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A Model for Pricing Pass-Through Securities Backed by Alternative Mortgage Instruments

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**CENTER FOR REAL ESTATE  
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WORKING PAPER 81-31

A MODEL FOR PRICING  
PASS-THROUGH SECURITIES BACKED  
BY ALTERNATIVE MORTGAGE INSTRUMENTS

BY

JEAN C. HURLEY

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A MODEL FOR PRICING PASS-THROUGH SECURITIES  
BACKED BY ALTERNATIVE MORTGAGE INSTRUMENTS

JEAN C. HURLEY

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Berkeley

Working Paper 81-31

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## Section 1

### INTRODUCTION

The fixed rate, fixed term, amortizing mortgage has been the primary vehicle for financing single-family housing in the United States since the 1930's. During the past ten years, however, volatile interest rates and surging housing costs have led scholars and practitioners in housing finance to study various alternative mortgage instruments. Their studies have led to the development of creative new structures to the traditional fixed payment mortgage. These are known collectively as alternative mortgage instruments (AMI).

The five most common AMI structures are listed below. In some cases these structures may be combined as in the GPM-VRM instrument, however for purposes of this paper they will be treated individually.

1. Variable Rate Mortgage (VRM)
2. Rollover Mortgage (ROM)
3. Renegotiable Rate Mortgage (RRM)
4. Graduated Payment Mortgage (GPM)
5. Shared Appreciation Mortgage (SAM)

A model is developed in this study to illustrate the factors affecting investor pricing of AMI pass through securities. The unique cash flow and risk characteristics of the five AMI structures given above are evaluated in terms of the pricing model. Finally, conclusions are drawn with respect to pricing of an AMI pass through vis-a-vis fixed payment mortgage pass throughs.



Section 2  
DESCRIPTION OF AMI'S

Pressure to develop alternatives to the traditional fixed rate fixed payment 30-year mortgage have come from two primary sources. First, financial institutions have pushed for the development of a variable rate mortgage (VRM). The purpose of the VRM is to reduce the interest rate risk inherent in borrowing short and lending long in a highly volatile interest rate environment frequently characterized by an inverted yield curve. Second, the graduated payment mortgage (GPM) and its variations have been developed to aid the first-time home buyer. These borrowers are faced with accelerating home prices and inflation induced increases in mortgage rates, leading to unmanageable debt service to income ratios. The GPM provides lower more manageable payments during the early years of the loan. Payments increase on a graduated basis, with the expectation that the borrower's income will increase as well.

Thus, all AMI'S are characterized by either a variable or adjusted interest rate, or by reduced mortgage payments during the early years of amortization. Exhibit I gives a brief definition of some of the AMI'S currently under study or in practice.

### Adjustable Rate Mortgages

An adjustable rate mortgage is a long-term loan with the interest rate subject to change at fixed intervals according to changes in an index of interest rates. Most adjustable rate mortgages are variable rate mortgages (VRM'S), but this group also includes rollover mortgages (ROM'S) and renegotiable rate mortgages (RRM'S).

### Variable Rate Mortgage (VRM)

The VRM is typically written for 30 years with a provision that enables the lender to increase (or decrease) the interest rate with fluctuations in a standard index of market rates. The borrower may elect to adjust the payment amount or maturity to accommodate the increase (decrease). In some cases negative amortization is permitted.

There is a limit or "CAP" on periodic rate increases and on total increases. Frequency of increase is also restricted. Exhibit 2 shows the loan features of four different VRM structures proposed for use in California.

### Rollover Mortgage (ROM)

Rollover mortgages, sometimes called Canadian rollover mortgages, currently account for nearly all Canadian single family residential mortgages. ROM'S typically have five-year terms, with amortization scheduled over a 20 to 30-year period. Interest rate adjustments are incorporated by structuring the

loan as a series of short-term fixed rate loans. At the end of the five-year term, a new loan is originated at the current market interest rate. The borrower "rollsover" a series of successively smaller loans before the debt is paid off. The borrower can refinance without penalty up to 90 days following notification of rate increase. Generally there is a charge of three month's interest for prepayment during the five-year term. The magnitude of rate adjustments is left to the discretion of the lender, but implicitly tied to current mortgage lending rates.

#### Renegotiable Rate Mortgage (RRM)

A renegotiable rate mortgage is a series of short-term loans issued for terms of 3 to 5 years each, secured by a long-term mortgage. The short-term loans are automatically renewable for the entire term of the mortgage. Only the interest rate may be changed at maturity reflecting movement in a mortgage rate index for all major lenders. There is a CAP on periodic rate increases and decreases and on rate changes over the life of the loan. Loan features of the RRM are shown in Exhibit 2. The RRM differs from the ROM in two major respects. The RRM is a long-term mortgage with financing guaranteed for up to 30 years; the ROM has no such guarantee. The rate on the RRM is determined by reference to an index rate; the ROM has no index.

#### Adjustable Payment Mortgages

Adjustable payment mortgages address the problems of young people and families who expect increased real income, but who

cannot meet initial downpayment or income requirements. These instruments are designed to permit a borrower to qualify for a larger loan than current income would normally support. The adjustable payments permit lower payments in the early years of the mortgage in exchange for higher payments in later years (graduated payment mortgage) or a share in any increase in the value of the property when it is sold, (shared appreciation mortgage).

Graduated Payment Mortgage (GPM)

A typical graduated payment mortgage calls for an increase in the monthly payment of 7½% per year for 5 years, and then continues this higher payment for the life of the mortgage. The monthly payments are not sufficient to cover the debt service of the loan in its early years. The shortfall is added to the principal balance of the loan as deferred interest. The chart below illustrates the difference in monthly payments and loan balance for a GPM and for a standard mortgage of \$50,000 at 9.5% for 30 years.

<u>Year</u>	<u>Monthly Payment</u>		<u>Loan Balance (at year end)</u>	
	<u>Standard</u>	<u>GPM</u>	<u>Standard</u>	<u>GPM</u>
1	\$420.50	\$318.60	\$49,700	\$50,968
2	\$420.50	\$342.50	\$49,350	\$51,733
3	\$420.50	\$368.19	\$49,000	\$52,252
4	\$420.50	\$395.79	\$48,550	\$52,476
5	\$420.50	\$425.48	\$48,100	\$52,350
6	\$420.50	\$457.38	\$47,650	\$51,812

and thereafter

continues to decline to  
0 after 30 years

Exhibit 3 lists the loan features of a standard GPM and an adjustable rate GPM.

Shared Appreciation Mortgage (SAM)

The shared appreciation mortgage is offered at some discount below market interest rates in return for a claim on some portion of the appreciation on the home's value after 10 years, or sooner if it is sold before then. The interest rate and the lender's share of appreciation are left to negotiation. If the home is not sold in 10 years, it is appraised for current market price. The borrower pays the lender a lump sum, called contingent interest, equal to the agreed share of the appreciation less any improvements and the cost of appraisal. The lender must refinance the home at the borrower's request to cover the unpaid balance of the mortgage and the contingent interest. If the home price doesn't rise, the lender receives only the below-market interest and principal payments. Loan features of SAM'S are shown in Exhibit 3.

Section 3

PASS-THROUGH MODEL

The pass-through pricing model developed for this study is as follows:

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

P = Price of pass through

CF = Cash flow from the pass through

r = Rate of return to the investor

The cash flow and return components of the model are further defined as follows:

$$\text{Cash Flow} = SP + UP + I + F + P_1 - P_0$$

SP = Scheduled principal payment

UP = Unscheduled principal payment

I = Interest payment

F = Fee for late payments & Prepayments

P<sub>1</sub> = Price at end of holding period

P<sub>0</sub> = Price at beginning of holding period

$$\text{Rate of Return} = \text{RF} + \text{D} + \text{NM} + \text{R}$$

RF = Risk-free rate

D = Default risk premium

NM = Non-marketability risk premium

R = Reinvestment risk premium

With all of the component variables defined the model becomes:

$$P = \frac{(\text{SP} + \text{UP} + \text{I} + \text{F} + \text{P}_1 - \text{P}_0)}{1 + (\text{RF} + \text{D} + \text{NM} + \text{R})}$$

The model is used in this study to discuss marketability & pricing of pass-through securities backed by AMI pools vis-a-vis passthrough backed by pools of standard fixed-payment mortgages.

In Section 2 of a 1980 study by Hurley and Moore (a study of Rate of Return on mortgage pass-through securities) the model components are defined and discussed in detail. (See Working Paper 81-25)

Section 4

PRICING AMI PASS-THROUGH SECURITIES

For the investment manager, the structure of even relatively straightforward FPM pass-through securities presents a challenge. The cash flow characteristics of pass-through securities depart from the simple and relatively assured cash flow patterns of standard bond investments in two fundamental ways. First the pattern of cash flow timing is far more complex than with a simple bond. This makes it difficult to define yield or maturity with any precision. Second, the cash flow is partially unknown as it depends on prepayments, delinquencies and default experience of the mortgages in the pool.

As a result of these complexities and uncertainties, the initial development of the pass-through market required considerable education on the part of issuers and investors. Since the thrift industry engages in mortgage lending as its primary use of funds, thrift institutions understood the value of pass-through securities and the underlying mortgages. Other investors were not as receptive, as their investment managers carefully studied market liquidity, spread relationships, accounting procedures, and return performance. One can anticipate a similar response with the introduction of AMI pass throughs, representing an even more complex and unpredictable cash flow than FPM pass throughs. Investor uncertainty means that AMI pass throughs can be expected



to require a higher yield than FPM'S. Thus, one investor's problem becomes another investor's opportunity.

Adjustable Rate Mortgage (ARM) Pass Throughs

Using the model given in the previous section, one can expect the following conditions to prevail in the pricing of ARM backed pass through securities. ARM'S include VRM'S, ROM'S and RRM'S.

Cash Flow Characteristics:

1. Scheduled Principal Payments

$$SP_{FPM} = P, r, t \quad SP_{ARM} = P, r, t, r_i, t_i, CAP$$

P = Original principal

r = Original rate

t = Original term

$r_i$  = Revised rate(s)

$t_i$  = Revised term(s)

CAP= Cap on rate increase

Timing and amount of SP for ARM pass throughs has a greater variance than for FPM'S because more variables are involved. This is due to interest rate changes and borrower's preference for change in payment amount or extension of maturity. ARM'S with a CAP will vary less than those without. In addition, rate changes will differ between associations or legal jurisdictions depending on the rate index used.

## 2. Unscheduled Principal Payments

Unscheduled principal payments are the subject of considerable study and controversy. Traditionally prepayments have resulted from the sale of the property, foreclosure and sale, and refinancing due to more favorable interest rates. Prepayments at sale are expected to decrease in the future because of the Wellenkamp decision negating the due on sale clause. However, there will be fewer assumptions at time of sale on ARM'S than on FPM'S because ARM'S will remain closer to market rates. Refinancing due to more favorable rates will also decline with ARM'S, because rates will be closer to market. Foreclosure and property sales could increase with ARM'S if rate increases are substantially more than any intervening increases in the borrower's income. In summary, the difference in unscheduled payments is as follows:

$$UP_{FMP} = PP, F, S \quad UP_{ARM} = \downarrow PP, \uparrow F, \downarrow S$$

- ↑ = Designates an increase
- PP = Prepayment for more favorable rate
- F = Foreclosure
- S = Prepayment at sale

Since foreclosures represent a considerably smaller percentage of unscheduled payments than prepayments or assumptions, we can assume that with ARM'S, unscheduled payments will decline and maturities will lengthen. This assumes continued high interest rates and inflation. If rates dropped substantially and the VRM was not offered to borrowers at a rate considerably below market, it would not be attractive. Uncertainty in the level of future interest rates leads to uncertainty in the level of  $UP_{ARM}$ .

### 3. Interest payments

Interest payments are a function of principal, coupon rate, and term to maturity.

$$I_{\text{FPM}} = P, r, t \quad I_{\text{ARM}} = P, r, t, r_i, t_i, \text{CAP}$$

Factors affecting interest payments are the same as those affecting scheduled principal payments. With an increase in term to maturity, total interest payments will increase. Because of the variable rate, however, the variance in interest payments will also increase.

### 4. Fees

Prepayment fees and late fees are generally not paid to the pass-through investor, and do not represent a significant component of cash flow. Since prepayments are expected to decrease with ARM'S, the associated fees should decrease as well. Late fees could be expected to increase if interest rates increase to make debt service a greater proportion of monthly income.

### 5. Price Volatility ( $P_1 - P_0$ )

The most significant factor affecting price of a pass-through security is the relationship of market interest rates to the pass-through coupon rate. With an FPM when market rates are highly volatile prices are equally volatile. With the ARM, however,

coupon rates will move with market rates, thus decreasing the volatility or variance of market price. The lower the rate CAP or the longer the allowable period between rate changes, the greater the price volatility.

$$PV_{FPM} = (r_c - r_m)V \quad PV_{ARM} = (r_c - r_m)V, CAP, rp$$

$r_c - r_m$  = Coupon rate - Market rate ,  $v$  = Volatility  
CAP = CAP on rate change  
rp = Rate adjustment period

#### Rate of Return Characteristics

1. Default Risk. Field and Cassidy (1977) concluded that the risk of payment delinquency is greater on a VRM than on a FPM. This results from increases in the debt service to income ratio when interest rates increase. Although default risk increases with delinquency risk, limitations on the magnitude and variability of VRM payments can reduce the level of this risk. Risk of default on a VRM due to an increase in the loan to value ratio does not differ significantly from the FPM. The same methods employed to reduce risk of default on FPM pass throughs can be used for VRM'S i.e., private mortgage insurance, letter of credit, etc. One would expect, however, that PMI premiums would be higher for VRM'S.

$$D_{FPM} = L/V, D/I, Q$$

$$D_{ARM} = L/V, \uparrow D/I, Q$$

D = Default Risk

L/V = Loan to value ratio

D/I = Debt service to income

Q = Other factors such as type of dwelling unit, geographic distribution, etc.

## 2. Non-Marketability Risk

Indications are that ARM pass throughs have been and will continue to be less marketable than FPM'S. Of the 25 public pass-through issues between 9-77 and 8-79, only two were backed by VRM pools. The VRM'S represent 14% of the value of all conventional pass throughs issued during that period, or \$200 million. No VRM pass throughs have been issued since 1978.

There are a number of inherent difficulties, in addition to lack of supply, that contribute to the non-marketability of ARM pass throughs. Restrictions on rate increases on the two VRM pass throughs have prevented them from keeping up with market rates. The coupon on the original issues in 1978 was 9.0, and at this date is only 10 1/8. Bond sales professionals claim that VRM'S are tough to sell because they are not responsive enough to changes in market rates.

Out of state (non California) investors who are subject to a 10% usury ceiling, find California VRM'S unattractive because interest rate increases are limited. This makes fixed rate investments more attractive to these investors. Some states prohibit VRM'S, therefore, lenders in those states may not buy them. Even in states where VRM'S are legal, Federally chartered S & L'S cannot purchase VRM'S with terms different from those authorized by the FHLBB. A fundamental obstacle to trading VRM pass throughs is their lack of uniformity. VRM pass throughs, even if they have the same origination rate, may have different

CAPS and rate indexes. In addition, different regional conditions affecting cost of funds and mortgage rates might lead to variations in rate adjustments. The lack of uniformity of VRM pass throughs will make it difficult for securities dealers to "make markets" for them by posting the prices at which they stand ready to buy and sell.

Finally, the complexity of the cash flows, maturity, and expected return of the VRM pass through constitute a barrier to marketability. As one FNMA official stated, "You need a degree in math to understand and trade in VRM pass-through securities".

$$NM_{FPM} = D, S \quad \uparrow NM_{ARM} = \downarrow D, \downarrow S$$

NM = Nonmarketability risk

S = Supply (i.e., size of market) of pass-through securities

D = Demand for pass-through securities

Non-marketability risk varies inversely with the size of the market and the demand for VRM pass throughs. Thus, the risk of non-marketability is greater for ARM'S than FPM'S because the market is smaller and demand is less.

### 3. Reinvestment Risk.

The risk of reinvestment at an unfavorable market rate is reduced with an ARM pass through. It is, however, not eliminated if the coupon rates cannot be adjusted to market. This is currently the case with VRM'S and as mentioned previously their rates have not been responsive to the dramatic shifts we have seen in market rates. It is expected that rate adjustments on ARM'S will continue to be restricted to some extent in order to insulate the consumer

(borrower) against the full impact of interest rate risk.

$$R_{FPM} = r_m \qquad \downarrow R_{ARM} = \uparrow r_m$$

R = Reinvestment risk

$r_m$  = Correlation with market rates

Reinvestment risk is lower for ARM pass throughs than for FRM'S because rate adjustments result in a higher level of correlation with market rates.

### Summary ARM Pricing

Incorporating the relevant information on ARM'S into the pricing model for pass-through securities, we can conclude the following:

$$P_{FPM} = \frac{SP + UP + I + F (P_1 - P_0)}{RF + D + NM + R}$$

$$\downarrow P_{ARM} = \frac{\uparrow \sigma^2 SP + \downarrow UP + \uparrow \sigma^2 I + F + \downarrow \sigma^2 (P_1 - P_0)}{RF + \uparrow D + \uparrow NM + \downarrow R}$$

The model demonstrates that the price the market is willing to pay for an ARM pass through will be lower than for a FPM pass through, given that all other characteristics are equal. There is an increase in the variance of scheduled principal payments ( $\sigma^2 SP$ ) and interest payments ( $\sigma^2 I$ ), a decrease in unscheduled payments (UP) and a decrease in price volatility  $\sigma^2 (P_1 - P_0)$ . Therefore, the expected cash flow cannot be predicted with as much precision for the ARM pass through as for the FPM. In terms of the W. F. Sharpe capital asset pricing model, there is greater variance in the expected return of the ARM pass through, hence greater risk and a lower price.

Observing the risk factors in the denominator, one can see

an increase in default risk and marketability risk, and a decrease in reinvestment risk. If we assume that the increase in the first two risk components at least offsets the decrease in the third, we can conclude that the risk premium for the ARM pass through equals or exceeds that for the FPM. This supports the previous conclusion that the market will price ARM pass throughs below FPM.

#### Adjustable Payment Mortgage (APM) Pass Throughs

This section uses the pass-through pricing model to compare APM pass throughs to FPM's. APM's include GPM's and SAM's.

#### Cash Flow Characteristics:

##### 1. Scheduled Principal Payments

Scheduled principal payments for SAM's are fixed like FPM's but carry a below-market coupon for the first ten years of the loan term or until the property is sold, whichever occurs first. A SAM and a FPM written at the same rate would pay the same principal for the first ten years. Since a SAM written at the same time as an FPM will carry a lower coupon, more scheduled principal will be paid on the SAM in the ten-year period than on the FPM at the higher market rate.

After the tenth year, scheduled principal payments on the SAM are uncertain. The lender's share of appreciation must be paid at that time. The original loan may continue but at the then market rate, or it may be rewritten to include the lender's appreciation with the unpaid principal. The borrower may prefer to refinance at or before the tenth year in order to extend the term or take advantage of a low rate FPM opportunity. The timing of scheduled principal payments on the SAM is a function of market interest rates at the end of the tenth year, assuming the loan continues to maturity.



There are no scheduled principal payments in the early years of a GPM. For a 9½% coupon GPM scheduled to increase 7½% per year for five years, no principal is received until year five. After the payments become fixed (in the sixth year), scheduled principal is received on a regular basis as with a FPM. The GPM and FPM return the same amount of principal, but with a GPM a larger portion is paid in later years, decreasing the present value of the GPM cash flows.

The scheduled principal payments are represented as follows:

$$SP_{FPM} = P, r, t \quad SP_{SAM} = P, r, t, r_i, Pf_i \quad SP_{GPM} = P, r, t, g$$

P = Original principal

r = Original rate

t = Original term

$r_i$  = Market rate at ten years

$Pf_i$  = Probability of sale or refinancing at or before ten years

g = Graduation factor, ie., number of periods and rate at which payments are graduated

There is greater uncertainty in the SAM principal payments than the FPM or GPM, particularly with respect to timing. The GPM principal payments are more certain, but the timing of the payments is less favorable since no principal is received during the graduation period.

## 2. Unscheduled Principal Payments

Unscheduled principal payments are increased under a SAM because the loan must be paid off when the property is sold, ie, the loan cannot be assumed. Offsetting this however, is a reduction in refinancings for a more favorable rate, since the loan is written at a below market rate. On the other hand,

the borrower may want to sell the property and reinvest before the end of ten years in order to shield a portion of his property appreciation from payment to the lender.

Foreclosures may be higher for both the SAM and the GPM because of a higher loan to value ratio.

Prepayment patterns on GPM's are uncertain at this time. One can argue that GPM borrowers will have purchased a house suitable to long term needs and will be less likely to move. On the other hand, GPM borrowers are likely to be individuals with potential for income growth, who are upwardly mobile and who are likely to be transferred or to trade up to a larger home. Assumptions could increase because of the higher loan balance on the GPM, however the higher monthly payments in later years could be counter balancing.

At best we can say that unscheduled principal payments for APM's are highly uncertain and have the following characteristics:

$$UP_{FPM} = PP, F, S \quad \uparrow UP_{SAM} = ?PP, \uparrow F, \uparrow S \quad ?UP_{GPM} = ?PP, \uparrow F, ?S$$

PP = Prepayment to refinance

F = Foreclosure and sale

S = Prepayment at sale

### 3. Interest Payments

For both the GPM and the SAM, a portion of the interest payment is deferred in the early years of the loan.

$$I_{FPM} = P, r, t \quad ? I_{SAM} = P, r, t, r_i, x a_i \quad \uparrow I_{GPM} = P, r, t, g$$

P = Original principal

r = Original rate

t = Original term

$r_i$  = Market rate ten years after purchase

x = Lender's percentage share of appreciation

$a_i$  = Appreciation at sale or ten years after purchase

g = Graduation factor, ie number of periods and rate at which payments are graduated

The amount of interest received for the GPM is higher than for a FPM written at the same rate. This is because the loan balance is increased by the amount of the interest deferred during the graduation period. This feature of GPM's has been contested by consumer groups as unfair because it is charging interest on interest. The amount of interest received on a SAM is highly uncertain, as it depends on the level of appreciation at the time of sale or ten years in the future.

#### 4. Fees

As with ARM's, fees are usually not passed on to the pass-through investor and are not considered a significant element of cash flow.

#### 5. Price Volatility ( $P_1 - P_0$ )

Price volatility is affected by the volatility of the difference between the coupon rate and market interest rates. The price volatility of GPM's and SAM's should approximate that of FPM's, since all carry fixed coupon rates. The true interest rate on a SAM is variable, however, because it depends on the

level of property appreciation. If the SAM loan continues beyond ten years, the price of the pass through would reflect the change in coupon rate at the tenth year.

$$PV_{FPM} = (rc - rm)V \quad \Delta PV_{SAM} = (rc - rm)V, aV, (rc_i - rm)V$$

$$PV_{GPM} = (rc - rm)V$$

PV = Price volatility

$(rc - rm)V$  = Volatility of coupon rate minus market rate

aV = Volatility of property appreciation

$rc_i$  = New coupon rate at the tenth year

Rate of Return Characteristics:

1. Default Risk

Default risk for GPM's is higher than for FPM's for several reasons. The purpose of the GPM is to enable more individuals to qualify for a loan. This means the initial income requirement is lower than for a FPM. The outstanding GPM balance is higher than for a FPM. There is greater variation in the payment stream along with the risk that the borrower may find it difficult to handle the increased payments. With a SAM there is the risk that the borrower will not have the cash to pay the deferred interest at the end of ten years and can not handle the payments on a new loan. A significant factor in the level of default risk is whether the borrower uses the APM to buy a more expensive home or to avoid being "house poor."

As with FPM's, the APM pass through can be shielded against default risk with mortgage insurance, a letter of credit, etc. One would expect insurance premiums to be higher for APM's than for FPM's.

$$D_{FPM} = L/V, D/I, Q \quad D_{SAM} = \uparrow L/V, \uparrow D/I, Q \quad D_{GPM} = \uparrow L/V, \uparrow D/I, Q$$

D = Default risk

L/V = Loan-to-value ratio

D/I = Debt service to income

Q = Other factors such as type of dwelling unit, geographic distribution, etc.

### 2. Non-marketability Risk

The marketability of GPM pass throughs is enhanced by the fact that they can be pooled to form a GNMA GPM security. The first GNMA GPM was issued in April 1979. By June 1979, there were 50 GNMA pools totaling \$146.3 million. The SAM mortgage has not yet been fully developed or accepted, and there is no secondary market at this time.

The risk of non-marketability is higher for GPM's than for FPM's, and is highest for SAM's.

$$NM_{FPM} = D, S \quad \uparrow NM_{SAM} = ?D, S(0) \quad \uparrow NM_{GPM} = \downarrow D, \downarrow S$$

NM = Non-marketability risk

S = Supply (ie, size of market) for pass-through securities

D = Demand for pass-through securities

### 3. Reinvestment Risk

The fixed rate on a GPM makes the reinvestment risk essentially the same as for a FPM pass through. The real interest rate on a SAM is uncertain, and is contingent upon inflation in property values and future interest rates. There should be less reinvestment risk with a SAM than for FPM's because of a higher correlation with market rates.

$$R_{FPM} = r_m \quad R_{SAM} = r_m, r_{im}, a_m \quad R_{GPM} = r_m$$

R = Reinvestment risk

$r_m$  = Correlation of coupon rate with market rates

$r_{im}$  = Correlation of future coupon rate with market rates

$a_m$  = Correlation of property appreciation with market rates

Summary APM Pricing

Incorporating the relevant information on ARM's into the pricing model for pass through securities, we can conclude the following:

$$P_{FPM} = \frac{SP + UP + I + F + (P_1 - P_0)}{RF + D + NM + R}$$

$$\downarrow P_{SAM} = \frac{\uparrow \sigma^2 SP + \uparrow \sigma^2 UP + \uparrow \sigma^2 I + F + \uparrow \sigma^2 (P_1 - P_0)}{RF + \uparrow D + \uparrow NM + \downarrow R}$$

$$?P_{GPM} = \frac{\uparrow \sigma^2 SP + \uparrow \sigma^2 UP + \uparrow I + F + (P_1 - P_0)}{RF + \uparrow D + \uparrow NM + R}$$

The model indicates that the price the market would be willing to pay for a SAM pass through is lower than for an FPM. There is an increase in the variance of all significant cash flow components and an increase in default risk and non-marketability risk, and a decrease in reinvestment risk.

Pricing of the GPM is not as clearly stated. The timing of principal payments is less certain than for a FPM pass through, but interest payments received are greater. Risk of both default (for conventional GPM pass throughs) and non-marketability is greater, leaving price uncertain. Further study is required, using actual GNMA-GPM pricing data, to refine the relationships between the pricing factors.

## Section 5

### SUMMARY AND CONCLUSIONS

The pricing of AMI pass throughs is an elaborate and complex subject. This paper has established and applied a framework for pricing these instruments. The analysis of pricing for each AMI structure was approached on a rather general basis. Emphasis was placed on the relationships of pricing factors and how the AMI instruments differ from the FPM. The study concludes that the fundamental pricing characteristics will lead the market to price AMI pass throughs below FPM's.

Further study of each AMI instrument is warranted. Available data on GNMA GPM's and the Home Savings VRM's should be used to test the pricing model given in this study. Pre-payment characteristics, which will become increasingly available as more AMI's are issued, should also be the subject of further study. This paper assumed a continuation of generally high inflation and interest rates. Further research should be done with the pass-through pricing model to test price sensitivity in various economic scenarios.

In this study, analysis focused on five individual AMI instruments. A significant new AMI instrument has been proposed combining the VRM and GPM characteristics. Unlike most AMI's, the GPM-VRM addresses the requirements of both the

lender and the borrower. This instrument should be the subject of a future study using the pass-through pricing model. This analysis would be more complex than for the basic AMI's. The combination of the VRM and GPM characteristics in one instrument could result in offsetting price effects.

The literature on AMI's indicates that the use of these instruments can be expected to increase substantially, to the point where they may soon completely replace FPM's. Therefore, further study of AMI pass throughs is both timely and essential.



EXHIBIT 1

Definition of AMI'S Under Study and in Practice

1. Standard Fixed-Rate, Fixed Payment Mortgage (FPM). The FPM has constant payments with a fixed rate of interest with a fixed maturity. The 40, 50, or 60 year mortgage is a possibility.
2. Graduated Payment Mortgage (GPM). The standard GPM has a fixed interest rate and maturity, but payments rise at a constant rate (annually or monthly). It may or may not involve initial negative amortization. Variants include:
  - 2A. Two-Step-GPM (TS-GPM). Payments are different for the first X years, then it reverts to FPM. (A variant of this, the flexible payment mortgage, is currently authorized for Federal S & Ls).
  - 2B. Purchase Assistance Mortgage (PAM). Just like the GPM or the TS-GPM, but with a higher initial downpayment to reduce initial mortgage payments.
3. Variable Rate Mortgage (VRM). The interest rate varies at least once in an uncertain way. The rate may vary according to an index of interest rates and a rule (possibly with constraints connecting the index and the contract rate). Variants include:
  - 3A. Variable Payment. Payments vary, with the term fixed.
  - 3B. Variable Maturity. Payments are fixed and the term varies.
  - 3C. Variable Payment and Maturity. Payments and term both vary according to some rule or an agreement each time the contract rate is to vary.
  - 3D. Canadian Roll-Over Mortgage (CROM). A FPM, except there is periodic refinancing at the current interest rate.
  - 3E. Dual Rate VRM (DR-VRM). The DR-VRM distinguishes between the interest rate used to compute payments and that used to debit the lender's accounts. The difference can be made up by changes in maturity or by an insurance system.
  - 3F. Constant Factor VRM (CF VRM). A DR-VRM with fixed payment interest rate, and fixed maturity. Payments are rescheduled annually in order to amortize the balance outstanding over the remaining term of the mortgage.

3G. Price Level Adjusted Mortgage (PLAM). The outstanding balance (and hence the payments) are increased by the rate of inflation, as measured by a selected price index. The term is variable on some PLAM'S.

3H. GP-VRM. A DR-VRM that has payments rising at a steady annual (or monthly) rate, with variable maturity. Other variants of this exist.

3I. PLAM-VRM. A PLAM with either a single or dual rate VRM feature.

4. Reverse Annuity Mortgage (RAM). Lender pays the borrower a fixed amount each month, either for a fixed period of time until a certain loan-to-value ratio has been reached, or until the recipient is deceased (i.e., an insurance scheme).

5. Shared Appreciation Mortgage (SAM). A FPM, but the lender receives a share in any increase in the value of the house when it is sold.

6. Deferred Interest Mortgage (DIM). In the DIM, the lender collects some of the initial interest payments (plus a fee) upon the sale of the house if it is sold within 5 years (or so), and if it is sold, the mortgage reverts to FPM, at the current market rate or at a predetermined rate, with deferred interest amortized over the remaining term.

7. Fixed-Payment, Adjustable Rate Mortgage (SB 1937, Foran)

8. Renegotiable Rate Mortgage (AB 3142, McAlister)

EXHIBIT 2 (ARM's)

VARIOUS EXISTING AND PROPOSED MORTGAGE INSTRUMENTS

LOAN FEATURE	EXISTING VRM(1)	PROPOSED NATIONAL BANK - VRM	PROPOSED FNMA VRM	TENTATIVE CALIF. VRM - C.A.R.(2)	EXISTING ARM(3)
Type of property:	Residential, 1-4	Residential, 1-4	Not Known	Residential, 1-4	Residential, 1-4
Term of loan:	No mention of term	No mention of term	Not Known	Offer not less than 29 years	Up to 30 years
Specified interim loan periods:	None	None	Not Known	None	3,4, or 5 years
Monthly payment changes:	Can fluctuate with interest changes	Can fluctuate with interest changes	Can fluctuate with interest changes	Can fluctuate with interest changes	Fixed for interim loan periods, change then with interest fluctuations
Interest Rate:					
a. Frequency of Permissible changes:	State: 6 months Federal: 1 year	6 months	1 year	6 months	At end of each specified interim loan period
b. Mandatory Change?:	Up - permissive Down - mandatory	Up - permissive Down - mandatory	Not Known	Up - permissive Down - mandatory	Up - permissive Down - mandatory
c. Minimum change:	1/10 of 1% (5)	May be specified by lender	Not Known	Not specified	None
d. Accumulation Permitted?:	Yes (5)	Yes	Not Known	Not specified	None
e. The Index:	State: Cost of Funds, Ca. S&Ls (5) Federal: Cost of Funds, U.S. S&Ls	Lender has 4 Options: I. Contract Rate, all lenders, existing homes, U.S. II. FNMA Auction Yield, FHA or VA mortgages, U.S. III. U.S. Treasury 3-year Securities, or IV. U.S. Treasury 5-year Securities, <u>BUT</u> in no case to exceed lenders'	"Market Conditions"	Cost of Funds, Ca. S&Ls	State: Lender has 2 options: I. Cost of Funds, Ca. S&Ls, or II. Contract Rate, all lenders, existing homes, U.S. Federal: Option II, above
f. Caps:					
I. Periodic:	State: ½ of 1% in 6 months Federal: ½ of 1% in 1 year	½ of 1% in 6 months	1% in 1 year	½ of 1% in 6 months	½ of 1% per an. for each year of the elapsed interim loan period
II. Term of Loan:	2.5%	None--thus, from a practical standpoint, 294	5% during the first 12 years, adjust thereafter to infinity	5%	5%
Negative Amortization:	No	Possible, at the option of borrower at the time of interest rate change (in lieu of, or to minimize, an increase in monthly payments) but not to exceed 5% of initial principal and loan must be fully amortized in 30 years	No	No	No
Equity Sharing:	No	No--except possible negative amortization	No	No	No

EXHIBIT 2 (ARM's) cont.

VARIOUS EXISTING AND PROPOSED MORTGAGE INSTRUMENTS

LOAN FEATURE	EXISTING VRM(1)	PROPOSED NATIONAL BANK - VRM	PROPOSED FNMA VRM	TENTATIVE CALIF. VRM - C.A.R.(2)	EXISTING ARM(3)
Borrower option upon change in Payment of interest:	State: Extend term to 40 years to maintain(or minimize change in monthly payments Federal: Extend term up to 1/3 of original	Incur negative amortization	Not Known	Extend term to 40 years to maintain (or minimize change in) monthly payments	None
Prepayment without penalty:	Within 90 days of notice of any interest increase	At any time beginning 30 days before first schedule rate adjustment date	Not Known	Within 90 days of notice of any interest increase	At any time beginning 90 days before expiration of first interim loan period
Are Loans Assumable?:	State: Presumably, yes under <u>Wellenkamp</u> Federal: Presumably no under Glendale (under appeal)	No, but subject to decision in <u>Glendale</u> appeal	Not Known	Yes	State: Presumably yes under <u>Wellenkamp</u> Federal: Presumably no under <u>Glendale</u> (under appeal)
Fees or charges at Point of Change:	None permitted	None permitted	Not Known	None permitted	None permitted
Notice Provisions:					
a. Initial Loss:	State: minimal Federal: Detailed including worst case	More detailed, including extreme cases	Not Known	Minimal	Some detail, with examples
b. Time of Change:	State: 30 days minimal (5) Federal: 30 days, some detail	30 days, some detail	Not Known	60 days, detailed	90 days, some detail
Offer of an alternative Instrument:	State: None required Federal: Fixed rate, level payment, fully amortized loan	None required	Not Known	None Required	State: fixed rate, minimum term of 29 years. Federal: None required
Limitation on percentage of loan portfolio:	State: None Federal: 50%	None	None	None	None
Senior Citizen Option:	No	No	No	Conversions to fixed rate mortgage at age 65 if owner-occupant for 9 years	No
Federal Preemption:	State: not applicable Federal: Yes for Federal S&Ls	Yes	Probably, if eligible for sale to FNMA	Not applicable	State: Not applicable Federal: Yes, for Federal S&Ls
Sunset:	State: None Federal: Dec. 31, 1982	None	Not Known	None	None

- (1) VRM - California, Civil Code §1916.5, and Federal under FHLBB regulations 12 CFR 545.64(c). Federal variations are noted. Federal provisions sunset December 31, 1982.
- (2) As proposed for discussion with S&Ls by C.A.R. by letter of 8-4-80.
- (3) RRM - California, Civil Code §1916.8, and Federal under FHLBB regulations 12 CFR 545.6-4a. Federal variations are noted.
- (4) GPM - for Calif. S&Ls, Financial Code §7153.9 (which sunsets January 1, 1983) and S&L Commissioner's regulation 10 Cal. Adm. Code 178. For banks, Financial §1237 (which sunsets January 1, 1984) has not be implemented.
- (5) For Calif. S&Ls, set by 10 Cal. Adm. Code 240.3. No standard for other Calif. lenders. For Federal S&Ls, by 12 CFR 545.6-4a.

EXHIBIT 3 (APM's)

VARIOUS EXISTING AND PROPOSED MORTGAGE INSTRUMENTS

LOAN FEATURE	CALIF. EXPERIMENTAL GPM (4)	PROPOSED FHLBB GPM - ADJUSTABLE RATE	PROPOSED FHLBB SHARED APPRECIATION
Type of property:	Owner-occupied, Residential, 1-4	Residential, 1-4	Owner-occupied, Residential, 1-4
Type of Loan :	Up to 30 years	Up to 30 years	10 years. Guaranteed refinancing 30 years. (amortization up to 40 years)
Specified Interim Loan Periods:	None	3,4, or 5 years	10th year
Monthly Payment Changes:	I. Increase 7½% per an. for 5 years or II. Increase 3% per an. for 10 years	I. Increase 7½% per an. for 5 years, or II. Increase 3% per an. for 10 years, PLUS reflection of interest changes at 3, 4, or 5 year intervals. but cumulative limit of 15% in any year	At 10th year
Interest Rate:			
a. Frequency of Permissible change:	Never	At end of each specified interim loan period	At 10th year
b. Mandatory Change?:	Not applicable	Up - permissive Down - mandatory	Mandatory to market
c. Minimum Change:	Not applicable	None	Not applicable
d. Accumulation Permitted:	Not applicable	None	Not applicable
e. The Index:	Not applicable	Contract Rate, all lenders, existing homes, U.S.	"The prevailing rate"
f. Caps:			
I. Periodic:	Not applicable	½ of 1% per an. for each year of the elapsed interim loan period	None
II. Term of loan	Not applicable	5%	None
Negative Amortization:	Yes, on prescribed and inflexible schedules in the loan documents	Yes, but never to permit a loan balance in excess of 95% of initial purchase price. Occurs by GPM feature and interest increases above 15% payment cap	Not precisely, but an unstructured sharing in equity appreciation.
Equity Sharing:	No--except negative amortization	No--except negative amortization	Yes, lender acquires a fee interest in specified % of equity appreciation (not to exceed 40%) during first 10 years of loan
Borrower Option upon change in Payment or Interest:	None	None	If loan remains at 10th year, pay lender's share of equity or guaranteed refinancing at current market
Prepayment without Penalty:	General law applies, Civil Code §2954.9, if owner-occupied	At any time beginning 90 days before expiration of first interim loan period	At any time
Are loans assumable?:	Yes	No	No
Fees or charges at point of change:	None permitted	None permitted	Appraisal fee only
Notice Provisions:			
a. Initial loan:	Minimal	Some detail, with examples	Detailed
b. Time of change:	None	90 days, some detail	90 days, detailed
Offer of an alternative instrument:	Standard mortgage loan "at current rates"	None required.	None required (but FHLBB intent)
Limitations on Percentage of loan portfolio:	10% of assets	None	None, (but FHLBB intent)
Senior Citizen option:	No	No	No
Federal Preemption:	Not applicable	Yes, for Federal S&Ls	Yes, for Federal S&Ls
Sunset:	January 1, 1983 (4)	None	None

Notes: See Notes for Exhibit 2, p. 29.

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INTERVIEWS

The following individuals were contacted as industry spokesmen, and asked for their opinion on AMI pass through securities.

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Legislative Analyst  
Crocker National Bank, Sacramento

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Alan Rothenberg  
Senior Vice President  
Citizens Savings and Loan Association  
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Dr. Peter Treadway  
Federal National Mortgage Association  
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Michael Welborn  
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