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A STUDY OF RATE OF RETURN ON MORTGAGE PASS THROUGH SECURITIES

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CENTER FOR REAL ESTATE AND URBAN ECONOMICS
UNIVERSITY OF CALIFORNIA, BERKELEY

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A STUDY OF RATE OF RETURN ON MORTGAGE PASS THROUGH SECURITIES*

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Working Paper 81-25

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*This paper is a revised version of an independent study for B.A. 293 presented to Professor James Hoag, Graduate School of Business, University of California, Berkeley.

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SECTION 1

ISSUER'S RATE OF RETURN

INTRODUCTION

This section examines the profit to the issuer of mortgage backed securities, more specifically the mortgage backed pass through. By comparing various paydown factors, it can be shown that there are significant differences in the returns to the issuer.

The most difficult aspect of the mortgage related security, particularly the pass through is the pricing. The capital market is very familiar with fixed rate, fixed term securities in which the promised cash flows are known for certain. The introduction of the pass through has created an entirely new problem. The ultimate yield to the investor is based upon the cash flows accruing during the holding period. The ex-ante quoted yields are based upon a 12-year prepayment assumption which, as discussed below, is not related to the underlying securities.

The problems associated with selling these securities relates to the ex-ante assumptions about the cash flows. Without evaluating the underlying mortgages and establishing the pool's prepayment characteristics, the security may be over or under priced.

A firm that issues mortgage loans has two basis alternatives i) to hold the loans in its existing portfolio or ii) package the loans in some manner and sell them in the secondary market. Packaging loans is deemed desirable due to the increased profit from turning the portfolio over.

There are many variations of the mortgage backed security. A firm can choose one of several alternatives depending upon its cash requirements, its servicing capabilities and expertise or its ability to properly market the issue. Mortgage related securities can be short term, such as mortgage backed commercial paper or longer in duration such as the pass through. In addition to the varying terms, the cash flows can be tailored to the investor's needs or desires. The more traditional approach, or at least the more understood, is the mortgage backed bond (MBB). The MBB has known cash flows typical of any corporate bond where interest is paid quarterly or semi-annually rather than related in any way to the underlying security. Whereas the cash flows accruing to an investor of a pass through are directly related to the mortgages included in the pool.

In addition to selling mortgaged backed securities, a lender may sell the loans outright to an institutional investor, thus shifting the interest rate and default risk to the buyer. Another alternative to reduce the lenders overall exposure is to sell a portion (or participation) of the loans while retaining the servicing for a fee.

PRICING PROBLEM

Once the decision to package the loans has been made, the problem of how to price them is created. It is well known in the industry that no matter how nicely you package the loans, you eventually come down to the problem of how to price them. The price should be related to the characteristics of the underlying security. However, the difficulty arises due to the fact that the characteristics of a mortgage loan make the problem of (exante) projecting cash flows, with any degree of accuracy, a formidable task.

Although the individual mortgages are perceived to be a relatively secure investment, a mortgage backed security will be priced above a comparable bond due to the uncertainty of the cash flows. The investor must bear some of the interest rate risk associated with early prepayments. This uncertainty becomes an important consideration when market conditions cause returns on investment opportunities, during the life of the security, to fluxuate in either direction, thus reducing the forecasting capabilities of portfolio managers, especially those with specific cash flow requirements

ESTIMATING PREPAYMENTS

Important elements of information required for an investor of mortgage backed securities are the timing, amount and probability of the cash flows received during the holding period. However, this information is just as critical to the issuer of mortgage backed securities. The flows to the issuer include scheduled principal and interest payments as well as prepayments of principal. If the probability of default is assumed away (the assumption incorporated into the following study), the scheduled principal and interest payments are easy to determine. The problem is to determine the cash flow resulting from unscheduled principal payments to estimate the issuers return.

As mortgage back securities continue to increase in number and acceptability, more attention will need to be given to the problem of prepayments of principal. As investors become more knowledgeable about the characteristics of the mortgage instrument, the pricing models will need to become more sophisticated, which will require some estimation of prepayments.

THE TWELVE YEAR PREPAYMENT ASSUMPTION

As discussed briefly in the introduction, the traditional pricing assumption (primarily for convenience and consistency within the market place) is to assume that during the first 12 years of the mortgage life, the investor receives scheduled principal and interest payments only. During the twelfth year, all the outstanding principal is prepaid at par. As is clear from the graph on Exhibit 1-1, this assumption has no relation to the underlying mortgages. This pricing convention has evolved from studies of FHA mortgages that indicate that the average life is approximately 12 years.

While the 12-year prepayment assumption is convenient, previous experience with the prepayment rate on mortgage backed securities (specifically pass-throughs) would indicate that the average life of the mortgages is much less than 12 years. If this is in fact the case, then the securities maybe under-priced by the issuer and investors are receiving excess returns for the given level of risk compared to other securities.

MORTGAGE CHARACTERISTICS

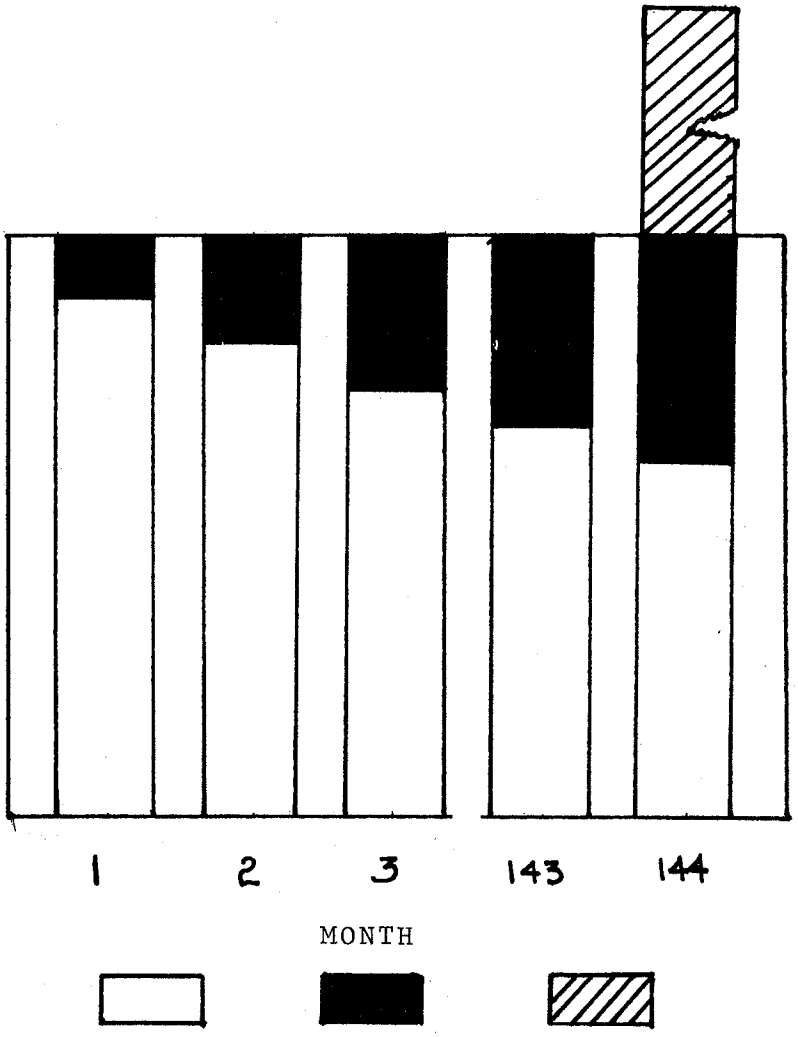
If the key ingredient to the pricing of the security is estimating the cash flow, than a description of the fundamental characteristics of the mortgages and the various reasons a borrower would choose to pay off his loan prior to maturity is important to understand.

There are several variations on the standard mortgage contract. A detailed description of the various types is listed on Exhibit 1-1 c. As of this writing, only conventional, and a limited number of variable rate mortgages have been packaged by private lenders. FHA and VA loans have been packaged for the GNMA securities since 1970.

Payment Characteristics

One of the key characteristics of the mortgage instrument is its fully amortizing feature. Exhibit 1-2 compares the cash flows of a mortgage to a traditional bond. As is

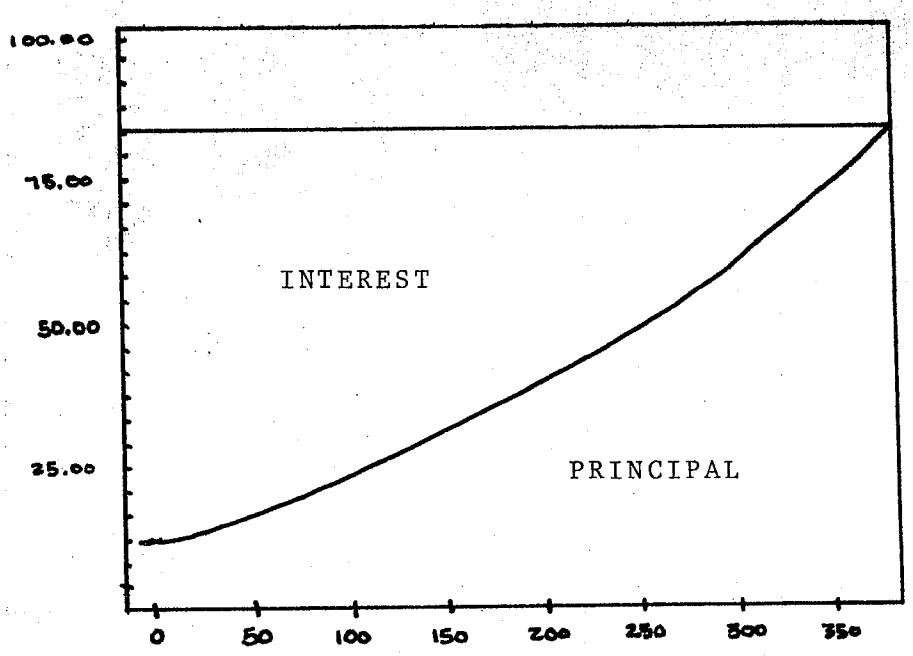
EXHIBIT 1-1 a



MORTGAGE CASH FLOW WITH

LUMP SUM PREPAYMENT

EXHIBIT 1-1 b



DOLLARS

MONTH

MORTGAGE CASH FLOW

$10,000 9.00% 30 Yr. Mortgage

EXHIBIT 1-1 c

TYPES OF MORTGAGES

1. Traditional Fixed Rate Mortgage

   - Fully amortizing
   - Fixed interest rate
   - Level payments

2. Graduated Payment Mortgage (GPM)

   - Fixed rate
   - Monthly payments are increased annually for the first five or ten years and then remain constant
   - Negative amortization during the early years

3. Rollover Mortgage

   - Fixed interest rate for a period of three to five years
   - At the end of the term the interest rate is changed in accordance with the movements of some referenced index
   - Some loans have limitation on the maximum interest rate increases

4. Variable Rate Mortgage (VRM)

   - Interest rate changes periodically (usually every six months)in accordance with the maximum interest rate changes are set by the Federal Home Loan Bank
   - In some VRM contracts, the borrower can extend the term of the loan when interest rates rise instead of increasing the payment

5. Indexed Principal Mortgage

   - Uses a real, non-inflationary interest rate, and revalues the outstanding principal periodically according to changes in the index to which it is tied

evident from the Exhibit, the promised cash flows from a bond are constant and are known ex-ante, whereas the cash flows from a mortgage, while constant on a dollar basis, are not known and are allocated between principal and interest differently each month. During the early years, the payment consist of almost entirely interest, with small amounts going towards principal reduction. However, this trend reverses itself at some point during the life of the loan.

If every loan made scheduled principal and interest payments until maturity, determining cash flows would not be difficult. However, because a loan includes a put option (i.e., the borrower has the right to "sell" the loan at any time, at a given price to the lender) the price of the mortgage, which reflects its cash flow assumptions becomes more difficult.

In trying to determine the ex-ante cash flows, the options available to the individual mortgagor need to be analyzed. The most important of these options are i) to move, ii) to refinance or to iii) default.

The Decision to Move

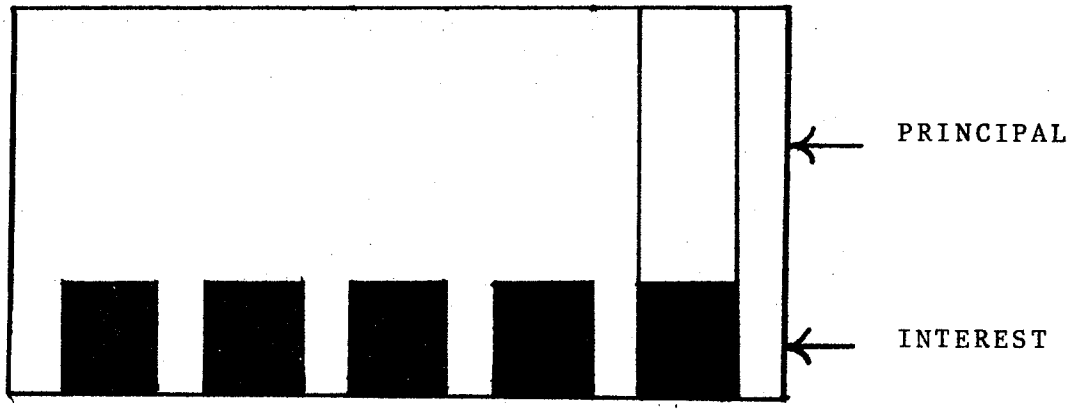
Homes are generally sold when they no longer meet the owner's needs either as a dwelling unit or an investment opportunity. For owner occupants, the reasons are both sociological and economic. Utility functions and budget constraints change over time, and thus a home that at one time was suitable, may no longer fit. Non-occupant owners are more likely to be influenced by economic developments and in general base their decision on whether or not to sell a house on the relative attractiveness by alternative investments.

Although current laws, resulting from the Wellenkamp vs. B of A, do not allow the lender to exercise a due on sale clause, for practical purposes, during these times of rising inflation, assumptions are generally not feasible due to the large equity build-ups. This means that if a borrower decides to move, he will prepay his mortgage at par (perhaps with a penalty) regardless of the prevailing interest rates.

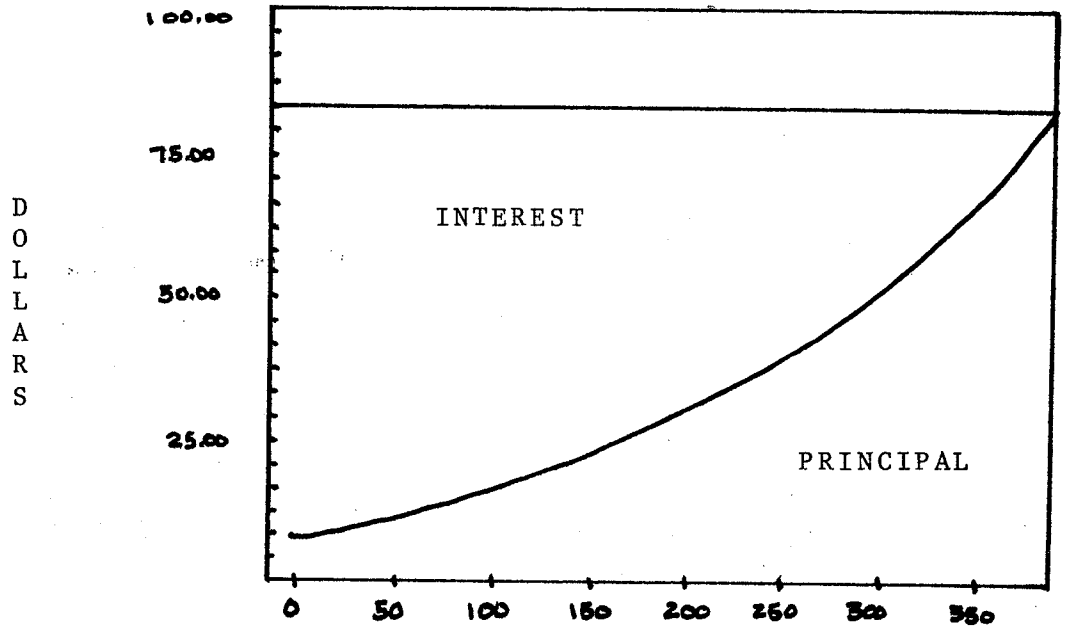
Decision to Default or Refinance

Generally, this can be thought of as a purely economic decision. As pointed out by Assay, the decision to refinance or default can be treated similar to the decision to exercise an (American) put or call option, that is, exercise will only occur when the market value of the mortgage (on the secondary market, for example) just exceeds the cost of retiring it and acquiring another, i.e., principal and prepayment penalties on the existing and origination fees on the new.

EXHIBIT 1-2



BOND CASH FLOW



MORTGAGE CASH FLOW

The decision to default will only occur when i) the value of the mortgaged property has fallen below the principal of the mortgage , and ii) the value of the possible property increases in the future is less than the present value of the required coupon payment.

It is clear that the problem of estimating future cash flows from the security becomes progressively more difficult as the various alternatives the individual borrowers have are incorporated into the analysis. However, in order to properly price the issue, some attempt at estimating the cash flows needs to be done.

The final sections of this paper will briefly discuss the studies that have been done to estimate the mortality rate of mortgages and then show how alternative cash flow assumptions can affect the ultimate return to the issuer.

PREVIOUS STUDIES

There have been a few studies done that have concentrated on prepayment rates for both FHA/VA and conventional mortgages. This paper utilized the studies done by Maurice E. Kinkade and Helen Frame Peters. A brief summary of each of these studies will follow.

Maurice E. Kinkade, completed an analysis of conventional mortgage prepayment rates. His study surveyed savings and loan associations and collected mortgage prepayment data in an effort to determine what conventional mortgage prepayment rates had been and to explain the variance in the rates.

He identified two basic reasons a mortgage will prepay i) the decision to move and ii) the decision to refinance to take advantage of lower interest rates. The study developed a model using variables which he believed to influence the decision to prepay. These variables were i) the age of the mortgage, ii) the difference between the interest rate on the outstanding mortgage and the rate on new mortgages, iii) housing turnover as measured by new housing starts and iv) the availability of mortgage credit as measured by net savings inflow by FHLB district.

In addition to estimating prepayment rates, Kinkade tested the hypothesis that any variance in prepayment rates is not firm or association dependent. The results of his analysis indicated that the hypothesis should be rejected. There does appear to be a difference in prepayment rates due to the firm effect that wasn't included in his theory. This could be due to varying credit policies, location of the home, loan to value ratio, etc. However, if there actually is a difference among firms with respect to prepayment rates, he concluded that aggregate data, such as using the 12 year prepayment assumption should not be used.

Helen Frame Peters, in an unpublished dissertation, analyzed the termination distributions of FHA insured residential mortgages. Her study updated the current methodology for calculating the price/yield relationship on a discounted mortgage portfolio.

Her analysis started with an in-depth look at the sources of variation in past termination rates, using an aggregate history of all FHA residential mortgage insured between 1957 and 1972. She separated defaults and prepayments, and developed models to test for variations according

to the year of origin, the year of termination, the maturity the state of origin, the housing type, the FHA program and the age of the mortgage.

Ordinary Least Squares Models were chosen which explained a large percentage of the variance found in the models. Once prepayment rates had been forecasted (those used in this study) yield calculations based on IRR were compared to those generated by the rule of thumb. Her study, looking only at prepayments, indicated that when market conditions are expected to remain stable, her new model is about 10-15 basis points more precise in nominal terms than the 12-year rule of thumb in pricing new issues and between 2-6 basis points more precise than the yield book at true average life. When market conditions are expected to change, the error in using a yield book for pricing new issues versus a reinvestment rate model will be much more costly.

ESTIMATING THE ISSUER'S PROFIT

The analysis utilizes the results of the Peters study described above. Although the principal pay-down factors were estimated for FHA mortgages for various discount points, it will be assumed for this analysis that conventional mortgages would follow a similar pattern as FHA loans with low discount points (in this study two discount points). The calculations and results presented were based upon a hypothetical pool of mortgage loans and an assumed coupon to the investor. The results, discussed in more detail below, while not considering all of the factors included in the issuer's return, do show the variability of return based upon various prepayment assumptions.

In order to compare various return possibilities to the issuer, five prepayment assumptions were analyzed. The first is the standard 12 year prepayment assumption that most quoted returns are based upon. The second, which is an extreme assumption (the limit of the pooling process) is to assume that there are no prepayments, thus reducing monthly cash flows to scheduled principal and interest only. The final three prepayment assumptions are based upon the pay-down factors calculated by Ms. Peters for rising, stable and falling market interest rates. Exhibits 1-3, 4 and 5 show the Peters pay-down factors used.

As previously mentioned, this study eliminated the possibility of defaults. Few studies have been done to estimate default distributions and individual firms have different experience with defaults. In addition to the default assumption, there was no adjustment for the timing of the cash flows to incorporate the use of the float, however, float does play a significant part in the overall return to the user. Exhibit 1-6 is an example of the increased return from the use of the proceeds via float.

The following chart summarizes the results of the calculations. Exhibit 1-7 details the data used for the study. The assumptions for all the calculations were the same:

Mortgage Interest	9%
Coupon Rate	8.5%
Mortgage Term	30 years
Pool Size	$100,000,000

EXHIBIT 1-3

PREPAYMENT RATES FOR 30-YEAR MORTGAGES
USING ENDORSEMENT YEAR EXPLANATORY MODEL
ASSUMING RISING MARKET YIELDS

YEAR AFTER INSURANCE	CURRENT MARKET DISCOUNT POINTS					
	2	4	6	8	10	12
1	.0349	.0278	.0208	.0137	.0066	.0000
2	.0395	.0329	.0262	.0194	.0125	.0056
3	.0503	.0444	.0383	.0320	.0256	.0189
4	.0532	.0480	.0426	.0370	.0310	.0248
5	.0600	.0558	.0513	.0464	.0412	.0357
6	.0620	.0587	.0551	.0512	.0468	.0420
7	.0619	.0596	.0569	.0538	.0503	.0463
8	.0613	.0599	.0581	.0559	.0533	.0502
9	.0568	.0560	.0549	.0534	.0514	.0490
10	.0524	.0522	.0516	.0507	.0494	.0476
11	.0482	.0484	.0483	.0480	.0472	.0460
12	.0441	.0447	.0451	.0452	.0449	.0442
13	.0402	.0412	.0419	.0424	.0426	.0423
14	.0366	.0378	.0388	.0396	.0402	.0404
15	.0332	.0346	.0358	.0369	.0378	.0384
16	.0300	.0315	.0330	.0343	.0355	.0363
17	.0270	.0287	.0303	.0318	.0331	.0343
18	.0243	.0260	.0277	.0293	.0309	.0322
19	.0217	.0235	.0253	.0270	.0287	.0302
20	.0194	.0212	.0230	.0248	.0266	.0283
21	.0173	.0191	.0209	.0227	.0246	.0264
22	.0154	.0171	.0189	.0208	.0227	.0246
23	.0137	.0153	.0171	.0189	.0208	.0228
24	.0121	.0137	.0154	.0172	.0191	.0211
25	.0107	.0122	.0139	.0156	.0175	.0195
26	.0095	.0109	.0124	.0142	.0160	.0180
27	.0083	.0097	.0112	.0128	.0146	.0165
28	.0073	.0086	.0100	.0115	.0133	.0152
29	.0064	.0076	.0089	.0104	.0121	.0139
30	.0421	.0529	.0663	.0830	.1037	.1293

FACTORS USED
IN STUDY

EXHIBIT 1-4

PREPAYMENT RATES FOR 30-YEAR MORTGAGES
USING ENDORSEMENT YEAR EXPLANATORY MODEL
ASSUMING STABLE MARKET YIELDS

YEAR AFTER INSURANCE	CURRENT MARKET DISCOUNT POINTS					
	2	4	6	8	10	12
1	.0361	.0291	.0220	.0149	.0078	.0008
2	.0447	.0382	.0315	.0248	.0180	.0110
3	.0550	.0492	.0432	.0371	.0307	.0242
4	.0624	.0576	.0525	.0471	.0415	.0356
5	.0667	.0629	.0587	.0543	.0495	.0444
6	.0673	.0645	.0613	.0578	.0539	.0497
7	.0659	.0640	.0618	.0592	.0562	.0528
8	.0640	.0630	.0617	.0600	.0580	.0555
9	.0585	.0581	.0575	.0564	.0551	.0533
10	.0532	.0534	.0533	.0529	.0521	.0509
11	.0483	.0489	.0492	.0493	.0490	.0484
12	.0436	.0445	.0453	.0458	.0460	.0459
13	.0392	.0405	.0415	.0424	.0430	.0433
14	.0352	.0366	.0379	.0391	.0400	.0407
15	.0315	.0331	.0346	.0359	.0371	.0381
16	.0281	.0298	.0314	.0329	.0343	.0356
17	.0250	.0267	.0284	.0301	.0317	.0331
18	.0222	.0239	.0257	.0274	.0291	.0307
19	.0196	.0213	.0231	.0249	.0267	.0284
20	.0173	.0190	.0208	.0226	.0244	.0262
21	.0153	.0169	.0186	.0204	.0223	.0242
22	.0134	.0150	.0166	.0184	.0203	.0222
23	.0118	.0132	.0149	.0166	.0184	.0203
24	.0103	.0117	.0132	.0149	.0167	.0186
25	.0090	.0103	.0117	.0133	.0151	.0169
26	.0078	.0090	.0104	.0119	.0136	.0154
27	.0068	.0079	.0092	.0107	.0123	.0140
28	.0059	.0069	.0081	.0095	.0110	.0127
29	.0051	.0061	.0072	.0084	.0099	.0115
30	.0307	.0386	.0486	.0610	.0763	.0955

FACTORS USED
IN STUDY

EXHIBIT 1-5

PREPAYMENT RATES FOR 30-YEAR MORTGAGES
USING ENDORSEMENT YEAR EXPLANATORY MODEL
ASSUMING FALLING MARKET YIELDS

YEAR AFTER INSURANCE	CURRENT MARKET DISCOUNT POINTS					
	2	4	6	8	10	12
1	.0374	.0303	.0232	.0161	.0091	.0020
2	.0538	.0474	.0408	.0341	.0274	.0205
3	.0630	.0574	.0517	.0457	.0396	.0332
4	.0894	.0853	.0809	.0763	.0715	.0664
5	.0873	.0844	.0813	.0779	.0742	.0702
6	.0828	.0811	.0792	.0769	.0743	.0714
7	.0767	.0760	.0750	.0738	.0722	.0703
8	.0706	.0708	.0707	.0703	.0697	.0687
9	.0619	.0626	.0630	.0633	.0633	.0631
10	.0540	.0551	.0560	.0568	.0573	.0576
11	.0470	.0484	.0496	.0508	.0517	.0525
12	.0407	.0423	.0438	.0452	.0465	.0476
13	.0352	.0369	.0386	.0401	.0416	.0430
14	.0303	.0321	.0338	.0355	.0372	.0388
15	.0261	.0278	.0296	.0313	.0331	.0348
16	.0223	.0240	.0258	.0276	.0294	.0312
17	.0191	.0207	.0224	.0242	.0260	.0278
18	.0163	.0178	.0195	.0212	.0230	.0248
19	.0138	.0153	.0168	.0185	.0202	.0220
20	.0117	.0131	.0145	.0161	.0178	.0195
21	.0099	.0112	.0125	.0140	.0156	.0173
22	.0084	.0095	.0107	.0121	.0136	.0152
23	.0070	.0081	.0092	.0105	.0119	.0134
24	.0059	.0068	.0079	.0090	.0103	.0118
25	.0050	.0058	.0067	.0078	.0090	.0103
26	.0042	.0049	.0057	.0067	.0078	.0090
27	.0035	.0041	.0049	.0057	.0067	.0079
28	.0029	.0035	.0041	.0049	.0058	.0069
29	.0024	.0029	.0035	.0042	.0050	.0060
30	.0114	.0144	.0183	.0231	.0292	.0368

FACTORS USED
IN STUDY

EXHIBIT 1-6

DETERMINATION OF VALUE OF FLOAT *

The value, in basis points, of the lag between receipt of mortgage payments and disbursement to investors is a two-part calculation. The first determines the benefit of the delay in payment to investors of regular principal and interest; the second determines the benefit of the delay in payment to investors of non-scheduled prepayments. Calculations are as follows:

Part 1/ Assumptions

Mortgage Payment Date - First of month, with payments received by the issuer, on average, the fifth of the month.

Pass-Through Date - Twenty-fifth of month with checks clearing by 30th day of month, on average, creating net float of twenty-five days float per month.

Reinvestment Rate - Current mortgage origination rate

Total Float - Approximately 1% of the outstanding principal balance is received every month in regularly scheduled principal and interest, according to standard mortgage tables for a 30 year mortgage

Then, float is

$$\text{Float} = \frac{25 \text{ days} \times 12 \text{ months}}{360} \times \text{Reinvestment Rate} \times \text{Total float (1\% of the pool)}$$

Example - Basis point benefit $= \frac{25 \times 12}{360} \times 11.5\% \times 1\% = 9.6$ basis points
(Reinv.) (Float)

Part 2/ Assumptions

Prepayment Date - Prepayments arrive in random fashion, or, on average, the fifteenth of the month.

Pass-Through Date - Twenty-fifth of the next succeeding month with checks clearing by the 30th days of month, on average, creating net float of 45 days.

Reinvestment Rate - Current mortgage origination rate

Total Float - According to current payment statistics, approximately 1% of the mortgages payoff every month, for total float approximately equal to the total float in Part 1.

* Saloman Brothers

Then, float is

$$\text{Float} = \frac{45 \text{ days} \times 12 \text{ months}}{360} \times \text{Reinvestment Rate} \times \text{Total float} \quad (1\%)$$

$$\text{Example - Basis point benefit} = \underset{\text{(Reinv.)}}{\frac{45 \times 12}{360}} \times 11.5\% \times \underset{\text{(Float)}}{1\%} = 17.3 \text{ basis points}$$

The sum of the basis points in each calculation gives the total float benefit for the pass-through pool.

EXHIBIT 1-7 a

12-Year Prepayment Assumption

	Cash Inflow			Cash Flow			
Year	Principal	Interest	Unscheduled Principal	Principal	Interest	Unscheduled Principal	Net to Issuer
1.	683,197	8,972,274	-0-	683,197	8,473,615	-0-	498,660
2.	747,286	8,908,186	-0-	747,286	8,413,287	-0-	494,899
3.	817,386	8,838,085	-0-	817,386	8,347,080	-0-	491,005
4.	894,063	8,761,409	-0-	894,063	8,275,939	-0-	485,470
5.	977,932	8,677,539	-0-	977,932	8,195,454	-0-	482,086
6.	1,069,669	8,585,803	-0-	1,069,669	8,108,814	-0-	476,989
7.	1,170,011	8,485,460	-0-	1,170,011	8,014,046	-0-	471,414
8.	1,279,766	8,375,705	-0-	1,279,766	7,910,388	-0-	465,317
9.	1,399,817	8,255,654	-0-	1,399,817	7,797,007	-0-	458,647
10.	1,531,130	8,124,342	-0-	1,531,130	7,672,990	-0-	451,352
11.	1,674,760	7,980,711	-0-	1,674,760	7,537,338	-0-	443,373
12.	1,831,864	7,823,607	85,923,119	1,831,864	7,388,962	85,923,119	434,645

EXHIBIT 1-7 b

RISING MARKET YIELD

	Cash Inflow		Cash Outflow		Net
	Principal	Int. (9.0%)*	Principal	Int. (8.5%)	to Issuer
1.	683,197	8,972,274	683,197	8,473,615	498,660
2.	726,167	8,656,431	726,167	8,172,488	483,943
3.	767,552	8,299,251	767,552	7,834,979	464,272
4.	800,569	7,854,211	800,569	7,406,026	448,185
5.	830,037	7,365,215	830,037	6,952,573	412,642
6.	850,223	6,824,396	850,223	6,441,716	382,680
7.	863,960	6,265,839	863,960	5,914,132	351,707
8.	872,216	5,708,404	872,216	5,387,631	320,773
9.	874,349	5,156,617	874,349	4,866,490	290,127
10.	875,476	4,645,371	875,476	4,383,642	261,729
11.	875,867	4,173,755	875,867	3,938,226	235,530
12.	875,696	3,739,962	875,696	3,528,533	211,429
13.	875,423	3,343,073	875,423	3,153,695	189,379
14.	875,419	2,981,273	875,419	2,811,995	169,279
15.	875,862	2,651,856	875,862	2,500,876	150,980
16.	877,236	2,353,000	877,236	2,218,617	135,382
17.	880,157	2,082,881	880,157	1,963,493	119,388
18.	885,405	1,839,668	885,405	1,733,770	105,898
19.	893,498	1,620,640	893,498	1,526,876	93,764
20.	906,093	1,424,829	906,093	1,341,891	82,938
21.	924,265	1,249,491	924,265	1,176,219	73,272
22.	950,068	1,092,744	950,068	1,028,072	64,642
23.	986,433	952,668	986,433	895,627	57,042
24.	1,037,761	827,285	1,037,761	776,995	50,290
25.	1,112,435	715,355	1,112,435	670,972	44,383
26.	1,223,826	614,534	1,223,826	575,287	39,247
27.	1,398,171	521,959	1,398,171	487,128	34,831
28.	1,702,014	434,928	1,702,014	403,664	34,264
29.	2,325,907	343,909	2,325,907	315,099	28,810
30.	4,230,000	209,037	4,230,000	190,224	18,813

* Based upon principal paydown detailed on Exhibit 1-3.

EXHIBIT 1-7 c

STABLE MARKET RATES

	Cash Inflow		Cash Outflow		
Year	Principal	Int.* - 9.0%	Principal	Int. - 8.5%	Net to Issuer
1.	683,197	8,972,274	683,197	8,473,615	498,660
2.	717,739	8,555,973	717,739	8,077,646	478,326
3.	753,953	8,152,203	753,953	7,696,157	456,046
4.	781,270	7,656,094	781,270	7,227,496	428,598
5.	799,445	7,093,757	799,445	6,696,324	397,433
6.	808,944	6,493,071	808,944	6,128,970	364,101
7.	811,760	5,887,257	811,760	5,556,800	330,457
8.	808,938	5,294,271	808,938	4,996,770	297,501
9.	800,084	4,718,631	800,084	4,453,146	265,484
10.	790,133	4,192,535	790,133	3,956,319	236,215
11.	779,422	3,714,169	779,422	3,504,575	209,595
12.	767,982	3,279,934	767,982	3,094,511	185,423
13.	756,259	2,888,009	756,259	2,724,409	163,600
14.	744,576	2,535,683	744,576	2,391,706	143,978
15.	733,013	2,219,353	733,013	2,092,997	126,356
16.	721,886	1,936,304	721,886	1,825,720	110,584
17.	711,529	1,683,825	711,529	1,587,310	96,515
18.	702,291	1,459,199	702,291	1,375,203	83,997
19.	694,511	1,259,715	694,511	1,186,833	72,882
20.	689,055	1,083,537	689,055	1,020,465	63,071
21.	686,412	927,944	686,412	873,527	54,416
22.	687,042	790,218	687,042	743,451	46,768
23.	693,096	669,373	693,096	629,293	40,079
24.	705,806	562,657	705,806	528,453	34,204
25.	729,336	469,002	729,336	439,903	29,099
26.	769,451	386,374	769,451	361,698	24,676
27.	839,337	313,338	839,337	292,428	20,910
28.	966,501	246,977	966,501	229,224	17,753
29.	1,236,981	182,900	1,236,981	167,578	15,322
30.	2,080,000	102,789	2,080,000	88,400	14,389

* Based upon principal pay-down detailed on Exhibit 1-4.

EXHIBIT 1-7 d

FALLING MARKET RATES

	Cash Inflow		Cash Outflow		
Year	Principal	Int.* - 9.0%	Principal	Int.* - 8.5%	Net to Issuer
1.	683,197	8,972,274	683,197	8,473,615	498,660
2.	724,286	8,634,007	724,286	8,151,318	482,689
3.	753,621	8,148,616	753,621	7,692,771	455,845
4.	773,587	7,580,806	773,587	7,156,423	424,384
5.	763,703	6,776,607	763,703	6,396,943	389,665
6.	746,469	5,991,607	746,469	5,655,625	335,982
7.	723,525	5,247,338	723,525	4,952,800	294,538
8.	696,461	4,558,136	696,461	4,302,000	256,136
9.	665,348	3,923,999	665,348	3,703,223	220,776
10.	634,766	3,368,140	634,766	3,178,372	189,767
11.	605,073	2,883,345	605,073	2,720,634	162,710
12.	576,352	2,461,510	576,352	2,322,355	139,155
13.	548,947	2,096,322	548,947	1,977,570	118,753
14.	522,849	1,780,582	522,849	1,679,479	101,103
15.	498,355	1,508,876	498,355	1,422,970	85,906
16.	475,307	1,274,911	475,307	1,202,099	72,812
17.	454,287	1,075,064	454,287	1,013,443	61,621
18.	435,055	903,994	435,055	851,910	52,084
19.	417,871	757,942	417,871	714,090	43,851
20.	403,390	634,330	403,390	597,406	36,924
21.	391,682	529,505	391,682	498,452	31,051
22.	383,202	440,749	383,202	414,664	26,085
23.	378,296	365,348	378,296	343,472	21,875
24.	379,223	302,310	379,223	283,933	18,377
25.	387,048	248,898	387,048	233,450	15,442
26.	404,625	203,179	404,625	190,203	12,976
27.	439,239	163,975	439,239	153,032	10,942
28.	507,565	129,702	507,565	120,379	9,323
29.	659,087	97,453	659,087	89,209	8,164
30.	1,140,000	56,336	1,140,000	48,450	7,886

* Based upon principal pay-down detailed on Exhibit 1-5.

EXHIBIT 1-7 e

NO PREPAYMENT

	9% Cash Inflow		8.5% Cash Outflow		
Year	Principal	Interest	Principal	Interest	Net to Issuer
1.	683,197	8,972,274	683,197	8,473,615	498,660
2.	747,286	8,908,186	747,286	8,413,287	494,899
3.	817,386	8,838,085	817,386	8,347,080	491,005
4.	894,063	8,761,409	894,063	8,275,939	485,470
5.	977,932	8,677,539	977,932	8,195,454	482,086
6.	1,069,669	8,585,803	1,069,669	8,108,814	476,989
7.	1,170,011	8,485,460	1,170,011	8,014,046	471,414
8.	1,279,766	8,375,705	1,279,766	7,910,388	465,317
9.	1,399,817	8,255,654	1,399,817	7,797,007	458,647
10.	1,531,130	8,124,342	1,531,130	7,672,990	451,352
11.	1,674,760	7,980,711	1,674,760	7,537,338	443,373
12.	1,831,864	7,823,607	1,831,864	7,388,962	434,645
13.	2,003,706	7,651,766	2,003,706	7,226,668	425,098
14.	2,191,667	7,463,804	2,191,667	7,049,149	414,656
15.	2,397,261	7,258,211	2,397,261	6,854,977	403,234
16.	2,622,140	7,033,331	2,622,140	6,642,592	390,740
17.	2,868,115	6,787,356	2,868,115	6,410,281	377,075
18.	3,137,164	6,518,307	3,137,164	6,156,179	362,128
19.	3,431,452	6,224,020	3,431,452	5,878,241	345,779
20.	3,753,345	5,902,126	3,753,345	5,574,230	327,896
21.	4,105,435	5,550,036	4,105,435	5,241,701	308,335
22.	4,490,553	5,164,918	4,490,553	4,877,978	286,940
23.	4,911,798	4,743,673	4,911,798	4,480,136	263,537
24.	5,372,559	4,282,913	5,372,559	4,044,973	273,940
25.	5,876,542	3,778,930	5,876,542	3,569,009	209,920
26.	6,427,802	3,227,670	6,427,802	3,048,355	179,315
27.	7,030,774	2,624,697	7,030,774	2,478,881	145,817
28.	7,690,309	1,965,162	7,690,309	1,828,140	137,023
29.	8,411,713	1,243,758	8,411,713	1,174,661	69,098
30.	9,200,790	454,682	9,200,790	429,422	25,260

COMPARISON OF ISSUER'S PROFIT
BASED UPON VARIOUS PREPAYMENT ASSUMPTIONS

Net Present Value (000's Omitted)

	Discount Rate		
	10%	15%	20%
No Prepayments	$4,107	$2,998	$2,336
12 yr. Prepayment Assumption	3,253	2,602	2,141
Rising Market	2,994	2,341	1,925
Stable Market	2,806	2,240	1,856
Falling Market	2,597	2,113	1,775

As a review of the chart indicates, depending upon the prepayment characteristics of the underlying mortgages and the implied discount rate for the pool, the issuer's ex-post return will be significantly different. Although, ex-ante, prepayment rates can never be known for certain, an estimate based upon a given pool's characteristics will aide the issuer in the decision to sell or not. In addition, a more complete analysis may result in favorable pricing from the investing community.

Before the firm can draw any conclusions from these results, consideration must be given to the expenses associated with servicing the pooled mortgages. While often ignored, servicing is a real cost which must be incorporated into any analysis on the feasibility of selling a mortgage-backed security. Servicing costs were not incorporated into this study, primarily because each firm has unique costs associated with the servicing of the mortgages.

The data that was used for this study could be expanded to include several interest rates within a pool, similar to the securities currently being offered. In addition, various interest rate fluxuations could be analyzed to show prepayment responses.

This study has separated the return from the security and the additional return or income generated from the reinvestment of the pool's proceeds. The fee income from mortgage production is a significant portion of the lenders overall return. However, it was felt that the mortgage-backed security should be analyzed as a seperate profit center without consideration given to this additional fee income.

Concluding Remarks

The purpose of this study was to examine the profits earned by the issuer of a mortgage backed securities. While not incorporating all the factors that affect the issuer's profit, the study has shown that differences in the pre-payment rates of the underlying mortgages, in addition to affecting the investor's return, has as significant effect on the issuer's profit as well.

Based upon previous studies and the results of this analysis, it is clear that the 12-year prepayment assumption, currently the standard for pricing mortgage backed securities, should be replaced with a more sophisticated analysis of the characteristics of the mortgages that make up the pool. If the current volitility of interest rates continues, the investors of mortgage backed securities will become more sensitive to the uncertain cash flows associated with such an investment.

The future of the mortgage backed securities depends on several factors. The first being the continued demand for such securities. It seems, at least intuitively, that at some point the market will have become saturated with secondary mortgage instruments. A second factor, one worth further study is the fact that by the mid-1980's, financial institutions will no longer be subject to interest rate controls (by virtue of the elimination of Regulation Q). This will enable them to be more competitive and their supply of funds should not fluctuate as it has in the past.

The alternative mortgages that are being proposed by financial institutions will create new pricing problems if the mortgages are ultimately sold in the secondary market. However, by issuing mortgages that have shorter terms or the ability to adjust the interest rate with movements in the general level of interest rates the need for selling off the loan portfolio may be eliminated.

Until the widespread use of alternative financing techniques or the elimination or Regulation Q, the selling of mortgages will continue to be a viable source of funds to the financial institutions, which will require a more thorough analysis of the prepayment characteristic to properly price the issue and determine both the investor's and issuer's ultimate return.

SECTION 2

RATE OF RETURN AND YIELD ON MORTGAGE PASS THROUGH SECURITIES

INTRODUCTION

This section examines yield and holding period rate of return to the investor. It looks at the three types of mortgage pass throughs, and derives a model to calculate holding period rate of return, given price and cash flow. The model illustrates the components of pass through cash flow, and the risk factors that determine the pass through rate of return required by the investor.

The evaluation of return and yield for pass through securities has been the center of a great deal of controversy in the investment community and among academics. Arguments that mortgages and mortgage backed securities are underpriced have been presented by Norgaard (1978) and refuted by Dunn and McConnell (1979). Models have been proposed by Haney and Crenwelge (1979) and Dunn and McConnell (1979) to calculate pass through cash flows and risk premiums. A rate of return index has been developed by Michael Waldman (Salomon Brothers, 1979) to measure holding period rate of return.

Why the active interest in pricing of pass through securities? First, the investor wants to assess the value of the pass through security as an investment vehicle in order to arrive at a price that provides an acceptable rate of return. Second, the issuer must evaluate the mortgage pass through with respect to alternative sources of funds. The issuer's cost of funds is contingent upon the investor's assessment of the value of the pass through and the resulting market price. Third, academics seek to measure the risk/return relationships of mortgage pass throughs to determine whether the pricing of these securities is consistent with the efficient market hypothesis and the W.F. Sharpe capital asset pricing model.

The following issuer/investor activities leading to the sale/purchase of a pass through security were developed from interviews with pass through specialists in commercial banks, savings and loans and investment banking firms.

A financial institution issues pass throughs in order to sell mortgage loans, and use the proceeds to pay off debt or reinvest in new loans. A mortgage pool is assembled, and the weighted average coupon rate is calculated. This sets the lower limit for the pass through coupon rate. Through consultation with an investment banker, the financial institution is advised that current market conditions require a

given basis point spread between the proposed issue and the quoted GNMA yield. This sets the maximum price for the issue.

Although the yield is not an accurate absolute measure of expected rate of return, the yield spread off of GNMA's is typically used to establish marketable selling prices for new issues. If this price provides the issuer with an adequate return, the pass through will be issued. If not, the issuer will defer the issue until market conditions are more favorable.

Investors in mortgage pass throughs, such as insurance companies, work with an array of required returns representing alternative investments. These returns are based upon forecasts of inflation trends, interest rate levels and other economic conditions, as well as the risk inherent in each unique investment.

The investor calculates the expected return on a pass through issue from expected cash flows and market price. If the return meets the investor's required rate, the pass through will be purchased. The investor may also calculate price from cash flow and required return. If the issue can be purchased at that price or lower, the investor will buy.

PASS THROUGH MODEL AND DATA

Publicly issued pass through securities are categorized by issuer as follows:

1. Government National Mortgage Association (GNMA) Pass Throughs
2. Federal Home Loan Mortgage Corporation Participation Certificates (FHLMC PC's)
3. Private Sbctor Pass Throughs (Issued by Savings & Loans and Commercial Banks)

Distinguishing characteristics for each type of pass through are shown in the Appendix in Exhibits A3-A5.

The data in this study are from the following four public issues:

ISSUER	COUPON	ISSUE DATE
GNMA	9.0%	9-01-78
FHLMC	9.0%	6-01-78
Bank of America	9.0%	4-19-78
Washington Mutual	9.0%	6-23-78

This study uses the following basic present value model to describe the price, return, cash flow relationship.

$$P = \frac{(CF)}{(1 + r)}$$

P = Price of the pass through
CF = Expected cash flow, including interest and price appreciation
r = Rate of Return

The components of the model may be broken down further as follows:

$CF = SP + UP + I + F + P_1 - P_0$
SP = Scheduled principal payment
UP = Unscheduled principal payment
I = Interest Payment
F = Fees for late payments and assumptions
P_1 = Price at end of holding period
P_0 = Price at beginning of holding period
$r = RF + D + NM + R$
RF = Risk free rate
D = Default risk premium
NM = Non-Marketability risk premium
R = Reinvestment risk premium

This study presents two analyses of pass through data, incorporating the assumptions in the model.

First, the study calculates monthly holding period rate of return for the four pass through issues from September, 1978 to August, 1980. The rate of return is regressed against quoted yields for the same periods to determine the level of correlation.

Second, the study calculates the spread off of GNMA's for yield and for rate of return on a monthly basis from September, 1978 through August, 1980. Yield is not a surrogate for return, however, the yield spread off of GNMA's is the benchmark the issuer is advised to use to set the issue price. The yield spread ostensibly represents the risk premium required above the risk free rate. Finally, the yield and return are regressed against the 90 Day Treasury Bill rate to determine the level of correlation.

The model given above is used to calculate the one month holding period rate of return.

$$1 + r = \frac{CF}{Po}$$

$CF = (P1 - Po) + I + PF$

P1 - Po = Price at the end of the month, adjusted for principal repayments, minus price at the beginning of the month.

I = Interest payment, since all issues bear 9% Coupons, I = 9/12 = .75%

PF = Principal pay down, or the scheduled and unscheduled principal payments received (from Salomon Brothers pay down data). Fee payments were not available and were not included.

The mathematical model with the expanded components becomes:

$$1 + r = \frac{I + PF\ (100) + [P1\ (1-PF)] - Po}{Po}$$

PF = Paydown Factor, or (PP_o) percentage of principal outstanding at the beginning of the month minus (PP_1) percentage outstanding at the end of the month divided by PP_o.

CASH FLOW COMPONENTS

This section discusses the cash flow components in the model with respect to the four issues studied.

Scheduled Principal Payments

Scheduled principal payments affect pass through rate of return as a result of the amortization period over which the principal is paid and by the delay in passing each payment through to the investor. Exhibit 2-4 explains the calculation of the scheduled payment amount from a present value annuity model.

The amortization period determines the timing of principal repayment cash flows, and is a function of the original maturity of the mortgages in the pool and their age at date of issue. When a pass through is purchased at a discount (as most are), the shorter the amortization period, the higher the rate of return. The reverse is true for purchases at a premium. Amortization periods for the four issues studied are shown below.

ISSUE	ORIGINATION DATE	ISSUE DATE	ORIGINAL TERM	AMORTIZATION PERIOD
GNMA	Unknown	9-01-78	30 yrs. max	30 yrs max.
FHLMC	Unknown*	6-01-78	30 yrs. max	29 yrs approx.
B of A	11-01/76	4-19-78	30 yrs. max	27.5 yrs
Wash Mut	2-12-77	6-23-78	30 yrs. max	28.58 yrs

*Approximately 95% of pool loans were less than 1 year old at issue date.

EXHIBIT 2-4

SCHEDULED PRINCIPAL PAYMENT

The scheduled principal payment is the total scheduled monthly payment at the pass through rate minus the interest payment.

$$SP_i = SMP_{ri} - I_{ri}$$

The monthly payment is a function of the original principal, the coupon rate and the original term to maturity.

$$SMP_{ri} = \frac{P_n}{PVIF_a}$$

SMP_{ri} = monthly payment at the pass through rate

P_n = original principal balance to be paid in n months

$PVIF_a$ = present value interest factor of an annuity to be paid in n monthly payments at the pass through rate according to:

$$PVIF_a = \frac{1 - \frac{1}{(1 + r)^t}}{r}$$

The monthly payment can be obtained without direct calculation by referring to a mortgage payment table.

All of these securities sold at a discount, therefore, the B of A issue represents the highest expected rate of return because it has the shortest amortization period.

Payment delay is the time period from issue date to receipt of first payment. This is the time required for the issuer (or servicer) to collect the mortgage payments and compute and mail the pass through payments to the investors. The longer the delay, the lower the rate of return, however, the impact is not substantial. A rough estimate of the effect of the delay is given by Mike Waldman (Salomon, 1979) as follows:

$$\text{Effect of Payment Delay on Reinvestment Return} = \frac{\text{Payment Delay}}{\text{Holding Period}} \times \text{Reinvestment Return}$$

Payment delay periods for the four issues studied are as follows:

ISSUE	ISSUE DATE TO FIRST PAYMENT	ACTUAL* DELAY
GNMA	45	14
FHLMC	75	44
B of A	55	24
Wash Mut	55	24

*Actual delay is less than period from issue to first payment because the buyer of a new monthly pay security would not expect payment for at least 30 days.

GNMA has the shortest payment delay period, and therefore, represents the highest expected rate of return.

Unscheduled Principal Payments

The rate of unscheduled principal payments, or the prepayment rate, is the most significant factor affecting the pass through cash flow. This impacts the timing of payments and the movement of funds from investment at the pass through rate to current market rates.

The 12 year prepayment assumption is the mortgage industry norm for quoting yields. It assumes no prepayments until the end of the twelfth year; then all mortgages are assumed to be prepaid at once. This assumption is unrealistic as an absolute measure, but is used to rank pass through issues against each other or against other fixed income investments.

Prepayment patterns are frequently described in terms of FHA experience. This refers to a table of decimal balances that represent the life expectancy of FHA insured mortgages insured between 1957 to 1975 with original terms of 26 to 30 years. Prepayment rates are expressed as percentages of FHA experience, eg. 100% FHA means that on

average the security has prepaid (or is expected to prepay) according to the FHA pattern, 200% implies a prepayment rate twice that of FHA, etc.

Mortgage pass through pools cannot be expected to prepay at rates indicated by FHA experience for several reasons. FHA refers only to FHA insured mortgages. Different types of mortgages often represent different classes of mortgagees, and therefore different prepayment rates. FHA refers to mortgages with original maturity of 26-30 years, mortgage pools quite often are predominately 30 years. FHA data goes back to 1957, the first pass throughs were issued in 1970. Only the first 21 years of FHA are based on actual data, the remaining nine are estimates only. FHA does not discriminate among mortgages with different rates, however, mortages with higher rates tend to prepay faster than those with lower rates.

Expected prepayment patterns given in the prospectuses for the issues studied were as follows:

GNMA	200% FHA
FHLMC	8 year weighted average life
B of A	200% FHA, 7 year average loan life
Wash Mut	200% FHA

Interest and Servicing Fee

Interest is passed through to the investor at the pass through rate, which is equal to the weighted average interest rate on the mortgage pool minus a servicing fee of about ½%. The pass through rate on all four issues studied was 9%. Servicing fees were as follows:

FHLMC Assumed to be zero, but actually unknown because the rates on a given mortgage pool are not revealed. FHLMC states that no mortgage bears a rate lower than the pass through rate.

FNMA .50% B of A .12% Wash Mut .16%

The GNMA pass through rate is always 50 basis points below the mortgage rate, and all of the mortgages in a given pool must bear the same rate. The servicing fee represents 44 basis points, and the GNMA administrative fee represents 6 basis points.

For private sector issues, the spread between pass through rate and mortgage rate has varied from a low of 3 basis points to a high of 75 basis points. A spread of about 50 to 65 points (b.p.) is considered to be break even. This represents about 35 b.p. for servicing costs and 30 b.p. for cost of initial sale, insurance, and administrative costs.

Prepayment Fees and Late Fees

Prepayment fees and late fees are generally not passed on to the pass through investor. Treatment of these fees for each of the issues studied is shown below:

GNMA	No fees are passed through
FHLMC	Prepayment fees are passed through to the investor Late fees are retained by the seller/servicer
B of A	All fees are retained by B of A
Wash Mut	Late fees are retained by Washington Mutual. Assumption fees are not included in notes issued by Washington Mutual

The issuers prospectuses describe the estimated compensation from assumption fees and late payment fees to be negligible. Furthermore, it is not uncommon for the issuer to waive prepayment fees.

COMPONENTS OF RETURN

According to the Harry Markowitz mean/variance portfolio theory and the W.F. Sharpe capital asset pricing model, the market demands compensation for risk. Risk is defined as the variance of the expected return about the mean. The mean is an expected value resulting from a distribution of probabilities.

The rate of return for a riskless investment is the "risk free" rate, and refers to government securities such as treasury bills. GNMA pass throughs, which are backed by the full faith and credit of the U.S. Government, are considered to be a risk free pass through security. Yield spreads between GNMA's and other pass through issues with the same coupon represent risk premiums. The risk premium is required by the investor to compensate for the probability of not earning the expected return. Risk factors that could lead to a lower return include default risk, non-marketability risk, and reinvestment risk.

Default Risk

The level of default risk depends on mortgage characteristics such as loan to value ratio, type of dwelling unit, geographic distribution, etc. This risk was reduced on the issues studied by various forms of guarantees and insurance as described below.

GNMA — Timely payment of principal and interest is guaranteed by GNMA. This constitutes backing by the full faith and credit of the U.S. Government.

FHLMC — FHLMC guarantees timely payment of interest, and collection of principal without any deduction to the extent of the holder's pro rata share. GHLMC indemnifies the holder against diminution in principal due to charges for property repairs, maintenance, and foreclosure.

B of A — Mortgage guarantee insurance covers defaults up to 5% of the original aggregate principal balance of the pool. All loans are covered by hazard insurance against various causes including fire, lightning and windstorm. In addition, insurance against special hazards including earthquakes, mudflows and floods is provided in the amount of 1% of the original aggregate principal balance of the pool. Hazards not covered by these policies are borne by the investor.

Wash Mut — Same as B of A.

As stated previously, GNMA is considered to be riskless. Mortgage pool characteristics that contribute to default risk for the three risky pass through securities studied are shown in Exhibit 2-5 and 2-6. A significant measure of default risk is the rating given by the investment rating agencies to private sector pass throughs. Both B of A and Washington Mutual were rated AA, the second highest rating given by the agencies.

Non-Marketability Risk

The risk of non-marketability refers to the risk of being locked into an investment that one prefers to sell because of more favorable alternative investments or a requirement to liquidate assets. The investor risks selling at an unfavorable price because of minimal trading activity.

Investors can buy primary offerings of GNMA's either directly from the GNMA security issuers or through a GNMA dealer. At year end 1977* there were about 500 active issuers of GNMA securities, 90% of whom were mortgage bankers. At the same time, the GNMA Dealers Association, formed in 1972, included 55 regular and associate members made up predominately of investment bankers, with a few regional investment houses and commercial banks. In addition to primary issuers, there is an active secondary market in GNMA's and a growing futures market.

FHLMC PC's can be purchased directly from FHLMC through securities dealers. In addition, certain securities dealers maintain a secondary market in FHLMC PC's. In October, 1979, there were 15 dealers in the FHLMC PC secondary

*1977 is used as a reference to represent market conditions at the time of issue of the pass throughs studied

EXHIBIT 2-5

MORTGAGE POOL CHARACTERISTICS

	LOAN/VALUE	TYPE OF DWELLING UNIT ONE FAMILY	TYPE OF DWELLING UNIT OTHER	SIZE OF LOAN PRINCIPAL To $60K	$60-100K	$100-200K	Aver
FHLMC	80%	95.0%	5.0%	$75K max on single family			
B of A	80%	94.4%	5.6%	47.2%	39.6%	13.2%	$58,400
Wash Mutual	80%	100.0%	0	81.0%	17.8%	1.2%	$41,400

	ORIGINATION DATE	POOL DATE	SERVICING FEE	DELINQUENCY # OF DAYS	% OF LOANS
FHLMC	95% less than	1 year old	None	Conventional	
				Up to 30	1.84%
				Over 30	.41%
				Foreclosures	.08%
				FHA/VA	
				Up to 30	5.66%
				Over 30	1.74%
				Foreclosures	.32
B of A	11/01/76	4/01/78	.120	Up to 30	2.52%
				Over 30	.46%
Wash Mutual	2/01/77	6/01/78	.160	Up to 60	.42%
				Over 60	.19%

EXHIBIT 2-6

GEOGRAPHIC DISTRIBUTION

FHLMC		B OF A (CALIF COUNTIES)		WASH MUTUAL (WASH COUNTIES)	
Los Angeles	38.90%			King (Seattle)	56.8%
Atlanta	17.81%			Snohomish (N.Seattle)	7.3%
Seattle	10.81%			Spokane (Spokane)	6.4%
Little Rock	9.84%	Los Angeles	21.6%	Yakima (Yakima)	5.8%
Denver	8.51%	Santa Clara	11.4%	Other Western	23.7%
Other	14.13%	Orange	11.4%	Other Eastern	6.5%
		Contra Costa	7.9%		
		Alameda	5.8%		
		San Mateo	4.3%		
		San Bernardino	3.8%		
		Marin/	2.8%		
		Other N.Calif.	11.0%		
		Other S.Calif.	20.0%		

market. Certain investment bankers issue and make a secondary market in conventional pass throughs.

Trading volume is also a measure of marketability. Average monthly issue volume for mortgage pass throughs in 1977* is shown below:

	Average Issue	Minimum Denomination
GNMA	$1.500 Billion/mo ($17.441 Billion/yr	$ 25,000
FHLMC	$400 Million/mo (4.883 Billion/yr	$100,000
Conventional	$225 Million/yr (2 issues)	$ 25,000

*1977 is used as a reference to represent market conditions at the time of issue of the pass throughs studied

Clearly GNMA offers the greatest marketability, and as a result the lowest risk of non-marketability. FHLMC offers greater trading opportunities than either of the two private sector pass through issues studied.

Reinvestment Risk

The risk of reinvestment at an unfavorable market rate depends upon the investor's estimate of future market conditions. Differentiation between the three types of risky pass throughs for reinvestment risk depends upon the particular security's response to changes in market conditions. In the pass through security market, reinvestment risk can be minimized by hedging with GNMA futures, i.e., selling short in the GNMA futures market to cover a long position on a pass through security.

Volatility of prices of the four issues studied with respect to Treasury Bill rates over the 24 month period is shown in Exhibit 2-7.

STUDY RESULTS

Holding Period Rate of Return

The holding period rate of return for the four issues studied from September, 1978 through August, 1980 is shown in Exhibit 2-13. The promised annual yield is shown in Exhibit 2-14. The extreme volatility

EXHIBIT 2-7

VOLATILITY OF T BILL RATES AND PASS THROUGH PRICES

DATE	MONTHLY AVERAGE RATES T BILLS	PRICES AT MONTH END GNMA	FHLMC	WASH MUTUAL	B OF A
1978					
September	7.85	98.125	97.00	96.375	96.375
October	7.99	96.50	95.75	95.75	95.123
November	8.64	96.50	95.625	95.00	93.75
December	9.08	94.625	94.00	92.50	92.25
1979					
January	9.35	95.625	95.125	93.125	92.625
February	9.32	94.375	94.375	92.75	92.75
March	9.48	94.625	94.3125	91.875	92.125
April	9.46	93.25	93.00	91.00	91.375
May	9.61	94.1875	93.875	90.75	90.875
June	9.06	95.50	95.00	92.0	92.125
July	9.24	94.50	94.25	91.625	92.00
August	9.52	93.375	93.125	90.50	90.625
September	10.26	90.375	90.00	88.50	88.50
October	11.70	83.875	83.50	82.375	82.125
November	11.79	86.00	85.50	82.875	83.125
December	12.04	85.75	84.875	83.00	83.125
1980					
January	12.0	80.75	81.25	78.00	77.75
February	12.86	75.125	73.125	72.625	72.375
March	15.20	74.375	73.75	71.375	71.00
April	13.20	85.25	83.75	82.25	82.25
May	8.58	87.50	87.00	84.625	83.875
June	7.07	88.25	87.125	85.25	85.0
July	8.06	84.25	83.375	80.75	80.50
August	9.13	79.375	80.25	77.50	76.50

MONTHLY HOLDING PERIOD
RATE OF RETURN (9-78 THROUGH 8-80)

	MATRIX 'gnr'		MATRIX 'fmr'		MATRIX 'bar'		MATRIX 'wsr'
r 1	-0.75	r 1	-0.11	r 1	-0.21	r 1	-0.37
r 2	-0.89	r 2	-0.51	r 2	-0.47	r 2	0.15
r 3	0.78	r 3	0.67	r 3	-0.59	r 3	0.01
r 4	-1.16	r 4	-0.90	r 4	-0.72	r 4	-1.82
r 5	1.85	r 5	2.02	r 5	1.29	r 5	1.54
r 6	-0.52	r 6	0.03	r 6	1.01	r 6	0.44
r 7	1.06	r 7	0.79	r 7	0.18	r 7	-0.08
r 8	-0.66	r 8	-0.58	r 8	0.05	r 8	-0.10
r 9	1.81	r 9	1.79	r 9	0.32	r 9	0.58
r 10	2.19	r 10	2.03	r 10	2.27	r 10	2.28
r 11	-0.26	r 11	0.04	r 11	0.76	r 11	0.46
r 12	-0.39	r 12	-0.33	r 12	-0.60	r 12	-0.29
r 13	-2.40	r 13	-2.48	r 13	-1.42	r 13	-1.26
r 14	-6.35	r 14	-4.10	r 14	-6.23	r 14	-5.88
r 15	3.44	r 15	0.95	r 15	2.33	r 15	1.61
r 16	0.59	r 16	0.25	r 16	1.02	r 16	1.13
r 17	-4.94	r 17	-3.26	r 17	-5.49	r 17	-4.99
r 18	-6.01	r 18	-8.99	r 18	-5.80	r 18	-5.83
r 19	0.03	r 19	1.96	r 19	-0.73	r 19	-0.62
r 20	15.65	r 20	14.67	r 20	17.06	r 20	16.37
r 21	3.53	r 21	4.84	r 21	2.94	r 21	3.83
r 22	1.73	r 22	1.06	r 22	2.26	r 22	1.66
r 23	-3.67	r 23	-3.31	r 23	-4.25	r 23	-4.38
r 24	-4.88	r 24	-2.83	r 24	-3.92	r 24	-3.03

EXHIBIT 2-14

ANNUAL YIELD (QUOTED MONTHLY)

	gny		fmy		bay		wsy
9-78	9.02	9-78	9.16	9-78	9.29	9	9.27
10	9.25	10	9.29	10	9.50	10	9.46
11	9.45	11	9.55	11	9.65	11	9.51
12	9.42	12	9.49	12	9.88	12	9.72
1-79	9.74	1-79	9.72	1-79	10.07	1-79	10.05
2	9.52	2	9.51	2	9.88	2	9.88
3	9.74	3	9.64	3	9.99	3	9.99
4	9.76	4	9.68	4	10.11	4	10.15
5	10.07	5	9.97	5	10.29	5	10.35
6	9.83	6	9.77	6	10.27	6	10.27
7	9.57	7	9.57	7	10.01	7	10.07
8	9.72	8	9.66	8	10.11	8	10.17
9	10.03	9	10.01	9	10.39	9	10.39
10	10.49	10	10.38	10	10.70	10	10.59
11	11.57	11	11.49	11	11.82	11	11.75
12	11.14	12	11.01	12	11.73	12	11.71
1-80	11.23	1-80	11.27	1-80	11.64	1-80	11.59
2	12.18	2	12.00	2	12.69	2	12.64
3	13.34	3	13.62	3	13.72	3	13.66
4	13.34	4	13.43	4	14.09	4	14.03
5	11.01	5	11.24	5	11.51	5	11.51
6	11.01	6	10.97	6	11.54	6	11.49
7	10.80	7	10.85	7	11.38	7	11.33
8	11.46	8	11.48	8	12.12	8	12.07

in return is the result of wild fluctuations in prices due to fluctuations in interest rates. Since yield assumes no principal paydown until year 12 and measures price volatility as a discount or premium from par (rather than a change from the previous month's price), yield is more stable than return.

It is clear from these results that yield is not an indicator of monthly holding period return. The results of the regression of returns against yields verify that observation (Exhibit 2-9). The correlation-coefficient between yield and return ranges from .27 to .30 for the four issues. While the degree of correlation is consistent between issues, the level of correlation is too low to assume any significant causal relationship.

GNMA Spread

The yield spread against GNMA is shown in Exhibit 2-12 based on annual yields. For thirteen of the twenty-four months studied, the FHLMC yield exceeded GNMA. The spread for the two conventional issues ranges from .06 to .75. In all cases the GNMA yield is lower. This is in marked contrast to the monthly rate of return spreads shown in Exhibit 2-11. The FHLMC spread ranges from 2.25 to (-2.98), and the conventional spreads range from 1.85 to (-1.83). The return on each of the three "risky" issues exceeded the GNMA return during ten of the twenty-four months studied.

Correlation With T-Bill Rate

The correlation of yields and returns with the monthly average of the 90 day T-Bill rate is shown in Exhibit 2-10.

The results of the regression on yields showed a fairly high level of correlation, ranging from .72 to .76. However, the regression for returns showed a very low level of correlations, ranging from .08 to .10.

Several factors could account for this difference in correlation. The holding period return is almost entirely a function of the price change from the beginning of the month to the end of the month. Yield, on the other hand, looks at price as a discount or premium from par, and amortizes the difference over 12 years. As a result, the yield is much less volatile than monthly rate of return.

The T-Bill rates used were monthly averages, but the price used to calculate rate of return was the price on a given day during the last week of the month. Yield was as of a given day during the first week of the month (to give promised yield for the month). These timing differences may have created a distortion in the correlation. A comparison of the monthly rate of return derived in this study to returns in a similar study by Salomon Brothers shows a similarity in results, indicating a satisfactory level of accuracy in the return

EXHIBIT 2-9

RATE OF RETURN REGRESSED AGAINST YIELD

Independent Variable - Annual Yield

Dependent Variable - Monthly Holding Period Rate of Return

	GNMA	FHLMC	B of A	WASH MUT
alpha	-10.26	-9.74	-10.57	-10.70
beta	.97	.93	.97	.99
SE (b)	.73	.68	.70	.68
r	.27	.28	.28	.30
r^2	.07	.08	.08	.09

EXHIBIT 2-10

YIELD AND RETURN REGRESSED AGAINST T-BILL RATE

Independent Variable - Monthly Average, 90 Day T-Bill Rate

Dependent Variable - Monthly Quote, Annual Yield

	GNMA	FHLMC	B of A	WASH MUT
alpha	5.88	5.88	6.17	6.19
beta	.46	.46	.47	.47
SE (b)	.09	.09	.10	.10
r	.76	.74	.72	.72
r^2	.57	.55	.52	.52

Independent Variable - Monthly Average, 90 Day T-Bill Rate

Dependent Variable - Monthly Holding Period Rate of Return

	GNMA	FHLMC	B of A	WASH MUT
alpha	-2.29	-1.59	-1.98	-1.79
beta	.23	.17	.20	.18
SE (b)	.47	.44	.48	.46
r	.10	.08	.09	.08
r^2	.01	.007	.008	.007

EXHIBIT 2-11

RATE OF RETURN SPREAD
AGAINST GNMA (9-78 THROUGH 8-80)

	MATRIX 'fmr-gnr'	MATRIX 'bar-gnr'	MATRIX 'wsr-gnr'
r 1	0.64	0.54	0.39
r 2	0.38	0.42	1.04
r 3	-0.11	-1.37	-0.77
r 4	0.27	0.44	-0.66
r 5	0.17	-0.56	-0.31
r 6	0.55	1.53	0.96
r 7	-0.28	-0.88	-1.14
r 8	0.08	0.70	0.56
r 9	-0.03	-1.49	-1.23
r 10	-0.16	0.07	0.09
r 11	0.30	1.01	0.72
r 12	0.06	-0.21	0.11
r 13	-0.08	0.98	1.14
r 14	2.25	0.12	0.47
r 15	-2.49	-1.11	-1.83
r 16	-0.35	0.43	0.54
r 17	1.68	-0.55	-0.05
r 18	-2.98	0.21	0.18
r 19	1.93	-0.76	-0.65
r 20	-0.97	1.41	0.73
r 21	1.31	-0.59	0.30
r 22	-0.67	0.53	-0.07
r 23	0.36	-0.58	-0.71
r 24	2.04	0.95	1.85

EXHIBIT 2-12

YIELD SPREAD AGAINST GNMA (9-78 THROUGH 8-80)

	MATRIX 'fmy-gny'	MATRIX 'bay-gny'	MATRIX 'wsy-gny'
r 1	0.14	0.27	0.25
r 2	0.04	0.25	0.21
r 3	0.10	0.20	0.06
r 4	0.07	0.46	0.30
r 5	-0.02	0.33	0.31
r 6	-0.01	0.36	0.36
r 7	-0.10	0.25	0.25
r 8	-0.08	0.35	0.39
r 9	-0.10	0.22	0.28
r 10	-0.06	0.44	0.44
r 11	0.00	0.44	0.50
r 12	-0.06	0.39	0.45
r 13	-0.02	0.36	0.36
r 14	-0.11	0.21	0.10
r 15	-0.08	0.25	0.18
r 16	-0.13	0.59	0.57
r 17	0.04	0.41	0.36
r 18	-0.18	0.51	0.46
r 19	0.28	0.38	0.32
r 20	0.09	0.75	0.69
r 21	0.23	0.50	0.50
r 22	-0.04	0.53	0.48
r 23	0.05	0.58	0.53
r 24	0.02	0.66	0.61

calculations. In addition there is a high level of correlation for the rate of return results between the four issues.

CONCLUSION

The purpose of Section 2 of this study was to examine yield and holding period rate of return to the investor. The study looked at three types (four issues) of mortgage pass throughs, and derived a model to calculate holding period rate of return. The model illustrated the components of pass through cash flow and the risk factors that determine the rate of return required by the investor.

The model derived for calculation of rate of return gives a definitive presentation of the sources of pass through cash flow and the relationships of pass through price, cash flow and return. In addition, this study presents return data by individual issue, rather than by composite of security type, thus isolating the cash flow characteristics and price volatility of a particular issue.

Extreme volatility in price and return for pass through securities is evident in the results of this study. The dramatic fluctuations in price from month to month illustrate the difficulty faced by the issuer in timing the release of a pass through issue. The investor is faced with the same level of uncertainty in setting a purchase price and attempting to forecast expected return.

Because this study presents actual holding period rates of return, it sets the stage for further evaluation of pass through securities in terms of the efficient market hypothesis and the W.F. Sharpe Capital Asset pricing model (CAPM). Using the CAPM assumption that $r = rf + B(rm-rf)$ one could derive the risk premium $(rm-rf)$ and beta (B) for pass through securities. The limitation is that conventional pass through securities have only been traded since 1977. Further study in this area is warranted, however, in terms of the assistance it could provide to the pass through issuer and purchaser.

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