nine months, inflation is presumed to be "correspondingly higher." If, for example, the ten-year CMT yield were to have averaged eight percent during the past nine months, a 50 percent increase would raise it to 12 percent. The Act, however, would permit an increase to 14 percent.

OFHEO would first determine what annual percentage difference in general inflation rates best corresponds to the difference between a 12 percent and a 14 percent ten-year CMT yield over a nine-year period. The difference in inflation rates could be assumed to be equal to the difference in interest rates or it could be based on an estimated historical relationship.

OFHEO would then translate that higher inflation rate into individual house price changes. Again, the differences in house price changes could be assumed to be equal to the difference in general price inflation rates or could be based on an estimated relationship.

As the last step, OFHEO would translate the difference in house price changes into differences in defaults. This could be done in the context of a multivariate default and prepayment model used for making many adjustments simultaneously (see "Models of Default and Prepayment" below), or it could be the subject of a separate analysis.

Question 11: Should OFHEO assume a "one-to-one" relationship between long-term differences in interest rates, general price inflation rates, and house price inflation rates or should it estimate more complex, but potentially more realistic, relationships between these phenomena?

Question 12: What is the best method of modeling the effects of higher house prices on defaults?

Mortgage Prepayments—Credit Risk

Prepayments are a significant factor in interest rate risk, but they also affect credit losses. Interest rate changes have a significant influence on mortgage prepayments. Prepayment rates are sensitive to the differences between current market yields and the levels of mortgage rates among outstanding mortgages. A homeowner today will refinance (and prepay) when current mortgage rates fall as little as 50 basis points below the rate on his or her mortgage.

Prepayment rates also depend on the time paths of interest rates. Homeowners who fail to refinance once mortgage rates become advantageous are relatively unlikely to do so in the future (many may not qualify for refinancing). Thus, prepayment rates for mortgages with a given coupon rate rise as interest rates fall below a particular threshold, but they eventually will slow, even if interest rates remain at the new lower levels or continue to decline. This phenomenon is commonly known as "burn-out."

The expected pattern of prepayments in the stress period might be quite different from the pattern experienced during the benchmark period. The drastic yield curve shifts that will be experienced during the initial year of the stress period will almost certainly not be found during the benchmark period that OFHEO must identify. The greater number of mortgages that prepay, the fewer are the candidates for subsequent default. Conversely, the fewer mortgages that prepay, the greater the number remaining that might default. At the same time, the default risk of mortgages remaining after a refinancing wave may be higher than previously. Many homeowners who did not take advantage of attractive refinancing opportunities may have been unable to do so because of higher risk profiles. Given the widely divergent interest rate movements that the Enterprises may experience during the stress period, loss adjustments for differing prepayment behavior could be considerable.

If OFHEO expresses mortgage default rates as conditional rates, defaults during any given time interval of the stress period will depend on the proportion of mortgages outstanding at the beginning of that time interval. Such an approach would, in effect, make a substantial adjustment for prepayments. A more complicated adjustment would take into account the generally higher quality of loans eligible for refinancing. In a stress scenario involving falling interest rates, for example, the stress test might take into account the generally higher quality of loans that qualify for refinancing and the potentially lower quality of surviving loans (see "Models of Default and Prepayment'' below). Alternatively, if the stress test involves no interaction of the total amount of defaults and prepayments, OFHEO still might adjust the timing of defaults during the stress period to be consistent with prepayments expected in a particular interest rate scenario. Mortgage prepayments are discussed further under "Interest Rate Risk" below

Question 13: Should anticipated prepayments affect the volume or timing of defaults in the stress period?

Mortgage Age

Holding homeowner's equity constant, a number of factors make the

likelihood of borrower default vary over the life of a loan. On one hand, changes in a borrower's circumstances subsequent to the loan's origination, such as unemployment, marriage, divorce, childbearing, mortality, and residential mobility, affect the likelihood of default and prepayment, and the cumulative frequency of such events increases as a loan ages. On the other hand, a record of consistent payments by a borrower over time increases the probability of continued loan performance.

Models that have included variables for both homeowner's equity and mortgage age have found the contribution of age to be statistically significant.²³ This may be particularly important if an origination year approach is used in the benchmark. Using an origination year approach, loans in the stress benchmark would all be newly originated loans, while those at the beginning of the stress period would be a mixture of old and new loans.

Question 14: Is it appropriate for OFHEO to factor mortgage age into the stress test, and, if so, what is the best method of doing so?

C. Models of Default and Prepayment

There are a number of approaches to relating the factors discussed above, such as LTV, mortgage type, mortgage age, and prepayments, to the performance of the Enterprises during the stress period. A comprehensive way to incorporate all of these factors into the stress test would be to estimate joint multivariate models of default and prepayment.²⁴ A joint model of default and prepayment would ensure the consistency of these key variables and reflect an appropriate time pattern of defaults as well. Researchers have estimated a number of such models.²⁵

²⁵ Multinomial logit models for default have been estimated by Campbell and Dietrich (1983) supra; P. Zorn and M. Lea, "Mortgage Borrower Repayment Behavior: A Microeconomic Analysis with Canadian Adjustable Rate Mortgage Data, AREUEA Journal, 17(1):188-136, 1989; and Cunningham and Capone (1990) supra. More recently, proportional hazards models have been used to analyze default and prepayment. See, for example, J. Quigley, "Interest Rate Variations Mortgage Prepayments and Household Mobility, Review of Economics and Statistics, 119(4):636 643, 1987; and J.M. Quigley and R. Van Order, "More on the Efficiency of the Market for Single Family Homes: Default," Center for Real Estate and Urban Economics, University of California, Berkeley, 1992.

 $^{^{\}rm 23}\,{\rm For}$ example, see the papers cited in footnote 11 above.

²⁴ Due to the unique difficulties of modeling multifamily default and prepayment, multifamily and single-family loans would probably need to be modeled separately. The modeling of loss severity is discussed in the next section.