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1. **Title and author(s).**

Can direction of stock price change be predicted by changes in key financial ratios?

2. **Summary of Research Questions and Results**

1) Is there a strong statistical correlation between the change of a financial ratio and a company's stock price?
   I want to find the strength of the correlation between the percent change of a financial ratio and the percent change of the company's stock price. This is to find how good of a predictor the change in ratio is of the change in stock price.
2) Given a percent change in a ratio, by what percent will stock price change?
   I am trying to compute how many percentage points a stock price will change per 1% change in financial ratio. If the financial ratios prove to be a good predictor of stock price, this calculation could find by how much a stock price will change.

3. **Motivation and background**

Predicting stock performance is a tricky matter. Stock performance is affected by a myriad of factors and trying to isolate what factor has the most influence is something that no one seems to be entirely certain of. Publicly traded companies are required to file with the SEC audited financial statements. These financial statements contain key, important information regarding the company. Using these financial statements, key ratios and metrics can be calculated that indicate the overall performance of the firm. My experiment seeks to see if changes in these ratios can be correlated to the changes in the company's stock price (i.e.: the markets reaction to the firm). For example, how much does a change in a company's return on assets ratio affect stock price? Does an increase in this ratio result in stock appreciation? Knowing the answers to this question could make a huge difference. Investors worldwide would be able to use this knowledge and make informed investing decisions. A huge amount of the guesswork of investing can be reduced if the stock performance of a company can be predicted by the change in a few key ratios.

4. **Dataset.**

Data about the company's past stock performance will be obtained from http://finance.yahoo.com. The opening and closing prices for the past 5 years can be downloaded into an Excel file which will then be saved into a CSV file and cleaned up for use by the program. The company's past financial statements will be retrieved from http://wrds-web.wharton.upenn.edu/wrds access to which is provided to me by the Accounting 440 class which I am currently taking. The financial statements can be saved into an Excel file and subsequently a CSV file as well. These two files (stock price and financial statements) will need to be manually obtained by the user and fed into the program via the command prompt.

5. **Methodology (algorithm or analysis).**

Use several select profitability ratios for this analysis. The ratios are: gross margin (gross profit/net sales), operating margin (operating income/net sales), profit margin (net income/net sales), return on equity (net income/avg shareholder's equity), and return on assets (net income/total assets). The years analyzed will be 2006 – 2012. In order to find the annual change of each financial ratio for 2006, financial statements from 2005-2012 must be obtained for each company.

The first order of business is to clean the financial statement data. This involves removing any commas in each financial number and deleting any other extraneous characters.

Next, the financial statement data needs to be organized by account (ex: all numbers for revenue must be kept together) and then sorted by year. It should be organized such that if one were to query, for example, "Revenue", they would find revenue numbers for 2005 -2012.

After all the financial data is properly ordered and sorted, the financial ratios can be calculated for each year. This is done by retrieving the appropriate numbers for the given year from the correct accounts and performing simple division. Using Profit Margin (net income / sales) as an example, the user needs to find net income and sales for 2005, use those numbers to calculate profit margin, and repeat the process for the following years.

Once all the ratios are calculated, the percent change of the ratios over the year need to be calculated. Continuing the profit margin example, one would get profit margin for 2005 and 2006, calculate the percent change between those two values, and the result would be the percent change of profit margin for 2006. This is repeated such that one gets the annual percent changes for all years up to 2012. Once this is performed for all ratios and all years, the result should be the annual changes for each ratio for the years 2006 to 2012.

Annual change in stock price must now be calculated. This is simply done by finding the opening price of the stock on the first day of the year and the closing price of the stock on the last day of the year, then finding the percent change. This is done for 2006 to 2012.

Finally, the statistical correlation between the financial ratio and the stock price needs to be calculated. I plan on doing this by using the financial ratio % change as the independent variable and the stock price % change as the dependent, such that x = % change in ratio and y = % change in stock price and the resulting data point is (x, y). For each ratio, I will find (x, y) among all companies and analyze each ratio as a whole. That is, correlation between ratio and stock price will not be calculated for each individual company, but for the entire population of companies as a whole. The primary figures I will use are the r-square value and the slope of the regression line.

The results will be sorted by r-square from greatest to least. This will provide the ratio with the strongest statistical relationship first and the weakest last.

6. **Results:**

Gross Margin:
R Square = 0.400201159537
Regression Slope = 3.7861670951
Operating Margin:
R Square = 0.292381671888
Regression Slope = 0.405400586557
Profit Margin:

R Square = -0.078371284451
Regression Slope = -0.00645327808642

Return on Assets:
R Square = -0.0880575854823
Regression Slope = -0.00707105569259

Return on Equity:
R Square = -0.092299361246
Regression Slope = -0.00571450999762

Strength of statistical relationship:

Gross margin appears to have the strongest correlation with an r-square of 0.4, indicating a medium correlation. Profit margin has the weakest correlation with an r-square of -0.07, indicating no correlation. I am not surprised with the results. While company profitability is an important factor, there are many other elements that affect stock price, including: public perception of the company, announcement of strategic business decisions, etc. A financial ratio in and of itself is not enough data to predict stock price. Moreover, given that business models vary greatly from firm to firm, a ratio will not be uniformly comparable between all companies. My analysis revealed that no profitability ratio is a strong predictor of stock price change.

Percent change in ratio's effect on stock price:

Gross Margin leads the way again. My results found that per 1% change in gross margin, stock price will increase 3.76%. This seems to be fairly consistent with the interpretation of gross margin: gross margin is the measure of the profitability of a company's core operations. An increase in gross margin would suggest that the core operations, the essence, of a firm have improved. The fact that a change in this ratio would cause the greatest change in stock price makes sense: investors see an increase in gross margin as the company's core growth.

7. Reproducing Results

① Log onto http://wrds-web.wharton.upenn.edu/wrds and select "Compustat" in the "Select a Data Set" drop down menu.
② Click "Tools" and then "Complete Financial Statements (xls)"
③ Set the date range for 2005 to 2012
④ Fill in the company's ticker (Amazon = AMZN, Google = GOOG, etc.)
⑤ Download the Excel spreadsheet that contains the financial statements.
⑥ Open the Excel file, then save as a CSV file and name it the name of the company.
⑦ Go to http://finance.yahoo.com and look up the company
⑧ Click on "Historical Prices" under "Quotes"

⑨ Under Set Date Range, set the start date to January 1, 2006 and the end date to December 31 2012
⑩ Click on the "Weekly" check box
⑪ Click "Get Prices"
⑫ Scroll to the bottom of the sheet, and find the "Download to Spreadsheet" link.
⑬ "Save link as" on the link and name the file "companystocks". (ex: 'googlestocks', 'amazonstocks', etc.)
⑭ In the same folder as the program, create a directory named "financial-data".
⑮ Create a folder for each company, name it after the company, and put the company's financial statement CSV file and the stock prices file in the folder. The Amazon folder should contain 'amazon.csv' and 'amazonstocks.csv'.
⑯ Repeat steps 2-15 for the remaining companies
⑰ In Terminal or the command prompt, type, "python ratiovsstocks.py financial-data" to run the program

8. **Collaboration and Reflection**

I will be working on this assignment by myself.

I learned that the biggest headache in performing analysis on data is finding data and making sure that the data is as cleanly formatted as possible. I really wish I had known how much of a pain finding good data is before I started this assignment. If I could do this project differently, I would find a more interesting problem to solve. I wanted to perform an in-depth statistical analysis of MMA. Perhaps see how much a fighter's career is impacted in terms of wins and losses by the amount of punches he absorbs, or the most common method of victory. The problem with this was that the only website that had the data I required did not provide it to the public. In the future, I would spend more time finding a research topic that has adequate data available for download.