

The M-Score

Beneish (*Financial Analysts Journal*, Sept/Oct 1999) has developed a model for classifying firms into fraudulent reporters and non-fraudulent reporters. The model includes eight variables (and an intercept), one of which is a total accruals variable. The output of the model is an M-score (M stands for “manipulation of earnings”), which can be converted into a probability that the financial statements contain fraud. Beneish has set some cutoffs for M that minimize expected costs of classification errors. Depending on the cutoff, the model correctly identifies between 38% and 76% of the fraudulent reporting companies, while misclassifying as fraud companies 3.5% to 17.5% of the non-fraudulent companies. The model is easy to employ. You may find it useful in preparing case 9.

The model is as follows:

$$M = -4.84 + 0.920*DSRI + 0.528*GMI + 0.404*AQI + 0.892*SGI + 0.115*DEPI - 0.172*SGAI + 4.679*ACCR - 0.327*LEVI,$$

where

$$DSRI = \text{Days sales in receivables index} = (netAR_t / Sales_t) / (netAR_{t-1} / Sales_{t-1})$$

$$GMI = \text{Gross margin index} = \left(\frac{Sales_{t-1} - CostofGoodsSold_{t-1}}{Sales_{t-1}} \right) / \left(\frac{Sales_t - CostofGoodsSold_t}{Sales_t} \right)$$

$$AQI = \text{Asset quality index} = \left(1 - \frac{CurrentAssets_t + netPPE_t}{TotalAssets_t} \right) / \left(1 - \frac{CurrentAssets_{t-1} + netPPE_{t-1}}{TotalAssets_{t-1}} \right)$$

$$SGI = \text{Sales growth index} = Sales_t / Sales_{t-1}$$

$$DEPI = \text{Depreciation index} =$$

$$\left(\frac{DepreciationExpense_{t-1}}{DepreciationExpense_{t-1} + netPPE_{t-1}} \right) / \left(\frac{DepreciationExpense_t}{DepreciationExpense_t + netPPE_t} \right)$$

$$SGAI = \text{Sales, general, and administrative expense index} = \left(\frac{SGAexpense_t}{Sales_t} \right) / \left(\frac{SGAexpense_{t-1}}{Sales_{t-1}} \right)$$

$$ACCR = \text{Total accruals} = (IBEI_t - CFO_t) / TotalAssets_t$$

$$LEVI = \text{Leverage index} = \left(\frac{LTD_t + CurrentLiabilities_t}{TotalAssets_t} \right) / \left(\frac{LTD_{t-1} + CurrentLiabilities_{t-1}}{TotalAssets_{t-1}} \right)$$

Year t is the year under investigation. Note that unlike the discretionary accruals analysis, variables scaled by Total Assets are scaled by end-of-year values.

The higher the M-score (most M-scores are negative), the more likely it is that a company's financial statements are fraudulent. Beneish's misclassification cost analysis suggests that financial statements with M-scores greater than -1.8 or so should be investigated further for FFR.

M-scores can be converted into probabilities using the following formula:

$$\text{Prob}(\text{FFR}|\text{M}) = \Phi(\text{M}),$$

where M is the M-score from applying the model and Φ is the cumulative distribution function of the standard normal distribution. For example, $\Phi(-1.96)$ is .025 (that is, 2.5% of the area of the standard normal curve is to the left of -1.96; this can be inferred from tables such as the one in the "statistics for fraud" document), indicating a 2.5% probability that the company is fraudulently reporting. The NORMSDIST function in Excel can be used to retrieve Φ values.