, the complicated lag and the variable affect associated with monetary base movements makes it virtually impossible to anticipate accurately the sign of the coefficient of the monetary base variable even though it seems plausible to do so on an a priori level. The only definitive statement which can be made about the two monetary indices outlined above is that their signs should be opposite or substantially different in magnitude when they are separately entered in the otherwise same regression equation.

The sign of a monetary variable is very much dependent upon the state of expectations.[1] For example, if interest rates are rising (falling) but SLA managers expect the present trend to continue, they may be less (more) willing to make mortgage loans now in hopes of obtaining a higher rate (now) in the near future. It is perilous to say much about the expected signs of the monetary coefficients, especially in

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[1]The extent to which expectations are unrealized determines the significance of this variable; the closer expected are to actual conditions, the higher should be the significance, ceteris paribus.

the short-run, because of the myriad forces operating concurrently. These opposing forces may function such that the monetary measures, the proxy for general mortgage market conditions, are insignificant. Again we leave the outcome to the regressions.

Loan profitability

The fourth broad determinant of SLA lending behavior is the expected profitability of the lending. In general, there are three forces operating simultaneously to determine lending profitability: (1) interest rates, (2) loan-to-value ratio, i.e., a measure of the loan downpayment, and (3) the length of amortization of the mortgage. The loan-to-value ratio, length of amortization, and the interest rate have a fixed relationship with one another and consequently are highly collinear. For example, when mortgage credit is relatively tight, interest rates are usually above normal, loan-to-value ratios are below normal, and the length of mortgages relatively short. As the mortgage credit market eases the interest rate usually falls, loan-to-value ratio rises, and amortization length increases. The fixed nature of the collinearity of these variables precludes their separate entry into a regression equation (54, pp. 46-52). One method, albeit incorrect, used to circumvent this collinearity problem has been to choose one variable, usually the interest rate, to reflect the movement of all of the credit term variables. This approach implicitly assumes the interrelationships between the set of collinear variables is expected to remain unchanged over time. This is, of course, a heroic assumption given the dynamic nature of the mortgage credit market and the associated institutions.

At least one researcher attempted a composite credit term index[1] but this method was critiqued and found in error by Brady.[2] To capture adequately all the credit terms a composite index is absolutely necessary. To that problem we now turn.

A composite credit term was constructed by dividing the product of the loan-to-value ratio and the length of the mortgage amortization into the effective rate on mortgages.[3] This composite credit term can also be criticized for reasons similar to the one Brady offered in critiquing Lee. If, however, we realize that extreme values for the three separate parts of the composite index simply do not materialize in reality, the index outlined above can be operational. In essence, we are sacrificing theoretical elegance for operationalism. As long as the individual credit terms are not excessively diverse from their usual parameters, it seems a trade off between terms is realistic.

What should be the expected sign of this credit term's coefficient? To see this, we express the credit term as Equation 3.1 and then analyze a change in each component part while the other two remain unchanged. As the mortgage rate rises, ceteris paribus, the composite credit term, CT^s, will also rise. Because of profitability, SLAs should want to make

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[1] Lee (46) used the product of the contract interest rate and the length of the amortization. He treated the loan-to-value ratio separately.

[2] Basically, Brady's criticism was that by Lee's composite index a borrower would be indifferent between say an interest rate of ten percent on a twenty year mortgage and a rate of fifty percent on a four year mortgage. This, Brady contends, is patently absurd.

[3] All three individual credit terms were computed by taking the conventional, FHA, and VA values for each and weighting them according to their importance in the SLA industry portfolio.

$$3.1 \quad CT^{S} = \frac{i}{(L/V)(LA)}$$

more mortgage loans; consequently, the relationship between mortgage credit supplied and the composite credit term is positive when only the interest rate is allowed to vary. As the loan-to-value ratio decreases, SLAs should desire to make more mortgage loans because their foreclosure risk has decreased. As the loan-to-value ratio decreases, CT^{S} increases; again we see a positive relationship between the composite credit term and the mortgage credit supplied by SLAs. By analogous reasoning we observe the same positive relationship when the amortization length is varied. Thus, it is concluded that the relationship between the composite credit term and mortgage credit supplied by SLAs should be positive because of the above outlined relationship of the individual credit terms.

It is putative the absolute level of the composite credit term will be relatively unimportant in influencing mortgage credit supplied because SLAs are single-input, single-output concerns.[1] When the inflow of funds is positive, they must invest in mortgages or add to their liquidity; thus, the absolute level of the composite credit term should be basically immaterial because of the dearth of good mortgage substitutes in their portfolios. A better indicator of possible loan profitability is probably the change in the composite credit term. For example, if the absolute level of the composite term is presently high but expected to

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[1] SLAs are severely limited in their portfolio mixes and can legally invest only in governments and mortgages. Mortgages and saving deposits are their principal assets and liabilities, respectively. For a summary balance sheet of the industry, refer to (57, pp. 93-8).

increase further, mortgage credit supplied may be partially curtailed for a short time in anticipation of even better lending conditions. In the meantime, inflow of funds may be added to liquidity reserves or employed to reduce outstanding debt, e.g., repay advances. Once more, expectations play a paramount role in the mortgage credit lending process.

SLAs are constantly faced with the dilemma of borrowing short and lending long since their primary liability is short-term and their principal asset is long-term; thus, association managers probably desire to place long-term funds at the most favorable credit terms. On the basis of the foregoing, it is hypothesized that relative credit terms are all important and first-differences in the absolute level of the composite credit term depicts relative levels. Furthermore, present decisions will likely be partially founded on previous period movements; hence, it seems prudent to surmise that changes in the composite term should be important when lagged.

Further considerations

The secular trend of mortgage credit outstanding by SLAs has been upward. The genesis of this trend is the absolute growth rate of the industry. Since the change in total nonfarm mortgage loans outstanding is the dependent variable, and no general secular trend is observed in this data, there is no need for a time trend adjustment of the raw data.[1] The upward trend in the latter part of the period is probably reflected in other variables such as saving inflows, and commitments. The seasonal

[1]There is no noticeable trend in the dependent variable until 1970:3, then it moves upward rather rapidly.

variation in the variables discussed above is substantial as can be ascertained by observing the raw data or by analyzing the seasonality of the residential housing construction cycle. The seasonal fluctuations are normal occurrences and must be accounted for in the regression analysis to prevent a misspecification of the supply equation. To account for cyclical variations in the raw data, quarterly seasonal dummy variables will be added to the estimation equation. The dummy variable for the fourth quarter is not explicitly included but is measured as $-(S_1 + S_2 + S_3)$.

The preceding analysis can be summarized as:

$$3.2 \quad M_t^s = a_0 + a_1 D_{t-n}^s + a_2 C_{t-n}^s + a_3 R_t^s + a_4 A_t + a_5 MM_t + a_6 CT^s + a_7 FGP + a_8 S_1 + a_9 S_2 + a_{10} S_3 + u.$$

An explanation of each variable in Equation 3.2 may be found in Appendix B with the exception of MM above which is a measure of monetary stringency. The subscripts on the variables denote time periods. No doubt some of the nonlagged variables included in the generic form of Equation 3.2 will have to be lagged to achieve significance. The coefficients of the independent variables are expected to have the following signs:

$$a_1 > 0;\ a_2 > 0;\ a_3 > 0;\ a_4 > 0;\ a_5 \gtreqless 0;\ a_6 > 0;\ a_7 < 0;\ a_8 \gtreqless 0;\ a_9 \gtreqless 0;$$

$$a_{10} \gtreqless 0.$$

The coefficient a_5 is indeterminate because the Meltzer index and the monetary base variable may have opposite signs. The coefficients of the seasonal dummy variables, a_8 through a_{10}, may take on either positive or negative values.

Empirical Results

Equation 3.2 was estimated using ordinary least squares and seasonally unadjusted data. The estimation equation performing best with respect to $\bar{R}^2$, the Durbin-Watson statistic, and standard error of regression was:

$$3.3 \quad M_t^s = \underset{}{-3728} + \underset{(3.61)}{.59D_{t-1}^s} + \underset{(4.36)}{.55C_{t-1}^s} + \underset{(3.25)}{.89R_t^s} + \underset{(2.82)}{.28A_t} + \underset{(2.37)}{12784\Delta CT_{t-1}^s} \underset{(2.48)}{}$$

$$\underset{}{-390S_1} + \underset{(2.12)}{15.1S_2} - \underset{(0.11)}{272S_3} + \underset{(2.62)}{277MI_{t-1}} \underset{(4.57)}{}$$

$$\bar{R}^2 = .977$$
$$\text{D-W} = 1.74$$
$$\text{SEE} = 271.0$$

The subscripts denote time and the t-statistic are in parenthesis below the coefficients. All the data variables included in the estimation Equation 3.3 have the hypothesized sign and are significant, based on a two tail t-test,[1] at the five percent level. The Durbin-Watson statistic does not indicate the presence of serial correlation among the residuals. The coefficient of multiple determination, adjusted for degrees of freedom, $\bar{R}^2$, is .977 which is by many researchers' standards embarrassingly high. The standard error of the regression estimate, SEE, is $271 million which is roughly ten percent of the average value of the dependent variable and well within the realm of expectations. The only variable hypothesized in Equation 3.2 which failed to be significant in Equation 3.3 was secondary mortgage market purchases by Fanny May and

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[1] In the remainder of the paper, all significance references are based on the t-statistic and a two-tail test unless stated otherwise.

Ginny May; the insignificance of this variable was not unanticipated.

It seems appropriate to analyze Equation 3.3 by considering each variable individually. Simultaneously, alternative forms of the independent variables will be presented and their performance discussed. Alternative forms of Equation 3.3 which include some of the excluded variables will be shown and the reasons for their rejection given. This mode of presentation allows others to view what was attempted but failed to perform as well as the form actually chosen.

The seasonal dummy variables, S_1 through S_3, were included in Equation 3.3 because to exclude them decreased the $\bar{R}^2$, increased the SEE, and generally made the reliability of the other variables less significant. Thus, to improve the tracking power of the equation and to compensate for the seasonal gyrations of the raw data, seasonal dummies are sine qua non. Only S_1 and S_3 are significant in terms of the t-statistic but, as the precedent of the literature dictates, all dummies are included.

The two measures of monetary movements did not display opposite signs but their absolute magnitudes were highly dissimilar. More specifically, the partial regression coefficient associated with ML_{t-1} is rather large whereas the MB_{t-1} coefficient is relatively small; since the two indices have similar absolute values for the observations, the absolute difference in the coefficients is analytically important. The general behavior of the equation when both variables were included indicated one of them was superfluous, i.e., a multicollinearity problem exists. When the monetary base variable was substituted for the Meltzer

index, Equation 3.4 was the result. The results are basically the same,

$$3.4 \quad M_t^s = \underset{(3.48)}{-.4732} + \underset{(2.79)}{.46D_{t-1}^s} + \underset{(3.22)}{.583C_{t-1}^s} + \underset{(2.34)}{.783R_t^s} + \underset{(2.10)}{.27A_t} + \underset{(2.12)}{1.4038\Delta CT_{t-1}^s}$$

$$\underset{(1.48)}{-305S_1} + \underset{(0.27)}{38.5S_2} - \underset{(2.31)}{259S_3} + \underset{(3.92)}{.434MB_{t-1}}$$

$$\bar{R}^2 = .974$$
$$D\text{-}W = 1.74$$
$$SEE = 293.0$$

the only real difference being the larger constant term in Equation 3.4. Equation 3.3 is considered slightly better because of its generally higher t-statistic values, its lower SEE, and the lower constant term. It was deemed more logical to retain the Meltzer index because its composite nature makes it more stable over time than the monetary base. Both indices performed best when lagged one period.

The net savings capital inflow lagged one period (D_{t-1}^s) is correctly signed and significant at the one percent level. This variable was always highly significant in all variants of Equations 3.3 and 3.4. Unlagged savings inflow were not always significant and led to a generally poorer estimation equation; a two period or more lag of the variable was always insignificant; a distributive lag structure of the saving inflow variable failed to perform as well as the single one quarter lagged value; hence, the lagged value for net savings capital inflow was chosen because it performed best.

The explanation for the significance of only the one quarter lagged value lies in the fact that SLA managers probably commit newly acquired funds from new deposits only after they are reasonably assured the funds are not transient. To commit new funds immediately upon

receipt might jeopardize liquidity and to hold funds idle longer than necessary could impair profits; therefore, it seems logical the lagged value of saving deposits inflows would have the greatest explanatory power.[1] It could be said that SLAs are willing to commit funds to long-term mortgages only after they are sure the funds are "permanent." Apparently, the time lag associated with this permanency decision is is the neighborhood of one quarter.

Current mortgage repayments[2] are significant at the one percent level and display the correct sign. Various lagged values and structures were attempted but none were significant. In fact, when the variable was lagged in excess of one quarter, the coefficient became negative although still insignificant. The unlagged version of the variable is probably significant because it is readily predictable. SLAs know approximately the volume of repayments they will receive in any given time period and plan their supply of mortgage credit accordingly. To exclude repayments from Equations 3.3 and 3.4 seriously impairs their ability to explain the supply of residential mortgage credit by SLAs.

The change in FHLBS advances outstanding (A) is signed correctly and significant at the five percent level. The significance of the unlagged, as opposed to the lagged, values of this variable is probably because associations are confident advances can be obtained when needed.

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[1] McElhone (48) discounted the importance of saving inflows in her monthly analysis because current inflows were insignificant. This author tried a distributive lag function of monthly saving inflows and found the three, four and five month lagged values explained the most.

[2] Repayments were not segregated on the basis of scheduled and unscheduled because separate series do not, to the author's knowledge, exist.

This was no doubt less true prior to 1968 but the FHLBS policy since then has been more conducive to obtaining needed advances (24, 67). When advances were lagged one quarter they became insignificant even though the sign remained correct. Generally, lagged advances caused a higher constant term, a lower D-W statistic, and a high SEE; however, all other variables remained correctly signed and significant. The significance of FHLBS advances is no anomaly in housing resarch because many housing studies have included this important policy variable in a lagged or an unlagged fashion. The significance of advances in the mortgage credit supply behavior of SLAs allows the FHLBS to have some control over the housing industry via the advances mechanism. It seems that control of advances could be implemented either through interest rates on advances or by direct surveillance; however, this debatable question is not an issue here. It has been shown that advances are important, how they are controlled is irrelevant for the purposes of this exposition.

Unfortunately, Fanny May and Ginny May secondary market purchases failed to be significant in any form. This, however, came as no surprise since only FHA and VA instruments had a secondary market during the period of this study and these types of mortgages are not held in substantial amounts by SLAs. Both current and lagged values of secondary market purchases were tried but the coefficients failed to be significantly different from zero and were not consistently signed. As was mentioned earlier, the secondary mortgage market may become vitally important to SLAs in the future since the newly created Federal Home Loan Mortgage Corporation (FHLMC or Freddie Mac) and Fanny May are now

dealing in conventional instruments. An assessment of the future impact of the secondary market on SLAs' mortgage credit supply behavior would be sheer conjecture due to the modicum of data now available. Therefore, no such assessment will be undertaken here, however, this is a potential topic for future research.

The coefficient associated with the change in outstanding commitments lagged one quarter (C^{s}_{t-1}) is of the assumed sign and highly significant. This variable was not significant when entered at its current values or when lagged more than one quarter. A distributive lag structure was attempted but abandoned due to poor results. When this variable was excluded from either Equation 3.3 or 3.4 the general quality of the equation deteriorated since the $\bar{R}^2$ and the D-W statistic decreased while the value of the constant term and the SEE increased.

A simple correlation coefficient of 0.66 exists between lagged commitments and repayments. This, however, is considered unimportant because the exclusion of either of these variables leads to less desirable results and their simultaneous inclusion does not signal the presence of high multicollinearity (54, p. 48). Thus, we see that commitments appear to be important and must be included as a determinant of SLA mortgage credit supply. The arguments against commitments outlined above have not been refuted, only weakened because the regressions have not "proved" commitments are important, but have only failed to prove their unimportance.

The composite credit term (CT^{s}) was not significant when entered as its absolute values, either lagged or unlagged. This lends credence to the hypothesis that SLAs do not consider the absolute level of mortgage

credit profitability important since they have very little selectivity of investment alternatives. In short, SLAs usually invest in mortgages or not at all. The greatest latitude they have in their portfolio management is the timing of their investments. They may invest now or if profitability is expected to improve they may defer new investment for a time. This expectational approach causes the relative credit terms to be very important.

The change in the composite credit index, a proxy for relative credit terms, was tried in the regression and found to be correctly signed and significant at the five percent level when lagged one quarter. The change version of the variable was not important when unlagged or lagged more than one period. This points out that relative credit terms are important and that associations do no hold funds in unproductive hoards for any length of time. By using the composite credit term and establishing its significance, all three of the measures of mortgage credit profitability, viz., interest rate, loan-to-value ratio, and amortization length, have been incorporated in the mortgage credit supply equation. It is contended here that this approach is superior to selecting a single measure, e.g., interest rate, and allowing it to represent all credit terms.

As an experiment, a measure of the effective interest rate on conventional mortgages was used to replace the composite credit term in Equation 3.3. To make the interest rate variable analogous to the composite credit term, it was entered in first-difference form and lagged one quarter. The result of this experiment appears in Equation 3.5. Even though Equation 3.5 shows basically the same results as

$$3.5 \quad M_t^s = -4391 + .50D_{t-1}^s + .65C_{t-1}^s + 1.11R_t^s + .175A_t$$
$$(4.89) \quad (4.25) \quad (3.55) \quad (4.02) \quad (2.15)$$

$$+ 1207\Delta i_{m,t-1} - 268S_1 - 3.18S_2 - 337S_3 + 286MI_{t-1}$$
$$(2.24) \quad (1.51) \quad (0.02) \quad (3.15) \quad (3.90)$$

$$\bar{R}^2 = .978$$
$$D\text{-}W = 2.12$$
$$SEE = 265.0$$

Equation 3.3, the latter is more complete in that it contains the other two credit terms and it more accurately tracks the actual series over the sample period. The change in the effective interest rate (Δi_m) was tried unlagged in Equation 3.5 but was clearly insignificant (t value of 1.01). When the interest rate was entered at absolute values it failed to achieve significance. This outcome also lends validity to the argument that SLAs consider relative instead of absolute credit terms because of their one-item portfolios.

A simple correlation matrix of the exogenous variables of Equation 3.3 would show a phase relationship between some of the data series. However, it should be realized that simple correlations are only elements of the the entire correlation matrix and, hence, may or may not contribute to problems of multicollinearity. One should not, a priori, rule out estimations of any regression equation because of high correlations between any two variables (54, p. 48). When multicollinearity is present, the exclusion of one of the variables from the regression will not appreciably reduce the explanation of the dependent variable. Since exclusion of any of the variables in the estimation equations given above reduces their explanatory power, it is concluded here that multicollinearity is not a burdensome problem. It appears that even though housing

researchers blame many econometric problems on multicollinearity, it may often be largely a theoretical nightmare rather than an empirical reality. Even if the sample correlation coefficients are taken as indicative of multicollinearity, the exclusion of any variable may still be unwise. This evolves because if forecasting is a primary objective, then intercorrelation of explanatory variables may not be too serious, provided it may reasonably be expected to continue in the foreseeable future (42, p. 207). Since the institutional structure of SLAs is not expected to undergo drastic changes in the immediate future, any intercorrelation now present should exist in later time periods.

Equation Performance and Forecasting

Equation 3.3 presented above should be amendable to short-run forecasting because it contains only two nonlagged independent variables. As mentioned earlier, repayments are relatively stable and accurate short-run forecasts should be possible. Advances can also be accurately anticipated; thus, all the predetermined variables in the SLA supply equation are lagged or easily predicted which indicates the possibility of an accurate data input for a short-run forecast. Additionally, the supply equation does not include the lagged endogenous variable which should allow a prediction of turning points in mortgage credit supplied by SLAs. The one quarter lags so frequently observed above should not come as a surprise because, intuitively, they seem natural considering the fact SLAs plan quarterly due to their quarterly dividend payments.

The sample period chosen to estimate mortgage credit supplied by SLAs includes two violent contractions of mortgage credit activity, viz., in 1966:3 through 1967:1 and 1969:3 through 1970:2.[1] If the estimation equation for M^S can track during these unusual periods, it should perform reasonably well when forecasting outside the sample period. The estimated and actual values of the dependent variable appear in Table 3.1. The general performance of Equation 3.3 is very good and even when the estimated value deviates substantially from the actual value, the error is not repeated in the following quarter. The performance of the equation after 1971:1 is especially encouraging since there was what appeared to be a substantial and permanent shift in the dependent variable. In toto, Equation 3.3 performed satisfactorily over the sample period and should continue to do so in immediate future periods.

An appropriate conclusion to this chapter is a forecast of the dependent variable in a time period outside, but temporally close, to the sample period. The last two quarters of 1972 have been chosen because the actual values of the dependent variable are available for these quarters and can be compared with the estimated values. Table 3.2 shows the forecasted values of the dependent variable yielded by Equation 3.3 above. These forecasted values are well within the realm of expectations for a first-differenced variable such as the net change in mortgage credit outstanding. The forecasting error for total mortgage credit outstanding would be practically nil and, additionally, the absence of

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[1]For an explanation of the cause of these downturns, see (31).

TABLE 3.1

Estimated, actual, and residual values of M^S
(In millions of dollars)

Quarter	Actual	(From Eq. 3.3) Estimated	Residual
1964:1	2187	2135	52
2	2936	2405	531
3	2765	2196	569
4	2280	2256	24
1965:1	1798	1561	237
2	2635	2513	122
3	2392	2202	190
4	1910	2078	-168
1966:1	1678	1693	-15
2	1623	2212	-589
3	384	525	-141
4	172	312	-140
1967:1	509	617	-108
2	2074	2030	44
3	2552	2497	55
4	2328	2430	-102
1968:1	1803	1537	266
2	2682	2426	256
3	2385	2229	156
4	2424	2249	175
1969:1	2175	1861	314
2	3271	3346	-75
3	2355	2427	-72
4	1616	1682	-66
1970:1	658	911	-253
2	2337	2038	299
3	3234	3276	-42
4	3938	3709	229
1971:1	2795	3195	-400
2	7207	7319	-112
3	7799	7890	-91
4	6118	5790	148
1972:1	5682	5385	297
2	8569	10348	-1779

TABLE 3.2

Forecasted values of M^s
based on Equation 3.3
(In millions of dollars)

Quarter	Actual	Estimated	Residual	Percent error
1972:3	8813	8988	-175	1.5
1972:4	8525	8654	-129	1.5

the lagged dependent variable increases the probability of forecasting future turning points of the aggregate data series. This potential ability of the equation to track at the turning points is its major advantage over a stock adjustment approach.

The variables included in Equation 3.3 should be brought up to date whenever possible in order to improve the quality of short-run predictions. In no way should the above analysis be construed to remain static in the long-run because policies, institutions, and attitudes randomly change over time and only an omniscience soothsayer knows their pattern. Since mortgage credit supplied is a necessary forerunner of residential housing purchases, the ability to predict mortgage credit should aid in forecasting housing activity. This connection with housing activity is the raison d'etre for the above analysis.

CHAPTER IV.

THE SHORT-RUN DETERMINANTS OF MORTGAGE CREDIT SUPPLIED BY MUTUAL SAVINGS BANKS

In this chapter a second group of financial intermediaries supplying credit to the residential mortgage market is examined. This group is the Mutual Savings Banks (MSBs). Almost all MSBs, or savings banks as they are sometimes called, are concentrated in New England and the Middle Atlantic states. Seven other states, Alaska, Indiana, Minnesota, Ohio, Oregon, Washington, and Wisconsin, as well as Puerto Rico have MSBs, but thirty-two states and the District of Columbia have none. Over ninety percent of the savings bank industry's total assets are concentrated in five states, viz., New York, Massachusetts, Connecticut, Pennsylvania, and New Jersey in the order of their importance.[1] Even though the bulk of these institutions are geographically concentrated, they rank first, nationwide, among institutional lenders in holdings of both VA-guaranteed and FHA-insured loans on regular owner occupied

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[1] For a summary of the operation, location, and structure of MSBs see (6, pp. 19-24). All the pertinent statistics of the industry are contained in (52).

homes.[1] In many of the MSB states, their deposits exceed the total savings accounts at savings and loan associations, commercial banks, and credit unions combined.

The savings bank industry has invested approximately seventy-five percent of its assets in mortgages of which about eighty-five percent are residential. FHA-insured and VA-guaranteed mortgage loans make up roughly sixty percent of the residential mortgage loans made by MSBs. The importance of MSBs cannot be denied and they doubtless have a substantial impact upon the macroeconomic, residential mortgage credit market, especially the government underwritten portion. Since MSBs are the most important supplier of funds to the government supported sector of the housing market, an assessment of their activity should be indicative of the FHA-VA financed sector of the market in general.

The purpose of this chapter is to formulate an equation whose independent variables explain the mortgage credit supplied by MSBs. Again, variables felt to be important a priori will be outlined and then tested by means of ordinary least squares multiple regression. The general format of the previous chapter will be duplicated and identical procedures only mentioned, not explained in detail. This motif should minimize redundancy as well as lead to some economy of space. Further-

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[1] According to recent Federal Reserve Bulletins the primary financial intermediaries hold the following percent of total FHA and VA residential property mortgages outstanding:

Institution	FHA	VA
MSBs	25	31
SLAs	21	27
LICs	16	13
CBs	13	8

more, the various assumptions and data difficulties outlined in the previous chapter also apply for MSBs.

Supply Variables

The net mortgage funds supplied to the residential mortgage credit market is taken to be the change in total nonfarm mortgage loans outstanding of all MSBs. It is realized the MSBs do not equally influence all geographical markets but to make an assessment of the impact they have in particular areas of the nation is beyond the scope of this paper. Their geographic concentration should not unduly attenuate their macroeconomic significance because a substantial portion of their mortgage loans are made on out-of-state properties.[1] We will proceed as if their influence is felt nationwide even though realistically their impact is felt only remotely in some areas.

Intuitively, mortgage market credit supplied by MSBs should be governed by the expected inflow of funds, prior commitments, expected profitability of the lending, and an index of mortgage market conditions. Again there is no doubt some simultaneity among the above rubrics but it should not be cause for alarm. In what follows, the broad classifications outlined above will be dissected and the constitutent parts scrutinized.

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[1] In 1971 approximately twenty-six percent of their mortgage loans were on out-of-state properties, whereas in 1965 over one-half of the loans were on out-of-state property. This percentage has been decreasing in recent years and some predict the decline to continue (51, pp. 11-12).

Inflow of funds

The influx of additional funds to MSBs come mainly from additions to saving deposits, prepayments and repayments of presently held mortgages, the sale of government underwritten mortgages in the secondary mortgage market, and possibly from advances by the FHLBS. Because of the low membership of MSBs in the FHLBS, it is expected that advances will not appreciably influence the mortgage credit supply behavior of these institutions;[1] however, if they have an influence, then it should be positive, i.e., mortgage credit supplied should increase as advances increase. MSBs also belong to the Federal Reserve System and may use the discount window; however, discounts and advances from the FRS would be inappropriate--as well as frowned upon by the Fed--for mortgage lending due to their relatively short-term nature.

The secondary market sale of FHA and VA mortgages by MSBs should be significant as a determinant of mortgage credit supplied because of the relative importance of these instruments in the total portfolio. However, the influence of secondary market activity is probably not what is intuitively expected. It might be hypothesized that as MSBs sell mortgages in the secondary market, the funds are used to support the purchase of newly issued mortgages. Such reasoning might lead to the conclusion that secondary market sales and mortgage credit supplied are positively related. The measure of mortgage credit supplied by MSBs used here is the net change in value of nonfarm mortgage loans outstanding; therefore, when mortgages are sold from the portfolio, mortgage

[1]Only about nine percent are members (52, p. 14).

loans outstanding decrease. Unless all the proceeds obtained from the secondary market sales are reinvested in new mortgages, the value of mortgage loans outstanding will diminish. Consequently, it is hypothesized that MSBs will not necessarily reinvest all the newly acquired funds--at least not within the short-run--and the relationship between secondary market activity and mortgage credit supplied by MSBs will be inverse. This hypothesis rests upon the belief that savings banks engage in the secondary market for reasons other than simply obtaining funds to support new mortgages, e.g., to increase liquidity or take advantage of other favorable investment opportunities. Again, it is left to the regression results to support or invalidate this hypothesis.

An increase in saving deposits and/or a surge in repayments should lead to a larger volume of mortgage credit supplied by MSBs. The reasoning here is identical to that given for SLAs. Additionally, some or all of the inflow variables may have to be lagged to achieve significance due to an expectational psychology on the part of MSB managers. The basic difference expected to prevail between MSBs and SLAs is the role played by advances and secondary market activity by Fanny May-Ginny May. The regressions for SLAs failed to prove that an importance is attached to secondary market activity but did indicate that FHLBS advances have a significant influence on mortgage credit supplied by these institutions. It is hypothesized in this chapter that the opposite will prevail for MSBs. These phenomena do have policy implications and will be further expounded in a later chapter.

Commitments

Advance commitments should influence the mortgage investment behavior of MSBs as they do SLA behavior. It appears that MSBs make longer term commitments than do SLAs as well as committing a relatively larger volume of their available funds, i.e., MSBs make relatively fewer over-the-counter loans.[1] Undoubtedly, this longer maturity structure associated with MSB commitments will lead to a greater lag of the commitment variable. It seems reasonable to surmise that a distributive lag structure of commitments may be important in explaining the behavior of MSBs.

The general comments presented for SLA commitments in the previous chapter are applicable to savings banks. It seems there is a stronger intuitive reason for including commitments in the MSB equations because of the greater use they make of them. Consequently, small is the number of researchers arguing against their inclusion as was done for SLAs.

The relationship between commitments and the dependent variable is expected to be positive as it was for SLAs. Unfortunately, total commitment data for the savings bank industry are not available and a proxy must be utilized in its stead. Commitment data for the New York state network of MSBs are available and will serve as this proxy.[2] It is contended this proxy is reliable since New York savings banks account

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[1] See the Federal Reserve Bulletin for the mortgage loan commitments of MSBs classified by maturity. Other authors (5, 24) agree that the maturity structure of MSBs is longer than that of SLAs.

[2] At least one other individual (41) has been similarly forced to such a compromise.

for approximately fifty-seven percent of the assets of the industry (52, p. 17).

Expected mortgage market conditions

Once again the Meltzer and the Saint Louis Fed monetary indices will be used to proxy expected mortgage market conditions. MSBs have more latitude in their portfolio composition because they are legally allowed to hold corporate stocks, bonds, notes, and debentures, obligations of state and political subdivisions, as well as other assets which are forbidden for SLAs.[1] In view of this more diversified investment menu, MSBs may have a limited interest in general monetary indices such as the two previously mentioned. Instead, they should display more interest in the return or expected movements in substitute portfolio items, e.g., the interest rate on corporate bonds. If this behavioral pattern is followed, general monetary conditions may be unimportant for MSBs. Furthermore, simultaneous inclusion of a monetary index and portfolio return variable may give rise to collinearity and all its damaging problems. This caveat should not be interpreted to mean monetary conditions are unimportant to the housing industry. It is simply being said that our indicators of monetary ease and stringency may be implicitly incorporated in other variables. If this suspected intercorrelation is present, one of the competing variables will be superfluous and no irrepairable damage will be done by excluding it. Nevertheless, a measure of monetary stringency will be included and

[1]For an aggregate portfolio of the industry, see (52, p. 10).

hopefully the regressions can provide an answer to this conundrum. If significant, the monetary indices should behave as they did in the SLA equations.

Loan profitability

The savings bank is not usually a single-asset concern as is the SLA; thus, the relative profitability of a mortgage loan depends upon the return from plausible alternative investments. The presence of substitute opportunities considerably complicates the picture because the residential mortgage credit a MSB is willing to supply depends upon the return from other potential portfolio items. This effect is captured by including the return from alternative investments as independent variables in the regression equations. A difficulty may arise since multicollinearity appears inevitable.

From examination of the MSB industry balance sheet, it appears the most likely substitutes for mortgage loans are corporate securities and government bonds.[1] Unfortunately, the rate of return on mortgages and these two general classes of substitutes is probably excessively collinear. To overcome partially the expected intercorrelation, the three rates of return will be reduced to two by differencing. The sign of the coefficients appended to these interest rate difference variables is expected to be positive if they are substitutes and negative if they

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[1] Corporate securities include stocks, bonds, notes, and debentures. Government bonds are obligations of the federal government or an agency thereof and may be guaranteed or not guaranteed. Obligations of state and political subdivisions play a minor role in the typical MSB portfolio.

are complements.[1]

Intuitively, two portfolio items might seem to be substitutes, but in reality function as complements. The mechanism could operate as follows: let the rate on government bonds rise; this rising rate should lead to the purchase of additional government bonds but only at the expense of the other portfolio items, ceteris paribus. Further assume the increased purchase of governments was financed by liquidating only corporate bonds. The portfolio is now more liquid than before the asset swap, i.e., highly liquid governments have been substituted for less liquid corporate bonds. The MSB manager may now desire to reduce liquidity of the portfolio by purchasing relatively illiquid mortgages. The result is that the rate on governments (and consequently the volume) and the increased mortgage lending are positively related which implies complements even though governments and mortgages may be regarded as substitute portfolio items (59, p. 100). The relationship is complementary because in the above example $(i_m - i_g)$ will have a negative coefficient.

The interest return on mortgage loans is only one component of their profitability. We must also contend with the loan-to-value ratio and the amortization length of mortgages when assessing the "return" of mortgage loans made by MSBs. To account for all the aspects

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[1] If the coefficient of $(i_m - i_g)$ is positive, this implies that as i_g falls, ceteris paribus, the value of $(i_m - i_g)$ increases and if the two instruments in question are substitutes, the dependent variable, mortgage credit supplied, should rise; thus, a positive sign implies substitutes in demand whereas a negative signed coefficient indicates complements.

of the mortgage loans, a composite credit term for MSBs will be used. This composite index is identical in construction to the one used for SLAs and the results should be the same; the only difference is the component values used here are those associated with MSBs. A fortiori, it is expected that the relative composite credit term, as reflected by the first-difference in the absolute values, will be more important to MSBs in view of their more diversified portfolio. Due to this greater investment choice, MSBs may not be as reluctant to make portfolio adjustments based on the composite credit term as SLAs apparently are; therefore, a lagged value of the composite credit term may be less significant for MSBs than it was for SLAs.

Further considerations

There appears to be no general secular trend of the dependent variable; consequently, it will not be necessary to detrend the series. To compensate for the seasonal fluctuations of the raw data, seasonal dummies will be included as they were for SLAs. Due to the similar aggregate supply behavior of SLAs and MSBs, the signs of the seasonal dummies are expected to be the same for both intermediaries.

The above analysis of MSBs' proclivity to supply residential mortgage credit is summarized in generic Equation 4.1. A description

$$4.1 \quad M_t^u = b_0 + b_1 D_t^u + b_2 C_{t-n}^u + b_3 R_t^u + b_4 A_t + b_5 MM_t + b_6 CT_t^u + b_7 FGP_t + b_8 (i_m - i_g)_t + b_9 (i_m - i_c)_t + b_{10} S_1 + b_{11} S_2 + b_{12} S_3 + u$$

of the new variables used may be found in Appendix B. Undoubtedly, some of the variables in the generic equation above will have to be lagged to achieve significance. The coefficients are hypothesized to

have the following signs:

$$b_1 > 0;\ b_2 > 0;\ b_3 > 0;\ b_4 > 0;\ b_5 \gtrless 0;\ b_6 > 0;\ b_7 < 0;\ b_8 \gtrless 0;\ b_9 \gtrless 0;$$

$$b_{10} \gtrless 0;\ b_{11} \gtrless 0;\ b_{12} \gtrless 0.$$

Coefficients b_8 and b_9 are indeterminate because each of these variables may be complements or substitutes in demand; however, it is expected that if either term is significant, it will be a substitute and thus have a positive sign. It should be remembered that Equation 4.1 is in generic form and some of the variables included will no doubt fail to attain significance and be excluded from the analysis. The empirical analysis will be used to ferret out those above mentioned variables which are unimportant in explaining the residential mortgage credit supplied by MSBs.

Empirical Results

Equation 4.1 was estimated by using ordinary least squares multiple regression analysis. Those predetermined variables failing to achieve a reasonable level of significance were excluded. The equation performing the best with respect to the usual criteria is shown as Equation 4.2.

$$\begin{aligned} 4.2 \quad = &- 783 + .338D^u_t + .419C^u_{t-2} + 1.1R^u_t + 4617\ CT^u_t - .088FGP_{t-1} \\ &\quad (3.2) \quad (6.54) \quad (4.85) \quad (4.81) \quad (2.23) \quad (2.09) \\ &+ 626(i_m - i_c)_t - 54.3S_1 + 62.5S_2 - 70.3S_3 \\ &\quad (6.47) \quad (1.48) \quad (1.69) \quad (1.88) \end{aligned}$$

$$\begin{aligned} \bar{R}^2 &= .86 \\ \text{D-W} &= 1.85 \\ \text{SEE} &= 89.5 \end{aligned}$$

All the variables included in Equation 4.2 have the hypothesized sign

and are statistically significant. The SEE is eighty-nine million dollars which is approximately ten percent of the average value of the dependent variable; this standard error is not felt to be excessive. The D-W statistic does not indicate the existence of autocorrelation among the residuals. The coefficient of multiple determination indicates that Equation 4.2 accounts for about eighty-six percent of the variation of the dependent variable. The empirical results will be examined by first discussing the excluded and then the included variables.

The general monetary indices failed to add explanatory power to the estimation equation; consequently, they were excluded from further analysis. Again, the exclusion of these variables should not lead to the deduction that monetary policy is immaterial; the complicated lag in affect, its variability and elusiveness, makes monetary policy very difficult to measure. The indicators used for monetary policy may be poor and/or a simultaneity problem may exist; whatever, the indices had to be excluded since their coefficients were not significantly different from zero. Equations 4.3 and 4.4 display the results when the two indices were separately included. In terms of equation statistics and partial regression coefficients, all the above equations are similar.

$$4.3 \quad M_t^u = \underset{(1.71)}{-524} + \underset{(5.47)}{.305D_t^u} + \underset{(4.71)}{.401C_{t-2}^u} + \underset{(4.75)}{1.06R_t^u} + \underset{(1.96)}{3649\Delta CT_t^u} - \underset{(2.29)}{.09FGP_{t-1}}$$

$$+ \underset{(6.10)}{594(i_m - i_c)_t} - \underset{(1.37)}{43.0MI_{t-1}} - \underset{(1.36)}{49.7S_1} + \underset{(1.53)}{55.7S_2} - \underset{(1.84)}{67.2S_3}$$

$$\bar{R}^2 = .87$$
$$\text{D-W} = 2.03$$
$$\text{SEE} = 87.3$$

$$4.4 \quad M_t^u = -.767 + .339D_t^u + .411C_{t-2}^u + 1.11R_t^u + .405\Delta CT_t^u - .09FGP_{t-1}$$
$$(2.92) \quad (6.36) \quad (4.37) \quad (4.59) \quad (2.01) \quad (2.06)$$
$$+ 617(i_m - i_c)_t - 15.4\Delta MB_{t-1} - 54.0S_1 + 60.4S_2 - 70.7S_3$$
$$(5.82) \quad (0.24) \quad (1.41) \quad (1.55) \quad (1.84)$$

$R^2 = .85$
D-W = 1.90
SEE = 91.9

Advances of the FHLBS were always insignificant, regardless of whether they were lagged, unlagged, or first-differenced. In view of the small MSB membership in the FHLBS, this outcome was not unexpected. The regression results did not seem to indicate collinearity between advances and secondary market purchases as some have advocated.[1] The fact seems to be that MSBs simply do not consider FHLBS advances an important influence in shaping their mortgage credit supply behavior.

The variable reflecting the difference in the mortgage and the government bond rates, $(i_m - i_g)$, was not important as an explanatory variable. This could have been because of intercorrelation between it and other variables but the behavior of the regression equation did not seem to substantiate this position. The $(i_m - i_g)$ variable did not appear to influence the supply behavior of MSBs even when $(i_m - i_c)$ was excluded from the estimation equation. This result could arise because governments are considered a form of liquidity, i.e., a substitute for cash, and not an alternative to mortgage investment. Since the mid-1940's, MSBs have reduced their holding of government securities from about

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[1] Silber (61, p. 23) contended the collinearity between advances and secondary market purchases precluded their simultaneous entry into an estimation equation. The above analysis plus a simple correlation coefficient of 0.45 seems to contradict this contention.

sixty-three to approximately four percent of total assets (52, p. 9). This quantum decrease indicates that government security holdings were being reduced, irrespective of mortgage lending movements. The regression equation including the $(i_m - i_g)$ variable is shown below.

$$4.5 \quad M_t^u = \underset{}{-.847} + \underset{(3.27)}{.315D_t^u} + \underset{(5.42)}{.414C_t^u} + \underset{(4.75)}{1.09R_t^u} + \underset{(4.78)}{.4536\Delta CT_{t-2}^u} - \underset{(2.17)}{.12FGP_{t-1}} \underset{(1.99)}{}$$

$$+ \underset{(5.48)}{.588(i_m - i_c)_t} + \underset{(0.85)}{83.0(i_m - i_g)_t} - \underset{(1.02)}{41.4S_1} + \underset{(1.62)}{60.6S_2} - \underset{(2.05)}{85.2S_3}$$

$$\bar{R}^2 = .86$$
$$\text{D-W} = 1.88$$
$$\text{SEE} = 90.2$$

The corporate securities return variable, $(i_m - i_c)$, is highly significant in Equation 4.2 and signed as hypothesized. This variable was unimportant, but still correctly signed, when lagged one quarter. From the regression analysis it may be concluded that corporate securities are substitutes for mortgage loans.[1] The high level of significance attached to this variable is no doubt based on the fact that MSBs increased their holdings of corporate securities from $3,777 million in 1965 to $10,435 million in 1971 (52, p. 32).

The composite credit term performed as expected; however, it does not appear to be more important for MSBs as hypothesized above. The variable was consistently insignificant when entered in its absolute form as was the SLA credit term. To be significant, the variable had to be first-differenced and unlagged. The explanation of this outcome probably rests upon the greater portfolio choices available to MSBs as

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[1]This, however, is not surprising because an examination of the industry balance sheet reveals that corporates are the second most important asset in the portfolio.

compared with SLAs. This composite credit term has made possible the inclusion of the interest rate, amortization length, and the loan-to-value ratio; ipso facto, this is considered very important.

The volume of current quarter repayments was significant as expected. The insignificance of the lagged version of this variable simply elucidates the realization that MSBs can accurately predict their volume of repayments. The saving deposit inflow variable appears to be very important in explaining MSB mortgage credit supplied. When the saving inflow was lagged one quarter it remained correctly signed but had a lower significance level (a t-statistic value of 1.65). The significance of unlagged saving deposit inflows suggests that MSBs are less hesitant to commit newly acquired funds than are SLAs. This lack of reluctance doubtless stems from the more liquid portfolio of MSBs. The greater liquidity derives from the availability of a secondary market for federally underwritten mortgages and the holding of corporate securities. A distributive lag function also proved unable to explain more than the single, unlagged version of the variable; therefore, the less complicated form was chosen.

The proxy variable for total MSB commitments performed exceptionally well when lagged two quarters. A distributive lag of the variable showed that its importance increased up through a two quarter lag and then deteriorated rapidly. Only the two quarter lag was significant and the more involved structure of the variable provided no more explanatory power than the simple lag.[1] The MSB is forced by policy to honor

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[1]The t-statistic values for C^u_t, C^u_{t-1}, and C^u_{t-3} were 1.31, 0.89, and 0.15, respectively.

advance commitments and this leads to the logical conclusion they must be important; thus, the findings of Equation 4.2 are unsurprising. Nevertheless, some researchers have failed to consider commitments. The seasonal dummy variables displayed the same signs as they did in the SLA equations. This identical pattern points out that both intermediaries are affected by the seasonality of the housing construction industry. The dummy variables are not an elixir, but their exclusion does deteriorate the quality of the estimation equations.

Equation Performance and Forecasting

Equation 4.2 can be used to make short-run forecasts of mortgage credit supplied by MSBs. Unfortunately, some of the exogenous variables in the estimation equations are unlagged and data inputs needed for forecasting must themselves be estimated. The additions to saving deposits is the one unlagged variable most susceptible to estimation error; the others are relatively stable and/or easily predictable. By drawing on previous investigations of saving deposit inflows, an accurate estimate of this variable should be possible.

Table 4.1 depicts the tracking of Equation 4.2 over the sample period. The equation performed satisfactorily during the sample period and should remain valid for short-run forecasts outside the sample span. Such a forecast was attempted for 1972:3 and 1972:4. The forecasted results appear in Table 4.2. The predictions are well within the realm of expectations since they compare favorably with those of the sample period. In toto, Equation 4.2 explains the mortgage credit

TABLE 4.1

Estimated, actual, and residual values of M^{1}
(In millions of dollars)

Quarter	Actual	(From Eq. 4.2) Estimated	Residual
1964:1	927	892	35
2	1038	1074	-36
3	1175	1102	73
4	1182	1224	-42
1965:1	937	929	8
2	883	958	24
3	1118	1151	-33
4	1107	1173	-66
1966:1	769	743	26
2	508	544	-36
3	754	638	116
4	764	722	42
1967:1	780	759	20
2	792	789	3
3	786	825	-38
4	732	826	-94
1968:1	551	496	55
2	573	585	-12
3	701	769	-68
4	942	1006	-64
1969:1	719	764	-45
2	653	657	-4
3	511	665	-154
4	633	603	30
1970:1	297	380	-83
2	525	450	74
3	558	565	-7
4	599	573	26
1971:1	728	827	-99
2	1007	1075	-68
3	1077	908	169
4	1447	1341	106
1972:1	878	908	-30
2	1386	1161	225

supplied by MSBs and should, along with the supply equations of the other intermediaries, provide a basis for short-term forecasting of total residential mortgage credit supplied.

TABLE 4.2

Forecasted values of M^{11}
based on Equation 4.2
(In millions of dollars)

Quarter	Actual	Estimated	Residual	Percent error
1972:3	1493	1402	91	6.1
1972:4	1491	1455	36	2.4

CHAPTER V.

THE SHORT-RUN DETERMINANTS OF MORTGAGE CREDIT SUPPLIED BY COMMERCIAL BANKS

The third group of financial intermediaries supplying credit to the residential mortgage market is commercial banks (CBs). The purpose of this chapter is to formulate a supply equation whose independent variables explain the volume of mortgage credit supplied by these institutions. The dependent variable of the supply equation will be the seasonally unadjusted change in residential mortgage loans outstanding held by all commercial banks.[1] Even though CBs hold less than nine percent of their total assets in the form of residential mortgage loans, the absolute value of this portfolio item is second only to that of SLAs (57, p. 38). One glance at the CB industry balance sheet shows a myriad of portfolio items; consequently, there will be many interrelationships and complexities encountered in the formulation of a mortgage credit supply equation. Some of the attempts to derive an estimation equation to explain mortgage credit supply have circumvented these complexities by concentrating only on the deposits of CBs and ignoring the other items (41, 59, 62). It is the contention here that the supply behavior of CBs is extremely complex and any simple approach to explain the dependent variable is doomed from its inception.

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[1] See Appendix B for the source of this and the other variables.

CBs make FHA-insured, VA-guaranteed, and conventional mortgage loans but the overwhelming majority of their mortgage funds are allocated to the conventional sector.[1] These institutions are heavily engaged in supplying construction loans to contractors and builders but this aspect of their operation has been excluded here; however, it should be realized that CBs are probably more important to the housing industry than the supply of mortgage credit indicates.[2]

The general approach in this chapter will be similar to the previous two but because of the uniqueness of CBs, the format will be altered slightly. In the immediately following section, the variables thought to be relevant will be outlined and hypotheses of their expected behavior formulated. The commercial banking industry is analyzed in the aggregate and attempts to relate the findings to a micro-economic level are likely to be frustrating.

Supply Variables

The forthcoming supply of mortgage credit from CBs should be dependent upon their anticipated inflow of loanable funds, an index of expected monetary conditions, and the expected profitability of mortgage lending. This last classification includes as assessment of substitute and complementary investment possibilities. Commitments are

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[1] At the end of 1971:4, CB loans for FHA, VA, and conventional mortgages accounted for 16.0, 5.7, and 78.3 percent of all their residential mortgage loans outstanding, respectively. The secular trend has been toward conventionals and away from government underwritten mortgages.

[2] See (16) for an overall assessment of the commercial banking industry upon the housing market.

not important in the CB analysis because little use is made of this technique. Most commitments made are of a short-term nature and will be taken down within thirty days. These intermediaries do make use of longer term commitments in supplying construction loans to builders (17) but this phase of their operation has been excluded from consideration.

In view of the small percentage of CBs total assets held as residential mortgages, there exists a sizable potential for loan expansion in this area; however, no assessment is made of what may evolve. Instead, it is implicitly assumed the industry will continue to function in the future as it has in the past.[1] The milieu in which the CB operates dictates that its portfolio contain more assortment than its nonbanking rival. For this reason, the analysis that follows is more subject to error than that undertaken in the previous two chapters.

Inflow of funds

The primary sources of loanable funds available to CBs are the demand and saving deposits of their customers. Some researchers (e.g., 41, 59, 62) have attempted to segregate these two deposits and assess their impact separately. This approach may have been appropriate in the period prior to the 1960's but the emergence of scientific portfolio management has perhaps rendered this technique obsolete. The thesis subscribed to in this paper is that the CB manager regards as important not so much the source of his funds but their volume. That

[1]This may be an unrealistic assumption if the recommendations of the Hunt Commission (39) are implemented.

is, the funds are agglomerated into a pool and loans made therefrom. Without a doubt, the banking entrepreneur does make some assessment of the permanency of funds but does not segregate them according to source.

The approach used to analyze deposit inflows will be to enter the funds into the regression analysis by source and assess their importance; then, pool the deposits and observe their joint affect. Since the CB manager is likely to take some note of permanency, these two inflows may be weighted differently. Generally, various combinations of weighted-pooled, unweighted-pooled, and segregated will be attempted and that combination performing best will be chosen. Regardless of the final form, the relationship between inflows and the dependent variable should be positive.

The banking industry does have access to the secondary mortgage market via their government underwritten mortgages but the probability of this substantially influencing their supply behavior is thought to be limited. The justification of this position is the minuscule role played by the government underwritten instruments in the typical CB portfolio. The fate of the Fanny May-Ginny May variable in the CB equation is expected to be the same as it was in the SLA equation, namely, insignificant. If, however, the unexpected occurs, the sign of the coefficient should be negative.

Since CBs cannot be members of the FHLBS, advances from Federal Home Loan Banks have no place in the supply equation. Banks may obtain advances and discounts from the Federal Reserve System but these are

short-term in nature and usually obtained to cure a specific disequilibrium malaise, e.g., deficient reserves. No serious thought is given to including these funds because of their short-term nature and the long-term character of mortgages. A similar criticism could be levied against including inflows from the Federal Funds market.

Repayments and prepayments are a source of loanable funds but unfortunately no accurate repayments data for CBs exist. Even though this exclusion is not unique to this analysis, it is considered an inherent weakness. Its omission is probably not as damaging to CBs as it would be to the nonbank financial intermediaries because the typical banking firm has a more diversified portfolio and mortgage repayments constitute a small part of their total inflow of funds.[1] Nevertheless, accurate repayments data would probably lead to a more reliable supply equation.

Expected mortgage market conditions

The Meltzer monetary stringency index and the Saint Louis Fed monetary base measure will be used as the proxy variables to assess the expected monetary conditions. These two measures look at the same phenomena and will not both be included in the same regression equation; instead, the variable performing the best, if either, will be utilized. In the previous two chapters, it was established that the signs of these variables are indeterminate. The complexities of the substitute-complement nature of the CB portfolio makes it even more hazardous to

[1]For a discussion of the importance of repayments to financial intermediary's mortgage credit supply, see (25).

hypothesize their signs in the present analysis. Additionally, simultaneity of the independent variables remains a burdensome problem which could mask the affect of the monetary variable. Expectations could also lead to an unforeseen outcome. The best solution of the sign ambivalence is probably to allow the regression results to supply the answer.

Loan profitability

A composite credit term for CBs will be constructed in the usual manner by using the weighted interest rates on mortgage loans, the loan-to-value ratios, and the amortization length of the loans. The expected sign of the coefficient is positive as has been true for SLAs and MSBs. The portfolio diversity of the typical CB will probably lead to an unlagged credit term as it did in the MSB equation. The first-difference form of this variable is expected to be the most significant because it more accurately reflects relative returns.

The relative profitability of a mortgage loan depends upon the bank's opportunity cost of making the loan. This opportunity cost is measured by the return on competing portfolio assets, e.g., the return on a state or local bond. This opportunity cost concept can be reflected by looking at the difference between the return on mortgage loans and other types of investment instruments. Ceteris paribus, the larger the difference, the more likely the CB is to supply mortgage funds. An examination of the aggregate CB balance sheet shows that the most likely portfolio competitors for mortgage loan funds are U.S. Government bonds, corporate securities, and obligations of state and local governments and political subdivisions. A priori, it seems reasonable to suppose these

items are substitutes and their return, when subtracted from the mortgage loan rates, should have a positive sign. There is, however, the possibility of a complementary relationship associated with any of the above investment items; nevertheless, the above items are expected to have a positively signed coefficient if they are statistically significant.

Since the interest rates associated with mortgage loans and the other three portfolio items listed above are likely to move together, multicollinearity may be encountered and supply its usual complications. Unfortunately, there is no statistical legerdemain to circumvent this difficulty but the reader should bear in mind its possible existence.

Further considerations

The seasonal movements in the raw data will be compensated for by entering the usual seasonal dummy variables in the regression equations. The signs of these variables cannot be predicted but their pattern should be similar to those observed in the SLA and MSB analysis. There is a definite upward secular drift of the dependent variable. This trend is apparent when the raw data are observed and is even more evident if the two major downturns are excluded from the series. This is compensated for by introducing a linear time trend variable into the regression analysis. The sign of its partial regression coefficient should be positive.

The above analysis of the commercial banking industry is summarized in the generalized Equation 5.1. In the generic equation the demand and time deposits were entered in a weighted-pooled fashion but the

$$5.1 \quad M_t^b = c_0 + c_1(w_1 DD_t^b + w_2 TD_t^b) + c_2 FGP_t + c_3 MM_t + c_4 CT_t^b + c_5(i_m - i_g)_t + c_6(i_m - i_c)_t + c_7(i_m - i_{sl})_t + c_8 S_1 + c_9 S_2 + c_{10} S_3 + c_{11} T + u \quad \text{where } 0 < w_1, w_2 < 1$$

empirical results may prove this procedure undesirable.[1] The independent variables of Equation 5.1 are expected to display the following signs:

$c_1 > 0$; $c_2 < 0$; $c_3 \gtreqless 0$; $c_4 > 0$; $c_5 > 0$; $c_6 > 0$; $c_7 > 0$; $c_8 \gtreqless 0$; $c_9 \gtreqless 0$; $c_{10} \gtreqless 0$; $c_{11} > 0$.

The coefficient of the monetary variable, c_3, is indeterminate because of the complex nature of the CB portfolio. The coefficients associated with the rate differenced variables, c_5 through c_7, are hypothesized to be positive because they are thought to be substitutes; however, this may prove false and their signs will be negative.

The generic form of the estimation equation includes all reasonably likely independent variables to explain mortgage credit supplied by CBs. The exclusion or inclusion of any variable will be based on its performance in the regression equation. Equation 5.1 will now be estimated by the usual least squares regression analysis.

Empirical Results

The estimation equations derived from the generic Equation 5.1 are not as straightforward as those of the other two nonbank intermediaries. The complication is rooted in an apparent intercorrelation of the rate differenced variables plus some suspected autocorrelation in the residuals.

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[1] In Equation 5.2, $w_1 + w_2 = 1$ and $0 < w_1 < 1$; thus, $w_2 = 1 - w_1$.

All complications aside, the equation performing best vis-à-vis the usual criteria is shown below as Equation 5.2. All the coefficients are signed as expected except S_3 which was expected to be negative as

$$5.2 \quad M_t^b = \underset{}{966} + \underset{(1.66)}{.0445}(.67TD^b + .33DD^b)_{t-2} + \underset{(2.10)}{12081}\Delta CT_t^b - \underset{(3.27)}{305}MI_{t-1} - \underset{(4.13)}{439}(i_m - i_g)_{t-1} - \underset{(2.09)}{283}S_1 + \underset{(3.73)}{111}S_2 + \underset{(1.51)}{188}S_3 + \underset{(2.47)}{33.1}T + \underset{(3.25)}{}$$

$$\bar{R}^2 = .82$$
$$\text{D-W} = 1.70$$
$$\text{SEE} = 218.0$$

it was for SLAs and MSBs. The SEE is approximately twenty percent of the mean value of the dependent variable which is larger than expected but not excessive considering the complex CB portfolio and the violent contractions in 1966-67 and 1969-70. The D-W statistic does not indicate the presence of serial correlation; however, neither does it document it absence. The method of presentation in this section will be to discuss in turn the three general categories of variables influencing supply.

The only inflow of funds variable achieving significance in Equation 5.2 is the weighted-pooled version of time and demand deposits.[1] The two period lag and the particular weights used were derived by separately entering the two variables as a polynomial distributive lag function in

[1]These two deposit variables are in net flow terms even though delta signs are not appended to them. Refer to Appendix B for a complete description of each.

the estimation equation.[1] When demand and time deposits were entered separately but simultaneously, one or both of the variables were insignificant; if the two variables were not entered simultaneously, they were significant. Such an occurrence points to intercorrelation among the variables. To alleviate this problem, the weighted composite outlined above was incorporated. Considerable ad hoc experimentation using various lags and weights was carried out but those shown in Equation 5.2 performed the best; therefore, it was concluded that the polynomial distributive lag technique used was satisfactory.

Since mortgage repayment data are not available for CBs, an attempt was made to incorporate a proxy variable. The variable used was the seasonally unadjusted installment credit repaid to all commercial banks. The variable's coefficient was not significantly different from zero nor was it consistently signed. Other proxies for repayments met a similar fate.

The Fanny May-Ginny May secondary market variable was also insignificant. This derives from the fact that CBs hold a relatively small amount of federally underwritten mortgages in their portfolios. The advent of the Federal Home Loan Mortgage Corporation may make the secondary market an important source of funds for CBs, but, unfortunately,

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[1]Following the technique outlined by Almon (4), a second degree polynomial with a four period lag and tied to zero on both ends gave the best results. The coefficients associated with the change in time deposits was 2.5 times as large as those associated with the change in demand deposits. The mean lag for time deposits was 2.36 periods whereas that of demand deposits was 1.8 periods. The time deposits equation had a considerably higher coefficient of determination (0.73) than did the demand deposits version (0.58). The lags and weights used also seem apropos on an intuitive basis. Silber (59) also got similar weights.

only time can provide the answer.

The Meltzer index of monetary stringency, the proxy for expected mortgage market conditions, is highly significant in Equation 5.2. There was concern about this variable being collinear with the time trend; however, such does not appear to be the case. Equation 5.3 was the result when the monetary base measure replaced the Meltzer index.

$$5.3 \quad M_t^b = \underset{(1.43)}{-800} + \underset{(5.51)}{.102(.67TD^b + .33DD^b)_{t-2}} + \underset{(2.77)}{12885\Delta CT_t^b} + \underset{(2.00)}{298\Delta MB_{t-1}}$$

$$+ \underset{(2.01)}{587(i_m - i_g)_{t-1}} - \underset{(3.87)}{358S_1} + \underset{(0.44)}{40S_2} + \underset{(3.28)}{299S_3} - \underset{(0.94)}{8.05T}$$

$$\bar{R}^2 = .72$$
$$\text{D-W} = 1.42$$
$$\text{SEE} = 273.0$$

The monetary base variable is statistically significant and signed opposite the Meltzer index variable. It appears the MB variable and T are collinear in Equation 5.3 which makes probability statements about their coefficients impossible and apparently causes chaos among the other variables. The addition of the monetary base variable leads one to suspect the resulting equation is less reliable than Equation 5.2. Not only does the coefficient of multiple determination decrease substantially but the constant term reverses polarity, the D-W statistic becomes dangerously low, the coefficient of the deposits variable doubles and its significance increases markedly, and the time trend takes on the wrong sign as well as becomes not significant. Multicollinearity may also exist between the deposit variable and MB. Even though computed partial regression coefficients may be unbiased when multicollinearity exists, their standard errors will have a tendency to be high; this

dilemma can lead to indeterminancy about their statistical significance. For the above reasons, the monetary base variable is excluded from further analysis and Equation 5.3 is judged less reliable than the previous estimation equation.

As an experiment, both of the above measures of monetary conditions were excluded and total excess reserves of all Federal Reserve System members were substituted. The excess reserves variable failed to reach an acceptable level of significance regardless of the form in which it was entered, i.e., lagged, unlagged, differenced and lagged, etc. This result does not invalidate the practice of using the volume of excess reserves as a measure of monetary stringency or ease, it simply fails to document their importance in explaining mortgage credit flows by CBs.[1]

The current quarter, first-differenced form of the composite credit term is significant in Equation 5.2. The importance of this value in explaining supply attests to the significance of including all measures of the credit terms. Credit rationing can occur in more than one way and the composite term points out the trade-offs among the rationing instruments.

The only other loan profitability variable included in Equation 5.2 is the difference in the mortgage and the long-term government rates. This variable performed best when lagged one quarter. The lag was determined by the regression analysis and the author knows of no logical or economic reason for its existence. The $(i_m - i_g)$ variable was included

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[1] Huang (35) discusses the use of excess reserves as a measure of monetary policy in a housing study.

because, of the three rate differenced variables associated with CBs, it performed best when entered separately. Due to high multicollinearity, all the variables could not be included simultaneously. When entered together, the standard error of the equation and that of each independent variable increased, and their coefficients were not significantly different from zero. When recorded separately, the order of their significance, from high to low, was (i_m-i_g), (i_m-i_c), and (i_m-i_{sl}); however, the latter two were not statistically significant. Parenthetically, all rate differenced variables had the largest t-statistic when lagged one quarter.

The linear time trend should be included because when it was eliminated from Equation 5.2, the equation's explanatory power profoundly deteriorated ($\bar{R}^2$ of 0.71 and SEE of 373). The seasonal dummies performed as expected with the exception of S_3. This result clashes with that observed from SLAs and MSBs in the previous chapters but agrees with Silber's findings (59, p. 97). This anomaly is not considered important and is mentioned only to point out a uniqueness of CB operation.

Portfolio complexities and other immeasurable complications have made the CBs more difficult to analyze than the nonbanking intermediaries. The results obtained in this exposition compare favorably with those obtained by other researchers; consequently, there is no need for an apology of the less than utopian results. The operation of CBs is cluttered with innumerable factors which are neither measurable nor amendable to rational economic analysis; mortgage loan operations of CBs, to the

detriment of housing researchers, are not atypical.[1]

Equation Performance and Forecasting

Table 5.1 displays the performance of Equation 5.2 over the sample period. The tracking power of the equation is not as good as desired but is acceptable considering the complexity of CB portfolio decisions. The peaks and troughs of the actual data series are traced but some of the other turning points are missed. Various other variables thought to be relevant were tried in Equation 5.2 to improve its predictive power, but all failed either due to genuine insignificance or because multicollinearity was masking their importance. The tentative conclusion of this writer is that CB operations are exceedingly complex and a simple linear equation is unable to capture this complexity.

A forecast of the dependent variable was performed for the last two quarters of 1972. These predictions appear in Table 5.2. The errors are larger than we would have liked, but considering the complexities of CBs, they can be tolerated. Other intermediary mortgage credit flow estimates have also yielded poor results for CBs. As can be seen by observing Table 5.1, the mortgage lending volume of CBs has been extremely fickle. This is probably because mortgage funds forthcoming from CBs are contingent upon the demand of other borrowers and investors. The CB is an intermediary primarily devoted to the credit needs of the business sector and CB funds flowing into mortgage credit are those

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[1] Adams (1, 2) provides a jocular presentation of the irrationalities of some commercial banking practices.

TABLE 5.1

Estimated, actual and residual values of M^b
(In millions of dollars)

Quarter	Actual	(From Eq. 5.2) Estimated	Residual
1964:1	418	341	77
2	856	712	144
3	682	1044	-362
4	501	622	-121
1965:1	455	444	11
2	995	859	136
3	1191	939	252
4	813	749	64
1966:1	435	520	-85
2	978	819	159
3	669	1105	-436
4	407	647	-240
1967:1	14	76	-62
2	597	691	-94
3	1152	1402	-250
4	1003	1030	-27
1968:1	515	363	152
2	956	1107	-151
3	1138	880	258
4	1182	854	328
1969:1	869	787	82
2	1230	1033	197
3	799	785	14
4	242	367	-125
1970:1	-5	-51	46
2	282	383	-101
3	527	459	68
4	322	559	-237
1971:1	703	858	-155
2	1920	1973	-153
3	2117	2032	85
4	1724	1540	184
1972:1	1933	1540	184
2	2845	2350	495

remaining after business needs are fulfilled. This phenomenon gives rise to the mortgage credit market acting as a balance wheel of the general economy and commercial banks, by dint of the sizable mortgage funds they loan, accentuates these countercyclical movements. These highly capricious movements complicate any attempts to explain rationally mortgage credit supply behavior of CBs; thus, our results from Equation 5.2 above are less than ideal but as good as can be expected.

TABLE 5.2

Forecasted values of M^b based on Equation 5.2 (In millions of dollars)

Quarter	Actual	Estimated	Residual	Percent error
1972:3	3194	2598	596	18.5
1972:4	2806	2439	367	13.0

CHAPTER VI.

THE SHORT-RUN DETERMINANTS OF MORTGAGE CREDIT SUPPLIED BY LIFE INSURANCE COMPANIES

The last major group of financial intermediaries to be considered in this study is Life Insurance Companies (LICs). There will be no attempt to classify these intermediaries by type of organization, class of customer, extent of diversification, etc.; they are treated as an industry supplying a homogenous product. Of the four financial intermediaries being analyzed during this sample period, only CBs are larger than LICs in terms of total assets. But in terms of total residential mortgage loans outstanding, LICs are the smallest of the four.[1] The portfolio of the typical LIC includes government and corporate securities as well as real estate mortgage loans. Their investment diversity is much greater than SLAs and MSBs but probably not as complex as CBs.

From 1966 forward, LICs have been increasing their residential mortgage lending but, generally, at a decreasing rate whereas the other three intermediaries have not consistently followed this trend. The insurance companies appear to be moving away from residential property

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[1]For balance sheet items and the record of mortgage activity of LICs, see (47). During 1972:4 total assets of SLAs exceeded those of LICs for the first time.

and into nonresidential and commercial loans;[1] however, there is some evidence that this downward trend is presently being reversed. Nevertheless, the secular trend of the change in residential mortgage loans outstanding during the time interval spanned by this analysis has unquestionably been downward. Residential mortgage loans accounted for about thirty percent of the total assets of LICs in 1965 but had decreased to approximately twenty percent by the end of 1971. Since the LICs hold a relatively small portion of their total assets as residential mortgages, there is a substantial potential for expansion; however, this potential is not an item of concern in this exposition.

In the interval covered by this study, LICs have tended to substitute conventional mortgages for federally underwritten ones. For example, in 1965, FHA, VA, and conventional instruments accounted for approximately twenty-three, eleven, and sixty-six percent, respectively, of total residential mortgage loans outstanding by LICs. At the beginning of 1971, the ratios had changed to seventeen, eight, and seventy-five percent, respectively.

The analysis of LICs will be similar to that of the other intermediaries. The one characteristic of LICs separating them from the other financial institutions is their heavy reliance upon forward commitments. A general discussion of the hypothesized independent variables follows; then the empirical results will be presented and analyzed.

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[1] LICs are also moving away from 1-to-4 family residential units and toward multiple-family structures.

Supply Variables

The objective of this chapter is to develop an equation to explain the net change in residential mortgage loans outstanding of all LICs. This variable is taken to be the volume of residential mortgage credit supplied by LICs during the quarter. Even though this supply variable has been decreasing through time, it is still of sufficient magnitude to influence substantially the volume of credit flowing into the housing industry.

Intuitively, the volume of mortgage credit supplied by LICs should be determined by the same general types of variables which determined that of other financial institutions. Following the motif established in the previous chapters, the four general classes of variables listed for SLAs and MSBs will be analyzed on an intuitive level and then accepted or rejected on the basis of the regression results. Again, any simultaneity problems are considered to be of a second order magnitude not seriously biasing the results.

Inflow of funds

At year-end 1971, only one LIC was a member of the FHLBS; therefore, advances from this system should not influence the credit supply behavior of LICs. Federally underwritten mortgages constitute only about twenty-five percent of all residential mortgages held at the end of 1971; therefore, the secondary market activity of Fanny May-Ginny May is likely to have no measureable influence on supply activity of LICs. If the secondary market is important, it should be negatively signed because of the reasons expounded in previous chapters.

The inflow of funds from mortgage repayments should have a substantial positive impact upon the residential mortgage credit supply behavior of the insurance industry. These data are not available for all LICs but it does exist for a sample of the whole which accounts for about eighty percent of the industry's assets (56). This repayments variable has been most important for the other nonbanking financial intermediaries and no exception is expected for LICs. The volume of repayment--especially prepayments--are likely to be influenced by other included variables, e.g., mortgage interest rates, but this simultaneity is not deemed important and will be ignored.

The remaining inflow source is that of premium payments and return on investments.[1] This source is analogous to deposits at the other intermediaries. A proxy for the nonrepayments inflow will be necessary since no explicit data series are available. The proxy to be utilized is the net change in total assets of all LICs minus the net change in policy loans and premium notes outstanding.[2] This proxy is expected to influence positively the supply behavior of these intermediaries. The sign of this variable may be troublesome because assets have secularly increased while the dependent variable has generally declined; hence, the relationship is likely to appear negative. This, of course, is alien to prudent investment behavior and must be dismissed if we assume

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[1] Premium payments account for seventy-five percent and investment earnings twenty-one percent of the total income of all LICs in 1970 (47, p. 58).

[2] Jaffee (41) used a similar proxy to measure "deposits" at LICs. His variable was life insurance reserves and other liabilities less policy loans.

rational economic behavior.[1] Hopefully, the time trend will play its proper role and compensate for the entire downward drift of aggregate supply.

Commitments

Life Insurance Companies make extensive use of the forward commitment process; thus, it seems likely that past commitments should influence current mortgage credit supply behavior.[2] LICs have a unique advantage over the other mortgage credit supplying institutions, viz., they can more accurately predict their inflow and outflow of funds. The relative certainty of fund flows allows them to commit monies further in advance. For example, according to the Life Insurance Association of America (27, p. 2):

> The turnover period . . . for mortgage and real property commitments outstanding, averaging 15 months during 1971, only about 1½ months shorter than in 1970, with the greater part of the contraction (about one month) traceable to increased cancellations.

Jaffee, for one, has empirically documented the importance of this very long commitment structure.[3]

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[1] One might argue that as the industry grows it becomes less interested in residential mortgages and therefore reduces its relative holding of the instruments. The opinion of this writer is that more assets spell more residential mortgages, ceteris paribus; unfortunately, other forces are operating to cause the residential mortgages to diminish in importance to the LIC. Jaffee (41) did obtain a statistically significant positve coefficient for his "deposit" variable, so there is some hope.

[2] Both Silber (59) and Jaffee (41) have found commitments very important in influencing the volume of funds LICs provide to the mortgage market.

[3] In his credit supply equation he has a distributive lag structure of new commitments going back seven quarters, see (41).

Since the loan commitments are made for such a long time in the future, it is expected that recent commitments will not influence current supply behavior. At least not in any consistent way. The sign of the commitments variable should be positive as it was for MSBs. In view of the complicated nature of LIC commitments, a distributive lag structure is probably the best way to express this variable. The only deviation from Jaffee's analysis will be to exclude recent commitments if they are not significant. The volume of advance commitments any LIC is willing to make must necessarily depend upon the trend in other included variables, and to increase efficiency a separate commitments equation probably should be constructed. As has been repeatedly pointed out, such an approach would doubtless add more complication than clarity; consequently, some error is tolerated to insure simplicity.

Expected mortgage market conditions

The expected mortgage market conditions should be properly reflected by monetary conditions. The Meltzer index and the monetary base measure will again be used as the variables measuring monetary influences. There is some doubt about these variables being of measureable importance in LIC activity. This arises because of the long-term commitments of these institutions. Commitments are based on future expected monetary conditions; these expected conditions may or may not materialize. Hence, the relationship between current supply activity and present monetary conditions is likely to be haphazard at the very best. To complicate the picture, LICs are probably more interested in principal security than income security because of their long-term, fixed dollar

liabilities. This phenomenon may lead to seemingly unorthodox investment behavior. In toto, the expected mortgage market conditions are thought to be implicitly included in commitments and the monetary indices will probably prove unimportant in explaining supply behavior.

Loan profitability

A composite credit term index was constructed as previously outlined. This variable is expected to influence positively mortgage credit supplied by LICs. No doubt the variable will have to be first-differenced to reflect relative changes in profitability before it will be statistically significant.

The balance sheet of the life insurance industry shows the primary investments to be mortgages, corporate securities, government securities, and policy loans in the order of their importance. Policy loans almost tripled during the period of this study and in 1971 they exceeded government securities in importance. This substantial increase has been attributed to the general rise in interest rates on other forms of borrowing (47, p. 90). Policy loans must be made by LICs when customers request them; consequently, their volume is largely independent of investment policies of LICs. Even though policy loans are made from funds which would otherwise be invested by LICs, they are not considered to compete with mortgage loans on an interest return basis because their rate has consistently been below that of mortgage laons. The volume of policy loans are considered in the deposit inflow variable above; therefore, no explicit variable including their interest rate is deemed necessary.

The bulk of the corporate securities are in bonds, debentures, and notes of greater than one year maturity. A variable representing the difference in the residential mortgage rate and the Aaa corporate bond rate will be included in the regression equation. The two most important domestic government securities held are U.S. Treasury and state and local obligations. The rate on these securities will be differenced from the mortgage rate to form two additional variables. Their relationship, either substitute or complement, will be determined by the sign of their coefficient in the regression analysis.

No doubt the above mentioned interest rate variables will be collinear and one or more of them excluded from the analysis. If, in fact, LICs are more concerned with principal rather than income security, interest rate variables may prove unimportant in explaining mortgage credit supplied. The interest rate is likely to be the determining factor, if and only if, all other considerations are equal.

Further considerations

Seasonal dummy variables and a linear time trend are included to compensate for cyclical and secular fluctuations, respectively. The time trend should display a negative coefficient because of the decline in the dependent variable during the period of this study. No particular polarity pattern is hypothesized for the seasonal dummies.

From the above a priori analysis, generic Equation 6.1 is formulated to explain the residential mortgage credit supplied by the life insurance industry. Some of the variables will probably need to be lagged and/or differenced to be significant; others will probably be

$$6.1 \quad M_t^1 = d_0 + d_1 D_t^1 + d_2 R_t^1 + d_3\left(\sum_{i=o}^{n} w_i C_{t-i}^1\right) + d_4 CT_t^1 + d_5 FGP_t + d_6 MM_t$$
$$+ d_7(i_m - i_g)_t + d_8(i_m - i_c)_t + d_9(i_m - i_{sl})_t + d_{10} S_1 + d_{11} S_2$$
$$+ d_{12} S_3 + d_{13} T + u \qquad \text{where } 0 < w_i < 1$$

excluded on the basis of the t-statistic. The signs of the coefficients are expected to be as follows:

$$d_1 > 0;\ d_2 > 0;\ d_3 > 0;\ d_4 > 0;\ d_5 < 0;\ d_6 \gtrless 0;\ d_7 \gtrless 0;\ d_8 \gtrless 0;\ d_9 \gtrless 0;$$

$$d_{10} \gtrless 0;\ d_{11} \gtrless 0;\ d_{12} \gtrless 0;\ d_{13} < 0.$$

The w_i's should all be positive but the more recent commitments are not expected to be statistically significant. Equation 6.1 will now be estimated and the variables rejected or accepted on the basis of the regression results.

Empirical Results

Generic Equation 6.1 was estimated by ordinary least squares and all the hypothesized variables failing to achieve significance were excluded from the analysis. Equation 6.2 is the end result of the estimation since it performed best with respect to the usual measures.

$$6.2 \quad M_t^1 = \underset{(0.96)}{-358} + \underset{(3.04)}{.92 R_{t-1}^1} + \underset{(3.46)}{.66\left(\sum_{i=4}^{8} w_i C_{t-i}^1\right)} + \underset{(2.84)}{5771 \Delta CT_{t-1}^1} + \underset{(2.25)}{447(i_m - i_g)_{t-1}}$$
$$- \underset{(2.18)}{386(i_m - i_c)_{t-1}} - \underset{(0.54)}{24.5 S_1} - \underset{(2.89)}{133 S_2} - \underset{(3.06)}{139 S_3} - \underset{(4.15)}{48.2 T}$$

$\bar{R}^2 = .85$
D-W = 1.67
SEE = 137.0

where $w_4 = 0.16$, $w_5 = 0.23$, $w_6 = 0.23$, $w_7 = 0.25$, and $w_8 = 0.13$

The signs of the coefficients conform to those hypothesized above and

estimation Equation 6.2 explains eighty-five percent of the variation in the residential mortgage credit supply behavior of LICs. The D-W statistic is lower than desired because it does not rule out the possibility of positive serial correlation; however, neither does it confirm its existence. The SEE is $137 million which is about eighteen percent of the average value of the dependent variable. Ideally, the SEE could be lower but considering the portfolio diversity of LICs, eighteen percent is not extremely large. The result obtained in Equation 6.2 will be explained by analyzing the generic Equation 6.1 and giving the reasons for excluding or including a particular variable.

As was expected, mortgage repayments appear to be very important in Equation 6.2. The significance of the lagged value of this variable is not readily explainable because there is no apparent reason for such behavior by LICs. The lagged value was found to be more important than its unlagged counterpart and it was chosen solely on the basis of the regression results. It seems logical to assume that LICs can predict accurately their repayments volume and commit new funds accordingly but apparently there is some lag involved. This unexpected result could be based on the lengthy commitment structure or a wait and see attitude about policy loan activity. The unlagged value of this variable was correctly signed and its coefficient was approximately the same (0.95) but the standard error was considerably higher; therefore, it was not as desirable as the lagged version.[1]

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[1]The t-statistic of the unlagged repayments was 1.94. There would probably be little harm done by using the unlagged as opposed to the lagged version but from a forecasting standpoint, a known value is preferable to an unknown one.

The proxy variable for the "deposits" inflow, change in total assets minus the change in policy loans outstanding, failed to be significant in its lagged or unlagged form. This was a disappointment because, intuitively, nonrepayment inflows would seem to be important in explaining supply.[1] When the deposits variable was included in the regression equation its coefficient was consistently of a negative sign but never significantly different from zero. This may or may not be a result of the secular decline of the dependent variable but it made little difference when the time trend was excluded. The above outcome, plus Jaffee's marginal results for this variable, points to its unimportance, at least in its present form.

As expected the Fanny May-Ginny May secondary market variable was not significant. This result was hypothesized because of the relative unimportance of federally underwritten instruments in the LIC portfolio. This result may be altered as the new secondary market in conventionals gains importance; therefore, any future research should at least consider this variable.

The commitment variable is correctly signed and statistically significant in the estimation equation. As hypothesized, the recently made commitments do not aid in the explanation of current mortgage credit supplied by LICs. This result evolves from the fact that very few short-term commitments are made by the industry. The commitment variable in Equation 6.2 does not include any commitment data during

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[1]The size of the "deposits" coefficient in Jaffee's analysis indicates the variable's importance is marginal at most.

the immediately preceding quarters.[1] The weights (w_i's) associated with the lags are based on the results from a distributive lag analysis of the variables using the Almon lag technique. The results shown in Equation 6.2 are the same as those of the Almon lag analysis; the present method of presentation was chosen because it was more straightforward.[2]

The current through the three quarter lagged values of the variable were insignificant when tried on an individual or a composite basis. A distributive lag function which included these variables was clearly inferior to the one used. An experiment was performed by individually including the lagged values of the commitment data in Equation 6.2. The variables were not consistently signed until the fourth quarter; the lagged variables remained positively signed and statistically valid through an eight quarter lag. The $\bar{R}^2$'s of the resulting equations peaked in the analysis using the seven quarter lag.[3]

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[1]This result differs from that of Jaffee's because his commitment term included the current through a seven quarter lag. Furthermore, his weights declined as the lag increased. Such a result is suspicious because of the large weights given to recent commitments. This structure neither conforms to that found in this analysis nor the commitments policies of LICs documented by the LIAA (27); however, such an approach was necessary for Jaffee's simulation model.

[2]The only difference in the two methods is that the Almon technique will cause the weights to change through time whereas weights assigned in Equation 6.2 are permanent through time. This limitation is justified since it will be easier to forecast when the weights are fixed.

[3]The $\bar{R}^2$ values for the C_{t-4} through C_{t-8} equations were 0.776, 0.816, 0.823, 0.827, and 0.769, respectively. Notice that these are almost perfectly correlated with the weights used even though the two values were derived independently.

The monetarists measure of monetary policy, the monetary base variable, performed better than the Meltzer index but neither were important. The first-difference form of the monetary base measure consistently had a positive sign but was never significantly different from zero. The Meltzer index was neither consistently signed nor statistically different from zero. This finding does not prove that LICs are uninterested in monetary conditions; it only points out that monetary movements as perceived by LICs are not being properly measured by these variables or they are implicitly included in other independent variables. Regardless of the cause of their unimportance, the monetary measures were excluded from the estimation equation because they failed to improve its predictive power.

The first-differenced, one quarter lagged form of the composite credit term is included in Equation 6.? because to omit it impairs the quality of the equation. The composite credit term has been important for all residential mortgage credit supplying intermediaries, albeit in slightly different forms, and apparently LICs are no exception. It only seems reasonable that all the mortgage credit terms should be important and the composite term used in the above analysis is the vehicle for their inclusion.

Opportunity cost is also important in mortgage lending decisions; this can be reflected by considering other substitute and complement portfolio items. The corporate and U.S. Government bond rates, when differenced from the mortgage rate, were important in explaining supply in Equation 6.2. These rates differenced variables performed best when lagged one quarter. Even though LICs hold a substantial quantity of

state, local, and political subdivision bonds, the rate differenced variable associated with these failed the significance test and was excluded as an independent variable.

The positive sign associated with the federal government rate variable implies that these instruments and residential mortgages are substitutes. The negative sign associated with the corporate bond rate is indicative of complements.[1] There is, of course, a possibility for the opposite association between the above instruments but the signs of the regression coefficients do not support such a relationship.

The LICs estimation equation includes only lagged independent variables; therefore, accurate short-term forecasts of the dependent variable should be possible. This should be true even though the SEE is relatively high. Any multicollinearity among the variables in Equation 6.2 should not restrict the forecasting potential as long as the interrelationships continue to exist. And there is no reason to assume that LICs will substantially alter their behavior in the future.

Equation Performance and Forecasting

The estimated and residual values obtained from Equation 6.2 are contained in Table 6.1 along with the actual values of the dependent variable. In general, the estimated values track the actual series

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[1] It has been said (59, p. 100) that portfolio items having similar risks will be substitutes whereas ones having dissimilar risks will be complements. This dictum does not appear to be verified by the regression analysis of LICs.

TABLE 6.1

Estimated, actual, and residual values of M^1
(In millions of dollars)

Quarter	Actual	(From Eq. 6.2) Estimated	Residual
1964:1	770	949	-179
2	861	1033	-172
3	983	989	-6
4	1526	1535	-9
1965:1	1030	1090	-60
2	883	975	-92
3	917	952	-35
4	1474	1415	59
1966:1	1124	1022	102
2	1060	865	195
3	1076	832	244
4	1107	1263	-156
1967:1	962	939	23
2	513	626	-113
3	201	405	-204
4	799	899	-100
1968:1	383	495	-112
2	356	422	-66
3	471	440	31
4	1020	799	221
1969:1	426	390	36
2	420	501	-81
3	450	531	-81
4	789	723	66
1970:1	590	531	59
2	555	613	-58
3	377	294	83
4	818	734	84
1971:1	295	375	-80
2	-15	-89	74
3	236	277	-41
4	786	795	-9
1972:1	2	426	-424
2	72	-71	143

but there are unexpected divergences in the two series. The complicated portfolio of LICs and the secular decline of the dependent variable doubtless hobbles the equation's general performance; however, the equation tracks more than adequate and should render useful forecasts of the endogenous variable.

The last two quarters of 1972 were estimated and the results appear in Table 6.2. The estimated value for 1972:3 is well within tolerance but the 1972:4 forecast is too low. This under prediction arises because of the prodigious increase in the dependent variable during 1972:4. The estimation equation did give a substantial increase for the period but due to the averaging characteristic inherent to regression analysis, the estimate was far short of the mark. The equation will doubtless adjust to the substantial shift in the following time period unless the dependent variable again fluctuates wildly. The results obtained from Equation 6.2, when combined with the estimation equations of the above analyzed intermediaries, should serve as a basis for forecasting aggregate residential construction activity. This task is the basis of the chapter to follow.

TABLE 6.2

Forecasted values of $\bar{M}^1$
based on Equation 6.2
(In millions of dollars)

Quarter	Actual	Estimated	Residual	Percent error
1972:3	260	289	-29	10
1972:4	1445	980	465	47

CHAPTER VII.

AGGREGATE MORTGAGE CREDIT SUPPLIED AND RESIDENTIAL HOUSING CONSTRUCTION

The volume (or value) of construction activity undertaken in the residential home building industry is but one step removed from the mortgage credit market. For example, during the period under investigation the increase in residential mortgage debt outstanding at the four primary intermediaries as a percentage of value of new residential construction activity ranged from a low of fifty-one percent in 1966 to a high of eighty-two percent in 1964 and 1971. These data along with the total new housing starts, exclusive of mobile home shipments, are shown in Table 7.1. There appears to be a similarity of movement between changes in mortgage debt at the selected institutions and both value of new construction and new housing units offered. It can be cogently argued that causality runs from mortgage credit to construction value and new starts because financing must come before, or at the latest simultaneously with, actual construction.[1] Due to the substantial cost of the average home, advance assurance of long-term financing is a necessary prerequisite for most potential buyers. The contractor, builder, or developer must be reasonably sure a market exists before he undertakes

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[1] Oftentimes the intermediary provides construction funds with the intention of permanently financing the units when they are marketed by the builder. For a discussion of the causality direction from mortgage credit to housing starts, see (35, p. 1225).

construction activity. Thus, indirectly the availability of mortgage credit spurs the builder to meet the demand of potential homeowners.[1] The upshot of this chain of events is that once mortgage credit flows are estimated, we are in a favorable position to estimate construction activity. If mortgage credit forthcoming can be estimated, forecasting housing starts is a logical corollary.

TABLE 7.1

Change in outstanding residential mortgage debt, value of new residential construction, and new private housing starts

Year[a]	Change in debt outstanding: residential property (bil. of $)	Value of new residential construction (bil. of $)	Debt as percent of const. exp.	New units (thous.)
1964	23.0	28.0	82	1529
1965	21.7	27.9	78	1473
1966	13.0	25.7	51	1165
1967	16.1	25.6	63	1292
1968	17.2	30.6	56	1508
1969	17.8	33.2	54	1467
1970	16.6	31.9	52	1434
1971	35.2	43.1	82	2052

[a]Source: Federal Reserve Bulletin

In the previous chapters, each of the primary mortgage credit supplying intermediary groups has been analyzed and an equation developed to forecast the short-run supply of residential mortgage credit

[1]There are, of course, errors of judgement made which cause gluts and shortages as well as a certain amount of outright speculation. The vacancy rate of new homes, both nationally and locally, is the barometer which keeps the construction activity in tune with actual demand.

from each. Table 7.1 shows that a large percentage of the funds for residential structures come from these intermediaries; thus, the supply of credit from these institutions will serve as a proxy for all funds flowing to residential structures. The objective of this chapter is to formulate equations to explain residential housing construction activity. The heart of these equations will be the summation of the mortgage credit supplied by the above analyzed financial institutions. The statistical method used will again be least squares multiple regression but the volume of mortgage credit supplied during the time period will now be an independent variable in the regression analysis. The dependent variables will be indicators of residential housing activity, either starts or value of new construction.

Relationships of the Various Intermediaries

Prior to incorporating aggregate mortgage credit supplied by the four above mentioned intermediaries, it must be shown that the activities of one group do not appreciably influence the operation of the others. To assess interdependence, two-stage least squares was used on the primary estimation equations formulated in the previous four chapters. Each equation was reestimated with the dependent variables of each equation serving, in turn, as an independent variable in the equation being analyzed. For example, the SLA estimation Equation 3.3 was reestimated using M^u, M^b, and M^l, one at a time, as independent variables.[1]

[1] It would have been better to include simultaneously all three of the mortgage credit supply variables as independent variables but the required computer time would have been prohibitively expensive.

If these new independent variables are insignificant and the estimation equations are not materially altered, this points to independence of the estimation equations. There are four intermediaries which must be analyzed two at a time; therefore, we have a total of twelve two-stage least squares regressions to analyze to exhaust all possibilities.[1] This two-stage analysis did not indicate the presence of interdependence because in each case the t-statistic associated with the intermediary independent variable was insignificant and the two-stage results did not deviate substantially from the ordinary least squares findings. The largest degree of interdependence seems to exist between SLAs and CBs.[2] If one were to hypothesize an interrelationship between any two of the above groups of intermediaries, MSBs and SLAs would probably be chosen because of their primary emphasis on supplying funds to prospective homeowners; however, the two-stage results do not document a similarity of credit supply operations.[3] In none of the two-stage equations was the explanatory power of the equation superior to those of the ordinary least squares equations derived above. The negative outcome of the two-stage analysis fails to document the interdependence of the estimation

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[1]Only the two-stage version of the primary estimation equation was formulated.

[2]When M^b was included in the SLA equation, its coefficient was -0.58 and had a t-statistic of -1.48. When M^s was included in the CB equation, its coefficient was 0.13 with a t value of 1.01.

[3]The M^u variable in the SLA equation had a coefficient of 0.59 but the t-statistic was only 0.74; the M^s variable in the MSB equation displayed a partial regression coefficient of 0.03 and a t value of 1.30. For an analysis of the mortgage credit cycles of the four intermediaries and how they differ, see (14).

equations previously formulated. If the two-stage analysis would have shown mutual dependence, the task here would have been simplified since the mortgage credit supplied by one intermediary could have been used as a proxy for the credit supplied by all. It is not being claimed that all intermediaries act independently in their mortgage credit supply activities all the time, but only that their interdependency is negligible from a statistical standpoint.

Since the two-stage least squares analysis undertaken above did not imply a substantial degree of interrelationships between the four credit supplying industries, it is appropriate to combine the four supply equations into one to obtain a proxy variable for total credit supplied to the residential mortgage market. This is accomplished by simply defining a new variable, M^T, which equals $M^s + M^u + M^b + M^l$. The supply equations of the above chapters can be used to estimate the mortgage credit supplied by the individual intermediaries and the summation of these estimates serve as a measure for total intermediary credit supplied. These estimated values will be denoted by an asterisk; thus, $M^{T*} = M^{s*} + M^{u*} + M^{b*} + M^{l*}$.[1]

Measures of Residential Housing Activity

There are numerous measures which could be used to assess changes in the supply of residential housing but probably the two most commonly used are new private residential housing starts (PHS) and the value of

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[1]Silber (59, 62) used a similar approach to total mortgage credit supply estimation.

private residential construction put in place (CPP).[1] These two series were chosen because PHS is a physical measure of residential housing activity whereas CPP is a monetary measure. When price changes are taken into account, the two should be similar and functionally related to the same variables. Assuming it is correct that mortgage credit availability is a requisite for additions to residential housing, it should be possible to explain PHS and CPP by considering intermediary credit supplied. The PHS variable will be analyzed first and then the CPP series will be examined. An attempt will be made to estimate these variables by using ordinary least squares multiple regression analysis.

A cursory look at the PHS series indicates that construction activity wanes in the fourth and first quarters--the cooler months--and intensifies in the second and third quarters--the warmer months. Any regression equation designed to explain PHS must compensate for this seasonal pattern. The dummy scheme previously employed is apropos. The seasonality pattern of the raw PHS data should yield a positive coefficient for the second and third quarters and a negative coefficient for the remaining quarters.[2]

Since no basic demand variables are being considered in this exposition, the only other variable needed to estimate PHS should be M^T. Since M^T is in current dollars and the cost of residential housing has been rising, to both builders and homeowners, we must deflate the

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[1]The exact descriptions and sources of these data series are given in Appendix B.

[2]The fourth quarter will be implicitly incorporated as it was previously.

credit supply variable to compensate. The deflator chosen is the Boeckh construction cost index of residences (B).[1] The coefficient of (M^T/B) should be positively signed and highly significant. The above analysis can be summarized as generic Equation 7.1.

$$7.1 \quad PHS = e_0 + e_1(M^T/B) + e_2S_1 + e_3S_2 + e_4S_3 + u$$

The initial estimation of Equation 7.1 over the sample period is shown as equation 7.2. The $\bar{R}^2$ is sufficiently high but the standard

$$7.2 \quad PHS = \underset{(7.2)}{181.7} + \underset{(8.6)}{.04321}(M^T/B) - \underset{(1.67)}{23.8}S_1 + \underset{(4.00)}{55.3}S_2 + \underset{(0.57)}{7.9}S_3$$

$$\bar{R}^2 = .987$$
$$D\text{-}W = .26$$
$$SEE = 45.8$$

error of the estimate of 45,800 units is higher than desired. The D-W statistic implies positive correlation among the residuals which means the error terms are not independently distributed.[2] An examination of the residuals indicated they were, without exception, negative prior to 1968:1 and always positive thereafter. This pattern indicates that a structural change took place between 1967 and 1968. An examination discloses no major event to account for such a change but numerous minor changes did occur. No single minor change was probably capable of generating the structural shift but when all are taken in concert, can explain the change. Some of the minor forces occurring were: (1) in 1968 Fanny May was privatized and Ginny May was established; (2) the Housing Act of 1968 established a national housing policy for the

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[1] A summary description for this index is given in Appendix B.

[2] For a discussion of the damage caused, see (23, pp. 49-69).

U.S. calling for twenty-six million new and rehabilitated units by 1978; (3) mobile home shipments increased; (4) the rate of inflation of housing as measured by the Boeckh index increased rapidly after 1968:[1] (5) the FHLBS policy since 1968 has been more conducive to obtaining needed advances; and (6) in May of 1968 FNMA adopted a forward commitment program in contra-distinction to its prior over-the-counter market.[2] There are other occurrences which influenced, both directly and indirectly, the relationship of PHS and deflated M^T but the above are sufficient to see that a structural change in 1968 was highly probable.[3]

A single Rho transformation was performed on the variables of Equation 7.2 but the autocorrelation was reduced only minimally. Repeated Rho transformations may have freed the equation of the bothersome autocorrelation but to pursue this procedure would have hobbled forecasting because of the added complexity. Hence, a dummy variable was incorporated to account for the shift. This was selected because of the clear-cut nature of the shift which occurred in 1968. The dummy variable (D) takes on the value zero prior to 1968:1 and the value one thereafter. When the dummy was added and Equation 7.2 reestimated, the autocorrelation problem appears to be solved. The new results are shown as Equation 7.3

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[1]From 1964:1 to 1967:4 the Boeckh index increased from 0.866 to 1.029 but from 1968:1 to 1971:4 the increase was from 1.034 to 1.375.

[2]The uncertainties of the over-the-counter program have been eliminated, and with substantial forward commitments in hand, loan originators have not tended to cut back on lending as they often did prior to 1968 (58, p. 77).

[3]For a discussion of structural change in the mortgage credit market, see (32, 33, 37, p. 434, 64). Jaffee (41, pp. 35-7) also had to include a dummy variable to account for 1968 in his simulation model.

and will be used as the primary estimation equation for PHS.

$$7.3 \quad PHS = \underset{(10.95)}{141.03} + \underset{(17.92)}{.04345}(M^T/B) - \underset{(3.71)}{25.61}S_1 + \underset{(7.94)}{53.06}S_2 + \underset{(1.47)}{9.92}S_3 + \underset{(9.83)}{74.77}D$$

$$\bar{R}^2 = .997$$
$$D\text{-}W = 1.85$$
$$SEE = 22.09$$

Equation 7.3 is a marked improvement over Equation 7.2 because of the higher t values, the significantly lower SEE, and the apparent absence of autocorrelation among the residuals. All the variables are properly signed and changes in PHS are almost perfectly explained. By first estimating M^T from the individual intermediary equations and then substituting into Equation 7.3 a reasonably accurate short-term forecast of PHS should be possible.

The value of private residential construction put in place is a financial variable as is M^T; therefore, any structural change in mortgage credit is likely to influence both equally and there should be no need for a dummy variable as there was in the PHS equation. The CPP series is divided by the Boeckh index to make the deflated mortgage credit supply variable a common component of both residential housing activity equations. The deflated CPP series was estimated over the sample period and the results appear in Equation 7.4.

$$7.4 \quad CPP/B = \underset{(20.9)}{4438.1} + \underset{(12.4)}{.524}(M^T/B) - \underset{(6.41)}{768.46}S_1 + \underset{(0.79)}{91.91}S_2 + \underset{(5.5)}{642.67}S_3$$

$$\bar{R}^2 = .997$$
$$D\text{-}W = 1.59$$
$$SEE = 383.8$$

The estimation equation conforms to expectations except the seasonal dummy for the fourth quarter has a positive coefficient of 34.88. This outcome is not considered major, especially since the coefficient associated with S_2 may not be significantly different from zero. The $\bar{R}^2$ is exceedingly high, the SEE is approximately \$384 million which is less than five percent of the average value of the dependent variable, and the D-W statistic does not indicate the presence of autocorrelation among the error terms. Equation 7.4 should give accurate short-run estimates of CPP/B when used to forecast outside the sample period.

Equation Performance and Forecasting

Equation 7.3 was estimated for the period 1964:1 through 1972:2 by using the actual values for M^T/B. To forecast PHS from this equation, M^T/B must first be estimated from Equations 3.3, 4.2, 5.2, and 6.2. To assess the tracking power of Equation 7.3 over the sample period, the estimated value for the total deflated mortgage credit supplied by the intermediaries, M^{T*}/B, was substituted for M^T/B in the equation. The results of this estimation appear in Table 7.2. The size and pattern of the residuals indicate that the substitution of M^{T*} for M^T did not disrupt the tracking power of Equation 7.3.

The final test for the efficacy of the PHS equation is to forecast outside the sample period. Since the estimated values for mortgage credit supplied by each intermediary has been made for 1972:3 and 1972:4, M^{T*} is available and a forecast of PHS for these two quarters will be made. The resulting estimates appear in Table 7.3 along with actual PHS and the estimation errors. The forecasts are well within the

TABLE 7.2

Estimated, actual, and residual values of PHS from Equation 7.3 when M^{T*} replaces M^{T}
(In thousands)

Quarter	Actual	Estimated	Residual
1964:1	335	332	3
2	477	460	17
3	408	414	-6
4	359	380	-21
1965:1	293	312	-19
2	468	451	17
3	400	401	-1
4	350	359	-9
1966:1	283	303	-20
2	401	400	1
3	296	293	3
4	216	237	-21
1967:1	218	223	-5
2	382	377	5
3	375	370	5
4	333	323	10
1968:1	293	312	-19
2	441	455	-14
3	411	397	14
4	364	372	-8
1969:1	324	335	-11
2	462	477	-15
3	379	389	-10
4	302	303	-1
1970:1	255	255	0
2	388	395	-7
3	401	387	14
4	389	371	18
1971:1	381	370	11
2	594	613	-19
3	573	579	-6
4	506	483	23
1972:1	505	478	27
2	661	676	-15

acceptable margin and Equation 7.3, periodically updated, should continue to give accurate short-term predictions of private residential housing starts.

TABLE 7.3

Actual, estimated, and residual values of PHS for a period outside the sample span (In thousands)

Quarter	Actual	Estimated	Residual	Percent error
1972:3	638	599	39	6.0
1972:4	554	557	-3	0.5

The methodology employed to estimate PHS from M^{T*} was also used to estimate CPP/B. Equation 7.4 was utilized and the results for the sample period appear in Table 7.4. As can be observed from this table, the residuals are usually a small percent of the actual values. CPP/B was estimated for the last two quarters of 1972; this data as well as the actual values appear in Table 7.5. The estimates are reasonably accurate and compare favorably with the results obtained for the PHS variable.

It has been the objective of this chapter, and actually the primary purpose of this exposition, to forecast residential housing starts. This has been accomplished via Equation 7.3. It is fully realized that to make long-term projections an assessment of basic demand variables would be necessary. The short-run technique used above concentrates strictly upon financial variables and should be updated as frequently

TABLE 7.4

Estimated, actual, and residual values of CPP/B from Equation 7.4 when M^{T*} replaces M^{T}
(In millions of dollars)

Quarter	Actual	Estimated	Residual
1964:1	6174	6282	-112
2	8140	7732	408
3	8439	8248	191
4	7476	7809	-333
1965:1	5837	6039	-202
2	7945	7626	319
3	8298	8094	204
4	7382	7556	-174
1966:1	5783	5925	-142
2	7301	7010	291
3	7074	6791	283
4	5545	6079	-534
1967:1	4214	4968	-754
2	5708	6732	-1024
3	7111	7715	-604
4	6711	7112	-401
1968:1	5222	5135	87
2	6976	6770	206
3	7586	7151	435
4	6997	6802	195
1969:1	5513	5422	91
2	7184	7038	146
3	7334	7046	288
4	6292	5972	320
1970:1	4788	4447	341
2	6135	6049	86
3	6646	7019	-373
4	6943	6792	151
1971:1	5811	5834	-23
2	8133	8676	-543
3	9081	9344	-263
4	8802	8148	654
1972:1	7449	6535	914
2	9195	9435	-240

as actual data allows; this will insure that the technique remains viable and capable of making accurate predictions.

TABLE 7.5

Actual, estimated, and residual values of CPP/B for a period outside the sample span (In millions of dollars)

Quarter	Actual	Estimated	Residual	Percent error
1972:3	9960	9576	384	3.9
1972:4	9601	9038	563	6.0

Some of the variables in the individual intermediary estimation equations can be or are controlled by various legal and regulatory agencies. This implies that these controllable variables can be used as policy instruments to prompt desired action in the residential housing sector. This is sometimes a complicated undertaking which deserves substantial consideration; therefore, these policy implications will be the topic of the following chapter.

CHAPTER VIII.

POLICY IMPLICATIONS

Since 1968 the nation has had a formal housing goal; it is the desire of the Executive Branch of the government to realize this objective by 1978.[1] While there are numerous obstacles, political as well as financial, standing in the way of achieving the goal of a decent home for every american citizen, much concern has been expressed about financial feasibility.[2] Particularily, will there be sufficient mortgage credit naturally forthcoming to realize the goal by 1978? Obviously, questions arise concerning other resource availability, including manpower, materials, and land, but these nonfinancial aspects of the problem are matters of only peripheral concern in this tractate.[3]

The studies assessing the naturally forthcoming mortgage credit needed to finance the American housing dream have concluded there is likely to be a deficiency unless drastic changes are made in the mortgage credit market (16, 66). Other researchers (e.g., 28) contend the

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[1] It is to be noted, however, no official study of the nation's resources and their allocation was made and no priorities were established. For a critique of the 1968 HUD Act see (15, 20).

[2] Based on the record since 1968, it appears the goal is not being avidly pursued by the housing authorities and the legislators of this country irregardless of its feasibility.

[3] Meltzer (50, pp. 43-5) believes these nonfinancial matters to be of utmost importance.

HUD Act of 1968 grossly underestimated the need for housing while some contend there is no housing deficiency presently and consequently no need for a federal policy bolstering the housing sector.[1] Given that the consensus opinion of financial shortage is correct, the question to be answered is how should this gap be alleviated?

Due to ceilings of some mortgage rates, state usury laws, rate ceilings on interest rates payable by some intermediaries, etc., we see the housing industry taking the brunt of a shortage of investment funds. In view of the recent major downturns in residential construction in 1966 and 1969, and the formal housing goal of the economy limned in the HUD Act of 1968, all indications are that the activities of federal government credit agencies such as FNMA, GNMA, FHLMC, and the FHLBS will be expanded significantly if a capital shortage develops. Parenthetically, if a surfeit is expected, the agencies should be encouraged to moderate their participation. The difficulty encountered is how much to expand--or contract--and which agency or combination of agencies to mobilize to accomplish this task. Given that there exists only a finite number of dollars to put into the housing sector, which federal credit agency gives the most output (mortgage credit to the housing sector) from a given input? In effect, which channel of bolstering the housing sector is the most efficient in terms of output of housing?

A related problem is how the general capital market will react when a federal government credit agency raises funds to buttress the

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[1] Renshaw (55) has been one of the latest to espouse this maverick view.

housing sector.[1] Are the buyers of agency debentures the same as the suppliers of funds to financial intermediaries (45)? If so, Peter is being robbed to pay Paul and the slice of the capital pie going to the housing sector is unchanged. Unfortunately, this area of mortgage finance has been eschewed and what empirical research is offered is tenuous. For the purpose of this exposition, we shall put aside this more basic question and concentrate on what evolves given that the federal credit agencies have made funds available to the housing sector through the financial intermediaries outlined above. In essence, we desire to judge the efficacy of the federally sponsored credit agencies given they do engage, either directly or indirectly, in the residential mortgage market.

Following the precedence of the published literature, we shall attempt to assess the effectiveness of the FHLBS advances to member associations and the FNMA-GNMA activity in the secondary mortgage market. There are basically two aspects which should be considered: (1) whether the agencies were contra- or procyclical during the study period, and (2) which of the two programs has the most impact on residential housing activity. There has been conflicting research on the second point and most of the attention here will dwell on this controversy. Before conclusions on this matter are drawn from the present research, a brief overview of the past research and ensuing controversy will be presented.

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[1]For a study of this problem, see (31, pp. 37-42, 32, pp. 190-200).

A Review of Past Analysis of FHLBS Versus FNMA

There are numerous studies attempting to assess the efficacy of federal credit intermediaries in the mortgage market, but our review is limited to those studies considered in Chapter II plus the work of Schwartz (58). These five researchers cover the spectrum of opinion which has been offered in this controversy. There will be no attempt to assess the accuracy of these studies or to compare one with the other.[1]

Brady (8) utilized regression analysis to explain housing starts and finds that FHLBS advances increase conventionally financed single-family housing starts while FNMA purchases increase FHA-VA starts. The magnitudes are: a one billion dollar increase in FHLBS advances (1958 dollars) raises conventional starts at a seasonally adjusted annual rate of 37,000 units in the current quarter while the same increase in FNMA-GNMA purchases raises FHA-VA financed starts by 33,000 units at annual rates.[2] When FNMA-GNMA purchases were entered into the equation explaining conventional starts, they had a negative partial regression coefficient. When explaining total private housing starts in a single equation only FHLBS advances proved to be significantly positive. Brady estimated that a one billion dollar increase in advances would raise starts

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[1] A comparison would be meaningless since the various researchers concentrated on a different time span and incorporated different methods.

[2] The t-statistic value associated with FNMA-GNMA is 1.7 which is lower than desired but is significant at the ten percent level.

at an annual rate of 145,000 units.[1]

Huang (35) also used regression analysis to explain housing starts and, in addition, he estimated the flow of mortgage credit. He finds that FHLBS advances increases the number of conventional financed housing starts and the supply of conventional credit.[2] His analysis also shows that FNMA purchases raise VA financed starts and the flow of VA mortgage credit but does not influence either FHA or conventional starts. Likewise, FHLBS lending influences only the conventional sector of the market. While the initial impacts of both FNMA and FHLBS activities are similar in magnitude to Brady's, Huang's equations contain lagged dependent variables so that an increase in FNMA purchases or FHLBS advances raises starts in the long-run by more than in the short-run.

Jaffee (41) does not attempt to explain housing starts but instead estimates a structural model explaining mortgage commitments and mortgage flows by the four major financial institutions in the mortgage market.[3] The impact on the mortgage market of FHLBS advances and FNMA purchases is derived by simulating the impact of FHLBS lending and FNMA activity on the mortgage supply behavior of the intermediaries. The results are

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[1]This is for the starts series which excludes mobile homes but does include multiple-family dwellings, i.e., the HTT series.

[2]The t-statistic associated with this variable was 1.51 in the starts equation and 1.76 for the value-measure equation; the t-statistic in the mortgage credit equation was 0.22; thus, these results raise some question about significance.

[3]By virtue of the fact that mortgage credit is only slightly removed from housing starts, the research being considered is pertinent to the controversy under discussion.

as follows: a one billion dollar purchase of mortgages by FNMA leads to a decline in private mortgage holdings of $460 million after four quarters and a more than one billion dollar decline after eight quarters.[1] A one billion dollar increase in FHLBS advances leads to a gradual increase in mortgage credit flows up to $830 million after four quarters but declines to $810 million after eight quarters. Jaffee's conclusion with respect to federal credit intermediaries is (41, p. 59):

> It thus appears that FHLBB policy actions, by routing funds to the mortgage market via a private intermediary, are significantly more effective than FNMA policies which directly supply the mortgage market.

Schwartz (58) argues, based on the simple correlation coefficients between FHLBS advances, FNMA purchases, housing starts, and all other mortgage flows, that FNMA activity is more contracyclical than FHLBS activity. His judgement of FHLBS policy is (58, p. 70): "Prior to 1966, advances moved with no strongly discernible pattern, and to the extent any pattern existed it tended to be procyclical and seemingly perversely so at times." Since 1966, Schwartz argues, the record of the FHLBS is mixed; some years they follow a procyclical policy and others a contracyclical one.[2] On the other hand he commends the FNMA

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[1] Somewhat contrary to a priori reasoning, the FNMA purchases influenced CBs most negatively after both four and eight quarters and MSBs least negative after four quarters but next to most after eight quarters. The decline in CBs and MSBs was $-.19 and $-.07 billion after four quarters and $-.48 and $-.26 billion after eight quarters, respectively.

[2] He points out that sometimes the FHLBS followed the policies they did not by design but because of political expediency and/or adverse behavior of member associations.

for its contracyclical behavior, especially since May 1968.

Silber (61) develops a reaction function framework for analyzing FHLBS and FNMA activities at stabilizing the volume of mortgage credit with the implicit view towards stabilizing housing activity. In effect, he sets out to determine whether the FHLBS and FNMA have, indeed, used their policy tools to implement their objectives during the period 1960:1 through 1970:4. He concludes from his empirical findings that FHLBS advances act to stabilize housing starts at least as far as starts are influenced by credit conditions (61, p. 14). Furthermore, the FHLBS was only concerned with offsetting the impact of credit conditions on housing starts and this advance policy does not take explicit account of FNMA purchases, i.e., FHLBS advances are apparently not coordinated with FNMA secondary market activity. He finds basically the same thing to be true of FNMA activity (61, p. 18). Even though the FHLBS and FNMA were contracyclical over the sample period, their activity was motivated differently by the same phenomena and this accounts for their uncoordinated action. He concludes (61, p. 19):

> FNMA is most concerned with the mortgage rate since its activities are related most directly to the mortgage market. The FHLBS is more concerned with saving flows since its impact on mortgage credit and housing operates through the savings and loan associations.

Silber feels that since the FHLBS advances and FNMA purchases are influenced by the same general phenomena, even though not to the same degree, and any housing starts equation including these two policy variables is likely to suffer from multicollinearity problems; therefore, he feels the results of Brady, Huang, and Jaffee should be rejected since both FHLBS advances and FNMA purchases were entered simultaneously.

He likewise rejects Schwartz's suggestion that only FNMA was contra-cyclical.[1]

In other work (60) Silber found that a one billion dollar increase in FHLBS advances increased housing starts by 49,600 units after three quarters and the same increase in FNMA purchases raised starts by 41,000 units after three quarters. He further contends the market for FHA-VA mortgages is not really independent of the conventional mortgage market, and vice versa; therefore, FNMA purchases should be included in the equation for conventionally financed starts and the FHLBS variable ought to appear in the equation for federally underwritten starts.[2]

Cyclical Behavior of the FHLBS and the FNMA-GNMA

In view of the fact that advances and secondary market activity influence SLAs and MSBs respectively, only these two intermediaries will be considered in assessing these federal credit programs. It is fully realized that sometimes the movements of funds are beyond the control of the administrative bodies of these agencies because of independent behavior of the intermediaries and/or political considerations. The counterbalancing nature of these agencies will be judged over the entire sample period and it may be that they act contrary to their usual

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[1] It is this writer's contention that Silber did not, nor could he, document his multicollinearity problem to any rigorous degree.

[2] Silber has recommended this be accomplished by treating FNMA and FHLBS as one federal credit program variable.

behavior at times.[1] Additionally, the cyclical movements of credit funds will be compared to the regular inflow of funds to these intermediaries, namely, deposits and repayments, in judging their counterbalancing efficiency.[2]

FHLBS advances

The primary purpose of the FHLBS advances is to regulate the supply of mortgage credit to members so as to avoid building booms and excesses in residential construction activity as well as to permit members to meet expanding demand not matched by savings inflow. This contracyclical posture dictates that the flow of advances should moderate when savings inflow increase and vice versa. The job of the FHLBS is complicated by the fact that members cannot be forced to accept advances nor can they be prevented from repaying past advances if they so desire; however, they do have some control via direct surveillance and interest rates levied for advances. The FHLBS should have a contracyclical influence if they encourage borrowing when inflows are diminished and restrict advances when inflows are plentiful. Their sector stability role is somewhat simplified by the fact that most advances are not tendered on a commitment basis and SLAs, their primary borrower, do not usually make a substantial volume of forward commitments. These

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[1]What sometimes appears to be improper strategy may be warranted. For example, in a period of economic slack and decreased savings inflow, the mortgage market may be amply supplied with funds; therefore, a purely ad hominem argument of contracyclical behavior is improper.

[2]Other problems arise when credit programs are assessed but they will not be analyzed herein. For example, what impact does monetary policy or the interest elasticity of loanable funds have upon these institutions and contrariwise?

phenomena allow a faster response to changes in savings inflows.[1]

A simple correlation of advances, saving deposit inflows, and the repayments to SLAs indicate that FHLBS advance activity has been contracyclical to the regular inflows. The simple correlation coefficients appear in Table 8.1 below. When D^s_{t-1} was used instead of D^s_t as it is in Equation 3.3, the simple correlation coefficient remained basically unaltered.

TABLE 8.1

Correlation matrix of inflows to SLAs

	A_t	D^s_t	R^s_t
A_t	1.00	----	----
D^s_t	-.58	1.00	----
R^s_t	-.14	.59	1.00

While the correlation matrix shows a contracyclical policy on the average, a closer examination of the data yields a different picture. Prior to mid-1968 the FHLBS policy appears to be procyclical except during part of the savings inflow downturn in 1966-67. Since early 1969, the FHLBS policy has been overwhelmingly contracyclical and this strong relationship no doubt dominated in the correlation matrix above. The regression analysis of the previous chapters would probably be improved if only data since 1968 were used but, unfortunately, the

[1]It also calls for a pool of relatively liquid reserves on the part of the FHLBS and the proper volume to maintain for emergencies is a thorny problem: if too large the FHLBS might be criticized but if too small they would be inadequate and again criticism might arise.

sample period is too short for a reliable examination. The general assessment of the FHLBS advances policy is that no obvious pattern emerges until early 1969 when a contracyclical propensity is adopted and maintained.

FNMA-GNMA activity

The primary objective of the FNMA-GNMA is to act as a buffer for the federally underwritten mortgage credit market, increasing their activity when other suppliers depart or indicate their intention to depart from the mortgage market. Their activity should subside when the supply of mortgage funds are ample. A correlation matrix of the inflow of funds, Table 8.2 below, indicates that FNMA-GNMA activity is inverse to deposit inflows but directly related to repayments. When FGP is lagged

TABLE 8.2

Correlation matrix of inflows to MSBs

	FGP_t	D_t^u	R_t^u
FGP_t	1.00	----	----
D_t^u	-.20	1.00	----
R_t^u	.60	.04	1.00

one quarter as it appears in Equation 4.2, the correlation coefficients are all positive but the one associated with D_t^u is only 0.009. From Table 8.2 it may be concluded that FNMA-GNMA policy was procyclical when repayments were considered but the relationship with deposit inflows is nebulous: the relationship appears contracyclical when all values

are the same quarter but no discernible policy appears when FGP_{t-1} is used. The coordination of FNMA-GNMA activity is complicated because since May 1968 a forward commitment program has been used by these agencies, MSBs regularly employ forward commitments, and originators of mortgages are reluctant sellers to FNMA because of the stock purchases and other costs associated with the transactions. These complications doubtless cloud the efficiency of the agency but they cannot be explicitly accounted for in a surface study such as this one.

A quarter by quarter assessment of FNMA-GNMA activity and the same quarter deposit inflows shows that prior to 1969 there was no consistent pro- or contracyclical policy. Since 1969 the secondary market activity of FNMA-GNMA has been contracyclical even though the simple correlations of the entire sample period appearing in Table 8.2 shows the opposite. The similarity of cyclical behavior of FNMA-GNMA and the FHLBS is fortuitous because it allows a comparison of their impact upon the residential housing sector.[1] Since the objectives of the two are basically the same and their activity has been parallel, any bias in the analysis should equally influence the two and a comparison of their influence should be possible by using the regression results of the previous chapters. This comparison is the subject of the next section.

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[1]No mention of volume or importance has been made because the markets covered by these agencies are of different sizes. It has been implicitly assumed that the influence of the agencies is linear and volume is unimportant.

FHLBS Advances and Housing Starts

Equation 3.3 above shows that the relationship between mortgage credit supplied by SLAs and FHLBS advances is, on the average, a direct one. A one billion dollar increase in advances will cause M_t^s to increase by $280 million in the same quarter, ceteris paribus. The $280 million increase in M_t^s, when incorporated into Equation 7.3, causes an increase of 12,166/B units in PHS. Since the Boeckh index has been consistently increasing over time, the number of new starts a given dollar volume of advances will "buy" has been decreasing. In 1972:3, a one billion dollar increase in advances would have led to 8,187 additional housing starts in the current quarter. Since the present investigation is oriented toward the short-run, no attempt was made to simulate the impact in future time periods. No doubt present quarter advances will influence future activity but since the multiple regression results failed to verify a statistically measurable impact, the comments made here are applicable only to the current quarter.[1] FHLBS advances were analyzed as if they had an influence only upon SLAs. This selective analysis arises because SLAs form the bulk of the membership of the FHLBS. Additionally, the simple correlation and the two-stage regression results indicate that SLAs act independently in their credit supply behavior, thus, not affecting other suppliers. Other intermediaries besides SLAs make conventional loans and may also be members of the FHLBS; hence, FHLBS

[1] If for no other reason, associations are likely to decrease their borrowing rate as their total indebtedness to the FHLBS increases; therefore, current advance policy is likely to influence future borrowings as well as repayments of past borrowings.

advances may influence their behavior, either directly or indirectly. This influence, if it exists, was not captured by the above regression analysis, consequently nothing can be said about its magnitude or importance.

By utilizing Equation 7.4 it can be seen that a one billion dollar increase in advances will cause CPP to increase by $146.72 million. When $\Delta CPP/\Delta PHS$ is computed, the resulting quotient is approximately $18,000 which is very close to the average loan size made by SLAs (57). This indicates that the equations are realistic as well as able to yield relatively accurate results.

Since SLAs make predominatly conventional loans, their activity can be taken as a proxy for the conventional sector of the mortgage market. This approximation allows a comparison of the results obtained here and those of the studies reviewed above. The present analysis seems to support those researchers who argue that increases in FHLBS advances has a stimulative influence upon the housing sector and, therefore, can be used as a policy tool to moderate the residential housing cycle.[1] No comparison as to volume is attempted because the analysis here is by institutions whereas previous research has been by loan type.

The conclusions we draw here are that FHLBS advances directly influence SLA mortgage credit supply activity and this, in turn, influences private housing starts, especially conventionally financed ones. While FHLBS advances may influence the behavior of other mortgage credit supplying intermediaries, it is not of a measurable magnitude in the

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[1]Brady (8, pp. 54-63 and 11, pp. 155-57) provides examples of how forecasting models can be converted into policy models.

above analysis; therefore, any assessment of the impact of advances upon these non-SLA institutions would be sheer speculation.

FNMA-GNMA Activity and Housing Starts

The secondary mortgage market activity of FNMA-GNMA was statistically significant only in the MSB equation. The FGP variable was significant only when lagged one quarter; thus, current quarter changes will influence the immediately following quarter's value of M^{u}. The FGP variable entered the MSB mortgage credit supply Equation 4.2 with a negative coefficient. This implies that as FNMA-GNMA increase their activity, the lending volume of MSBs moves in the opposite direction. The activity of FNMA-GNMA probably influences MSB supply activity both directly and indirectly. A direct influence arises because MSBs are likely to moderate their mortgage lending activities when such lending appears relatively unprofitable and this is precisely the instant when FNMA-GNMA must support the market by buying if they are to be contracyclical. There is also an indirect influence because MSBs and FNMA-GNMA are no doubt competiting for funds in the capital market.[1]

According to Equation 4.2, a one billion dollar increase in FNMA-GNMA purchases would result in a reduction of M^{u}_{t+1} of eighty-eight million dollars. When this decreased mortgage credit supplied is entered

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[1]This offsetting influence has also been the subject of criticism against the FHLBS (45). Such asymmetric reactions to FNMA-GNMA and FHLBS activities are possible, given the different sectors of the mortgage market affected by each. FNMA-GNMA buys mortgages which have the nationwide market. The offsetting reactions by private financial institutions can occur rather quickly. The mortgage loans made by SLAs with FHLBS advances probably reach relatively isolated demands for mortgage credit.

into Equation 7.3, the resulting decrease in PHS is 3,824/B units. In terms of 1972:3 housing starts, a one billion dollar increase in $FGP_{1972:2}$ would result in 2,575 fewer starts. This inverse relationship supports those researchers who contend that FNMA-GNMA activity actually thwarts housing activity.[1]

This apparent defeating influence of FNMA-GNMA may actually be moderated because no doubt some of their purchases of mortgages comes directly from MSBs. To this extent, the adverse influence is offset. The exact magnitude of such offsetting behavior is not measurable from the above analysis but it can be said that unless it is approximately 10,800 starts (about $200 million), FNMA-GNMA activity will be less stimulative than FHLBS lending. Such a quantum offset is unlikely;[2] therefore, it seems proper to conclude from the above analysis that for the period studied, FHLBS lending has more of an impact upon residential housing starts in the short-run than does a similar dollar volume of FNMA-GNMA secondary market purchases. In fact, the evidence indicates that the latter's activity may have been self-defeating.

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[1] Jaffee is perhaps the strongest proponent of this position but Brady's work also partially confirms this result; however, to the extent that MSB supply activity is a proxy for the federally underwritten sector of the market, these results differ from those of Brady's.

[2] Mortgage companies, which originate but normally do not invest in mortgage loans, have accounted for from seventy-five to nearly ninety percent of the amount of mortgages sold to FNMA, with the higher proportions within this range recorded in the past few years (32, p. 192).

CHAPTER IX.

SUMMARY AND CONCLUSIONS

It has been the objective of this paper to investigage the residential mortgage credit market by segregating supplying intermediaries and linking physical or financial residential construction activity to these credit flows. The approach has been short-term; consequently, only financial variables have been explored. It has been concluded from the above regression results that the short-run fluctuations in mortgage credit flows have been explained adequately to allow the physical volume of housing activity to be accurately forecast for short periods of time into the future. The approach employed in the above analysis has been simplistic in that the complex interactions have not been fully investigated. This shortcoming is a problem associated with all research in the housing sector and arises mainly because of the paucity of reliable data. In recent years the various agencies and financial intermediaries associated with the mortgage credit market have taken concerted action to remedy this deficiency. As better data become available the present research can be updated and some of the incalculability deriving from the short sample period overcome.

The first step in this research was to analyze the determinants of the volume of mortgage credit each intermediary would supply. It was found these intermediaries are influenced by the same basic variables, but not equally so. Also each intermediary has its own lending idio-

syncrasy; consequently, there is some variation of variables in the supply equation of each group. There were no unalterable attempts to keep the intermediary supply equations symmetrical by including the same variables irrespective of their statistical significance. It may be that too much emphasis was put upon statistical significance and not enough on intuitive deduction; however, we have adopted the position that intuitive appeal may be misleading when working with forces as capricious as portfolio adjustments of institutions guided by human behavior.

The best supply equation of each group of intermediaries was combined to estimate a proxy for the total mortgage credit supplied to the residential mortgage market. This estimate in turn was employed as the primary independent variable in the housing starts and the value-of-starts equations. The estimates during the sample period and the forecasts outside the sample span derived from the equations were reasonably accurate. Our results compare favorably with other research even though the above analysis has not been along the lines of a formal model.

The supply equations of the intermediaries specializing in mortgage credit, SLAs and MSBs, were used to judge the efficiency of two federal programs designed to moderate housing cycles. Our conclusion was that the FHLBS advances appear to stimulate housing while FNMA-GNMA secondary market activity does not; in fact, it seems FNMA-GNMA have the opposite influence of what they are attempting. This outcome exists even though both federal programs have been contracyclical with intermediary inflows since 1969. This efficacy of the federal credit programs

is based on a static, short-run analysis and a long-term analysis might substantiate a different conclusion. The results we obtained support some previous researchers but refutes others. It appears the FHLBS advances are clearly superior to the FNMA-GNMA activity in stimulating housing production in the short-run; the verdict of the long-run cannot be answered from the above analysis. The short-term was chosen for this analysis because we wished to assess the importance of financial variables. The basic demand variables are needed to assess the long-run impacts of a particular housing policy and it is felt poor data reliability and constant structural changes in the housing sector make this type of analysis marginal.

It is felt the connection between financial variables and housing activity has been demonstrated in this surface study. No attempt was made to formulate a complete model of the mortgage credit market because of the lack of good data on the demand side and the uncertainty of the success of financial variables. It seems that a logical step to take in the future research along this line is to construct a complete model of the mortgage credit market concentrating on the supplying intermediaries and financial variables. There is a need for research to investigate the possibility of treating some of the exogenous variables in this research as endogenous and estimating them separately. This is a major undertaking and is likely to be frustrating because of the complex nature of financial intermediaries and their portfolio arrangements and rearrangements.

We, along with many others, feel there is a need to moderate the cyclical swings in housing. Unfortunately, the policy makers cannot

implement the necessary monetary and fiscal policies to attain this goal until the housing cycle and how it is interrelated to other sectors of the economy is fully understood. The above research implies that the control of residential construction is rooted in the control and management of the financial intermediaries. Recommended changes in the depositary institutions are now being considered but little thought is being given to the impact upon the housing sector. This nonconsideration of housing is indicative of the importance usually afforded to this sector of the economy. This relegation is doubtless a function of the fewness of resources employed in the past to understand the housing sector. More and better research is needed to outline measures to stabilize housing production. Until there is more research pointing the way to stability, the U.S. housing sector is likely to continue meandering along a similar course in servitude to the remainder of the economy.

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APPENDIX A.

EQUATIONAL OUTLINE OF REVIEWED MODELS

The major equations of the research reviewed in Chapter II are listed below. A brief explanation of the variables are also given to aid in the interpretation of the equations. Since Jaffee's equations utilized different sample periods, we have listed these below each equation. Huang's equations are from two different periods; thus, the date of the research is given directly below the equations.

Brady's Model

$$\underset{}{ICNFR58} = \underset{(4.6)}{41.206} + \underset{(5.4)}{.398B} - \underset{(4.0)}{3.21IC} + \underset{(7.5)}{.862LVC} + \underset{(7.5)}{.002FHLBS} - \underset{(6.8)}{.433T}$$

$$\bar{R}^2 = .862$$
$$D\text{-}W = 2.43$$
$$SEE = .684$$

$$\underset{}{HTT} = \underset{(2.7)}{-4330.6} + \underset{(3.9)}{52.54B} - \underset{(3.0)}{434.3IC} + \underset{(3.4)}{70.64LVC} + \underset{(2.6)}{.145FHLBS} - \underset{(4.2)}{47.85T}$$

$$\bar{R}^2 = .5693$$
$$D\text{-}W = 1.49$$
$$SEE = 123.6$$

$$\underset{}{HFED} = \underset{(1.9)}{120.5} - \underset{(1.9)}{29.9IFHA} + \underset{(1.7)}{.033AFEDF} + \underset{(3.9)}{8.229B} - \underset{(5.9)}{11.257T}$$

$$\bar{R}^2 = .67$$
$$D\text{-}W = .79$$
$$SEE = 22.99$$

$$HC = \underset{(1.9)}{-720.93} + \underset{(6.5)}{20.94B} - \underset{(6.9)}{241.8IC} + \underset{(4.4)}{22.09LVC} + \underset{(2.7)}{.037FHLBS} - \underset{(7.0)}{33.4T}$$

$\bar{R}^2 = .875$
D-W = 2.26
SEE = 29.83

$$HM = \underset{(5.2)}{-1434.8} + \underset{(5.6)}{1.182HTUS} + \underset{(8.0)}{14.257T}$$

$\bar{R}^2 = .616$
D-W = 1.617
SEE = 97.4

A description of the notations used by Brady follows:

AFEDF	net acquisition of federally underwritten mortgages by FNMA-GNMA.
B	Boeckh index of residential construction costs.
FHLBS	net quarterly change in Federal Home Loan Bank advances outstanding, seasonal adjusted.
HC	number of conventionally financed housing starts at seasonally adjusted annual rates, single-family dwellings only.
HFED	number of federally underwritten housing starts at seasonally adjusted annual rates.
HM	number of multiple-family housing starts at seasonally adjusted annual rates, private nonfarm.
HTT	HC + HFED + HM.
HTUS	HC + HFED.
IC, IFHA	true interest rates on conventional and FHA mortgages, respectively.
ICNFR58	value of the HTT series in 1958 dollars.
LVC	loan-to-value ratio on conventional mortgages.
T	linear time trend.

Huang's Model

$$TMS = -14950.0 + 1421.0RM_{-1} - 245.4RS_{-1} - 1276.0RL_{-2} + 373.1MB$$
$$(4.19) \quad (1.38) \quad (.901) \quad (1.66) \quad (8.24)$$
$$+.333SA_{-3} + 14.71FHLN_{-1} - .183FNMA$$
$$(5.34) \quad (4.19) \quad (.382)$$
$$\bar{R}^2 = .93$$
$$D\text{-}W = 1.35 \qquad \text{(date: 1971)}$$

$$S = -20240.0 + 6380.0i - 2171.0i_{-2}^{L} + 2.281R_{-3}^{P} + .487S^{A}$$
$$(3.5) \quad (3.5) \quad (1.74) \quad (4.45) \quad (3.5)$$
$$\bar{R}^2 = .725 \qquad \text{(date: 1966)}$$

$$GMS = -977.0 + 369.5RGM_{-1} - 160.3RS_{-1} - 538.8RL_{-2} + 73.73MB$$
$$(1.41) \quad (2.10) \quad (2.08) \quad (3.02) \quad (5.60)$$
$$+ .000902SA_{-3} + .207FHLN_{-1} + .191FNMA$$
$$(.0547) \quad (2.17) \quad (1.03)$$
$$R^2 = .65$$
$$D\text{-}W = .87 \qquad \text{(date: 1971)}$$

$$CMS = -13360.0 + 995.9RCM_{-1} - 125.2RS_{-1} - 690.3RL_{-2} + 290.6MB$$
$$(4.61) \quad (1.11) \quad (.569) \quad (1.12) \quad (7.80)$$
$$+ .345SA_{-3} + 1.196FHLN_{-1}$$
$$(6.32) \quad (4.05)$$
$$\bar{R}^2 = .937$$
$$D\text{-}W = 1.48 \qquad \text{(date: 1971)}$$

A description of the notations used by Huang follows:

CMS, GMS — total supply of residential mortgage credit made for conventional mortgages and federally underwritten mortgages, respectively.

FHLN — net advances of the FHLBS to the member associations, sum of monthly figures, in millions of dollars.

FNMA — net purchases by the FNMA and the GNMA of FHA-insured and VA-guaranteed mortgages in the secondary market, in millions of dollars.

i, RM — average weighted market yield of all types of home mortgages, in percentage points.

i^L, RL — market yield on recently issued Aaa rated corporate bonds, in percentage points.

MB — source base plus reserve adjustments, in billions of dollars.

R^P — reserve position of the member banks, or excess reserves less borrowings from FRBs, in billions of dollars.

RCM — estimated market yield on conventional mortgage loans made, in percentage points.

RGM — weighted average of market yields on FHA and VA loans made according to amount of loan, in percentage points.

RS — open market money rate of 4-6 month commercial paper in New York, in percentage points.

S — gross flow of FHA-insured, VA-guaranteed, and conventional nonfarm residential mortgage loans, in millions of dollars.

S^A, SA — net increase in savings deposits at selected institutions, in millions of dollars.

TMS — total residential mortgage loans made under FHA insurance and VA guarantee plus the estimated total extention of conventional mortgage credit, in millions of dollars.

Jaffee's Model

$$\Delta M_g^S = \underset{(.47)}{.152} - \underset{(7.1)}{.83}DUM + \underset{(2.0)}{.118}\overline{\Delta D}^S + \underset{(3.4)}{.26}D^S + \underset{(1.7)}{.19}A^S + \underset{(5.3)}{.625}R^S - \underset{(3.7)}{.299}M_{-1}^S + \underset{(11.5)}{1.95}\sum_{i=0}^{6} w_i OC_{-i}^S$$

$\bar{R}^2$ = .995 — w_0 = .39 — w_4 = .05 — sample period: 1957:2

D-W = 1.73 — w_1 = .27 — w_5 = .01 — through 1968:4

SEE = .103 — w_2 = .18 — w_6 = -.01

p = .741 — w_3 = .10

$$\Delta M_g^M = -.779 - .284DUM + .334\overline{\Delta D}^M + .115D^M + .40R^M - .32M_{-1}^M$$
$$(2.1) \quad (3.4) \quad (6.1) \quad (3.2) \quad (\text{cntr}) \quad (3.5)$$
$$+ .440\sum_{i=0}^{6} w_i OC_{-i}^M$$
$$(15.0)$$

$\bar{R}^2 = .969$ $\quad w_0 = .27$ $\quad w_4 = .10$ sample period: 1960:2
D-W = 2.16 $\quad w_1 = .22$ $\quad w_5 = .06$ through 1968:4
SEE = .066 $\quad w_2 = .18$ $\quad w_6 = .03$
$w_3 = .14$

$$\Delta M^C = .005DD^C + .072\sum_{i=0}^{4} v_i TD_{-i}^C + .016\sum_{i=0}^{4} w_i (TD_{-i}^C)(RM-RL) - .176M_{-1}^C$$
$$(0.77) \quad (3.8) \quad (3.5) \quad (3.3)$$

$\bar{R}^2 = .94$ $\quad v_0 = .14$ $\quad w_0 = .24$ sample period: 1955:1
D-W = 1.81 $\quad v_1 = .22$ $\quad w_1 = .25$ through 1968:4
SEE = .128 $\quad v_2 = .26$ $\quad w_2 = .23$
p = .632 $\quad v_3 = .24$ $\quad w_3 = .18$
$v_4 = .14$ $\quad w_4 = .10$

$$\Delta M_g^I = -.757 - .358DUM + .089\overline{\Delta D}^I + .029D^I + .251R^I - .053M_{-1}^I$$
$$(2.2) \quad (4.1) \quad (0.96) \quad (2.3) \quad (1.5) \quad (2.5)$$
$$+ .991\sum_{i=0}^{7} w_i NC_{-i}^I$$
$$(15.5)$$

$\bar{R}^2 = .972$ $\quad w_0 = .17$ $\quad w_4 = .13$ sample period: 1955:1
D-W = 2.06 $\quad w_1 = .17$ $\quad w_5 = .11$ through 1968:4
SEE = .089 $\quad w_2 = .16$ $\quad w_6 = .08$
p = .121 $\quad w_3 = .15$ $\quad w_7 = .04$

A description of the notations used by Jaffee follows:

C commercial banks
I life insurance companies
M mutual savings banks
S savings and loan associations

A^S FHLBB advances to SLAs.

D^i, i=S,M,I deposits at the ith intermediary.

$\overline{\Delta D}^i$, i=S,M,I deviation of current deposit flow from a four quarter moving average at the ith intermediary.

DD^c	demand deposits less required reserves on demand deposits at member commercial banks.
DUM	dummy variable taking the value one 1968:1 to 1968:4 and zero elsewhere.
M^i, i=S,M,I,C	mortgage stock at the ith intermediary.
ΔM_g^i, i=S,M,I	gross mortgage flow at the ith intermediary.
ΔM^c	net change in commercial bank mortgage holdings.
NC^I	new commitments of LICs.
OC^i, i=S,M	outstanding stock of commitments at the ith intermediary.
R^i, i=S,M,I	repayment of outstanding mortgages at the ith intermediary.
RL, RM	commercial loan and mortgage rates, respectively.
TD^c	time deposits less required reserves on time deposits at commercial banks.

Silber's Model

$$M^S = \underset{(3.67)}{.279D^S} - \underset{(1.48)}{169.6i_{fhlb}} + \underset{(9.8)}{.744M^S_{-1}} - \underset{(.045)}{20.6S_1} + \underset{(.935)}{443.7S_2} + \underset{(1.47)}{648.8S_3} + \underset{(.444)}{207.6S_4}$$

$R = .99$
$D\text{-}W = 1.60$
$SEE = 186.3$
$Rho = .65$

$$M^u = \underset{(2.47)}{-2058} + \underset{(2.64)}{.164D^u} - \underset{(2.43)}{239.0(i_{cb}-i_m)} + \underset{(1.79)}{145.2(i_{gb}-i_m)} + \underset{(3.3)}{.063\Delta\overline{M}} + \underset{(15.4)}{.865M^u_{-1}}$$

R = .99
D-W = 1.67
SEE = 81.4
Rho = .42

$$M^c = -2086.6 + .028DD^c + .047TD^c + .846M^c_{-1}$$
$$\quad\quad (1.79) \quad (2.15) \quad (3.92) \quad (19.2)$$

R = .99
D-W = 1.72
SEE = 271.1
Rho = .34

$$M^l = 2815.7 + .059A^l - 292.5(i_{cb}-i_m) + 240.0(i_{gb}-i_m) - 61.7LV$$
$$\quad\quad (1.42) \quad (1.96) \quad (1.25) \quad\quad (1.37) \quad\quad (1.68)$$
$$+ 540.9CM_{-2} + 891M^l_{-1}$$
$$\quad\quad (3.18) \quad (15.4)$$

R = .99
D-W = 2.31
SEE = 280.2

A description of the notations used by Silber follows:

c commercial banks
l life insurance companies
s savings and loan associations
u mutual savings banks

A^l	level of LIC assets.
CM_{-2}	outstanding commitments of LICs lagged two quarters.
D^i, i=s,u	deposits at the ith intermediary.
DD^c	demand deposits at all commercial banks.
$(i_{cb}-i_m)$	interest rate of corporate bonds minus the mortgage rate.
(i_{fhlb})	interest rate charged for FHLBS advances.
$(i_{gb}-i_m)$	interest rate of government bonds minus the mortgage rate.

LV	loan-to-value ratio of mortgages held by life insurance companies.
M^i, i=s,l,u,c	total mortgage loans outstanding at the ith intermediary.
$\Delta\overline{M}$	change in total mortgages outstanding at MSBs.
S_i, i=1,2,3,4	seasonal dummy variables for the ith quarter.
TD^c	time deposits at all commercial banks.

APPENDIX B.

NOTATION, SYMBOL DEFINITIONS, AND DATA SOURCES

All data were collected for 1964:1 through 1972:2 and those variables lagged in the regressions were collected the same number of quarters prior to 1964:1. The data were derived in one of three ways: (1) compiled by the author, (2) taken from the Data Resources Institute data banks, or (3) taken from the national housing market data bank of the Federal Home Loan Bank Board.[1] Unless stated otherwise, all data are unadjusted and all interest rates are expressed in percent.

Notation

Superscripts: identify specific intermediary

- b commercial banks
- l life insurance companies
- s saving and loan associations
- u mutual savings banks
- T aggregate, defined specifically below
- * estimated

Subscripts: identify period of lag; current period denoted as t. Others identified below.

Δ first difference of variables, e.g., $\Delta Z = Z_t - Z_{t-1}$.

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[1] This data bank was originally compiled by Brady (9).

Symbol Definitions and Source

A	change in total advances outstanding supplied by the FHLBS and held by all members of the FHLBS. Derived from monthly data supplied in the Federal Reserve Bulletin. In millions of dollars.
B	Boeckh construction cost index of residences. Derived from monthly data supplied in Construction Review. 1967 = 1.00.
C^i, i=l,s,u	change in outstanding residential mortgage loan commitments for the ith intermediary. For LICs the data were obtained from Forward Investment Commitments of Reporting Life Insurance Companies. The reporting LICs represent about eighty percent of the industry's assets. The data for SLAs and MSBs were derived from monthly series listed in the Federal Reserve Bulletin. The MSB values are for all savings banks in New York state and serve as a proxy for all MSBs. All values in millions of dollars.
CPP	private residential construction put in place. The data were adapted from monthly series reported in the Survey of Current Business. In millions of dollars.
CT^i, i=b,l,s,u	composite credit term index for the ith intermediary. Derived by computing a conventional, FHA, and VA weighted index of interest rates, loan-to-value ratios, and amortization lengths and then dividing the product of the weighted L/V and LA into the weighted interest rate. Interest rate and L/V are expressed in percent and the LA denominated in years. Components of the indices were supplied by the FHLBS, and the weights were determined by using the volume of conventional, FHA, and VA mortgages held by the ith intermediary.
D	dummy variable taking on the value zero prior to 1968:1 and the value one thereafter.
D^i, i=s,u	change in deposits at the ith intermediary. It is the change in saving capital held by all insured SLAs and the change in total deposits at all MSBs. The SLA values were derived from monthly data supplied by the FHLBB and the MSB values were computed from the monthly series reported in the Federal Reserve Bulletin. In millions of dollars.

DD^b — change in demand deposits at all commercial banks. Includes only those demand deposits which are a component of the money supply. Adapted from daily figures reported in the Federal Reserve Bulletin. In millions of dollars.

FGP — secondary mortgage market purchases of the Federal National Mortgage Association and the Government National Mortgage Association minus their sales. Data prior to 1968:3 relates to the secondary market activity of the old FNMA. Data derived from monthly listings in the Federal Reserve Bulletin. In millions of dollars.

i_c — interest rate on Aaa corporate bonds. Adapted from monthly data listed in the Federal Reserve Bulletin.

i_g — interest rate of long-term (greater than ten years) U.S. Government bonds. Adapted from monthly data supplied in the Federal Reserve Bulletin.

i_m — interest rate on conventionally financed new homes, FHLBB series, effective rates. It reflects fees and charges as well as contract rates and an assumed prepayment at the end of ten years. Taken from the Federal Reserve Bulletin and Brady (9).

i_{sl} — yield on Aaa state and local government general obligation bonds. Adapted from monthly data reported in the Federal Reserve Bulletin.

LA — length of amortization period of a mortgage and expressed in years. Data supplied by the FHLBB and Brady (9).

L/V — loan-to-value ratio of a mortgage loan. Expressed in percent. Supplied by the FHLBB and Brady (9).

M^i, $i=b,l,s,u$ — change in total residential mortgage loans outstanding at the ith intermediary. SLA data were adapted from monthly series supplied by the FHLBB. MSB data supplied by the National Association of Mutual Savings Banks. CB data includes loans held by nondeposit trust companies but not bank trust departments and were adapted from monthly series in the Federal Reserve Bulletin. LIC data adapted from monthly listings in the Federal Reserve Bulletin. All values in millions of dollars.

M^T — $M^b + M^l + M^s + M^u$.

M^{T*} — $M^{b*} + M^{l*} + M^{s*} + M^{u*}$ as derived from the primary supply equations for each intermediary.

ΔMB — change in the St. Louis Fed's monetary base measure. In millions of dollars. Taken from the Data Resource Institute data bank.

MI — Meltzer index of monetary stringency. Computed as follows: the rate of interest on new issues of three month U.S. Government bills, calculated as the average rate on new issues, multiplied by one minus the ratio of free to total reserves of the New York and Chicago Central Reserve City Banks. The component parts of the index were taken from the Federal Reserve Bulletin. Also see Brady (9).

PHS — total private residential housing starts. Taken from Construction Reports, Housing Starts: U.S. Department of Commerce, Bureau of the Census (C20 series). In thousands of units.

R^i, i=l,s,u — net mortgage repayments, scheduled and unscheduled, to the ith intermediary. SLA data taken from monthly series supplied by the FHLBB. MSB data is for all MSBs in New York state and was supplied by the Board of Governors, Federal Reserve System. LIC data are for reporting LICs and were obtained from Record of Insurance Investments and Economic and Investment Report which were issued by the Life Insurance Association of America. All values in millions of dollars.

S_1, S_2, S_3 — seasonal dummy variables for the first, second, and third quarters, respectively. The dummy variables take on a value of one in the appropriate quarter, a minus one in the fourth quarter, and a zero in the remaining two quarters. The value of one was arbitrarily chosen.

T — a linear time trend which is tied to zero at the beginning of the series. Incremental steps of one unit were arbitrarily used; however, any linear trend will serve as adequately.

TD^b — change in time deposits of all commercial banks. Excludes those deposits due to domestic commercial banks and U.S. Government. Source is the Federal Reserve Bulletin. In millions of dollars.