FACTORS INFLUENCING THE PROFITABILITY OF MANUFACTURING FIRMS LISTED ON THE NEW YORK STOCK EXCHANGE

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ABSTRACT,
The purpose of this study is to assess the factors influencing profitability of manufacturing firms listed on the New York Stock Exchange. The investigated variables include: firm size, intensity of research and development, growth rate, productivity, age, net asset turnover, leverage ratio, and current ratio. Consequently, the dependent variable is profitability. Data was collected from the ORBIS database on 250 American manufacturing firms for years 2012-2017. The results indicate a positive relationship between investment in research and development, growth rate, employee productivity, leverage ratio, current ratio and the dependent variable: profitability. No statistically significant relationship was found for independent variables firm size and age and profitability. The results also suggest a negative relationship between net asset turnover and profitability.

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1. INTRODUCTION

1.1 Background

Profitability is a commonly used indicator of firm performance. Consequently, it is in the best interest of every organization to maximize their return rate to satisfy shareholders, attract new capital and to ensure continued operations. Studying the determinants of profitability has thus been the focus of numerous scientific disciplines and continues to grow in popularity. For example, (Barney, 2001; Stulz, 1990) found that the profitability of a firm is significantly influenced by its internal resources and assets; namely property, machinery and employees. A study by (Jiasinghani, 2015) found evidence that investing in research and development projects contributes significantly to the profitability rate of a firm. Another investigation by (Slater & Olson, 2002) identified level of competition and macro-economic factors to be the main contributors of profitability.

As mentioned, this study is not the first to investigate profitability determinants of publicly listed firms. Research by (Margaretha & Supartika, 2016) examined the influence firm size, age, sales growth, productivity and industry affiliation have on profitability rate for Indonesian small and medium enterprises. (Salman & Yazdanfar, 2012) conducted a similar investigation by focusing on growth of sales, firm size, productivity, turnover, and age and their impact on a firm's profit. Subsequently, the research by (Goddard, Tavakoli, & Wilson, 2005) analyzed the profitability determinants of European manufacturing firms. This study differs from previous research by exploring the implications of research and development intensity, current ratio, leverage and net asset turnover on profit within the manufacturing industry. Thus, a detailed portrayal of profitability and the influence of firm-specific factors is established.

Although there has been a significant amount of research conducted on profitability in general, most empirical investigations focus on small and medium-sized firms. Furthermore, past studies tend to concentrate on firms that operate in developing countries, such as Indonesia, India and China. Other studies have used non-current data from the 1990s and earlier, weakening the relevance of their outcomes in today's conditions. The significance of industry affiliation is also commonly neglected, failing to distinguish between financial, medical and industrial firms. There has thus been a lack of empirical research conducted the profitability determinants specifically relevant to industrial firms. This study aims to address these limitations and investigate the significance of profitability factors presented as the independent variables.

This study is relevant because modern businesses are operating in a more complex landscape due to increasing competition and international trade. Sustaining profit has thus become a difficult objective for all firms, especially for manufacturing firms in the United States. According to the OECD, American manufacturers have taken a great hit starting in the early 2000s due to the low cost of Asian suppliers. A large portion of contracts is thus awarded to foreign competitors, making it difficult for domestic manufacturers to stay competitive and profitable. This makes them exceptional samples for studying profitability determinants as American manufacturing firms operate under similar conditions, with the identical goal of generating profit.

The significance of US-based industrial firms is that they are often considered to be the backbone of the American economy, making up over one-third of the national GDP. These organizations play a key role in terms of providing employment, supplying quality goods and services, and addressing stakeholder concerns in the landscape. Due to the industry's importance, the American government is working to implement tariffs and taxes on imports to stimulate growth for domestic firms. The profitability of American industrial firms is therefore crucial to the national economy and continued development.

1.2 Research Objectives

The motivation for this study is to provide additional insight and empirical evidence on the profitability determinants for American manufacturing firms in the current setting.

The main contribution of this investigation is to further investigate the implications of profitability determinants for manufacturing firms operating in the United States. More specifically, the purpose is to identify the relationship between firm size, R&D intensity, age, growth rate, productivity, asset turnover, leverage ratio, net working capital and profit rate of a company. As mentioned earlier, previous academics and publications focused on countries other than the United States, used an older time period and used economic indices as a basis for data. In this study, a dataset is created on 250 firms that are classified as a manufacturing firm and operate primarily in the United States. This leads to the following research question:

To what extent do firm size, investment in research and development, year-to-year growth, employee productivity, firm age, net asset turnover, current ratio and leverage ratio influence the profitability of publicly listed manufacturing firms in the United States for the years 2012-2017?

Profitability determinants are examined for effectively 221 American manufacturing firms for the years 2012-2017, as 29 of the 250 firms were found irrelevant or had a lack of available information. The companies are selected from the NASDAQ website, which provides an overview of publicly listed firms organized per industry category. All data used and referenced during this research is obtained from the ORBIS database. This source, created by Bureau van Dijk, provides financial information on private and public organizations located all over the world.

In order to model the effect of profitability determinants, past studies used descriptive statistics, such as ordinary least squares (OLS), also referred to as classical linear regression, to analyze profitability. In this study, a linear regression model is formulated to investigate the relationship between the dependent and independent variables, in accordance with the empirical model used by (Salman & Yazdanfar, 2012).

From a practical perspective, research on profitability determinants is beneficial for setting strategy, asset allocation and ensuring organizational effectiveness. The conclusions set forth by this study, together with the presented regression model, can be used as a guideline for decision-making relevant to business managers and manufacturing firms. The model established also prompts managers to evaluate their own expected profitability rate and enables the identification of areas of concern.

This paper is divided into four parts. The first section contains a review of literature, past studies, and hypotheses. The second section discusses research methodology, empirical model, variables and data collection. The third section elaborates on findings and in the fourth section, conclusions and results are presented with their significance to real-life applications.

2. LITERATURE REVIEW AND HYPOTHESES

In the ever-evolving American industrial market, manufacturers are constantly looking for ways to cut costs and maximize profitability. Profit enables businesses to satisfy shareholders requirements and ensure firm survival. It can also benefit stakeholders, as positive externalities of profitability generally include social responsibility and philanthropy. It is therefore in the manager's best interest to regularly measure performance and organizational effectiveness, most frequently done through profitability ratios. Researching profitability enables the evaluation of key factors playing a role in generating profit, providing invaluable feedback for strategy setting and establishing a clear focus on return on investment.

To increase the relevance of results, this study investigates more profitability determinants than other studies. Previous investigations used between three and four variables, on average. This study will investigate 8 variables with the purpose of providing additional insight into the forces influencing profit rate, creating a more realistic model. Additionally, a large sample of listed manufacturing firms operating in the same industry are analyzed, thus extending research conducted in the past by providing insight in the American industrial market. In other investigations, factors such as fixed asset turnover, leverage ratio and net working capital are generally omitted, being considered of lower importance or due to lack of available information. However, this study aims to shed light on their relationship to a company's profit rate. In the following sub-chapters, possible relationships between independent variables and profitability are investigated for American manufacturing firms.

2.1 Firm Size

Previous studies have established an abstruse understanding of the impact firm size has on profitability. Their conclusions can be divided into two main views. Firstly, (Aldrich & Auster, 1986) argued that smaller firms suffer from "liability of smallness," implying that organizations with fewer assets lack the resources and know-how to be significantly profitable. (Margaretha & Supartika, 2016) analyzed public firms listed on the Indonesian Stock Exchange and found a negative relationship between firm size, in terms of total assets, and profit rate. Research by (Salman & Yazdanfar, 2012) on Swedish small and medium enterprises identified a similar relationship. Correspondingly, (Ramasamy, 2005) also found a negative influence of firm age on the profitability of a firm analyzing Asian businesses. (Dhawan, 2001) analyzed firms operating in the American industrial sector and reached the conclusion that smaller companies will result in higher profit rates though have a lower survival rate than larger organizations. (Hirsch, Schiefer, Gschwandtner, & Hartmann, 2014) analyzed the European food industry finding that firm size, together with industry concentration, to be the main drivers of profitability. (Fama & French, 1995) also investigated this relationship on corporations listed on the New York Stock Exchange, finding a direct, positive link between total assets of a firm and its returns.

The second perspective of firm size and its influence on profitability aligns with Barney's Resource-based View. (Barney, 1991) found that firms with more assets and capital benefit from a competitive advantage, allowing the firm to engage in more investments and projects than smaller organizations, rendering it more profitable in aggregate. Consistent with the RBV, (Hall & Weiss, 1967) found that a firm's total assets have a positive influence on profitability when analyzing public firms in the United States. (Vijayakumar, 2011) established that larger firms in India experience a higher return on assets than smaller firms. (Eslava, Haltiwanger, Kugler, & Kugler, 1964) found that the diversification capabilities of larger firms enable a higher, less variable profit rate, compared to smaller firms. However, (Stelker, 1963), a study by the University of Berkeley noticed that for organizations with more than $5-10 million in assets, firm size has little to no impact on return on assets.

Larger firms should be more profitable in the long-run for the following reasons: 1) ability to sustain higher losses for a longer period of time due to greater amount of total assets, 2) less dependent on one customer segment or market due to portfolio diversification, and 3) stronger market presence establishes credibility, making larger organizations more attractive for investment, line of credit and preferred choice for awarding sales contracts. Therefore, the following hypothesis is created.

H1: The size of a firm positively influences profitability.

2.2 R&D Intensity

Research and development, or R&D, has become a crucial factor in the effectiveness and success of modern organizations. Research conducted in this field has yielded conflicting results with regards to its influence on profitability. (Dhawan, 2001) defines R&D as an investment in intangible assets that provide a major contribution towards the long-term growth and profitability of a firm. This relationship was further analyzed by (Jiasinghani, 2015), whom conducted his study in the Indian pharmaceutical industry. The conclusion showed a strong, positive relationship between R&D and profit rates, but stressing that benefits are in the long-run. (Jiasinghani, 2015) also expressed the need for persistent R&D investment for sustained profitability, as return on investment is usually experienced in the future. (Nakao, 1993) conducted a study on research and development intensity and its implications on profitability for Japanese industrial firms. The results further support a positive correlation between R&D intensity and profitability. A study conducted by (Audretsch, 1995) measured the implications of research and development activities on profitability and found that R&D intensity further promotes innovation activities. In turn, these innovation activities yield greater profitability rates for both small and large firms. However, smaller firms have a more favorable perspective of R&D investments than larger organizations. (Warauswitharana, 2015) investigated the R&D expenditure of American firms corresponding to their profitability to create a predictive model. The results showed that research and development expenditure significantly contribute to the overall profitability of a firm.

On the other hand, (Loderer & Waelchli, 2009) found that firms investing a below-average amount into research and development also experience lower profit rates. Over time, this could result in a downward spiral as less capital is available for R&D, further reducing future profits and competence. (Kamran, Hillier, & Tanusasmita, 2011) found an insignificant relationship between R&D and profitability when analyzing Australian public firms. There were no detectible effects that research and development had on market-to-book value or profitability of the analyzed organizations. R&D investment declines over time, as does the profitability of a firm.

If a firm invests more in R&D activities, then it should become more profitable for the following reasons: 1) discovering new innovations to revolutionize the market, 2) lowering cost of production, 3) staying competitive by improving product assortment, and 4) finding new materials to minimize waste and reduce supplier leverage. Therefore, the following hypothesis has been formulated:

H2: The intensity of R&D of a firm positively influences profitability.

2.3 Growth Rate

Previous studies on the relationship between growth rate and profitability yielded contradicting results. Taking the perspective of Greiner's Enterprise Growth theory, growth can be defined as the ability of an organization to expand quickly and effectively. A study by (Yang, 1996) found that as firms get bigger, they also improve in operational capabilities and profitability, assuming a constant standard of quality. Similarly, research conducted by (Cho & Pucik, 2005) analyzed the influence of growth on profitability finding a strong, positive relationship in support of the Enterprise Growth theory. A study led by (Yazdanfar, 2013) analyzing Swedish organizations also found a positive correlation between firm growth and profitability. An investigation by (Yang, 1996) further investigated this relationship, finding that growth of an organization will place it in a "higher echelon" of competition, enabling greater earnings potential and profitability.

In contrast, research conducted by (Cho & Pucik, 2005) suggests that firm growth and profit rate are mutually exclusive objectives. Similarly, the study by (Baumol, 1982) suggests that an organization should primarily focus on either profitability or growth. (Jasra, 2011) pursued a study on Spanish small and medium enterprises, finding that organizational growth negatively impacts profitability. During growth, resources are being allocated to development and equipment, as opposed to increasing efficiency in operations.

If an organization grows in size, measured in total assets, then an increase in resources and capital should result in a greater return on assets for the following reasons: 1) achieves economies of scale, 2) enables entry to new markets, and 3) allows access to, if not more, outside capital. Based on these premises, the following hypothesis has been created:

H3: The growth rate of a firm positively influences profitability.

2.4 Productivity

Empirical research conducted on the influence productivity has on profitability yielded mostly one-sided results. Prior studies suggest that a higher level of productivity will result in higher profitability within a business. (Stierwald, 2009) conducted a study on 961 large Australian firms finding that productivity has a positive influence on a company's profit rate. Research by (Margaretha & Supartika, 2016) analyzed public firms listed on the Indonesian Stock Exchange and formed similar conclusions. (Eslava, Haltiwanger, Kugler, & Kugler, 1964) analyzed the effectiveness of productivity-enhancing efforts, predominantly reallocation, of US firms expanding into a developing country. Their research resulted in a strong, positive correlation between higher productivity rates and profitability. A study on the Chinese textile industry by (Zhang & Wang, 2010) investigated the implications of rising raw material costs on productivity and profitability. The industry experienced a significant level of growth in terms of productivity as an effort to maintain low costs. Profitability increased accordingly, though at a considerably slower rate.

If an organization experiences a higher level of productivity, then profitability should increase for the following reasons: 1) ceteris paribus, a reduction of cost per capita results in a greater profit per capita, 2) higher productivity reduces waste, reducing the resources required to produce one unit, and 3) attaining a lower cost per unit and higher productivity levels can attract more contracts. Therefore, the following hypothesis has been formulated:

H4: The productivity of a firm positively influences profitability.

2.5 Firm Age

According to (Akben-Selcuk, 2016), implications of firm age on performance can be divided into three main schools of thought. Firstly, younger organizations suffer from "liability of newness," referring to the high failure rate of new businesses, as discussed by (Aldrich & Auster, 1986). This means that newer organizations have a difficult time surviving the first couple of years after incorporation.

Secondly, older firms have a natural advantage in terms of performance, as younger firms are focusing on survival and growth, as opposed to maximizing profitability. A study by the University of Michigan supports this conjecture, as (Majumdar, 1997) found older, more developed firms to have a significantly higher level of profit than newer firms, analyzing 1020 international firms. Congruently, (Vijayakumar, 2011) analyzed the Indian automobile industry and found that firm age positively affects profitability. There can also be a point where businesses become "too big to fail." This concept states that an organization has become so large and integrated that a government will step in to prevent its failure. A practical example of this occurred on December 19, 2008 when General Motors and Chrysler were given a bailout of over $13 billion under American President Bush.

Thirdly, the Organizational Life Cycle theory by (Dodge & Fullerton, 1994) states that older organizations, or firms in a later stage of the life cycle, tend to experience declining performance. The investigation by (Loderer & Waelchli, 2009) validated this view by concluding a negative relationship between profitability rate and the age of a business. This phenomenon occurs due to depreciating and obsoleting assets, in combination increasing costs and slower growth hindering profitability. The study by (Hirsch, Schiefer, Gschwandtner, & Hartmann, 2014) on the European food industry found that firm age negatively influences profitability levels.

More-established and older firms should perform better in terms of profitability for the following reasons: 1) older organizations likely are further along in the learning-curve, thus have more experience and know-how in their operations, 2) have developed strong, in-imitable relationships with suppliers and possibly competitors, and 3) less overhead than newer organizations, as most equipment and asset investments have been paid off and fixed costs minimized. Therefore, the following hypothesis has been formulated:

H5: The age of a firm positively influences profitability.

2.6 Net Asset Turnover

Asset turnover can be defined as the net sales per unit of asset within a firm and serves as a measurement for organizational efficiency. A study conducted by (Salman & Yazdanfar, 2012) concluded a statistically significant relationship between asset turnover and profitability. Their investigation focused on a sample of small firms operating in Sweden.

If an organization is more efficient in terms of revenue generated per asset, then the overall ratio of return on asset should increase proportionally. Therefore, the following hypothesis is created:

H6: The net asset turnover rate has a positive influence on profitability.

2.7 Leverage Ratio

The leverage ratio, also called the debt ratio, measures the total amount of liabilities compared to the total assets held by a firm. Generally, the lower the debt ratio of a business, the lower the risk associated with investment. Previous studies are divided in their conclusions regarding the influence of leverage ratio on profitability. The first perspective suggests a negative correlation between the amount of debt held by a firm and their profitability. A study by (Murugesu, 2013) investigated companies on the Columbo Stock Exchange between 2008 and 2015, finding a negative influence on profitability. Studies conducted by (Hall & Weiss, 1967; Baker, 1973; Hurdle, 1974) (Hall & Weiss, 1967) also found a negative relationship between leverage and profitability of a company. Additionally, (Admati, Demarzo, Hellwig, & Pfleiderer, 2018) investigated the implications of debt issuance and leverage on organizations. Their findings support the claim that once debt is issued, shareholders can resist leverage reductions and stock buybacks. This makes it difficult for a firm to recapture shares; thus, deeming debt issuance unfavorable with regard to profitability.

On the other hand, research by (Singapurwoko, 2011) found that debt can actually increase the profitability of a firm. Through an investigation of firms listed on the Indonesian Stock Exchange, a positive relationship between debt and profitability was found in the aforementioned study. The main argument being that debt issuance injects more funds into the organization, stimulating organizational growth and thus enabling higher profitability and efficiency.

Firms with a lower debt rate should be more profitable for the following reasons: 1) implies lower chance of bankruptcy, 2) less dependence on shareholders, plus leverage can be hard to resolve, and 3) lower total liabilities on balance sheet, maintaining a favorable financial position

H7: The leverage ratio has a negative influence on profitability.

2.8 Current Ratio

The current ratio of a firm is a measure for liquidity and efficiency in asset utilization. The study conducted by (Deloof, 2003) investigated the relationship between working capital and profitability for 1,009 Belgian firms during the 1992-1996 period. The outcome revealed that a company can experience higher levels of profitability by reducing accounts receivable and inventory. Thus, having a faster inventory turnover and receiving payment quicker results in a more liquid and more profitable organization. A study by (Gill, Biger, & Mathur, 2010) examined the influence of current ratio on profitability by investigating 88 American firms listed on the New York Stock Exchange for periods 2007-2008. Their research found the current ratio to have a positive influence on profitability. More specifically, companies can influence their profit rate by efficiently handling cash conversion and account receivables. (Nazir & Afza, 2009) pursued an identical study on working capital management and its implications on profitability. The outcome suggested that business managers can create more value, or instigate a higher level of profitability, through conservative and efficient working capital practices.

If an organization is more efficient in terms of current ratio, then the firm will experience higher levels of profit for the following reasons: 1) less risk related to inventory surplus and perishability, 2) higher levels of liquidity in case of economic down-turn, and 3) quicker cash conversion cycles reduce risk of customer non-payment, or bad debt. Therefore, the following hypothesis is formulated:

H8: The current ratio has a positive influence on profitability.

3. METHODOLOGY

3.1 Model

In this study, the estimation methodology used to study the impact of independent variables on the dependent variables is ordinary least squares (OLS) regression. This approach is in accordance with previous studies, which predominantly used descriptive statistics and OLS to investigate profitability determinants such as (Margaretha & Supartika, 2016; Salman & Yazdanfar, 2012).

To check the suitability of ordinary least squares regression, three foundational assumptions are checked. Firstly, the model should be linear in parameters. In this case, the regression model used is shown below and satisfies this criterion. Secondly, the sample must be randomly selected. For this research, 250 publicly listed manufacturing firms were selected at random from the New York Stock Exchange website. Thirdly, there must be no multicollinearity. This is proven in the following chapter.

The ordinary least squares regression approach enables the formulation of a function fit to represent the dependent variable, profitability, with the minimum sum of squared errors within the dataset for company *i*. Based on the identified independent variables, the following equation is created:

$$ROA_i = \beta 0 + \beta 1 Size_i + \beta 2\ R\&D_i + \beta 3\ Productivity_i + \beta 4\ Growth_i + \beta 5\ Age_i + \beta 6\ Asset\ Turnover_i + \beta 7\ Leverage_i + \beta 8\ Current_i + \varepsilon_i \quad (1)$$

In the regression model above, ROA is the return on assets; *Size* represents the variable firm size, R&D represents the variable *R&D Intensity*; Productivity is *Productivity*; Growth is *Year-to year Growth rate*; Age is *Firm Age*; Asset Turnover = *Net Asset Turnover*; Leverage = *Leverage Ratio* and Current = *Current Ratio*. The coefficient *β0* represents y-intercept, and ε signifies the random error associated with the regression model.

Table 1. Description of Variables and Measurement.

Variables	**Measurement**
Dependent Variable(s)	
Profitability	Net Income / Total Assets
Independent Variable(s)	
Firm Size	Log of Total Assets
R&D Intensity	Log of R&D Expenditure in $USD
Growth	Year-to-year growth = [(Total Assets$_t$ – Total Assets$_{t-1}$) / (Total Assets$_{t-1}$]
Productivity	Log (Gross Profit / Number of Employees)
Firm Age	Log of years since incorporation
Net Asset Turnover	NAT = Sales / (Shareholder Funds + Noncurrent Liabilities)
Leverage Ratio	Debt Ratio = Total Liabilities / Total Assets
Current Ratio	Current Assets / Current Liabilities

3.2 Variables

Following the empirical model used by (Caporale, Cerrato, & Zhang, 2017; Salman & Yazdanfar, 2012; Margaretha & Supartika, 2016), the following firm-specific variables have been selected as independent variables: firm size (logarithm of

total assets), R&D intensity (logarithm of total R&D expenditure), growth (year-over-year growth), productivity (logarithm of gross profit per employee), firm age (logarithm of years of existence), net asset turnover (sales / (shareholder funds + non-current liabilities)), leverage ratio (total liabilities / total assets) and current ratio (current assets / current liabilities). The corresponding formulas for each covariate is shown in Table 1.

3.3 Sample Data

In this paper, a sample is constructed based on information gathered on firm categorization by the New York Stock Exchange (NYSE), which publishes detailed financial information on publicly traded firms.

NYSE classifies public corporations based on the industry they operate in into 16 categories: aerospace, auto-tires-trucks, basic materials, business services, conglomerates, computers and technology, consumer discretionary, consumer staples, construction, finance, industrial, medical, oils-energy, retail-wholesale, transportation, and utilities. As in (Salman & Yazdanfar, 2012), we focus exclusively on industrial organizations. The sub-category of industrial firms, such as the manufacturing of engines, textile or semiconductors, is not included in the main analyses as these leave the results of this investigation unchanged.

For each firm included in the sample, ORBIS Database provides a compilation of data on financial performance and each of the independent variables. This database provides access to data on public corporations for the current year and past years, which may vary per firm depending on age and date of incorporation. According to the Bureau van Dijk website, ORBIS contains detailed information on over 275 million organizations. For specification purposes, industrial firms listed on the New York Stock Exchange are cross-referenced with firms published on ORBIS. This leaves 250 American manufacturing firms to represent the sample of this empirical investigation. Therefore, a unique dataset is created for American industrial firms listed on the New York Stock Exchange.

Prior to data analysis, firms without financial data available for years 2012-2017 are omitted from investigation. Inconsistency in data availability could give rise to uncertainty and error, therefore these manufacturers were removed from the sample. Secondly, firms operating outside the United States are removed due to a variance in net income, as there may be a difference in taxation levels, macroeconomic factors and costs of production. Additionally, manufacturing firms producing medical equipment are omitted due to the provision of field-specific tax cuts and subsidy provided by the American government. This leaves a sample of 221 industrial firms eligible for investigation.

As done in research by (Caporale, Cerrato, & Zhang, 2017) to minimize impact of outliers, the variables leverage and current ratio of firms are capped at the 95th percentile and the lower 5th percentile. Profitability is capped at the 99th percentile and 1st percentile. Descriptive statistics and the correlation matrix are presented respectively in Tables 2 and 3. Additionally, to further stabilize results, the mean values are winsorized for each variable. This procedure includes the value adjustment of an extreme outlier, reducing it to the next-greatest value plus one.

4. RESULTS

4.1 Descriptive statistics

Descriptive statistics enables the evaluation of patterns and trends present in the sample of American manufacturing firms. According to the OECD, the manufacturing industry has faced a tremendous decline in the last two decades. As a matter of fact, it has been estimated that between the years 2000 and 2010, one-third of all manufacturing jobs had been cut, causing a huge economic disruption. It is therefore interesting to note that in Table 2, the average profitability of firms is 7.5%, together with a mean growth rate of 13% per year. This suggests that the market is likely recovering from this economic trough. However, the high standard deviation of profitability hints at a still unstable market, as set forth by (Caporale, Cerrato, & Zhang, 2017). In this section, the statistics for each independent variable will be analyzed respectively.

First of all, the statistics on *firm size* indicate an average of 13.5, measured as the logarithm of total assets in thousands of dollars. Converting this value to dollars yields the value \$660,003.22 meaning that the average *size* of the analyzed manufacturing firms is in fact \$660,003,224.90 and falls in the 'very large' classification by both the ORBIS Database and NYSE. Additionally, the smallest sampled firms have a total amount of assets adding up to \$1.5m and the largest firm \$360bn.

Secondly, the variable *R&D intensity* is measured as the log of total yearly R&D expenditure. The average expenditure for manufacturing firms adds up to \$29,732,618 with a standard deviation of about \$7,000, which is relatively small, suggesting values are evenly distributed close to the mean. The maximum any analyzed firm invests in R&D is \$11bn in one fiscal year, and the minimum being \$60,000.

Table 2. Descriptive Statistics

Variable	MAX	MIN	Mean	Median	ST.DEV	25%	75%
Profitability	.767	-.766	.075	.079	.172	.022	.140
Firm Size	19.7	7.3	13.4	13.4	2.2	12.1	14.9
R&D Intensity	16.3	4.1	10.3	10.4	1.9	9.3	11.3
Productivity	8.69	.07	4.89	4.92	1.13	4.42	5.44
Growth	1.99	-.834	.130	.080	.268	.021	.211
Firm Age	5.15	.693	3.49	3.43	.764	2.99	3.94
Asset Turnover	6.31	.13	1.15	.97	.77	.71	.97
Leverage ratio	1.20	.05	.351	.308	.216	.155	.525
Current ratio	31.04	.66	3.37	2.58	2.85	1.74	3.91

Thirdly, covariate *productivity* is measured as the log of gross profit per employee in thousands of $USD. On average, each employee brings approximately $132,954 in value per year, with a standard deviation of approximately $3,100. The minimum productivity level being $1,073 and the maximum being $5.9m in gross profit per employee.

Fourth, the independent variable *growth* is found to have a mean value of .130 and can be interpreted as 13% year-to-year growth in total assets for one sampled firm. The maximum value of growth experienced in this sample is 199%, and the minimum value of growth -83.4% indicating a decline in total assets. An average, positive rate of growth suggests that the market may be recovering, however the large standard deviation of .268 indicates a yet unstable market.

The fifth analyzed covariate is *firm age*, measured in years since date of incorporation. Table 2 reveals the mean firm age of the sample to be 43 years, the newest analyzed firm being 2 years old and the oldest 172 years. This spread reaffirms that a diverse sample of firms was established, diminishing potential for random error or bias.

Sixth, the *NAT*, or Net Asset Turnover, covariate is measured as a ratio comparing sales to liabilities and equity. This variable provides insight into the efficiency level of a firm and reveals that, on average, the sampled American manufacturing firms have a NAT ratio of 1.15. The US industry average rate has been determined as 0.7 by (CSI Market, 2018), which the calculated value surpasses significantly. This indicates that, on average, manufacturing firms are allocating their assets effectively in their operations.

The seventh variable, *leverage ratio*, considers the amount of debt present in a firm's capital structure. For the sample, the average leverage ratio is 35.1% with a standard deviation of 21.6%. As a general benchmark, a 50% ratio or less is preferable. In this case, the analyzed firms have a significantly low debt rate considering the intensive amount of capital involved with the manufacturing industry. The sampled firms therefore have a low reliance on debt for operations, deeming them less risky from an investment perspective. The maximum ratio found is 1.20 which is highly unfavorable. In contrast, the minimum value comes out to .05, or 5% debt within the structure and is highly favorable, though uncommon.

Lastly, the eighth covariate measured in this study is the *current ratio*, comparing current assets to current liabilities as a ratio. A value of 1.00 or higher indicates that a firm is capable of paying off short-term debts. The average value of 3.37 shows that American manufacturing firms are in a strong position to handle debt. In a more extreme instance, the maximum observed current ratio is 31.04, suggesting that at least one analyzed firm has a 31:1 ratio of current assets to current liabilities.

4.2 Correlation analysis

Table 3 shows a correlation matrix of the independent variables investigated in this study. Within this sample, no significantly high correlations were found for these variables. The maximum correlation is equal to 0.404, falling below the significance threshold of 0.50. An interesting observation is that firm age has a positive relationship to leverage ratio and R&D investment. This indicates that older organizations tend to rely on debt for sustainability. Consequently, older organizations invest more money in R&D, likely as an effort to stay competitive in a rapidly changing market.

R&D intensity also has a positive relationship with productivity, though is negatively related to organization growth. In terms of productivity, R&D could give rise to more efficient production and operation activities, thus justifying this relationship. Additionally, investing in R&D takes a cut out of gross profits, as a portion is reinvested into the business for a future profit. Therefore, in terms of growth, R&D has a negative relationship in the short-term, though long-term implications are more complex to determine. Additionally, firm size and R&D have a positive correlation of .372. Larger firms likely have access to more capital, enabling a relatively higher quantity of funds allocated towards research and development compared to smaller firms.

4.3 Results and Discussion

This study investigated the influence of covariates on profitability. In this section, the presence of multicollinearity is examined, and the regression results are discussed.

To investigate the presence of multicollinearity, a collinearity test has been conducted yielding statistics on VIF and tolerance. The findings are presented in Table 4. According to (O'Brien, 2007), the threshold for a concerning level of multicollinearity is 5.00. For this sample, the highest VIF value is 1.699, which is below the threshold level. Tolerance is another indicator for this phenomenon and a minimum value of 0.20 is recommended by (Menard, 1995). Any tolerance value lower than .20 indicates a multicollinearity problem. For this sample, each tolerance value well surpasses this cut-off value, the lowest value being .589. Therefore, it is safe to assume that the effects of multicollinearity are negligible for this sample, considering both VIF and tolerance.

Table 3. Correlation Matrix

	Profitability	Firm Size	R&D	Productivity	Growth	Age	NAT	Leverage Ratio	Current Ratio
Profitability	1.000	.165*	.273*	.307*	.186*	.034	-.247*	.126	.239*
Firm Size		1.000	.372*	.068	-.025	.083	-.061	.404*	-.172*
R&D			1.000	.267*	-.014	.183	-.267*	.204*	-.168*
Productivity				1.000	.071	-.130	-.283*	-.147*	.341*
Growth					1.000	-.098	-.139*	-.086	.145*
Age						1.000	-.167*	-.026	-.149*
NAT							1.000	.402*	-.284*
Leverage Ratio								1.000	-.390*
Current Ratio									1.000

*Indicates a correlation significant at the 95% level.

Table 4. Collinearity statistics of covariates.

Variable	Tolerance	VIF
Firm Size	.728	1.373
R&D	.667	1.499
Productivity	.741	1.349
Growth	.958	1.044
Age	.880	1.137
Asset Turnover	.636	1.573
Leverage	.589	1.699
Current	.696	1.438

*Dependent Variable: Profitability.

In the following, each proposed hypothesis will be evaluated based on the findings from the regression analysis.

H1. The size of a firm positively influences profitability.

For the variable firm size, results from the regression analysis displayed in Table 5 indicate that there is a positive relationship between size and a firm's profitability. This can be inferred from the small but positive coefficient value of .001. However, the relationship was found not to be statistically significant at the .01, .05 or .10 levels. Therefore, we fail to reject the null hypothesis and have insufficient evidence to suggest a relationship between firm size and profitability. These results contradict Barney's Resource Based View stating that larger firms are more apt to perform and generate profit, together with the results from past studies by (Barney, 1991; Hall & Weiss, 1967). It also disagrees with studies that found a negative correlation between firm size and profitability such as (Aldrich & Auster, 1986; Margaretha & Supartika, 2016; Salman & Yazdanfar, 2012; Dhawan, 2001) and the liability of smallness theory by (Aldrich & Auster, 1986). We reject the alternative hypothesis H1 and conclude no significant relationship between firm size and profitability.

H2. The intensity of R&D of a firm positively influences profitability.

In terms of the covariate R&D intensity, the regression analysis yielded a coefficient of .013 with a t-statistic of 2.079. This variable was found to have a significant influence on profitability at the 0.05 level. There is sufficient evidence to reject the null hypothesis, thus we accept the alternative hypothesis H2. This outcome is in agreement with past research by (Jiasinghani, 2015; Nakao, 1993; Audretsch, 1995; Warauswitharana, 2015), finding that firms investing more in R&D experience greater profit rates.

H3. The productivity of a firm positively influences profitability.

According to Table 5, productivity has a positive influence on profitability, as the regression provided a coefficient of .026. The analysis found this relationship to be statistically significant at the 0.05 significance level. Therefore, we reject the null hypothesis and have reason to believe that there is a positive relationship between productivity and profitability in the analyzed sample of American manufacturing firms. Alternative hypothesis H3 is therefore accepted. These results are in accordance with past studies by (Stierwald, 2009; Margaretha & Supartika, 2016; Eslava et al., 1964; Zhang & Wang, 2010) which concluded a positive relationship between productivity and profitability.

H4. The growth rate of a firm positively influences profitability.

For the independent variable growth rate, the regression analysis provided a coefficient of .093 which is statistically significant at the 0.05 level providing sufficient evidence to reject the null hypothesis. Therefore, there is a

Table 5. Regression Analysis

	1.	2.	3.	4.	5.	6.	7.	8.
Firm Size	.013**	.006	.007	.007	.007	.007	.001	.001
	(2.470)	(1.046)	(1.213)	(1.284)	(1.277)	(1.341)	(.008)	(.097)
R&D		.022***	.015**	.016***	.015**	.013**	.008	.013**
		(3.515)	(2.486)	(2.594)	(2.386)	(1.977)	(1.279)	(2.079)
Productivity			.039***	.037***	.038***	.035***	.038***	.026**
			(3.897)	(3.729)	(3.793)	(3.371)	(3.774)	(2.540)
Growth				.111***	.114***	.106**	.106***	.093**
				(2.781)	(2.828)	(2.612)	(2.672)	(2.459)
Age					.010	.006	.008	.014
					(.716)	(.832)	(.784)	(1.270)
Asset Turnover						-.025*	-.050***	-.039**
						(-1.656)	(-.2988)	(-2.377)
Leverage							.198***	.239***
							(3.211)	(3.941)
Current								.016***
								(3.821)
Constant	-.102	-.228	-.362	-.374	-.407	-.325	-.247	-.349
	(-1.404)	(-2.873)	(-4.296)	(-4.505)	(-4.284)	(-3.044)	(-2.301)	(-3.247)
Adj. R^2	.023	.071	.128	.154	.152	.159	.194	.241
Observations	221	221	221	221	221	221	221	221

a. Dependent Variable: Profitability.

b. The first value represents the unstandardized coefficient. The second value presented in parentheses is the t-statistic.

*Indicates significance at the 0.10 level. **Indicates significance at 0.05. ***Indicates significance at 0.01.

significant, positive relationship between firm growth and profitability rate and we accept the alternative hypothesis H4. This result corresponds with Greiner's theory and research by (Yang, 1996; Cho & Pucik, 2005; Yazdanfar, 2013)

H5. The age of a firm positively influences profitability.

Considering the variable age and its influence on profitability, the regression analysis found a coefficient of .014 for this relationship. However, these results were not found to be statistically significant at the .10, .05 or .01 levels. Therefore, we fail to reject the null hypothesis, finding insufficient evidence to support a relationship between firm age and profitability. The alternative hypothesis H5 is thus rejected. These results are in agreement with the Organization Life Cycle theory and studies by (Dodge & Fullerton, 1994; Loderer & Waelchli, 2009; Hirsch et al., 2014).

H6. The net asset turnover rate has a positive influence on profitability.

The regression analysis shows a negative relationship between the variable net asset turnover (NAT) and profitability. The yielded coefficient is -.039, indicating an inverse influence. Furthermore, the relationship is found to be found significant at the .05 level providing sufficient evidence to reject the null hypothesis. However, the proposed alternative hypothesis expected a positive relationship, while the regression found a negative correlation. The alternative hypothesis H6 is rejected. The outcome thus contradicts (Salman & Yazdanfar, 2012), who suggested a positive relationship between NAT and profitability.

H7. The leverage ratio has a negative influence on profitability.

For the leverage ratio variable, a strong and statistically significant positive relationship was found with profitability. This suggests that firms incurring debt have a larger capital base to sustain growth and can utilize more resources for operations and profitability. The high coefficient of .239 indicates a strong influence, statistically significant at the 0.01 level. There is enough evidence to reject the null hypothesis; however, the alternative hypothesis suggested a negative influence of leverage ratio on profitability. Thus, we reject the alternative hypothesis H7. These outcomes are in agreement with the study conducted by (Singapurwoko, 2011) who found leverage to have a positive influence on profitability.

H8. The current ratio has a positive influence on profitability.

Lastly, the relationship between current ratio and profitability has a coefficient of .016 indicating a small influence. This relationship is found to be statistically significant at the .01 level. Therefore, we reject the null and accept the alternative hypothesis H8; current ratio has a positive influence on the profitability rate of a firm. The results agree with past studies by (Deloof, 2003; Gill et al., 2010; Nazir & Afsa, 2009) which suggested that firms with a greater current ratio tend to be more profitable.

For this regression, 221 observations were used in each simulation. The r-squared value indicates the amount of variation in the dependent variable caused by the independent variables. The adjusted r-squared corrects this variance based on the number of covariates used in the model. For this regression, the calculated adjusted r-squared value comes out to .243. Therefore, 24.3% of the variation of profitability is caused by firm size, research and development, productivity, growth, age, NAT, current ratio and leverage ratio.

5. CONCLUSION

This paper aimed to investigate the relationship between the profitability of American manufacturing firms and factors: size, R&D intensity, productivity, growth, age, net asset turnover, leverage ratio, and current ratio. A sample of 221 manufacturing firms operating in the US were analyzed based on data collected from the ORBIS Database for years 2012-2017. An ordinary least square regression model was used as a method to investigate the profitability and enable the estimation of profitability based on these determinants.

Concerning the research question of this study, the results suggest that there is a statistically significant, positive relationship between R&D investment, firm growth, productivity leverage ratio and the current ratio. Consequently, there was no relationship found between firm age and size and its profitability. However, a negative relationship was found between net asset turnover and profitability.

Previous studies and research papers used descriptive statistics and ordinary least square analyses to investigate the profitability of manufacturing firms. These techniques were also used to investigate the variables of this study and formulated a regression model enabling the estimation of profitability based on covariate coefficients. This study provides additional verification and confirmation of past research and theories and creates a foundation for future research into profitability determinants of manufacturing firms. Practical implications of this study are sought to benefit business managers, government-policy makers and academics with the following recommendations:

1. Investment in R&D is crucial for sustained profitability; although, it may not yield a return in the short-term.
2. Debt issuance, or leveraging, is proven to be a profitable endeavor, though can have negative long-term implications for organizational performance.
3. Older and larger firms are not necessarily more successful firms.

There are potential limitations in the empirical model used in this research. First of all, the sample size used in this study can be considered as a limitation. Future studies can address this concern by casting a greater net on American manufacturing firms eligible for investigation. Secondly, the long-term implications of R&D investments were not investigated and could pose a significant influence on a firm's profitability over time. This would provide more insight into the significance and importance of consistent R&D. Thirdly, this study only considered data used for years 2012-2017. In order to investigate the implications of the 2008 market crash and the 2018 American-Chinese import tariffs, a greater range of time could prove interesting for future research.

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