Earnings Management: Empirical Evidence on value relevance and Income smoothing.

van Praag, B.J.

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APPENDIX C: NOTES ON STATISTICAL METHODOLOGY

This appendix provides some brief explanation of the tests used in this thesis that are not part of the standard statistical software. In particular two tests are discussed here. First a brief overview is given of testing non-nested hypotheses with the use of Vuong Z-statistics is given. Vuong Z-scores are the standard methodology for comparison of different regression models in a value relevance setting. Second, the testing of significant differences in correlation coefficients as used in the income smoothing analyses is discussed.

**Vuong Test**

This test is used to determine whether one model provides a statistically better fit than another model with the same dependent variable. When independent variables are compared using different regression models the test for significance is based on non-nested hypotheses. Using a likelihood ratio to express the difference in fit as a Z-score, models can be compared and tested. The procedure for computation is as follows:

Run the following two regressions:

A) \[ \text{BHRI} = a + b \text{NDE} + e \] (NDE calculated for some EM proxy)

B) \[ \text{BHRI} = a + b \text{NI} + e \]

Gather the following variables

- \( \text{RSS}_{\text{NDE}}, \text{RSS}_{\text{NI}} \)
- \( \hat{e}_{\text{NDE}}, \hat{e}_{\text{NI}} \)
- \( n \)

Calculate \( m_i \) with the following formula

\[
m_i = \frac{1}{2} \log \left( \frac{\text{RSS}_{\text{NDE}}}{\text{RSS}_{\text{NI}}} \right) + \frac{n}{2} \left( \frac{\hat{e}_{\text{NDE}}^2}{\text{RSS}_{\text{NDE}}} - \frac{\hat{e}_{\text{NI}}^2}{\text{RSS}_{\text{NI}}} \right)
\]

Summarize \( m_i \) for sample. This yields the likelihood ratio
To estimate the standard deviation regress \( m_i \) on unity with a NOORIGIN regression. The coefficient will be equal to:

\[
\frac{1}{2} \log \left( \frac{\text{RSS}_{\text{NDE}}}{\text{RSS}_{\text{NI}}} \right)
\]

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The explanation below is based on Dechow 1994. A more detailed discussion can be found in Vuong (1989)
and tells us the mean difference in explanatory power between NI and NDE.

Obtain the $Z$ statistic with the following conversion

$$Z = t - \text{value} \times \left( \frac{(n-1)}{n} \right)^{1/2}$$

A positive and significant $Z$ value implies that the NI is the model of choice.

**Test of equality of two correlations**

For the third hypothesis in the empirical analysis a test is used to determine whether correlations differ significantly. The test described below uses a Fischer Z-transform to express the difference in coefficients in terms of a $Z$-score. The null hypothesis is expressed as:

$$H_0: \rho_1 = \rho_2$$

Next the Fischer transformation is applied:

$$Z_r = \frac{1}{2} \left[ \log(1 + r) - \log(1 - r) \right]$$

$$\sigma_{Zr} = \frac{1}{\sqrt{n - 3}}$$

$$\sigma_{Z_{1-2}} = \sqrt{\frac{1}{n_1 - 3} + \frac{1}{n_2 - 3}}$$

$$Z = \frac{Z_1 - Z_2}{\sigma_{Z_{1-2}}}$$

This is an insensitive test to decide whether two correlations have different strengths.

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30 More information can be found in: Cohen, J and P. Cohen (1983)