Error-Correcting Adjustments in the SSB Prepayment Model

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A prepayment model projects expected prepayment rates on a given MBS for a specified path of interest rates. Even if the SSB prepayment model correctly determines the *expected* prepayment (that is, it is right on average), actual prepayments will still differ from projections each month. Actual speeds are subject to *noise* caused by sampling error and other independent factors. The errors in this case are as likely to be positive as negative, fluctuating around zero and there is no correlation between the errors from month to month. However, in some cases the errors can persist for a while, with the model being too high or too low for a period of time. These "runs" of errors with the same sign, will display systematic correlation from month to month and are caused by a temporary difference between the model assumptions and reality. Even though the model is right in the long run, these factors lead to periods of under- or overestimation of actual prepayments by the prepayment model.

To correct for these transient differences between projected and actual prepayment speeds we analyze the correlation between errors in consecutive months. This leads to a model for the error in a given month conditional on past errors. Using this model we predict the expected error in that month and adjust the model accordingly.

Basic Methodology

For a month n, we denote $Projected(n)$ to be the projected SMM during that month and $Actual(n)$ to be the actual SMM during that month (if available). The relative error for month n is defined as follows:

$$E(n) = (Actual(n) - Projected(n)) / Projected(n)$$

We model these errors as described in an earlier Salomon publication[1]. This model states that the error at month n depends linearly on the error in the previous month plus some random noise.

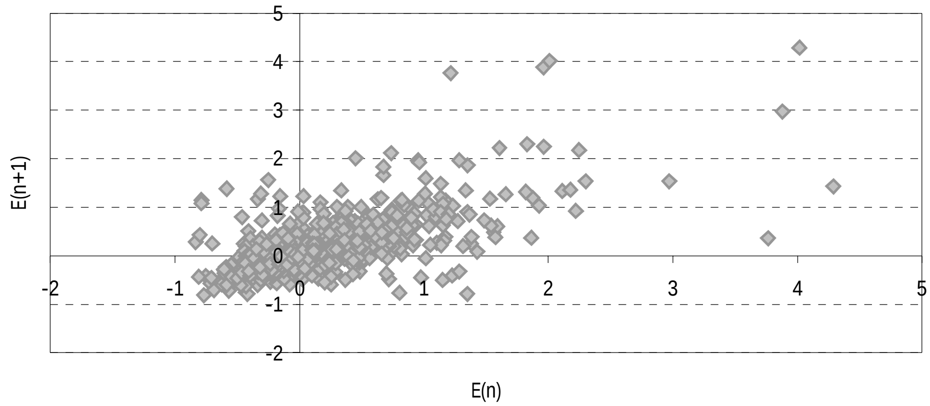
$$E(n+1) = b\,E(n) + Noise$$

The coefficient b can be interpreted as the correlation between errors in consecutive months. If $b=0$, then the errors consist of pure noise, which means that the next error is independent of the last error. If $0<b<1$, the errors are mean reverting to zero and hence are transient. If $b=1$, the errors are not transient, an indication that the model is misspecified.

In the following picture we plot historical error for any month versus the error in the previous month for FNMA collateral issued after 1991. This picture suggests that there is some correlation between errors in consecutive months and confirms our model.

[1] Random Error in Prepayment Projections, Lakhbir Hayre, Salomon Brothers Inc, July 1996.

Figure 1.



Source: Salomon Smith Barney.

Using our model we can predict that *on average* the error for any given month is b times the error for the previous month.

$$\hat{E}(n+1) = b \cdot E(n) \qquad (1)$$

The coefficient b is estimated statistically from historical data, so at each month we obtain a new estimate for b, denoted $b(n)$. Because errors from the recent past should have more influence on the estimate of b than the distant past, more weight is given to recent data.

The base model projections are adjusted as follows. If n is the last month for which we have actual prepayment data we change our projected prepayment for month $n+1$ to compensate for the estimated error given by equation (1).

$$\begin{aligned} Adjusted\ Projected(n+1) &= Projected(n+1)(1+\hat{E}(n+1)) \\ &= Projected(n+1)(1+b(n)E(n)) \end{aligned}$$

Continuing this, we obtain that, given errors up to month n,

$$Adjusted\ Projected(n+2) = Projected(n+2)(1+b(n)b(n)E(n))$$

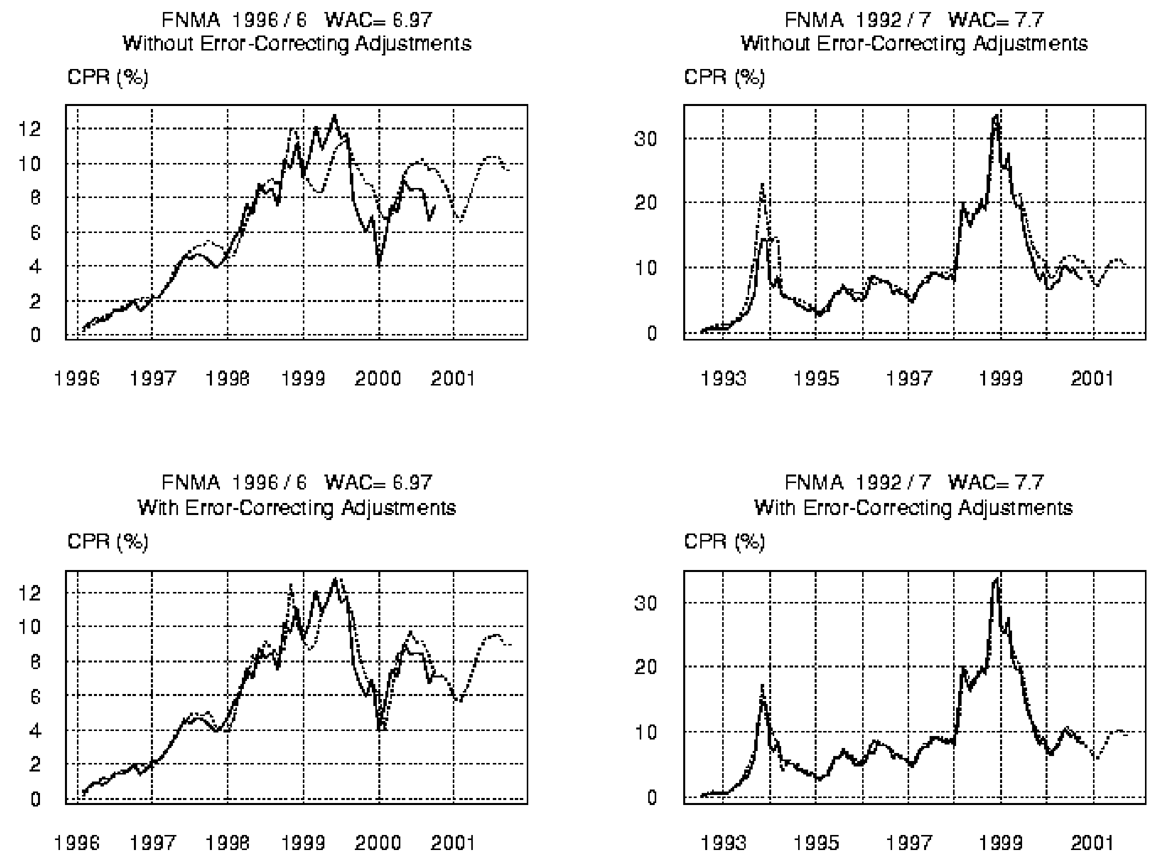
$$Adjusted\ Projected(n+k) = Projected(n+k)(1+(b(n))^k E(n))$$

Hence, for month $n+k$, given errors up to month n,

Because our model for the errors in mean reverting, the adjustments die out and long-term projections are mostly unchanged. The influence of past errors decays proportional to the powers of the correlation. The higher the correlation, the slower the decay will be.

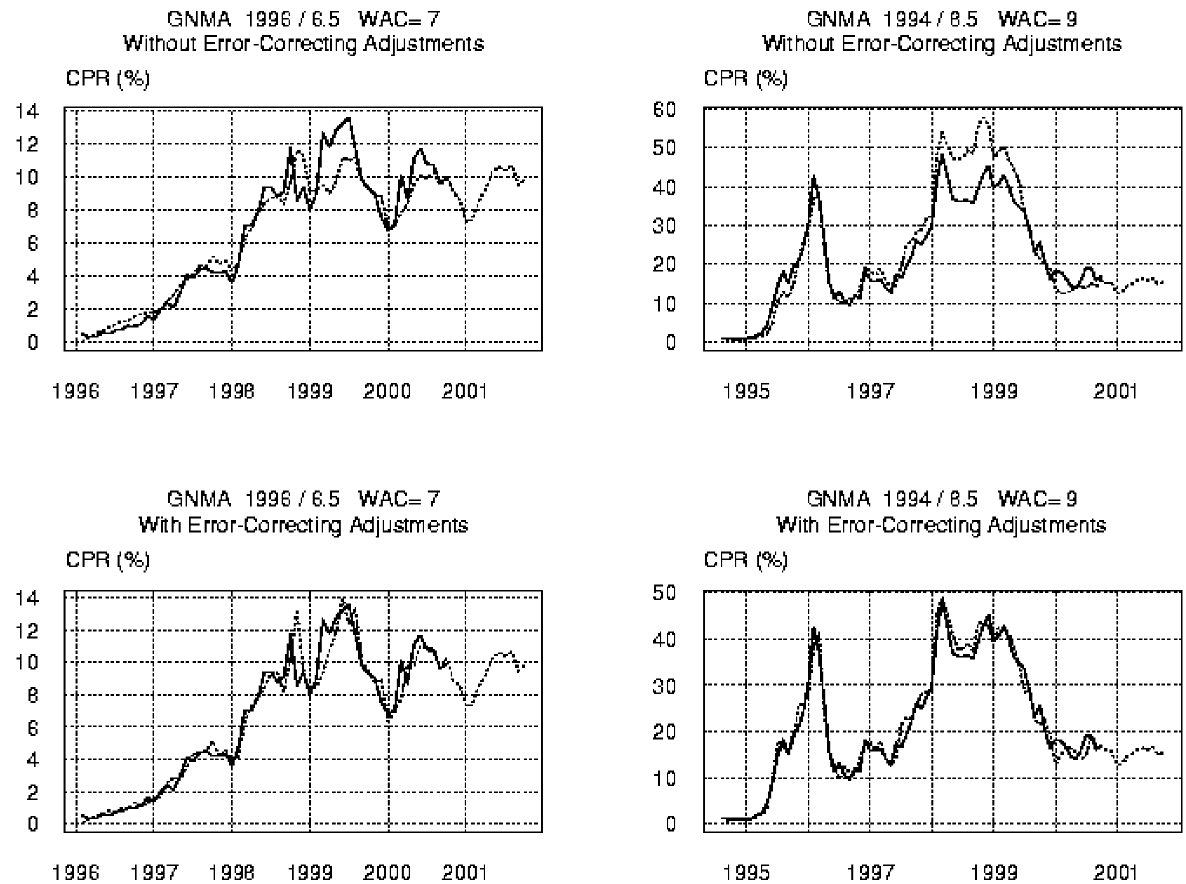
Attached are pictures of historical projections for 4 FNMA cohorts and 4 GNMA cohorts. These show the fits with and without the error-correcting adjustment. The first 2 pages show how the adjustments work for fits that are not so good and the last 2 pages show the adjustments for good fits. The adjustments have little effect on long-term projected speeds and hence the OAS' change only slightly.

Figure 2. Fannie Mae 30-Year Prepayment Speeds 1996/6 1992/7



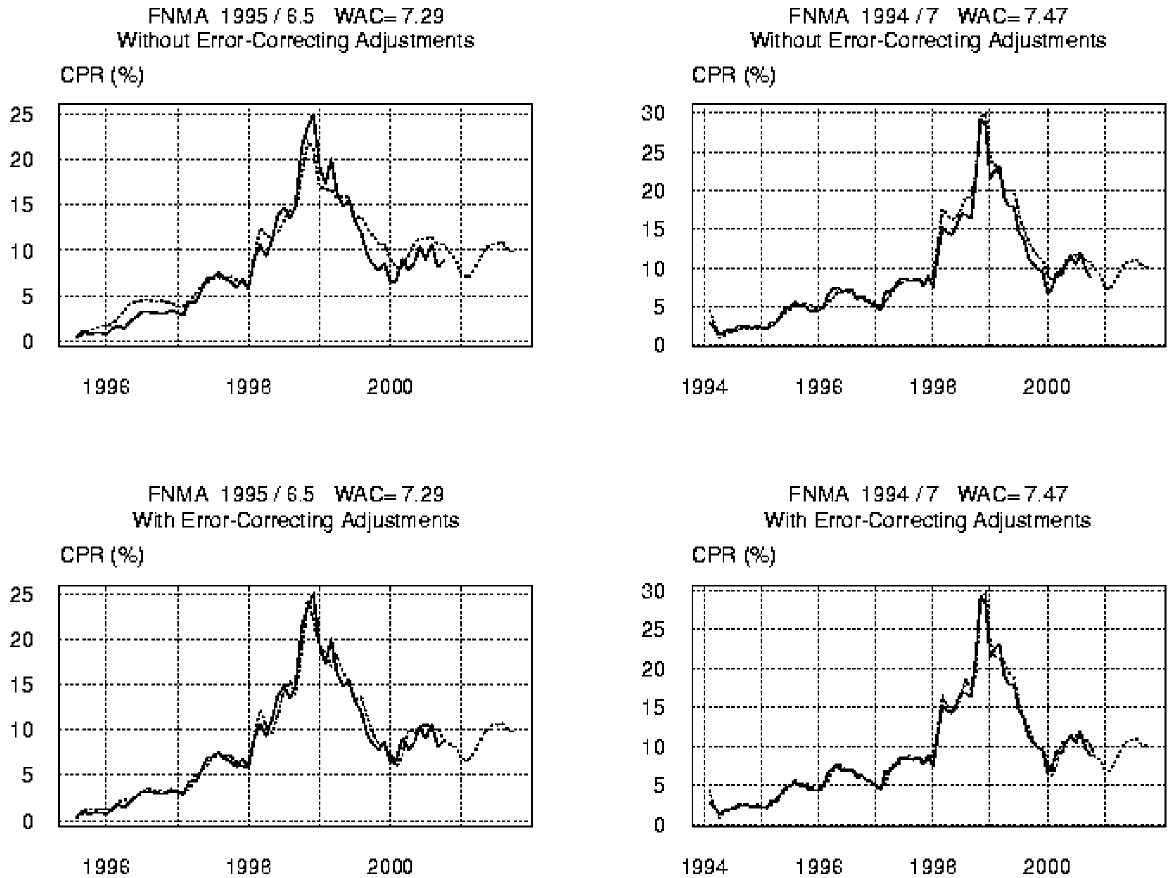
Source: Salomon Smith Barney.

Figure 3. Ginnie Mae 30-Year Prepayment Speeds 1996/6.5 1994/8.5



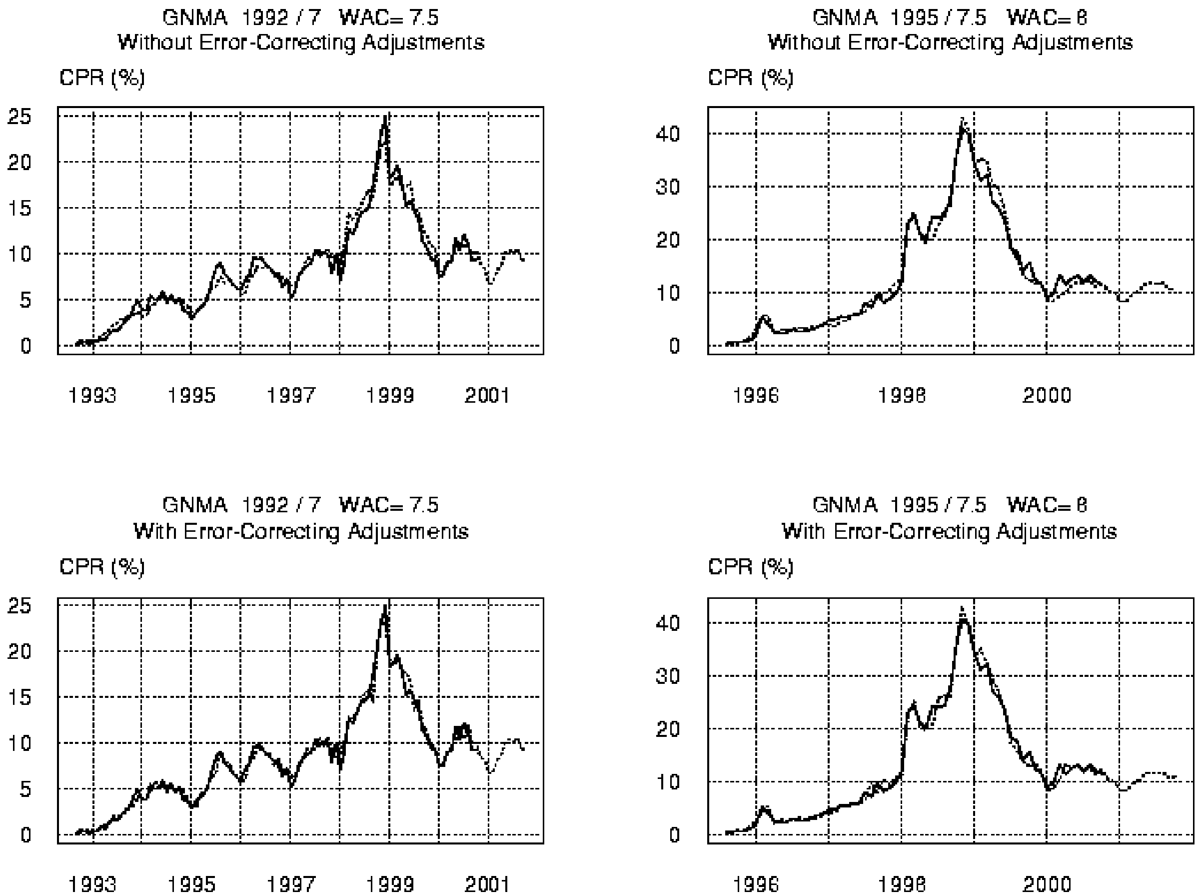
Source: Salomon Smith Barney.

Figure 4. Fannie Mae 30-Year Prepayment Speeds 1995/6.5 1994/7



Source: Salomon Smith Barney.

Figure 5. Ginnie Mae 30-Year Prepayment Speeds 1992/7 1995/7.5



Source: Salomon Smith Barney.