Risk and Return – Is there an unholy cycle of ratings and yields?☆

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Abstract

After every major financial crisis, the question about the responsibility of the rating agencies resurfaces. Regarding government bonds, the most frequently voiced concern targeted "unreasonably" bad ratings that might trigger capital flights and increasing risk premia which sanction further rating downgrades. In this paper we develop a multivariate, nonparametric version of the Pesaran type cointegration model that allows for nonlinearities, to show that a unique equilibrium between ratings and sovereign yields exists. Therefore, we have to reject the concern that there is an unholy cycle leading to certain default in the long run.

Keywords: Government debt, Ratings, Cointegration

JEL-Classification: C14, C25, F34, G24

☆Parts of this research was conducted while Gregor von Schweinitz was visiting scholar at the Henan University, Kaifeng. Research of Gregor von Schweinitz was partly funded by the European Regional Development Fund through the programme "Investing in your Future" and by the IWH-Speed Project 2014/01. The authors are grateful for the comments by participants of the research seminar at the Wang Yanan Institute for Studies in Economics (WISE) at Xiamen University.

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1. Introduction

After every major financial crisis, the question about the responsibility of the rating agencies resurfaces. Regarding government bonds, which are the main interest of this paper, the most frequently voiced concern is not the rating agencies' failure to predict, but "unreasonably" bad ratings that in turn cause capital flight, driving the risk premium up, thereby causing further problems that are sanctioned with another rating downgrade (Ferri et al., 1999).[1]

A lot of the literature revolving around this issue either focuses on explaining ratings and in particular in proving some arbitrariness of ratings (Bolton et al., 2012), or on showing that ratings have an impact on capital markets even when the relevant structural explanatory variables are already considered (Cantor and Packer, 1996).

However, this is not sufficient to address the question whether there is indeed a vicious cycle between ratings and the risk premium that can drive a country from a good to a bad equilibrium. While several papers have shown the mutual Granger causality between ratings and the interest rate in short run models (Afonso et al., 2012), it takes much more than short run fluctuations in the financial market to actually cause a country to default. Since the current yield is not paid on total debt, but only on new debt (including debt rolled over), a high interest rate has to be sustained over some time to actually increase the fiscal burden. Thus, to properly address the question of multiple equilibria we need to focus on the long-run relation of interest rates and ratings. With the present paper, we aim at filling this gap in the literature. Contrary to most of the literature that tries to explain ratings in detail, we deliberately employ a very parsimonious bivariate specification to focus on the interaction between the interest rate and ratings. We propose a model that is inspired by Pesaran type cointegration models. Our nonlinear model does not impose restrictions on the (possibly infinite) number of equilibria, and uses a semiparametric estimator that allows to estimate a smooth function over a set of rating classes defined by dummy variables. Even though not imposing a unique equilibrium through the model specification, our results strongly favor a model that yields a unique equilibrium.[2]

[1] This result is heavily criticized by El-Shagi (2010).

[2] To our knowledge the only other paper following a similar approach is the recent paper by Gärtner and Griesbach (2012) which is plagued by severe specification problems, including using a model setup that strongly favors multiple equilibria by construction.

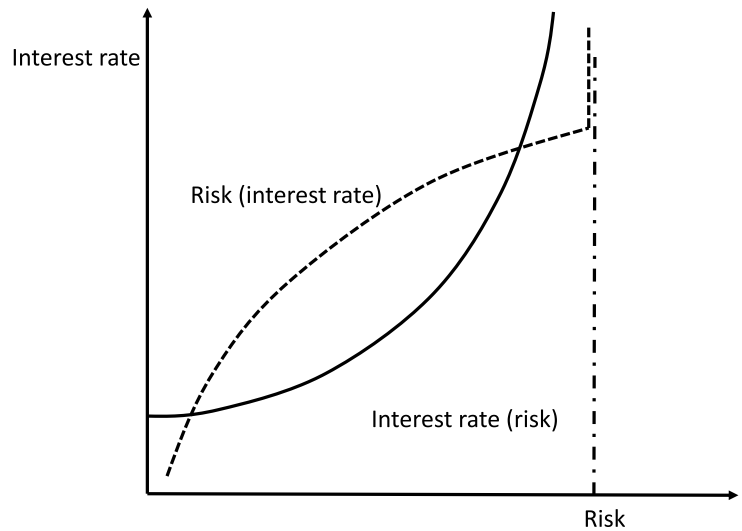

Figure 1: Risk and risk premium (Gärtner and Griesbach, 2012)

2. Model and Method

It is beyond doubt that risk and the interest rate affect each other mutually. However, there is not necessarily a unique long-run relation (implying infinite equilibria), nor a unique equilibrium. While the interest rate premium goes to infinity at an increasing rate when default risk approaches 100%, the default might be unavoidable at a finite interest rate, if the burden of interest rate payments becomes unbearable (Gärtner and Griesbach, 2012). Once the risks premium exceeds a certain threshold (the upper right intersection of the dotted and the solid line in Figure 1), the risk corresponding to this interest rates causes an even higher risk premium than the one already observed. Beyond this threshold, a vicious cycle leading to certain default follows. However, if the risk premium is below this level, there is a beneficial cycle of decreasing risk and premium.
In this paper we aim to estimate those long-run relations using a highly parsimonious model, that exclusively features yields and ratings (interpreted as a function of risk). Even though the impact of interest rates on risk (and vice versa) is not necessarily direct, but might be transmitted through other variables such as government debt, we choose to not model the transmission mechanism, for two reasons. First, the parsimony of the model allows us to

remain agnostic about the precise transmission mechanism. Second, many variables that might be considered are only available annually, thus hampering our ability to identify the short run dynamics, which is essential for a correct identification of the long-run relation in our type of model. However, we estimate a version of the model that accounts for country fixed effects, thereby allowing structural differences.

We estimate two separate Pesaran type models, where the long-run relationship between several variables is identified by explaining the change of one variable through lagged levels and first differences of the variables of interest. This allows us to identify the long-run relations as they are implied by the changes of the interest rate and rating changes respectively. Since we estimate separate models, we might have situations where the interest rate is changing due to the "misalignment" of ratings and yields, although there is no pressure to adjust the rating; and vice versa.

Our interest rate equation takes the form:

$$\Delta i_{n,t} = \beta_n + \beta_1 i_{n,t-1} + \sum_{c=2}^{18} \beta_c r_{c,n,t-1} + \sum_{l=1}^{p} \alpha_l \Delta i_{n,t-l} + \sum_{l=1}^{p+1} \gamma_l \Delta r_{n,t-l} + \varepsilon_{n,t}, \quad (1)$$

where i is the interest rate, $\Delta r \in -1, 0, 1$ the change of the rating, r_c the dummy indicating that the rating is lower or equal than c, n is a country index, and t the time index. Since we use last day of the month ratings and monthly averages of interest rates, $r_{c,n,t}$ is obtained after $i_{n,t}$. Therefore, contrary to Pesaran et al. (2001) we do not use the contemporaneous first difference of the exogenous variable (i.e. the rating), since this would imply explaining the interest rate by future rating changes. Instead, we include a further lag.

Exploiting the categorical nature of ratings, we estimate an ordered probit model for the change of the rating:

$$y^*_{n,t} = \psi_1 i_{n,t-1} + \sum_{c=2}^{18} \phi_c r_{c,n,t-1} + \sum_{l=0}^{p} \rho_l \Delta i_{n,t-l} + \sum_{l=1}^{p} \omega_l \Delta r_{n,t-l} + v_{n,t}, v \sim \mathcal{N}(0,1) \quad (2)$$

$$\begin{aligned} \text{rating downgrade if:} \quad & y^*_{n,t} < \mu_1 \\ \text{rating upgrade if:} \quad & y^*_{n,t} > \mu_2, \end{aligned}$$

where y^* is the latent variable that is linearly dependent on the explanatory variables.

Since some rating classes are merely observed in very few situations, time and country idiosyncrasies would drive the estimated coefficients rather than the actual impact of a rating of the corresponding rating dummies. While technically allowing "nonlinearities" in the impact of ratings (compared to treating ratings as pseudo continuous), this creates huge unwarranted differences in the impact of similar ratings. Although modeling ratings through class dummies, we would like to have a smooth function over rating classes, unless there is strong evidence suggesting otherwise.

We therefore allow for smoothing by augmenting the likelihood with a penalty term for differences between adjacent β's. This is inspired by an approach originally suggested by Breitung et al. (2013) for mixed frequency data sampling (MIDAS).[3]

Our objective function now has the form:

$$LL_{smooth} = LL_{model} + \sum_{c=2}^{18} \ln(\phi(\lambda(\beta_c - \beta_{c-1}))) \tag{3}$$

By increasing the weight λ of this penalty, it is possible to enforce a smooth behavior of adjacent coefficients. Breitung et al. shows, that λ can generally be mapped on the effective loss of degrees of freedom. That is, we can use standard information criteria to select the degree of smoothing. For the results reported in the remainder of this paper, both smoothing and lag order are chosen based on the Bayesian information criterion separately for both equations.

When estimating the long-run relation twice from a limited amount of data using different models, we are bound to get at least slightly different results, whether or not there is a unique long-run relationship. To test whether the difference in the long-run relations implied by the two equations is meaningful, we compare our model to a restricted version where we enforce a unique long-run relationship in both equations. The restricted model is strongly rejected at the 1% percent level.[4] Therefore, we exclusively present the results

[3] As our dummies $r_{c,n,t}$ are additive, we penalize first differences of parameters instead of second differences as in Breitung et al. (2013).

[4] To avoid model selection based only on the negative effect of stronger smoothing on LL_{model} negatively, we also compare models with identical λ, again with superiority of the

of the unrestricted model.

3. Data

We use a monthly unbalanced panel of 55 countries from January 1980 to January 2014.
To maximize our sample size we work with domestic real yields and ratings for long term debt denominated in foreign currency.
The yields are deflated using lagged inflation as a proxy of inflation expectations.
Ratings for each agency are measured on an equidistant scale attributing 1 to all ratings below CCC (i.e. the different grades of default ratings) and 18 to an AAA rating. For the aggregate rating, we take the average rating, rounded to the next integer. Since there usually is only little deviation this reflects a majority vote on the rating in most cases. However, when looking at rating changes, we consider every single change and not only those that cause the average rating to shift. Since we are only interested in the long-run relationships and not in the dynamics, this is feasible and improves identification by adding a substantial amount of information.
For monthly conversion we use the rating of the last day of the month (to preserve the categorical nature), and monthly averages of the interest rate, to avoid importing the daily volatility of interest rates into the model.
Robustness tests with different measures (estimations with country fixed effects; yield deflation by future inflation; using the yield of the last day of the month; ratings of domestic debt) yield broadly similar results. The results hold further in the baseline and all robustness checks, if we enforce an equal degree of smoothing in both equations.

4. Results and conclusions

The long-run results are summarized in figure 2. The solid line represents the interest rate that would indicate an expected interest rate change of 0, conditional on the rating given on the abscissa, and past interest and rating changes being zero, i.e. the long-run relation of interest and rating implied by interest rate dynamics. The dotted line represents the interest rate that is required at a given rating (with lagged changes of both interest

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unrestricted model.

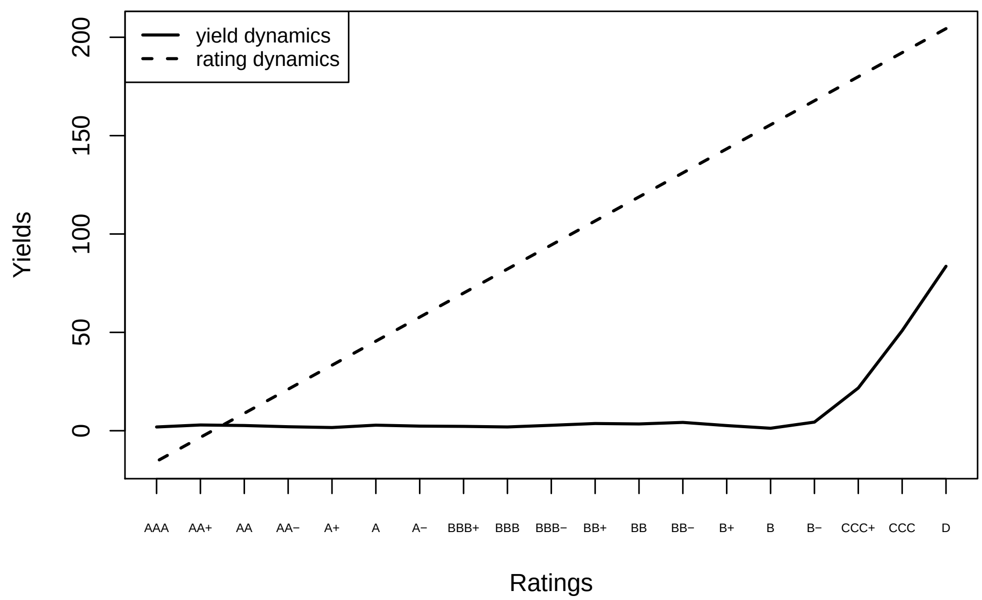

Figure 2: Long-run relation between yields and ratings.

rates and ratings being zero) to ensure that the probabilities for rating up- and downgrades are identical ($y^* = (\mu_1 + \mu_2)/2$), that is, it represents the long-run relation between interest and rating implied by rating dynamics.
Our findings are in line with theory. High interest rates lead to bad ratings, and bad ratings cause a risk premium. However, this latter effect only kicks in once the ratings reach speculative grade (Cantor and Packer, 1996). For high quality investment grade ratings the relevance of the rating for the interest rate is virtually zero. Only when the rating agencies identify considerable risk, the yield sharply increases. Yet, for all ratings except the very bests, the interest rate implied by the rating is below the level where the interest rate causes a rating which is that bad. In other words, if there are no further negative shocks lower ratings would improve – thereby allowing a lower risk premium. That is, there is no mechanism driving a country into default automatically starting from moderate risk levels.

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