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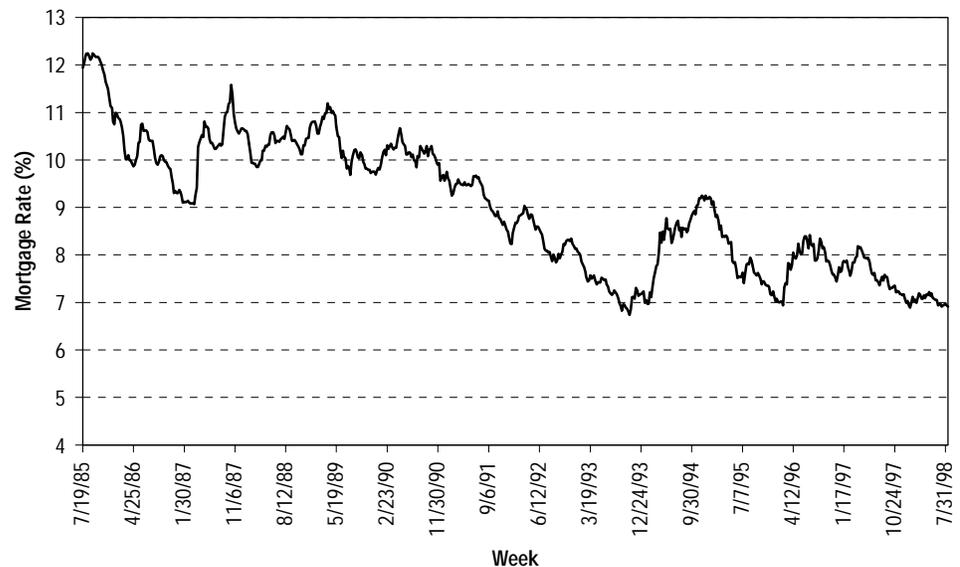
## Assessing Prepayment Model Risk

Mortgage rates remain close to historic lows, and as discussed in last week's commentary, a drop in the ten-year yield to about the 5.25% level will bring mortgage rates clearly below their early 1998 lows, igniting another media effect and leading to a surge in refinancings. Prepayment fears are most apparent in the mortgage derivatives market, with OASs on some 7.5% and 8% IOs currently 500bp or higher. These high OASs at least partly reflect fears that actual speeds going forward will be faster than projected by prepayment models. Given that changes in the mortgage origination process, demographics, housing markets, and so on will inevitably lead to prepayment surprises, this is a legitimate concern. In this article we use past prepayment patterns to analyze the type and magnitude of prepayment surprises that have occurred and then use this to estimate prepayment model risk going forward.

### A Comparison of Several Prepayment Waves

Figure 31 shows 30-year mortgage rates, as measured by Freddie Mac's weekly survey, from 1985 onward.

Figure 31. Freddie Mac 30-Year Mortgage Rate Weekly Survey



Sources: Freddie Mac, Smith Barney Inc./Salomon Brothers Inc.

Rates fell sharply from 1985 to early 1987, from 1991 through the end of 1993, from early 1995 to early 1996, and finally from the spring of 1997 through early 1998. In each case, there was a surge in refinancings. Figure 32 shows speeds for various coupons in peak months of these four refinancing waves.

Figure 32. Peak Speeds in Four Refinancing Waves

Coupon	9.5		10.0		10.5		11.0		11.5		Estimated Corresponding No-Point Mortgage Rate
	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	
Orig. Yr	1984	1985	1984	1985	1984	1985	1984	1985	1984	1985	
<b>Apr 87 CPR (%)</b>	<b>13.5</b>	<b>14.0</b>	<b>30.0</b>	<b>30.2</b>	<b>60.4</b>	<b>59.4</b>	<b>68.2</b>	<b>65.6</b>	<b>62.3</b>	<b>63.7</b>	<b>9.57%</b>

Coupon	7.0		7.5		8.0		8.5		9.0		Estimated Corresponding No-Point Mortgage Rate
	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	
Orig. Yr	1991	1992	1991	1992	1991	1992	1991	1992	1991	1992	
<b>Nov 93 CPR (%)</b>	<b>13.6</b>	<b>14.4</b>	<b>48.4</b>	<b>39.6</b>	<b>67.1</b>	<b>59.1</b>	<b>72.0</b>	<b>63.4</b>	<b>65.4</b>	<b>58.6</b>	<b>7.21%</b>

Coupon	7.0		7.5		8.0		8.5		9.0		Estimated Corresponding No-Point Mortgage Rate
	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	
Orig. Yr	1994	1995	1994	1995	1994	1995	1994	1995	1994	1995	
<b>Mar 96 CPR (%)</b>	<b>6.6</b>	<b>4.0</b>	<b>12.5</b>	<b>12.0</b>	<b>27.4</b>	<b>23.2</b>	<b>36.2</b>	<b>37.9</b>	<b>38.7</b>	<b>43.0</b>	<b>7.48%</b>

Coupon	7.0		7.5		8.0		8.5		9.0		Estimated Corresponding No-Point Mortgage Rate
	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	
Orig. Yr	1995	1996	1995	1996	1995	1996	1995	1996	1995	1996	
<b>Mar 98 CPR (%)</b>	<b>22.9</b>	<b>18.7</b>	<b>39.5</b>	<b>42.8</b>	<b>52.7</b>	<b>52.3</b>	<b>55.2</b>	<b>49.9</b>	<b>54.4</b>	<b>57.0</b>	<b>7.30%</b>

Sources: Freddie Mac, Smith Barney Inc./Salomon Brothers Inc.

There are several striking features of the speeds shown in Figure 32:

*Peak prepayment speeds have not increased over time.*

- ▶ The speeds on higher coupons in 1987 may surprise some people who assume that speeds have been uniformly becoming faster. In fact, peak speeds on coupons well in-the-money have *not* increased since the 1980s and tend to be in the 65%-to-70% CPR range.
- ▶ The most significant change from the 1980s to 1993 was an increase in speeds on *cuspy* coupons. For example, 7.5s were less in-the-money than 10s in 1987, yet speeds on 7.5s in late 1993 peaked at 40% CPR or more, compared with peak speeds of about 30% CPR for 10s in April of 1987. This can be attributed to a reduction in refinancing costs over time (the elbow shift) and the greater availability of no-point mortgages and more publicity about refinancing opportunities (the media effect).
- ▶ Thirty-year mortgage rates were about the same in late 1993 and early 1998.<sup>13</sup> However, the only coupons to show an increase in speeds (albeit minor) were the low cusp 7s, indicating only a slight reduction in costs. In addition, as detailed elsewhere,<sup>14</sup> the sudden jump in refinancing applications in early 1998 indicates a stronger media effect.
- ▶ Perhaps the most startling numbers in Figure 32 are the relatively slow speeds in 1996 and on higher coupons in 1998. The 1996 numbers, we feel, illustrate the importance of the media effect and borrower psychology; mortgage rates in 1996, while low by historical standards, were higher than what had been experienced just two years previously and hence seemed to cause little excitement. The relatively low speeds on higher coupons in 1998 provide an

<sup>13</sup> The Treasury yield curve was steeper in 1993, but as we have argued elsewhere (see, for example, the January 9, 1998, issue of this publication), its importance for MBS speeds is overstated: The spread between 30-year and 15-year *mortgage* rates was not much different in 1993 and 1998.

<sup>14</sup> See *Bond Market Roundup: Strategy*, Salomon Smith Barney, May 29, 1998.

indication of the increasing demographic diversity of the borrowers in agency pools, owing to programs such as affordable housing initiatives.

*Prepayment model risk is assessed by shifting the elbow and strengthening the media effect.*

#### Prepayment Surprises Going Forward

As mentioned earlier, current IO OASs seem to reflect fears that prepayments in the future will be faster than projected by models. While there are a myriad of assumptions in any prepayment (or, more generally, econometric) model, any of which could turn out to be wrong, the review of past refinancing waves above suggests that we can for simplicity focus on two potential changes, namely, reductions in costs (elbow shift) and increases in borrower awareness and reactivity to low rates (media effect).

**Elbow Shift, or Further Declines in Refinancing Costs.** What elbow shifts are implied by the speeds in Figure 33? Ignoring other factors such as the media effect, a comparison of the 1987 speeds on 1985 9.5s and 1993 speeds on the 1992 7s suggests an elbow shift of about 20bp; a comparison of the 10s and 10.5s in 1987 with the 7.5s in 1993 indicates an elbow shift of 40bp to 50bp. A comparison of the 7s in 1993 and 1998 suggests an elbow shift of perhaps 10bp to 15bp (although the 7.5s, still a cuspy coupon and hence significantly affected by elbow shifts, suggest almost no shift). Averaging these numbers and assuming *no* other changes such as increases in borrower awareness or lender proactiveness (the media effect), the changes in speed from the 1980s to 1993 can be explained by an elbow shift of 30bp to 40bp, while from 1993 to 1998 speeds imply a 10bp elbow shift at most.

The SSB prepayment model already assumes a reduction in costs of 0.5 points over the next two years thanks to automated underwriting systems and for our analysis here will assume a further reduction equivalent to an elbow shift of 25bp over the next two years.<sup>15</sup> As a more extreme case, we also consider an elbow shift of 50bp, which is close to the maximum that speeds imply over the last ten years. Figure 33 shows projected one-year speeds for conventional 7.5s for the base case and for these two elbow shifts.<sup>16</sup>

For a 25bp elbow shift, one-year projections increase by up to 10% CPR for cuspy coupons about 100bp in-the-money, and less in other cases. Note that these are one-year *average speeds*; peak speeds will increase more.

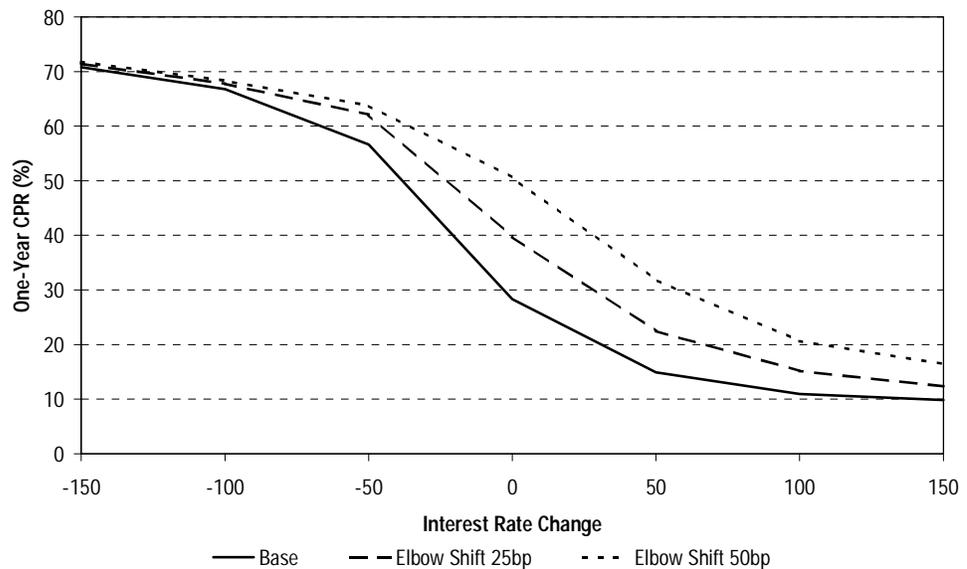
**Media Effect.** The media effect refers to the turbo-charging of speeds that occurs when rates hit multiyear lows, as publicity about low rates makes borrowers more prone to refinance and lenders more proactive.<sup>17</sup> The SSB model assumes that the media effect has increased over time, and we will assume here that the media effect will increase by an additional 25% over the next two years. While the impact of the media effect on projected speeds in the SSB model depends on a host of factors,

<sup>15</sup> The relationship between costs and elbow shifts depends on one's horizon. The industry standard for 30-year loans is that a point is worth 25bp, implying a duration of about four years, or a borrower horizon (prepaid life) of about seven years.

<sup>16</sup> These projections are from the dials page on *Yield Book*, which assumes an immediate elbow shift. In our analysis, we assume that the shifts occur linearly over two years.

<sup>17</sup> See Lakhbir Hayre & Arvind Rajan, *Anatomy of Prepayments*, Salomon Brothers, June 1995.

Figure 33. One-Year Projections for Conventional 7.5s Using Elbow Shifts



Source: Smith Barney Inc./Salomon Brothers Inc.

such as current and past rates, seasoning, and so on, the increase can, roughly speaking, be interpreted as meaning that the fraction of a class that prepays like the next-fastest class increases by 25% (there is also an effect on the lender side, with a greater temporary reduction in costs). Because if rates decline from here the media effect will be high even in the base case, and there is a leveling off in its impact when it is high, the effect on projections is moderate; for example, if rates decline 50bp, peak speeds on 7.5s will increase from about 65% to 70% CPR. However, for OAS analysis, on interest-rate paths where rates rise and then decline to multiyear lows, the effect will be more significant.

Impact on IOs

Figure 34 shows OASs for selected IOs and a long, locked-out IO using the base SSB model and the adjusted models described above.

Figure 34. OASs on IOs Using Various Prepayment Models<sup>a</sup>

IO	Collateral		Price	Base Model OAS	Media Effect 25% Higher and Elbow Shift of			
	Coupon	WALA			25bp		50bp	
				OAS	OAS	Change	OAS	Change
Trust 294	7.0 %	10	23-12	445 bp	165	-280	-64	-509
PC 188	7.5	13	19-20	657	367	-290	140	-517
Trust 291	8.0	24	18-06	646	397	-249	219	-427
FN97.61 PK	8.0	18	42-04	513	371	-142	281	-232

<sup>a</sup>Using market vols and closing prices for August 13, 1998.  
Source: Smith Barney Inc./Salomon Brothers Inc.

*IOs look attractive even adjusted for prepayment model risk.*

The results in Figure 34 indicate the current fundamental cheapness of the IOs, especially 7.5s and higher coupons. Even under an extreme assumption of an elbow shift of 50bp, which would imply the almost complete elimination of remaining closing costs such as title insurance and legal fees, OASs on the 7.5% and higher IOs are still in three figures. Note also the lower declines in OAS for the long, locked-out IO; its structure helps to partially shield it from prepayment model risk.

### Conclusions

Our analysis provides a method for estimating prepayment model risk, in a way that allows for a divergence between model assumptions and reality over a period of time. This, we feel, is preferable to the usual method of using multiples of the model, which can grossly misstate near-term speeds (for example, recent speeds on 7.5s and 8s have been lower than projections, hence using multiples greater than one will exacerbate the problem). The analysis suggests that IOs are cheap even when adjusted for prepayment model risk. The fact that we are close to historic lows may imply that the market gives more weight to further declines in rates than is given by term structure models (which are essentially centered around forward rates).

Another investor concern may be that peak speeds in a rally will surpass the 65%-to-70% CPR levels of past refinancing waves. It is somewhat surprising that peak speeds in March 1998 were not higher given the technological advances that have occurred in the mortgage origination process. This issue and other aspects of prepayment risk will be studied in a future elaboration of this article.