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Addendum 1* to the CRI Technical Report (Version: 2016, Update 1)

This document updates the Addendum 1 of the CRI Technical Report (Version: 2016, Update 1) and details a further improvement to the treatment of the parameter estimation of the CRI PD model for the Chinese sample as compared to Addendum 1. This change has been implemented for the Probabilities of Default (PDs) and Actuarial Spreads (ASes) released on 20 January 2017. This change has made the model setting more general and has improved the model performance for the Chinese firms significantly. The way to compute the statistical inference is also explained in this addendum.

I. Revision to the parameter estimation on the intercept and the DTD Level

In the CRI's PD model, the parameters for all covariates are assumed to be time-invariant. The overall performance of the model on various countries/groups (e.g. North America, Europe, etc.) is good (e.g. the accuracy ratio (AR) for 1-year PD for the North American firms is 82%; the 1-year AR for emerging market is 77%). One rare exception is the Chinese sample with an AR of 57% for 1-year PD. The relatively poor performance is also reflected in Figure 1 where the predicted number of defaults over the 1-year horizon has missed the general pattern of the realized number of defaults over the prediction horizon for the sample period.

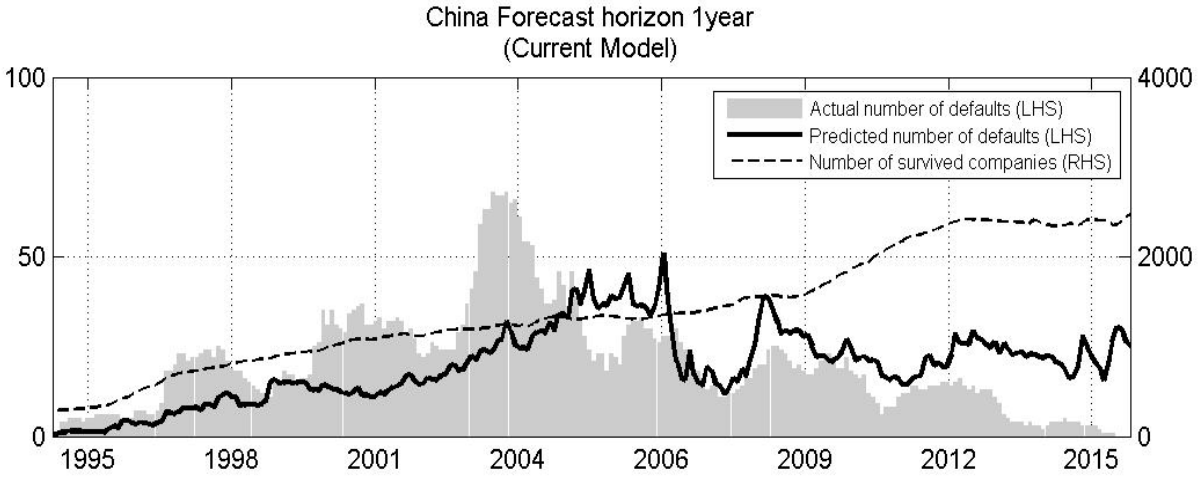

Figure 1

The CRI team has recently discovered a structural break for the Chinese sample occurring in December 2004. By simply allowing two parameters (i.e., coefficients for the intercept and DTD Level) to have a break before and after December 2004, the CRI model's performance on Chinese firms can be measurably improved. The adopted modification is to allow the break to occur in a smooth fashion instead of using a 0 and 1 dummy, and the smooth transition is accomplished by employing a logistic function.

Denote by t_0 the default prediction time where a structural break occurred, which is set to be December 31, 2004 for Chinese firms. We define the parameter for prediction horizon τ which is subject to a structural break at t_0 as

$$\beta(t,\tau;t_0) = \tilde{\beta}(\tau) + \tilde{\gamma}(\tau) \times \frac{1}{1+e^{-\tilde{\alpha}(\tau)(t-t_0)}} \quad (1)$$

where $\tilde{\alpha}(\tau)$ is a positive function of τ, controlling the rate of transition from one parameter value to another. For each prediction horizon τ, $\beta(t,\tau;t_0)$ moves in a smooth manner from $\tilde{\beta}(\tau)$ to $\tilde{\beta}(\tau)+\tilde{\gamma}(\tau)$ when the default prediction time advances toward and then beyond t_0. All functions of τ on the right-hand side of the above equation are modeled by a Nelson-Siegel (NS) function with three parameters as in the CRI Technical Report (Version: 2016, Update 1). Using three parameters ensures that the NS function approaches zero as τ goes to infinity.

The Addendum 1 model specification has 52 parameters in total where 12 are the newly introduced ones and 40 are in the original model for Chinese firms. These parameters are again estimated with the sequential Monte Carlo method as described in the CRI Technical Report (Version: 2016, Update 1).

The Addendum 1 model with a structural break in two parameters delivers a far superior performance on predicting defaults of Chinese firms. The accuracy ratios for 1-year, 2-year, and 5-year PDs have increased from 57%, 49% and 37% to 68%, 65%, and 54%, respectively. Figure 2 also shows a marked improvement of the new model over the old one whose performance was reflected in Figure 1.

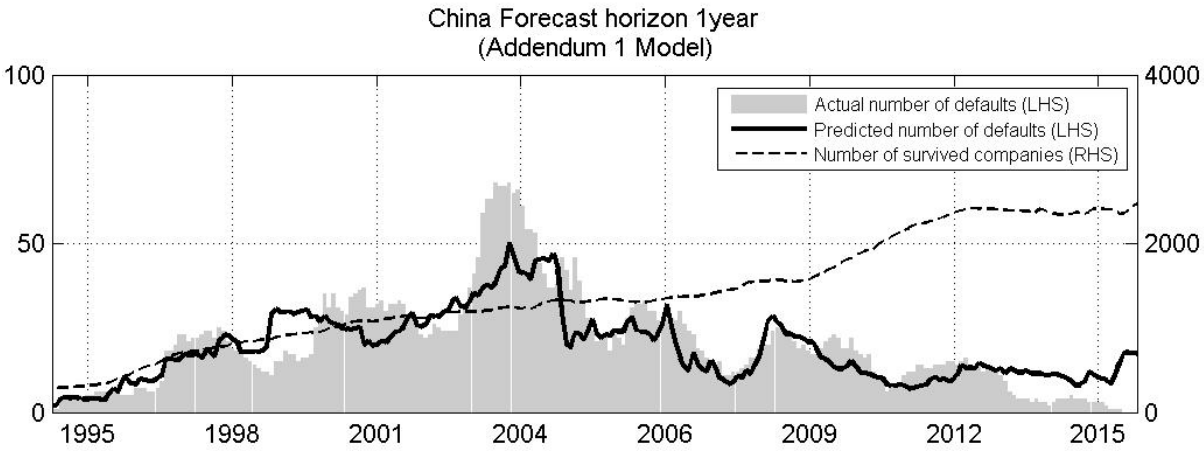

Figure 2

In this addendum, a further modification in model specification is introduced to relax the constraints on the NS parameters of $\tilde{\gamma}(\tau)$ and $\tilde{\alpha}(\tau)$ when τ approaches the infinite future. Specifically, $\tilde{\gamma}(\tau)$ and $\tilde{\alpha}(\tau)$ of the intercept coefficient and $\tilde{\alpha}(\tau)$ of the DTD level coefficient are right now modeled by a NS function with four parameters instead of three. As a result, the latest model specification has 55 parameters in total where 15 are additional to the original 40. These parameters are again estimated with the sequential Monte Carlo method as described in the CRI Technical Report (Version: 2016, Update 1).

Compared to its counterpart in Addendum 1, the new model specification with 55 parameters has delivered a similar goodness of fit, as seen in Figure 3, and accuracy ratios, i.e. 67%, 64%, and 52% for 1-year, 2-year, and 5-year prediction horizons, respectively. It improves the shorter term forecast more markedly. For example, the accuracy ratio for the 1-month PD has increased from 60% to 67%.

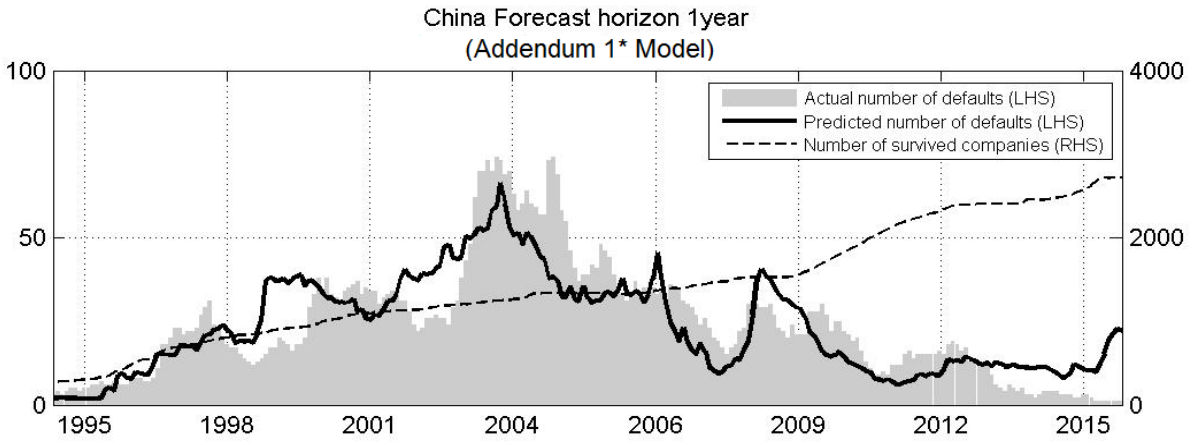

Figure 3

II. Statistical inference of the parameters with structural break

The statistical inference for the parameters on intercept and DTD level are based on Shao's self-normalized statistic (Shao, 2010). Denote by T the current month and t_0 again when the structural break occurred, the number of points N for computing the norming matrix (CRI Technical Report 2016, equation (28)) and the confidence intervals is set to be $T - t_0 + 1$.