ANALYSIS OF INDONESIA BOND’S DURATION: CORPORATE VERSUS GOVERNMENT BOND

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ABSTRACT

The duration of a bond is a measure of its interest rate risk. The objective of this research is to test whether corporate bond duration is higher compared to government bonds. The higher duration means that bond’s price is more affected to the change in its yield. Effective Duration and Modified Duration Approaches are used to calculate the duration. The sample used is bonds that traded in Indonesia Stock Exchange. The result shows that there is no enough evidence that Indonesia corporate bonds duration is higher compared to government bonds. The implication for this is that there is no difference in interest rate risk between corporate bonds and government bonds.

Keywords: interest rate risk, bonds risk, bonds duration

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INTRODUCTION

Interest rate risk is the risk to bond’s price arising or decreasing from the movement of interest rates. The price of a typical bond will change in the opposite direction from a change in interest rate. The actual degree of sensitivity of a bond’s price to changes is depending on various characteristics of the issue, such as coupon and maturity.

Investors are interested in estimating the price sensitivity of a bond to changes in market interest rates. There is a parameter to measure the price sensitivity of a bond which is called duration.

Although duration has a long history, it is still an important and widely used tool in the risk management of portfolios of interest rate sensitive assets. Generally, bonds with a high duration have higher price volatility.

Most papers studying duration focus on default-free (Government) bonds, but for the many portfolio managers also investing in default-able (corporate) bonds, it is important to understand the sensitivity of default-table bonds to interest rate changes.

There is some contradiction about duration research or paper. Chance (1990) states that “. . . default able bonds have durations lower than their maturities and, thus, are less sensitive to interest rates than their default-free counterparts . . .” Most recent paper, Kraft and Munk (2007) is modeling the durations (the percentage price sensitivity with respect to the default-free short rate) of corporate and Treasury bonds in the reduced-form, intensity-based credit risk modeling framework. In a frequently used intensity-based model for corporate bond valuation showing that, given the parameter estimates found in empirical studies, the duration of a corporate coupon bond may very well be larger than the duration of a similar Treasury bond. This finding contrasts with conclusions of previous studies.

In this paper, I test the difference of duration between corporate and government bonds. The duration of a bond is a measure of its interest rate risk. I use two approaches to measure duration. First approach is modified duration and the second is effective duration. I compare the duration of Government Bond to Corporate Bond. The bonds that I analyze are the bond that traded in Indonesia Stock Exchange.

Through this research, there is a question that needs to be answered:

- Does Indonesia Corporate Bonds duration is higher compare to Indonesia Government Bonds?

LITERATURE REVIEW

A bond is a long-term debt security. It represents debt because the bond buyer actually lends the face amount to the bond issuer. The certificate itself, if there is one, is evidence of a lender-borrower relationship. It is a security because, unlike car loan or home improvement loan, the debt can be bought and sold in the open market. In fact, a bond is a loan intended to be bought and sold.

Duration is a measure of the approximate sensitivity of a bond’s value to rate changes. More specifically, it is the approximate percentage change in value for a 100 basis point change in rates. To improve the estimate provided by duration, a measure called “convexity” can be used. Hence, using duration combined with convexity to estimate the percentage price change of a bond to changes in interest rates is called duration/convexity approach.
Sarkar and Hong (2004, has estimated empirically the effective durations for a large sample of long-term US corporate, from monthly data on bond prices and long-term interest rates. Time series regression analysis is used to estimate the effective duration of a sample of long-term corporate bonds (both non-callable and callable), based on their price changes over time in response to interest rate changes. They also include a squared term to capture any second-order effects (related to convexity, for instance). Thus the following regression is run:

\[
\frac{\Delta P}{P} = B_0 + B_1 (\Delta y) + B_2 (\Delta y)^2 + \varepsilon
\]

Where \( P \) is the bond price, \( y \) is the long-term interest rate, \((\Delta P, \Delta y)\) refer to monthly increments (since they are using monthly data), \( \varepsilon \) is a random error term, and \((B_1; B_2)\) the regression coefficients. The bond’s effective duration is then given by -B1.

Based on the ownership, this study argues that corporate bonds tend to have higher interest rate risk than government bonds. Therefore, it is hypothesized that the duration of corporate bonds is higher than the duration of government bonds.

**RESEARCH METHODOLOGY**

![Research Model Diagram]

*Figure 1. Research Model*
Firstly, the bonds weekly prices data is collected for the last 3 years. This data is collected from Danareksa, the Debt Research Division. Other information such as maturity date, coupon, risk free rate (BI rate) is collected from other resources. Maturity date, rating, coupon information is collecting from company financial report, and Indonesia Stock Exchange website (www.idx.co.id). For historical risk-free rate is collecting from Bank Indonesia website (www.bi.go.id)

To compare duration of government to corporate bond, the bonds are selected by matching some criteria. The criteria are:
1. Maturity of bonds has to be in the same month in the same year.
2. The bond is giving fixed coupon rate

After filtering the data, bonds that match criteria are:

**Table 1. List of sample Bond**

<table>
<thead>
<tr>
<th>Government Bond Name</th>
<th>Maturity</th>
<th>Gov Bond Coupon</th>
<th>Corporate Bond Name</th>
<th>Maturity</th>
<th>Corp Bond Coupon</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR002</td>
<td>15/06/2009</td>
<td>14.000%</td>
<td>WOMF02C</td>
<td>07/06/2009</td>
<td>13.900%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>WOMF03B</td>
<td>07/06/2009</td>
<td>15.150%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ADMF02A</td>
<td>08/06/2009</td>
<td>14.400%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>CMNP03B</td>
<td>08/06/2009</td>
<td>12.750%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASDF07E</td>
<td>13/06/2009</td>
<td>14.100%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BDKJ04</td>
<td>17/06/2009</td>
<td>12.500%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>OTMA05A</td>
<td>19/06/2009</td>
<td>9.400%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>TBLA01</td>
<td>24/06/2009</td>
<td>14.750%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASDF08C</td>
<td>28/06/2009</td>
<td>9.375%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>KLBTF01</td>
<td>28/06/2009</td>
<td>13.625%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SONA01A</td>
<td>28/06/2009</td>
<td>14.750%</td>
</tr>
</tbody>
</table>

| FR005                | 15/07/2007 | 12.250%         | TUFJ03B             | 08/07/2007 | 12.825%         |
|                      |          |                 | PLJAO1A             | 12/07/2007 | 12.375%         |
|                      |          |                 | ADHI03              | 13/07/2007 | 13.250%         |
|                      |          |                 | TLKM01              | 16/07/2007 | 17.000%         |
|                      |          |                 | ASDF05F1            | 26/07/2007 | 10.900%         |

| FR010                | 15/03/2010 | 13.150%         | ASDF09C             | 06/03/2010 | 9.625%          |

<p>| FR012                | 15/05/2010 | 12.625%         | FIFA07C             | 02/05/2010 | 10.500%         |
|                      |          |                 | KREN01C             | 08/05/2010 | 13.000%         |
|                      |          |                 | BSLT03              | 12/05/2010 | 12.750%         |
|                      |          |                 | FIFA08B             | 13/05/2010 | 12.125%         |
|                      |          |                 | MAYA02A             | 29/05/2010 | 11.750%         |
|                      |          |                 | WOMF04A             | 29/05/2010 | 11.250%         |</p>
<table>
<thead>
<tr>
<th>Code</th>
<th>Date</th>
<th>Rate</th>
<th>Code</th>
<th>Date</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>FR013</td>
<td>15/09/2010</td>
<td>15.425%</td>
<td>BEXI03B</td>
<td>28/09/2010</td>
<td>12.700%</td>
</tr>
<tr>
<td>FR014</td>
<td>15/11/2010</td>
<td>15.575%</td>
<td>PTPV01A</td>
<td>12/11/2010</td>
<td>12.875%</td>
</tr>
<tr>
<td>FR015</td>
<td>15/02/2011</td>
<td>13.400%</td>
<td>TUF05C</td>
<td>20/02/2011</td>
<td>11.000%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>BCAF02D</td>
<td>27/02/2011</td>
<td>11.375%</td>
</tr>
<tr>
<td>FR018</td>
<td>15/07/2012</td>
<td>13.175%</td>
<td>BLTA03</td>
<td>05/07/2012</td>
<td>10.350%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ADHI04</td>
<td>06/07/2012</td>
<td>11.000%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SCTV02</td>
<td>10/07/2012</td>
<td>10.950%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DUT05</td>
<td>11/07/2012</td>
<td>12.850%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JPFA01</td>
<td>11/07/2012</td>
<td>12.750%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PLIA01D</td>
<td>12/07/2012</td>
<td>13.875%</td>
</tr>
<tr>
<td>FR019</td>
<td>15/06/2013</td>
<td>14.250%</td>
<td>MYOR03</td>
<td>05/06/2013</td>
<td>13.750%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>DNRK03C</td>
<td>20/06/2013</td>
<td>13.500%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>SMRA02</td>
<td>25/06/2013</td>
<td>14.100%</td>
</tr>
<tr>
<td>FR021</td>
<td>15/12/2010</td>
<td>14.500%</td>
<td>BFNC02</td>
<td>03/12/2010</td>
<td>12.750%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>JMPD10O</td>
<td>04/12/2010</td>
<td>16.150%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ASDF08F</td>
<td>28/12/2010</td>
<td>10.300%</td>
</tr>
<tr>
<td>FR022</td>
<td>15/09/2011</td>
<td>12.000%</td>
<td>BEXI03C</td>
<td>28/09/2011</td>
<td>12.800%</td>
</tr>
<tr>
<td>FR024</td>
<td>15/10/2010</td>
<td>12.000%</td>
<td>ISAT03B</td>
<td>22/10/2010</td>
<td>12.875%</td>
</tr>
<tr>
<td>FR025</td>
<td>15/10/2011</td>
<td>10.000%</td>
<td>BSDE02</td>
<td>20/10/2011</td>
<td>15.000%</td>
</tr>
<tr>
<td>FR026</td>
<td>15/10/2014</td>
<td>11.000%</td>
<td>INKP02A</td>
<td>01/10/2014</td>
<td>13.000%</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>PIDL02A</td>
<td>01/10/2014</td>
<td>13.000%</td>
</tr>
<tr>
<td>FR028</td>
<td>15/07/2017</td>
<td>10.000%</td>
<td>PPLN09A</td>
<td>10/07/2017</td>
<td>10.400%</td>
</tr>
<tr>
<td>FR029</td>
<td>15/04/2007</td>
<td>9.500%</td>
<td>ASDF05E2</td>
<td>26/04/2007</td>
<td>10.625%</td>
</tr>
<tr>
<td>FR030</td>
<td>15/05/2016</td>
<td>10.750%</td>
<td>PPGD11A</td>
<td>23/05/2016</td>
<td>13.100%</td>
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<td>FR033</td>
<td>15/03/2013</td>
<td>12.500%</td>
<td>BDKI05A</td>
<td>04/03/2013</td>
<td>11.250%</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>MAIN01</td>
<td>06/03/2013</td>
<td>11.800%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>ELTY01B</td>
<td>11/03/2013</td>
<td>12.850%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>AIRJ01B</td>
<td>13/03/2013</td>
<td>12.500%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>APOL02A</td>
<td>18/03/2013</td>
<td>12.000%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>LTLS03</td>
<td>26/03/2013</td>
<td>11.650%</td>
</tr>
<tr>
<td>FR034</td>
<td>15/06/2021</td>
<td>12.800%</td>
<td>PPLN08B</td>
<td>21/06/2021</td>
<td>13.750%</td>
</tr>
<tr>
<td>FR043</td>
<td>15/07/2022</td>
<td>10.250%</td>
<td>PPLN09B</td>
<td>10/07/2022</td>
<td>10.900%</td>
</tr>
</tbody>
</table>

Duration calculation is divided into two approaches. The first approach is calculating Modified Duration on each weekly transaction and compares it between Government bond and corporate bond. The following method is used to calculate Modified duration.
Macaulay Duration = \[
\frac{(1)C}{(1 + y)} + \frac{(2)C}{(1 + y)^2} + \ldots + \frac{(n)C}{(1 + y)^n} + \frac{(n)M}{(1 + y)^n}
\]

Investor commonly refer to the ratio of Macaulay duration to 1+y as modified duration; that is,

\[\text{Modified duration} = \frac{\text{Macaulay Duration}}{1 + y}\]

The second approach is by calculating effective duration. A time-series regression as in Ogden (1987) is conducted by regressing the change in interest rate on the change in bond price. However, a squared term is also included to capture any second-order effects (related to convexity, for instance). Thus the following regression is run:

\[
\frac{\Delta P}{P} = B_0 + B_1(\Delta y) + B_2(\Delta y)^2 + \varepsilon
\]

Where:
- \(P\) is the bond price
- \(y\) is the long-term interest rate
- \((\Delta P, \Delta y)\) refer to weekly increments (since the data is weekly data)
- \(\varepsilon\) is a random error term, and
- \(B_1, B_2\) are the regression coefficients.

The bond’s effective duration is then given by \(B_1\).

To test the hypothesis, this study measures the delta of duration between government and corporate bond. Delta (\(\Delta\)) Duration is defined as follow:

\[\text{\(\Delta\) Duration} = \text{Duration Government bond} – \text{Duration Corporate bond}\]

In line with the hypothesis we expect that \(\mu\) of \(\Delta\) Duration has to be less than 0.

For this research, the null and alternative hypothesis is:

\(H_0: \mu \geq 0\)
\(H_1: \mu < 0\)

A t test and critical value approach is used to test the hypothesis.

\(t\) test of hypothesis for the mean (\(\sigma\) unknown)

**RESEARCH RESULT**

\(\Delta\) Modified Duration Approach Result

The result summary of \(\Delta\) Modified Duration, can be seen in the table below:
Table 2. Result Summary of Δ Modified Duration Approach

<table>
<thead>
<tr>
<th>Descriptive statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-0.00144</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.005187</td>
</tr>
<tr>
<td>Median</td>
<td>-0.01724</td>
</tr>
<tr>
<td>Mode</td>
<td>-0.0064</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.169496</td>
</tr>
<tr>
<td>Sample Variance</td>
<td>0.028729</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>20.50141</td>
</tr>
<tr>
<td>Skewness</td>
<td>2.905367</td>
</tr>
<tr>
<td>Range</td>
<td>2.304695</td>
</tr>
<tr>
<td>Minimum</td>
<td>-0.85212</td>
</tr>
<tr>
<td>Maximum</td>
<td>1.452574</td>
</tr>
<tr>
<td>Sum</td>
<td>-1.5399</td>
</tr>
<tr>
<td>Count</td>
<td>1068</td>
</tr>
<tr>
<td>Confidence Level(95.0%)</td>
<td>0.010177</td>
</tr>
</tbody>
</table>

The table shows the statistic descriptive of Δ Duration of Modified Duration Approach. Δ MDuration = Modified Duration Government – Modified Duration Corporate
For the distribution data modified duration approach, can be seen in figure 2 below:

![Data Distribution Modified Duration Approach](image)

**Figure 2.** Data Distribution of ΔModified Duration

**Effective Duration result**
After all data has been done for the regression, the summary table of the duration of government bond and its comparable corporate bond can be seen in table 3 below:
Table 3. Result Summary of ΔEffective Duration Approach

<table>
<thead>
<tr>
<th>Descriptive statistics</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-2.76195</td>
</tr>
<tr>
<td>Standard Error</td>
<td>1.597731</td>
</tr>
<tr>
<td>Median</td>
<td>-0.92477</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>6.7786</td>
</tr>
<tr>
<td>Sample Variance</td>
<td>45.94942</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.290241</td>
</tr>
<tr>
<td>Skewness</td>
<td>-1.18265</td>
</tr>
<tr>
<td>Range</td>
<td>26.61809</td>
</tr>
<tr>
<td>Minimum</td>
<td>-20.017</td>
</tr>
<tr>
<td>Maximum</td>
<td>6.601123</td>
</tr>
<tr>
<td>Sum</td>
<td>-49.715</td>
</tr>
<tr>
<td>Count</td>
<td>18</td>
</tr>
<tr>
<td>Largest(1)</td>
<td>6.601123</td>
</tr>
<tr>
<td>Smallest(1)</td>
<td>-20.017</td>
</tr>
</tbody>
</table>

The table shows the statistic descriptive of Δ Effective Duration.
Δ EffDuration = Effective Duration Government – Effective Duration Corporate
For the distribution data Effective duration approach, can be seen in figure 3 below:

Figure 3. Data Distribution of ΔEffective Duration
Hypothesis Testing
In this section, I test the hypothesis for both approaches using t test and critical value approach.

Modified Duration Approach
To perform this hypothesis test, the ten step method is used:

Steps 1 and 2: Ho: \( \mu \geq 0 \)
H1: \( \mu < 0 \)

Step 3: \( \alpha = 0.05 \)
Step 4: n = 1068
Step 5: A t test is used.

Step 6: For a given sample size n, the test statistic t follows a t distribution with n-1 degree of freedom. Due to the level significance of \( \alpha = 0.05 \) is selected, the critical value of the t distribution with \( 1068 - 1 = 1067 \) degrees of freedom can be obtained from t Table. From t table, the critical value is -1.6449. The decision rule is: reject Ho if t < -1.6449; otherwise do not reject Ho

Step 7: n = 1068, mean = -0.00144, \( \sigma = 0.169496 \)
\[ t = \frac{-0.00144 - 0}{0.169} = -0.277644238 \]

Step 8: since t = -0.277 > -1.6449, the observed statistic is in the region of non rejection.
Step 9: Accept Ho
Step 10: The data provided provide insufficient evidence to conclude that the mean of \( \Delta \)Modified Duration is less than 0.

Effective Duration Approach
Again, to perform this hypothesis test, the ten step method is used:

Steps 1 and 2: Ho: \( \mu \geq 0 \)
H1: \( \mu < 0 \)

Step 3: \( \alpha = 0.05 \)
Step 4: n = 18
Step 5: A t test is used.

Step 6: For a given sample size n, the test statistic t follows a t distribution with n-1 degree of freedom. Due to the level significance of \( \alpha = 0.05 \) is selected, the critical value of the t distribution with \( 18 - 1 = 17 \) degrees of freedom can be obtained from t Table. From t table, the critical value is -1.7341. The decision rule is: reject Ho if t < -1.7341; otherwise do not reject Ho

Step 7: n = 18, mean =-2.76195, \( \sigma = 6.7786 \)
\[ t = \frac{-2.76195 - 0}{6.7786} = -1.728 \]

Step 8: since t = -1.728 > -1.7341, the observed statistic is in the region of non rejection.
Step 9: Accept Ho
Step 10: The data provided provide insufficient evidence to conclude that the mean of \( \Delta \) Modified Duration is less than 0.

From hypothesis testing (Modified Duration and Effective Duration Approach), it is concluded that there is no enough evidence that Indonesia corporate bonds duration is higher compare to Indonesia government bonds. The implication for this is that there is no difference on the interest rate risk between corporate and government bonds. Investment manager can use duration as a measure of interest rate risk for their investment strategy, but can not differentiate which one is more risky to interest rate risk between corporate and government bond.

**CONCLUSION & RECOMMENDATIONS**

**Conclusion**
In Indonesia, there is no enough evidence that duration of corporate bond is higher compare to government bond. The higher duration mean that it more affected to the change in interest rate. The implication for this is that there is no difference between corporate bond and government bond in term of interest rate risk.

**Recommendations**
1. Research in Indonesia on corporate bond is not many. With this research, we hope there will be more research on Indonesia corporate bond.
2. More research on Indonesia corporate bond might be interesting such as corporate bond yield spread and liquidity.

**REFERENCES**


