ASSESSING PROFITABILITY OF FORTUNE 500 FIRMS USING MOVING AVERAGES AND LINEAR MODELS (LINEAR IN THE PARAMETERS)

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Abstract: Based on data forFORTUNE 500 firms for the years 1955 through 2012 moving averages are used to examine profitability. F irms are broadly categorized as 'VENERABLE OLD FIRMS' and 'OTHERS'. Within each of these two broad categories, there are myriad ways of further sub-categorizing, e.g., financial services & insurance, transportation, high technology, agriculture &manufacturing, foods, beverages& chemicals, health & medical,and miscellaneous.Sub-categorizing is difficult because firms are able to diversify by leveraging their comparative advantages to move profitably into areas (products) that were not in their purview when the firm was first established.

Profitability, for our purposes is viewed as normal (NP), above normal (ANP), and monopoly (MP).

Key Words: ANP (ABOVE-NORMAL PROFITS), MP (MONOPOLY PROFITS), S (SALES), P (PROFITS), MT (MONOPOLY THEORY)

1. Background / Introduction

Once upon a time, a university professor was 'leafing-thru' a recently published trade magazine when his eyes fell on the sequence 'Fortune 500 Firms'. He turned the page, and there, right there on the next 15-pages was a list of 500 US firms RANKEDfrom 1st to 500th. Additionally, for each firm there was givenTOTAL REVENUE and PROFIT. Then things became really interesting, a WEBSITE was given that provided the exact same data for the 'FORTUNE 500 firms for all years from 1955 to 2005.

Some immediate questionsare: What measures, what qualities, what factors, etc., determine a firm's rank, size, profitability? Questions such as these abound, but by making a few simplifying assumptions we can frame a t opic, "ASSESSING PROFITABILITY OF FORTUNE 500 FIRMS USING MOVING AVERAGES AND LINEAR MODELS" and use the data at-hand to explore it. Initially our intent was to use the entire data set (all 500 firms), but in the time available we realized that only a sample could be managed. The greater work is proceeding, but we choose to report our findings for a sample of firms.   The following graph will be our 'reference point'.
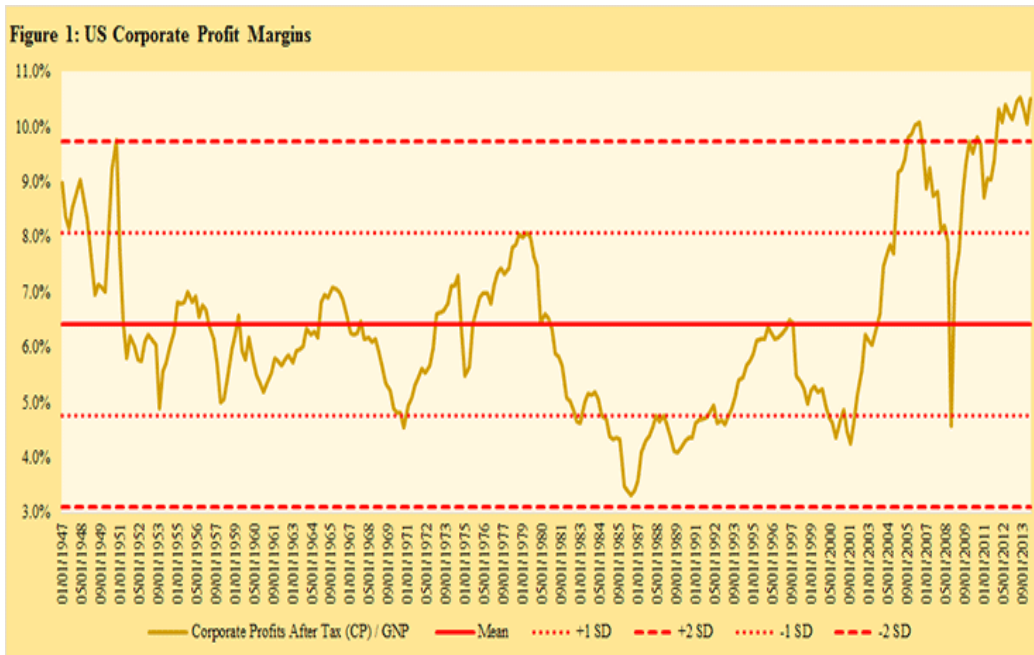
Figure 1: Historic Firm Profitability

2. Analysis

An interesting and insightful place to begin our exploration is with moving averages for our sample of 36 firms grouped into five categories, 'VENERABLE OLD FIRMS', 'HIGH TECHNOLOGY FIRMS', 'FINANCIAL SERVICES FIRMS', 'TRADITIONAL LARGE GROCERY FIRMS', and 'BIG BOX &EVERYTHING FIRMS'. What we have termed VENERABLE OLD FIRMS includes a broad spectrum of firms that have existed for quite a long time,(much earlier than the beginning point of our data), and intersects the other three categories. The other three categories have relatively short time series, beginning at the earliest, in the late 1970sBelow are the relevant graphical displays. The graphs have been scaled to allow six graphs (firms) per page, resulting in a manageable number of pages (7 pages) of graphs to be discussed.

Figure 2a: Venerable Old Firms

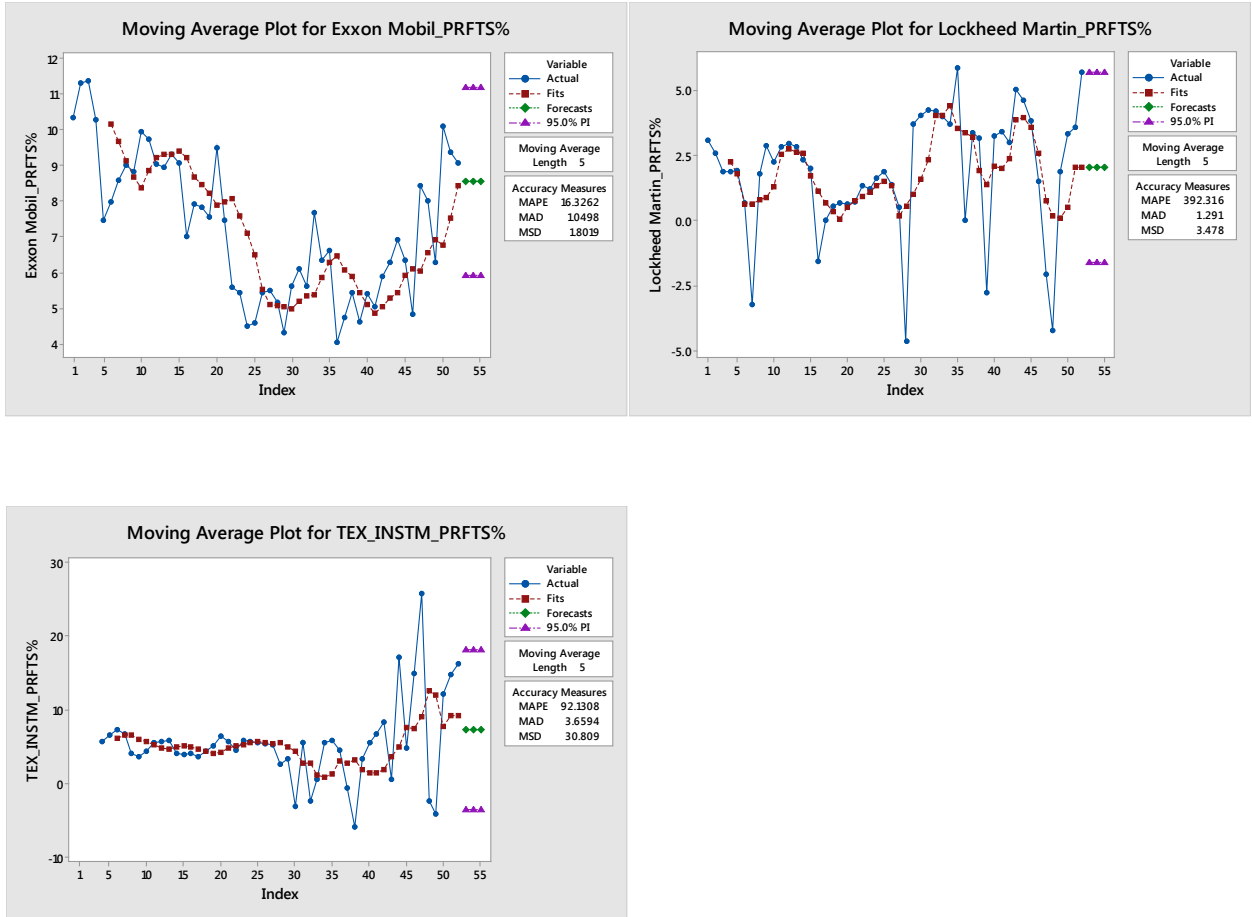**Figure 2b:** Venerable Old Firms

Figure 2c: Venerable Old Firms
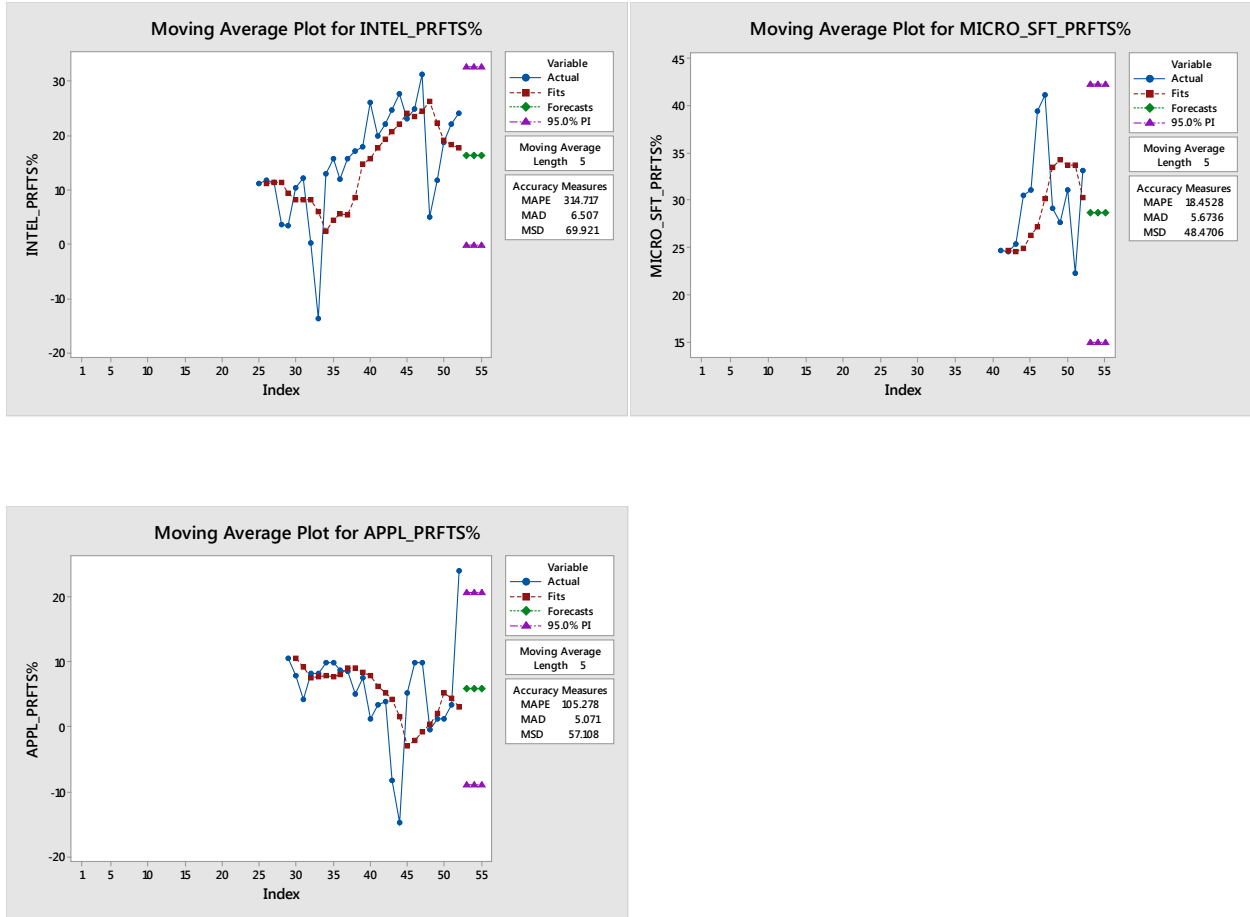
Figure 2d: Venerable Old Firms
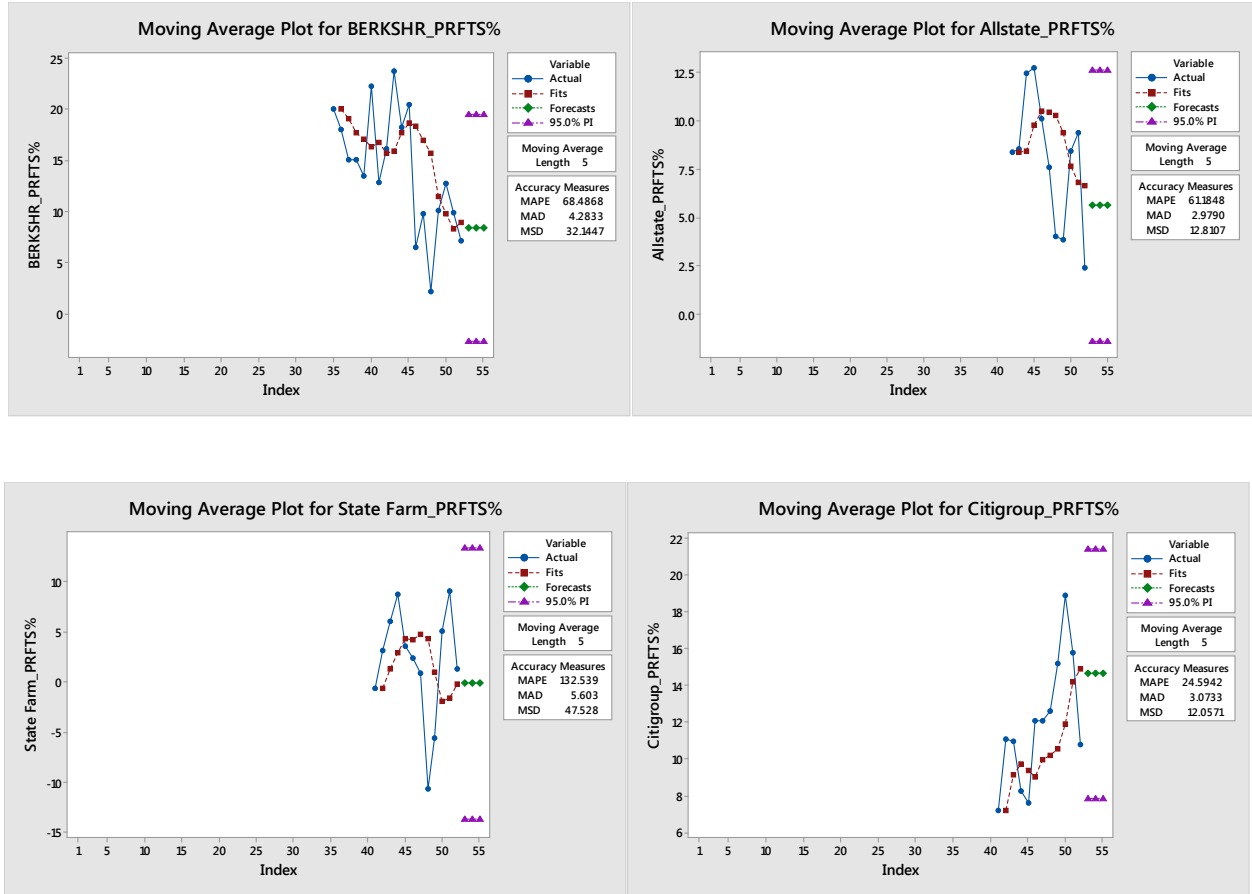
Figure 3: High Technology Firms

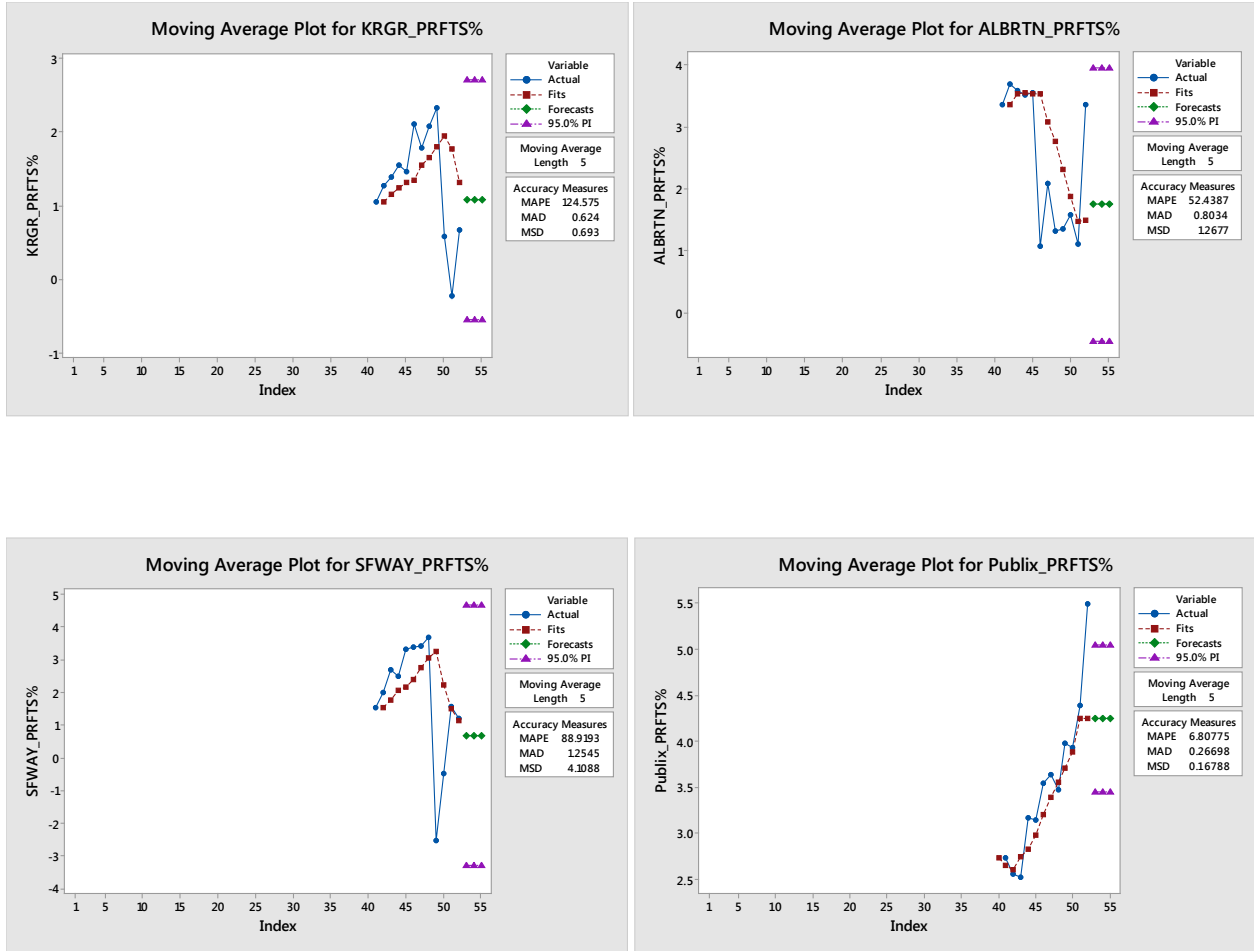**Figure 4:** Financial Services Firms

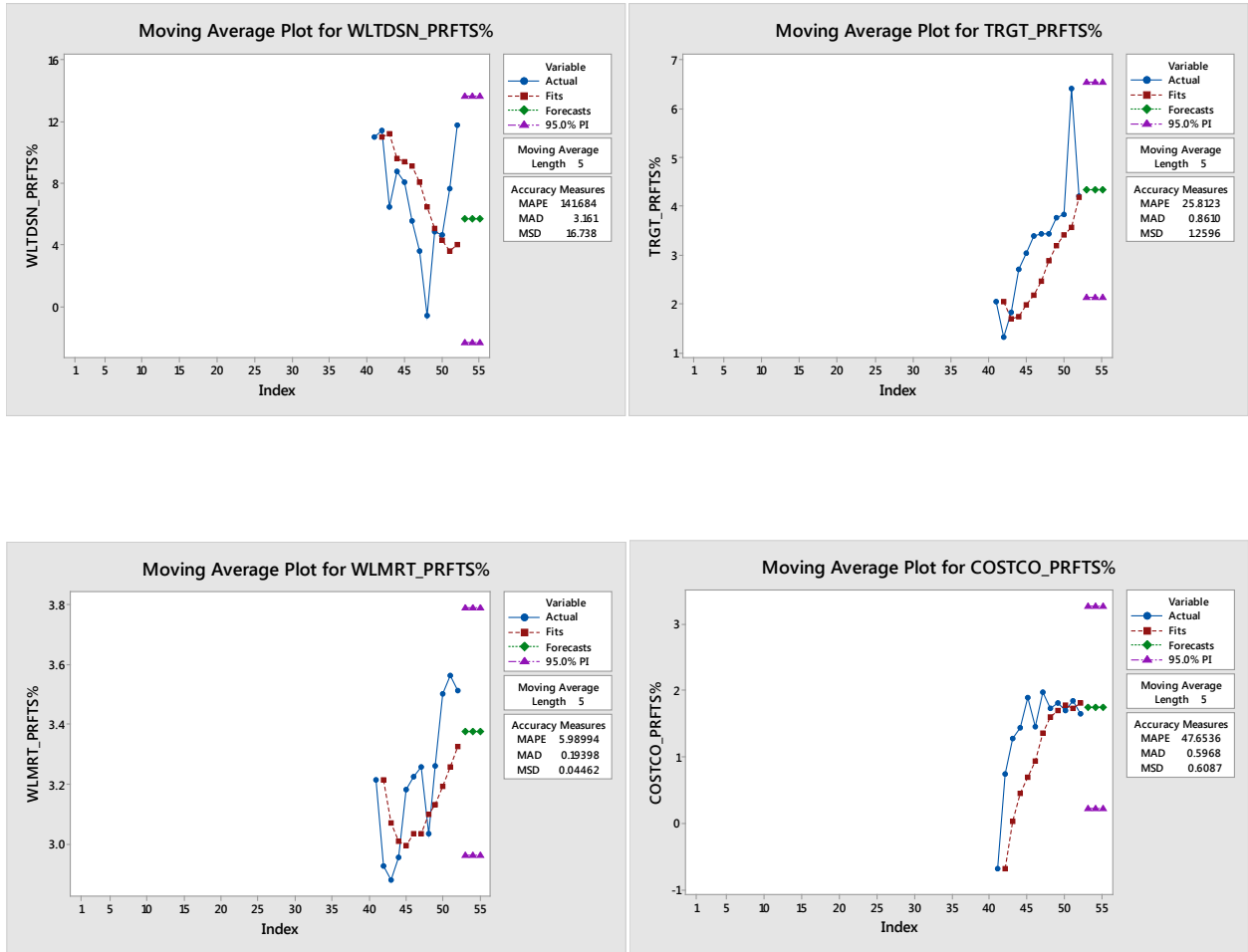**Figure 5:** Traditional Large Grocery Firms

Figure 6: Big Box and Everything Firms

Here, we present graphically an alternative approach to assessing and modeling profitability in companies (firms). A small number of firms are used for illustrative purposes.
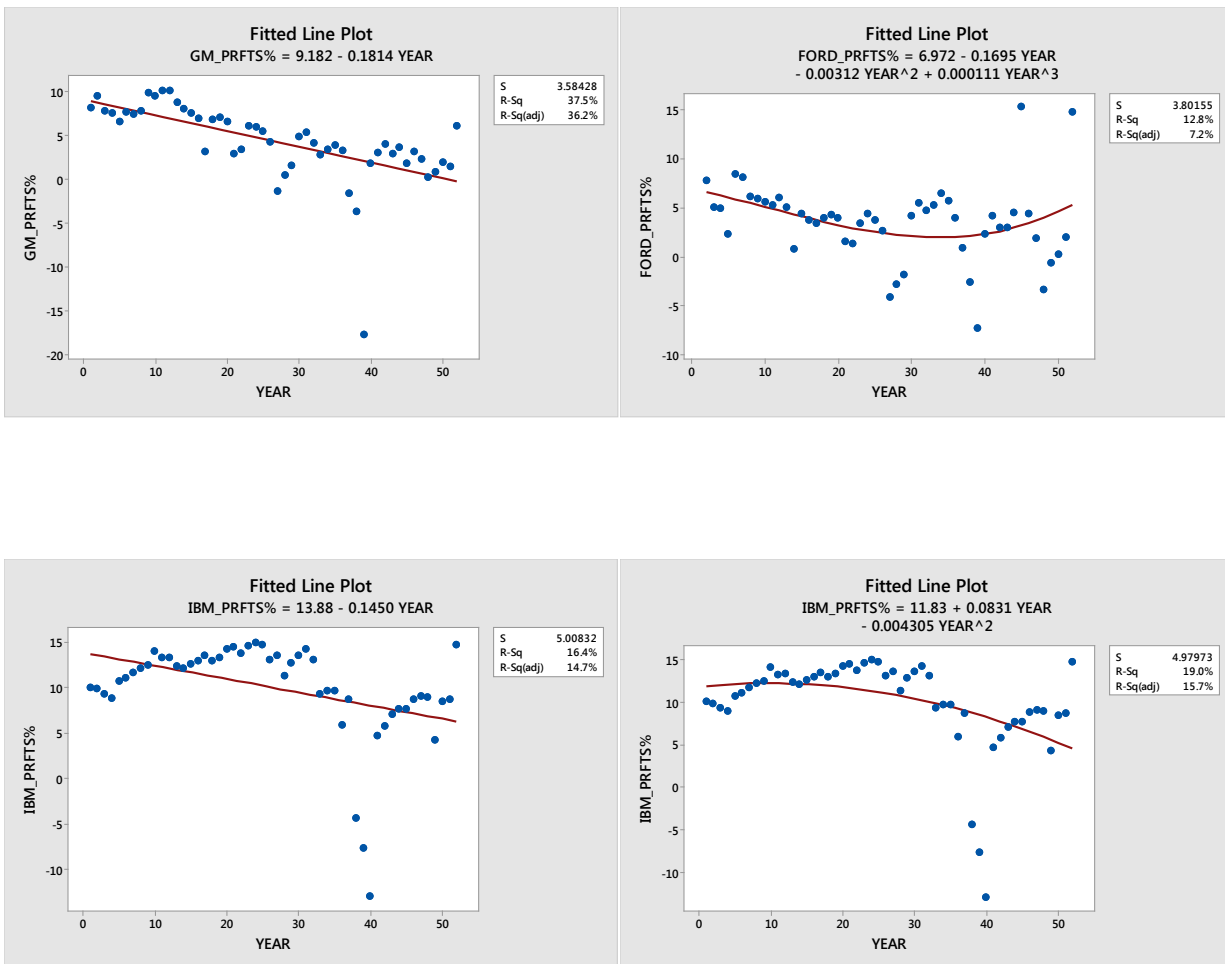

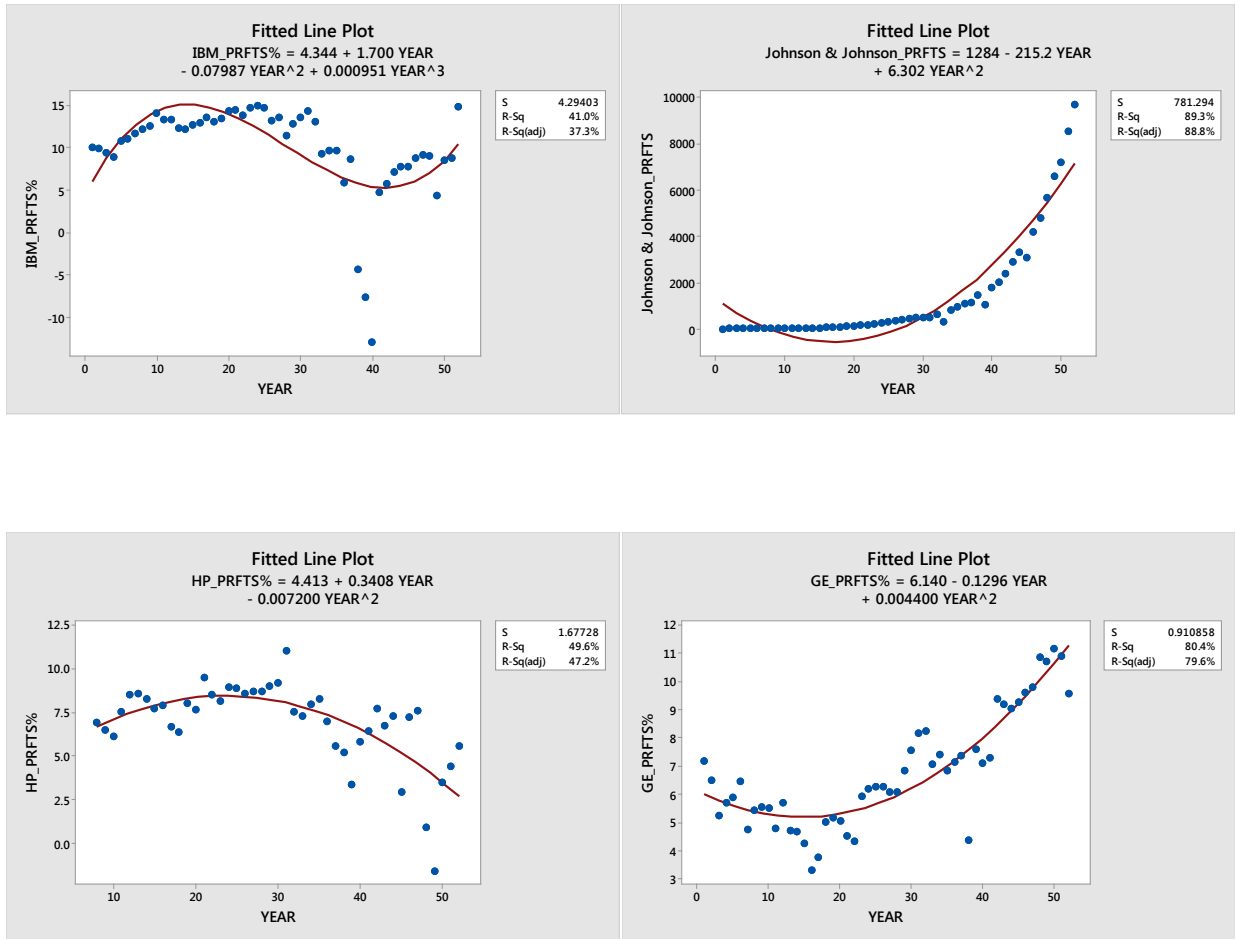**Figure 7a:** Alternative Temporal Profitability Models

Figure 7b: Alternative Temporal Profitability Models

3. Discussion

Our primary approach to identifying FIRMS that 'performed differently' has been to examine firm performance over the breadth of our data, which comprised as many as 52-years of data for a high percentage of the firms. O n this 'first pass' through the FORTUNE 500 data we are choosing to focus on the moving average results since these results will withstand a more 'robust scrutiny' (violate fewer assumptions, have fewer measurement issues).

Although, strictly speaking, the sample of 36-firms used in the moving average is not a probability sample, the results accord well with the profits-margin graph presented in the background section.For convenience, we put it here also.

The sample of 36-firms was divided into 5-categories, call them 'VENERABLE OLD FIRMS', 'HIGH TECHNOLOGY FIRMS', 'FINANCIAL SERVICES FIRMS','TRADITIONAL LARGE GROCERY FIRMS', and 'BIG BOX &EVERYTHING FIRMS'. Clearly, this grouping is not entirely satisfactory, but as stated, this is just an initial exploratory effort to gauge what may be feasible.

The category 'VENERABLE OLD FIRMS' constitutes fifty-eight percent of our sample of 36 firms, (21/36), displayed as Figures 2a – 2d; the category 'HIGH TECHNOLOGY FIRMS', just over eight percent (3/36), displayed as Figure 3; the category 'FINANCIAL SERVICES FIRMS', just over eleven percent (4/36), displayed as Figure 4; the category 'TRADITIONAL LARGE GROCERY FIRMS', just over eleven percent (4/36), displayed as Figure 5; and 'BIG BOX &EVERYTHING FIRMS', also just over eleven percent (4/36)[**], displayed as Figure 6.

The commercially available statistical software program that was employed produced the 5-period centered moving averages for all firms and a 3-period ahead forecast. Consider Figure 1a for the category 'VENERABLE OLD FIRMS', and in particular, the firms Cocoa Cola (20%), Altria(16%), P&G (12%), General Motors (3%), IBM (10%), and Abbott Labs (14%), reported parenthetically are the associated 3-period ahead forecasts. [NOTE:Values in parentheses are forecast % profits.]

In sequence, we report the remaining FIGURES (2b – through 2d) for this category. Results for Figure 2b show that the firms, GE (11%), Boeing (3.5%), Caterpillar (8%), Raytheon (1%), Ford (2%), and Merck (20%) have 3-period ahead forecasts as indicated.

Results for Figure 2c, and specifically the firms Dow Chemical (4%), HP (2.5%), 3M (13%), Johnson & Johnson (13.5%), United Technologies (6.5%), and Monsanto (6%) are reported as sh own.Results for Figure 2d are the last three firms in the category'VENERABLE OLD FIRMS'. The firms are Exxon-Mobil (8.5%), Lockheed-Martin (1.8%), and Texas Instrument (9%).

Let us turn now to the next category of firms, 'HIGH TECHNOLOGY FIRMS' which are reported in Figure 3. The firms are Intel (15%), Microsoft (28%), Apple (6%), with 3-period ahead forecasts shown as indicated above. Figure 4 shows the results for the category 'FINANCIAL SERVICES FIRMS'. The firms are Berkshire-Hathaway (8%), Allstate Insurance (5%), State Farm Insurance (0.5%), and Citigroup Bank (15.5%). Figure 5 displays the results for the firm category 'TRADITIONAL LARGE GROCERY FIRMS'. The firms in this category are: Kroger (1%), Albertson (1.5%), Safeway (0.5%), Publix (4.3%). The fifth and last category of firms is 'BIG BOX &EVERYTHING

FIRMS'. There are just three firms in this category, and they are: WalMart (3.2%), Costco (0.3%), and Target (4.4%), but we 'dumped' Walt Disney (5%) into this category arbitrarily.

Now, regarding the last 8 graphs (Figures 7a and 7b) showing linear, quadratic or cubic models of profitability in the firms GM, Ford, IBM, Johnson & Johnson, HP, and GE we offer some observations.

The moving average for GM showed a steady decline in profitability over the years, but by fitting a simple linear model to the data we obtain the equation:

GM_PRFTS% = 9.182 – 0.181t,

which suggests that profit at GM fell 0.181% per year. The model is far from perfect, but the R^2 value is sufficiently high (0.362) that a clear signal should have been received and corrective actions should have been taken prior to the event of 2008.

Ford, GM's sister company in the automobile industry, over the same time period showed a fairly strong tendency to track GM downward, not as pronounced, to the extent that a simple linear model fits the data less well as a cubic model:

FORD_PRFTS% = 6.972 – 0.170t -0.00312t^2 +0.000111t^3, with only a weak but significant R^2 value of 0.072.

A more interesting situation is that of IBM, where we fit three models, linear, quadratic, and cubic:

Linear   IBM_PRFTS% = 13.88 -0.145t,

with an associated R^2 of 0.147, nothing to 'write home about', but a clear downward trend is evident. A marginally better fitting model is:

Quadratic   IBM_PRFTS% = 11.83= 0.083t -0.004t^2,

with anassociated R^2 of 0.157. Since we are on this path, why not try a cubic model:

Cubic   IBM_PRFTS% = 4.344 + 1.70t -0.080t^2 + 0.00095t^3,

with an associated R^2 of 0.373. Thus, fitting the cubic model pays 'big dividends.

Another firm, Johnson_&_Johnson, is nicely modelled with a quadratic:

Quadratic Johnson_&_Johnson_PRFTS = 1284 -215.2t + 6.302t^2,

with an associated R^2 of 0.888, a high value of the adjusted coefficient of determination in any case.

The last two firms to be used in this demonstration are Hewlett Packard (HP) and General Electric (GE), both modelled convincingly as quadratics:

Quadratic   HP_PRFTS% = 4.413 + 0.341t – 0.007t^2, with an associated R^2 of 0.472.

GE_PRFTS% = 6.140 -0.129t + 0.0044t2, with an associated R2 of 0.796.

This concludes our demonstration of how being sensitive to what we see graphically can be used in choosing the appropriate model.

4. Conclusions

Some firms are earning above normal profits (ANP) and some are earning monopoly profits (MP). These firms are achieving spectacular profits 'over-the long-haul'. The precise reason(s) for their success is complex, and we dare not at this point try to offer any except to say that exceptional leadership, the requisite accumulation of 'Druckerian insight', market savvy, managerial acumen ('The Jack Welch Effect'), and no doubt, a little good luck here and there, must certainly be among them.

5. Future Work

Clearly, we have just begun to explore the many dimensions of the FORTUNE 500 data from the past, the present, and the future. There are so many ramifications, assumptions, questions, etc., etc., dauntingly, the same kinds of issues that were raised decades ago. This initial work has relied heavily of graphical explorations, primarily to try to visualize relationships, associations, links that might otherwise not be detected easily. It is true that much work has been done in the intervening years, but much yet remains to be done. Technological advances have afforded new opportunities for digging deeper. That is exactly what lies ahead for us.

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