Mortgage Mechanics II: The Graduated Payment Loan

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In the previous *Illinois Real Estate Letter* issue, we examined the mechanics of the standard fixed-rate mortgage loan (FRM). FRMs have been popular with first-time home buyers in recent periods when inflation rates and, as a result, interest rates have been low and stable. However, the FRM can be expensive, in terms of lost purchasing power, early in a period when inflation is expected to be high. If high inflation is expected, then at the start of an FRM term the *real* (inflation-adjusted) debt service payment is at its highest expected level, while the borrower's real income is likely to be at its lowest point because of life cycle issues.

One tool for addressing this *tilt problem*, at least to some extent, is the focus of this issue's *Mortgage Mechanics* segment: the graduated payment mortgage loan (GPM). Introduced in the 1970s, the GPM is really just a special type of fixed-rate mortgage loan, since the interest rate on the most basic type of GPM is fixed throughout the loan term. The difference in the FRM and GPM instruments lies in the timing of the principal repayments. With the lender's yield held constant, payments on a GPM are rearranged such that the early cash flows are lower than they would be on a corresponding FRM, but then later cash flows (after the borrower's income is expected to have risen) are higher than they would be on a corresponding FRM.

The GPM's advantages to the home buyer might seem obvious: lower initial payments make the loan more affordable in the early years. At the same time, a peculiar GPM feature known as *negative amortization* tends to discourage lenders, and sometimes borrowers as well. If amortization is negative, then principal owed actually *increases*, rather than falling, with each successive payment early in the loan's life. Because lender risk is increased by negative amortization (and by some other features associated with the GPM), this type of loan can carry a higher downpayment requirement or a higher interest rate. In an ironic twist, these features offset the affordability benefits that GPMs were designed to provide.

The Structure of the GPM

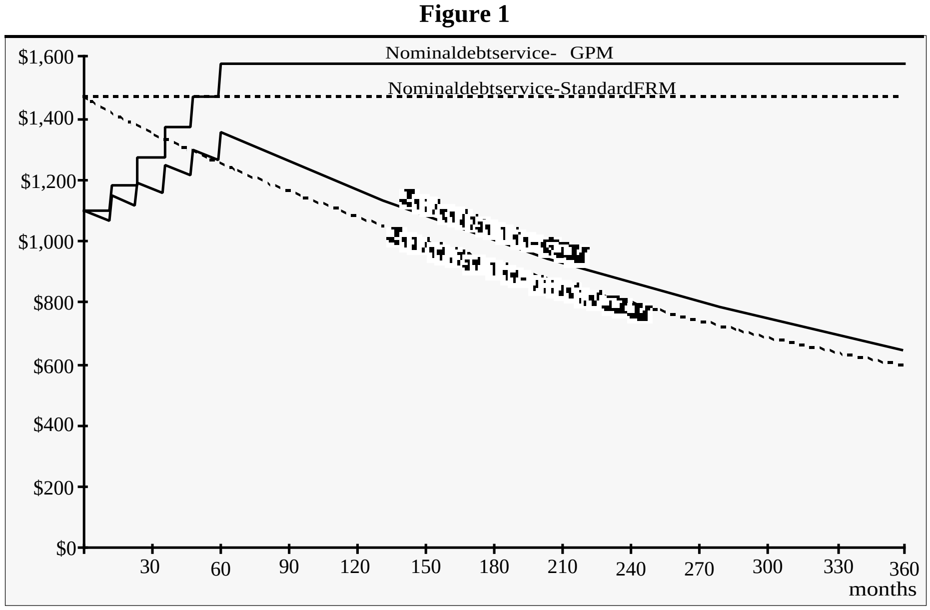
The GPM is like the FRM in that each is a long-term, fixed rate, fully amortizing loan on which the borrower makes monthly debt service payments to the lender. However, unlike the FRM, for which the debt service payment is constant throughout the term, the payment on a GPM escalates one or more times during the early years of the term.

More precisely, the *nominal* monthly debt service payment on a GPM is at its lowest level in the beginning of the loan's term. Then, after some specified time period (such as one year), the monthly debt service amount increases to a new level, where it remains for a specified period (another year, for example). Debt service payments continue to "step up" in this manner in the early years of the loan's life, until they reach a plateau for the remainder of the term.

While an infinite number of initial payment and step-up combinations would be possible, a relatively few GPM structures have proven modestly viable in the lending arena. Among these have been plans supported by the Federal Housing Administration (FHA), whose mission of helping financially pressed home buyers has led the agency to experiment with innovative loan products such as GPMs. At one time there were five different payment plans available though FHA's Section 245 GPM program. These varied in the initial payment levels, the rates of monthly payment increases, and the numbers of years over which the payments rose. However, the best known plan is a 30-year fixed-rate GPM loan with five annual increases beyond the initial payment level, each of which is 7.5% higher than the previous years's payment. The first graduation takes place at the start of the second year; annual 7.5% increases continue through each of the next four years. Then with the fifth increase (which occurs at the beginning of the sixth year), the payments reach a plateau where they stay for the remaining 25 years.

While FHA played a pioneering role in developing GPMs, not all GPMs are federally insured. A borrower might simply prefer not to pay FHA insurance premiums, or might borrow more than Section 245's allowed maximum (a limit that varies by region; any higher initial principal is classified as a *jumbo* loan). To illustrate the mechanics of a GPM with five 7.5% payment increases, we present a graphical example involving a jumbo loan with a $200,000 initial principal, an 8% nominal interest rate, and monthly payments over 30 years. Figure 1 depicts nominal and real (inflation-adjusted) debt service payments on this loan. For

Figure 1



purposes of comparison, we also show nominal and real debt service for an 8%, 30-year, $200,000 standard FRM loan.

Figure 1 shows that, in the early years of the loan term, the GPM's nominal debt service payment rises in a stairstep fashion (a *step function*, rather than the horizontal line that characterizes nominal payments for the FRM). After starting at $1,102, nominal monthly debt service on the GPM rises in 7.5% steps to $1,582 (at the beginning of the sixth year). The somewhat cumbersome calculation of the $1,102 initial payment is presented in the sidebar on page 15.

The GPM is designed to yield the same rate of return for the lender as does the standard FRM, while rearranging payments for the borrower's benefit. A lender should be indifferent (aside from issues of risk, which we ignore for the moment) between a GPM loan and a standard FRM loan if the present values of all cash flows (the respective initial principal amounts and future debt service payments) are equal. It should be intuitively obvious that, because the GPM's early nominal monthly payments are lower than those on a corresponding standard FRM, the GPM payments must eventually surpass those of the FRM if the lender is to realize the same rate of return on the two loan instruments.

For the case illustrated in Figure 1, the GPM's initial-year nominal monthly payment is $366 less than the standard FRM's unchanging $1,468 figure. However, nominal debt service for the GPM increases just beyond $1,468 at the start of year five, and stays constant at $1,582 from the beginning of year six through the remainder of the 30-year term.

First, the Good News

In an inflationary period, real debt service for the standard FRM is relatively high at the beginning of the loan's term, but is much less than nominal debt service by the end of the term (see our discussion of the FRM in the Summer/Fall 1996 *Illinois Real Estate Letter* issue). This tilt problem surfaces when inflationary expectations are high; the high nominal interest rate, which includes a premium for inflation expected by the lender, causes the monthly debt service to be higher throughout the term than it would be if lower inflation were expected. As a result, the borrower's inflation-adjusted initial payments are expensive. But if the borrower's income rises with the general price level, a decline in real debt service as the expected inflation is realized makes later debt service payments increasingly affordable for the borrower.

The tilt problem that characterizes the FRM does not apply equally to the GPM. While *nominal* payments under the GPM arrangement shown in Figure 1 rise sharply from year to year early in the term, the *real* debt service level rises only slightly each year. The GPM's rising nominal payments become more manageable, in other words, as the borrower's income rises with inflation. Because of the structure and timing of the nominal payments in this GPM loan, the borrower may qualify for a larger loan than would be observed in the standard FRM case.

Now, the Bad News

There are problems, however, with the GPM loan structure. Perhaps the most severe, in the eyes of lenders, is that the early nominal payments are so low that they do not even cover interest, at the stated rate, on the remaining principal balance. We can best illustrate this negative amortization by examining the principal and interest components of the debt service payments over the life of a GPM, as shown (along with the nominal debt service payment) in Figure 2. Notice that, from the beginning of the sixth year (61st month) forward, the GPM behaves much like the standard FRM, with interest decreasing at an increasing rate, principal repayment rising at an increasing rate, and constant nominal debt service. It is in the first five years that the GPM's unusual features reveal themselves.

As is also true in the standard FRM case, we compute the interest component of a GPM payment as the monthly interest rate multiplied by the remaining principal balance. Hence, interest *due* in the first month, when exactly $200,000 in principal is owed, is $1,333 (= 8%/12 months x $200,000, the same amount of interest due on the standard FRM the first month). But recall that the entire amount actually *paid* each month during the first year of this GPM is only $1,102. Indeed, we see from Figure 2 that interest due exceeds the nominal value of the debt service payment early in the loan term. Note that debt service in the standard FRM case always exceeds interest due, so the principal balance falls with each monthly payment (amortization is positive).

Because amortization on a GPM is initially negative, the lender must add the amount by which interest due exceeds debt service to the principal owed, and must subsequently compute interest based on the higher amount of principal. For example, in the first month $231 (= $1,333 – $1,102) is added to the outstanding principal amount; the effective repayment of principal is negative $231, so principal owed at the beginning of the

Figure 2

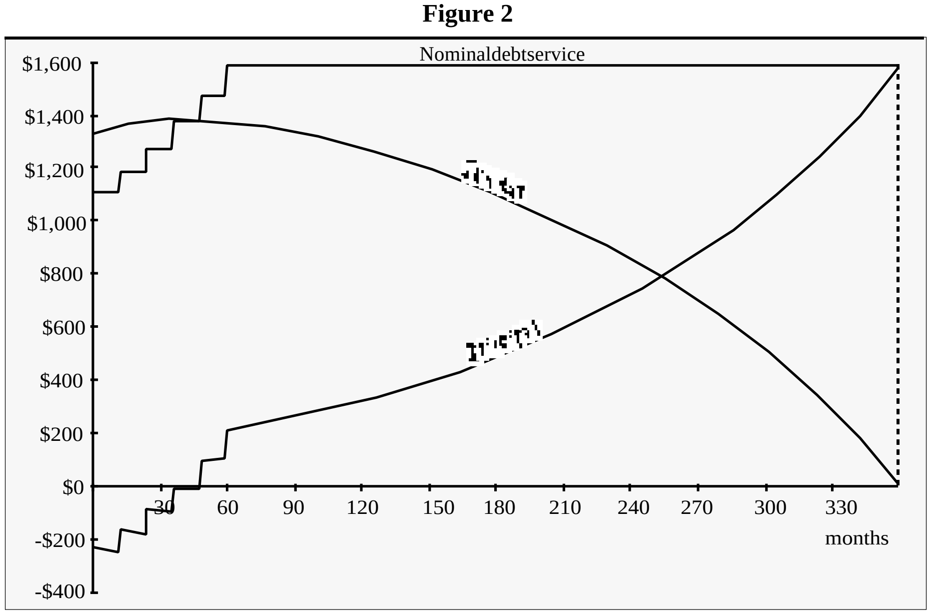
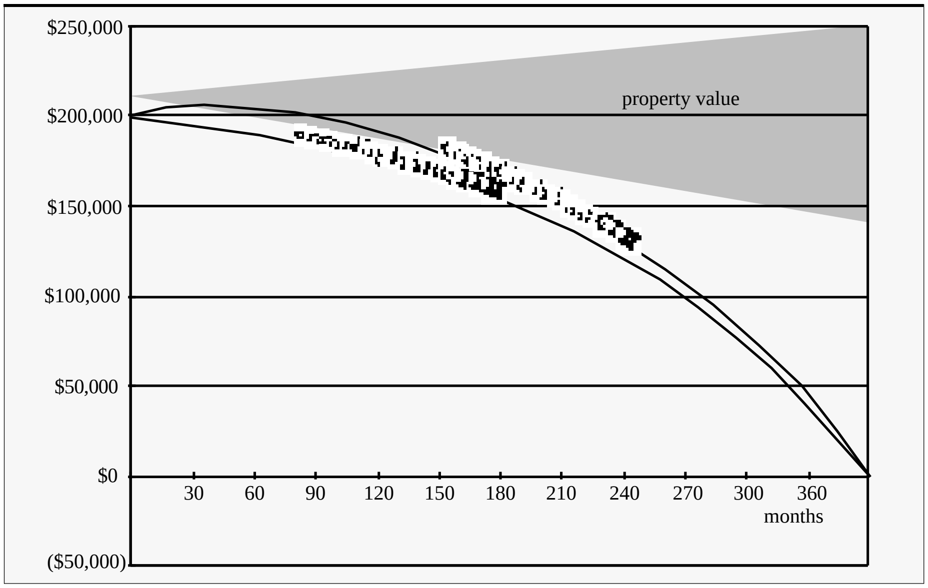


Figure 3



second month is $200,231. Note the graphical representation of this phenomenon in Figure 2, with principal repayment shown below the horizontal axis during the first few years of the term. As the principal balance continues to rise, interest due each month also increases, as is shown by the interest function's slightly rising slope early in the term.

Of course, as monthly debt service systematically escalates from year to year, it eventually reaches a level at which principal repayment is greater than zero. For the loan illustrated, principal repayment becomes positive at the beginning of the fifth year (the 49th month). At that time, the interest due with each successive payment starts to decline. Yet even though the principal balance begins falling from its $206,191 peak in the 49th month, it does not fall below its original $200,000 level until the *82nd* month! (Principal repayments become positive for this type of GPM loan at approximately the same point in time regardless of the contract interest rate. But for higher interest rates, amortization on the original $200,000 balance begins later in the term.) For the same loan, the principal balance would not fall below $200,000 until the 114th month if the stated interest rate were 10%. At a 12% contract interest rate, the remaining principal balance would not fall below $200,000 until the 147th month, nearly halfway through the term.

Consequences for the Lender

What are the implications for the lender? First, negative amortization causes the loan-to-value (LTV) ratio to increase, thereby increasing the risk that the borrower might default. Figure 3 illustrates why lenders might wish to avoid loan situations that include negative amortization. The gray shaded area represents uncertainty in the future value of the property pledged as collateral on the loan. Because of negative amortization, if the home value declines even slightly during the first few years of the term, the lender who has advanced a GPM loan with a high LTV (95% in the case illustrated) can find that the outstanding principal balance is greater than the market value of the property. This scenario is shown in Figure 3 by the portion of the gray-shaded property value area lying below the curve representing the outstanding loan balance. This problem does not accompany the corresponding FRM case.

Thus, while the yield a lender earns on a GPM loan may be identical to that earned on a standard FRM loan if their contract interest rates are equal, a key difference between the two types of instruments is exposure to default risk. To counteract this problem, lenders require slightly higher downpayments in GPM situations. An ironic result is that the affordability features of GPMs are somewhat ambiguous; the benefits that a cash-short borrower realizes through lower initial debt service payments are offset, to some extent, by the need to pay more out-of-pocket at the closing.

The lender also faces greater interest rate risk with a GPM than under standard FRM loan arrangements. Interest rate risk is often analyzed through a measure known as *duration*, a concept related to the time that elapses before cash flows are received; higher duration corresponds to greater interest rate risk. Because of the low early-year payments, a GPM has a longer duration than a standard FRM, and because of this longer duration the GPM is a more interest rate sensitive (and thus riskier) loan than is a standard FRM. In other words, if interest rates rise after the contract rate has been set, the value of a GPM, with its increasing loan balance, is likely to decline more than the value of a standard FRM of equal size and maturity. The lender compensates for the increased interest rate risk associated with a GPM by charging a slightly higher rate than on the standard FRM. The higher rate serves to further offset the GPM's purported affordability benefits.

One final problem with GPMs is that all of the interest *due* is taxed as income, even though much of what the lender receives in the early years of the term is an unrealized increase in the principal balance (the note value) rather than cash. Yet the borrower can deduct interest from income before computing taxes only in the year when it is actually paid; this restriction even further reduces the affordability benefits that the GPM is designed to promote early in the loan term. Interest added to the principal balance can be deducted only as it is paid, after amortization has begun to occur.

Conclusion

The graduated payment mortgage loan, touted as a cure for housing affordability problems of people with rising incomes, suffers several drawbacks. GPMs handle only part of the tilt problem associated with anticipated inflation, and features that increase lenders' risks lead to higher costs for borrowers. Finally, GPMs (like FRMs) do nothing to address unexpected changes in inflation. The latter problem is the focus of the Price Level Adjusted Mortgage (PLAM), to be discussed in a future *Mortgage Mechanics* offering. ■

Figure 4

To calculate the initial payment on a 30-year graduated payment mortgage loan with five increases of 7.5% and an 8% interest rate compounded monthly, apply the basic formula:

$$\text{INITIAL PMT} = \frac{\text{LOAN}}{(1+\alpha)\beta + \varphi}$$

Solving for the separate components:

$$\alpha = \left(\frac{(1+g)^{t+1}}{\left(1+\frac{i}{12}\right)^{(t+1)\times 12}} - \frac{(1+g)}{\left(1+\frac{i}{12}\right)^{12}} \right) \left(\frac{\left(1+\frac{i}{12}\right)^{12}}{(1+g) - \left(1+\frac{i}{12}\right)^{12}} \right)$$

$$\alpha = \left(\frac{(1.075)^{6}}{(1.0067)^{72}} - \frac{1.075}{(1.0067)^{12}} \right) \left(\frac{(1.0067)^{12}}{1.075 - (1.0067)^{12}} \right)$$

$$\alpha = \left(\left(\frac{1.5433}{1.6135}\right) - \left(\frac{1.075}{1.083}\right) \right) \left(\frac{1.083}{1.075 - 1.083} \right) = 4.88986$$

$$\beta = \frac{\left(1+\frac{i}{12}\right)^{12} - 1}{\frac{i}{12}\left(1+\frac{i}{12}\right)^{12}}$$

$$\beta = \frac{(1.0067)^{12} - 1}{.0067(1.0067)^{12}}$$

$$\beta = \frac{.0830}{.0072} = 11.49585$$

$$\varphi = (1+g)^{t} \left(\frac{\left(1+\frac{i}{12}\right)^{n-(t\times 12)} - 1}{\frac{i}{12}\left(1+\frac{i}{12}\right)^{n}} \right)$$

$$\varphi = (1.075)^{5} \left(\frac{(1.0067)^{288} - 1}{.0067(1.0067)^{360}} \right)$$

$$\varphi = 1.4356\left(\frac{5.7776}{.0729}\right) = 113.77192$$

Putting it all together:

$$\text{INITIAL PMT} = \frac{\$200{,}000}{(1+4.88986)\,11.49585 + 113.77192}$$

$$\text{INITIAL PMT} = \$1{,}102.04$$

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