

Prediction errors of determining the risk-free interest rate for a 5-years regulatory period

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1. Introduction

In order to determine the allowed revenues of companies subject to incentive regulation, estimations need to be made of the future efficient level of costs. One component of these costs is formed by the costs of capital. These costs depend on the size of the Regulatory Asset Base (RAB) and the Weighted Average Costs of Capital (WACC). The WACC depends on a number of parameters and one of them is the risk-free rate of interest (RFR). Generally the future value of the RFR is based on historical data, but the key question is: which historical period to use to estimate the future value of the RFR? This question has been answered by Hartog van Banda and Mulder (2013) for a regulatory period of 3 years. They concluded that a historical reference period of 3 years gives the lowest prediction error. Following their method, we calculate the prediction errors of alternative historical reference periods for a 5-year regulatory period. First we briefly describe the method and the data, then we present the results and finally, we formulate our conclusions.²

2. Method

The WACC is usually determined about half a year before the start of the next regulatory period. While the previous regulatory frameworks for the energy networks in the Netherlands had a duration of 3 years, the current framework sets the revenues for a period of 5 years. This means that the WACC and, hence, the RFR, needs to be predicted 4.5 to 5.5 years in advance.³

We estimate the prediction error of a number of historical periods by using a set of historical yields. For each day in the period 1998-2010 we assume that the regulator takes a decision on the level of the future RFR using different historical reference periods, from 1 day (i.e. the spot rate) up to 5 years. For each decision, we calculated the predictive power by comparing the forecasted yield for the last year with the actual yield on each day in that year. The difference between these two gives the error term between the prediction and the actual yield. For each decision, taken on a specific day, we take the maximum error over all days for which a prediction has been made, i.e. all days during the last year of the new regulatory period. For further analysis, we take the square of this (maximum) error term in order to control for the

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² For an extensive description of the method, see Hartog van Banda and Mulder (2013).

³ The first day of the last year of the new regulatory period starts 4.5 years after the day the WACC has been set by the regulator, while the last day of this year is 5.5 years later since that day.

sign of the term and to give large errors larger weights. Next, we take the mean of all squared errors over all decisions over the whole period 1998-2010 and, finally, we take the root of this mean to express the error back to an interest percentage. This prediction error is the so-called Root Mean Square Error (RMSE).

3. Data

The analysis is conducted on daily data on average yields of 10 years State bonds of the Netherlands and Germany over the period 1993-2015 (see Figure 1). Starting on the first day in 1998, we determine the (moving) averages of this yield for different historical reference periods and consequently calculate the prediction error. The last day of making the prediction is the end of 2010 as we need to be able to look ahead for 5 years (i.e. to the year 2015).

Figure 1 Average yield on 10-year Dutch and German government bonds



3. Results

From Table 1 follows that the prediction error hardly differs between the historical reference periods of 1 day up to 3 years. Making the reference period longer to 4 years or 5 years, however, the prediction error increases significantly.

Table 1 Prediction error (RMSE) for different lengths of historical reference periods in case of a 5-years regulatory period

Reference period	RMSE (in % yield)
1 day	1.42
1 month	1.42
3 months	1.42
6 months	1.42
9 months	1.43
1 year	1.42
1.5 year	1.41
2 years	1.41
2.5 years	1.42
3 years	1.45
4 years	1.56
5 years	1.68

4. Conclusion

Using historical data on the Dutch and German yields on 10-years governments bonds over the period 1993-2015, we find that the average prediction error is hardly affected by the length of the historical reference periods up to a period of 3 years. In all cases, the prediction error is about 1.4%. Hence, it doesn't make much difference whether the spot rate is used of the day that the regulator takes the decision or that the average value over a number of months or even a few years is taken. Extending the historical reference period to 4 or 5 years, however, raises the prediction error significantly.

References

Hartog van Banda, M., & Mulder, M. (2013). Forecasting the yield on 10-year State bonds as part of the WACC for regulated industries. *International Research Journal of Applied Finance*, IV(2), 174 - 185.