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Forward Commitment Decisions of Life Insurance Companies for Investments in Bonds and Mortgages

For many years, corporate bonds and mortgages on residential and nonresidential properties have dominated the investment portfolios of life insurance companies. Although the fractions have varied somewhat over time in response to changing market conditions, the *Life Insurance Fact Book* (1977)

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shows that corporate bonds have accounted for between 35% and 40% of *all* assets in each of the last twenty-five years, and the share of mortgages has ranged from 28% to 39%. But the reported assets of insurance companies include those in special accounts for pension plans, various miscellaneous assets such as cash equivalents and office buildings not held primarily for investment purposes, and policy loans available contractually as a service to policyholders. If these assets are eliminated from the totals in order to focus on the *discretionary* allocations of *insurance* company funds for *investment* purposes in their general accounts, mortgages and corporate bonds together have accounted for upwards of 80% of life insurance company investments throughout the period since post-World War II[1] (as they did earlier). While investments in common stocks were generally growing over much of this period, common stocks held in the general accounts have been less than 10% of the corresponding volume of mortgages and corporate bonds held in every year except 1972.[2] Similarly, direct investments in real estate have uniformly amounted to considerably less than 5% of investments in mortgages and corporate bonds.

Life insurance companies acquire virtually all of their mortgages and a very large fraction of their corporate securities by way of forward commitment of funds made at currently determined rates some significant time before the funds are actually disbursed and the assets go onto the balance sheet. All corporate debt securities acquired through "private placements" involve the forward commitment process, and such issues have typically represented over 90% of all corporate bonds acquired by the ALIA's sample of 28 large life insurance companies[3] except in years of severe recession.[4] The fraction of mortgages involving forward commitment is even larger. Since 1960, the total of bonds and mortgages acquired by these large companies through forward commitments have typically averaged over 95% of all the corporate bonds and mortgages they acquired, and the fraction was above 90% in almost every quarter prior to the recent turbulent recession.[5] Although smaller insurance companies generally are less active in the forward commitment markets than these large companies, a large fraction of the industry-wide acquisitions of bonds and mortgages has clearly been made by way of forward commitments.

These assets acquired through the forward commitment process not only dominate the overall investment portfolios of life insurance companies; these companies account for major parts of the total market demand for such securities. Life insurance companies have acquired about four-fifths of all new privately-placed issues of corporate securities in most years of the postwar period.[6] Life insurance companies have also been important suppliers of funds for multifamily and nonresidential mortgages[7] and they were major suppliers to the 1-4 family residential mortgage market until recent years when the yields available in this market became relatively less attractive.[8]

A detailed study of the forward commitment decisions of life insurance companies thus forms an essential part of any effort to understand the overall investment policies of these major institutional investors and of their response to changing interest rates and expectations of inflation in recent years. Such a study should also contribute to our understanding of the functioning of the markets for corporate debt and for both residential and nonresidential mortgages. The present paper is addressed to these objectives.

A brief review of recent studies of life insurance company forward commitment policies will provide a useful context and serve to focus some of the issues which are of major concern in our own work.[9] George Bishop[10] recently studied the response of life insurance company investments to changes in monetary policy and the resulting changes in general credit market conditions in the period 1965–70. He provides a very useful National Bureau-type dating of the periods characterized by each of five monetary postures ranging from extreme ease to severe restraint, and his broad-ranging analysis of the responses of insurance company investments to these changes in market conditions provides many valuable observations on the general policies followed by these institutions. Three recent studies by Bisignano,[11] Pesando,[12] and Ribble[13] provide essentially econometric investigations of the statistical regularities shown in the aggregate commitment data for the industry, broken down by type of property or loan underlying the commitment.[14] Another recent study by Jaffee[15] focuses on life insurance companies' commitments for residential mortgages as part of the residential market including the acquisitions of such loans by other investors such as Mutual Savings Banks and Savings and Loan Associations.

These studies adopt[16] the now relatively standard "stock-adjustment" model to explain insurance company forward commitments for each type of investment. Desired future holdings of each asset (for instance, income property mortgages) in *dollars* is made a linear function of the product of the current commitment yield spreads against other assets and the expected future size of the total portfolio of assets.[17] The desired gross acquisitions (taking account of those already held) is then made to depend on flows of repayments on the existing stock and estimated increments of investible funds over a planning horizon. Through the stock-adjustment mechanism, new commitments in turn depend positively on desired gross acquisitions and negatively on the volume of commitments outstanding at any given time.

These studies have established that current commitment yield differentials between different types of assets (private placements, mortgage loans on multifamily residential and nonresidential properties and one-to-four family home mortgages) generally influence the relative allocation of new commitments for these assets as expected by theory.[18] This allocation between types also responds as would be expected to the typical length of the commitment period for each type of asset, and new commitments of each type are found to respond strongly and positively to the current and expected future flows of investible funds. But while the effects of expected future flows and current yield spreads have been tested and confirmed, the possible effects of expected changes in the general level of interest rates have simply been ignored in these recent studies,[19] implicitly or explicitly.

At each point in the stock adjustment process, these studies have treated the insurance companies as if they were making forward commitments in a "spot market" rather than in a futures market. But the distinctive and essential characteristic of a forward commitment is precisely that the lending institution commits itself to lend specified amounts of funds at specified dates in the future *at fixed contractual rates of interest* (and other credit terms) *determined at the time the commitment is made rather than at the later time when the funds are drawn down.* The relevant opportunity cost of any forward commitment is clearly the return which would be realized on the future investment which could have been made if the present forward commitment had not been made. Other things being equal, the volume of new forward commitments being made at each point in time should depend inversely upon current expectations of the future rates on alternative investments foregone if more forward commitments are currently undertaken. Moreover, given evidence of risk-aversion, the level of forward commitment votings should depend not only on the expected values of these opportunity cost rates but also upon the degree of confidence or uncertainty involved in these assessments of future rates.

One of the present authors[20] has developed a theoretical model of these essential relationships in the context of a single investment period. The present paper will generalize this theoretical structure to a more realistic and dynamic setting involving multiple time periods. It will also summarize the evidence obtained in a rather extensive and intensive set of field interviews with responsible investment officers in the industry regarding the role of interest rate expectations in the adjustment of their forward commitment positions and policies in the inflationary period following 1965, and it will provide an econometric analysis (on both a monthly and quarterly basis) of the forward commitments made by life insurance companies over the turbulent twelve-year period 1965–1976. As background, Section I will fill in the general characteristics of the markets in which life insurance companies make forward commitments. Section II will describe the flow of investible funds in insurance companies to motivate a simple static model of optimal forward commitment positions. Section III develops a multiperiod analysis of target future asset distributions and of the adjustment of the scale of new commitment votings to changing conditions and expectations, taking account of the constraints imposed on their reactions to new conditions and assessments by the institutional decision-making structure of the companies themselves, and their relations with certain suppliers and intermediaries. Section IV reports our field evidence regarding the impact of interest rate expectations on forward commitment activity[21] and presents the results of our statistical analysis of aggregated industry-wide data.

Section V summarizes the general conclusions and suggests some of the broader implications of our work.

[I] GENERAL CHARACTERISTICS OF THE MARKETS IN WHICH LIFE INSURANCE COMPANIES MAKE FORWARD COMMITMENTS

James O'Leary has provided the classic definition of a forward commitment:

> A forward investment commitment is a binding agreement on the part of a lending institution to make available a given amount of funds, upon given credit terms, at specified dates or over an agreed-on period of time. . . .The agreement gives the interest rate, maturity, redemption privileges, and so forth, and sets forth a schedule of disbursement or "take-down" of the funds. Whether it is written or oral, the lender regards it as morally binding, and the borrower, too, is obligated.[22]

The fact that forward commitments typically bind the lender to advance specified amounts of funds at *fixed* contractual rates of interest determined at the time the commitment is made rather than at the later time when the funds are drawn down distinguishes these commitments from lines of credit as well as the longer-term loans of commercial banks, which often involve floating rates that vary with changes in the prime or some other base rate. The fact that the borrower obtaining a forward commitment is also obligated to take down the funds in the agreed amounts[23] further distinguishes forward commitments from the "lines of credit" common in commercial bank lending which merely give the potential borrower a "call" upon any amount of credit up to a stated maximum at any time over a specified period. In making forward commitments, as in granting lines of credit, the lender must act in the face of uncertainty regarding the volume of investible funds he will have available to discharge his obligation when the funds are to be drawn down. Finally, the fact that forward commitments specify rates set when the commitment is made, rather than when the funds are disbursed, also makes the essential portfolio decision one between currently known rates and the uncertain rates which will be available at some considerable time in the future.

Commitment Duration

The time period over which the forward commitment is outstanding before the actual funds are disbursed varies from under a month to two or three years or more, depending on the type of investment and other circumstances. Commitments to purchase mortgages on existing homes are usually outstanding less than three months, while commitments for mortgages on new homes generally run from six to twelve months to cover the period of construction. The length of commitments for mortgages on apartment and office buildings, shopping centers and industrial and commercial projects generally runs from two to perhaps four years, in order to allow for long construction periods of such projects. Advance commitments to industrial borrowers for directly-placed securities are often outstanding for only one to three months, but may involve prearranged schedules of disbursements over as much as a year or so; and if arranged to finance toll roads, pipeline construction or the purchase of a large stock of heavy equipment, commitments may again be outstanding for three or four years before all the funds are finally drawn down.[24]

Advantages for Borrowers

The use of forward commitments has substantial advantages for borrowers. If a potential borrower knows that he will need a certain amount of funds at some given time in the future, arranging an advance commitment from a lender to provide the funds will substantially reduce his risks that they may not be available when they are needed. Also, since the rate and other terms are set when the commitment is made, obtaining a forward commitment insures the borrower against an increase in market rates to the time the funds are drawn down.[25] In addition, borrowers directly placing their securities with lenders through the forward commitment process will avoid the additional costs, including legal expenses and registration fees, involved in preparing to register and clear a public issue with the S.E.C. Significant underwriting expenses on a public issue are also avoided.[26] Each of these considerations, alone or in combination, are sufficient to insure that the demands of risk-averse borrowers for forward commitments will be a declining function of the rate of interest specified in the commitment contract, other things being equal.[27]

When advantageous, borrowers can arrange a flexible schedule for drawing down the funds as needed over a considerable period rather than being constrained to a single bulky public issue, and they have the further advantage of being able to negotiate repayment schedules and the other restrictive covenants of the loan in ways peculiarly fitted to their own situations and prospects, rather than being forced into the rather standardized provisions of the typical public issue. Shapiro and Wolf have also persuasively argued that for a major group of industrial borrowers[28] these advantages substantially outweigh the higher nominal interest charges on privately placed issues as compared with rates on public issues. In addition, many borrowers, whose relatively weak financial position would not qualify for credit *via* public issues with relatively standardized terms and conditions, are enabled to get funds through forward commitments for private placements because of the opportunity for the lender to negotiate special restrictive covenants in the loan contract which reduce the risks to prudent levels. Moreover, borrowers on privately placed issues arranged through forward commitments can anticipate on the basis of experience that if conditions change in unexpected and adverse ways during the life of the loan, terms and conditions can be renegotiated much more conveniently and flexibly when dealing with a single lender (or a small number at most) rather than with the trustees of a widely held public issue.

These advantages of convenience, avoided expense, risk reduction and flexibility which industrial borrowers gain from lenders' forward commitments to advance funds on privately placed securities are more than matched by the advantages of forward commitments to *mortgage* borrowers. For many of the latter, obtaining an advance guarantee of funds becomes *essential*, not just a matter of convenience, risk reduction and monetary advantage. Consider the important cases of residential developments, apartments, office buildings and shopping centers. The development and construction loans are usually advanced by other short-term lenders such as commercial banks, but generally *only on the condition* that a long-term lender has already made a forward commitment (before construction starts) to make the permanent mortgage on the property after completion.[29] Similar considerations apply to the financing of the new construction of single-family residences, and we also observe that mortgage bankers which specialize in originating loans on existing properties as well as new construction usually will not assume the risks of long-term lending and consequently also require forward commitments of permanent lenders before proceeding.

Attractions to Lenders

The prevalence of forward commitments can be explained not only by these considerations of economic advantage (or virtual necessity) to the borrowers, but also by various advantages accruing to the lenders making the advance commitments. As Jones succinctly observes: "Life insurance companies participate in issuing forward commitments because they are peculiarly able to do so, and it pays."[30] Most life insurance companies are large in an absolute sense in comparison with most other financial institutions. Their net cash inflow of funds for private placements and market investments together are not only very large, but have been considerably more stable (even after allowing for non-discretionary policy loans) than those of most other institutional investors because of the more heavily contractual nature of their inflows. Except for periods of unusual turbulence, such as 1966, 1968–70, and 1973–74, insurance companies have been able to make reasonably accurate projections of their future investible funds positions and the very bulk of the required investments has encouraged a posture of arranging to acquire mortgages and other loans well in advance of the actual disbursement of the funds. By making forward commitments, they can carry through the whole investment process of selection and negotiation in a much more orderly way which largely circumvents any need to place large amounts of funds in limited periods of time in a possibly unreceptive market.

Since the rate on funds later advanced on forward commitments is almost always fixed at the time of the commitment,[31] the insurance company also very importantly is able to pin down a *known* rate on the funds committed for future delivery instead of having to rely on the *uncertain* rate which will alternatively be available on any open market purchase at time of delivery.[32] We find this consideration of risk-avoidance, although largely ignored and surely never emphasized in earlier studies, to be one of the most important and fundamental reasons by lenders such as life insurance companies to engage in making forward commitments. Indeed, if a *certain* sum of money will have to be invested at a given future time either through (a) the disbursement of funds at a known rate under a forward commitment or (b) the direct purchase of publicly issued securities at an uncertain yield *expected* to be high as the rate of commitment, even a small degree of risk-aversion would lead to the placement of *all* of the funds in the "forward" market through advance commitment.[33] (As shown below, insurance companies do not in fact place all their funds in forward commitments because of uncertainty regarding the flow of investible funds which will be available in the future and its negative covariance with future interest rates, as well as considerations of relative demands for funds in different markets—but the opportunity to pin down a known rate on the funds committed is nevertheless one of the primary advantages of forward commitments for life insurance companies. These other considerations are merely partial offsets.)

A third advantage accruing to lenders from engaging in the market for forward commitments is that it enables them to tap very large outlets for their investment funds which would otherwise be closed to them. As we have seen, much of the entire mortgage market—and *all* mortgages on larger units of new construction—simply *requires* (because of the borrowers' constraints) that funds be advanced on a forward commitment basis. By providing forward commitments, life insurance companies are able to broaden the range of borrowers to whom they can lend. This facilitates the placement of large masses of investible funds and provides the well-known and very real advantages of greater diversification in their total investment portfolios.

Clearly it does "pay" for life insurance companies to make large fractions of their total investments in the forward commitment markets because they thereby are able to create more efficient and more fully diversified portfolios with larger risk-adjusted returns than would otherwise be available to them. This single statement subsumes all the separate advantages of forward commitment activity for life insurance companies. From an analytical standpoint, there is no need, as several studies[34] have done, to cite evidence of persistent positive yield differentials[35] of rates being charged on forward commitments over contemporaneous open market rates as direct proof that forward commitments "pay." Indeed, such comparisons are misspecified and may be very misleading. They are misspecified because the alternative to committing the funds today at a fixed rate for future delivery is to invest/commit the funds at some future date at a presently uncertain rate. Clearly, whether or not "it pays" depends upon the spread between the forward commitment rate and the expected spot rates *in the future* after appropriate allowance for risk. Comparisons of the forward commitment rate and current spot rates are not directly relevant.

The persistently positive yield spreads cited are also misleading if they are understood to demonstrate that forward commitment activity "pays" for life insurance companies because of non-competitive returns due to market power or bargaining advantages. It is clear from our field work and other evidence that insurance company managements are (i) risk-averse investors who are uncertain at any given time, (ii) about the interest rates which will be available in the future, and (iii) about how large their relevant flows of investible funds will turn out to be, and that (iv) they are well aware of the negative covariance between the availability of investible funds and changes in interest rates.[36] A companion paper develops rigorous proofs that these conditions are sufficient to insure that, other things equal,[37] (a) the fraction of its expected investible funds which every insurance company will allocate to forward commitments is a rising function of the spread $(r_c - \bar{r}_m)$ between the rate currently available on forward commitments and the expected future market rate; and (b) with significant negative covariances, this yield spread must be substantially *positive* in order to induce *any* company to commit a large fraction (say 90% or more) of its investible funds to forward commitments. It follows that, however uninhibited the competition between suppliers of commitments and however large their number, the great bulk of their aggregate investible funds will be allocated to the commitment market instead of the alternative public new issue market *only if* commitment rates are significantly higher than expected market rates. Borrower's demands for commitments at any time are of course a declining function of this yield spread, but historically the intersections of the declining demand curves with the rising supply curve has brought forth a volume of new commitments which is consistently very large relative to the expected volume of investible funds.[38] This analysis of the position and shape of the supply curve for forward commitments consequently shows that the yield spread between forward commitment rates and expected future spot market rates would have to be positive, even under the most purely competitive conditions in the forward commitment market. Consequently, the presence of continuously positive spreads over the relevant public issue rates does not necessarily imply that lenders in the forward commitment market are realizing more than purely competitive returns in this market through the exercise of super bargaining. Although there may be *other* more direct evidence of "market power" and of returns greater than those which would be available in perfectly competitive markets, the existence and persistence of positive yield differentials *per se* is not probative evidence of such a situation.

[II] CHARACTERISTICS OF FLOWS OF INVESTIBLE FUNDS, AND A SIMPLE MODEL OF THE SCALE OF FORWARD COMMITMENT STOCKS AND VOTINGS

To set the context for our specific analysis of company behavior with respect to forward commitments themselves, we need first to examine the characteristics of the major cash flows which determine the volume of investible funds available to support any level of forward commitments which may have been undertaken.

Flows of Investible Funds

The cash flows through a life insurance company during any interval of time, such as a month, quarter, or year, can be conveniently summarized in a cash flow statement in the following form:

Uses		Sources	
(B1)	Increase in policy loans	(A1)	Excess of premiums[39] over benefit payments, expenses and taxes
(C1)	Net increase in cash and short-term securities	(A2)	Net investment income
		(A3)	Regular mortgage amortization
(D)	Cash flow available for investments	(A4)	Scheduled bond maturities
		(B2)	Mortgage prepayments in full
		(B3)	Calls of securities
		(C2)	Sales of long-term securities and other assets
		(C3)	Net increase in borrowing

Because of the necessary accounting balance between the two sides of the statement, the volume of cash flow or funds currently available for investment in the period can appropriately be regarded as determined by the algebraic sum of all the other elements. To facilitate analysis, we have coded these other entries into three separate groups with significantly distinctive characteristics.[40]

The four items marked (A) in the exhibit are the largest and relatively most stable sources of investment funds for the insurance companies. They are also largely beyond control over limited periods, since any discretionary or "policy" actions management might take will affect them significantly only over future intervals measured in years, not months or quarters. Premium receipts and benefit payments are largely determined by policies already outstanding, and given the long-term character of most insurance company investments and the fact most carry fixed interest rates, net investment income is similarly determined within rather narrow limits by the assets on hand at the beginning of any period.[41] Regular amortization of mortgage principal and scheduled maturities of bonds also provide substantial flows of funds for investment which are correspondingly stable because of their contractual character.[42] These (A) items provide the ballast for the ship in fund-flow terms, and their sum has been both massive and relatively stable even during the turbulent markets of the last twelve years. Over this period, data from the ALIA show that the sum of these (A) items has represented 68% or more[43] of the total cash flow available for market investments (item D) in each year, and there were only two years (1966 and 1969) over the entire twelve year period through 1976 when the total of the industry's (A) items fell below that of the previous year; in both cases the decline was only about $55 million or less than 0.5%,[44] and was followed by a much larger positive gain in the following year in both instances. The sum of (A) items in absolute terms grew rather slowly over the late 1960's, but has grown more rapidly on average since 1970.[45]

Generally speaking, the (B) items were also relatively stable until the mid-1960's. But in more recent years, the (B) items have generally become much more volatile and have often shown relatively large variations from year-to-year or even quarter-to-quarter in response to economic conditions and fluctuations in interest rates. Moreover, each of these items shares the characteristics of responding almost entirely to the decisions of borrowers so that they are not subject to any effective control by the insurance companies.

Mortgage prepayments in full decline in periods of tight money because the induced decline in housing starts contributes to a reduction in the turnover of existing properties, and these processes reverse when money eases. Similarly, calls of securities usually reflect the efforts of corporations to reduce their interest costs by refunding existing debts at more favorable rates,[46] or their efforts to improve their balance sheets by paying off debt or substituting equity for debt; some calls (contingency sinking funds) are triggered by loan provisions permitting or requiring payments when the borrower's earnings are unusually high. Changing conditions of relative ease or tightness in the capital markets, the level of current rates relative to that on original issues, and other exogenous factors have a strong effect on the volume of retirements before maturity. In the period of tight money in 1966, for instance, the combined volume of discretionary mortgage repayments and called securities declined by nearly 30% from their level in 1965, and continued to fall in every year to 1971 with declines of 15%-20% in both 1969 and 1970. After exceeding previous peaks by 1972, there was another decline of 25% by 1974. These declines were each on the order of 5% of the prior year's total of all cash flows available for investment.

But the largest fluctuations in recent years have come from variations in the levels of policy loans. Outstanding policies with cash values give the policyholder the right to borrow against the loan value of his policy at a fixed rate, set at 5% or 6% in a preponderence of existing contracts.[47] As market rates rose above this level, the volume of policy loans has risen sharply and become quite variable as interest rates and other circumstances relevant to the borrower have changed. In the initial round of tight money in 1966, for instance, the net increase in policy loans was nearly three times as large as in 1965; after falling about a third in 1967 during easier money markets, the net increase in policy loans nearly tripled again by 1969;[48] and after falling over 60% to 1972, they tripled to an historically high rate by 1974, only to fall by 50% with easier money conditions in 1975. On several occasions within the period, the year-to-year increase in policy loans outstanding amounted to from 4% to 7% of the prior year's total cash flow of investible funds available for discretionary investments. Policy loans alone accounted for well over half of the 14% net decline in funds for discretionary investment between 1968 and 1969.[49]

In total, the (B) items amounted to $3,077 million in 1965 (over one-sixth of all investible funds) but involved a net *outflow* of over $600 million in 1969 and 1970. By 1972 they had recovered to a $2,654 million inflow, but fell to a mere $59 million in 1974. By 1976, they had risen to only $1,877 million, substantially below their levels in 1965. The absolute year-to-year *change* in the total of the (B) items averaged $1,106 million over this period, and reached a high of $2,563 million.

It will be convenient to refer to the *sum* of the (A) items and the (B) items together as the *exogenous cash flow*[50] of the company (or industry aggregate), since none of the items in this summation is subject to any appreciable control or influence by the company in the short run. In contrast, the increases or decreases in the other non-investment accounts [labeled (C) in our sources and uses statement] *are* very much subject to current discretionary decisions month-by-month and quarter-by-quarter. The way in which management chooses to exercise its discretion over these "other accounts," however, will depend on certain longer run policy considerations, on the character of the imbalances which are currently developing between flows in the other accounts, and in particular, on the imbalances between the *net* inflows from all (A) and (B) accounts taken together relative to the aggregate outflows of investments funds in the current period required to satisfy all the forward commitments contracts made earlier for takedown in the current period.

We have seen that the volume of exogenous cash inflow available in any period may turn out to differ significantly from the volume previously realized or expected, and that these exogenous flows of investible funds vary strongly and inversely with interest rates and conditions in the financial markets. We have also observed the dominant role of acquisitions from earlier forward commitments for mortgages and corporate debt in insurance companies' total holdings of these assets, and the dominance of these assets in their overall investment portfolios.[51] While companies in some cases have some limited flexibility in arranging for borrowers to move up or defer the dates on which previously commited loans are drawn down, much the largest part of all long-term investments made in a given month or quarter have been predetermined by the forward commitments made at earlier times for disbursement in the current period. Our earlier form of sources and uses statement ignored this consideration and made it appear that current investment outlays *and* the set of net changes in the discretionary (C) accounts must be balanced against the exogenous fund flows. But for purposes of revealing the balancing adjustments required between *current investment* decisions for current disbursement (within the current month or quarter) and the concurrent set of increases or decreases in other non-long-term-investment accounts, the earlier statement should be modified by subtracting current disbursements on previously outstanding forward commitments from *both* sides. Retaining each of our earlier (C) entries, we now have:

Uses		Sources	
(C1)	Net increase in cash and short-term securities	(NX)	*Net* exogenous cash inflows (see text)
(ND)	Long term investments *net* of disbursements on prior commitments	(C2)	Sales of long-term securities and other assets
		(C3)	Net increase in bank borrowing

where (NX) is the (algebraic) sum of all the earlier (A) and (B) items *less* current disbursements on previously outstanding forward commitments.

In normal times, sales of securities will simply be incident to the replacement of some publicly traded bonds or stocks with others as part of each company's efforts to hold attractive subportfolios of these securities as a part of their overall asset mix,[52] but since insurance companies are long-term investors, their turnover rates even in these subportfolios have been relatively low until rather recently when portfolios of marketable securities have been more actively managed in an effort to upgrade quality or improve yields. But given our concern with forward commitment policy, it must be observed that such *trading* of existing assets merely involves balancing increases in (C2) and (ND), with no effect on the critical (NX) entry. Net borrowing has traditionally been minimal, and cash balances have been held essentially as transaction balances. Most of the funds needed as a "buffer stock" against adverse surprises in the flows of other funds have, of course , been held in short term earning assets rather than cash.

As long-term investors with an historical aversion to borrowing (except to even out intra-year seasonal factors), any unexpected *increase* in (NX) will typically be used first to pay down any outstanding commercial bank loans and/or to restore depleted balances of cash and short-term securities to normal working levels; any excess will either be invested in long-term publicly issued bonds to the extent that their yields are relatively attractive, or "warehoused" in additional cash and short-term securities in anticipation of future opportunities to make higher yielding forward commitments.[53] Forward commitments with early take-down dates may also be increased. When, however, the exogenous sum of (A) and (B) items shows previously unexpected strength over a succession of periods, the level and growth of such flows expected in the future will generally be raised. Since the outstanding forward commitments will not reflect these new expectations, pro-forma projections of expected *net uncommitted* exogenous cash flows at each of the relevant intervals in the planning horizon will become larger than previously intended levels, and the volume of new forward commitments made for longer periods to take-down will be increased until an appropriate set of levels of expected future (NX) values has been restored.

Unexpected declines in exogenous cash flows may create more serious problems, since the outstanding stock of forward commitments due to be drawn down in the current period will have been geared to earlier expectations of the flows of investible funds for that period. Companies generally plan to maintain some margin of safety in the form of positive *expected* values of (NX) in each future period (after netting scheduled take-downs of outstanding forward commitments against expected values of exogenous cash flows), so that most fluctuations in exogenous cash flows merely involve variations in the size of positive values of (NX). On several occasions since 1965, however, exogenous cash inflows have fallen short of funds required to satisfy earlier forward commitments, and (NX) has turned sharply negative. The first and most dramatic occasion was in the credit crunch of 1966 when there was a large unanticipated increase in policy loans and a decline in the other (B) elements. Given little margin in liquid assets and strong aversion to borrowing, the shortfall in (NX) in the second quarter of 1966 was met by a record sale of $1,200 million of securities (all in the one quarter) which provided about 25% of the funds required to satisfy the forward commitments previously made for take-down at this time.[54] (To keep perspective, however, it should be noted that even this extraordinary peak sales was only on the order of 1.5% of all corporate and government securities in the portfolio.)

In all other pressure periods in the ensuing decade much more moderate adjustments were needed in security sales,[55] in part because with more perceived uncertainty in exogenous fund flows the pace of forward commitments had been adjusted to provide larger margins of safety in the form of larger *expected* values of (NX). The turbulence of 1966–69 also led to a marked increase in the normal or moving-average "trend" size of the "buffer stocks" of funds held in cash and short-term securities. Another enduring change brought out in our field work involves attitudes toward borrowing. Before 1965, life insurance companies held closely to the traditional view that the industry should confine itself to investing the savings of policyholders; while borrowing was available as an extraordinary source of funds, its use was held to a minimum. With the added pressures and uncertainties after 1965, attitudes toward borrowing have somewhat loosened; lines of credit at commercial banks have been established and used more freely for seasonal needs. Most companies still continue to try to avoid having to show any debt on year-end balance sheets,[56] but our field interviews indicated that some companies have been moving away from this traditional aversion to debt. Indeed, a few seem to have moved rather far toward a posture in which moderate amounts of borrowing will be undertaken quite freely (even over year-end dates) to average out the errors in forecasting investible funds over a longer period of time and a few insurance companies have actually issued bonds in recent years. This operating policy, of course, involves holding commitments enough below expected investible funds in future periods to permit the repayment of the debt. But such action by these companies more freely using debt does not differ in any essential way from the operating patterns of other companies. All companies will reduce new commitments in future periods below the levels they would otherwise have had following a period in which investible funds have fallen significantly short of previously forecast levels.

Some Simple Models of Forward Commitments

This analysis of the flows of investible funds through life insurance companies clearly suggests that the volume of forward commitments they will want to have outstanding at any point in time for take-down during any given interval of time in the future will depend significantly upon (a) the exogenous cash flow currently *expected* during that future time interval. (b) the rate available on forward commitments compared with the *expected* value of the "opportunity cost" rate on alternative investments, and (c) their reactions as risk-averse investors to the uncertainties inherent in their current assessments of both the relevant future flows of investible funds and the alternative investment rate. A previous paper[57] formalized these relationships in some simple models pertaining to a single forecast period, assuming that managements were risk-averse[58] with respect to the levels of the companies' investment incomes. Since the other models we introduce later build upon and generalize this work, a brief summary will be useful for convenient reference.

Optimal Stocks of Forward Commitments

This first model assumes that there is only a single type of forward commitment, and that calendar time is divided into a series of non-overlapping discrete intervals or periods, with no carryover of outstanding commitments from one period to the next. All forward commitments are made at the beginning of any period and all are taken down at the end. The rate of interest available on forward commitments is known and certain at the beginning of the period. Exogenous cash flows of investible funds become available at the end of the period and are used to cover take-downs of commitments, with any excess cash flow invested in the public market. At the beginning of the period, both the amount of investible funds which will prove to be available, and the rate at which any residual can be invested in the public market at the end of the period, are normally-distributed random variables. We use the following notation:

$\tilde{F} \equiv$ uncertain size of the exogenous cash flow that will be available for investment at the end of the period.

$r_c \equiv$ the rate of interest *currently* available on funds committed now for delivery at the end of the period.

$\tilde{r} \equiv$ the uncertain rate at which funds for immediate delivery may be invested at the end of the period.

$K \equiv$ the amount of funds committed at the beginning of the period for forward delivery at the end of the period.

$\tilde{Y} \equiv$ the size of the investment income stream produced, beginning at the end of the period, by the current decision regarding forward commitments.

$\bar{Y}, \bar{r}, \bar{F} \equiv$ the expected values of the indicated variables.

$V_y, V_r, V_F \equiv$ the variances of the indicated variables.

$\sigma_{Fr} \equiv$ covariance between $\tilde{F}$ and $\tilde{r}$.

$\beta \equiv \sigma_{Fr}/V_r$, the slope of regression of investible funds on the market interest rate.

$U(Y) \equiv$ the utility function of the lending institution that exhibits risk aversion, i.e., $U'(Y) = \partial U/\partial Y > U''(Y) = \partial^2 U/\partial Y^2 < 0$.

$\gamma \equiv -U''(Y)/U'(Y)$, the Pratt-Arrow coefficient of absolute risk aversion.

The random amount of investment income realized from a *total* investment of $\$\tilde{F}$, including $\$K$ committed in advance, will be

$$(1) \quad \tilde{Y} = Kr_c + (\tilde{F} - K)\tilde{r}$$

With no penalty costs for shortfalls, the expected value and variance of $\tilde{Y}$ become

$$(2) \quad \bar{Y} = (r_c - \bar{r})K + \bar{r}\bar{F} + \sigma_{Fr}$$

and

$$V_y = K^2 V_r - 2K\sigma_{Fr,r} + V_{(Fr)}$$

which reduces to[59]

$$(3) \quad V_y = (K^2 - 2K\bar{F})V_r - 2K\bar{r}\sigma_{Fr} + V_{(Fr)}$$

From the standard mean-variance model of portfolio theory, it follows that the *optimal* stock of forward commitments is given by

(4) $$K^* = \bar{F} + \frac{r_c - \bar{r}}{\gamma V_r} + \beta \bar{r}$$

The optimal *beginning-of-period* stock of outstanding forward commitments for take-down at the end of the period is thus a *positive* function of (i) the *expected* value of the exogenous flow of investible funds at take-down time, $\bar{F}$, and of (ii) the "commitment premium ratio: $(r_c - \bar{r})/V_r$." But since, as observed earlier, movements of $\tilde{F}$ around its trend values are strongly and *inversely* correlated with changes in market rates, the value of β will be *negative*. Equation (4) thus also shows that optimal stocks of forward commitments K^* will vary *inversely* with (iii) the absolute size of the negative β value, (iv) the *level* of expected market rates $\bar{r}$ at the end of the period, as well as (v) the degree of risk-aversion γ, and (vi) the degree of uncertainty V_r in assessments of future rates (through the commitment premium ratio). It should be noted that the effects of given increases in commitment rates r_c will be smaller at times of greater uncertainty in assessments of future rates, since r_c enters the equation only in the commitment premium term.

The companion paper shows that explicit allowance for financial penalty costs incurred[60] when available investible funds fall short of the volume of forward commitments being drawn down will reduce[61] the volume of forward commitments K^* that would otherwise be optimal under any given set of circumstances, but that the pattern of dependencies between K^* and the other variables remains the same in all essential respects.[62]

To this point, the model has assumed for simplicity that the companies acted with a given degree of (absolute) risk-aversion with respect to the level of the flow of investment income provided by their investments, but with the growth of group insurance there is evidence that companies have generally become much more concerned with their "new money rate"—the yield *per dollar* of total investments being made. The companion paper[63] shows that the results of the previous model again carry over in all essential respects except that the decision variable becomes the *ratio* of the optimal stock of forward commitments to the expected value of the flow of investible funds which will be available at take-down time. Specifically, in addition to the definitions of variables and specifications of the forward commitment problem used above, let

$\tilde{y} \equiv \tilde{Y}/\tilde{F}$, the average rate of return earned on all investments made at the end of the period, i.e., the new-money rate.

$\bar{y}$, $V_y \equiv$ the expected value and variance of $\tilde{y}$.

$h \equiv K/\bar{F}$, the fraction of total funds expected to be available for investment and which are committed in advance.

$U(\bar{Y}) \equiv$ the company's (risk-averse) utility function over the average rate of return on all funds invested.

$\lambda \equiv$ the company's measure of *proportionate* (or "relative") risk-aversion.

Then, the linearized expression[64] for the optimal forward commitment position at the beginning of the period is

$$(5)\quad h^* = K^*/\bar{F} = 1 + \frac{r_c - \bar{r}}{\lambda V_r} + \beta\bar{r}$$

Once again the optimal fraction of expected flows of investible funds varies *directly* with the commitment premium ratio, and *also inversely* with the expected market rate $\bar{r}$ (because β is always negative) and the current degree of uncertainty regarding this future rate.

In view of the dominant concern of insurance executives with the *rate* of return on their new investments, equation (5) will provide the base for our later analysis. This form of the criterion has the further advantage of being homogeneous of degree zero, a form commonly used in econometric work on investment portfolios.

Optimal New Forward Commitment Votings

These models have dealt with only a single time period to focus simply on the optimal *stock* of forward commitments desired at the beginning for take-down at the end, relative to the beginning-of-period expectations (and uncertainties) regarding what the flows of investible funds and market rates will be at take-down time. In practice, many forward commitments will be made for take-down after more than one period. If we let a subscript τ represent the current decision date and $\tau + 1$ represent the end of the current period, we may let $K_{\tau-1}$ denote the carryover[65] stock of forward commitments previously made for take-down at $\tau + 1$, and C_τ represent the *new* forward commitments voted at time τ for take-down at $\tau + 1$ will be

$$(6)\quad K_\tau = K_{\tau-1} + C_\tau$$

Correspondingly, $K_{\tau-1}$ of the investible funds expected at $\tau + 1$ will have already been committed. Consequently, our equation (5) for optimal *stocks* of forward commitments K_τ, after subtracting $K_{\tau-1}$ from both sides of the equation, implies that optimal *new* commitments will satisfy the following equation:

$$(7)\quad C_\tau^*/\bar{F}_{\tau+1} = \frac{K_\tau^*}{\bar{F}_{\tau+1}} - \frac{K_{\tau-1}}{\bar{F}_{\tau+1}} = 1 - \frac{K_{\tau-1}}{\bar{F}_{\tau+1}} + \frac{r_c - \bar{r}}{\lambda V_r} + \beta\bar{r}$$

All our previous conclusions regarding the effects of current commitment rates and expectations (and uncertainties) regarding future market rates and investible fund flows on optimal *stocks* of forward commitments thus apply equally to decisions on *new* forward commitments votings after allowing for carryover stocks of such commitments already outstanding.

[III] DETERMINATION OF TARGET ASSET PORTFOLIOS AND ADJUSTMENTS TO CHANGING CONDITIONS AND EXPECTATIONS

Target Portfolios Distributions

When the Life Insurance Association of America described the investment process in life insurance companies for the Commission on Money and Credit,[66] it noted that Finance Committees make their decisions "on the broad allocation of funds. . . with a view toward maintaining the desired portfolio balance or moving toward some *desired target* asset distribution."[67] The target distribution of different types of assets in insurance company portfolios clearly reflects the long-term character of most of their liabilities as well as the more usual concerns with relative risks and returns on different assets.

Life insurance companies need to have a relatively large fraction of their total assets invested in long-term obligations or real estate in order that the weighted-average "duration" of their assets may more nearly match the long weighted-average futurity of their liabilities to policyholders.[68] In effect, this reflects the generally accepted principle that long-term assets should be held by financial institutions whose liabilities are essentially long term in character, while others such as commercial banks with predominately short-term liabilities should concentrate their investments in shorter-term instruments. However, the duration of the menu of available investment outlets is such that it is almost impossible for life insurance companies actually to hold a portfolio of assets whose weighted average duration will be as long as needed to match the corresponding duration of their contractual liabilities, at least with respect to the very large fraction of their total assets representing the "whole life" part of their business. Since there are substantial costs and long-term risks involved in any such failure to match the duration of assets and liabilities, it is necessary to allow for any such discrepancies in assessing the overall utility function of company managements.

Apart from these concerns with the duration of their assets, managements are also of course seeking to obtain the best available returns on their invested funds after making appropriate allowance for their risk-averse dislike for the uncertainty of these returns. Given a choice between two sets of assets with equivalent uncertainty of return and duration, management will choose the set with the higher expected return. And given another choice between two sets of assets with equal expected returns and duration, the set with the lower uncertainty of return will be chosen.

All the principle results needed to set the determination of forward commitments in the context of the determination of a company's optimal overall portfolio of assets may be most conveniently obtained from a simple mean-variance model of portfolio balance after allowing for the added disutility of any imbalance in asset-durations.[69] Formally, we may consequently represent the company's objective function for the selection of the best mix of portfolio assets as the effort to maximize the

(8) *criterion* $U(\bar{y}_p, V_{yp}, D_p - D^*)$

where

$\frac{\partial U}{\partial \bar{y}} > 0$, reflecting the preference for expected portfolio return;

$\frac{\partial U}{\partial V_{yp}} < 0$, reflecting the aversion to risk; and

$\frac{\partial U}{\partial D_p} > 0$, reflecting the preference for having portfolios which will minimize the shortfall between the duration D_p of the assets held below the duration of liabilities to policyholders.[70]

The maximization of (8) is consequently equivalent to the maximization of

(9) $Q = \bar{y}_p - \lambda V_{yp}/2 + \delta D_p$

subject to the constraint

(10) $\Sigma_i^n d_i = 1$

where

$d_i \equiv$ the fraction of the total portfolio allocated to and held in the i^{th} asset,
$n \equiv$ the number of different portfolio assets being considered,
$\lambda \equiv$ the coefficient of proportionate risk-aversion, as in section II, and
$\delta \equiv$ the premium for an additional year of portfolio duration.[71]

The terms in (8) and (9) are given by:

(11a) $\bar{y}_p = \Sigma_i d_i \bar{y}_i$

(11b) $V_{yp} = \Sigma_i \Sigma_j d_i d_j \sigma_{ij}$

(11c) $D_p = \Sigma_i d_i D_i$

where

$\tilde{y}_i \equiv$ the uncertain return on the i^{th} asset
$\bar{y}_i \equiv$ the *expected return* on the i^{th} asset
$\sigma_{ij} \equiv$ the *covariance* of the returns $\tilde{y}_i$ and $\tilde{y}_j$ (where σ_{ii} will now represent the *variance* of the return on the i^{th} asset itself)
$D_i \equiv$ the *duration* of the return on the i^{th} asset.

To maximize the objective Q in equation (9) subject to the "adding up" constraint (10), we form the Lagrangian

(12) $L = \bar{y}_p - \lambda V_{yp}/2 + \delta D_p + \eta(1 - \Sigma_i d_i)$

and set its derivatives with respect to each of the n assets and the "shadow value" η simultaneously equal to zero. After using (11), this indicates that the optimal portfolio mix over all n assets will be given by the set of the values of d_i which simultaneously satisfy the n equations

$$\text{(13a)} \quad \frac{\partial L}{\partial d_i} = \bar{y}_i + \delta D_i - \lambda(d_i \sigma_{ii} + \sum_{j \neq i} x_j \sigma_{ij}) - \eta = 0$$

where η has the value which insures that

$$\text{(13b)} \quad \frac{\partial L}{\partial \eta} = 1 - \Sigma_i d_i = 0$$

so that the sum of the percentage allocations d_i will add up to unity in accordance with the original constraint (10). The resulting value of η can be shown to measure the marginal certainty-equivalent value to the company of having a small additional amount of funds to invest and in this sense is a marginal risk-adjusted "hurdle-rate" which provides a bench-mark from which to measure the comparative advantages of each of its alternative investment outlets.[72]

We should also observe that since the term in parentheses in equation (13a) is simply the covariance of the i^{th} assets' return with the return on the entire portfolio $\bar{\sigma}_{ip}$ this important equation can be written in the simpler form

$$\text{(13a')} \quad \frac{\partial L}{\partial d_i} = \bar{y}_i + \delta D_i - \lambda \sigma_{ip} - \eta = 0$$

and the optional target allocation can be determined equally well from solving this equation subject to (13b).

These "portfolio balance" equations, as usual, make the target fraction of all assets d_i invested in any particular type of instrument vary directly with its own expected yield $\bar{y}_i$, and inversely to its *marginal* contribution to the overall risk of the company's entire asset portfolio.[73] But, we also observe that, if other things are equal or balance out, a larger fraction of assets will be invested in assets with longer durations. There is a premium measured by the symbol δ on the weighted average futurity of all the cash flows from an asset.[74] If risk considerations are neutral, companies will prefer assets with longer maturities to those with shorter maturity offering the same expected return, and indeed will be willing to sacrifice *some* expected return in order to gain the greater contribution which the longer lived asset will make to the balance between the futurities of its assets and liabilities. In short, our equations indicate the best possible mixture of assets for a company to plan to hold will be one in which the proportions of different assets have been adjusted to the point where the *marginal risk-and-duration-adjusted portfolio returns on all assets are equalized.* But this characteristic of the optimal planned portfolio must not obscure the fact that there is a separate equation like (13a) for *each* asset in the portfolio, all solved simultaneously, so that the optimal proportions d_i^* for each asset will depend upon its expected returns, marginal portfolio risk and duration, all considered *relative* to those of the other assets in the portfolio.

This model of the determination of the optimal mix of assets effectively captures the interplay between the preferences of life insurance companies for higher expected returns, and their evident concern with having the appropriate weighted average maturity or duration of assets in their portfolio, as well as their aversion to risk and uncertainty of return. Although this model retains most of the simplicity of the portfolio models usually found in the literature, it differs very significantly in its content and implications because of the explicit inclusion of the company's "duration-preference" in its objective function and the consequent appearance of a maturity premium in the optimizing equations (13). Moreover, the explicit inclusion of a company's "duration preference" identifies the relevant returns in this model of optimal portfolio structure as the yields to maturity (or more precisely the duration-yields) of the assets in question, and not the much shorter "holding-period" yields of a month or a quarter which have more usually been emphasized in the recent academic "portfolio theory" literature which has been concerned almost exclusively with stock markets and equity portfolios *per se*. These important features of our model clearly correspond to the objectives—and the thinking—of the life insurance investment officers whose behavior we are modelling. Not only do they give great weight to the maturities of their assets, but they are observed to be primarily concerned with the yields-to-maturity of their assets and judge both the *expected* returns *and the risks* of each of their investment possibilities in these terms. It is *because of* their fundamental concern with matching the duration of assets to the duration of the liability claims against them that companies are essentially concerned with the *rates of return* on any feasible set of asset holdings which will be realized *over this longer horizon.*[75] Moreover, it is their concern to match the futurity of their assets to their liabilities, combined with the relatively long duration of their liabilities, which leads companies to hold very large fractions of their total assets in bonds, mortgages, and other long-term assets.

The Planning Process and Adjustment of New Commitments to Changing Conditions and Expectations

The investment planning process builds upon forecasts of the exogenous cash inflows [the sums of the (A) and (B) items on p. 604] which will become available for and require investment over a planning period extending several years into the future.[76] Generally these forecasts will provide separate estimates for each of the next several months, and then for a few quarterly intervals, with semiannual or annual estimates further in the future. Forward projections of the total assets of the company at various future dates in the planning period are prepared by adding the cumulated cash inflows expected to the existing asset base after allowing for that part of the inflow which represents repayments of assets currently held. These estimates of future total asset levels are then combined with the company's desired target asset proportions, which embody its long-run investment policy and assessments of future conditions as described above, to determine *desired target levels* of balance sheet holdings of broad classes of mortgages and bonds and other assets at different dates in the future. On the basis of these forecasts of desired target stocks of different types of assets at the relevant future dates, and of the expected (largely exogenous) inflows of investible funds (including repayments), the companies develop *time-schedules of planned gross acquisitions of each major type* of long-term asset over the next several months, quarters or semiannual periods extending at least three or four years in the future. Finally, for assets subject to the forward commitment process, these planned schedules of gross acquisitions by type are adjusted in the planning tables to allow for the expected take-downs in each period of the existing stocks of outstanding commitments. These planning schedules of desired gross acquisitions and scheduled take-downs of existing commitments of each type over the relevant future[77] time periods then become the basis for *budgeted authorizations* to the respective investment divisions of the company to proceed to negotiate *new forward commitments* for the assets desired.

As conditions change and new information affecting expectations of future flows of investible funds and interest rates becomes available, these planning tables and schedules of budgeted authorizations for new commitments will be revised and updated, usually at monthly or quarterly intervals. Also, managements in practice establish their budgeted authorizations for new forward commitments of each type after making certain allowances for institutional inflexibilities and the uncertainties involved in their projections of fund flows which will be described later. But given the primary concern of the paper with the response of the aggregate forward commitment positions of life insurance companies and especially their votings of *new* commitments to their expectations of future interest rates and market conditions, it is important to observe that, on the basis of *any given set of expectations*, the aggregate of all new forward commitments planned for take-down over any given future period, together with those already outstanding which will be drawn down in the period, depends very simply on the aggregate inflow of exogenous investible funds expected over this period. For definiteness, consider some target planning date H periods (months or quarters) in the future, and let

$A_t \equiv$ the present amount of *total* assets at time t.
$A^e_{t+H} \equiv$ expected *total* assets at the target date H periods in the future.
$A^*_{it+H} \equiv$ desired book investment in the i^{th} asset at time $t + H$.
$d^*_i \equiv$ desired proportion of A^e_{t+H} to be held in the i^{th} asset.
$A_{it} \equiv$ current book investment in the i^{th} asset.

$K_{it} \equiv$ outstanding commitments for the i^{th} asset scheduled for take-down between time t and $t + H$.

$C_{i,t} \equiv$ new commitments for the i^{th} asset made in period t.

$C_{i,t+k} \equiv$ new commitments for the i^{th} asset to be made in period $t + k$, where $0 < k \leq H$.

$F^e_{t+k} \equiv$ exogenous cash flows expected in period $t + k$, where $0 < k < H$.

$F_t \equiv$ exogenous flow of investible funds at time t [the sum of the (A) and (B) items on p. 604 above].

$R^e_{t+k} \equiv$ the *expected* value of the *sum* of mortgage amortization prepayments, maturities and calls of securities [items (A3), (A4), (B2) and (B3) on p. 604] in period $t + k$.

$R^e_{i,t+k} \equiv$ the expected return of principal through amortization, etc. on the i^{th} asset at time $t + k$.

The desired balance sheet investment in the i^{th} asset at time $t + H$, conditional on the expected total assets at that time will be

$$(14) \quad A^*_{i,t+H} = d^*_i A^e_{t+H}$$

where the *desired* proportion d^*_i to be held in the i^{th} asset will depend upon its expected return, its marginal portfolio risk and its duration, all taken relative to those of other assets, as shown above. The expected assets H periods in the future will be equal to the present assets A_t *plus* the exogenous flows in the interim *less* that part of this exogenous flow which represents repayments or retirements of all types of assets already held:

$$(15) \quad A^e_{t+H} = A_t + \sum_{k=0}^{k=H} (F^e_{t+k} - R^e_{t+k})$$

Next we observe that the *total* amount of new commitments which will be needed between the present time t and the future time $t + H$ will be equal to the excess of the desired future holding over the present stock of any asset *less* the amount of already outstanding commitments *plus* the amount of additional commitments required to make up for repayments on existing holdings:

$$(16) \quad \sum_{k=0}^{k=H} C_{ik} = A^*_{i,t+H} - A_{it} - K_{it} + \sum_{k=0}^{k=H} R^e_{i,t+k}$$

If now we rearrange and sum over all assets which involve forward commitments, adding a term $(dp)^e$ to represent the *expected* purchases of "other assets," we have

$$(17) \quad \Sigma_i \Big(K_{it} + \sum_{k=0}^{k=H} C_{ik}\Big) + \Sigma_i (dp)^e = \sum_{i,j} d^*_i A^e_{t+H} - \sum_{i,j} A_{it} + \sum_{i,j} \sum_{k=0}^{k=H} R^e_{i,t+k}$$

$$= A^e_{t+H} - A_t + \sum_{k=0}^{k=H} R^e_{t+k}$$

Consequently, after substituting from equation (15), we have finally

$$(18) \quad \Sigma_i (K_{ii} + \sum_{k=0}^{k=H} C_{ik}) + \Sigma_i (dp)^e = \sum_{k=0}^{k=H} (F^e_{t+k} - R^e_{t+k}) + \sum_{k=0}^{k=H} R^e_{t+k} = \sum_{k=0}^{k=H} F^e_{t+k}$$

which was to be established.

We now observe that this sum of cash inflows to the end of any forecast period will be an increasing function of both the current level of cash flows F_t and the expected rate of growth of this inflow. This will be true for each of the forecast intervals relevant to current investment and forward commitment decisions. Moreover, after allowing for the different "lead-times" involved in different types of forward commitments[78] and the different stocks of commitments already outstanding at any time, it follows from (18) that the ratio of *all* new forward commitments desired at any time t to the current rate of investible funds inflows will vary *inversely* with the outstanding stock of forward commitments previously made and *directly* with the currently expected rate of growth of new investible funds:

$$(19) \quad C^*_t / F_t = f(\overline{GR}_t, K_t, X)$$

where

$C^*_t \equiv$ the desired (target) dollar volume of new commitments in the current t^{th} period for future take-down.
$\overline{GR}_t \equiv$ the currently expected rate of growth in the flow of investible funds F_t, and X represents *other* relevant determinants.

Although the volume of new forward commitments actually made can be expected to track the scale of *desired* new commitments as just specified reasonably well, there are several reasons to expect that they will not do so exactly. Apart from mere random differences, there will be deviations because most forward commitments involve a significant period of investigation and negotiation of mutually satisfactory terms and provisions of the final loan agreements. The volume of negotiations underway at any time will be substantially correlated with the volume of new commitments currently being made which induces a correlation of commitments made in any short period with those made in previous periods. In addition, and most important, there are significant internal and external (market) inflexibilities which attach avoidable costs to any rapid change in the pace of new commitment activity. Companies have separate mortgage and bond departments, each with several groups of skilled and experienced professionals with special knowledge and market contacts relevant to their particular type of forward commitment. For instance, the mortgage department may be divided into sections responsible for single family loans, multifamily residential properties, industrial and commercial mortgages, and farm mortgages, and the bond department will have a group specializing in large, longer-term commitments for private placements. Any marked changes in the general pace of activities in any of these divisions within a year or so would involve heavy explicit and "opportunity" costs.[39] Each of these (relatively) large and (relatively) specialized groups of staff personnel must be given a reasonably steady flow of work for both morale and efficiency considerations, and this source of inflexibility is substantially compounded by their dependence on whole networks of mortgage and investment bankers or branch offices and other contacts for the supply of each type of loan. If any company were to sharply cut back its volume of commitments through a supplier, the correspondent would have to seek out other institutional outlets and would then be less likely to satisfy the given company's renewed larger demands at a later date. These considerations taken together mean that on average the *actual* pace of new forward commitment votings will be a weighted average of the *target* level specified earlier in equation (19) and the average actual pace of new commitment activity over the last six months or so:

$$(20) \quad C_t/F_t = \alpha(C_t^*/F_t) + (1-\alpha)(\bar{C}_t/F_t) \qquad 0 < \alpha < 1$$

where C_t^*/F_t is determined by equation (19), and

$\bar{C}_t \equiv$ average dollar amount of new commitment votings over the previous six or twelve months.

Finally, as previously noted, our summary description of the forward commitment planning process (pp. 616–617) is modified in practice by introducing judgmental allowances for the unavoidable uncertainties surrounding any estimates of data projected very far into the future. With due allowance for the varying degrees of flexibility the company will have in subsequently adjusting its different types of forward commitment to the levels which are later desired, each Finance Committee will authorize new commitments at any time which together with those already outstanding will total up over all departments to somewhat less than those which would be required if its current expectations and *expected* values of future total assets and exogenous cash flows were in fact to be realized. In effect, relative to its current best estimates of the future, the Finance Committee carries an "uncommitted reserve" of *expected* exogenous cash flows at each point in time which will be available for later disposition if its earlier estimates turn out to be realized or exceeded. Since more unanticipated events can occur in a longer than in a shorter period, these allowances for the uncertainties in estimates of future fund flows will almost always be greater than those regarding conditions in the nearer term future. In practice, insurance companies maintain a relatively "fully committed" posture in terms of the fund flows they expect to have available over limited periods such as one to perhaps three months into the future, but they generally maintain increasing overall margins of slack in their *overall* commitment positions with respect to more distant draw-down dates and horizons. Commitments, such as those for newly constructed income properties, and others subject to long lead times and greater institutional inflexibility, will of course be budgeted relatively close to target levels determined by their desired share of *expected* assets two years or more ahead, and most of the uncommitted overall reserves over these longer horizons will take the form of commitments still to be authorized for private placements (and other industrial loans) having shorter take-down intervals. These procedures enable the company to avoid many of the costly and difficult shorter-term adjustments in later periods that would otherwise be required whenever exogenous cash flows turned out to be significantly below current expectations. They also enable the companies to make more flexible adjustments to changing market conditions than would otherwise be possible.[80]

An Alternative Model of Optimal Forward Commitment Votings

All these considerations and practices suggest that the response of new forward commitment votings to interest rate expectations of insurance company managements may be somewhat richer and more complex than encompassed in the simple models introduced earlier on pp. 609–612. These models were derived on the assumption that any exogenous fund flows not required to discharge forward commitments "maturing" at a given date would be invested in new long-term public issues at that time,[81] and both the expected value $\bar{r}$ and the variance term V_r involved this rate. But allowance for the fact that the volume of new commitments C_t being voted at any time t will include commitments with longer—as well as shorter—term periods to take-down, and the fact that larger margins of slack (relative to *expected* flows of investible funds) are maintained for longer take-down horizons both indicate that the relevant uncertain "opportunity cost" rate in forward commitment decisions may often be the rate at which forward commitments themselves can be made at the later target date rather than the rate then available in the public market. Moreover, the fact that insurance companies as a matter of policy have long maintained such a large fraction of their total assets in instruments obtained by means of forward commitments strengthens this presumption. On this interpretation, the derivation of equation (7) on p. 612 above is substantially unchanged,[82] but the $\bar{r}$ and V_r in the "forward commitment premium ratio" $(r_c - \bar{r})/V_r$ must be redefined to measure the *expected* rate which will be available on new forward commitments made later and the uncertainty involved in the *current assessments* of what this uncertain later rate will be. Other things equal in this model, the relevant commitment premium ratio, and consequently the volume of new commitments being voted at any time t, vary *inversely* with *both* the *expected* future commitment rate *and* the uncertainty currently involved in its assessment. Our following econometric analysis will test the performance of this "future commitment rate" version of the basic model as well as the original "market rate" formulation, making use of the adjustment equations (19) and (20) in each case.

[IV] EVIDENCE ON ADJUSTMENTS TO CHANGING CONDITIONS AND INTEREST RATE EXPECTATIONS

Evidence from Field Work and Direct Interviews

Some useful background evidence regarding the effects of expectations of changes in general levels of interest rates and future funds flows (as well as the effects of the uncertainties surrounding these expectations) on the forward commitment decisions of life insurance companies was provided by the rather extensive field interviews undertaken as part of this study.[83] It will be convenient to summarize these findings before turning to the statistical analysis of the industry-wide data.

We found no evidence in our field interviews and studies of the data of individual companies that there was any significant adjustment of overall forward commitment positions during the first half of the 1960's in response to interest rate expectations. Until the latter part of 1965, each of these life insurance companies determined the *overall* level of their new commitments period by period with predominant emphasis on the gaps between anticipated investible funds in future periods and the volume of existing commitments which would be drawn down at corresponding times from these prospectively available funds.[84] During this period, interest rates were relatively low and stable, inflation was no problem, and there were no significant profits to be expected from shifting the *timing* of new investment commitments *between periods* on the basis of any relatively weak expectations of general changes in the levels of market rates.[85]

The increased level and volatility of interest rates in the second half of the 1960's, however, led four of the five companies interviewed in most depth to make rather large adjustments in their overall forward commitment positions in response to the changes they expected at different times in the general levels of interest rates. The fifth company also varied its commitment position on the basis of its interest rate expectations, but as a matter of policy its adjustments were limited to no more than 10% either way throughout the period. Following the unexpected increases in interest rates in late 1965 and 1966, three of these companies stepped up their new forward commitment activity very substantially in response to their expectations that interest rates were about to decline, and two of the three raised their commitment positions again in late 1967 and 1968 when the renewed increase in rates was once more believed to be temporary. Altogether, the increases were enough to raise the stocks of outstanding commitments in the companies by from 50% to 100% relative to their fund flows. A fourth company which had not responded to interest rate forecasts in 1966 also substantially increased its forward commitment position in 1967:3–1968:2 as a result of its belief that interest rates would decline. In late 1968 and much of 1969, new forward commitment activity was generally being reduced quite rapidly as high and rising interest rates reduced exogenous fund inflows while outstanding stocks of commitments were still heavy, but there is also some evidence that at least three companies accelerated their reductions in new commitment activity relative to their expected flows of investible funds because of their expectations that interest rates would increase further.[86]

The companies which had made the larger increases in their forward commitment positions, however, found that such temporal concentration of their investment activity had strained the capacity of their staffs and field networks to generate investment opportunities and evaluate them effectively, and the companies which had later sharply cut back their new commitment votings subsequently had some difficulty restoring their position in the new commitment market after their backlogs had been worked off. Moreover, following the costly errors which had been made in 1966 and early 1968 in betting heavily on forecasts of interest rate declines, all the companies had developed a sharply increased awareness of the uncertainties involved in forecasting future interest rate movements. This greater awareness of the chances of error in such forecasts, along with the greater appreciation of the institutional inflexibilities mentioned earlier, by the early 1970's led the companies generally to adopt formal policy limitations on the extent to which commitment positions could be adjusted to accommodate expected changes in levels of interest rates.[87]

In the five companies studied in most depth, during the latter part of the decade 1965–1975 such adjustments were limited to 10–15% or less of the otherwise normal *ratio* of commitments to expected flows of investible funds.[88] While the companies which had most actively varied their commitment positions in earlier years had thus returned to relatively more stable strategies geared predominately to expected new inflows of investible funds, most companies interviewed (including the six others examined less intensively) continued to make some adjustments in these ratios on the basis of their interest rate expectations throughout the period studied. Our field work, however, was unable to distinguish clearly between responses to expected movements in market rates and those involving changes in expected levels of returns which would be available on new commitments themselves in the future.

Our field work also revealed a very marked awareness of, and growing concern with, the strongly adverse effects of both high and increasing interest rates on the volume of investible funds themselves, as discussed above on pp. 605–607. The induced increases in nondiscretionary policy loans and reductions in prepayments on other existing assets [the (B) items above] had sharply reduced the cash flow effectively available for forward commitments as well as other discretionary investments, and there was of course a vivid appreciation of the fact that lower and falling interest rates, whenever they might realized, would have correspondingly favorable effects on their exogenous fund flows. These responses of investible funds to interest rates are picked up in the "$\beta\bar{r}$" term in our model, and our field work clearly suggests a strong and continuing significance for this aspect of the relation of interest rate expectations to forward commitment activity throughout the period studied. Even though the companies had reduced the extent to which forward commitment ratios would be varied on the basis of interest rate expectations directly, they continued to make significant changes in these commitment ratios on the basis of their expectations of the relative size of prospective future flows of investible funds, and our field work indicated that *these* assessments continued to be significantly influenced by interest rate expectations.

Statistical Analysis of Industry Data

Our statistical analysis is based on the theoretical model of the optimal or target ratio of new forward commitment votings to current rates of flows of investible funds given in equation (7) above,[89] as modified in equation (19) to allow for expectations of future growth in the flows of investible funds (and hence in the target *future* stocks of balance sheet assets), as well as the fact that many forward commitments will not be taken down for many months or calendar quarters in the future. After equation (7) and (19) are substituted into (20) to allow for the institutional rigidities and reaction costs involved in the decision-making and planning process for forward commitments, we arrive at the equations actually fitted in our statistical work:

$$(21)\quad \frac{C_t}{F_t} = a_0 + \underset{(+)}{a_1}\left(\frac{r_{ct} - r_t^e}{V_{r_t^e}}\right) + \underset{(-)}{a_2}\,\frac{K_{t-1}}{F_t} + \underset{(+)}{a_3}\,\bar{\bar{G}}\bar{R}_t + \underset{(-)}{a_4}\,r_t^e + \underset{(+)}{a_5}\,\frac{C_{t-\tau}}{F_t} + \tilde{u}_t$$

and

$$(22)\quad C_t = b_6 + \underset{(+)}{b_0}\,F_t + \underset{(+)}{b_1}\left(\frac{r_{ct} - r_t^e}{V_{r_t^e}}\right)F_t + \underset{(-)}{b_2}\,K_{t-1}$$

$$+ \underset{(+)}{b_3}\,\bar{\bar{G}}\bar{R}_t \cdot F_t + \underset{(-)}{b_4}\,r_t^e \cdot F_t + \underset{(+)}{b_5}\,C_{t-\tau} + \tilde{v}_t$$

The theoretically expected sign is given just below each coefficient, and all variables are as defined earlier, except that we now write r_t^e for the expected *future* value of the "opportunity cost" rate as assessed at time t and V_t^e for its ex *ante* variance, while $\tilde{u}$ and $\tilde{v}$ are of course random error terms.

These equations were fitted to data covering all the forward commitment activity of the life insurance industry on both a monthly and a quarterly basis for the period running from January 1965 through March 1976. We concentrate our statistical analysis on the *aggregate* new commitment votings by the life insurance industry *over time* because of our primary focus in this study on the role of interest rate *expectations* on forward commitment activity. (It will be recalled from pp. 597–598 above that the role of these expectations was the "missing link" in previous studies which focussed on the effects of such factors as the relative yields and the differing backlog positions and take-down patterns of different types of commitments on the volume of new forward commitments made for residential income property mortgages, private placements, etc.) Given our concern here with the role of yield expectations on aggregate commitment activity, we do not need to introduce a separate term for the "duration preference" of the companies (see pp. 613–616 above) into our equations (21) and (22).[90]

Before presenting the empirical results it will be useful to specify the content of each series used in estimating the regression equations and to comment briefly on the way certain methodological issues were handled.

C_t is the aggregate of all new forward commitments entered into in the current month, estimated for the entire industry from reports to the ALIA by companies holding about 80% of all industry assets.

r_{ct} is the weighted average rate on all new commitments made in the month. ALIA data showing the rate and dollar volume for separate types[91] of commitments were used, the weights being the ratio of the volume of each type to C_t.

K_{t-1} is the aggregate outstanding stock of forward commitments at the beginning of the t^{th} month. If the data for stocks outstanding at the end of the prior month were used, it would be necessary to estimate separate equations to allow both for cancellations during the month and for the previously outstanding commitments drawn down during the month. To avoid these problems, we measured the relevant K_{t-1} by $K_t - C_t$, i.e., the *actual* stock at the end of the current month *less* the new commitments added *during* the month.

F_t is the flow of exogenous investible funds in the t^{th} month. Since (unlike all the preceding data) ALIA surveys provide only quarterly figures on the flows of investible funds, we had the choice (taken by other studies) of aggregating all series to quarterly levels and using the measured cash flow data, or of maintaining a monthly time period and interpolating the quarterly cash flow data. The latter course has certain important advantages. As Mundlak,[92] among others, has shown, temporal aggregation not only loses information (thereby reducing the efficiency of our estimates) but also can introduce bias into estimates of lag structures. By using monthly observations these problems can be avoided. However, these advantages are bought at the possible cost of introducing some measurement error into our cash flow data.

Our decision was to develop interpolated estimates of monthly investible funds data based upon a quarterly regression of investible funds upon personal income, the level of the long-term rate of interest (Moody's Baa corporate) and the change in the long-term rate of interest.[93] The coefficients obtained were used with monthly observations on personal income and the rate of interest to distribute the quarterly data on gross investible funds across the three months in each quarter. To minimize the risk of measurement error, we then formed a three-months moving average (denoted $\bar{F}_t$) of our interpolated F_t, and fitted equations (21) and (22) with and without the substitution of $\bar{F}_t$ for F_t. As noted above, we also checked out our equations on a quarterly basis.

$\bar{C}_{t-\tau}$ is either a six or a twelve month *average* (excluding the current month) of the past levels of C_t. The purpose of this variable is to allow for the important institutional inflexibilities and readjustment costs previously discussed. The longer lagged average accomplishes this more effectively than would merely using C_{t-1}, and also minimizes the problem of inconsistent estimates which would be raised by using the latter term in the presence of serially correlated disturbances.

$\bar{G}\bar{R}_t$ is the expectation at time t of the future rate of growth of F_t. It is measured monthly by the exponentially smoothed rate of growth ($\alpha = 0.1$) of $2(AVF_t - AVF_{t-12})/(AVF_t + AVF_{t-12})$ where AVF_t is a seven-month *centered* average of F_t. This exponential smoothing of longer averages allows the modest flexibility in the context of essential long-run stability which would be expected a *priori* in these estimates of the longer run average growth prospects of the industry.

r_t^e and $V_{r_t^e}$ as previously noted, are general symbols respectively for the expected *future* value of the "opportunity cost" rate as assessed at time t, and the *ex ante* variance of this assessment. It will be noted that in equations (21) and (22) these variables occur simultaneously and in ratio form in the commitment premium ratio $(r_c - r_t^e)/V_{r_t^e}$, and there is no known theoretical derivation of the best statistical procedures to use in this complex setting.[94] Most previous work on financial markets has ignored variances, although a few studies have simply entered them as a separate variable in linear form. Although the latter may be appropriate in the usual analyses of portfolios involving contemporaneous risks, the ratio form is required by the different structure of the forward commitment problem, as shown above.

The procedure actually adopted was to follow the usual practice of estimating r_t^e by a moving average or polynomial distributed lag on past values of the relevant interest rate. For each such estimate of r_t^e, the corresponding estimate of the *ex ante* variance was obtained by exponentially smoothing the lagged *ex post* error variance around the prior estimates of r_t^e. Specifically, we set

$$(23) \quad V_{r_t^e} = \alpha v_{r_t^e} + (1 - \alpha) V_{r_{t-1}^e}$$

with

$$v_{r_t^e} = \sum_{i=1}^{12} w_i (r_{t-i} - r_{t-i}^e)^2 / 12$$

where r_{t-1} is the actual observation at time $t - i$, and r_{t-1}^e is the predetermined value of the expectation (using the chosen algorithm) which would have been held at the earlier time $t - 1$. In particular, we ran regressions using three different specifications of the unobservable expectation r_t^e (combined with its associated $V_{r_t^e}$) using equation (23): (a) we computed r_{bt}^e as a 12 month moving average of the lagged values of the Baa rate on marketable issues; (b) we computed an autoregressive expectation r_{mt}^e based on a third-degree polynomial distributed lag using the past 15 monthly values of the Baa rate;[95] and finally (c) we computed r_{ct}^e as a 12 month moving average of past values of the composite commitment rate r_c itself.

The resulting equation estimates are summarized in Tables 1 and 2. We display the parameter estimates when the commitment premium ratio is measured by $(r_{ct} - r_{ct}^e)/V_{r_{ct}^e}$ since this specification produced somewhat higher significance levels than either $(r_{ct} - r_{bt}^e)/V_{r_{bt}^e}$ or $(r_{ct} - r_{mt}^e)/V_{r_{mt}^e}$, when used with any of the three measurements $(r_{bt}^e, r_{mt}^e$ or $r_{ct}^e)$ for the fourth term in the equation and either the twelve or six month lagged average of the prior C_t's. The expected positive signs on the commitment premium ratios were shown in each case, and the differences in t-values were not large, but they were quite consistent in direction. We regard this as evidence that the "opportunity cost rate" involved in assessments of the commitment premium ratio is primarily the expected future level of the commitment rate itself, rather than the expected level of the public-issue rate as hypothesized in the initial single-period version of the underlying theoretical model. But as observed on pp. 621–622 above, this reliance on expectations of the future commitment rate itself is to be expected in the multi-period context of the forward commitment process, given the continuing high target ratio of commitment-type-assets to total assets throughout the period.

Similarly, we display the results using autoregressive expectations of market rates r_{mt}^e as the specification of the fourth term in the equation, rather than r_{ct}^e or r_{bt}^e. Although the sign on this term was consistently negative as expected on each measurement, regardless of which commitment premium specification was used, and again the differences in t-values were not great, the differences were consistent in direction favoring r_{mt}^e. This result was perhaps also to be expected, since in the derivation of the underlying model the coefficient on this

TABLE 1 Regressions Explaining Ratios of New Commitment Votings to Current Fund Flows January 1965–March 1976 Equation (21)

Variable	Monthly with F_t		Monthly with $\bar{F}_t$	
$(r_{ct} - r^e_{ct})/V_{r^e_{ct}}$	0.00188	0.00135	0.00152	0.0010
	(2.265)	(1.673)	(1.835)	(1.283)
K_{t-1}/F_t	−0.0102	−0.0173	−0.0163	−0.0217
	(−0.782)	(−1.519)	(−1.235)	(−1.834)
$\bar{G}\bar{R}_t$	0.8242	0.4518	0.6401	0.3692
	(2.794)	(1.519)	(2.055)	(1.209)
r^e_m	−0.0738	−0.0545	−0.0842	−0.0604
	(−3.856)	(−3.108)	(−4.158)	(−3.260)
$\bar{C}_{t-1}$ (12 mo.)$/F_t$	0.2603	—	0.1746	—
	(1.700)		(1.076)	
$\bar{C}_{t-1}$ (6 mo.)$/F_t$	—	0.4479	—	0.4209
		(3.504)		(2.965)
ρ	−0.680	−0.624	−0.681	−0.626
R^2_{corr}	0.365	0.419	0.337	0.386
DW	2.13	2.19	2.15	2.21
$F(5/129)$	16.376	20.327	14.619	17.854

separate expected interest rate term is the covariance (or more precisely, the regression coefficient) of prospective investible funds and interest rates. The decisions of policyholders to take out or increase policy loans, and the decisions of borrowers to prepay principal on outstanding mortgages and securities is clearly more closely related to public market rates than to the rates on new commitments as such.

In general, the regression results reported in Tables 1 and 2 support the inferences of our theoretical analysis and the indications of actual company practice obtained in our field investigations. All the variables in both sets of equations have the expected signs, generally at acceptable levels of significance, and the overall regressions in all cases pass very high tests of significance. In Table 1, the dependent variable is either the ratio of current commitments to the actual or normalized *current* flow of investible funds C_t/F_t or $C_t/\bar{F}_t$. (Incidentally, the mean of this variable over the eleven year period 1965 through early 1976 was 1.003, which confirms again the predominant role of investments acquired through forward commitments in the investment posture of the life insurance industry.) Except in one case at the 10% level, the commitment premium terms $(r_{ct} - r^e_{ct})/V_{r^e_{ct}}$ are all significant at the 5% level or better.[96] We also note that, since the standard deviation of the time series of this ratio was as high as 23.9,[97] a swing of two standard deviations in this series would induce an estimated change of between 5% and 10% in the ratio of current commitment votings to its current flows of investible funds, which seems

TABLE 2 Regressions Explaining Dollar Volume of New Commitment Votings January 1965–March 1976 Equation (22)

Variable	Monthly with F_t		Monthly with $\bar{F}_t$		Quarterly	
constant	101.28	74.148	19.208	29.561	−35.384	5.393
	(0.603)	—	(0.104)	(0.171)	(−0.152)	(0.028)
$\frac{r_{ct} - r^e_{ct}}{V_{r^e_{ct}}} \cdot F_t$	0.00142	0.00123	0.00135	0.00113	0.00265	0.00187
	(1.653)	(1.473)	(1.632)	(1.405)	(2.448)	(1.751)
K_{t-1}	−0.033	−0.0275	−0.0373	−0.0338	−0.0248	−0.0261
	(−1.907)	(−1.805)	(−2.129)	(−2.171)	(−1.082)	(−1.471)
$\overline{CR}_t \cdot F_t$	0.909	0.443	0.544	0.206	0.7105	0.3868
	(2.920)	(1.451)	(1.481)	(0.625)	(1.536)	(1.0537)
$r^e_m \cdot F_t$	−0.0359	−0.0379	−0.0614	−0.053	−0.0656	−0.0479
	(−1.297)	(−1.486)	(−1.779)	(−1.729)	(−1.537)	(−1.423)
F_t	0.836	0.875	1.3156	1.184	1.330	1.051
	(2.147)	(2.441)	(2.535)	(2.578)	2.046	(2.051)
$\bar{C}_{t-1}$ (12 mo.)	0.604	—	0.476	—	0.398	—
	(3.516)		(2.403)		(1.584)	
$\bar{C}_{t-1}$ (6 mo.)	—	0.5877	—	0.526	—	0.545
		(4.241)		(3.378)		(3.143)
ρ	−0.709	−0.671	−0.713	−0.677	−0.455	−0.274
R^2_{corr}	0.540	0.567	0.530	0.557	0.678	0.763
DW	2.16	2.25	2.19	2.28	2.04	2.06
$F(6/128)$	27.221	30.199	26.185	29.040	—	—
$F(6/38)$	—	—	—	—	16.403	24.57

about right in the context of our detailed studies of individual companies reported earlier. Similarly, the coefficient as an average over the period for the expected market rate r^e_m comes through with the consistently strong negative value at a high level of significance ($\alpha < .001$) as expected. It will be recalled that our field investigations found that even the companies which most severely limited the *direct* response of their new commitments to expected interest rate levels continued to be seriously concerned with the inverse impact of prospective changes in rates on the flows of funds which they would have available for investment later. This indirect response of their current commitments to expected rates *via* expected future fund flows, as estimated in our equations, involved a change of between 5% and 9% in the ratio of commitments to *current* fund flows (C_t/F_t) for every 1% change in their estimate of the future interest rate.[98] This strong effect, in turn, is broadly consistent with direct estimates of the regression slopes of the monthly supply of investible funds on interest rates.[99]

In addition to these significant negative inverse shorter-run adjustments in new commitment ratios in response to the effects of changes in the expected levels of interest rates on the flows of investible funds over the following six or twelve months, the long lead times involved in several important categories of forward commitments require that current commitment activity also reflect expectations of asset levels much further in the future which depend on trend-like assessments of the longer-term rates of growth in the flows of investible funds. The variable $\overline{GR}_t$ measuring these latter effects also appears with the expected positive sign and generally good levels of significance. The inflexibilities in the institutional framework are reflected in the positive effect of the lagged average rate of commitment activity, and when measured by a lagged six-months average, this effect is found to be highly significant in the commitment ratios fitted to monthly data. Although the "stock-adjustment" effect of the lagged stock of outstanding forward commitments K_{t-1} always has the expected negative sign, this variable generally shows a lower level of significance in the monthly equations of Table 1 where the dependent variable is the ratio of new commitments to fund flows. This circumstance probably just reflects the fact that both the new commitment and outstanding stock variables cover all types of forward commitments, while it is well known that the companies have substantial leeway in adjusting current commitment activity to desired levels by entering into commitments (especially some corporate loans and securities) with near-term take-down dates.

As noted earlier, most previous studies of the forward commitment activity of life insurance companies have not only ignored the potential effect of interest rate expectations, but have relied on statistical estimates of the *dollar* volume of new commitments using quarterly data. The results obtained with our equations, fitted on both a monthly and a quarterly basis and using the dollar volume of new commitment activity C_t as the dependent variable, are shown in Table 2. It will be observed that our equation, fitted to quarterly data in keeping with usual practice, explains as much as three-fourths of the variance of commitment activity over this turbulent eleven years. Moreover, in the fittings with both monthly and quarterly data, the constant term in the "dollar volume" equations turns out to be essentially zero in all cases, providing important confirmation of the essential homogeneity of the equation and of the essential role played by the *ratio* of new commitments to flows of investible funds in the entire decision-making process. As expected, the current (or current average) flow of investible funds is a strong determinant of the current dollar volume of new commitments. The role of institutional inflexibilities represented by the lagged average level of commitment activity comes through more strongly in these equations explaining the dollar volume of new commitments than it did in the estimates based on the ratio form of the equation.

In the context of some of the principal concerns of the present study, it should also be noted that the fitted coefficients of the commitment premium ratio term is about the same in these "dollar" equations as in the fittings in ratio form, and that in spite of the collinearities introduced by entering as a product with F_t, this term largely retains its levels of significance in the monthly fittings and is quite significant on any usual standards in the quarterly estimates. Although the indirect interest expectation term and the expected growth rate show lower levels of separate significance in the dollar volume equations—doubtless because of the induced collinearity of $\overline{GR}_t \cdot F_t$ and $r^e_{mt} \cdot F_t$—they remain useful variables in the equation. The lagged stock of commitments K_{t-1} shows up more strongly in the monthly equations in dollar form, but with quarterly data its significance level is lower probably because of the flexibility over this interval in arranging "short-term" commitments discussed earlier.

In sum, the results of these statistical analyses thus support the inferences of our theoretical analyses and the patterns of behavior found in our field investigations. Anyone of a Bayesian persuasion will of course form still stronger final conclusions and judgments by combining the "preposteriors" based on this prior work with the regression evidence just described.

[V] CONCLUSIONS

Mortgages, private placements and other corporate securities acquired through forward commitments dominate the entire investment portfolios of these major institutional investors. The time interval between the making of the commitment and the actual investment of the funds ranges from a few weeks to as much as three years or more, with large fractions of all commitments outstanding for periods in excess of six and twelve months. An essential feature of these forward commitments is that the insurance company commits itself to lend specified amounts at specified future dates at *fixed* contractual rates (and other terms) determined *when* the commitment is *made* rather than at the later date when the funds are actually paid out and invested. The relevant opportunity cost of any forward commitment is not the market rate on public investment at the time the commitment is made, but rather the uncertain rate of return which, in the absence of the current commitment, could have been realized on alternative investments made at the future time when the current commitments will be taken down. Since life insurance companies are risk-averse investors, their forward commitment votings would theoretically be expected under any given set of other conditions to vary inversely with both this expected "opportunity cost rate" itself and the degree of uncertainty involved in their *ex ante* assessments of these future rates. Higher (lower) expected future market rates would also be expected to reduce (increase) current commitment votings because of the well recognized and strong inverse correlation between these rates and the flows of investible funds to the institutions. Both our intensive field studies of several important companies and our statistical analysis of aggregate industry data provide clear evidence supporting these conclusions.

Individual companies were not uniform in either the timing or in the extent of the adjustments of their forward commitment positions on the basis of their interest rate expectations during the early years of higher and more volatile interest rates following 1965. But those which made the largest adjustments became increasingly aware of the substantial uncertainties unavoidably involved in forecasts of interest rate movements and of the institutional constraints and costs involved in any such large changes in commitment activity, leading them to revert to more stable strategies in the later years of the period. Most companies interviewed continued to make adjustments in their ratios of new commitments to current fund flows on the basis of their interest rate expectations within policy limits of roughly 10% throughout the period studied, and our statistical analysis confirms this more limited adjustment on average across all companies in the industry and over the eleven years fitted in our regressions. In both the field evidence and the statistical analysis, these adjustments are separate from and in addition to the further indirect depressing effects of high interest rates on commitment ratios by way of their negative association with future flows of investible funds.

These adjustments of the pace of forward commitment activity to interest rate expectations of course occur within the broader context of the longer term target portfolio distributions and expectations of future levels of total assets. The former are shown to depend not only upon the relative expected yields on different assets, but also upon the relative "duration" of their income streams because of the added risks involved in holding portfolios of assets whose duration is less than that of the companies' liabilities. The dollar volume of new commitments depends essentially upon the expected future rate of growth of investible funds, as well as on the size of the current flow, because larger expected growth rates imply the need for more assets of each type in place in the future, other things equal, and with long lead times, more commitments will need to be made earlier. For any given target level of each asset to hold in the future, however, the need for *current* new commitments will vary inversely with the stock of commitments already outstanding; but the internal and external inflexibilities of the institutional context and the economic costs of changes in pace also make the desired level of new commitment activity an increasing function of the lagged average pace of such commitment votings.

The results of this study also add to our understanding of the effects of monetary policy and inflation on the investment activity of these major institutional investors, and of the channels and mechanisms through which these effects are realized. Changes in monetary policy which raise interest rates will reduce the concurrent flow of total new investment commitments being made by life insurance companies because the higher rates reduce the flows of investible funds [via the (B) items discussed on pp. 605–606], but the current investment *outlays* for income property mortgages and other long lead time forward commitments will be little affected for some time, since these outlays are primarily determined by the scheduled take-downs of commitments already outstanding. The major effects on actual investment outlays into these channels will develop with a substantial lag.[100] Higher interest rates reduce both the current and expected future flows of investible funds which in turn directly reduce the current pace of *new* forward commitment votings, and *these* reductions are magnified both by the induced increase in the expected level of future interest rates and in the current ex *ante* uncertainties regarding what such future rates will in fact turn out to be. But these compounded reductions in the pace of new forward commitment votings merely reduce the inputs into the relatively large total stock of outstanding commitments whose take-down schedules largely determine the current financial investments of the companies in these important sectors of the capital markets. Changes in monetary policy which ease interest rates correspondingly work themselves through the commitment process with an extended distributed lag.

The results of this study also add to our understanding of the effects of inflation and of inflationary expectations on the investment policies of these major institutional investors. Investment officers of these life insurance companies were well aware of the "Fisher effect" and of the negative impact of higher rates induced by inflation on their current and prospective future flows of investible funds. They based their expectations of changes in future interest rates very largely on their judgments regarding probable changes in inflation rates (and the effects such changes in rates of inflation would have on Federal Reserve policy). Accelerating inflation and its associated higher levels of interest rates also added to their uncertainties regarding further changes in rates. Through all these channels our study shows that changes in current and expected future inflation rates have had a compounded effect on the forward commitment positions of life insurance companies, both individually and in the aggregate, and that these impacts on commitment activity then induce a whole sequence of later changes in actual commitment take-downs (i.e., investments for the balance sheet).

While we have thus found very strong and compounded impacts of inflation and expectations of inflation on these major investment activities of the insurance companies, our work also indicates that fundamental modifications are required in the prevalent views, dating from the interpretations of Irving Fisher at the turn of the century, regarding the *mechanism* by which expectations of inflation affect nominal interest rates. Both Fisher and much current writing hypothesize that market interest rates will rise in the face of expected inflation as a result of both the increased demands of borrowers who can repay in funds of reduced purchasing power, *and* because lenders are expected to require higher nominal rates in order to protect the real returns on their investments, and thereby the purchasing power of their capital. In contrast, these investment managers without exception clearly recognized that their liabilities are denominated in schedules of *nominal* dollars, and all our field work indicated that in making investment decisions to acquire assets to be held against such liabilities their objective has been to maximize their nominal "new money rates," or the rate-of-return-over-time in nominal dollars. We have indeed found that they will vary their current pace of forward commitment votings in response to changing expectations of future nominal commitment rates and nominal fund flows, and their uncertainties regarding these, but we found no evidence of any withholding of funds until returns had risen enough to preserve purchasing power *per se*. Increases in inflation serve to reduce the volume of funds insurance companies have available for investment, but life insurance companies continue to lend what funds they do have available in spite of any decline in *real* purchasing power returns due to subsequent inflation. The prevalent view that, in addition to having fewer funds to invest, the companies also withhold funds from lending in order to maintain their real return as such is contrary to our evidence.[101] They are simply risk averse maximizers of the "nominal" returns on their investment portfolios, given the opportunity set available to them.

NOTES

1. Specifically, after data for investments in separate accounts (*Life Insurance Fact Book*, 1977, p. 87) are deducted from the totals (p. 68), mortgages and corporate bonds have accounted for more than 80% of the sum of mortgages, corporate bonds, common stock, government securities and real estate held for investment purposes.
2. The fraction of common stocks in special accounts for pension plans has been substantially higher, ranging from 72 to 87% of all such assets over the last decade. *Ibid.*, p. 87.
3. The companies in this sample were both large and active in private placements; the ratios would be lower for the large majority of smaller companies.
4. See Eli Shapiro and Charles R. Wolf, *The Role of Private Placements in Corporation Finance* (Harvard Graduate School of Business Administration, 1972), pp. 54–56 and ALIA reports. In recession years as new issue rates fall and companies seek to restore a more normal balance of short and long debt in their balance sheets, there is a surge of new public underwritten issues. At such times, there is a decline in the fraction of private placements to the total of public and private corporate issues acquired by life insurance companies. For the 28 large companies, the ratio fell to 85% in 1958; unfortunately, this 28 company series was discounted in 1966.
5. See W. Leigh Ribble, Jr., *The Portfolio Behavior of U.S. Life Insurance Companies*, unpublished Ph.D. thesis, M.I.T., August, 1973, p. 211, and ALIA reports. In the years 1973–75, the ratio averaged between 85% and 90%, but the ALIA notes that all these ratios may be somewhat overstated since some advance pledges to underwriters for public bond issues may be included in their commitment data.
6. See George A. Bishop, *Capital Formation Through Life Insurance: A Study of Growth of Life Insurance Services and Investment Activities* (Richard D. Irwin, 1976), pp. 146–147.
7. Federal Reserve Flow of Funds accounts show that life insurance companies acquired 25%–40% of all nonresidential commercial mortgages issued in most postwar years. They were similarly large suppliers of multifamily residential mortgages in each of the years 1948–52 and 1964–70. Through 1972, life insurance companies continued to hold more

commercial mortgages than any other investor. Their role of being the largest holder of multifamily mortgages has given way since 1970 to the more rapid growth of large savings and loan associations, but they remain the second largest investor in these mortgages.

8. In 1950, life insurance companies invested $2.4 billion in home mortgages, which was nearly one-third of all net issues of such mortgages in that year and represented three-fourths of their mortgage acquisitions of all types. But the favorable yield spreads of the early 1950's gradually deteriorated and during the late 1960's turned sharply negative (186 basis points lower than income property mortgages and 215 basis points lower than private placements by 1970–71), with the result that insurance companies gradually withdrew from this market, letting their new home mortgage investments fall short of amortization and repayments in every year after 1966.

9. In addition to the studies noted in the text which deal specifically with the forward commitment activity of life insurance companies, other important recent work has dealt with the *acquisitions* of corporate securities (bonds and private placements) by life insurance companies, and five other major sectors investing in this market, using a separate structural equation for each sector. See Benjamin M. Friedman, "Financial Flow Variables and the Short-run Determination of Long-term Interest Rates," *Journal of Political Economy*, Aug. 1977, pp. 661–689. Friedman's work, like that reported here, finds that the adjustment of investment positions is heavily dependent on current cash flows—and also that the acquisitions of a particular type of asset (corporate bonds) depends heavily on relative yields as would be expected. The latter effect is confirmed by other studies of commitment data *per se* (see footnote 18 below) and is not additionally tested in the present study.

10. George A. Bishop, *The Response of Life Insurance Investments to Changes in Monetary Policy, 1965–1970*; Life Insurance Association of America, (Dec. 1971).

11. Joseph R. Bisignano, *The Portfolio Behavior of Nonbank Financial Institutions*, unpublished Ph.D. dissertation, Stanford University (1971).

12. James E. Pesando, *A Model of Life Insurance Company Portfolio Behavior*, unpublished Ph.D. dissertation, University of Toronto (1971).

13. *Op. cit.*

14. Another recent study, J. David Cummins, *An Econometric Model of the Life Insurance Sector of the U.S. Economy* (Lexington Books, 1975) presents an analysis of the flows of investible funds and the *acquisitions* of different types of assets by life insurance companies but does not separately examine the determinants of the volume of new forward commitments as such.

15. Dwight M. Jaffee, "An Econometric Model of the Mortgage Market," Chapter 5, in *Savings Deposits, Mortgages and Housing*; Studies for the Federal Reserve-MIT-Penn Economic Model (Ed. by Edw. M. Gramlich and Dwight M. Jaffee. Lexington Books, Lexington, Mass., 1972).

16. Pesando simply regresses new commitments on current cash flows, yield spreads and repayments.

17. Ribble, *op. cit.*, extrapolates current estimates of growth in the flows of investible funds to estimate the expected future size of the total desired portfolio of assets to be acquired through commitments; Jaffee, *op. cit.*, simply multiplies current yield spreads by the current level of insurance reserves and uses the current flow of investible funds as an independent variable.

18. However, not all yield spreads have been found to be significant and have the expected sign in all separate equations. The substitution between income properties and one-to-four family mortgages has uniformly been found to be strongest and that with securities and industrial private placements weakest. The frequent failure to find stronger effects for the yield differential between securities and the several categories of mortgage loans probably reflects (a) substantial multicollinearities in the data; (b) the fact that the available data do not distinguish between commitments for private placements with a relative-

ly long period to takedown and commitments for industrial loans (and even underwritten public issues) for which the funds will be advanced within periods as short as one or two months (both are combined in single series of yields and commitments for "securities"); (c) the fact that shorter-term securities commitments are actively used to adjust overall commitment positions to desired levels; and finally, (d) the fact that the institutional rigidities and costs of changing the pace of new commitment activity (cf. below, pages 619 to 620) are much more severe for most types of mortgage loans than even for longer-term private placements, while they are comparatively minor for "security" commitments with relatively early takedown dates.

19. Michael Fleuriet ("Public and Private Offerings of Public Debt: Changes in the Yield Spread," Bulletin 1975-1, New York University Graduate School of Business Administration, Institute of Finance) in a still more recent study has recognized the dependence of commitment yields on expected future interest rates and shown that the spreads between quarterly expected forward rates and current public rates explain much of the variation in spreads between current commitment rates on corporate private placements and rates on new public issues. Fleuriet also explained total insurance company commitments with a regression on current cash flows (+), expected future rates (−) and current commitment yield (+), using quarterly data for 1960–1971 with all variables entered separately.

    Lawrence Jones' earlier seminal study (*Investment Policies of Life Insurance Companies*, Harvard Graduate School of Business Administration, 1968) also had undertaken to assess the extent to which insurance companies had acted on their expectations of future interest rate movements, but his statistical tests were inconclusive, using monthly data for 1953–59. In neither Fleuriet's nor Jones' work was there a systematic development of the underlying portfolio theory in a multiperiod planning context. As shown below, such a theory requires a richer set of variables and a different form of estimating equation than used in these earlier studies.

20. John Lintner, "Interest Rate Expectations and Optimal Forward Commitments for Institutional Investors," *Explorations in Economic Research* (NBER), Fall, 1976, pp. 445–520.

21. A description of our field work and detailed studies of individual companies is given on page 622 below. The insights obtained in these field investigations are incorporated at various points in the text, especially in section III.

22. James J. O'Leary, "Forward Investment Commitments of Life Insurance Companies," in *The Quality and Economic Significance of Anticipations Data*, A Conference of the Universities-National Bureau Committee for Economic Research (Princeton, 1960), p. 325. This quotation is also used by George A. Bishop, *op. cit.*, pp. 30–31. Other useful descriptions of forward commitment practices are found in Jones, *op. cit.*, pp. 19–24.

23. The lender's obligation to provide the funds is legally binding. Although the borrower's obligation to draw down the funds is not legally enforceable in many cases, there is a strong presumption and moral obligation on the latter. American Life Insurance Association (ALIA) data show that cancellations have been only a small fraction of outstanding commitments throughout the period since 1961.

24. See Ribble, *op. cit.*, Chapter 5 for a detailed investigation of the time patterns of takedowns on various categories of commitments. Over 70% of home mortgages commitments were taken down within six months and 92% within one year. Only 55% of commitments for securities and private placements were taken down within six months, and 23% were still outstanding after two years. On income properties, only 10% were drawn down in less than six months and only 25% within a year and nearly 40% were taken down after a lapse of more than two years (p. 124).

25. Indeed, risk-averse borrowers will always prefer to arrange for a substantial part of their total anticipated borrowing requirements through forward commitments except when the covariance between profit rates and the open market borrowing rate is very high and/or

the (known) rate on forward commitments is very much higher than the *expected* value of the (uncertain) future open market borrowing rate. For proofs and formulas, see Lintner, *op. cit.*, p. 460.

26. The avoidance of the underwriting and S.E.C.-related additional costs of a public issue is of course a feature of all private placements, but most private placements in practice involve the forward commitment process. See Shapiro and Wolf, *op. cit.*
27. See Lintner. *op. cit.*, pp. 459–461, and also Irwin David Lane, "Commercial Bank Loan Commitments," unpublished Ph.D. dissertation (1974), Stanford University.
28. *Op. cit.*, pp. 22–24.
29. This was almost universal practice before the emergence of the REITs around 1970. The latter as a competitive device about this time began to extend rapidly increasing volumes of new construction loans without prior take-out commitments, but their subsequent bad experience is well-known and the practice has been abandoned.
30. *Op. cit.*, p. 326.
31. O'Leary, *op. cit.*, p. 325. Jones, *op. cit.*, p. 328, later observed a few instances in which rates would be set at time of takedown, but his field work as well as our own indicates such cases are the exception rather than general practice.
32. A known instead of an uncertain rate on forward commitments has an especially strong attraction for life insurance companies because they have actuarially known liability structures—which largely eliminates the prospect of a positive covariance between liabilities and asset returns which are important features of the situation of certain other intermediaries.
33. See Lintner, *op. cit.*, pp. 454–455, and 470–471.
34. For instance, Jones, *op. cit.*, p. 326; and Ribble, *op. cit.*, pp. 39 and 226.
35. When commitment rates in the private placement market over the twenty years 1951–1970 are compared with the yields on public issues of roughly comparable quality (Aa-Baa on the Moody ratings), differentials in favor of forward commitment rates are found to be almost consistently positive ranging between a low of about 25 basis points up to as much as roughly 125 basis points. Jones, *op. cit.*, p. 327, and Shapiro and Wolf, *op. cit.*, pp. 125–128.

    However, these rate comparisons are based on the differences between average quarterly rates on public and private issues which in fact are made at different dates within the quarter, which are heterogeneous in intrinsic quality and have often markedly different non-interest rate terms, restrictions and provisions. Shapiro and Wolf (p. 128) also report an alternative set of tabulations of the actual commitment rates on a series of 325 private placements bought by the Pension Department of the Bankers Trust Company between 1956 and 1967, together with the estimated rates at which these specific issues with their attendant provisions would have sold in the public market on the same date(s). The resulting "paired comparisons" still show differentials which are always positive, although somewhat smaller.

36. The next section analyzes the flows of investible funds for insurance companies. Although the larger part of these flows is relatively stable, there is a strong negative covariance with changes in interest rates because of their effects on the volume of calls of outstanding securities and full prepayments of mortgages and, most importantly, on the volume of non-discretionary policy loans.
37. Notably, given the non-interest rate terms and conditions of the debt instrument underlying the forward commitments, the demands of borrowers for such forward credits expressed as a function of the commitment rate, and the uncertainty involved in their assessments of future interest rates and flows of investible funds. See Lintner, *op. cit.*, pp. 450–451, and 456–466, esp. p. 462; and below pp. 609–612.

38. This statement follows from the dominance of bonds and mortgages in insurance company portfolios and the very large fraction of all these investments acquired by way of forward commitments, as noted in our introduction.
39. Item (A1) also includes receipts on annuity contracts.
40. This classification follows that used by George Bishop, *op. cit.*, esp. p. 12ff.
41. These two sources (A1) and (A2) together are usually combined under the rubric of "net increase in ledger assets." Since 1965, these have represented two-thirds or more of the total of the (A) items, and from 43% to over 60% of all investible funds (item D).
42. While delinquencies and defaults introduce some uncertainty, the amounts involved have been very small relative to the payments required by the outstanding contract through most of the post-WW II period.
43. The sum of the (A) items ranged from a low of 68% of item (D) in 1972 [when the algebraic sum of (B) items was unusually large due to declining interest rates as explained below] to a high of nearly 93% in both 1969 and 1970 [when the sum of (B) items involved a net *outflow* of $619 million and $679 million].
44. In both cases, the decline was only 0.3% of the total investible cash flow of the preceding year.
45. Much of the greater growth in (A) items in recent years has been due to the rapid (though somewhat uneven) growth in the sales of annuity contracts.
46. Most of the bonds bought in recent years will have prohibitions of call or refunding for a period of five or ten years, but will be subject to call thereafter—and the large volume of bonds bought earlier and still held are free of such restrictions.
47. In recent years, the companies have raised the specified loan rate on new policies (usually to 8% if permitted by state law) in order to reduce the dependence of policy loans on credit conditions. But these changes only affect new contracts which are still only a small fraction of all policies.
48. These changes are all stated for the industry as a whole; the fluctuations in individual companies were often much larger.
49. Statistical analyses of changes in policy loans are found in Francis H. Schott, "Disintermediation Through Policy Loans at Life Insurance Companies," *Journal of Finance*, June, 1971, pp. 719–729; and Cummins, *op. cit.*, pp. 84–88. Chapter 4 of the latter reference also provides a statistical analysis of the total exogenous flow of investible funds to the companies.
50. This term for the combined flows has also recently been used by Ribble, *op. cit.*, in keeping with economists' standard terminology.
51. See introduction to this paper.
52. The very special case of the progressive liquidation of the excess holdings of U.S. Government securities accumulated during World War II has been examined in detail by Jones, *op. cit.*, Chapters III and IV. These holdings were reduced rather rapidly from $21.6 billion (44.9% of assets) to $11.0 billion (16.1%) in 1951 just after the "accord." Thereafter the pace of sales was markedly slower but persistent on into the late 1960's. The immediately relevant observation here is the relatively slow but persistent character of the removal of the portfolio imbalance after 1951.
53. See below, p. 621 and esp. the footnote.
54. Security sales incident to the normal roll-over of portfolios had been fluctuating moderately around a quite stable level of about $400 million per quarter, according to ALIA reports. Following the peak of $1,200 million in 1966:2, such sales declined to roughly previous levels, and then again rose sharply to nearly $800 million with the renewed "crunch" of 1968:2.
55. In fact, the volume of security sales was only about half as large during 1974 as it had been in 1973. Unfortunately, the available data do not distinguish between sales to improve

quality or yield on existing portfolios and those executed to finance take-downs of forward commitments.

56. The traditional aversion to borrowing for more than seasonal purposes has been buttressed since 1959 by a federal tax based on total assets as of December 31 which encourages repayment of all possible debt before that date each year.
57. See Lintner, *Explorations*. *op. cit.*
58. The concept of risk-aversion, of course, merely implies that (a) when given a choice between two investments (or investment positions) having the same risk, risk-averse investors will choose the one with the greater *expected* return, and that (b) in choices involving the same expected returns, the alternative with the smaller relevant risk will be preferred.
59. See Lintner, *Explorations*, *op. cit.*, p. 456.
60. For instance, from forced sales of existing securities, or commercial banks borrowing, at yields (or costs) greater than the rate obtained on the forward commitments being drawn down.
61. Alternatively, larger values of r_c will be required to bring forth a given K^* relative to $\bar{F}$, especially as the ratio $K^*/\bar{F}$ becomes large.
62. See Lintner, *Explorations*, *op. cit.*, pp. 463–466 and Appendix A.
63. Lintner, *Explorations*, *op. cit.*, pp. 469–487.
64. When future interest rates are uncertain but F is known in advance, the $\beta\bar{r}$ term does not appear explicitly as a separate term in equation (5), but analysis of the new money rate criterion when F is also uncertain and negatively correlated with $\tilde{r}$ establishes that $\partial h/\partial\beta$ increases with r and that $\partial h/\partial\bar{r}$ increases with β. See *ibid.*
65. In practice, adjustments will be made in outstanding stocks to allow for the (generally small) fraction of outstanding commitments which can be expected to be cancelled before the scheduled take-down time. Such cancellations are allowed for in our econometric work as indicated on p. 625 below.
66. *Life Insurance Companies as Financial Institutions* (a monograph prepared for the Commission on Money and Credit prepared by the Life Insurance Association of America; Prentice Hall, 1965), Chapter 7, pp. 170–190. In this section, we also draw on our own field work as well as "Insurance Companies," Chapter VI in *Institutional Investor Study Report of the Securities and Exchange Commission*, Volume 2, esp. pp. 685–687 and 771–772; and other references as cited.
67. Our own field work confirms the central importance of these "desired target asset distributions" in more recent years. (italics added in quotation from p. 177.)
68. The concept of duration was originally introduced by Frederick R. Macauley in *Some Theoretical Problems Suggested by the Movements of Interest Rates, Bond Yields and Stock Prices in the United States Since 1856* (National Bureau of Economic Research, New York, 1938), and was applied to the asset and liability portfolios of life insurance companies in Paul A. Samuelson, "The Effect of Interest Rate Increases on the Banking System," *American Economic Review*, March 1945, pp. 16–27. Further analysis of the concept is found in John Lintner, "Optimum or Maximum Corporate Growth Under Uncertainty" in *The Corporate Economy*, Robin Marris and Adrian Wood (eds.), Harvard University Press, Cambridge (1971), and Lawrence Fisher and Roman L. Weil, "Coping With the Risk of Interest Rate Fluctuation: Returns to Bondholders From Naive and Optimal Strategies," *Journal of Business*, October 1971, pp. 408–431, esp. 415 ff., as well as Michael H. Hopewell and George G. Kaufman, "Bond Price Volatility and Term to Maturity: A Generalized Respecification," *American Economic Review*, September 1973, pp. 749–753.
69. The companion theoretical paper (Lintner, *Explorations*, *op. cit.*) showed that skewness-considerations compound the effects of negative covariances on the appropriate level of forward commitments relative to expected flows of investible funds *as the company*

moves from its current balance-sheet position toward its desired portfolio balance of assets in the future, but it turns out that such added features of the distribution of returns have only a secondary effect on the optimal target portfolio balance of assets itself.

70. It can be shown that even most growth stocks in a world of uncertainty have a certainty equivalent duration less than the duration of liabilities to policyholders. See David Durand, "Growth Stocks and the Petersburg Paradox," *Journal of Finance*, September 1957, esp. pp. 354–362; and John Lintner, "Optimum or Maximum Corporate Growth Under Uncertainty," in *The Corporate Economy*, Robin Marris and Adrian Woods, eds., (Harvard University Press, Cambridge, 1971), esp. pp. 197–206.

    To allow more formally for the existence of such stocks with $D_i > D^*$, we should write the term $D_p - D^*$ in (8) more precisely as $|D_p - D^*|$ and carefully follow the inequalities on the derivations with respect to each stock separately; but this refinement is not needed at this point.

71. Longer duration carries a premium because the duration of the component assets (and hence the weighted average duration of the portfolio) is *less* than D^*, the weighted average duration of the life insurance liabilities. (See footnote 74.)

72. See John Lintner, "The Aggregation of Investor's Diverse Judgments and Preferences in Purely Competitive Securities Markets," *Journal of Financial and Quantitative Analysis*, December 1969, pp. 347–400; esp. pp. 375–376.

73. Using (11b) we have

$$\frac{\partial V_{yp}/2}{\partial d_i} = d_i \sigma_{ii} + \sum_{j \neq i} x_j \sigma_{ij} = \sigma_{ip}$$

    The derivative is taken with respect to half the portfolio-variance since the risk aversion coefficient λ measures the acceptable rate of substitution between added expected rates of portfolio return and half the added portfolio variance. See Lintner, *op. cit.*, "The Aggregation . . . ."

74. The mean duration of whole life policy and annuity contract liabilities (and also those in pension accounts) run from 20 to 30 years or more. See Durand, *op. cit.* and references in this citation. But the *maximum* duration (regardless of "maturity") of bonds with a 4% coupon will only be 17 years if bought to yield 6% to maturity and will be only about 13 years when bought to yield 8% to maturity. Moreover, higher coupon rates will reduce duration. See Fisher and Weil, *op. cit.*, p. 418. The duration of most private placements and mortgages will be still lower (a) because of their shorter maturities, and (b) because of scheduled amortization and repayments. Since the great bulk of the balance sheet assets of life insurance companies have duration shorter than the mean duration of their liabilities the conclusion in the text follows.

75. Even though insurance companies have more actively "managed" their bond portfolios in recent years, this increased trading has typically involved substitutions of issues thought to offer improved return with no added risk, or improve quality with no loss of return; the underlying concern with matching the duration of assets and liabilities continues.

76. In addition to the usual reasons which make relatively long horizons desirable in the forward planning of other large organizations, it is clear from our earlier discussion of the take-down periods of forward commitments (see pp. 599–600 above) that any planning period shorter than three years would fall within the horizons of decisions *already* made (notably forward commitments on income-property mortgages) and private placements with longer periods to take-down.

77. The forward planning tables made at any one time will of course have considerably different time-profiles for different types of forward commitments. For instance, in the case of either multifamily residential or industrial income property mortgages, both of which involve long periods of negotiation and construction, commitments must be made far in ad-

vance of take-downs. A very large fraction of all such mortgages which can be acquired even within any two or three year period must *already* be covered by outstanding forward commitments, and virtually all the funds allocated for such mortgages during the next six or twelve months will have been already committed. In contrast, the commitment period for some securities and for 1–4 family and farm and ranch mortgages is relatively short; only about one sixth or less of such mortgages which might be wanted over a two or three year period will already be committed, and a substantial fraction of such estimated requirements even over shorter intervals of three or four calendar quarters will have to involve *new* forward commitments yet to be made.

78. Commitments for mortgages on income properties and some industrial private placements involve take-down deferrals of three years or more. The planning horizon of H months or quarters must be at least this long, because any new investments of such types needed to achieve or maintain the desired proportions of future asset portfolios must be committed this far ahead. Although forward commitments for other mortgages and some industrial loans and securities involve shorter take-down intervals, in practice the horizon relevant to determining the pace of new commitments with these relatively shorter take-down periods is substantially longer than their specific take-down periods because of the institutional inflexibilities and costs of rapid changes in the pace of new commitment activity, as described below. The principal exception involves quite short term commitments (two months or less) for corporate securities which are frequently used for residual adjustments to short-run deviations in the flows of investible funds.

79. The department handling securities and shorter-term private placements generally has much more flexibility than the others. In part, this reflects the relatively short commitment period involved in most of these transactions which means that at any point in time the ratio of its outstanding commitments to the authorized totals over any considerable period will be relatively low. To some extent, it also probably reflects the fact that the personnel of securities departments are somewhat less specialized and the relations with investment bankers and other "finders" and negotiating intermediaries are generally more flexible than the relation with the external network providing mortgages.

80. Suppose, for instance, a shift were to occur in the relative availability of different types of loans or a shift in their relative yields between the early planning date and the planning horizon. If companies were "fully committed" against expected flows of exogenous funds, companies would be unable to adjust their commitment budgets to take advantage of the new developments; if one department had fully committed its funds, these could not be "recaptured" to give to another. But with some margins of slack in the overall budgeted authorizations made earlier, the adjustment to these newer opportunities can be made much more easily.

81. However, penalty costs for shortfalls of investible funds below funds required to take down maturing commitments were also explicitly included probablistically in the analysis. See p. 611 and footnote 62.

82. Specifically, in a more explicit notation, r_c represented the known rate at which commitments could be made at time t for take-down at time $t + 1$; now write this as r_{ct}. $\bar{r}$ in the earlier model represented the expectation of $\tilde{r}_{m,t+1}$, and V_r its variance. Assume that the alternative use of the uncommitted part of $\tilde{F}_{t+1}$, instead of immediate long-term investment at $\tilde{r}_{m,t+1}$, is a package of a temporary "warehouse" investment of the funds at a short-term rate of $\tilde{r}_{s,t+1}$ in effect to "escrow" a new commitment made *at* time $t + 1$ at a rate $\tilde{r}_{c,t+1}$ for take-down at a still later date. Now let $\tilde{r}^{*}_{c,t+1}$ represent the "yield to maturity" of the package combining $\tilde{r}_{s,t+1}$ and $\tilde{r}_{c,t+1}$. Since the latter rates are both uncertain as of time t, $\tilde{r}^{*}_{c,t+1}$ is also uncertain with the expected value and variance of $\bar{r}^{*}_{c,t+1}$ and $V_{\tilde{r}^{*}_{c,t+1}}$ respectively as assessed at time t. With this reinterpretation of variables, the derivation given above on pp. 610–612 is otherwise unchanged and need not be repeated.

83. Our field work consisted of in-depth interviews with several senior investment officers and members of the Finance Committees in five large insurance companies which were among the top ten life insurance companies in the United States and accounted for over one-third of the industry's total assets. Less extensive discussions were also held with six additional companies and with ten other individuals closely familiar with the industry. Extensive collections of data on the investment operations of each department in each company were carefully analyzed along with internal investment memoranda before the interviews. This procedure resulted in the development of hypotheses and questions that were specific to the company being studied and increased the productivity of the subsequent interviews by allowing us to examine specific portfolio changes that were made at various times in each company. At least three interviews were held in each company, typically with senior members of the mortgage department and the securities department, the chief economist or treasurer, and the chief investment officer. The decision to have several interviews with differently-situated officers within each company reflected our interest in studying the investment process at several levels in the organization and our concern that any one individual might have an incomplete and imperfect recollection of the acts and events of the prior ten years. It also allowed careful discussion of specific aspects of the investment operation with the individual with specific responsibility and expertise. As noted, less extensive discussions were also held in six additional companies and with ten other individuals (such as investment bankers, mortgage bankers, and trade association economists and executives) intimately familiar with the industry.

84. With respect to each period, however, there was rather clear evidence that the *mix* of forward commitments would be shifted toward investments offering relatively higher returns, and some adjustments would be made to accommodate shifts in the relative demands for different types of funds by borrowers, taking due account of organizational rigidities that limited the speed and extent of changes in new commitments, especially in mortgages departments.

85. If Jones' "fully invested" or "loaned up" objective is interpreted to mean that the volume of outstanding and newly made commitments will be managed to "track" the volumes of expected investible funds in future periods more or less closely, then our field evidence on the five companies studied in most depth—as well as our evidence on the larger number individually studied in less depth—are fully consistent with this type of expectationally loaned-up policy up to the mid-1960's. See Jones, *op. cit.*

86. New commitment votings were also reduced because of the anticipated impact of expected rising rates on their *expected* future flows of investible funds, as discussed below.

87. In several companies, these tighter limits also reflected an increased concern over their commitment position relative to that of their competitors, especially among companies whose forward commitment ratios deviated significantly from the industry average during the later 1960's and were wrong in their forecasts. This reflects a growing awareness of the importance to each company heavily involved in group insurance of its *relative* performance among competing institutions as measured by their relative "new money rates."

88. In more detail, one company had a policy limit of 10% on such adjustments in its new commitments ratio for expected changes in interest rates; another, 5%; another said they had to be "no more than moderate"; another would adjust new securities commitments by 5–10%, and would adjust new mortgage commitments by 10–15% if it felt rates were going to increase but would make no adjustment in mortgage ratios if it felt rates were going to fall; and the final company would adjust commitments other than mortgages as much as 15% if it expected interest rates to move as much as 50 basis points.

89. This substitution is appropriate both for the original theoretical model and the alternative since the two models differ only in the identification of which opportunity cost rate is relevant to the commitment decision.

90. From equation (13) above, it is clear that terms for the relative duration of each type of commitment do in principle belong in each of a set of "portfolio balance" equations undertaking to determine simultaneously the absolute or relative volume of different types of new commitments being made. Given that the weighted average duration of whole life liabilities exceeds the duration of long maturity publicly issued corporate bonds, as well as that of each of the major types of obligations obtained via forward commitments, there will be a positive premium on relative duration in each portfolio equation. However, in our present context the role of duration *per se* is merely implicit: it justifies (see p. 616 above) our use of yields-to-maturity (rather than monthly or quarterly holding period yields) in our equations, and it explains the preponderant position of the assets which life insurance companies obtain through the forward commitment process in their overall portfolios of all assets.

91. We used ALIA's series for fourth grade (equivalent to Moody's Baa) security commitment yields because security commitments are concentrated in this quality-rating. The nonresidential mortgage commitment yield series was obtained from the Capital Markets section of the Federal Reserve Board and is based upon a study by Royal Shipp prior to mid-1965 and on ALIA surveys thereafter. 1970. (See Royal Shipp, "The Structure of the Mortgage Market for Income Property Mortgage Loans," in Jack M. Guttentag and Phillip Cagan, eds., *Essays on Interest Rates*, Vol. 1, National Bureau of Economic Research, Columbia University Press, New York, 1969, pp. 77–106.) All disaggregated volume data are also from the ALIA.

92. Yair Mundlak, "Aggregation over Time in Distributed Lag Models," *International Economic Review*, Vol. 2, No. 2, May 1961, pp. 154–163.

93. Personal income is introduced to capture the income effect on the supply of savings through policy reserves and *insured* pension fund reserves (excluding "special accounts" for uninsured plans). The level of the interest rate and its change are introduced to capture disintermediation through policy loans as well as reduced prepayments of mortgages and securities (i.e., (B2) and (B3) on p. 604).

94. One might at first think of deriving independent estimates of r_t^e and of V_t^e. In the context of testing statistical hypotheses where the underlying assumptions for least squares estimation are satisfied, such independence of means and variances is assured by these maintained assumptions. But the present situation is fundamentally different, since V_t^e is an ex ante estimate of the error variance arising in past experience from the maintained use of any algorithm generating past as well as current expectations r_{t-i}^e; given any set of past numbers, any shift in the calculation of the ex ante mean r_t^e will necessarily change the computed value of the ex ante variance, as shown by the formula in the text. The theoretical requirement is thus to derive procedures for the optimal *simultaneous* estimation of a variance and the mean/variance ratio, with (a) the implicit variance estimate in the denominator the same as the separate (though simultaneous) estimate, *and* (b) the implicit estimate of the mean in the numerator consistent with the calculation of both variance estimates.

Actually, in theoretical terms, the situation is still more complicated. We may observe that (21) and (22) are essentially supply curves; if these are considered implicitly to be embedded in a simultaneous pair of commitment supply and demand equations whose solution value for the commitment rate is r_{ct}, then r_{ct} and $\tilde{\omega}_t$ (or $\tilde{V}_t$) are not independently distributed as required for consistent estimates using OLS. In principle, r_t^e/V_t^e should be estimated by an instrumental variable procedure using r_t^e/V_t^e, together with all other right hand side variables in (21) [or (22)], and some set of variables to reflect movements in the other side of the market (such as expenditures on nonresidential structures, residential outlays, g.n.p., the federal deficit, the cumulative algebraic excess of non-financial corporations, net cash flows less investment outlays, and some other interest rate series to represent opportunity costs to borrowers) as instruments. But the first stage of this 2SLS procedure requires the estimates of r_t^e and V_t^e discussed above, and can scarcely be expected to sort out which of alternative estimates of the latter are most appropriate. Correspondingly, any measurement errors in the latter variables will contaminate the first stage estimates (because r_{ct}/V_t^e is a right-hand variable, apart from the fact that any measurement error in V_t^e enters non-linearly). This first-stage contamination in principle destroys the consistency of the second-stage parameter estimates (which is the object of the game), as well as further reducing their efficiency.

Also, we observe that the r_{ct} values form a much smoother series than any other interest rates used, which implies that the offending covariance between r_{ct} and $\tilde{u}_t$ is probably not large in the first place. In view of these considerations, we proceeded with OLS estimates, using estimates of r_t^e and V_t^e as described in the text.

95. The weights (before normalizing by their sum 1.33) were:

$w_1 = .04$	$w_4 = .07$	$w_7 = .10$	$w_{10} = .15$	$w_{13} = .08$
$w_2 = .05$	$w_5 = .08$	$w_8 = .11$	$w_{11} = .18$	$w_{14} = .04$
$w_3 = .06$	$w_6 = .09$	$w_9 = .12$	$w_{12} = .14$	$w_{15} = .02$

These weights are smoothed monthly interpolations of the quarterly lag structure for expectations of the future long bond rate, estimated by Friedman and Roley in equations explaining corporate bond investments by the life insurance industry. See Benjamin F. Friedman and V. Vance Roley, "Investors' Portfolio Behavior Under Alternative Models of Long-term Interest Rate Expectations: Unitary, Rational or Autoregressive," [Harvard University, mimeo, (1977)].

96. In all cases, we report "one-tail" levels of significance since prior theory has established the sign of each variable.

97. For comparisons, the mean of this series was 8.02.

98. If we use the lagged average $\bar{C}_t/F_t$ term the reported coefficients are raised to about 0.10, which would imply a still larger long-term adjustment to changes in expected interest rates.

99. Direct regressions of funds on interest rates indicate that after allowing for quadratic time trends, a change of one-percent in the level of interest rates induced an average change of $210 million in the monthly flow of investible funds, which is about 16% of the mean flow over the period. This fraction, however, would be expected to be somewhat higher than the adjusted long-term coefficient of 0.10 shown from equations (21) and (22) in the text because the latter is a *net* effect after allowing for the impact of the other terms in that equation.

100. Cash outlays for the take-down of outstanding commitments for certain corporate private placements and securities with a relatively short lead-time of course respond more promptly to changes in interest rates during both tight and easy money periods.

101. In a later independent study, using data on security acquisitions rather than forward commitment activity, Professor Friedman has reached similar conclusions regarding the Fisher effect premium. See Benjamin M. Friedman, "Price Inflation, Portfolio Choice and Nominal Interest Rates," Harvard [illegible]tute for Economic Research Discussion Paper #603, Feb. 1978.