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Value Relevance of DuPont Identity

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Abstract

This study provides an empirical support to the relevance of very prevalent and well-established almost a century ago the DuPont Identity in the context of India, one of big 10 emerging markets (Garten, 1997). The DuPont Identity, a familiar form of financial statement analysis (Soliman, 2008) for use in equity valuation (Nissim and Penman, 2001), decomposes the return on equity (ROE) into three multiplicative components: net profit margin (operating efficiency), assets turnover ratio (asset use efficiency) and equity multiplier (financial leverage). The present study is based on the valuation theory which considers the viewpoint of equity investors to empirical investigate the value relevance of accounting information (Beisland, 2009). In this study, value relevance of three measures of accounting information used in the DuPont Identity is investigated for 228 manufacturing firms listed in National Stock Exchange (NSE) of India over a period of ten years from 2006-07 to 2015-2016. The findings indicate that the firms should focus on asset use efficiency and financial leverage components of DuPont Identity since a statistically significant impact of these two components on the stock returns is found. The strategic use of asset efficiency and financial leverage inevitably ensures the operating efficiency of the firms. This empirical investigation is an addition to the value relevance literature with an important insight to the firms and the participants of stock market about the usefulness of DuPont Identity in the context of India.

Keywords: DuPont identity, value relevance, stock returns, financial leverage

JEL classification: M10; M19; M41

1. Introduction

The determinants of profitability are to be understood by the business managers to have a long-term strategic management focus (Melvin et al. 2004). The DuPont Model, also labeled as

DuPont Identity or DuPont Analysis or DuPont Equation in the literature (Eagle and Djatej, 2012), is used by the businesses for analyzing the profitability of a firm. This model is based on the relationships among three components: net profit margin, asset turnover, and financial leverage and it is represented as the product of these components (Mishra et al. 2009). The DuPont Identity, a strategic model formulated by an engineer, F. Donaldson Brown, of the DuPont Corporation in 1920, for measuring the financial performance of the DuPont Corporation. Over a period, the application of DuPont model has well been received by many organizations for valuing the equity or determining the return on equity (ROE, hereafter). To provide relevant information to the active stock investors for the estimation of the value of the firms is the prime objective of the financial reporting. Is the reporting of financial data associated with the estimation of the market value of the firms, or is another source of information important to estimate the market value of the firms (Beisland, 2009)? To seek the answers to these questions many studies in accounting literature have examined the association of accounting values with the market value of the firms over a period of five decades, but according to the study of Barth (2000) the term 'value-relevance' (an accounting value is defined as value-relevant if it has a predicted association with the market value of the firms) has been used first time by the study of Amir et al. (1993). One of the main literature under the modern Capital market-based accounting research (hereafter, CMBAR) often viewed as the origin from the study of Ball and Brown (1968) is considered to be a value relevance literature. This value relevance literature is based on valuation theory which takes the point of view of equity investors to empirical examine the value relevance of accounting information (Beisland, 2009).

This paper takes DuPont analysis, a familiar form of financial statement analysis (Soliman, 2008) for use in equity valuation (Nissim and Penman, 2001), for empirically examining its relevance in the context of an emerging market, called India, as the structures of business organizations in the emerging or developing markets are different from those in developed markets (Sarkar et al. 2008). India is one of big 10 emerging markets Garten (1997). Liquidity, taxation, stock market benchmarks, and different transactions and accounting methods are some of the parameters where international stock markets differ (International Equity Markets, http://www.bauer.uh.edu). The process of integration of emerging markets into world markets is incomplete though correlations between developed and emerging markets have increased (Bekaert and Harvey, 2013). Moreover, it is very difficult to replicate the depth of institutional liquidity, the kind of infrastructure and pools of human capital built by the developed markets organically (Capital Markets in 2025, http://www.pwc.de). Furthermore, emerging markets are heterogeneous in their level of development and environmental surroundings (Bianchi, 2014). This suggests that 'developed' and 'emerging' markets are really different in many aspects including the structures of business organizations. An enormous scale of scholarly interest in emerging market phenomenon in management discipline is found in a casual review of academic literature on emerging markets (Merchant and Allen-Ford, 2012). Since considerable research studies on this topic have not been explored in the context of emerging markets, therefore this study claims to question this relationship in an emerging market, named India. The study of Merchant and Allen-Ford (2012, pp.369) lists India as one of the emerging

markets defined by Dow Jones (2010), Economist (2009), FTSE(2010), MSCI (2010) and Hoskisson et al. (2000).

DuPont analysis decomposes the ROE into three multiplicative components: net profit margin (NPM, hereafter), assets turnover ratio (ATR, hereafter) and equity multiplier (EM, hereafter) and it has been extensively put into practice since its development in the early 20th century by E. I. DuPont de nemours and Company (Chang et al. 2014). These three components are also referred as operating efficiency (net profit margin), asset use efficiency (asset turnover ratio) and financial leverage (equity multiplier), respectively. The firm's financial performances are highlighted by DuPont analysis in three major areas: profitability, turnover, and leverage (Botika, 2012). The objective of this study is to find an empirical evidence of value relevance of the DuPont analysis of the common stocks of 228 manufacturing firms listed in National Stock Exchange (NSE) of India over a period of ten years from 2006-07 to 2015-2016. The standard ordinary least square regression model at the level of a portfolio of firms is employed to present the empirical results demonstrating which of three components of DuPont analysis influences the stock returns most. The findings indicate that the firms should focus on asset use efficiency and financial leverage components of DuPont Identity since a statistically significant impact of these two components on the stock returns is found. The strategic use of asset efficiency and financial leverage inevitably ensure the operating efficiency of the firms. The present study is an addition to the value relevance literature in Indian context under CMBAR that studies the association between stock price-based dependent variable and accounting variables.

The rest of the paper is organized as follows. The next section is described related literature and hypothesis development. Section 3 explains the empirical test and design. The results and discussion are taken in Section 4 and Section 5 presents the robustness check of the model used in the study. Finally, Section 6 has the conclusions with limitations and implication.

2. Literature Review and Hypothesis Development

2.1 Review of Literature

If no association between accounting information and the market value of the company is found, the financial reports are unable to fulfill one of their primary objectives (Beisland, 2009). Ball and Brown (1968) show that earnings and earnings-based measures are value relevant owing to their association with stock returns. If an accounting number is helpful in explaining value or returns over long windows, it can be considered to be value relevant (Holthausen and Watts, 2001). An accounting amount will be value relevant only if the amount reflects relevant and reliable information to investors in valuing the firms (Barth, 2000). One of the four interpretations of Francis and Schipper (1999) indicates that the value relevance is measured by a statistical association between financial information and stock prices or returns. Consistent with Francis and Schipper's fourth interpretation of value relevance, Beisland (2009) defines value relevance as the ability of financial statement information to capture and summarize information that determines the firm's value. The study of Beisland (2009) is exclusively devoted to equity investment which takes the value relevance research as the measurement of the usefulness of accounting information from the point of view of equity investors. Aboody et

al. (2001) define value relevance as a mapping from accounting information to 'intrinsic value'. The study of Ohlson (1995) proposed a most relevant model of value relevance analysis and value relevance analysis assumes that information is value-relevant if it affects the market value of the firm (Carnevale et al. 2009).

The DuPont Identity, a familiar form of financial statement analysis (Soliman, 2008) for use in equity valuation (Nissim and Penman, 2001), decomposes the return on equity (ROE) into three multiplicative components: net profit margin, asset turnover ratio, and equity multiplier. These three components are also referred as operating efficiency (net profit margin), asset use efficiency (asset turnover ratio) and financial leverage (equity multiplier), respectively. The firm's financial performances are highlighted by DuPont analysis in three major areas: profitability, turnover, and leverage (Botika, 2012) and the firm's financial performance measured by ROE is linked to the share value of listed or publicly traded companies (Isberg and Pitta, 2013). To understand the ROE comprehensively, it is important to study its main drivers. The study of Chen et al. (2014) mentioned that ROE, a fairly representative index of performance evaluation, comprehensively takes the level of operations and financial positions of companies. Eagle and Djatej (2012) have derived a formula for determining the main reasons of the change in ROE from one period to the next. This formula measures the percent changes in ROE with the percent changes in the DuPont components.

This DuPont Identity has been extensively put into practice since its development in the early 20th century by E. I. DuPont de Nemours and Company (Chang et al. 2014). The DuPont Management successfully disaggregated the Return on Equity (ROE) into three important drivers which hold the operating and non-operating activities of the company. However, the DuPont analysis was also done by using Return on Net Operating Asset (RNOA, hereafter), the product of profit margin and asset turnover, for valuation and other investigations (Nissim and Penman, 2001; Fairfield and Yohn, 2001; Soliman, 2008; Chang et al. 2014; Bauman, 2014). The usefulness of the DuPont Identity can be reflected through the estimated relationship of accounting data from both the income statement and the balance sheet.

2.2 Hypothesis Development

There are several empirical studies which have explored various accounting variables which impact the stock returns (Ball and Brown, 1968; Gahlon and Gentry, 1982; Bhandari, 1988; Habib, 2004; Dimitrov and Jain 2008; Gomes and Schmid, 2010; Garcia and Jorgensen, 2010). Ball and Brown (1968) show that changes in earnings are associated with stock returns and, therefore, earnings are considered value relevant. There is a positive relationship between stock returns and debt to equity ratio of the firms (Bhandari, 1988). Thus, debt to equity ratio is considered to be value relevant. Habib (2004) investigates the quality (value relevance) of accounting information by taking the explanatory power of accounting earnings and book values as well as the explanatory power of earnings alone with respect to stock price. Dimitrov and Jain (2008) find that annual stock returns are significantly associated with contemporaneous changes in financial leverage and, hence, changes in financial leverage are value relevant. The relationship between financial leverage and stock returns in a dynamic world is more complex than static textbook examples as suggested by Gomes and Schmid

(2010). Garcia and Jorgensen (2010) found a positive relation between the degree of operating leverage and average stock returns in cross-section which supported the theoretical models of Carlson, Fisher, and Giammarino (2004), Zhang (2005), and Cooper (2006). Garcia and Jorgensen (2010) also found a positive, but weak, relation between the degree of financial leverage and stock returns. Based on the above theoretical and empirical investigations, it can be hypothesized to examine the value relevance of various accounting numbers. The present study is an attempt to explore the value relevance of three important accounting numbers which are combined together to form a strategic model of DuPont Identity.

The study of Soliman (2008) examined the use of DuPont analysis, a familiar form of financial statement analysis, by the market participants and evidenced an association between DuPont components and stock returns. The valuation model of Halsey (2001) provided theoretical support for the DuPont model's focus on ROE decomposition in understanding the implications of price-to-book and price-earnings ratios. Chowdhury and Chowdhury (2010) considered the DuPont analysis, a widely used tool for financial analysis of the companies, to measure the financial performance of select commercial banks in India. The previous studies (Halsey, 2001; Liesz and Maranville, 2008; Mishra et al. 2009; Chowdhury and Chowdhury, 2010; Eagle and Djatej, 2012; Chang et al. 2014; Burja and Mărginean, 2014) employed the decomposed form of ROE for their respective empirical investigation. The ROE is the rate at which the value of the investment made by the owners of a firm is increased and the investors use the concept of ROE to determine whether the firms provide acceptable compensation for the risk inherent in owning shareholding in the firm. (Isberg and Pitta, 2013) Therefore, the decomposed form of ROE, also called a DuPont Identity, into three multiplicative components for this study can also be used to measure the market performance of listed manufacturing firms in India. For this purpose, a hypothesis is being formulated as:

> ***H1:*** *Three multiplicative components: net profit margin (NPM), assets turnover ratio (ATR) and equity multiplier (EM), of the Return on Equity (ROE), a decomposed form of DuPont Identity, significantly impact the stock returns of listed manufacturing firms.*

3. Empirical Test Design

3.1 Data Selection and Estimation of Variables

The financial data of the sample manufacturing firms have been extracted from the Prowess database created by the Center for Monitoring Indian Economy (CMIE) and the 228 firms having the complete financial data (monetary value of all required data as on March 31 for every financial year) for the period of ***ten*** years have been considered for this study. The Prowess database has formed the basis of several published empirical studies on the Indian corporate sector (Khanna and Palepu, 2000; Sarkar and Sarkar, 2000; Bertrand, Mehta, and Mullainathan, 2002) as reported by Sarkar, et al. (2008). The data of NSE listed manufacturing firms is extracted from CMIE Prowess database with the values of required accounting variables (Annual Net Sales, Profit after tax, Total Assets, Equity and Stock Prices) as on March 31 for the period from 2006-07 to 2015-2016 for the total sample of 228 firms with the distribution of firms by nine industry. The financial year in India is from April 1 to March 31 of the following year (Sarkar, et al. 2008). The estimation of different variables for this study is

represented in equations one to five, respectively. The equations (1), and (2) measure the cumulative return of each stock and the beta value of each firm's stock. A formula of continuously compounded returns is used to estimate the cumulative stock returns in equation 1. The beta value of each firm in equation (2) is estimated by using market model regression which runs using the monthly stock returns for ten years. The equations (3), (4), and (5) measure the 10-year average value of NPM, ATR, and EM of each firm, respectively.

Dependent Variable

$$R_j = [\Sigma \ ln \ (P_t / P_{t-1})], \ t = 2007\text{-}2016 \qquad j = 1\text{-}228 \tag{1}$$

Where, R_j = Firm j's 10 years cumulative return;

P = Closing Price of the Stock of firm j at the end of year t and t-1.

Instrumental Variable

$$R_{it} = \alpha_i + \beta_i \ R_{mt} + u_{it} \qquad i = 1\text{-}228, \ t=1\text{-}120 \tag{2}$$

Where, R_i and R_m = Monthly rates of return in month *t* on a common stock and an Market Index (NSE Nifty 50);

α_i = Intercept,
β_i= Slope coefficient representing the Systematic Risk (hereafter β) of a common stock

Independent Variables

$$NPM_i = [\Sigma(NPM_{it})/10], \ t = 2007\text{-}2016 \qquad i = 1\text{-}228 \tag{3}$$

Where, NPM_i = Firm i's 10 year average NPM ratio;

NPM = Closing Value of NPM ratio of firm i at the end of each year.

$$ATR_i = [\Sigma(ATR_{it})/10], \quad t = 2007\text{-}2016 \qquad i = 1\text{-}228 \tag{4}$$

Where, ATR_i = Firm i's 10 year average AT Ratio;

ATR = Value of AT Ratio (ATR) of firm i at the end of each year.

$$EM_i = [\Sigma(EM_{it})/10], \qquad t = 2007\text{-}2016 \qquad i = 1\text{-}228 \tag{5}$$

Where, EM_i = Firm i's 10 year average EM ratio;

EM = Value of EM ratio of firm i at the end of each year.

3.2 Regression Model

A Regression ***Model*** is being set up to investigate the impact of NPM, ATR, and EM on the stock returns of the 228 sample firms to test the proposed hypothesis. To reduce the error- in-variables bias, a portfolio grouping (Note 1) approach (Mandelker and Rhee, 1984) is taken to test the combined effects of three components (NPM, ATR, and EM) of DuPont Identity. The common stock of the 228 sample firms is ranked in ascending order on the basis of the size of the systematic risk (β), the instrumental variable for ATR and EM. The instrumental variable

should have a significant correlation with the independent variable and it is used to correct a potential selection bias (Note 2) while forming portfolios. We take the 10-year average of β as the instrumental variable for ATR and EM. Every four stocks from above rank order are grouped together to form a portfolio (Note 3). Huffman (1989) grouped four stocks together to make a portfolio. This means the first four stocks are put in portfolio 1, the next four in portfolio 2 and the last four in portfolio 57. The cross-sectional regression model created based upon the ranking of the size of β is performed to find the empirical results.

$$R_p = \partial_0 + \partial_1 NPM_p + \partial_2 ATR_p + \partial_3 EM_p + ¥_p, \quad (p=1\text{-}57) \tag{6}$$

Where, R_p, NPM_p, ATR_p and EM_p are the portfolio (p) means of each Portfolio, respectively. $¥_p$ = Error term.

The next section shows the empirical findings of this study with the discussion on the relevance of each component of DuPont Identity. It presents the correlation among the variables under study and the regression results of the model formulated in the above equation (6).

4. Results and Discussion

Table 1 presents the correlation matrix for the variables under study. There is a significant positive correlation between the stock returns and ATR (0.352, p<1%) and the stock returns and EM (0.036, p<10%), respectively. However, there is an insignificant correlation between the stock returns and NPM. This suggests that the firms operating in the manufacturing sector of India should focus more on the ATR (Asset use efficiency) and the EM (Financial Leverage) than NPM (Net Profit Margin) for enhancing their stock returns in the marketplace. This positive correlation leads to consider the value relevance of ATR and EM in the DuPont Identity.

Table 1. Correlation (Pearson) matrix

	BETA	RETURN	NPM	ATR	EM
BETA	1.000	0.041	0.067	- 0.247*	0.210*
RETURN		1.000	0.015	0.352*	0.036***
NPM			1.000	- 0.136	-0.207
ATR				1.000	-0.482*
EM					1.000

***,**, and * indicate significance at the 10%, 5%, and 1% level respectively.

Table 2 presents the regression results of the model estimated by equation (6). The panel I in Table 2 depicts cross-sectional regression coefficients on the data sets ranked in ascending order based upon the size of Beta (β). Table 2 shows that NPM has an insignificant effect on the stock returns. However, ATR and EM have statistically significant impact on the stock returns when the ranking based on the size of Beta (β) is used. This means that ATR and EM have

significant contribution in explaining the returns of common stock of the firms. However, NPM has an insignificant contribution in explaining the stock returns.

Any accounting number of interest in explaining value or returns (over long windows) given other specified variables is typically deemed to be value relevant if its estimated regression coefficient is significantly different from zero (Holthausen and Watts, 2001). Thus, two components, ATR and EM, of DuPont Identity can be considered to be value-relevant as their regression coefficients are significantly different from zero as per Table 2 over long windows. Since the Model is statistically found significant at 1% significance level with a virtuous explanatory power (Adj. R^2=15.5%) as per Table 2, therefore the value relevance of DuPont Identity can empirically be validated. However, two components, asset use efficiency and financial leverage, of DuPont Identity do have a significant impact on the stock returns of the sample firms. Thus, the firms should focus more on the efficient use of their assets and finance these assets than profit margin which is generally an outcome of the efficient use of assets and financial leverage.

Table 2. Portfolios formed based upon the rankings of the size Beta (β)

$$R_p = \partial_0 + \partial_1 NPM_p + \partial_2 ATR_p + \partial_3 EM_p + ¥_p \quad , \quad (p=1\text{-}57)$$

Portfolios	∂_0	∂_1	∂_2	∂_3	Adj. R^2	F-statistic
I. Based upon the size of β.						
	-1.190	2.393	1.019	0.837	0.155	4.417*
	(-1.40)	(1.18)	(3.62)*	(2.18)**		
	VIF	1.130	1.409	1.445		
		Durbin-Watson: 2.109				

***,**, and * indicate significance at the 10%, 5%, and 1% level respectively. Figures in parentheses are t-values.

The next section checks the robustness of the portfolio grouping approach employed to find the empirical results of this study. It shows why does the regression model formed on the basis of portfolio grouping approach present more appropriate empirical results?

5. Robustness Check

A robustness check with no use of portfolio grouping approach is also employed. The cross-section regression as per the equation (7) on the individual stock of 228 sample firms is run to test the proposed hypothesis. Table 3 presents the result of cross-section regression

equation (7) performed at an individual firm level. The result shows that there is no significant impact of NPM, ATR, and EM on the stock returns. Moreover, the model at all significant levels has also been found insignificant. The present study has also done the panel data analysis by employing the Random Effects Regression model for the sample firms. The model has been found significant at 1% significance level but no significant joint impact of NPM, ATR, and EM on the stock returns is found. Thus, the portfolio grouping approach is considered the appropriate approach for the empirical investigation of this study as the portfolio grouping approach reduces the error- in- variables bias and corrects the potential selection bias by using the instrumental variable.

$$R_i = \mu_0 + \mu_1 NPM_i + \mu_2 ATR_i + \mu_3 EM_i + e_i \qquad (i=1\text{-}228) \qquad (7)$$

Where, R, NPM, ATR, and EM are the cumulative stock returns of ten year and ten years' average values of Net Profit Margin, Asset Turnover Ratio, and Equity Multiplier, respectively for each firm; e_i = Error term.

Table 3. Regression at individual firm level

$R_i = \mu_0 + \mu_1 NPM_i + \mu_2 ATR_i + \mu_3 EM_i + e_i \quad (i=1\text{-}228)$						
Portfolios	μ_0	μ_1	μ_2	μ_3	Adj. R^2	F-statistic
	1.049	1.499	0.292	-0.096	0.009	1.688
	(2.33)**	(1.26)	(1.79)	(-0.455)		

***,**, and * indicate significance at the 10%, 5%, and 1% level respectively. Figures in parentheses are t-values.

6. Conclusions

The present study is based on the valuation theory which considers the viewpoint of equity investors to empirical investigate the value relevance of accounting information (Beisland, 2009). Li, Nissim, and Penman (2014) also provide a detailed empirical support to the usefulness of DuPont decomposition for the investors in valuation. This study provides an empirical support to the relevance of very prevalent and well-established DuPont Identity, a strategic equation formulated by the DuPont Corporation in 1920, in the context of an emerging market, called India. The DuPont Identity, a familiar form of financial statement analysis (Soliman, 2008) for use in equity valuation (Nissim and Penman, 2001), decomposes the return on equity (ROE) into three multiplicative components: net profit margin (operating efficiency), assets turnover ratio (asset use efficiency) and equity multiplier (financial leverage). DuPont decomposition is found useful for forecasting the variance in stock returns in the study of Li, Nissim, and Penman (2014). In the present study, the stock return of the firms under study is better explained by the asset use efficiency (asset turnover ratio) and the

financial leverage (equity multiplier) than the operating efficiency (net profit margin). Thus, the firms should make the strategies for the efficient use of assets and financial leverage to enhance their stock returns in the marketplace.

This study is limited to the listed manufacturing firms in India for a period of ten years from 2006-07 to 2015-2016. The present study offers an important insight to the practitioners, the scholars, the finance managers and the investors for the usefulness of DuPont Identity in the context of India, one of fastest growing emerging markets in the world. This study is consistent with the study of Halsey (2001) for providing a framework to the accounting instructors and the accountants to analyze the economic factors of equity value and the performance of the firms. Besides, other emerging markets can also be studied to test the consistency in the empirical results of this study.

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Notes

Note 1. Mandelkar and Rhee, pp.52 reports the studies of Beaver, W., Kettler, P. and Scholes, M. (1970); Black, F., Jensen, M. C. and Scholes, M. (1972) and Fama, E. F.,and MacBeth , J. D. (1973) for details about such grouping procedures and their statistical merits.

Note 2. Mandelkar and Rhee, pp.52 reports the work of Theil, H. (1971), pp.445 from his book.

Note 3. Note that Mandelkar and Rhee use a portfolio of five stocks while Huffman is used a portfolio of four.

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